DRAFT LICENSE APPLICATION
EXHIBIT E
ENVIRONMENTAL ANALYSIS

SKAGIT RIVER HYDROELECTRIC PROJECT
FERC NO. 553

Seattle City Light

December 2022

TABLE OF CONTENTS

Section No. **Description** **Page No.**

Exhibit E: Environmental Analysis

List of Appendices

List of Figures

List of Tables

List of Acronyms and Abbreviations

°C ....degrees Celsius
°F................................degrees Fahrenheit
1-D ....one-dimensional
2-D ....two-dimensional
7-DADMax ....7-day mean of daily maximum
ABA ....Architectural Barriers Act
ac ....acre
ac-ft/yr........................acre-feet per year
ACHP..........................Advisory Council on Historic Preservation
ADA............................Americans with Disabilities Act
AIAN...........................American Indian or Alaskan Native
AIR.............................Additional Information Request
AIS ....aquatic invasive species
AISU ....Aquatic Invasive Species Unit
ANC ....acid neutralizing capacity
AOU...........................American Ornithologists' Union
APE............................Area of Potential Effects
APLIC ....Avian Power Line Interaction Committee
AV..............................audio-visual
BA..............................Biological Analysis
BBS............................Breeding Bird Survey
BC Parks ....British Columbia Parks
Bd...............................*batrachochytrium dendrobatidis*
BFD............................bird flight diverters
BIP ....beaver intrinsic potential
BLM...........................Bureau of Land Management
BMI ....benthic macroinvertebrate
BMP ....best management practice
BP...............................before present
BPA............................Bonneville Power Administration
ca. ....circa

CBOD........................carbonaceous biological oxygen demand
CEQ............................Council on Environmental Quality
CFR............................Code of Federal Regulations
cfs...............................cubic feet per second
CFU............................colony-forming unit
CGC...........................Cultural Geographics Consulting, LLC
CIP.............................capital improvement project
City Light...................Seattle City Light
cm...............................centimeter
CMZ...........................channel migration zone
CoSD..........................City of Seattle datum
COSEWIC.................Committee on the Status of Endangered Wildlife in Canada
COVID-19.................Novel Coronavirus
CPUE.........................catch per unit effort
CRHP.........................Canadian Register of Historic Places
CRWG........................Cultural Resources Work Group
cu yd...........................cubic yard
cu yd/yr......................cubic yard per year
CWA..........................Clean Water Act
CZMA........................Coastal Zone Management Act
DAHP.........................Department of Archaeology and Historic Preservation
DDT...........................dichloro-diphenyl-trichloroethane
DFC............................desired future condition
DIP.............................demographically independent population
DLA...........................Draft License Application
DNR...........................Department of Natural Resources (Washington State)
DO.............................dissolved oxygen
DOC...........................dissolved organic carbon
DPS............................distinct population segment
EA..............................Environmental Assessment
EBM...........................ecosystem-based management
Ecology......................Washington State Department of Ecology
eDNA.........................environmental DNA

EFH ....essential fish habitat
EJ................................environmental justice
ELC ....Environmental Learning Center
ENSO ....El Niño–Southern Oscillation
EPA ....Environmental Protection Agency
EPMT ....Exotic Plant Management Team
EPRI ....Electric Power Research Institute
ESA ....Endangered Species Act
ESU ....Evolutionarily Significant Unit
EV ....electric vehicle
FC...............................federal candidate
FCC ....Flow Coordinating Committee
FE ....federal endangered
FERC..........................Federal Energy Regulatory Commission
FLA ....Final License Application
FMP............................fisheries management plan
FPA ....Federal Power Act
FPC ....Federal Power Commission
FR...............................Federal Register
FSA ....Fisheries Settlement Agreement
ft ....foot/feet
FT ....federal threatened
FTEC..........................fish tissue equivalent concentration
ft^2 ....square feet
ft/mi............................feet per mile
ft/sec...........................feet per second
ft/yr.............................feet per year
GIS ....Geographic Information Systems
GMP...........................General Management Plan
GMU ....Game Management Unit
gpm ....gallons per minute
GPS ....Global Positioning System
GRA ....geospatial risk assessment

ha................................hectare
HEC-RAS ....Hydrologic Engineering Center River Analysis System
HGM ....hydrogeomorphic
hp................................horsepower
HPMP.........................Historic Properties Management Plan
HSM...........................habitat suitability model
HSRG.........................Hatchery Scientific Review Group
HUC ....Hydrologic Unit Code
IHA ....Indicators of Hydraulic Alteration
ILP..............................Integrated Licensing Process
IMISWG ....Inter-Ministry Invasive Species Working Group
in ....inch
IP ....Intrinsic Potential
IPaC............................Information for Planning and Consultation
ISR ....Initial Study Report
km ....kilometer
km^2..............................kilometer squared
km^3 ....cubic kilometer
kph..............................kilometers per hour
kV...............................kilovolt
KVA ....Key Viewing Area
kWh............................kilowatt hour
lb ....pound
L_{ep}...............................energy-equivalent noise level
LF ....lineal feet
LiDAR........................Light Detection and Ranging
L_{max} ....maximum instantaneous noise level
L_{min}..............................minimum instantaneous noise level
LP ....licensing participant
LWD ....large woody debris
m ....meter
μeq/L..........................microequivalents per liter
μg/L............................micrograms per liter

mg/L..........................milligrams per liter

mg/m^3..........................milligrams per cubic meter

mg C/L ....milligrams of carbon per liter

mg N/L ....milligrams of nitrogen per liter

mg P/L.......................milligrams of phosphorus per liter

mg S/L.......................milligrams of sulfur per liter

MHz ....megahertz

mi ....mile

mi^2 ....mile squared

mi^3 ....cubic mile

mL ....milliliter

mm ....millimeter

MMPA ....Marine Mammal Protection Act

MP.............................milepost

MPG..........................major population group

mph ....miles per hour

MPN..........................most probable number

MSA...........................Magnuson-Stevens Fishery Conservation and Management and Reauthorization Act

msl.............................mean sea level

MW ....megawatt

MWh ....megawatt hour

NAVD 88...................North American Vertical Datum of 1988

NCC ....Non-Flow Coordinating Committee

NCI............................North Cascades Institute

NCCN ....North Coast and Cascades Inventory & Monitoring Network

ND.............................non-detectable

NEPA ....National Environmental Policy Act

NF ....North Fork

NGO..........................non-governmental organization

NHPA........................National Historic Preservation Act

NMFS........................National Marine Fisheries Service

NOAA ....National Oceanic and Atmospheric Administration

NOI ....Notice of Intent
NPS ....National Park Service
NRA ....National Recreation Area
NRF ....nesting, roosting, and foraging
NRHP ....National Register of Historic Places
NRI ....Nationwide Rivers Inventory
NSO ....northern spotted owl
NTU ....nephelometric turbidity unit
NWFP ....Northwest Forest Plan
NWFSC ....Northwest Fisheries Science Center
NWRFC ....Northwest River Forecast Center
NWS ....National Weather Service
O&M ....operations and maintenance
OFCN ....Official Flood Control Notice
OFM ....Office of Financial Management
org/m^3 ....organisms per cubic meter
PA ....Programmatic Agreement
PAD ....Pre-Application Document
PBF ....physical and biological features
PCB ....polychlorinated biphenyls
PCT ....Pacific Crest Trail
PCTA ....Pacific Crest Trail Association
PDO ....Pacific Decadal Oscillation
PEM ....Palustrine emergent
PFA ....post-fledgling family area
PFMC ....Pacific Fisheries Management Council
PFO ....Palustrine forested
PHS ....Priority Habitats and Species
PME ....protection, mitigation, and enhancement
PNT ....Pacific Northwest Scenic Trail
PQL ....practical quantification limit
PRM ....Project River Mile
Project ....Skagit River Hydroelectric Project or Skagit River Project

PSE............................Puget Sound Energy
PSP............................Proposed Study Plan
PSS............................Palustrine scrub-shrub
PSTRT........................Puget Sound Technical Recovery Team
PUB...........................Palustrine unconsolidated bottom
RCC...........................Reservoir Control Center
RCW ....Revised Code of Washington
REA...........................Ready for Environmental Analysis
RLNRA......................Ross Lake National Recreation Area
RM ....river mile
ROW ....right-of-way
RPM ....rotations per minute
RSP ....Revised Study Plan
RTE...........................rare, threatened, and endangered
RTRM ....relative thermal resistance to mixing
RV ....recreational vehicle
SA ....settlement agreement
SC..............................state candidate
SCC...........................System Control Center
SCORP.......................State Comprehensive Outdoor Recreation Planning
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE..............................state endangered
SEEC..........................Skagit Environmental Endowment Commission
SFEG..........................Skagit Fisheries Enhancement Group
SGCN.........................Species of Greatest Conservation Need
SHPO ....State Historic Preservation Officer
SPD ....Study Plan Determination
SPU ....Seattle Pacific University
sq. mi.........................square mile
SR..............................State Route
SRBEIC......................Skagit River Bald Eagle Interpretive Center
SRKW........................Southern Resident killer whale

SRSC..........................Skagit River System Cooperative
SS ....sensitive species
ST ....state threatened
STSA..........................S'ólh Téméxw Stewardship Alliance
SWC...........................Skagit Watershed Council
SWE ....snow-water-equivalent
SWIS ....State Wetlands Integration Strategy
TBSA ....Turbine Blade Strike Analysis
TCL ....traditional cultural landscape
TCNWCB ....Thurston County Noxious Weed Control Board
TCP ....traditional cultural property
TDG ....total dissolved gas
TDS ....total dissolved solid
TIC ....total inorganic carbon
TMDL ....Total Maximum Daily Load
TNC............................The Nature Conservancy
TOC............................total organic carbon
TRREWG...................Terrestrial Resources and Reservoir Erosion Work Group
TSS.............................total suspended solid
TWG ....Terrestrial Work Group
U&A...........................usual and accustomed
UBCRM ....University of British Columbia Regime Model
UCM ....Unit Characteristic Method
UHA...........................usable habitat area
USACE ......................U.S. Army Corps of Engineers
U.S. ....United States
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

USR............................Updated Study Report

UTP ....uridine-5’-triphosphate

VSP ....viable salmon population

WAC ....Washington Administrative Code

WARSEM ....Washington Road Surface Erosion Model

WDF...........................Washington Department of Fisheries

WDFW.......................Washington Department of Fish and Wildlife

WGS...........................Washington Geological Survey

WHCV ....Wetlands of High Conservation Value

WHNP........................Washington Natural Heritage Program

WIC............................Wilderness Information Center

WISAARD.................Washington Information System for Architectural and Archaeological Records Data

WMRC.......................Wildlife Management Review Committee

WRIA ....Water Resources Inventory Area

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

WSDOT ....Washington State Department of Transportation

WSE ....water surface elevation

WSNWCB..................Washington State Noxious Weed Control Board

WSR...........................Wild and Scenic River

WWAA ....Western Washington Agricultural Association

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

WWU ....Western Washington University

This page intentionally left blank.

EXHIBIT E: ENVIRONMENTAL ANALYSIS

1.0 INTRODUCTION

The Skagit River Hydroelectric Project (Skagit River Project or Project) is located in the upper Skagit River watershed with the Project generating facilities being located in the middle of the Ross Lake National Recreation Area (RLNRA) in the North Cascades National Park Complex. The Skagit River watershed is the traditional territory of several Indian Tribes and Canadian First Nations. The Skagit River ecosystem supports important runs of anadromous fish that are key to the cultural, spiritual, and economic health of Indian Tribes and other residents. Anadromous fish from the Skagit River system are integral in the food chain of the entire Puget Sound ecosystem and a critical food source for Southern Resident killer whales (SRKW). Recognizing these facts, the City of Seattle, through its City Light Department (City Light), has committed to fulfilling regulatory requirements while adopting an ecosystem-based management (EBM) approach to inform decisions for operating the Project over the next 40-50 years.

EBM is an integrated management approach that recognizes the complexity of interactions within an ecosystem. Decisions are based on science and ongoing monitoring provides the basis for adaptive management of license implementation. Decisions related to environmental effects take the entire watershed into account and incorporate input from all levels of government, Indian Tribes, Canadian First Nations, and other interested parties.

City Light is the licensee of the existing 700-megawatt (MW) Skagit River Project. The Project is located in Whatcom, Skagit, and Snohomish counties, Washington. The Project consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. The Project was originally licensed in 1927 by the Federal Energy Regulatory Commission's (FERC or Commission) predecessor agency, the Federal Power Commission. 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. 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: flood risk management; 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.

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 listed threatened 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.

The Project operates under a license administered by FERC. The current license for the Project expires 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. For the relicensing of the Project, City Light used the FERC Integrated Licensing Process (ILP) to provide the framework for its consultation with Indian Tribes, Canadian First Nations, federal and state agencies, and other licensing participants (LPs) during the period leading up to the filing of the Draft License Application (DLA).

City Light recognizes the importance of observations and recommendations provided by Indian Tribes and Canadian First Nations during development of content for this Exhibit E. Their representatives have shared foundational perspectives that the entire Project vicinity occupies a place of profound significance since time immemorial. City Light acknowledges Indian Tribes and Canadian First Nations have ancient and lasting cultural relationships to the place where the Skagit River Project is located and that these relationships are critical to consider during the relicensing process, as well as during ongoing operations and maintenance activities.

The DLA presents City Light's initial proposed Project operations and non-operational protection, mitigation, and enhancement (PME) measures, i.e., the Proposed Action. At this time, City Light proposes to operate the Project in a manner consistent with the current license, while incorporating information from updated data collection methods, monitoring, and adaptive management strategies. To the extent proposed operational measures have been identified to date, the current proposal describes these measures in greater detail in Sections 3.1.4 and 3.3.1 of this Exhibit E. In addition, City Light proposes to implement a suite of non-operational PME measures which are described in Sections 3.3.3 and 4.2 of this Exhibit E. The proposed PME measures have been informed by the relicensing studies and other available information along with City Light's ongoing engagement with LPs.

City Light continues to engage LPs regarding the PME measures that will be included in the Proposed Action in the FLA. City Light expects that this LP engagement (along with the results of the FERC-approved studies) will result in revisions to these proposed PME measures as well as additional proposed PME measures in the FLA's Proposed Action.

Copies of the DLA, as filed with FERC, have been distributed to all known interested Indian Tribes, Canadian First Nations, state and federal agencies, local governments, non-governmental organizations, and members of the public.

1.1 Purpose of Exhibit E

The purpose of this Exhibit E is to describe the following: (1) existing Project facilities, lands, and waters; (2) existing Project operations and maintenance; (3) the continuing impacts of existing Project operations and maintenance on resources, including direct, indirect, and cumulative impacts based on information generated during the relicensing study program; and (4) all proposed Project facilities, lands, and waters, the proposed operation and maintenance plan, and proposed PME measures for each resource area.

The environmental analysis in this Exhibit E (Section 4) presents the assessment of effects associated with City Light's existing and proposed Project operations and facilities and the expected benefits of proposed PME measures. The resource analyses contained in this Exhibit E will provide the foundation for FERC's National Environmental Policy Act (NEPA) analysis.

1.2 Document Organization

In organizing this Exhibit E, City Light relied on FERC's Scoping Document 2 (SD2) for the Project (FERC 2020b), FERC's content requirements for Exhibit E (18 Code of Federal Regulations [CFR] § 5.18(b)), FERC's guidance document, Preparing Environmental Documents: Guidelines for Applicants, Contractors, and Staff (FERC 2008), and City Light's Revised Study Plan (RSP) (City Light 2021), Notice of Certain Agreements on Study Plans for the Skagit Relicensing (June 9, 2021),[1] and Initial Study Report (ISR) (City Light 2022).

This Exhibit E is divided into two general parts: (1) Introduction, Consultation, and Proposed Action and Alternatives sections (Sections 1-3) (A list of meeting consultation with LPs is contained in Appendix A); and (2) the Environmental Analysis, Cumulative Effects, Developmental Analysis, and Consistency with Comprehensive Plans sections (Sections 4-7), which makes up the bulk of Exhibit E.

Following a general description of the basin, Section 4, the Environmental Analysis, utilizes the following section headings for each resource area:

- Affected Environment – Briefly describes the existing environment based on information from the Pre-Application Document (PAD) (City Light 2020a), study reports included in the ISR, and study information from the second year of study that is available for the DLA.
- Environmental Analysis – Describes the impacts of the Project under existing and proposed operations, based on the results of relicensing program studies.
- Proposed Resource Measures – Describes City Light's proposed PME measures and their supporting rationales, based on study results and expected benefits of the PME measures.
- Unavoidable Adverse Impacts – Characterizes any adverse impacts that will occur despite the implementation of proposed Project operations and the identified PME measures.

Section 5, Cumulative Effects of the Proposed Action, identifies those resources for which cumulative effects have been identified and indicates whether the Proposed Action would contribute to such cumulative effects.

Section 6, Developmental Analysis, presents a discussion on the costs associated with proposed PME measures on power generation and economic benefits of the Project

1.3 Statutory and Regulatory Requirements

The relicensing of non-federal hydroelectric projects by FERC is considered a federal undertaking (36 CFR § 800.16(y)). As such, a license for the Project is subject to regulatory requirements under the Federal Power Act (FPA) and other applicable statutes. The major regulatory and statutory

[1] Referred to by FERC in its July 16, 2021 Study Plan Determination as the "updated RSP."

requirements and City Light's status of compliance with or consultation under these laws, as applicable, are discussed below.

1.3.1 Federal Power Act

1.3.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA provides that the Commission must require construction, operation, and maintenance by a licensee of such fishways as may be prescribed by the Secretaries of Commerce or the U.S. Department of the Interior.

1.3.1.2 Section 4(e) Conditions

Section 4(e) of the FPA provides that any license issued by the Commission for a project within a federal reservation must be subject to and contain such conditions as the Secretary of the responsible federal land management agency deems necessary for the adequate protection and use of the reservation.

1.3.1.3 Section 10(a) Recommendations

Section 10(a) of the FPA requires the Commission to consider the extent to which a project is consistent with the federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project.

1.3.1.4 Section 10(j) Recommendations

Section 10(j) of the FPA provides that each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

1.3.2 Section 401 of the Clean Water Act

Under Section 401 of the Clean Water Act of 1977 (CWA), a license applicant must obtain certification from the appropriate state pollution control agency that verifies compliance with the CWA. FERC's regulations at 18 CFR § 5.23(b) require that a license applicant using the ILP must file a copy of its request for water quality certification or evidence of waiver within 60 days of the date FERC issues the notice of acceptance and Ready for Environmental Analysis (REA). Consistent with these requirements, City Light plans to file its application for water quality certification with the Washington Department of Ecology (Ecology) within 60 days of the date FERC issues the notice of acceptance and REA. As required by the current Section 401 regulations, City Light will request a meeting with Ecology no less than 30 days prior to the submittal of the request for water quality certification.

City Light has consulted with Ecology throughout the relicensing process regarding the design and implementation of water quality studies needed to support its application for water quality certification.

1.3.3 Endangered Species Act

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species.

FERC is the lead federal agency for relicensing of the Project, and therefore must consult with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to determine whether its actions or authorizations would likely jeopardize the continued existence of any endangered or threatened species or adversely affect any designated critical habitat. Jeopardy exists when an action would "…reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR § 402.02).

On June 26, 2020, FERC initiated informal consultation with USFWS and NMFS under Section 7 of the ESA and the joint agency regulations thereunder at 50 CFR, Part 402, and designated City Light as FERC's non-federal representative for carrying out informal consultation. City Light consulted with USFWS and NMFS in developing the aquatic and terrestrial study plans for threatened and endangered species and during implementation of the studies. Draft Biological Assessments (BA) for federally listed species are under development in consultation with USFWS and NMFS, and City Light anticipates submitting draft BAs with the FLA.

Federally listed fish species in the Skagit River basin include the Puget Sound Chinook Salmon Evolutionarily Significant Unit (ESU), Puget Sound Steelhead distinct population segment (DPS), Puget Sound Management Unit Bull Trout, Coastal-Puget Sound DPS, and Puget Sound/Strait of Georgia Coho Salmon. Southern Resident killer whale will also be considered in consultation activities with NMFS.

Federally listed terrestrial species with the potential to occur in the Project vicinity include grizzly bear (*Ursus arctos horribilis*), gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), marbled murrelet (*Brachyrampus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), yellow-billed cuckoo (*Coccyzus americanus*), and Oregon spotted-frog (*Rana pretiosa*).

1.3.4 Magnuson-Stevens Fishery Conservation and Management and Reauthorization Act

The Magnuson-Stevens Act as amended by the Sustainable Fisheries Act of 1996 established procedures designed to identify, conserve, and Essential Fish Habitat (EFH) for fish species that are regulated under a federal fisheries management plan. Under this Act, EFH is defined as the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The consultation requirements of Section 305(b)(2) of the act specify that federal agencies must consult with the Secretary of Commerce on any actions that may adversely affect EFH. Section 4.2.3 Fish and Aquatic Resources, Rare, Threatened and Endangered Species, provides City Light's analysis of Project effects on three species of federally-managed Pacific Salmon – Chinook, Coho, and odd-numbered-year Pink Salmon – that occur in the Project vicinity and are protected under the act. City Light's EFH assessment will be included within the draft BA for the NMFS that City Light anticipates submitting with the FLA.

1.3.5 Coastal Zone Management Act

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

1.3.6 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) requires FERC to take into account the effect of licensing a hydropower project on any historic properties and allows the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment on the Proposed Action. ‘‘Historic Properties’’ are defined as any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places (NRHP). The effect of the Project on historic properties, as well as PME measures associated with historic properties, are described in Section 4.2.8 of this Exhibit E and the annotated outline of the Historic Properties Management Plan (HPMP) being filed in conjunction with this DLA (Appendix B). A draft HPMP will be filed with the FLA and will include documentation of consultation to date with the NHPA Section 106 consulting parties. NHPA Section 106 consultation parties and has conducted subsequent consultation efforts throughout the relicensing process, in the form of meetings, emails, phone calls, and document reviews. Documentation of consultation with NHPA Section 106 consulting parties will be submitted with related documents and will be appended to the HPMP.

1.3.7 National Wild and Scenic Rivers Act

The National Wild and Scenic Rivers Act was passed to protect select rivers of the United States from development that would substantially alter their wild or scenic nature. Selected rivers are preserved because they possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other values. Section 7(a) of the Wild and Scenic Rivers Act requires federal agencies to make a determination as to whether the operation of the Project under a new license would invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the designated river corridor. On November 10, 1978, Congress designated a section of the Skagit River as a Wild and Scenic River (WSR) from “the pipeline crossing at Sedro-Woolley upstream to and including the mouth of Bacon Creek” (Public Law 95-625). The entire Skagit WSR System as designated by Congress includes a combined total of 158.5 miles of the Skagit, Sauk, Suiattle, and Cascade rivers. Additional details on the WSR are provided in Section 4.2.6.1 of this Exhibit E.

1.3.8 Wilderness and National Trails System Acts

The Wilderness Act of 1964 established the National Wilderness Preservation System, which 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, however, the federally designated Stephen Mather Wilderness is located on North Cascades National Park Service Complex lands surrounding and adjacent to the Project (NPS 2019c). The Stephen Mather Wilderness includes portions of the North Cascades National Park, RLNRA, and the Lake Chelan

National Recreation Area (Wilderness Connect 2019). Public Law 100-688 that created the wilderness area preserved FERC's jurisdiction over the nearby hydroelectric projects.

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 2019). Additional details related to the National Trails System Act are provided in Section 4.2.6.1 of this Exhibit E.

1.3.9 Pacific Northwest Electric Power Planning and Conservation Act

Under section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Northwest Power and Conservation Council developed a program to protect, mitigate, and enhance fish and wildlife resources associated with development and operation of hydroelectric projects within the Columbia River basin. The Project is not located within, nor would it affect, the Columbia River basin. Thus, there is no requirement for an analysis of this Project under the Pacific Northwest Electric Power Planning and Conservation Act of 1980.

1.4 Purpose of Action and Need for Hydroelectric Power

1.4.1 Purpose of Action

FERC, under the authority of the FPA, may issue new licenses for a period of 30 to 50 years for the construction, operation, and maintenance of jurisdictional hydropower projects. FERC is considering the issuance of a new license to City Light for the existing Skagit River Hydroelectric Project. The purpose of the proposed action is to allow the Project to continue to provide reliable, low-cost, low-emissions electrical capacity and energy for the benefit of City Light's residential, commercial, industrial, and government customers, and to serve the energy, capacity, and ancillary services needs of the region.

In making a determination as to whether to issue a license for a hydroelectric project, FERC must conclude that the Project will be best adapted to a comprehensive plan for improving and/or developing a waterway. Beyond the power generation and developmental purposes (e.g., flood risk management, irrigation, water supply) for which licenses are issued, FERC must afford equal consideration to energy conservation; protection, mitigation, and enhancement of fish and wildlife and their habitat; protection and enhancement of recreational opportunities; and the overall preservation of environmental quality. In deciding whether and under what terms and conditions a new license should be issued to City Light for the Skagit River Project, FERC is required to balance the relevant economic, environmental, and engineering factors pertinent to its decision.

It is anticipated that FERC's Environmental Assessment (EA) or Environmental Impact Statement will evaluate the environmental and economic effects of the following alternatives: (1) No Action, i.e., continuing to operate the Project as it is currently operated, with no resource measures beyond what already exist; (2) operating the Project consistent with operations and measures proposed by City Light; (3) operating the Project as proposed by City Light with modifications recommended by FERC staff ("Staff Alternative"); and (4) the "Staff Alternative with Mandatory Conditions," i.e., recommendations by FERC and incorporating mandatory conditions provided by the relevant resource agencies.

1.4.2 Need for Hydroelectric Power

City Light is an integrated electric utility serving nearly 940,000 people in the greater Seattle metropolitan area and approximately 471,000 residential and non-residential customers. City Light's service territory covers 131 square miles. The City of Seattle depends heavily on hydropower, and the Project is a major contributor to Seattle's resource needs. For example, in 2021 hydropower accounted for 86 percent of Seattle's total power resources, with 23.3 percent provided by the Project (Figure 1.4-1).

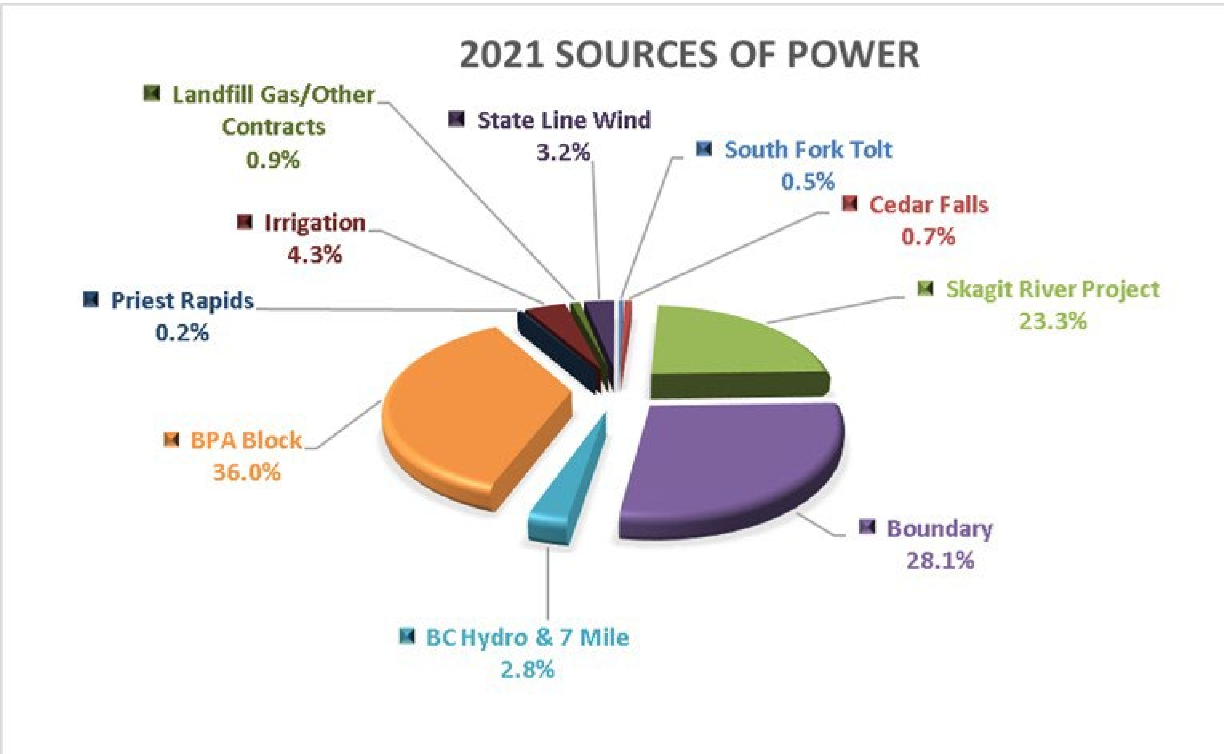


Figure 1.4-1. Sources of City Light's power in calendar year 2021.

City Light has 2,027 MW of installed generation capacity at six power plants (including the Skagit River Project). Additionally, City Light has power supply contracts with the Bonneville Power Administration (BPA) for approximately one-third of City Light retail needs. Other contracts include hydroelectric output from several irrigation projects, a wind farm, BC Hydro, and other sources. In 2021, City Light's retail sales for the year totaled 8,922,444 megawatt hours (MWh). City Light finished 2021 with total revenues of $1,109 million, expenses of $892 million and net income of $198 million.

The Project is a valuable component of the City Light's generating resources, representing approximately 35 percent of City Light-owned hydroelectric generating capacity and supplying 20 percent (depending on water conditions) of Seattle's power requirements. The Project is also critical for the role it plays as City Light's principal load-following resource. Generation at the Project typically begins in the early morning hours and ramps up to meet peak morning demand. Power is generated throughout the day, rising and falling in response to customer demand, and then increases again to meet peak evening demand.

Much of the Project's value to City Light and the region is due to its flexibility and reliability, that is, its ability to ramp up or down within the hour and in immediate response to customer demand. This flexibility allows the Project to respond to daily fluctuations in customer demand, both in the City of Seattle and the region. This flexibility is possible because of the three-dam system, which allows ramping to occur quickly at the Ross and Diablo plants, with Gorge plant regulating flows downstream to protect anadromous fish. This design is what distinguishes the Project from many other Northwest hydropower facilities with similar generating capacities but only a single dam. Flexible operations at these facilities are typically constrained by ramping regulations for anadromous fish protection downstream.

At this time, City Light proposes to operate the Project in a manner consistent with the current license (as described in Sections 3.1.4 and 3.3.1 of this Exhibit E). Operating the Project as proposed will continue to allow City Light to provide clean, safe, and reliable power to its ratepayers while also protecting anadromous fish in the Skagit River downstream. To the extent that a new license imposes constraints on within-hour operations at the Project, City Light and the region will need to replace that power with an alternative resource.

2.0 CONSULTATION

The Federal Energy Regulatory Commission (FERC or Commission) regulations require applicants to consult with appropriate resource agencies, Indian Tribes, and other entities before filing a license application. Licensing participants (LPs) have been consulted throughout the Project relicensing process, both during engagements required by FERC's Integrated Licensing Process (ILP), and through additional consultation opportunities provided by Seattle City Light (City Light). Detailed description of National Historic Preservation Act (NHPA) Section 106 consultation is in Section 4.2.9 of this Exhibit E.

In January 2019, City Light began a voluntary Study Plan Development Process with LPs in preparation for initiating the relicensing process. The purpose of this early process was to provide a forum, structure, and additional time for discussion with LPs with the goal of identifying resource issues that may warrant study during relicensing. These discussions resulted in the development of a suite of issues and associated studies included in the Pre-Application Document (PAD; City Light 2020a).

Following filing of its PAD, City Light continued meeting with LPs and provided early drafts of study plans for comment and discussion of studies necessary to inform the relicensing process. The proposed study plans in the Proposed Study Plan (PSP) included documentation of comments received on these early drafts and City Light's responses, as well as responses to study requests filed with FERC by October 24, 2020.

After filing the PSP, City Light held the requisite PSP Meetings (January 6 and 12-14, 2021) followed by ten topic-based discussion meetings (January 26 and 28, and February 2, 4, 9, 11, 16, 18, 23, and 25, 2021) to continue efforts to resolve outstanding differences between City Light's proposed studies and LP study requests. In response to feedback received during the fourteen PSP Meetings with the LPs, City Light developed and circulated 15 issue resolution forms proposing compromises and providing additional information and modifications to its proposed studies in an effort to resolve differences over study requests.

Following the PSP meetings and after careful review of LP comments on the PSP, City Light and the LPs agreed to a collaborative process to focus on study implementation and collaboration regarding June 9, 2021 "Notice of Certain Agreements on Study Plans for the Skagit Relicensing" (June 9, 2021 Notice) commitments.

Nearly 50 organizations have participated in approximately 190 collaborative process discussions to date. Appendix A of this Exhibit E provides a list of consultation meetings and participating organizations through November 2022. The Final License Application (FLA) will include a consultation record comprised of an updated meeting and participant list, the corresponding materials for the listed meetings (agenda, presentations, summary), and documentation of other LP communications specific to relicensing study development and implementation. A consultation record for communications specific to Section 106 of the NHPA is also being maintained and will be submitted with related documents and will be appended to the Historic Properties Management Plan (HPMP).

This Exhibit E includes a preliminary list of protection, mitigation, and enhancement (PME) measures to be included in the new license (see Section 3.3.3 for a comprehensive list and Proposed Resource Measures subsections for each resource area in Section 4.2). Many of these PME measures have been developed with input from LPs. City Light continues to engage LPs regarding the PME measures that will be included in the Proposed Action in the FLA. City Light expects that this LP engagement (along with the results of the FERC-approved studies) will result in revisions to these proposed PME measures as well as additional proposed PME measures in the FLA's Proposed Action.

2.1 ILP Schedule

Table 2.1-1 provides a summary of the major FERC filings made by City Light during the relicensing of the Project to date, beginning with the PAD through filing of this Draft License Application (DLA), and remaining milestones pre- and post-filing of the FLA. The table also includes document filings associated with related mandatory processes, including the Washington State Department of Ecology (Ecology) Section 401 water quality certification process, National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) Section 7 Endangered Species Act (ESA) consultation, and consultation pursuant to Section 106 of the NHPA. Following the filing of the FLA in April 2023, FERC will establish a firm schedule for the processing of the FLA and evaluate City Light's licensing proposal through the National Environmental Policy Act (NEPA) process.

Table 2.1-1. Milestones, responsible parties, dates, and applicable regulations associated with filing of the Skagit River Project license application.

Significant Milestones	Responsible Party	Date [1]	Applicable Regulation [2]
Notice of Intent (NOI) and PAD	City Light	4/27/2020	18 CFR §§ 5.5 and 5.6
Proposed Study Plan (PSP)	City Light	12/8/2020	18 CFR § 5.11(a)
Revised Study Plan (RSP)	City Light	4/7/2021	18 CFR § 5.13(a)
Updated RSP [3]	City Light	6/9/2021	18 CFR § 5.13(a)
Conduct First Season of Studies	City Light	2021	18 CFR § 5.15(a)
Initial Study Report (ISR)	City Light	3/8/2022	18 CFR § 5.15(c)(1)
Conduct Second Season of Studies	City Light	2022	18 CFR § 5.15(a)
File DLA	City Light	12/1/2022 [no later than 150 days prior to the deadline for filing a new or subsequent license application]	18 CFR § 5.16 (a)-(c)
Comments on DLA	LPs	3/1/2023 [within 90 days of DLA filing]	18 CFR § 5.16(e)
File Updated Study Report (USR)	City Light	3/8/2023 [no later than 2 years after Commission approval in Study Plan Determination (SPD)]	18 CFR § 5.15(f)
USR meeting	City Light and LPs	3/23/2023 [within 15 days of USR]	18 CFR § 5.15(f)

Significant Milestones	Responsible Party	Date [1]	Applicable Regulation [2]
File USR Meeting Summary	City Light	4/7/2023 [within 15 days of USR meeting]	18 CFR § 5.15(f)
File Meeting Summary Disagreements [4]	LPs	5/7/2023 [within 30 days of study results meeting summary]	18 CFR § 5.15(f)
File Responses to Meeting Summary Disagreements [4]	City Light	6/6/2023 [within 30 days of filing meeting summary disagreements]	18 CFR § 5.15(f)(5)
Study Dispute Determination [4]	FERC	7/6/2023 [within 30 days of filing responses to disagreements]	18 CFR § 5.15(f)
File FLA	City Light	4/30/2023 [no later than 24 months before the current license expires]	18 CFR §§ 5.17 and 5.18
File Biological Assessment (BA); including Essential Fish Habitat (EFH) Assessment	City Light	4/30/2023 [to be filed with FLA]	18 CFR § 5.18(b)(3)(ii) and (iii)
File HPMP	City Light	4/30/2023 [to be filed with FLA]	18 CFR § 5.18(b)(3)(v)
Issue public notice of FLA	City Light	5/14/2023 [within 14 days of filing]	18 CFR § 5.17(d)(2)
Request formal ESA consultation	City Light	TBD [5]	
Submit 401 certification application to Washington Department of Ecology (Ecology)	City Light	TBD [no later than 60 days after Ready for Environmental Analysis (REA) determination by FERC] [6]	18 CFR § 5.23(b)

1 If the due date falls on a weekend or holiday, the deadline is the following business day.
2 CFR = Code of Federal Regulations.
3 City Light's June 9, 2021 filing of its "Notice of Certain Agreements on Study Plans for the Skagit Relicensing" (June 9, 2021 Notice), referred to by FERC in its July 16, 2021 SPD as the "updated RSP."
4 Shaded actions are not necessary if there are no study or meeting summary disputes.
5 Consultation to be initiated based on FERC's recommended alternative defined in FERC staff's environmental assessment.
6 Per 18 CFR § 5.22(a), when the Commission has determined that the application meets the Commission's requirements as specified in §§ 5.18 and 5.19, the approved studies have been completed, any deficiencies in the application have been cured, and no other additional information is needed, it will issue public notice as required in the Federal Power Act (FPA).

2.2 NOI and PAD

City Light filed a NOI and PAD with the Commission on April 27, 2020 (City Light 2020a). The PAD serves as the first document in a phased process to provide the information necessary to both review existing conditions and inform development of a comprehensive proposal for Project operations, including protection, mitigation, and enhancement (PME) measures, over the term of the new license. The PAD also provides a preliminary assessment of known Project effects and proposed PME measures that may be implemented as a starting point for discussions with LPs. The PAD outlined goals and objectives of 24 studies that have since been further developed and expanded to 33 studies as presented in the RSP and the ISR.

2.3 Commencement of Relicensing and Environmental Scoping

On June 26, 2020, FERC issued public notice of the PAD and NOI and commencement of the relicensing pre-filing process, which kicked off the formal licensing proceeding and started the public comment period on the PAD. FERC's June 26, 2020 notice also designated City Light as FERC's non-federal representative for carrying out informal consultation pursuant to Section 7 of the ESA and to fulfill its responsibilities under Section 106 of the NHPA. In addition, the notice requested that LPs provide comments regarding the PAD and provide study requests. Concurrently, FERC issued Scoping Document 1 (SD1) to outline the subject areas to be addressed in its environmental analysis of the Project pursuant to the NEPA (FERC 2020a).

Due to the proclamation declaring a National Emergency concerning COVID-19, issued by the President on March 13, 2020, FERC waived 18 CFR § 5.8(b)(viii) and notified the public that it does not intend to conduct a public scoping meeting or site visit to the Project. Instead, FERC solicited written comments, recommendations, and information, on the SD1. If needed, a site visit may be held later in the study process.

On December 4, 2020, FERC issued its Scoping Document 2 (SD2) for the relicensing of the Project (FERC 2020b).

2.4 PAD and SD1 Comments and Study Requests

In accordance with 18 CFR § 5.9, comments on the PAD and SD1 and study requests were due within 60 days of notice of the PAD and NOI (no later than August 25, 2020). In June 2020, several LPs requested a modification of the ILP process plan and schedule to extend the study request and PAD/SD1 comment period by 60 days in light of impacts of COVID-19 public health emergency on their ability to collaborate with City Light and each other. FERC granted the extension request on June 25, 2020, extending the comment deadline to October 24, 2020, and modifying subsequent steps through the study dispute process in the Process Plan and Schedule accordingly. See Appendix B of the PSP for a list of PSP study request and comment letters provided by LPs (City Light 2020b). LP comments on the PAD and comments and additional information received from continuing consultation with LPs have been considered and incorporated, as appropriate, into this Exhibit E.

2.5 PSP

In accordance with 18 CFR § 5.11(a) and building upon the existing information identified and summarized in the PAD and informed by the over 60 work group meetings held prior to filing of the PSP, City Light filed its PSP within 45 days after the deadline for filing comments on the PAD and SD1 and study requests, on December 8, 2020 (City Light 2020b).

2.6 PSP Meeting

In accordance with 18 CFR § 5.11(e), City Light was required to hold a Study Plan Meeting(s) within 30 days after the deadline for filing the PSP (no later than January 7, 2021). The purpose of the meeting is to clarify the intent and content of City Light's PSP and identify any outstanding issues or information needed with respect to the proposed studies. City Light held four days of meetings on January 6 and 12-14, 2021. Due to the COVID-19 public health emergency, the meetings were held virtually. The background, concepts, and studies described in the PSP were presented during the Study Plan Meetings.

In addition, City Light hosted ten additional topic-based meetings in late January through February 2021, in coordination with LPs and aimed at resolving outstanding differences between City Light's proposed studies and LPs' study requests. The agenda for those meetings were developed by the LPs at their request. In response to feedback on the PSP received during the 14 meetings with the LPs in January and early February 2021, City Light developed 15 issue resolution forms proposing compromises and providing additional information and modifications to a number of study requests, and circulated them to the LPs prior to the deadline for PSP comments. The commitments reflected in these issue resolution forms were incorporated into the RSP (City Light 2021).

2.7 Comments on the PSP

In accordance with 18 CFR § 5.12, comments on City Light's PSP, including any revised information or study requests, were due to FERC within 90 days of the PSP being filed (no later than March 8, 2021). Commentors were requested to include an explanation of any study plan concerns and any agreements reached with City Light regarding those concerns. Proposed modifications to the PSP were requested to address the requisite Study Criteria as described in Section 4 of the RSP. See Appendix B of the RSP for a list of PSP comment letters provided by LPs (City Light 2021).

2.8 RSP

In accordance with 18 CFR § 5.13(a), City Light filed its RSP within 30 days of the due date for comments on the PSP, on April 7, 2021 (City Light 2021). The RSP specifically addressed all comments received on the PSP. The RSP also included a description of the efforts made to resolve differences over study requests. For any requested study not adopted in full or in part in the RSP, City Light provided the rationale for its decision based on FERC Study Criteria.

2.9 Comments on the RSP

In accordance with 18 CFR § 5.13(b), comments on City Light's RSP, including any revised information or study requests, were due to FERC within 15 days of the RSP being filed (no later than April 22, 2021). On April 2, 2021, prior to City Light's filing of its RSP, the Swinomish Indian Tribal Community requested a modification of the ILP process plan and schedule to extend the RSP comment period by 14 days, supported by Ecology and City Light in letters dated April 5 and 6, 2021, respectively. FERC granted the extension request on April 6, 2021, extending the comment deadline to May 6, 2021, and modifying subsequent steps through the study dispute process in the Process Plan and Schedule accordingly.

Subsequently, on May 12, 2021, the Coalition of Bands of the Nlaka'pamux Nation (Nlaka'pamux Nation) requested an additional extension for RSP comments after the Nlaka'pamux Nation recently became aware of the Project relicensing process, which FERC granted in a letter dated May 17, 2021, extending the comment deadline for the Nlaka'pamux Nation to June 1, 2021.

A total of 19 comment letters from federal and state agencies, Indian Tribes, Canadian First Nations, non-governmental organizations (NGOs), and other LPs were filed with FERC.

2.10 June 9, 2021 Notice

Following filing of the RSP, City Light continued to work with LPs to attempt to resolve outstanding areas of disagreement regarding the proposed studies. The ongoing discussions resulted in the filing of the "Notice of Certain Agreements on Study Plans for the Skagit Relicensing" with FERC on June 9, 2021 (the "June 9, 2021 Notice").

Additionally, in response to City Light's June 9, 2021 Notice, in a letter dated June 14, 2021, FERC agreed to assess the June 9, 2021 Notice (referred to by FERC as an "Updated RSP") in its Study Plan Determination (SPD). As such, FERC provided 15 days for filing of comments on the Updated RSP (no later than June 29, 2021) and modified the Process Plan and Schedule through the study dispute process, accordingly.

2.11 SPD and Study Disputes

In accordance with 18 CFR § 5.13(c), FERC issued the SPD on July 16, 2021, approving with modifications City Light's RSP (filed April 7, 2021). No study disputes were filed.

2.12 Study Reporting and Study Plan Modification

Following the issuance of FERC's SPD, and as required by 18 CFR § 5.15, City Light continued to engage with LPs in work group meetings to provide progress updates on study implementation. In addition, the work group meetings provided the venue to collaboratively refine the scope, methods, and implementation of the relicensing studies as described in the June 9, 2021 Notice. City Light agreed to significant modifications to some study plans at the request of LPs, which were described in relevant study reports filed with the ISR (City Light 2022).

In accordance with 18 CFR § 5.15(c)(1) and (2) and (f), at the conclusion of each study season City Light is to file an ISR and USR and hold a meeting with LPs and FERC staff to discuss the initial and updated study results (ISR meeting and USR meeting), respectively. Accordingly, City Light filed its ISR on March 8, 2022 (City Light 2022) and will file its USR (due by March 8, 2023) pursuant to FERC regulations. City Light submits all study documents that must be filed with FERC via FERC's e-library system (www.ferc.gov/docs-filing/elibrary.asp) as well as through the Skagit Relicensing Public Document Library on City Light's website (https://www.seattle.gov/light/skagit/Relicensing/default.htm).

2.13 ISR Meeting and Comments

In accordance with 18 CFR §5.15(c)(2), City Light held three days of ISR Meeting(s) March 21-23, 2022. The purpose of the meeting is to discuss the study results and City Light's and/or LPs' proposals, if any, to modify the study plan in light of the progress of the study plan and data collected. Due to the COVID-19 public health emergency, the meetings were held virtually.

Following the ISR Meetings, the FERC ILP regulations provide the opportunity for City Light and/or LPs to request modifications to the study plan in light of progress of the study program and results to date, either as part of City Light's ISR Meeting Summary (due 15 days after the meetings, by April 7, 2022; 18 CFR §§ 5.15(c)(3)) or if LPs file Disagreements/Requests to Amend Study Plan (due 30 days after filing of the ISR Meeting Summary, by May 7, 2022; 18 CFR §§ 5.15(c)(4)). A total of 14 comment letters from federal and state agencies, Indian Tribes, Canadian First Nations, NGOs, and other LPs were filed with FERC. City Light filed a response to ISR comments on June 6, 2022. FERC issued a Determination on Requests for Study Modifications on August 8, 2022, adopting one requested study modification, adopting one study modification in part, and declining to approve the remaining requested modifications.

2.14 DLA

In accordance with 18 CFR § 5.16(a)-(c), City Light is filing its DLA with FERC no later than 150 days prior to the deadline for filing a new license application (no later than December 1, 2022).

2.15 Comments on the DLA

With filing of the DLA, LPs have 90 days to comment on the document. A summary of the LPs' DLA comments and City Light's responses thereto will be provided in the FLA.

2.16 FLA

In accordance with 18 CFR § 5.17, City Light will file a FLA with FERC no later than 24 months before the current Project license expires (no later than April 30, 2023). Concurrent with the FLA filing, City Light will file two draft BAs (one for NMFS and one for USFWS), along with a draft EFH Assessment.

2.17 Post-FLA Filing

City Light will file its FLA with FERC in April 2023. While City Light expects to propose a suite of PME measures in the FLA, it anticipates the need to continue engagement with LPs after the filing of the FLA to finalize the proposed PME measures for the new license. To the extent this LP engagement extends beyond the filing of the FLA, City Light will supplement the FLA with any additional PMEs or agreements that result from the negotiations.

Once FERC has determined that the application meets all filing requirements, studies have been completed, any deficiencies have been resolved, and no additional information is required, FERC will issue the notice of acceptance and Ready for Environmental Analysis (REA).

The acceptance/REA notice solicits comments, protests, and interventions—along with recommendations, preliminary terms and conditions, and preliminary fishway prescriptions—including all supporting documentation. Comments, protests, and interventions must be filed within 60 days of the notice. City Light then has 45 days to respond to submitted comments (105 days from the REA notice).

Additionally, City Light will prepare a 401 Water Quality Certification application for the Project that will be submitted to Ecology no later than 60 days after FERC's REA notice.

3.0 PROPOSED ACTION AND ALTERNATIVES

At this time, City Light proposes to operate the Project in a manner consistent with the current license (as described in Sections 3.1.4 and 3.3.1 of this Exhibit E). Exhibit E includes a preliminary list of protection, mitigation, and enhancement (PME) measures to be included in the new license (see Section 3.3.3 for a comprehensive list and Proposed Resource Measures subsections for each resource area in Section 4.2). Many of these PME measures have been developed with input from licensing participants (LPs). City Light continues to engage LPs regarding the PME measures that will be included in the Proposed Action in the Final License Application (FLA). City Light expects that this LP engagement (along with results of the Federal Energy Regulatory Commission [FERC]-approved studies) will result in revisions to these proposed PME measures as well as additional proposed PME measures in the FLA's Proposed Action.

3.1 No-Action Alternative

No-action means that the Skagit River Project would continue to operate as authorized by the terms and conditions of the current license. Existing facilities would remain in place and existing protection or mitigation measures would continue, but there would be no additional protection or enhancement of natural resources. If the Project were to continue to operate under the terms of the current license, City Light would continue to produce energy in the present manner, and the environmental consequences of its operation would remain unchanged. Any ongoing effects of the Project would continue. The No-Action Alternative represents the baseline Project energy production and environmental conditions for comparison with other alternatives.

3.1.1 Project Location

The Skagit River Project is located in northern Washington State, across Whatcom, Skagit and Snohomish counties, and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities (Figure 3.1-1). The Project generating facilities are in the Cascade Mountains of the upper Skagit River watershed, between Project River Miles (PRM) 94.5 and 127.9 (U.S. Geological Survey [USGS] river miles [RMs] 94 and 127).[2] 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 (Newhalem and Diablo), the North Cascades Environmental Learning Center (ELC), a variety of recreation facilities, and multiple parcels of fish and wildlife mitigation lands.

The Project Boundary is extensive, spanning over 133 miles from the U.S.-Canada border to the Bothell Substation just north of Seattle, Washington. In addition, there are "islands" of fish and wildlife mitigation lands and recreation facilities 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 administered by the National Park Service (NPS) as part of the North Cascades National Park Complex. The RLNRA

[2] City Light has developed a standard Project centerline and river mile system to be used throughout the relicensing process, including the study program, to replace the outdated USGS RM system. Given the long-standing use of the USGS RM system, both it and the PRM system are provided throughout this document. For further details see Appendix C.

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 maintains FERC's jurisdiction "in the lands and waters within the Skagit River Hydroelectric Project," as well as hydrologic monitoring stations necessary for the proper operation of the Project (16 United States Code [U.S.C.] § 90d-4; Public Law 90-544, Sec. 505 dated October 2, 1968, as amended by Public Law 100-668, Sec. 202 dated November 16, 1988).

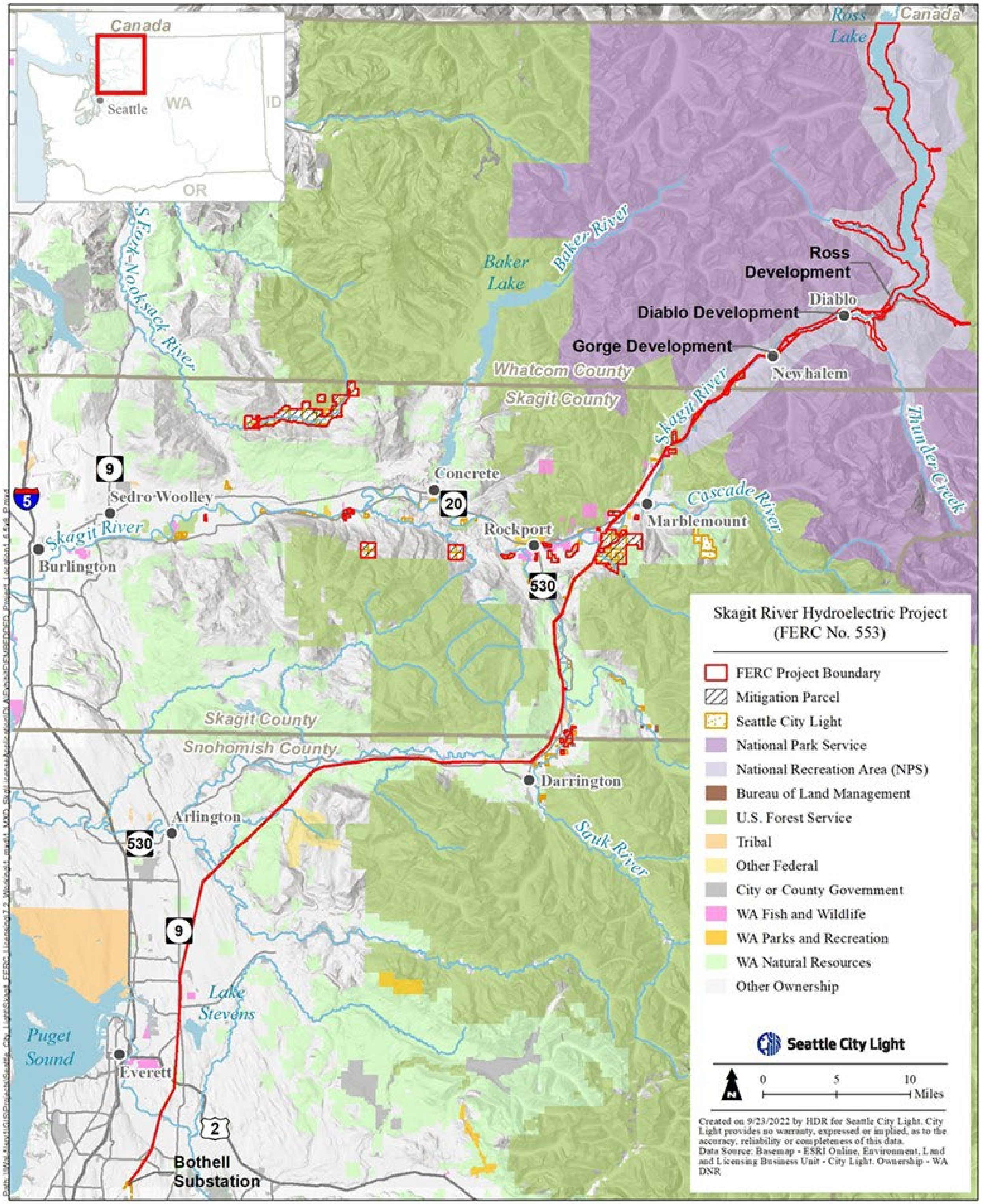


Figure 3.1-1. Location map of the Skagit River Project.

3.1.2 Existing Project Facilities

The Project has a total authorized installed capacity of 700.27 megawatts (MW).[3] 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 3.1-2 through 3.1-5. The Project powerhouses and dams and many associated structures are listed on the National Register of Historic Places (NRHP). Specifications for each development are summarized in Table 3.1-1 and described in detail below.

[3] Authorized installed capacity values presented herein are those approved by the February 2, 2021 Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges (174 FERC ¶ 62,066).

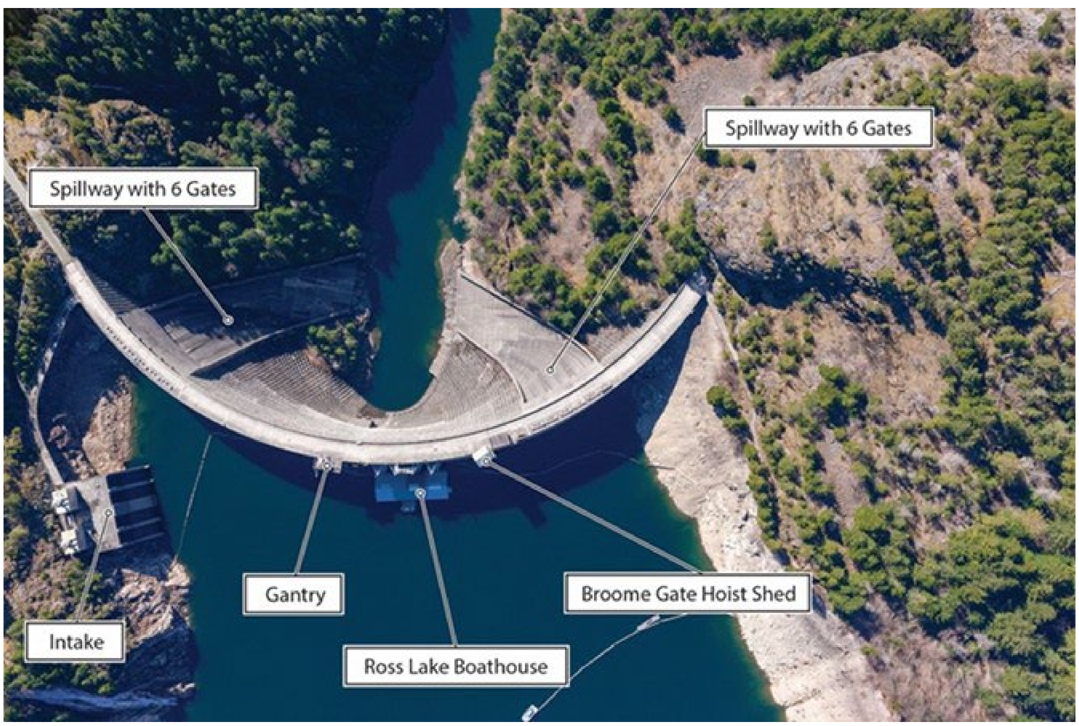


Figure 3.1-2. Aerial view of Ross Development and associated facilities.

Figure 3.1-3. Aerial view of Diablo Development and associated facilities (not visible in photo: intake on right bank and valve house on face of the dam).

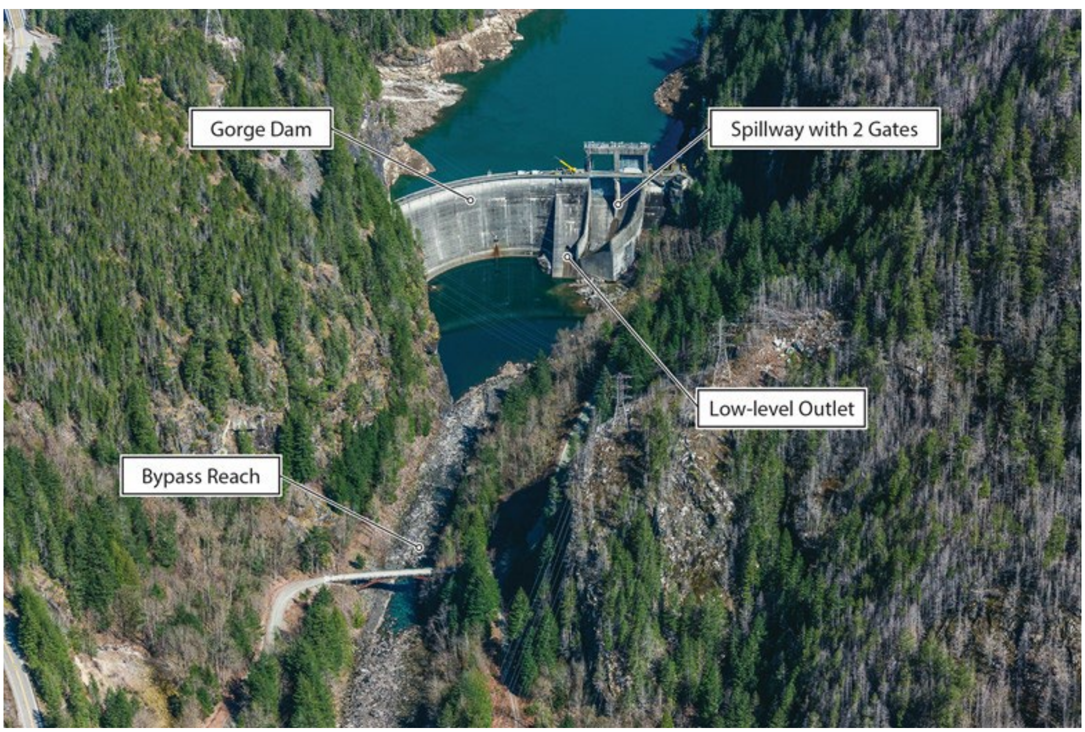


Figure 3.1-4. Aerial view of upstream end of Gorge Development and associated facilities (not visible on photo: log chute on face of dam).

Figure 3.1-5. Aerial view of downstream end of Gorge Development and associated facilities.

Table 3.1-1. Specifications for the three developments of the Skagit River Project.[4]

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)	886.8 ft NAVD 88[1] (880.5 ft CoSD)	1,224.65 ft NAVD 88 (1,218 ft CoSD)	1,621.2 ft NAVD 88 (1,615 ft CoSD)
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

4 As filed by City Light (August 19, 2020) and approved by FERC in Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges, 174 FERC ¶ 62,066 (February 2, 2021) with minor modifications to a few values and addition of North American Vertical Datum of 1988 (NAVD 88) values for elevations; effectively replacing PAD, Table 3.4-1 (April 27, 2020).

Project Component	Development		
	Gorge	Diablo	Ross
Spillway crest elevation	831.3 ft NAVD 88 (825 ft CoSD)	1,193.65 ft NAVD 88 (1,187 ft CoSD)	1,588.2 ft NAVD 88 (1,582 ft CoSD)
Maximum spillway capacity (at normal maximum water surface elevation)	120,000 cfs	98,500 cfs	124,800 cfs
Reservoir			
Normal maximum water surface elevation	881.51 ft NAVD 88 (875 ft CoSD)	1,211.36 ft NAVD 88 (1,205 ft CoSD)	1,608.76 ft NAVD 88 (1,602.5 ft CoSD)
Normal operating minimum water surface elevation (authorized by current Project license or due to other constraints) [3]	873.51 ft NAVD 88 (867 ft CoSD)	1,204.36 ft NAVD 88 (1,198 ft CoSD)	1,480.76 ft NAVD 88 (1,474.5 ft CoSD)
Length of reservoir	4.5 miles	4.5 miles	24 miles[4]
Surface area at normal maximum water surface elevation	235 acres	905 acres	11,725 acres[4]
Shoreline length at normal maximum water surface elevation[5]	11 miles	20 miles	84 miles[6]
Gross storage	8,200 acre-ft	88,800 acre-ft	1,432,000 acre-ft[7]
Usable storage	1,600 acre-ft	6,200 acre-ft	1,063,000 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)
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[8]	1	2
Invert elevation	801.3 ft NAVD 88 (795 ft CoSD)	1,086.65 ft NAVD 88 (1,080 ft CoSD)	1,429.2 ft NAVD 88 (1,423 ft CoSD)
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	N/A	190 ft	N/A
Diameter of concrete-line section	20.5 ft	19.5 ft	24.5 ft
Diameter of steel-lined section	N/A	19.5 ft	N/A
Penstocks:			
Number	4	3	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	503.21 ft NAVD 88 (497 ft CoSD)	887.38 ft NAVD 88 (881 ft CoSD)	1,217.65 ft NAVD 88 (1,211.5 ft CoSD)

Project Component	Development		
	Gorge	Diablo	Ross
Powerhouse			
Total plant capability[9]	207.58 MW	182.4 MW	450 MW
	839.98 MW total		
Total authorized installed capacity[9,10,11]	189.3 MW	158.47 MW	352.5 MW
	700.27 MW total		
Annual capacity factor	52%	48%	13%
Normal tailwater elevation at dam	501.34 ft NAVD 88 (495 ft CoSD)	881.26 ft NAVD 88 (875 ft CoSD)	1,210.96 ft NAVD 88 (1,205 ft CoSD)
Normal gross head	380 ft	330 ft	397.5 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: 51,850 hp at 325 ft net head, 257 RPM Unit 23: 45,000 hp at 325 ft net head, 257 RPM Unit 24: 147,500 hp at 354 ft net head, 163.7 RPM	Units 31, 32: 117,200 hp at 318 ft net head, 171.5 RPM Units 35, 36: 2,200 hp at 306 ft net head, 720 RPM	120,000 hp at 355 ft net head, 150 RPM
Governors	Woodward	ASEA	Woodward
Hydraulic capacity (at maximum plant output)[12]	7,440 cfs	8,250 cfs	16,000 cfs
Hydraulic capacity (minimum)	170 cfs	70 cfs	400 cfs
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); Table M-1 and General Description of Mechanical, Electrical and Transmission Equipment of Exhibit M, as approved by FERC by order dated February 2, 2021, with relevant recent updates.

1 All elevations in the table are North American Vertical Datum 1988 (NAVD 88) w/ City of Seattle datum (CoSD) value in parentheses.

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 Normal operating minimum water surface elevation is defined in the Environmental Assessment (EA) for the 1995 License Order for Ross Lake. For Diablo Lake, the maximum operating drawdown is based on constraints related to the boathouse; for Gorge it is based on an increased potential for fish stranding, as determined by City Light fisheries biologists. These elevations may be exceeded for maintenance purposes with appropriate authorization.

4 Approximately 23 miles and 11,225 acres in the U.S. and 1 mile and 500 acres in Canada.

5 Shoreline length calculated from Light Detection and Ranging (LiDAR) data collected in 2018 that is in NAVD 88 datum.
6 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.
7 USGS uses 1,440,700 acre-feet as the capacity of Ross Lake.
8 FERC has authorized a second power tunnel at Gorge which has not yet been constructed but could potentially be developed in the new license term.
9 There are two bifurcated intakes at Diablo Dam but only one is in use; the second intake was for planned future expansion of the powerhouse and a second tunnel, which were never constructed.
10 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.
11 The small "house" units (35 and 36) at Diablo are used primarily to provide power to the town, the powerhouse, and the North Cascades ELC on the north shore of Diablo Lake.
12 Maximum output at Ross is limited to 9,500 cfs and 7,200 cfs at Diablo, consistent with existing water rights for power production. An application for an additional 6,500 cfs at Ross is pending; the need for additional water rights at Diablo is being evaluated. The value previously cited for in relicensing documents for Diablo was 7,130 cfs.

3.1.2.1 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. 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, Canada. The Ross Development is relatively inaccessible, especially by vehicle. The powerhouse is typically accessed by boat from Diablo Lake. An approximately 1.5-mile-long gravel road (aka Haul Road) connects the powerhouse to the dam and reservoir and is used by vehicles barged up Diablo Lake by City Light. The powerhouse, dam and reservoir are also accessible by foot via several trails:

- Ross Dam Trail, which is one mile long and drops 700 feet from a parking lot along State Route (SR) 20 at milepost (MP) 134 to the Haul Road, which then connects to the powerhouse, dam, and reservoir;
- Happy Panther Trail, which starts from the East Bank Trailhead along SR 20 at MP 138 and runs for 6 miles along Ruby Arm to the Ross Dam Trail and Haul Road; and
- Diablo Lake Trail, which starts at the parking lot near the ELC, runs for nearly 4 miles along the north side of the lake, crosses a suspension bridge, and ends near Ross Powerhouse and the start of the Haul Road.

The three trails and the Haul Road are open to pedestrian access by the public. The only vehicle access (other than the Haul Road) to the reservoir is via a 40-mile-long gravel road from Hope, British Columbia, to Hozomeen at the very north end of the reservoir. The boat ramps at Hozomeen provide the only public launches for motorized boats.

Ross Powerhouse is about 1,100 feet downstream of Ross Dam, on the left bank at the eastern end of Diablo Lake. There are four Westinghouse generating units (Units 41, 42, 43, and 44), each with a nameplate rating of 112.5 MW. Units 42, 43, and 44 each have an authorized installed capacity of 91.875 MW, and Unit 41 has an authorized installed capacity of 76.875 MW, for a total authorized installed capacity of 352.5 MW at the development. 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.

Ross Dam is immediately upstream of Ross Powerhouse at PRM 105.7 (USGS RM 105.1). At 540 feet from bedrock to crest, it is the highest of the three Project dams. The intake structure is on the left side of the dam (facing downstream). The dam has two spillways—one on each side and each with six gates operated by an electric hoist. Two of the spillway gates can be controlled remotely; the others are operated locally at the dam. In addition to the spillways, Ross Dam has two concrete lined power tunnel intake structures, two butterfly valves at the 1,346.2-foot NAVD 88 (1,340-foot CoSD)[5] level and two hollow jet valves near the right bank at 1,275.2 and 1,260.2 feet NAVD 88 (1,269 and 1,254 feet CoSD). The two sets of valves can be opened to evacuate the reservoir once water levels drop below the level of the spillway 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 crane used to raise and lower the broome gates that isolate the six-foot conduits 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.

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 11,725 acres and storage volume of 1,432,000 acre-feet at the normal maximum water surface elevation of 1,608.76 feet NAVD 88 (1,602.5 feet CoSD). There are several sets of debris booms upstream of the dam to keep floating wood and boats out of the forebay and away from the intake.

3.1.2.2 Diablo Development

The Diablo Development is between the Ross and Gorge developments and in addition to generating power it reregulates flows between the other two developments. The powerhouse is on the north side 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 concrete-lined tunnel 1,900 feet long, that leads to three steel-lined penstocks. There is a surge tank located near the downstream end of the tunnel, uphill from the powerhouse. Diablo powerhouse, dam, and reservoir are all accessible by SR 20 and/or short access roads off this highway.

Diablo Powerhouse holds two Westinghouse generators (Units 31 and 32) and each has a nameplate rating of 90 MW and authorized installed capacity of 78.035 MW. There are also two smaller, house-unit generators (Units 35 and 36), each with nameplate ratings and authorized installed capacities of 1.2 MW. Total authorized installed capacity at the development is 158.47 MW. 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.

[5] City Light is in the process of converting Project information from its older vertical elevation datum (CoSD) to the more current and standardized elevation datum (NAVD 88). As such, elevations are provided relative to both data throughout this DLA. The conversion factor between CoSD and NAVD 88 varies depending on location. A table converting elevation values of common benchmarks, staff gages, and key Project features from CoSD to NAVD 88 and a map of the same features are appended to this DLA (Appendix C), both of which have been updated since first being provided in the PAD.

Diablo Dam is located at PRM 101.6 (USGS RM 101.2), about five miles upstream of Gorge Dam and four miles downstream of Ross Dam. The concrete arch dam is 389 feet from bedrock to crest and has two spillways, one on each side, and a total of 19 spillway gates—7 on the south spillway and 12 on the north. The three southern-most gates are automated via an electric hoist that can be locally or remotely operated. The remaining 16 gates are controlled locally at the dam using the "mule," an electric motor-driven hydraulic hoist that consists of two hydraulic cylinders to open or close the associated spillway gate. The mule runs on rails along the road on top of the dam and is positioned over the desired gate, when needed. The lifting chains for the gates are accessed below the deck plates on the dam. A valve house on the face of the dam has four outlets—three butterfly valves that can evacuate water from the reservoir at levels below the spillway gates and one Larner-Johnson valve that is not used at elevation 1,050.65 feet NAVD 88 (1,044 feet CoSD). There are two bifurcated intakes on the right side of the dam but only one is in use, as the second intake was for planned future expansion of the powerhouse and a second tunnel, which were never constructed. The crest of the dam also serves as a road that provides access to a boat house and other marine facilities and the ELC. The road across the dam is open to the public from 7 a.m. to 5 p.m.

Diablo Lake has a surface area of about 905 acres and gross storage of 88,800 acre-feet at a normal maximum water surface elevation of 1,211.36 feet NAVD 88 (1,205 feet CoSD). Debris booms near the dam keep floating wood and boats away from the intakes and spillway gates; other booms delineate restricted boat use and operational areas on the reservoir.

There is no bypass reach or riverine section between Diablo Dam and Powerhouse. Hydraulic conditions in this area are controlled by the existence of a gravel/cobble bar located at the confluence of Stetattle Creek with Gorge Lake and by the orientation of Diablo Powerhouse outflows. Under normal operations, the reach between Diablo dam and Powerhouse is watered and hydraulically connected to the upper end of Gorge Lake.

3.1.2.3 Gorge Development

Gorge Powerhouse is on the left bank (facing downstream) of the Skagit River just upstream of the Town of Newhalem and can be reached via SR 20 by vehicle bridge across the river or by a nearby suspension foot bridge. Both bridges are open to pedestrian access by the public. There are four Westinghouse generating units (Units 21, 22, 23, and 24). Units 21 and 22 each have a nameplate rating of 36.86 MW and authorized installed capacity of 31.5 MW; Unit 23 has a nameplate rating of 36.86 MW and authorized installed capacity of 30.2 MW. Unit 24 is significantly larger, with a nameplate rating of 97 MW and an authorized installed capacity of 96.1 MW. Total authorized installed capacity at the development is 189.3 MW.

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 steel-lined 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 steel-lined 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 concrete-lined 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. The current Skagit River Project license includes a second power tunnel at the Gorge Development which has not yet been constructed.

Gorge Dam, located at PRM 97.2 (USGS RM 96.6), is about 2.5 miles upstream of Gorge Powerhouse and 4 miles downstream from Diablo Dam near Gorge Creek. It is accessed by a short gravel road off SR 20 and not open to public vehicles. The dam is a combination concrete arch and gravity structure that rises 300 feet from bedrock to crest; the intake is on the left side. 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. The spillway gates can also be overtopped by up to 5 feet of water if the reservoir elevation were to go up to 886.51 feet NAVD 88 (880 feet CoSD). Training walls on either side of the spillway direct water into the river channel downstream. Two low-level outlets on the face of the dam at elevation 770.3 feet NAVD 88 (764 feet CoSD) can be used to evacuate water from Gorge Lake below the spillway gate level. Debris booms are positioned to keep floating wood and boats away from the dam. A log chute allows floating woody debris to be passed downstream of the Project in a controlled manner, when needed.

Gorge Lake is 4.5 miles long and extends upstream to the base of Diablo Dam. At the normal maximum water surface elevation of 881.51 feet NAVD 88 (875 feet CoSD), the lake has a surface area of 235 acres and gross storage of 8,200 acre-feet. During normal operations, water from Gorge Dam is conveyed to the powerhouse via the 11,000-foot-long power tunnel, creating a 2.5-mile-long bypass reach of the Skagit River between the dam and the powerhouse. This reach serves as the active spillway for Gorge Dam. Almost the entire bypass reach and the reservoir are bordered by SR 20.

3.1.2.4 Townsites

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 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. As of July 2022, 32 of the 92 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 staff working for NPS and the North Cascades Institute (NCI) and the Whatcom County Sheriff's Office. Most of the buildings remaining in the two towns are listed in the NRHP. Both towns have emergency sirens.

Newhalem is located between SR 20 and the Skagit River, just downstream of Gorge Powerhouse (Figures 3.1-1 and 3.1-6). The northern portion of the town is occupied by Gorge Switchyard and a large maintenance yard with warehouses, storage buildings, shops, and a water tower. The remainder of the town includes 28 houses, a variety of other lodging facilities, 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 60 miles and a frequent stop for travelers and visitors to the RLNRA. In addition, two popular recreation sites are accessed from Newhalem—Trail of the Cedars and Ladder Creek Gardens. During the current Project license, a variety of visitor services have been added in Newhalem, including expanded restrooms, an information center, parking, electric vehicle charging stations, and interpretive signs. All land occupied by Newhalem is owned by City Light.

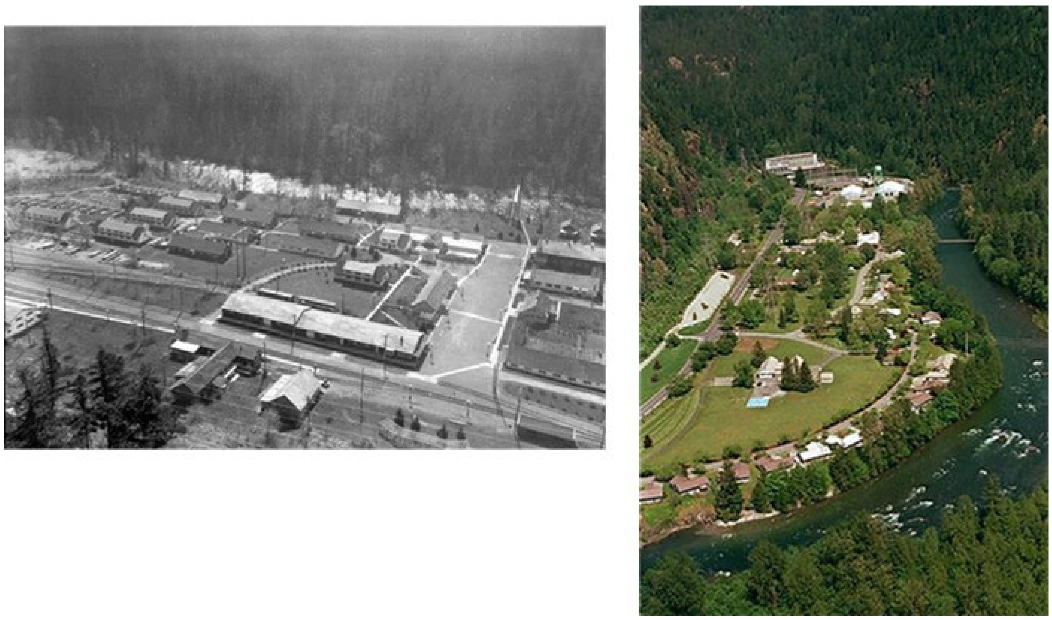


Figure 3.1-6. Newhalem, 1928 and today.

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 3.1-1), dividing it into two sections—one known as Hollywood and the other as Reflector Bar (Figure 3.1-7). City Light owns the Hollywood area, which is primarily residential, consisting of 23 houses, nearly all built in the 1950s. It also includes a firehouse and Ross Lodge, a restored historic building that is used by City Light and available to NPS and NCI for meetings and small conferences. In addition, there are two NPS trailheads in the Hollywood area; one for Sourdough Mountain and the other for Stetattle Creek. Wastewater treatment for the Hollywood area is provided by a large onsite septic system.

Reflector Bar is located on federal lands managed by NPS. Reflector Bar formerly had 12 houses, also built in the 1950s, but these were removed in 2022 because they were in poor condition and no longer needed. The land in the housing area is being restored to native habitat in coordination with NPS. Remaining structures in Reflector Bar include 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. Wastewater treatment for Reflector Bar is provided by an onsite septic system.

Figure 3.1-7. Reflector Bar area of Diablo, circa 1935 and 2000.

3.1.2.5 Transmission

The Project Boundary includes approximately 351.83 circuit miles of primary transmission lines connecting the Project to the bulk electrical grid. The lines terminate at Bothell Substation, just north of Seattle, in Snohomish County; the substation is located partially within the Project Boundary. The other substation associated with the lines is North Mountain, outside of the Town 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. The North Mountain Substation 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. From Ross Powerhouse to Bothell Substation, the right-of-way (ROW) is approximately 100 miles long and ranges from 150 to 400 feet wide. The various components of this system are described below, and a schematic is provided in Figure 3.1-8.

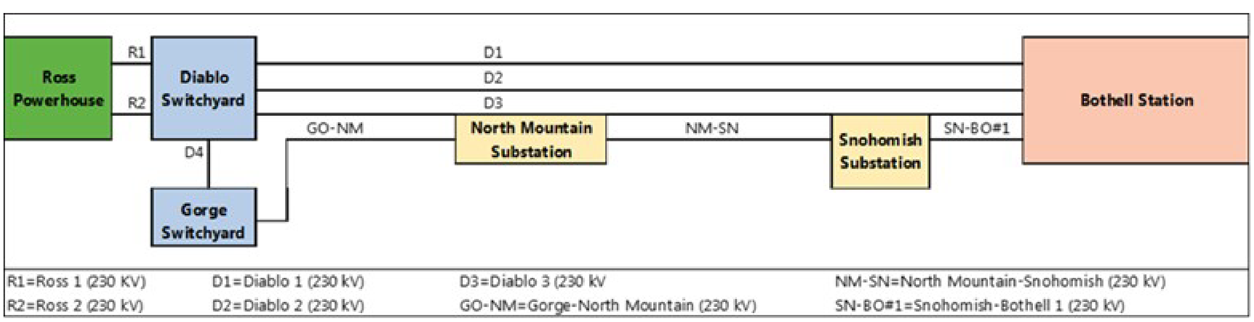


Figure 3.1-8. Transmission single-line diagram.

- 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 3.1-9). The R1 and R2 lines from Ross terminate at the 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 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 Snohomish Substation and then another 7.6 miles to Bothell as SN-BO#1.

Figure 3.1-9. Diablo switchyard.

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.

3.1.2.6 Transportation Infrastructure

Current transportation infrastructure at the Project includes roads, marine facilities, and helipads. The marine facilities and helipads are displayed in Figure 3.1-10. 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 but is not currently functional.

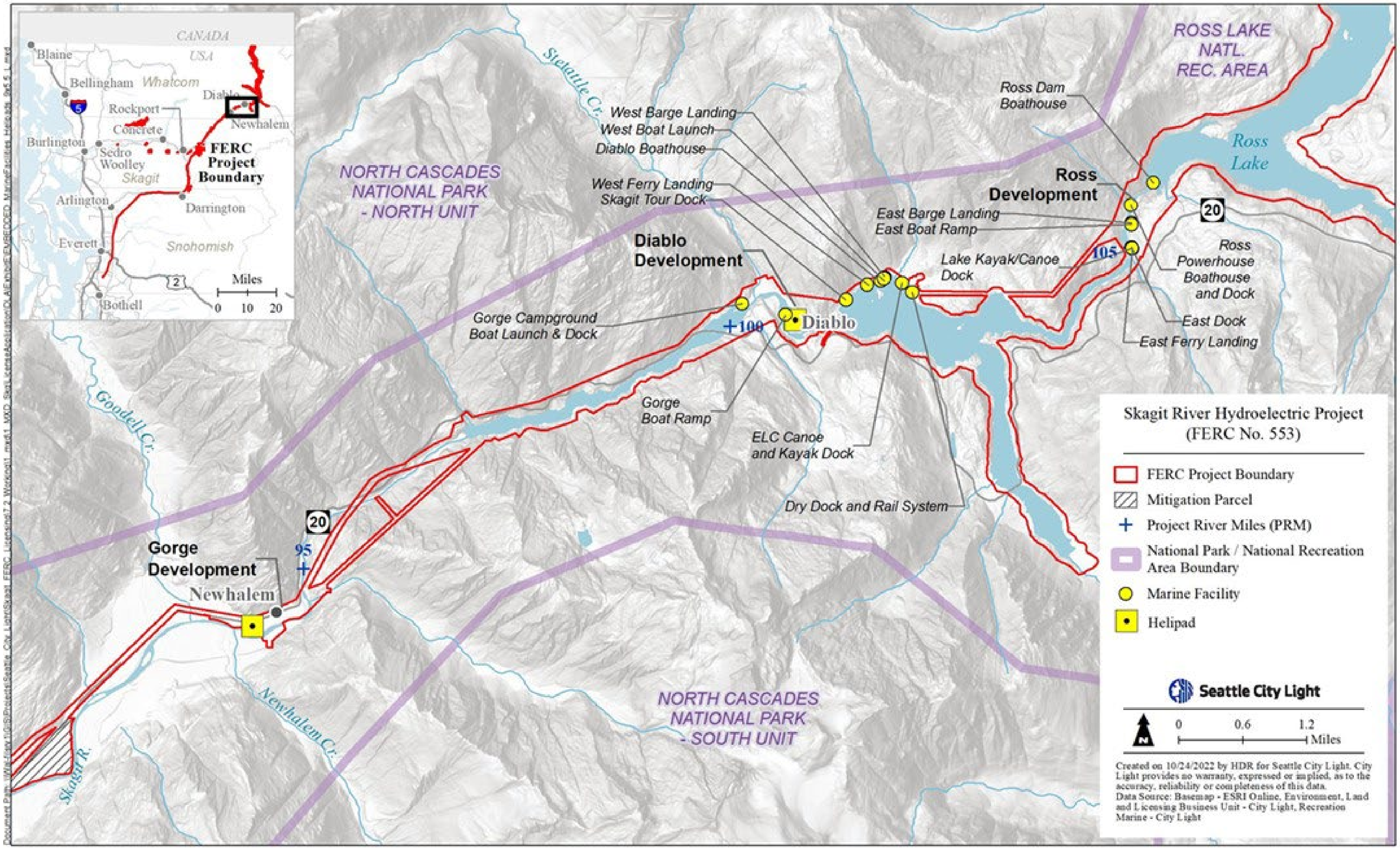


Figure 3.1-10. Helipads and marine facilities for the Skagit River Project.

Access Routes

The three Project developments were accessible only by rail until the early 1940s when the U.S. Forest Service (USFS) constructed a dirt road to Newhalem. City Light gradually improved the road starting in 1954 and eventually extended it 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 mid-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 result in temporary closure of 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 the 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. Flooding in 2021 destroyed large sections of this road and it was closed through 2022 with scheduled repairs to occur in 2023.

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) from SR 20;
- Diablo Dam Road (paved, gated but open for public access 7 a.m. – 4 p.m.) from SR 20 to the ELC;
- A short spur road from Diablo Dam Road to the Diablo Lake shoreline west of Sourdough Creek (gravel);
- A spur road from Diablo Dam Road to the top of the Incline Lift (paved);
- The road to Babcock Communications Tower (gravel/dirt surface, gated) from SR 20;
- 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 from SR 20 to the Aggregate Storage Facility near the 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 Ross Lake Resort and 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 FLA.

Helipads

There are two helipads at the Project—one in Newhalem and the other on Reflector Bar in Diablo (Figure 3.1-10). The Newhalem helipad is used by a contractor to conduct a survey in late March-early April of snowpack and water content at the remote snotel station. During times when SR 20 is closed at Newhalem, helicopters shuttle staff and supplies from Newhalem 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 minor modifications will be needed to make this site usable for emergencies.

Marine Facilities

Given the relatively limited vehicle access to the Project reservoirs, a variety of boats and associated docks, landings and storage structures/areas are required to support generation operations. The locations of marine facilities are shown in Figure 3.1-10.

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 3.1-10):

- 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 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, trailered 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 Concessions Contract. 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, performing inspection and maintenance of the dams and appurtenances, 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 3.1-11). 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 also 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 3.1-11. Ross Lake boathouse.

3.1.2.7 Recreation Facilities

City Light operates and maintains a number of recreation, interpretive, and visitor facilities at the Project, several of which are Project recreation facilities as listed below (Figure 3.1-12):

(1) North Cascades Environmental Learning Center;

(2) Skagit Tour Dock;

(3) Diablo Dam Parking Area;

(4) West Ferry Landing;

(5) East Ferry Landing;

(6) Ross Lodge Picnic Shelter;

(7) Gorge Lake Boat Launch;

(8) Ladder Creek Falls Trail and Gardens;

(9) Trail of the Cedars;

(10) Gorge Powerhouse Visitor Gallery;

(11) Gorge Powerhouse Parking Area;

(12) Skagit Information Center and restrooms;

(13) Gorge Inn Museum;

(14) Newhalem Picnic Sites;

(15) Newhalem Parking Areas and complimentary vehicle charging station;

(16) Newhalem Interpretive Displays; and

(17) Newhalem Playground.

These recreation facilities are described in detail in Section 4.2.6.1 of this Exhibit E.

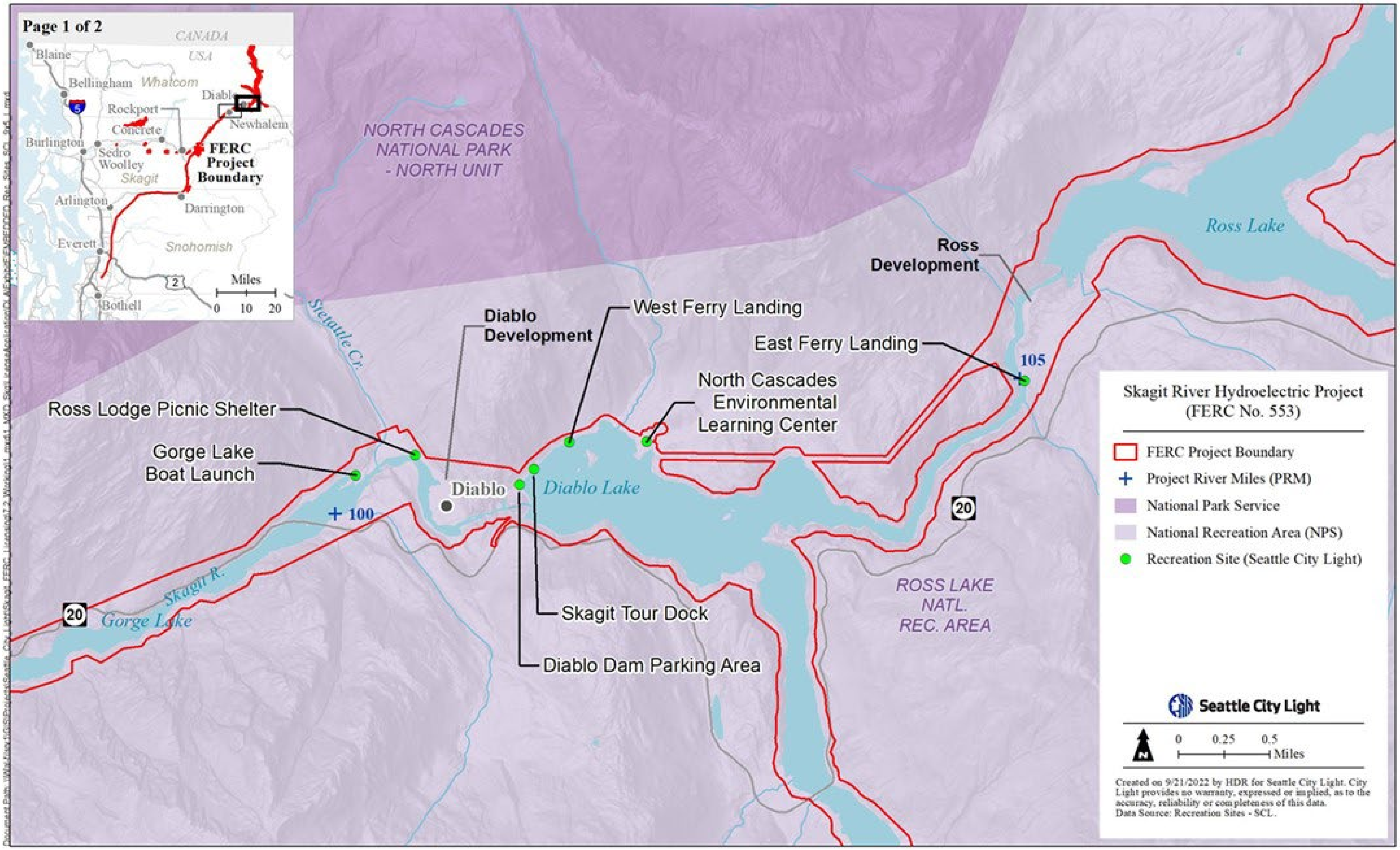


Figure 3.1-12. City Light recreation facilities of the Skagit River Project (page 1 of 2).

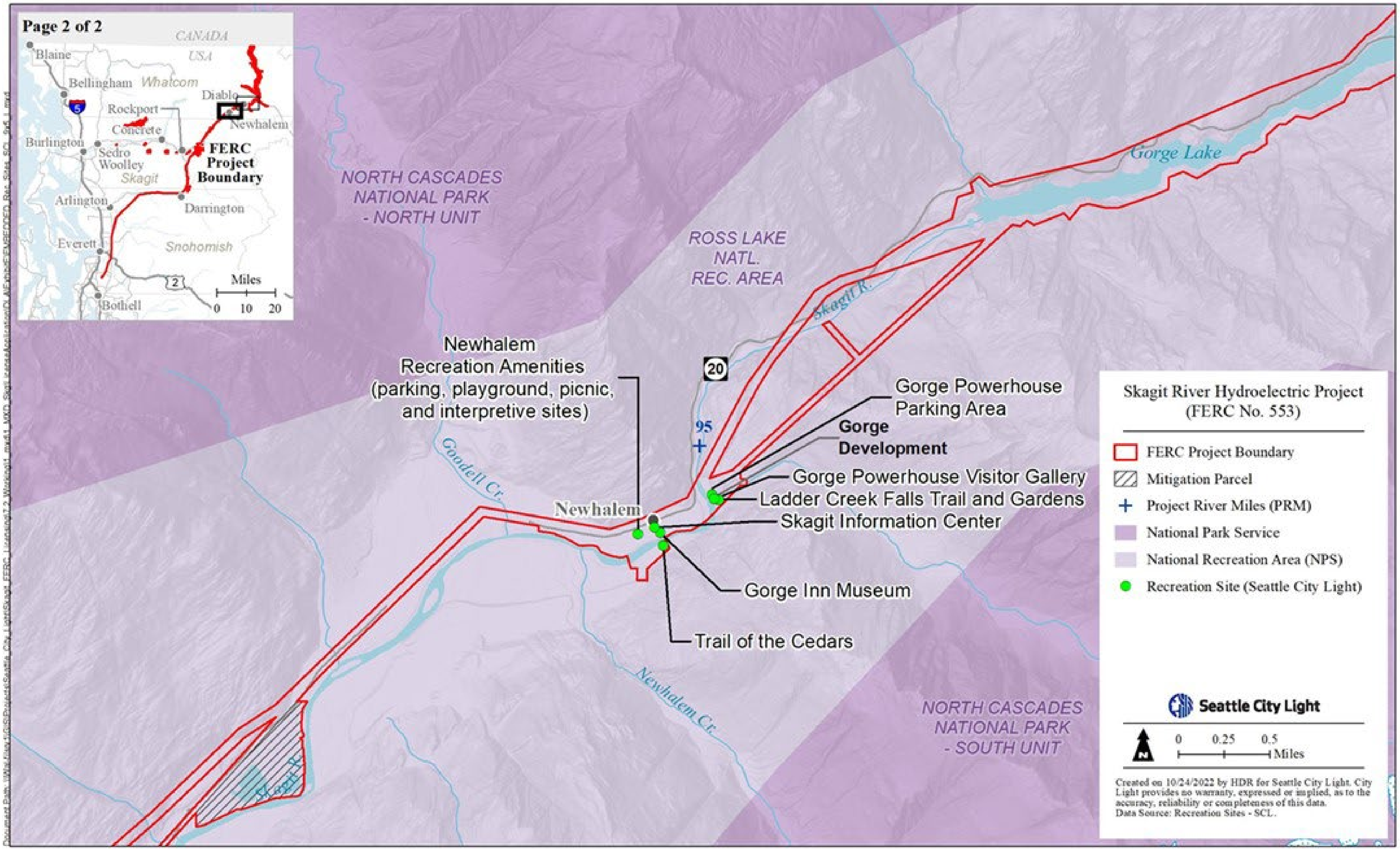


Figure 3.1-12. City Light recreation facilities of the Skagit River Project (page 2 of 2).

3.1.2.8 Other Facilities

City Light owns and/or 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 near Newhalem Ponds, just south of Newhalem;
- A storage yard for aggregate materials, including wood, rock, and soil near Newhalem Ponds, just south of Newhalem (Aggregate Storage Facility);
- 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-megahertz (MHz) radio system; and a remote base site for a 37-MHz radio system. 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 communication and fiber optic cables mounted on transmission line towers and/or distribution poles or underwater;
- 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 eight 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 on the Skagit River at Newhalem, near the bridge to Trail of the Cedars; Newhalem Creek, upstream of the diversion for the Newhalem Creek Hydroelectric Project; Bacon Creek below Oakes Creek; the Cascade River at Marblemount; and the Skagit River at Marblemount, just upstream of the confluence with the Cascade River. Another gage was recently installed on the Skagit River several miles upstream of Ross Lake in British Columbia. It is maintained by Environment and Climate Change Canada under an agreement with City Light; and
- Various survey station pedestals and associated structures on and near the dams.

3.1.2.9 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 3.1-13). These include:

- Newhalem 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.
- 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.

3.1.2.10 Fish and Wildlife Mitigation Lands

City Light owns multiple parcels of lands in the Skagit, Sauk, and South Fork Nooksack watersheds managed for wildlife and fish habitat, totaling approximately 10,804 acres (Table 3.1-2). All of the fish and wildlife mitigation lands are within the current Project Boundary (Figure 3.1-14).[6]

Table 3.1-2. Skagit River Project fish and wildlife mitigation lands.

Property Name	Fish or Wildlife Program	Acres
North Sauk	Wildlife	45.6
Dan Creek	Wildlife	42.1
Everett Creek	Wildlife	38.5
North Everett Creek	Wildlife	173.8
Sauk Island	Wildlife	21.3
Nooksack – Main	Wildlife	3,627.4
Nooksack West	Wildlife	388.9
Nooksack – Olivine Ends	Wildlife	226.7
Bear Lake	Wildlife	154.9
Savage Slough[1]	Fish and Wildlife	211.1
Pressentin	Wildlife	637.0
Finney Creek	Wildlife	641.5
McLeod Slough	Wildlife	126.0
Napoleon Slough	Wildlife	61.6
False Lucas Slough	Wildlife	203.6
Barnaby Slough	Wildlife	225.5
O'Brien Slough	Wildlife	47.2
Illabot North	Wildlife	725.9
Illabot South	Wildlife	2,521.8
South Marble 40	Wildlife	41.1
B&W Road 2	Wildlife	10.9

6 In 2020, City Light amended the Project Boundary to include additional fish and wildlife mitigation lands that were recently acquired under ongoing implementation of the current Project license (April 1, 2020 request to amend Exhibit K, as modified in its August 19, 2020 Response to FERC's May 21, 2020 Additional Information Request). Project Boundary acreage values presented herein are those approved by the February 2, 2021 Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges (174 FERC ¶ 62,066).

Property Name	Fish or Wildlife Program	Acres
B&W Road 1	Wildlife	79.4
Bacon Creek	Wildlife	118.8
Corkindale Creek	Wildlife	142.6
County Line Ponds	Fish	56.3
Newhalem Ponds	Fish	111.1 [1]
Bogert and Tam	Fish	16.9
Johnson Slough	Fish	67.5
Day Creek Slough	Fish	38.4
	Total:	**10,803.4**

1 Acreage includes approximately 4-acre storage area that is dedicated to Project operations.

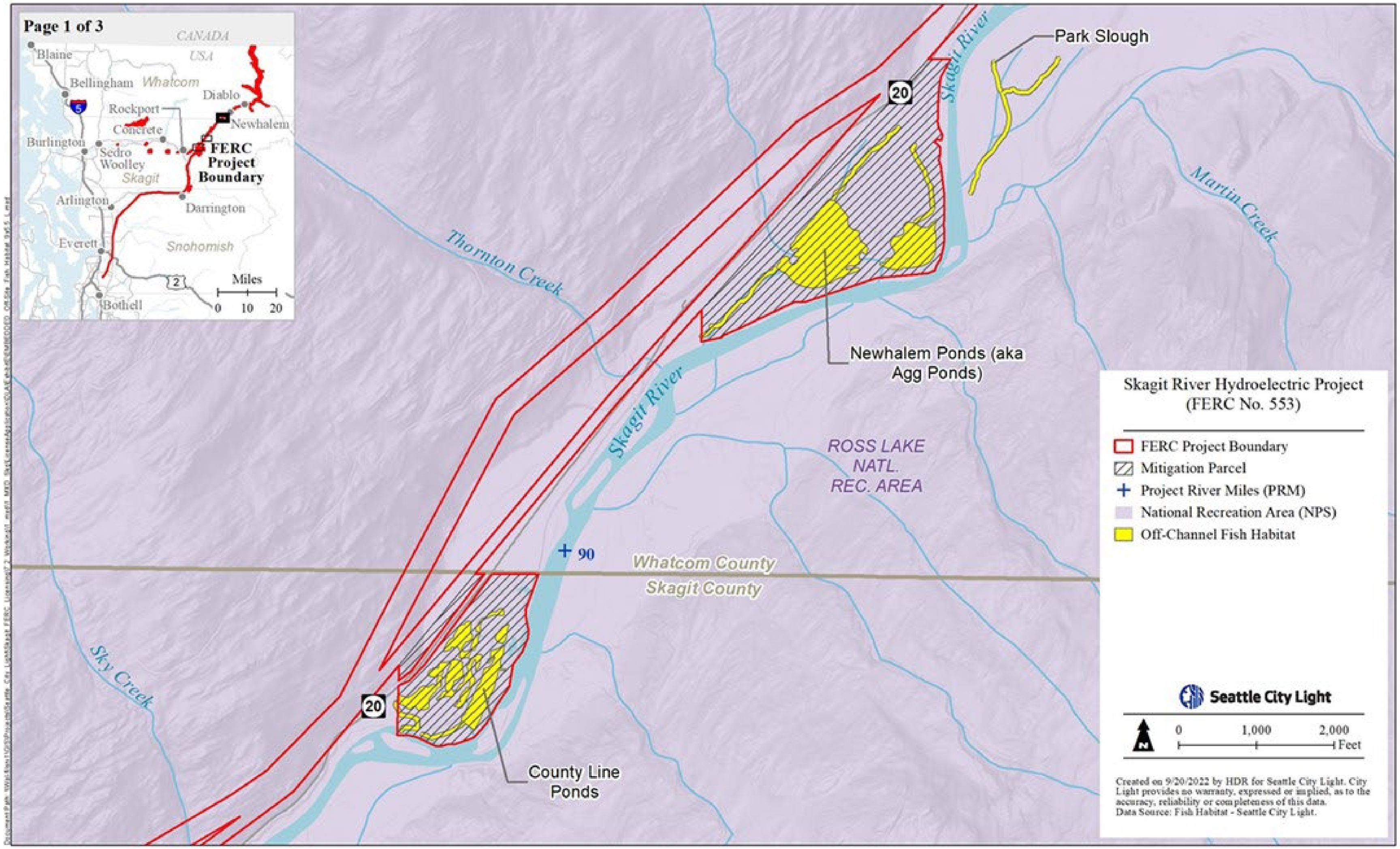


Figure 3.1-13. Off-site fish habitat sites of the Skagit River Project (page 1 of 3).

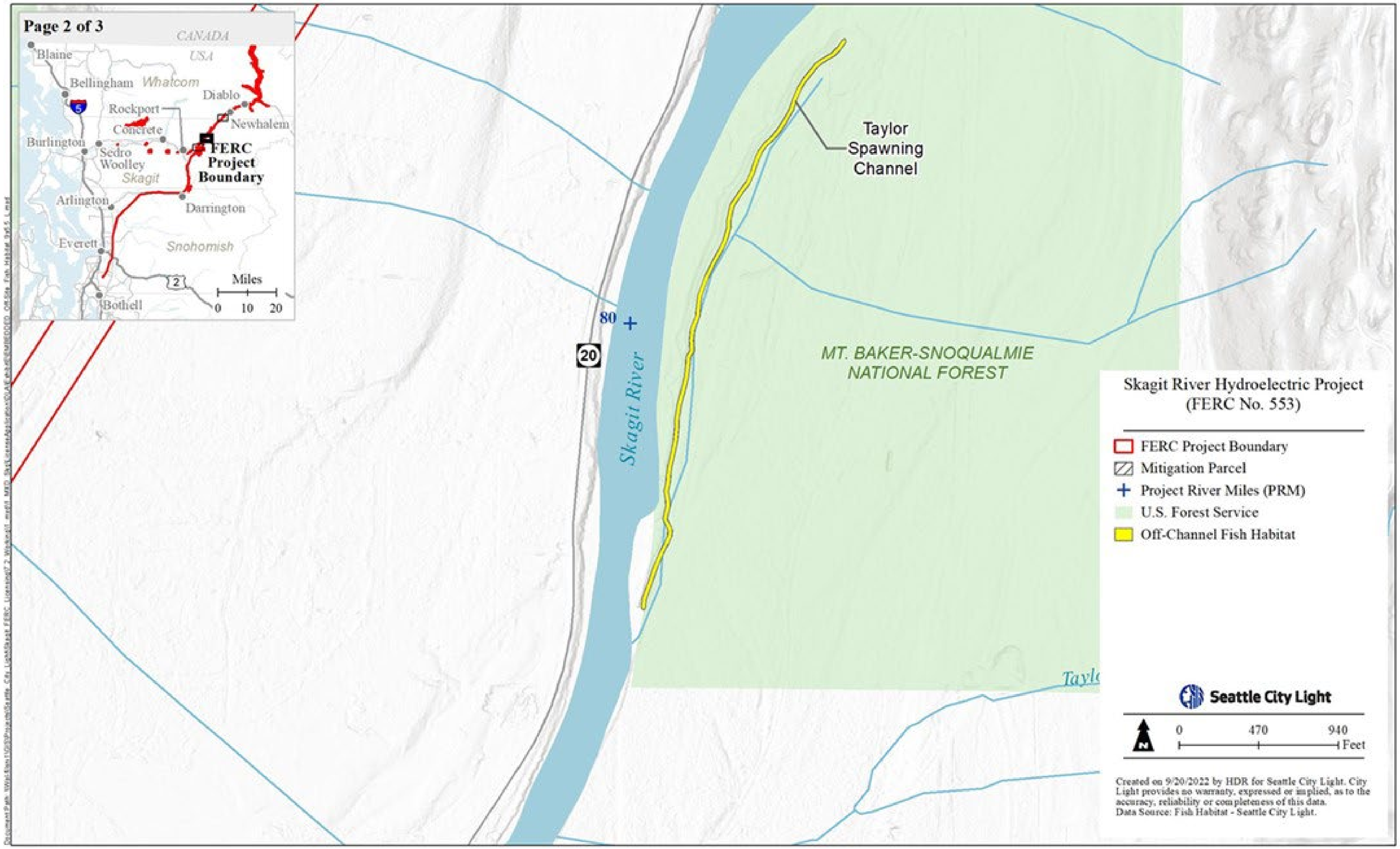


Figure 3.1-13. Off-site fish habitat sites of the Skagit River Project (page 2 of 3).

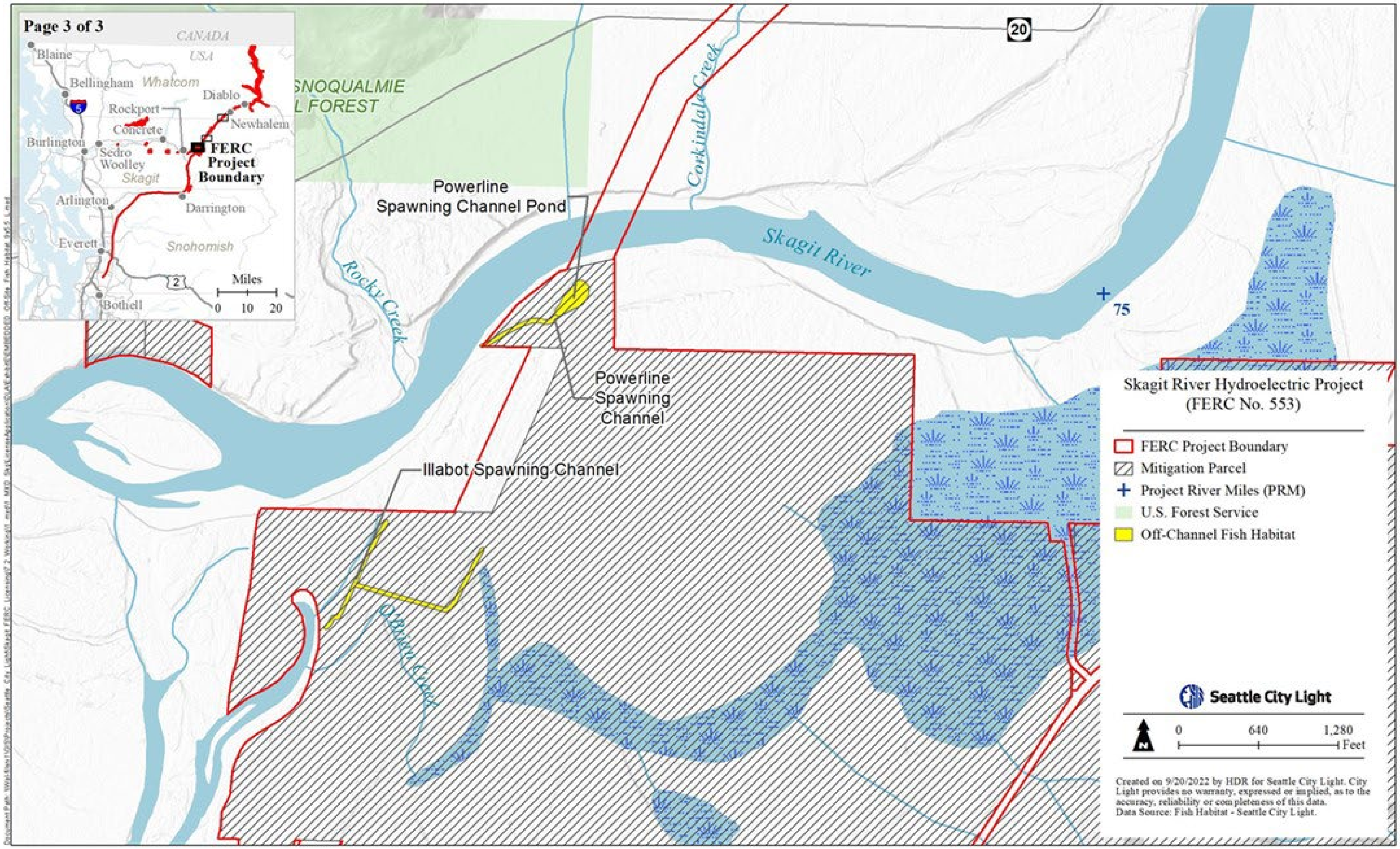


Figure 3.1-13. Off-site fish habitat sites of the Skagit River Project (page 3 of 3).

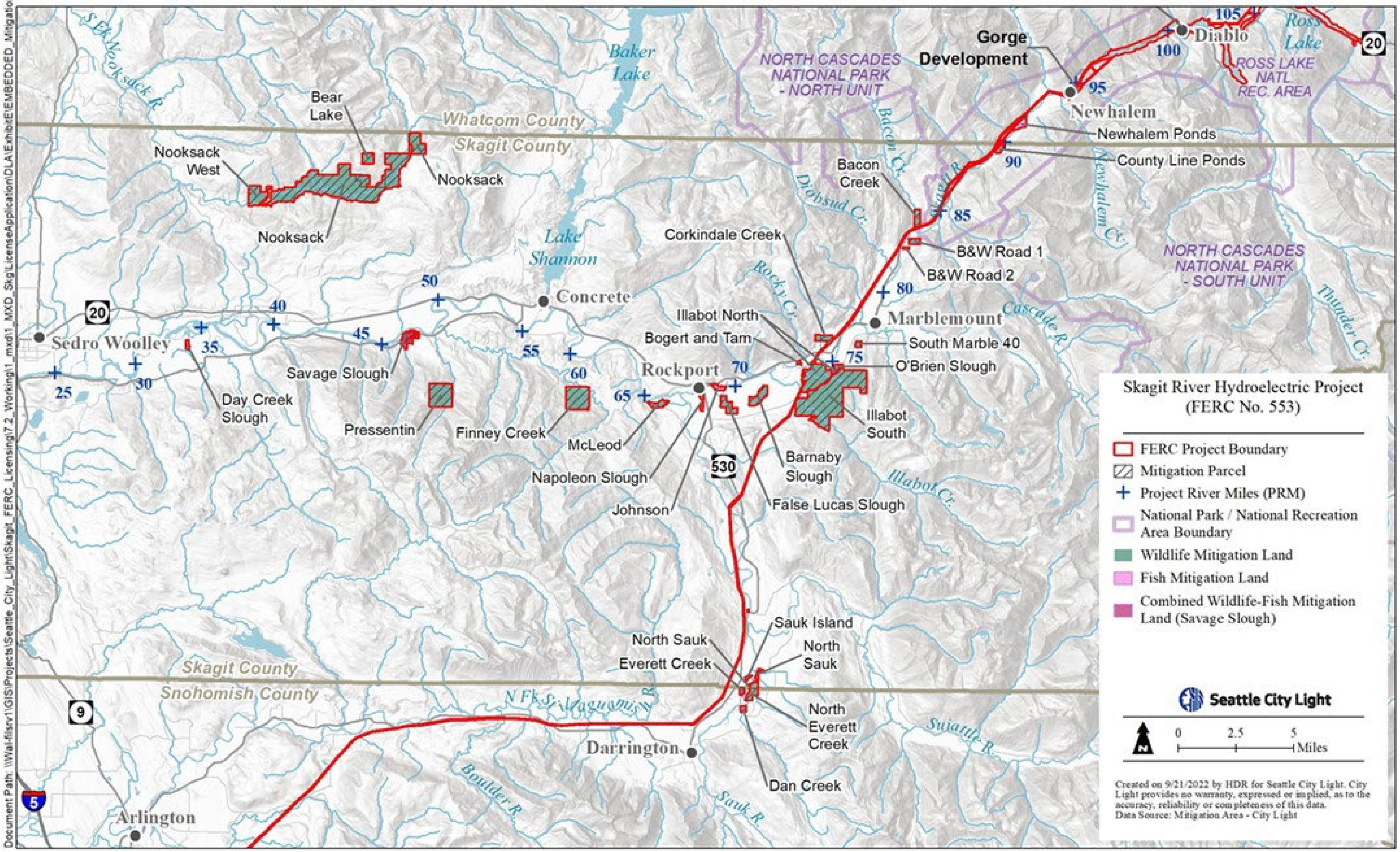


Figure 3.1-14. Fish and wildlife mitigation lands of the Skagit River Project.

3.1.2.11 Project Boundary

The Skagit River Project Boundary is located in the traditional territory of several Indian Tribes and Canadian First Nations and encompasses 32,773 acres and includes all Project facilities, including the dams, powerhouses, reservoirs, power tunnels, switchyards, transmission lines, and the towns of Newhalem and Diablo, as well as all fish and wildlife mitigation lands and Project recreation sites (Figure 3.1-15). It terminates in Washington State, at the U.S.-Canada border, and thus does not include the lands and waters around and within Ross Lake in Canada. Most of the City Light-owned fish and wildlife mitigation lands, as well as the USFS-managed Marblemount and Sauk River boat launches, are non-continuous features within the Project Boundary and are mapped as “islands”.

The Skagit River Project encompasses 19,233.51 acres of federal lands administered by the NPS and USFS – 19,007.01 acres that are non-transmission related, and 226.5 acres in the transmission line ROW.[7]

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 potential future development subject to the High Ross Treaty. As a result, the Project Boundary around Ross Lake extends up several of the major tributaries, including Big Beaver, Little Beaver, Lightning, and Ruby creeks. While included within the Project Boundary, lands associated with the inundation zone of High Ross (5,213.78 acres)[8] are not impacted by Project operations.

---

7 In response to FERC’s May 21, 2020 Additional Information Request, City Light submitted revised Exhibits K and M, which include updated federal lands values. Federal land acreage values presented herein are those approved by the February 2, 2021 Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges (174 FERC ¶ 62,066).

8 Per February 2, 2021 Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges (174 FERC ¶ 62,066).

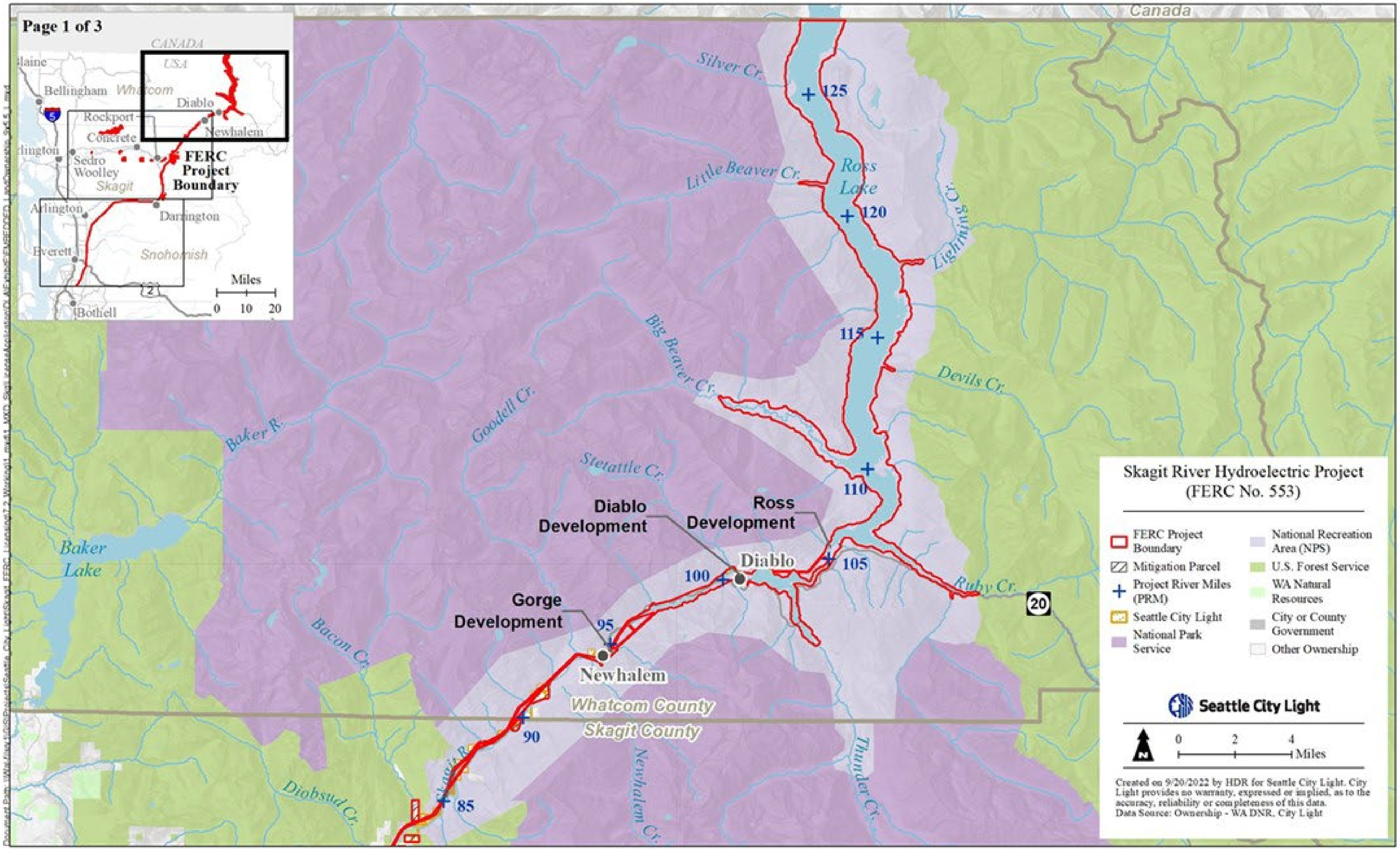


Figure 3.1-15. Skagit River Project vicinity land ownership (page 1 of 3).

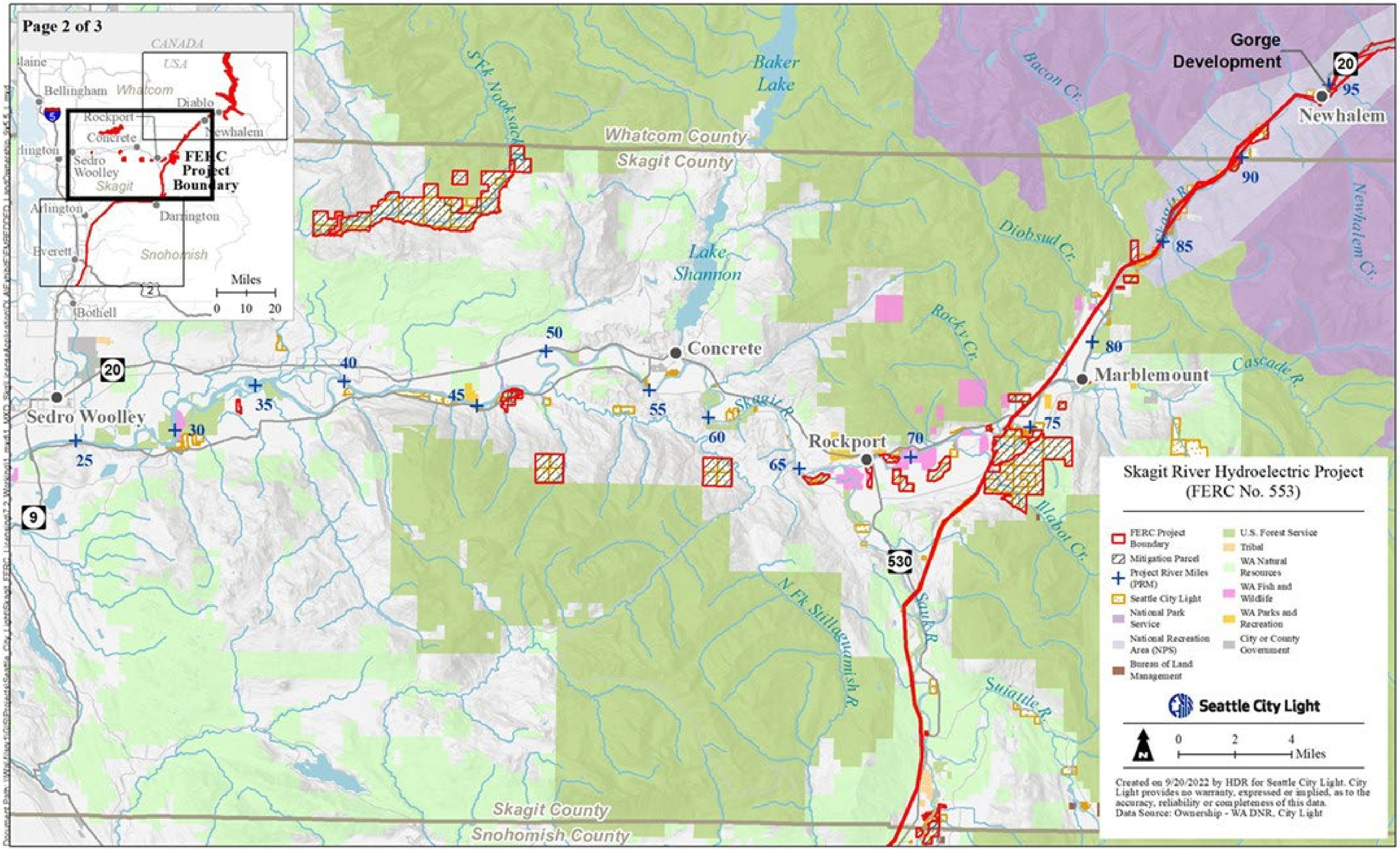


Figure 3.1-15. Skagit River Project vicinity land ownership (page 2 of 3).

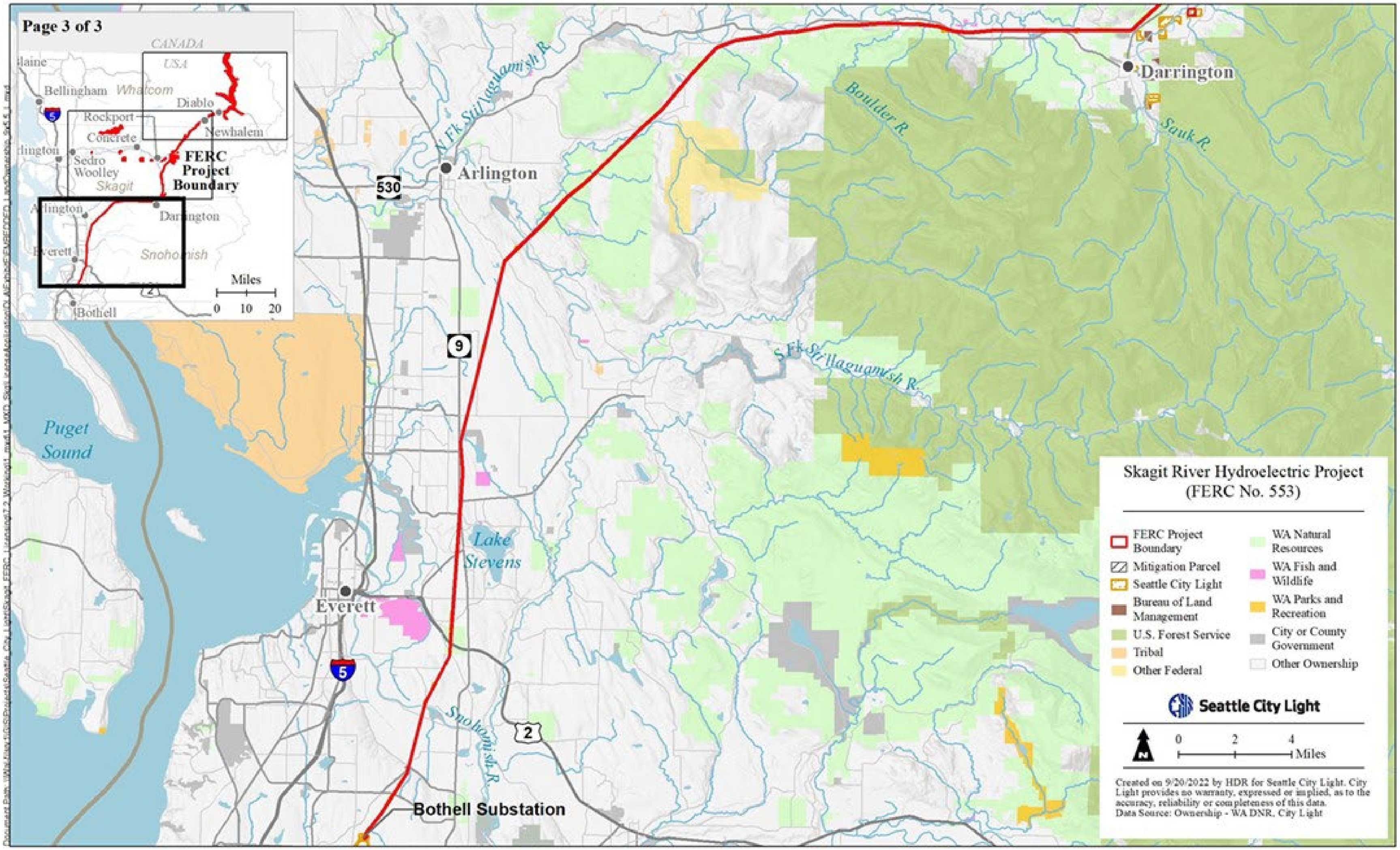


Figure 3.1-15. Skagit River Project vicinity land ownership (page 3 of 3).

3.1.3 Project Safety

The Skagit River Project has been operating for more than 27 years under the current Project license and during this time, Commission staff has conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance. In addition, the project has been inspected and evaluated every 5 years by an independent consultant and a consultant's safety report has been submitted for Commission review. As part of the relicensing process, the Commission staff would evaluate the continued adequacy of the proposed Project facilities under a new license. Special articles would be included in any license issued, as appropriate. Commission staff would continue to inspect the Project during the new license term to assure continued adherence to Commission-approved plans and specifications, special license articles relating to construction (if any), operation and maintenance, and accepted engineering practices and procedures.

3.1.4 Project Operations

The three Project developments are hydraulically coordinated to operate as a single project. Project operation under the current license is designed to meet and prioritize four objectives: (1) flood risk management; (2) salmon and steelhead protection flows downstream of Gorge Powerhouse; (3) recreation; and (4) power generation. To achieve these goals, City Light must adhere to specific current license requirements for Ross Lake levels and for streamflows and ramping rates downstream of Gorge Powerhouse.

3.1.4.1 Reservoir Operations

Ross Development

Ross Lake, the impoundment created by Ross Dam, is the largest of the three Project reservoirs with a usable storage capacity of 1,063,000 acre-feet. If needed, the reservoir can be surcharged by 5.5 feet to the top of the spillway gates to absorb an additional 69,000 acre-feet (U.S. Army Corps of Engineers [USACE] 2002). City Light operates Ross Lake to provide storage for downstream flood risk management; downstream fish protection; recreation at the lake; and power production.

Monthly minimum, average, and maximum water surface elevations at Ross Lake for the period 1988-2020 are provided in Table 3.1-3.

Under existing operations, Ross Lake is drawn down on a yearly basis during winter to capture flows from spring runoff and to provide for downstream flood risk management. The drawdown typically begins the Tuesday after Labor Day and continues until the lake reaches its lowest level in late March or early April. Article 301 of the current license requires City Light to draw down Ross Lake to a level that provides 60,000 acre-feet of storage for flood risk management by November 15 and 120,000 acre-feet by December 1, and to maintain this available storage through March 15. City Light must also comply with Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA (USACE 1967), which is incorporated into the Project license by reference. This document was updated in 2002 and provides the current guidance for Project operations for flood risk management.

Flood risk management operations are initiated by the Seattle District, USACE, Reservoir Control Center whenever it receives a flood forecast from the National Weather Service (NWS), Northwest River Forecast Center (NWRFC), or a flood forecast prepared internally indicating that natural flows at Concrete will reach 90,000 cfs in 8 hours on a rising flood. The Reservoir Control Center notifies City Light and initiates an official flood risk management operation at that time. This flood notification is referred to as an "Official Flood Control Notice (OFCN)." The OFCN is logged by the Reservoir Control Center and City Light at the time it is issued/received. The Reservoir Control Center also notifies the System Control Center (SCC) and cancels the OFCN when the flood risk management operation is ended. During the flood period through which the Reservoir Control Center controls operations of the Project, City Light retains the right to discharge up to 5,000 cfs from Ross (plus or minus 20 percent allowances for operational latitude) as such flows are necessary for normal generation at the other two Project developments. Additionally, Ross Lake may be surcharged if the water surface elevation reaches 1,608.76 feet NAVD 88 (1,602.5 feet CoSD) before flood recession occurs to provide the additional reduction of release downstream.

The Skagit River Project Water Control Manual (USACE 2002) describes the USACE water control plan for the Skagit River Project, which is the maximum beneficial use of flood risk management storage at Ross to reduce flooding in the lower Skagit Valley during the October-March flood season. During flood events, both Ross and Upper Baker are coordinated concurrently by the Reservoir Control Center to optimize their combined flood risk management storage. See Section 2.3.3 of Exhibit B of this DLA for additional details about the flood risk management procedure during a flood event.

Ross Lake water surface elevation is also managed to meet recreational needs during the summer months. Article 403 of the current license requires City Light to fill Ross Lake as soon as possible after April 15, achieve normal maximum water surface elevation depth by July 31, and maintain normal maximum water surface elevation depth through Labor Day.

Table 3.1-3. Monthly minimum, average, and maximum elevations (feet, NAVD 88) into Ross Lake (1988-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	1,558.8	1,541.7	1,520.5	1,530.3	1,575.6	1,603.4	1,608.4	1,608.4	1,603.4	1,595.3	1,591.1	1,582.7	1,608.4
	Average	1,550.8	1,532.5	1,508.1	1,510.6	1,551.2	1,590.5	1,607.3	1,606.2	1,599.5	1,593.0	1,587.2	1,579.2	1,568.1
	Minimum	1,543.1	1,521.6	1,498.6	1,496.7	1,531.0	1,576.2	1,603.6	1,603.6	1,595.5	1,589.1	1,583.1	1,575.0	1,496.7
1989	Maximum	1,574.5	1,548.7	1,512.6	1,526.9	1,569.8	1,607.4	1,608.7	1,608.7	1,605.0	1,597.9	1,597.1	1,598.3	1,608.7
	Average	1,562.7	1,532.1	1,502.6	1,509.8	1,553.8	1,596.2	1,608.3	1,607.1	1,601.7	1,594.6	1,592.7	1,594.6	1,571.7
	Minimum	1,549.3	1,514.4	1,498.2	1,496.8	1,528.2	1,571.8	1,607.7	1,605.4	1,598.1	1,591.1	1,586.9	1,591.3	1,496.8
1990	Maximum	1,591.0	1,572.2	1,544.4	1,541.9	1,567.3	1,605.1	1,608.8	1,608.6	1,608.2	1,602.5	1,608.4	1,599.7	1,608.8
	Average	1,584.2	1,559.2	1,530.6	1,529.9	1,554.2	1,587.7	1,608.1	1,608.3	1,604.2	1,601.4	1,602.8	1,596.8	1,580.8
	Minimum	1,573.3	1,545.5	1,519.9	1,519.9	1,541.8	1,568.8	1,606.1	1,607.9	1,599.7	1,599.2	1,598.1	1,593.4	1,519.9
1991	Maximum	1,593.3	1,575.7	1,553.6	1,524.7	1,553.1	1,597.9	1,608.7	1,608.7	1,608.1	1,602.9	1,594.7	1,591.9	1,608.7
	Average	1,584.5	1,566.8	1,540.7	1,522.2	1,534.0	1,573.7	1,606.1	1,608.4	1,605.5	1,598.7	1,593.5	1,589.7	1,577.1
	Minimum	1,573.5	1,554.3	1,524.8	1,519.1	1,520.5	1,554.3	1,599.3	1,608.1	1,603.1	1,594.7	1,591.5	1,584.8	1,519.1
1992	Maximum	1,584.1	1,570.9	1,551.0	1,550.0	1,582.5	1,603.0	1,604.2	1,599.9	1,594.6	1,593.3	1,586.2	1,572.5	1,604.2
	Average	1,574.3	1,561.8	1,543.6	1,540.8	1,568.5	1,593.0	1,602.4	1,597.7	1,593.5	1,590.5	1,579.4	1,564.9	1,575.9
	Minimum	1,567.2	1,551.4	1,539.7	1,538.1	1,551.5	1,583.5	1,599.6	1,594.7	1,592.4	1,586.5	1,572.9	1,558.3	1,538.1
1993	Maximum	1,557.6	1,539.0	1,522.3	1,525.8	1,583.8	1,605.7	1,608.6	1,608.7	1,608.0	1,602.7	1,597.0	1,581.7	1,608.7
	Average	1,547.4	1,531.2	1,520.0	1,523.3	1,553.5	1,597.6	1,607.3	1,608.5	1,605.7	1,599.6	1,589.3	1,578.4	1,572.1
	Minimum	1,539.4	1,522.0	1,518.2	1,522.2	1,526.3	1,585.2	1,605.8	1,608.1	1,602.9	1,597.3	1,581.9	1,573.6	1,518.2
1994	Maximum	1,573.4	1,559.3	1,546.2	1,556.2	1,586.1	1,601.5	1,606.7	1,605.9	1,600.7	1,592.3	1,585.7	1,576.3	1,606.7
	Average	1,567.3	1,550.4	1,544.9	1,547.9	1,572.8	1,593.9	1,605.1	1,604.0	1,596.6	1,588.1	1,580.4	1,572.8	1,577.2
	Minimum	1,559.6	1,542.9	1,543.4	1,544.0	1,556.9	1,586.5	1,601.9	1,600.8	1,592.5	1,585.8	1,575.3	1,569.8	1,542.9
1995	Maximum	1,572.6	1,551.0	1,546.8	1,523.9	1,560.3	1,594.7	1,608.4	1,608.7	1,605.5	1,602.0	1,608.6	1,607.9	1,608.7
	Average	1,560.4	1,548.1	1,535.5	1,518.2	1,532.3	1,580.3	1,604.1	1,607.5	1,603.4	1,601.1	1,602.4	1,597.9	1,574.5
	Minimum	1,548.8	1,544.2	1,524.6	1,514.0	1,514.3	1,562.5	1,595.8	1,605.8	1,601.3	1,600.0	1,598.3	1,593.6	1,514.0
1996	Maximum	1,596.0	1,586.0	1,581.4	1,567.8	1,571.4	1,597.1	1,608.2	1,608.2	1,607.5	1,601.3	1,596.3	1,590.8	1,608.2
	Average	1,593.5	1,583.3	1,574.3	1,565.3	1,566.2	1,587.2	1,605.6	1,607.7	1,605.2	1,598.9	1,593.7	1,585.8	1,588.9
	Minimum	1,586.6	1,581.8	1,566.0	1,561.8	1,562.9	1,571.7	1,597.8	1,607.2	1,601.7	1,596.4	1,590.9	1,579.2	1,561.8

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1997	Maximum	1,580.7	1,569.4	1,550.1	1,537.9	1,583.2	1,608.4	1,608.5	1,608.6	1,608.1	1,608.5	1,605.3	1,593.6	1,608.6
	Average	1,574.9	1,561.5	1,539.9	1,532.7	1,554.2	1,603.0	1,608.3	1,608.2	1,607.3	1,605.9	1,599.4	1,588.1	1,582.1
	Minimum	1,568.0	1,551.0	1,531.6	1,528.6	1,532.8	1,586.9	1,608.0	1,607.9	1,606.6	1,604.0	1,593.8	1,583.0	1,528.6
1998	Maximum	1,583.0	1,566.0	1,551.0	1,533.1	1,576.4	1,603.8	1,608.6	1,608.5	1,603.8	1,595.2	1,583.7	1,579.0	1,608.6
	Average	1,574.4	1,559.3	1,540.5	1,525.2	1,558.3	1,593.8	1,607.7	1,607.2	1,599.5	1,589.8	1,580.3	1,576.8	1,576.2
	Minimum	1,566.4	1,551.7	1,534.0	1,519.7	1,527.4	1,577.8	1,604.4	1,604.0	1,595.5	1,584.0	1,579.0	1,574.4	1,519.7
1999	Maximum	1,577.1	1,559.2	1,529.2	1,495.2	1,519.2	1,583.4	1,608.5	1,608.6	1,607.4	1,600.3	1,605.4	1,597.3	1,608.6
	Average	1,569.7	1,545.2	1,510.8	1,481.6	1,491.8	1,551.1	1,600.9	1,607.4	1,604.2	1,597.1	1,598.1	1,596.3	1,563.1
	Minimum	1,560.1	1,530.3	1,496.1	1,473.1	1,484.0	1,521.4	1,585.0	1,606.1	1,600.7	1,593.7	1,592.9	1,594.7	1,473.1
2000	Maximum	1,594.4	1,569.4	1,544.2	1,535.6	1,565.7	1,604.7	1,608.5	1,608.6	1,605.6	1,599.6	1,592.7	1,578.4	1,608.6
	Average	1,583.5	1,557.4	1,533.0	1,527.9	1,547.9	1,587.1	1,607.1	1,607.5	1,602.4	1,596.1	1,586.2	1,570.4	1,575.6
	Minimum	1,570.1	1,545.1	1,522.7	1,521.7	1,536.1	1,566.6	1,605.0	1,605.9	1,599.1	1,593.0	1,578.7	1,563.7	1,521.7
2001	Maximum	1,563.3	1,554.1	1,544.5	1,538.8	1,570.9	1,591.7	1,597.3	1,596.2	1,591.0	1,584.1	1,585.9	1,585.1	1,597.3
	Average	1,559.9	1,549.8	1,540.0	1,535.6	1,551.8	1,582.5	1,596.1	1,593.5	1,587.4	1,580.3	1,581.0	1,582.6	1,570.2
	Minimum	1,554.5	1,544.9	1,537.1	1,533.8	1,539.5	1,572.0	1,592.2	1,591.0	1,584.4	1,577.5	1,576.3	1,581.0	1,533.8
2002	Maximum	1,585.2	1,569.4	1,550.4	1,523.7	1,547.8	1,605.3	1,608.6	1,608.5	1,607.4	1,603.4	1,595.8	1,589.1	1,608.6
	Average	1,579.6	1,558.1	1,534.1	1,518.4	1,527.4	1,580.1	1,607.6	1,608.0	1,605.4	1,600.4	1,592.1	1,586.2	1,574.9
	Minimum	1,570.6	1,551.1	1,517.9	1,510.9	1,521.2	1,550.2	1,605.4	1,607.4	1,603.6	1,596.3	1,589.3	1,584.4	1,510.9
2003	Maximum	1,584.3	1,576.8	1,565.3	1,567.7	1,585.3	1,607.5	1,608.6	1,608.6	1,604.0	1,607.6	1,604.0	1,593.9	1,608.6
	Average	1,577.4	1,572.1	1,562.6	1,567.0	1,572.0	1,600.3	1,608.1	1,606.5	1,600.4	1,598.4	1,600.0	1,590.9	1,588.1
	Minimum	1,570.4	1,564.5	1,558.4	1,565.9	1,567.5	1,586.8	1,607.2	1,604.1	1,596.2	1,592.2	1,594.5	1,586.3	1,558.4
2004	Maximum	1,585.9	1,563.7	1,534.7	1,554.3	1,591.6	1,608.5	1,608.4	1,608.3	1,607.0	1,604.7	1,595.3	1,594.0	1,608.5
	Average	1,574.8	1,548.7	1,531.9	1,544.1	1,574.6	1,603.6	1,608.3	1,607.0	1,606.1	1,600.9	1,589.7	1,590.9	1,581.8
	Minimum	1,564.4	1,533.2	1,530.0	1,535.1	1,555.7	1,592.1	1,608.1	1,606.2	1,605.0	1,595.9	1,585.8	1,585.8	1,530.0
2005	Maximum	1,593.0	1,591.9	1,579.9	1,582.2	1,597.6	1,604.1	1,608.0	1,608.4	1,607.1	1,599.5	1,593.5	1,577.8	1,608.4
	Average	1,586.6	1,586.1	1,576.9	1,576.5	1,590.3	1,600.8	1,606.6	1,608.1	1,603.0	1,597.2	1,584.4	1,572.2	1,590.8
	Minimum	1,578.6	1,580.3	1,575.6	1,575.2	1,582.7	1,597.9	1,604.4	1,607.4	1,599.0	1,594.2	1,578.3	1,567.0	1,567.0
2006	Maximum	1,577.5	1,566.4	1,539.1	1,511.1	1,566.3	1,604.3	1,608.6	1,608.5	1,607.2	1,600.6	1,604.9	1,595.3	1,608.6
	Average	1,573.9	1,554.8	1,518.6	1,502.7	1,535.8	1,589.8	1,607.4	1,608.2	1,604.4	1,597.7	1,599.3	1,592.9	1,574.0
	Minimum	1,566.9	1,540.2	1,501.1	1,499.5	1,512.5	1,567.8	1,604.7	1,607.4	1,600.8	1,595.1	1,594.8	1,589.8	1,499.5

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2007	Maximum	1,590.3	1,570.6	1,554.9	1,556.7	1,589.3	1,608.5	1,608.5	1,608.1	1,606.6	1,599.5	1,591.6	1,592.4	1,608.5
	Average	1,583.2	1,558.9	1,547.8	1,554.7	1,569.2	1,605.4	1,608.2	1,607.6	1,603.7	1,596.9	1,588.1	1,589.7	1,584.6
	Minimum	1,571.5	1,547.8	1,539.6	1,552.1	1,554.2	1,591.5	1,607.9	1,606.7	1,599.6	1,592.0	1,584.8	1,584.1	1,539.6
2008	Maximum	1,585.4	1,559.3	1,533.4	1,508.9	1,570.8	1,606.3	1,607.9	1,608.3	1,607.7	1,598.9	1,597.0	1,593.6	1,608.3
	Average	1,574.2	1,544.9	1,521.4	1,500.6	1,525.2	1,590.4	1,607.6	1,607.9	1,603.9	1,595.2	1,594.0	1,588.0	1,571.2
	Minimum	1,560.2	1,533.6	1,510.0	1,494.7	1,495.5	1,573.1	1,607.2	1,607.2	1,599.3	1,590.9	1,589.8	1,582.3	1,494.7
2009	Maximum	1,582.0	1,573.9	1,558.4	1,548.6	1,584.2	1,608.1	1,608.4	1,608.2	1,607.2	1,603.0	1,602.4	1,595.4	1,608.4
	Average	1,579.3	1,565.9	1,553.0	1,546.0	1,561.8	1,603.6	1,607.8	1,607.4	1,605.6	1,600.7	1,599.5	1,589.9	1,585.2
	Minimum	1,574.5	1,558.7	1,547.9	1,544.3	1,548.9	1,586.5	1,607.3	1,606.7	1,603.2	1,598.5	1,595.7	1,583.8	1,544.3
2010	Maximum	1,583.5	1,575.5	1,563.0	1,553.4	1,573.6	1,606.3	1,608.1	1,608.1	1,606.6	1,604.6	1,589.7	1,585.5	1,608.1
	Average	1,580.1	1,568.7	1,558.1	1,551.0	1,560.3	1,593.1	1,607.3	1,607.5	1,604.7	1,599.7	1,588.4	1,583.9	1,583.7
	Minimum	1,576.2	1,563.4	1,553.6	1,548.6	1,553.2	1,575.0	1,606.2	1,606.6	1,603.2	1,589.0	1,585.0	1,582.0	1,548.6
2011	Maximum	1,582.9	1,576.9	1,557.4	1,530.8	1,541.0	1,592.8	1,608.6	1,608.5	1,606.5	1,602.2	1,597.1	1,589.3	1,608.6
	Average	1,579.6	1,569.0	1,542.5	1,524.5	1,521.6	1,571.3	1,604.3	1,607.5	1,603.3	1,599.9	1,590.3	1,583.9	1,574.9
	Minimum	1,575.9	1,558.4	1,530.5	1,514.8	1,511.7	1,542.8	1,594.0	1,606.5	1,601.2	1,597.4	1,586.5	1,579.3	1,511.7
2012	Maximum	1,581.1	1,568.1	1,541.2	1,535.2	1,569.2	1,595.8	1,607.9	1,607.8	1,606.1	1,602.1	1,602.7	1,592.9	1,607.9
	Average	1,576.4	1,555.5	1,527.9	1,517.9	1,550.6	1,586.3	1,604.7	1,607.1	1,603.4	1,598.4	1,596.9	1,588.3	1,576.2
	Minimum	1,568.7	1,542.2	1,518.1	1,512.3	1,536.5	1,570.9	1,597.1	1,606.3	1,600.0	1,595.9	1,593.1	1,580.6	1,512.3
2013	Maximum	1,579.8	1,551.9	1,526.5	1,527.2	1,577.7	1,601.7	1,608.2	1,608.1	1,607.8	1,608.2	1,596.8	1,587.4	1,608.2
	Average	1,566.5	1,539.3	1,523.1	1,524.7	1,556.6	1,591.1	1,606.9	1,607.2	1,606.9	1,603.1	1,592.1	1,580.4	1,575.1
	Minimum	1,552.7	1,527.0	1,518.6	1,518.7	1,526.1	1,578.3	1,602.8	1,606.3	1,605.2	1,597.2	1,587.5	1,572.5	1,518.6
2014	Maximum	1,571.8	1,563.4	1,549.7	1,545.5	1,585.1	1,608.1	1,608.6	1,607.8	1,606.3	1,599.1	1,598.0	1,596.8	1,608.6
	Average	1,567.8	1,555.6	1,547.7	1,542.6	1,562.2	1,601.4	1,608.0	1,607.1	1,602.5	1,596.3	1,595.0	1,594.9	1,581.9
	Minimum	1,563.9	1,548.3	1,545.7	1,540.5	1,540.9	1,586.3	1,607.0	1,606.5	1,599.4	1,594.6	1,591.2	1,593.3	1,540.5
2015	Maximum	1,592.6	1,592.1	1,583.6	1,579.2	1,598.1	1,604.7	1,605.9	1,603.3	1,604.2	1,594.9	1,597.0	1,595.7	1,605.9
	Average	1,587.0	1,588.6	1,577.7	1,578.0	1,585.3	1,603.2	1,605.0	1,603.0	1,600.2	1,589.7	1,591.6	1,592.7	1,591.8
	Minimum	1,583.1	1,583.7	1,575.3	1,577.0	1,577.7	1,598.8	1,603.2	1,602.5	1,595.4	1,584.6	1,586.6	1,587.6	1,575.3
2016	Maximum	1,586.6	1,571.3	1,565.8	1,577.5	1,598.9	1,607.7	1,608.1	1,608.0	1,605.4	1,594.6	1,593.9	1,592.5	1,608.1
	Average	1,573.6	1,568.0	1,558.4	1,562.1	1,592.3	1,604.7	1,607.6	1,606.9	1,600.5	1,592.9	1,592.1	1,586.4	1,587.2
	Minimum	1,564.7	1,564.4	1,551.1	1,551.0	1,578.0	1,598.8	1,607.3	1,605.5	1,595.0	1,591.5	1,589.4	1,577.2	1,551.0

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Maximum	1,576.2	1,552.7	1,550.8	1,550.7	1,586.9	1,604.7	1,607.4	1,606.4	1,604.4	1,593.6	1,594.6	1,592.3	1,607.4
	Average	1,561.4	1,551.2	1,547.8	1,549.2	1,562.7	1,598.2	1,606.7	1,605.0	1,600.2	1,589.3	1,586.2	1,585.3	1,578.8
	Minimum	1,552.6	1,549.2	1,542.7	1,547.0	1,546.2	1,589.2	1,605.3	1,604.4	1,594.0	1,586.8	1,580.1	1,580.0	1,542.7
2018	Maximum	1,579.5	1,564.0	1,536.7	1,503.1	1,584.3	1,603.1	1,608.0	1,608.0	1,604.6	1,592.3	1,584.8	1,583.1	1,608.0
	Average	1,571.2	1,557.4	1,507.5	1,491.7	1,549.4	1,593.6	1,607.1	1,606.0	1,598.8	1,585.6	1,582.5	1,580.2	1,569.4
	Minimum	1,563.7	1,539.0	1,491.0	1,487.5	1,504.6	1,584.9	1,603.5	1,604.6	1,592.3	1,579.4	1,579.4	1,577.6	1,487.5
2019	Maximum	1,577.7	1,559.4	1,531.8	1,512.2	1,553.8	1,568.9	1,572.9	1,572.6	1,571.0	1,565.3	1,562.0	1,555.0	1,577.7
	Average	1,571.3	1,546.4	1,517.0	1,505.4	1,529.9	1,563.9	1,571.5	1,572.2	1,568.1	1,562.8	1,558.5	1,552.0	1,551.6
	Minimum	1,560.2	1,532.8	1,505.4	1,499.7	1,511.3	1,555.4	1,569.1	1,571.3	1,565.6	1,561.4	1,555.4	1,549.7	1,499.7
2020	Maximum	1,554.6	1,561.2	1,543.8	1,519.2	1,580.9	1,606.2	1,608.4	1,608.3	1,607.1	1,600.2	1,596.6	1,593.1	1,608.4
	Average	1,552.6	1,555.2	1,529.1	1,513.0	1,549.0	1,595.8	1,607.7	1,607.9	1,603.6	1,597.5	1,594.4	1,590.2	1,574.8
	Minimum	1,550.2	1,544.8	1,517.3	1,509.6	1,520.7	1,582.8	1,606.3	1,607.3	1,600.3	1,592.7	1,591.9	1,587.2	1,509.6
33-Year Summary	Maximum	1,596.0	1,592.1	1,583.6	1,582.2	1,598.9	1,608.5	1,608.8	1,608.7	1,608.2	1,608.5	1,608.6	1,607.9	1,608.8
	Average	1,572.9	1,557.1	1,537.8	1,531.6	1,553.5	1,590.7	1,605.2	1,605.4	1,601.2	1,595.1	1,590.3	1,584.6	1,577.3
	Minimum	1,539.4	1,514.4	1,491.0	1,473.1	1,484.0	1,521.4	1,569.1	1,571.3	1,565.6	1,561.4	1,555.4	1,549.7	1,473.1

City Light typically operates the Ross Powerhouse continuously to pass flow downstream, although it occasionally increases and decreases generation for short periods to help meet load-following demand or other Project purposes. Spills over Ross Dam are infrequent (relative to Diablo and Gorge developments) due to the large reservoir storage capacity. Spill is typically associated with gate testing, is usually short in duration, and averages only a few cfs of flow per event (Table 3.1-4). Over the five years (2017-2021), Ross Dam has spilled 55 times; 8 of these occurred between October 28 and November 9, 2020 associated with Units 41 and 42 being offline and a high inflow event on November 5, 2020. Another 33 days of spill occurred in the fall of 2021 corresponding to a high inflow event.

Table 3.1-4. Ross Dam spill events (2017-2021).

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2017	1	<1
2018	2	<1
2019	0	0
2020	12	2,147
2021	40	3,872

Diablo Development

The Diablo Development is operated primarily to regulate flow between the Ross and Gorge developments. Monthly minimum, average, and maximum water surface elevations at Diablo Lake for the period 1988-2020 are provided in Table 3.1-5.

Table 3.1-5. Monthly minimum, average, and maximum elevations (feet, NAVD 88) into Diablo Lake (1988-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	1,208.7	1,209.2	1,210.0	1,209.4	1,209.3	1,210.5	1,209.8	1,211.1	1,210.5	1,209.6	1,211.1	1,210.4	1,211.1
	Average	1,207.4	1,208.2	1,208.9	1,205.6	1,201.8	1,208.4	1,208.4	1,208.7	1,209.1	1,207.6	1,207.3	1,208.1	1,207.5
	Minimum	1,204.9	1,207.0	1,207.9	1,193.0	1,192.5	1,206.4	1,206.8	1,206.6	1,207.4	1,204.5	1,205.2	1,205.7	1,192.5
1989	Maximum	1,210.6	1,210.1	1,210.2	1,210.9	1,210.8	1,210.2	1,212.0	1,210.5	1,210.2	1,208.3	1,211.6	1,210.8	1,212.0
	Average	1,208.2	1,207.5	1,208.3	1,208.4	1,208.7	1,208.6	1,209.8	1,208.5	1,208.4	1,206.6	1,208.4	1,209.0	1,208.4
	Minimum	1,204.6	1,204.2	1,206.3	1,206.5	1,207.3	1,206.2	1,206.8	1,207.1	1,205.6	1,204.0	1,205.7	1,206.5	1,204.0
1990	Maximum	1,211.3	1,211.0	1,211.5	1,211.4	1,211.1	1,210.8	1,212.0	1,210.9	1,210.0	1,210.6	1,211.7	1,210.3	1,212.0
	Average	1,209.0	1,208.7	1,209.6	1,208.6	1,209.1	1,208.5	1,209.8	1,208.6	1,208.6	1,208.7	1,209.6	1,207.9	1,208.9
	Minimum	1,205.9	1,205.7	1,206.5	1,206.7	1,207.6	1,206.4	1,206.9	1,205.3	1,205.5	1,206.9	1,207.7	1,203.5	1,203.5
1991	Maximum	1,210.7	1,211.1	1,210.2	1,211.7	1,211.4	1,211.8	1,212.2	1,211.5	1,211.7	1,211.1	1,209.7	1,209.6	1,212.2
	Average	1,208.1	1,208.7	1,209.1	1,208.1	1,209.1	1,209.0	1,209.9	1,209.7	1,209.7	1,208.6	1,208.3	1,208.2	1,208.9
	Minimum	1,204.0	1,205.6	1,207.4	1,204.1	1,206.8	1,206.5	1,207.3	1,206.8	1,206.0	1,207.1	1,206.9	1,206.4	1,204.0
1992	Maximum	1,210.9	1,210.4	1,211.7	1,210.3	1,210.0	1,210.0	1,211.2	1,210.3	1,209.8	1,206.8	1,210.2	1,210.5	1,211.7
	Average	1,209.6	1,209.1	1,209.3	1,208.9	1,209.0	1,209.3	1,209.1	1,209.0	1,206.2	1,196.3	1,208.6	1,208.3	1,207.7
	Minimum	1,207.9	1,207.1	1,208.0	1,206.9	1,208.3	1,208.5	1,207.6	1,207.2	1,190.5	1,189.6	1,205.9	1,204.4	1,189.6
1993	Maximum	1,208.9	1,210.0	1,209.8	1,210.5	1,210.7	1,210.8	1,209.6	1,210.5	1,210.2	1,210.4	1,210.5	1,210.3	1,210.8
	Average	1,207.3	1,208.7	1,209.0	1,209.6	1,209.0	1,209.1	1,208.8	1,209.1	1,209.3	1,209.3	1,208.7	1,208.6	1,208.9
	Minimum	1,204.1	1,207.0	1,208.3	1,208.8	1,206.5	1,207.6	1,207.3	1,207.4	1,208.3	1,207.7	1,206.9	1,204.9	1,204.1
1994	Maximum	1,210.2	1,210.8	1,210.0	1,210.3	1,210.1	1,210.0	1,210.6	1,210.3	1,210.3	1,210.1	1,210.3	1,210.4	1,210.8
	Average	1,208.8	1,209.0	1,208.3	1,208.6	1,208.9	1,208.6	1,208.7	1,208.5	1,208.9	1,208.0	1,208.3	1,208.6	1,208.6
	Minimum	1,205.2	1,205.8	1,204.9	1,206.3	1,206.8	1,206.2	1,206.5	1,204.7	1,207.6	1,206.4	1,206.9	1,207.4	1,204.7
1995	Maximum	1,210.0	1,209.6	1,209.4	1,210.4	1,210.7	1,210.5	1,211.3	1,211.1	1,209.6	1,210.0	1,210.4	1,210.0	1,211.3
	Average	1,208.4	1,208.2	1,208.1	1,205.9	1,208.9	1,208.8	1,209.1	1,208.7	1,208.6	1,208.4	1,208.2	1,207.9	1,208.3
	Minimum	1,207.0	1,205.0	1,204.7	1,203.1	1,205.7	1,206.1	1,206.9	1,206.0	1,207.6	1,206.2	1,205.9	1,205.0	1,203.1
1996	Maximum	1,209.9	1,209.6	1,210.1	1,210.5	1,211.2	1,210.3	1,210.5	1,211.1	1,210.2	1,210.2	1,210.5	1,209.3	1,211.2
	Average	1,208.7	1,207.9	1,208.3	1,208.4	1,209.2	1,208.5	1,209.0	1,208.7	1,208.5	1,205.8	1,208.0	1,207.6	1,208.2
	Minimum	1,206.9	1,204.2	1,206.8	1,204.6	1,207.5	1,204.9	1,207.1	1,207.4	1,206.5	1,201.8	1,206.5	1,205.7	1,201.8

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1997	Maximum	1,209.8	1,209.7	1,210.7	1,211.3	1,211.8	1,211.9	1,211.9	1,211.6	1,211.2	1,211.7	1,210.4	1,209.6	1,211.9
	Average	1,207.7	1,208.6	1,209.0	1,209.0	1,209.1	1,209.4	1,209.7	1,209.4	1,209.4	1,208.8	1,208.3	1,208.4	1,208.9
	Minimum	1,206.4	1,207.7	1,207.4	1,207.5	1,206.6	1,207.0	1,208.0	1,207.6	1,207.8	1,205.4	1,205.5	1,207.5	1,205.4
1998	Maximum	1,209.4	1,209.6	1,210.3	1,211.1	1,211.2	1,211.3	1,210.0	1,210.2	1,210.0	1,209.4	1,209.2	1,209.1	1,211.3
	Average	1,208.1	1,208.3	1,208.8	1,209.8	1,209.2	1,209.4	1,208.9	1,208.2	1,207.9	1,208.1	1,208.0	1,207.1	1,208.5
	Minimum	1,205.8	1,207.0	1,206.0	1,207.9	1,207.8	1,207.1	1,207.3	1,206.5	1,205.7	1,206.7	1,207.2	1,204.4	1,204.4
1999	Maximum	1,211.1	1,210.3	1,210.7	1,209.6	1,211.2	1,210.0	1,211.5	1,211.6	1,210.8	1,211.3	1,211.4	1,211.0	1,211.6
	Average	1,208.5	1,208.3	1,208.0	1,207.5	1,209.2	1,208.5	1,209.2	1,209.3	1,209.3	1,209.3	1,209.4	1,209.2	1,208.8
	Minimum	1,205.9	1,205.5	1,205.2	1,205.0	1,207.2	1,206.4	1,207.2	1,205.7	1,207.9	1,207.3	1,207.6	1,207.2	1,205.0
2000	Maximum	1,210.6	1,210.3	1,211.1	1,210.7	1,211.3	1,211.9	1,210.6	1,211.4	1,210.7	1,210.1	1,211.4	1,209.2	1,211.9
	Average	1,209.4	1,209.1	1,209.3	1,208.5	1,208.8	1,209.0	1,208.9	1,209.4	1,208.6	1,208.6	1,209.0	1,208.2	1,208.9
	Minimum	1,206.7	1,208.3	1,208.1	1,206.8	1,206.9	1,207.1	1,206.9	1,206.5	1,206.5	1,207.1	1,207.3	1,206.9	1,206.5
2001	Maximum	1,210.7	1,210.2	1,210.4	1,210.4	1,210.7	1,211.1	1,210.7	1,211.0	1,210.6	1,209.6	1,209.1	1,208.8	1,211.1
	Average	1,208.7	1,208.7	1,209.0	1,208.8	1,208.8	1,209.3	1,209.3	1,209.4	1,209.5	1,208.6	1,207.7	1,207.5	1,208.8
	Minimum	1,207.2	1,207.0	1,207.2	1,207.3	1,207.0	1,207.3	1,207.8	1,207.1	1,207.9	1,207.2	1,206.1	1,205.7	1,205.7
2002	Maximum	1,210.9	1,210.1	1,210.4	1,209.7	1,211.1	1,210.2	1,211.2	1,209.4	1,208.6	1,209.3	1,208.1	1,209.2	1,211.2
	Average	1,208.1	1,208.6	1,208.6	1,208.4	1,208.3	1,208.4	1,209.2	1,206.8	1,206.9	1,207.8	1,206.5	1,207.9	1,208.0
	Minimum	1,206.0	1,206.8	1,206.9	1,205.8	1,206.0	1,205.7	1,206.8	1,203.7	1,204.1	1,205.4	1,204.0	1,206.4	1,203.7
2003	Maximum	1,210.6	1,209.0	1,208.3	1,210.5	1,211.0	1,210.7	1,211.0	1,210.0	1,210.1	1,210.4	1,209.5	1,210.2	1,211.0
	Average	1,207.8	1,207.9	1,207.3	1,208.2	1,208.9	1,208.9	1,208.7	1,208.5	1,208.6	1,208.3	1,208.2	1,208.5	1,208.3
	Minimum	1,206.4	1,205.8	1,205.6	1,206.4	1,206.8	1,207.0	1,206.3	1,207.4	1,206.9	1,206.9	1,206.2	1,207.1	1,205.6
2004	Maximum	1,210.1	1,210.2	1,211.1	1,210.2	1,210.8	1,211.3	1,210.6	1,211.7	1,211.1	1,209.9	1,210.5	1,210.3	1,211.7
	Average	1,208.7	1,209.1	1,209.1	1,208.7	1,209.0	1,209.1	1,209.2	1,209.5	1,209.2	1,208.8	1,209.1	1,209.1	1,209.1
	Minimum	1,207.0	1,207.2	1,207.9	1,207.4	1,206.0	1,207.3	1,207.3	1,207.1	1,207.6	1,207.5	1,207.5	1,206.9	1,206.0
2005	Maximum	1,210.5	1,210.7	1,210.3	1,210.0	1,209.9	1,208.3	1,210.6	1,210.1	1,211.0	1,210.7	1,209.7	1,210.3	1,211.0
	Average	1,208.4	1,209.2	1,208.9	1,208.5	1,205.5	1,204.8	1,208.9	1,209.0	1,208.8	1,208.6	1,207.5	1,208.1	1,208.0
	Minimum	1,204.8	1,208.4	1,206.6	1,205.3	1,202.7	1,203.2	1,206.6	1,207.6	1,207.2	1,204.3	1,204.8	1,205.4	1,202.7
2006	Maximum	1,209.8	1,209.7	1,210.0	1,209.4	1,211.5	1,210.7	1,210.8	1,210.9	1,210.4	1,210.5	1,210.7	1,209.9	1,211.5
	Average	1,207.9	1,208.3	1,208.1	1,208.1	1,208.6	1,209.1	1,209.1	1,209.6	1,209.2	1,209.2	1,208.5	1,208.5	1,208.7
	Minimum	1,206.3	1,206.8	1,206.5	1,206.0	1,206.5	1,207.0	1,207.0	1,208.5	1,207.9	1,206.4	1,206.4	1,207.6	1,206.0

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2007	Maximum	1,210.3	1,209.7	1,209.6	1,209.9	1,209.9	1,211.1	1,211.2	1,210.5	1,209.8	1,210.4	1,210.1	1,209.0	1,211.2
	Average	1,207.7	1,208.1	1,208.1	1,208.0	1,208.5	1,208.9	1,209.7	1,208.6	1,208.1	1,208.4	1,207.9	1,207.8	1,208.3
	Minimum	1,206.5	1,206.9	1,205.6	1,206.4	1,207.7	1,206.9	1,207.5	1,205.4	1,205.9	1,206.4	1,206.8	1,206.8	1,205.4
2008	Maximum	1,209.4	1,210.6	1,209.8	1,210.0	1,210.7	1,210.3	1,211.1	1,210.0	1,209.9	1,209.9	1,209.6	1,210.1	1,211.1
	Average	1,208.0	1,208.9	1,208.5	1,207.7	1,208.8	1,208.0	1,208.0	1,208.6	1,208.4	1,208.1	1,207.8	1,208.7	1,208.3
	Minimum	1,207.0	1,207.7	1,206.9	1,204.7	1,206.9	1,206.6	1,203.4	1,207.3	1,206.1	1,206.4	1,205.0	1,207.0	1,203.4
2009	Maximum	1,209.7	1,209.5	1,209.5	1,210.9	1,210.1	1,210.5	1,210.4	1,209.8	1,209.9	1,210.2	1,211.2	1,209.3	1,211.2
	Average	1,208.2	1,208.3	1,208.1	1,207.4	1,208.4	1,208.9	1,208.9	1,208.4	1,207.9	1,207.7	1,207.5	1,207.6	1,208.1
	Minimum	1,205.9	1,207.4	1,206.1	1,204.7	1,206.5	1,207.5	1,207.5	1,207.1	1,207.0	1,206.5	1,205.6	1,206.3	1,204.7
2010	Maximum	1,208.8	1,209.1	1,208.8	1,210.5	1,210.3	1,209.0	1,210.9	1,209.9	1,210.8	1,209.7	1,208.8	1,209.5	1,210.9
	Average	1,207.5	1,207.9	1,207.6	1,207.9	1,208.1	1,207.8	1,208.6	1,208.1	1,209.2	1,207.9	1,206.7	1,207.7	1,207.9
	Minimum	1,206.2	1,206.9	1,206.6	1,206.6	1,206.7	1,206.8	1,205.8	1,206.6	1,207.0	1,206.4	1,204.6	1,205.7	1,204.6
2011	Maximum	1,210.0	1,208.9	1,209.7	1,208.9	1,209.8	1,209.3	1,210.8	1,209.6	1,209.7	1,208.8	1,209.9	1,207.6	1,210.8
	Average	1,208.0	1,208.0	1,208.0	1,207.3	1,207.9	1,207.9	1,208.8	1,208.2	1,207.8	1,207.6	1,207.6	1,206.9	1,207.8
	Minimum	1,206.4	1,207.2	1,205.5	1,205.3	1,205.1	1,206.5	1,206.6	1,204.5	1,206.6	1,206.9	1,206.0	1,205.0	1,204.5
2012	Maximum	1,208.5	1,208.3	1,208.9	1,210.0	1,208.7	1,209.8	1,210.0	1,209.7	1,210.0	1,211.1	1,208.6	1,208.3	1,211.1
	Average	1,207.4	1,207.3	1,207.1	1,208.0	1,207.3	1,207.8	1,208.5	1,207.8	1,208.0	1,207.6	1,207.3	1,207.2	1,207.6
	Minimum	1,206.7	1,206.5	1,206.1	1,205.9	1,206.0	1,206.3	1,207.2	1,206.3	1,207.0	1,206.4	1,206.4	1,206.5	1,205.9
2013	Maximum	1,209.0	1,209.3	1,208.5	1,208.4	1,208.9	1,209.2	1,208.8	1,209.3	1,208.8	1,210.5	1,208.2	1,208.7	1,210.5
	Average	1,207.7	1,207.6	1,207.2	1,207.2	1,207.7	1,207.9	1,207.5	1,207.8	1,207.5	1,207.9	1,207.4	1,207.6	1,207.6
	Minimum	1,206.9	1,206.4	1,206.2	1,206.5	1,206.3	1,206.4	1,206.6	1,206.7	1,206.6	1,206.0	1,206.1	1,206.8	1,206.0
2014	Maximum	1,208.6	1,208.7	1,208.8	1,208.7	1,209.2	1,210.5	1,210.4	1,210.4	1,209.7	1,208.9	1,210.4	1,209.2	1,210.5
	Average	1,207.7	1,207.5	1,207.1	1,207.3	1,207.6	1,208.5	1,208.3	1,208.7	1,208.5	1,207.0	1,207.5	1,207.3	1,207.7
	Minimum	1,206.7	1,206.4	1,205.7	1,205.5	1,206.1	1,206.8	1,206.7	1,207.3	1,205.5	1,204.7	1,206.3	1,206.3	1,204.7
2015	Maximum	1,209.7	1,210.1	1,209.2	1,209.3	1,209.5	1,209.6	1,209.8	1,209.3	1,208.9	1,208.5	1,210.5	1,208.8	1,210.5
	Average	1,208.4	1,207.8	1,208.1	1,208.4	1,206.9	1,206.2	1,208.1	1,208.0	1,206.3	1,201.9	1,205.5	1,207.0	1,206.9
	Minimum	1,207.2	1,206.3	1,206.0	1,206.6	1,203.1	1,203.1	1,205.9	1,205.6	1,201.1	1,200.6	1,201.7	1,204.8	1,200.6
2016	Maximum	1,210.8	1,209.0	1,209.9	1,209.3	1,210.0	1,211.0	1,210.4	1,210.6	1,208.8	1,210.6	1,208.7	1,208.6	1,211.0
	Average	1,208.0	1,207.5	1,207.8	1,207.2	1,208.1	1,209.1	1,208.6	1,208.6	1,207.4	1,206.9	1,207.2	1,207.7	1,207.8
	Minimum	1,206.8	1,206.3	1,206.8	1,200.7	1,206.0	1,207.3	1,207.2	1,206.8	1,206.1	1,204.6	1,204.8	1,206.0	1,200.7

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Maximum	1,208.9	1,209.9	1,209.2	1,208.9	1,210.4	1,210.6	1,209.4	1,209.4	1,208.9	1,209.0	1,208.7	1,209.6	1,210.6
	Average	1,207.7	1,207.7	1,207.4	1,207.1	1,208.0	1,208.4	1,208.2	1,206.9	1,204.0	1,206.6	1,206.0	1,207.6	1,207.2
	Minimum	1,206.0	1,205.9	1,206.0	1,205.8	1,206.2	1,206.1	1,207.2	1,201.2	1,199.9	1,202.3	1,202.9	1,206.2	1,199.9
2018	Maximum	1,209.2	1,208.5	1,208.5	1,208.8	1,209.9	1,209.6	1,209.8	1,209.7	1,208.9	1,209.3	1,208.3	1,208.5	1,209.9
	Average	1,206.9	1,207.1	1,207.4	1,207.1	1,208.0	1,207.9	1,207.9	1,207.7	1,207.5	1,207.5	1,207.1	1,207.2	1,207.4
	Minimum	1,204.4	1,205.2	1,206.1	1,205.7	1,205.5	1,206.4	1,206.5	1,205.9	1,206.4	1,204.4	1,205.7	1,205.8	1,204.4
2019	Maximum	1,209.4	1,209.1	1,208.9	1,210.1	1,209.6	1,210.2	1,210.9	1,209.6	1,209.3	1,209.0	1,208.6	1,209.6	1,210.9
	Average	1,207.6	1,207.5	1,207.5	1,207.5	1,207.9	1,207.8	1,207.8	1,208.1	1,208.0	1,206.8	1,207.2	1,207.1	1,207.6
	Minimum	1,206.4	1,205.5	1,205.6	1,206.5	1,206.3	1,206.6	1,206.4	1,206.6	1,206.5	1,204.4	1,206.4	1,205.9	1,204.4
2020	Maximum	1,208.4	1,209.5	1,209.5	1,209.1	1,211.0	1,210.2	1,210.2	1,208.3	1,208.4	1,209.4	1,210.2	1,207.7	1,211.0
	Average	1,207.2	1,206.8	1,207.4	1,208.0	1,208.0	1,208.2	1,207.6	1,207.4	1,206.1	1,207.3	1,207.1	1,206.7	1,207.3
	Minimum	1,206.1	1,205.5	1,205.7	1,206.9	1,206.1	1,206.5	1,205.6	1,206.5	1,203.0	1,206.5	1,204.6	1,204.6	1,203.0
33-Year Summary	Maximum	1,211.3	1,211.1	1,211.7	1,211.7	1,211.8	1,211.9	1,212.2	1,211.7	1,211.7	1,211.7	1,211.7	1,211.0	1,212.2
	Average	1,208.1	1,208.2	1,208.3	1,208.0	1,208.2	1,208.4	1,208.8	1,208.5	1,208.2	1,207.4	1,207.8	1,207.9	1,208.1
	Minimum	1,204.0	1,204.2	1,204.7	1,193.0	1,192.5	1,203.1	1,203.4	1,201.2	1,190.5	1,189.6	1,201.7	1,203.5	1,189.6

Under normal operation, the reservoir level typically fluctuates between 4 and 5 feet per day. Because of its limited usable storage (6,200 acre-feet) relative to Ross Lake, the reservoir cannot absorb large fluctuations in flow under normal operations. Therefore, the Diablo Development spills much more frequently than the Ross Development (Table 3.1-6). Spill can occur any time inflow to the reservoir exceeds plant capacity, typically during periods of high runoff. Diablo Dam also spills when the powerhouse units are offline or additional flow is needed to meet fish protection flows downstream of the Gorge Powerhouse. Under typical operations, represented by 2019 2020, and 2021, Diablo Dam spills an average of 62 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 but lower in magnitude.

Table 3.1-6. Diablo Dam spill events (2017-2021).

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2017	224	1,364
2018	274	1,393
2019	80	1,482
2020	60	2,474
2021	46	5,149

Like the Ross Powerhouse, City Light typically operates the Diablo Powerhouse continuously to pass flow downstream, although it occasionally increases and decreases generation for short periods to help meet load-following demand or other Project purposes.

Gorge Development

The Gorge Development is operated primarily to regulate flows downstream of the powerhouse for salmon and steelhead protection in the upper Skagit River. 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 five-year period 2017 through 2021, Gorge Dam has spilled between 9 and 56 days annually, with an average flow of 2,570 cfs (Table 3.1-7).

Table 3.1-7. Gorge Dam spill events (2017-2021).

Year	Number of Days with Spill	Average Flow per Spill Day (cfs)
2017	37	2,006
2018	42	2,934
2019	9	589
2020	20	1,374
2021	56	5,946

To comply with the license requirement that incorporates the Revised Fisheries Settlement Agreement (FSA; City Light 2011) Flow Plan, City Light operates Gorge Lake and Powerhouse in coordination with Ross and Diablo lakes to provide a continuous, stable flow regime in the upper Skagit River with minimum and maximum flows into the mainstem Skagit River downstream of Gorge Powerhouse as outlined in the FSA. Monthly minimum, average, and maximum water surface elevations at Gorge Lake for the period 1988-2020 are provided in Table 3.1-8.

Reservoir fluctuations are limited to about 3 to 5 feet and City Light does not typically operate the powerhouse to meet load-following demand.

The Gorge Development creates a 2.5-mile-long bypass reach of the Skagit River between the dam and powerhouse. There are no minimum flow requirements in the current Project license for the Gorge bypass reach. Therefore, except during spill events at Gorge Dam, bypass reach flow is limited to accretion flow, spill-gate seepage, tributary input, and precipitation runoff.

Spill at Gorge Dam into the 2.5-mile-long Gorge bypass reach occurs any time that inflow exceeds the generating capacity of the powerhouse, or if additional flow is needed to meet fisheries protection flows in the upper Skagit River.

Table 3.1-8. Monthly minimum, average, and maximum elevations (feet, NAVD 88) into Gorge Lake (1988-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	880.2	880.5	881.4	880.7	881.1	880.1	879.9	879.8	879.6	880.5	880.9	881.0	881.4
	Average	878.9	879.1	879.5	879.2	879.1	879.2	878.6	877.4	877.9	878.8	878.5	879.5	878.8
	Minimum	877.7	877.4	878.4	877.9	877.2	877.2	876.6	871.6	876.2	876.5	876.5	876.3	871.6
1989	Maximum	879.4	879.7	879.6	880.7	880.5	881.4	885.2	880.5	880.2	879.9	883.6	884.3	885.2
	Average	877.8	877.8	878.6	878.3	878.6	879.2	880.4	879.2	878.9	878.3	878.4	879.7	878.8
	Minimum	875.5	874.3	876.4	875.6	875.3	876.8	875.9	877.7	877.5	876.5	875.4	877.8	874.3
1990	Maximum	880.7	879.8	880.9	880.7	881.0	881.2	885.1	880.8	880.5	883.1	884.6	880.8	885.1
	Average	878.8	878.7	879.9	879.2	879.8	879.2	881.4	879.0	879.3	879.9	879.6	878.9	879.5
	Minimum	876.0	877.3	878.0	876.3	874.0	877.3	877.7	877.0	876.3	877.8	875.6	876.6	874.0
1991	Maximum	880.5	882.0	880.1	881.0	883.2	883.3	885.1	883.6	884.6	880.5	880.6	880.6	885.1
	Average	879.0	879.3	879.1	879.0	880.9	881.0	882.3	880.8	880.0	879.3	879.5	878.9	879.9
	Minimum	875.8	873.4	877.0	876.5	878.6	876.2	878.8	877.4	877.6	876.9	877.5	878.0	873.4
1992	Maximum	880.8	880.7	880.9	880.9	880.6	880.1	880.6	880.4	880.1	880.4	880.7	880.6	880.9
	Average	879.6	879.7	880.0	879.2	879.1	879.1	879.3	878.9	879.2	879.4	879.1	879.1	879.3
	Minimum	878.6	877.8	878.8	877.0	877.5	877.5	877.6	877.3	878.4	877.6	875.8	877.1	875.8
1993	Maximum	880.5	880.2	880.9	880.8	881.0	880.5	879.9	880.2	880.1	880.4	880.5	880.8	881.0
	Average	878.6	878.8	879.3	879.9	879.6	879.5	879.1	871.4	879.1	879.4	879.5	879.5	878.6
	Minimum	876.1	877.3	877.7	878.9	876.6	878.7	877.5	826.3	876.0	878.2	878.6	878.2	826.3
1994	Maximum	880.4	880.9	880.9	880.5	880.6	880.4	880.5	880.4	880.1	880.1	881.2	880.4	881.2
	Average	879.4	879.8	879.5	879.7	879.5	879.1	878.8	878.8	879.1	879.0	879.0	879.2	879.2
	Minimum	876.9	876.7	876.4	878.4	877.7	878.2	876.4	875.6	876.9	877.7	877.3	876.9	875.6
1995	Maximum	880.5	881.3	880.2	880.6	880.7	881.0	881.4	881.0	880.0	881.2	885.3	881.3	885.3
	Average	878.6	878.3	879.3	879.6	879.9	879.5	879.7	878.6	878.8	879.1	878.5	878.3	879.0
	Minimum	876.3	874.5	878.3	877.5	878.9	876.9	877.8	875.4	877.4	876.8	870.8	873.7	870.8
1996	Maximum	881.0	880.8	880.8	880.7	881.3	880.8	881.0	880.9	880.4	881.0	881.0	880.6	881.3
	Average	878.9	879.2	879.2	879.6	880.3	879.6	879.3	878.9	878.9	879.4	879.2	879.0	879.3
	Minimum	876.8	876.8	875.4	878.3	878.8	878.3	874.8	877.4	876.8	878.1	877.5	877.9	874.8

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1997	Maximum	880.8	880.5	880.7	880.8	883.7	885.0	883.9	881.4	881.3	883.7	884.1	881.1	885.0
	Average	878.0	879.4	879.3	879.7	880.4	880.5	881.2	843.5	879.7	879.9	880.2	879.3	876.7
	Minimum	875.7	878.3	878.0	878.3	877.9	876.9	878.1	788.5	877.5	877.3	876.2	877.6	788.5
1998	Maximum	880.1	880.8	881.4	881.2	880.7	881.4	881.2	880.5	880.8	879.8	880.6	880.0	881.4
	Average	878.9	879.6	879.4	879.9	879.1	879.4	879.5	878.8	878.5	878.6	878.5	878.0	879.0
	Minimum	877.2	878.2	877.0	879.1	877.2	877.0	877.1	877.9	876.0	876.5	876.7	875.0	875.0
1999	Maximum	880.4	881.1	881.0	880.4	881.1	881.2	885.2	883.5	880.9	881.2	880.8	881.0	885.2
	Average	879.0	879.2	879.4	879.5	879.5	879.3	880.2	879.7	879.1	878.5	879.4	879.5	879.4
	Minimum	876.7	877.3	877.7	878.1	875.0	876.7	877.8	876.2	876.7	875.8	877.1	876.9	875.0
2000	Maximum	880.6	880.2	880.0	880.1	881.2	881.0	880.9	880.7	879.8	879.2	879.7	880.7	881.2
	Average	879.0	879.3	879.2	878.3	880.1	879.4	878.7	878.7	878.0	877.5	877.6	878.2	878.7
	Minimum	875.7	877.9	877.5	875.0	877.7	876.6	875.0	876.2	876.4	875.7	874.6	876.2	874.6
2001	Maximum	880.4	879.6	879.4	878.8	880.8	880.4	878.7	878.1	878.6	878.0	878.7	879.1	880.8
	Average	878.5	877.9	877.7	877.4	877.6	877.1	876.4	876.3	876.3	876.8	876.9	877.0	877.1
	Minimum	876.5	876.5	875.5	875.8	875.8	875.2	874.4	874.1	874.9	875.4	874.0	875.2	874.0
2002	Maximum	883.9	880.9	880.3	879.9	880.8	883.6	883.5	880.5	880.2	880.1	879.0	880.1	883.9
	Average	878.1	878.7	876.3	878.1	878.0	880.1	881.1	878.4	878.3	877.8	877.6	878.2	878.4
	Minimum	876.3	876.5	857.9	874.9	873.8	875.1	877.4	876.0	877.0	875.9	876.2	877.1	857.9
2003	Maximum	880.7	881.1	880.5	879.6	880.8	880.9	883.2	880.1	879.4	882.3	880.4	881.2	883.2
	Average	878.7	878.4	877.9	877.9	878.3	878.6	878.9	878.0	877.9	878.3	865.2	876.8	877.1
	Minimum	876.4	876.1	875.4	876.3	876.2	876.0	876.8	876.5	876.7	876.2	826.6	859.5	826.6
2004	Maximum	880.7	880.3	880.2	880.1	880.9	881.5	880.7	881.4	880.7	880.8	880.8	880.6	881.5
	Average	878.7	878.9	878.7	878.7	879.2	879.4	879.2	878.9	878.5	878.6	878.6	878.9	878.9
	Minimum	876.7	877.7	876.7	877.1	877.5	877.1	877.0	877.3	877.6	875.7	876.6	877.1	875.7
2005	Maximum	880.9	880.6	880.4	880.2	881.2	880.5	879.3	879.4	881.9	881.1	880.2	880.8	881.9
	Average	878.6	879.5	878.7	878.2	878.8	878.6	878.1	878.1	878.2	879.0	878.6	878.7	878.6
	Minimum	876.1	877.9	877.6	876.4	876.1	876.7	874.2	876.4	877.1	876.9	876.7	875.9	874.2
2006	Maximum	880.2	880.8	880.9	880.0	882.7	883.4	883.6	880.1	880.0	879.8	880.7	879.7	883.6
	Average	878.4	879.0	879.2	878.5	878.6	879.7	880.9	878.1	878.3	878.3	878.8	878.3	878.8
	Minimum	876.3	877.1	877.2	876.5	874.7	876.9	877.3	877.2	876.1	876.9	876.8	877.1	874.7

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2007	Maximum	880.4	880.2	881.6	880.8	880.3	881.3	882.4	879.9	879.4	880.6	879.5	879.1	882.4
	Average	878.3	879.0	878.9	879.4	878.7	876.6	879.6	878.3	878.2	878.6	877.9	877.7	878.4
	Minimum	876.8	877.7	876.6	877.3	876.5	852.2	877.4	876.9	877.3	876.5	876.6	875.6	852.2
2008	Maximum	880.4	880.8	880.7	880.2	880.6	880.7	882.3	880.4	880.2	880.6	880.8	880.7	882.3
	Average	879.0	879.2	879.1	878.8	878.9	879.2	879.5	873.3	878.1	878.8	876.1	879.1	878.2
	Minimum	877.1	877.0	877.6	877.8	875.8	877.0	877.2	830.6	875.9	877.2	860.6	876.4	830.6
2009	Maximum	880.3	880.3	879.4	880.5	880.2	880.4	880.8	880.5	880.3	880.3	880.5	880.5	880.8
	Average	876.3	878.7	878.0	877.8	878.7	878.6	878.3	878.3	878.1	876.3	875.8	878.7	877.8
	Minimum	856.9	877.6	875.0	876.2	877.3	875.2	875.4	875.9	876.8	857.4	861.6	876.7	856.9
2010	Maximum	880.3	880.5	880.3	879.5	880.1	880.6	880.1	879.9	880.4	879.9	880.3	879.3	880.6
	Average	878.3	878.3	878.4	877.9	878.3	878.9	878.8	878.4	878.6	874.0	878.2	876.8	877.9
	Minimum	876.5	876.7	877.0	875.6	876.9	877.4	877.0	876.4	876.5	867.7	872.7	871.7	867.7
2011	Maximum	880.0	879.9	880.4	879.9	880.0	879.9	880.4	881.0	879.9	879.4	880.3	878.8	881.0
	Average	877.8	878.2	878.4	878.3	878.3	878.4	878.5	877.3	878.0	877.8	873.1	877.8	877.7
	Minimum	874.7	877.2	873.3	874.4	876.0	876.3	876.9	866.3	876.4	876.1	852.6	875.2	852.6
2012	Maximum	878.6	878.7	880.0	880.4	880.8	881.1	880.0	880.4	879.4	881.1	879.6	879.1	881.1
	Average	877.7	877.8	877.4	877.8	878.7	878.4	878.7	878.2	878.5	877.9	877.5	878.0	878.1
	Minimum	876.5	876.6	875.6	876.2	875.5	876.2	875.9	876.8	877.7	876.0	875.0	877.0	875.0
2013	Maximum	880.9	879.6	880.3	879.6	879.5	879.5	878.9	827.5	828.5	828.2	879.1	879.4	880.9
	Average	878.4	878.3	877.8	877.9	878.1	878.1	851.0	826.5	826.4	827.3	851.7	878.3	860.7
	Minimum	876.4	877.2	875.2	876.2	876.4	877.1	824.5	825.6	825.8	826.6	826.8	877.2	824.5
2014	Maximum	879.3	878.7	879.5	880.5	879.3	880.5	879.8	879.8	878.9	878.7	880.7	879.3	880.7
	Average	877.9	877.9	877.2	877.9	878.0	878.3	878.2	878.2	878.1	877.6	877.5	877.3	877.8
	Minimum	876.1	876.9	872.5	876.7	876.6	876.7	876.8	877.0	877.3	876.2	873.2	875.8	872.5
2015	Maximum	880.6	879.0	880.3	879.2	879.3	879.7	879.4	880.6	879.8	880.1	878.9	878.5	880.6
	Average	878.2	877.5	878.4	877.8	878.3	878.2	877.8	878.4	877.8	877.3	876.4	876.7	877.7
	Minimum	876.9	876.5	876.6	876.0	876.7	876.2	876.6	876.4	876.4	876.8	867.2	871.0	867.2
2016	Maximum	879.9	879.6	879.2	879.9	879.4	880.0	879.7	879.9	879.6	879.8	879.3	879.9	880.0
	Average	878.0	877.8	877.8	877.8	878.1	877.8	878.2	878.4	877.8	876.6	876.9	877.6	877.7
	Minimum	876.7	875.9	876.6	875.2	875.8	874.5	877.0	876.3	876.0	872.4	874.0	876.1	872.4

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Maximum	879.3	880.4	881.0	880.2	880.6	880.2	880.5	879.4	879.2	879.3	879.8	880.4	881.0
	Average	877.7	878.2	877.8	878.0	878.2	877.6	877.6	878.1	877.7	876.9	876.7	877.9	877.7
	Minimum	875.4	876.4	874.5	875.4	876.6	872.9	876.0	876.4	875.9	872.2	873.2	874.3	872.2
2018	Maximum	879.7	878.6	879.4	879.7	879.7	880.2	879.0	879.2	879.6	879.5	879.0	878.5	880.2
	Average	877.8	877.7	878.1	878.0	878.2	878.0	877.7	877.7	877.8	878.1	877.5	877.3	877.8
	Minimum	874.8	876.9	876.9	876.2	875.7	875.7	875.0	876.4	876.7	875.9	876.0	875.6	874.8
2019	Maximum	878.8	879.3	879.5	880.3	880.3	879.0	878.8	879.7	880.0	878.5	878.2	878.8	880.3
	Average	877.8	877.8	878.1	873.5	877.9	877.7	877.6	877.8	878.1	876.6	877.3	877.2	877.3
	Minimum	876.8	876.1	877.2	831.2	876.9	876.4	876.3	877.0	877.0	873.6	876.4	875.6	831.2
2020	Maximum	879.1	880.9	879.4	879.2	880.7	879.5	879.6	879.2	879.7	879.1	880.6	880.4	880.9
	Average	877.5	877.3	877.7	877.7	878.0	877.9	877.8	877.9	878.2	877.7	878.1	877.9	877.8
	Minimum	875.5	876.0	876.4	876.4	876.3	876.2	876.5	876.7	876.7	874.8	875.8	875.4	874.8
33-Year Summary	Maximum	883.9	882.0	881.6	881.2	883.7	885.0	885.2	883.6	884.6	883.7	885.3	884.3	885.3
	Average	878.4	878.6	878.6	878.4	878.9	878.8	878.3	875.4	876.8	876.6	876.8	878.3	877.8
	Minimum	856.9	873.4	857.9	831.2	873.8	852.2	824.5	788.5	825.8	826.6	826.6	859.5	788.5

3.1.4.2 River Operations

From 1991 through 2012, flows in the mainstem Skagit River downstream of Gorge Powerhouse were determined by the current 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 Indian Tribes and Washington Department of Fish and Wildlife (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[9] and the Revised FSA Flow Plan (City Light 2011) are described below by species and life stage.

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 Indian Tribes. The spawning periods and maximum average daily flows for each species as identified in the Revised FSA Flow Plan are as follows:

- Chinook Salmon – August 20 through October 15, each year.
- Pink Salmon – September 12 through October 31, odd years.
- Chum Salmon – November 1 through January 6, each year.

During the spawning period of each salmon species, daily average 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 (USGS 12178000) 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

[9] July 17, 2013 Order Amending the License and Revising Annual Charges for Project 553 (144 FERC ¶ 62,044).

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).

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. Streamflow properties include the river's height (stage) in relation to a specific habitat and the rate at which the stage changes in response to streamflow changes. Operational factors control changes in streamflow, 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 gage (USGS 12181000) 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 as measured at the Newhalem gage.

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 required by 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 Flow Plan (City Light 2011).
- During the month of August, the instantaneous daily minimum flow at Newhalem gage is 2,000 cfs, though this is reduced to 1,500 cfs when flow insufficiency provisions are in effect (see Revised FSA Flow Plan, Section 6.4; City Light 2011).

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 natural flows at the Newhalem gage are > 4,000 cfs. When natural flows at Newhalem gage are ≤ 4,000 cfs, the down-ramp amplitude is limited to 2,000 cfs per day from June 1 – August 30 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 natural 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 instantaneous 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 3.1-9) 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 3.1-9. 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.

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 through January 31 each year.

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.

3.1.5 Project Capacity, Production, and Outflow Records

3.1.5.1 Dependable Capacity

The Skagit River Project’s dependable capacity is 805.4 MW.

3.1.5.2 Energy Production/Generation

The Project has a total authorized installed capacity of 700.27 MW, and the generation capability is nearly 840 MW[10] (Table 3.1-1). 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 3.1-1). Major renewals at the Project since it was completed in 1961 with construction of High Gorge Dam have included generator rewinds at the Gorge Development in 1982, 1983, and 1990, at the Diablo Development in 2018 and 2019, and at the Ross Development in 2005, 2006, 2007, and 2009; and replacement of transformers at Ross Powerhouse 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 (2016-2020) is approximately 2,336,051 MWh, with a variation of 729,700 MWh between the highest and lowest year (Table 3.1-10). Average monthly generation ranged from a low of 74,950 MWh in 2019, to a high of 74,950 MWh in 2016.

Table 3.1-10. Skagit River Project annual and monthly average energy production (2016-2020).

	2016	2017	2018	2019	2020	5-Year Average
Total Annual MWh	2,698,195	2,433,111	2,263,105	1,968,495	2,317,350	2,336,051
Monthly Average MWh	74,950	67,586	62,864	54,680	64,371	64,890

Monthly generation for each of the developments over the 2016-2020 period is summarized in Table 3.1-11. 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 3.1-16).

[10] Authorized installed capacity values presented herein are those approved by the February 2, 2021 Order Amending License, Approving Revised Exhibits K and M, and Revising Annual Charges (174 FERC ¶ 62,066).

Table 3.1-11. Skagit River Project generation (MWh) per generation year (January – December; 2016-2020).

	2016			2017			2018			2019			2020			Average Monthly		
Month	Gorge	Diablo	Ross	Gorge	Diablo	Ross	Gorge	Diablo	Ross	Gorge	Diablo	Ross	Gorge	Diablo	Ross	Gorge	Diablo	Ross
Jan	116,472	104,199	105,899	96,874	87,366	89,663	105,023	56,313	89,970	106,448	65,267	91,243	58,869	44,878	28,318	116,472	104,199	105,899
Feb	104,974	92,006	85,118	59,497	44,897	34,326	112,688	50,689	124,308	97,275	70,801	85,283	97,812	86,812	79,594	104,974	92,006	85,118
March	108,924	97,363	93,811	78,952	67,949	57,645	100,114	59,448	106,554	90,253	78,525	64,148	98,156	87,323	80,172	108,924	97,363	93,811
April	83,030	64,868	46,370	89,965	57,220	66,440	65,841	50,351	27,196	75,250	59,304	40,360	72,283	55,916	40,005	83,030	64,868	46,370
May	71,655	75,316	58,659	105,152	51,182	58,710	71,064	30,636	15,828	70,848	54,148	27,620	65,838	42,742	16,834	71,655	75,316	58,659
June	82,805	67,335	51,533	109,382	59,450	86,248	70,904	38,068	31,511	62,250	46,649	28,104	93,270	42,866	62,675	82,805	67,335	51,533
July	76,864	62,529	47,689	88,041	60,268	57,628	71,340	54,987	34,383	51,211	37,083	22,973	97,797	73,338	61,228	76,864	62,529	47,689
Aug	54,769	42,486	33,032	58,960	46,909	33,415	35,147	48,960	32,783	46,062	32,930	19,566	53,076	41,066	29,818	54,769	42,486	33,032
Sept	70,228	58,718	60,217	65,133	52,445	55,161	73,718	56,333	58,755	60,473	37,221	35,682	69,428	55,299	53,478	70,228	58,718	60,217
Oct	93,083	67,024	67,638	72,812	57,966	51,993	81,133	61,114	61,331	61,092	36,836	35,342	86,310	36,524	70,775	93,083	67,024	67,638
Nov	87,681	62,081	67,146	84,832	47,150	63,934	80,228	57,488	48,301	56,735	48,163	39,607	86,101	71,423	67,780	87,681	62,081	67,146
Dec	86,024	76,277	74,372	89,152	60,098	86,296	79,775	61,735	59,088	54,967	44,102	34,674	79,243	65,484	64,819	86,024	76,277	74,372
Average Annual Monthly	86,376	72,517	65,957	83,229	57,742	61,788	78,915	52,177	57,501	69,405	50,919	43,717	79,849	58,639	54,625	86,376	72,517	65,957
Total Annual	1,036,509	870,202	791,484	998,752	692,900	741,459	946,975	626,122	690,008	832,864	611,029	524,602	958,183	703,671	655,496	1,036,509	870,202	791,484

Figure 3.1-16. Average monthly generation for the Skagit River Project (2016-2020).

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 2016-2020 (Figure 3.1-17). 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 all five years between 2016 and 2020. 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.

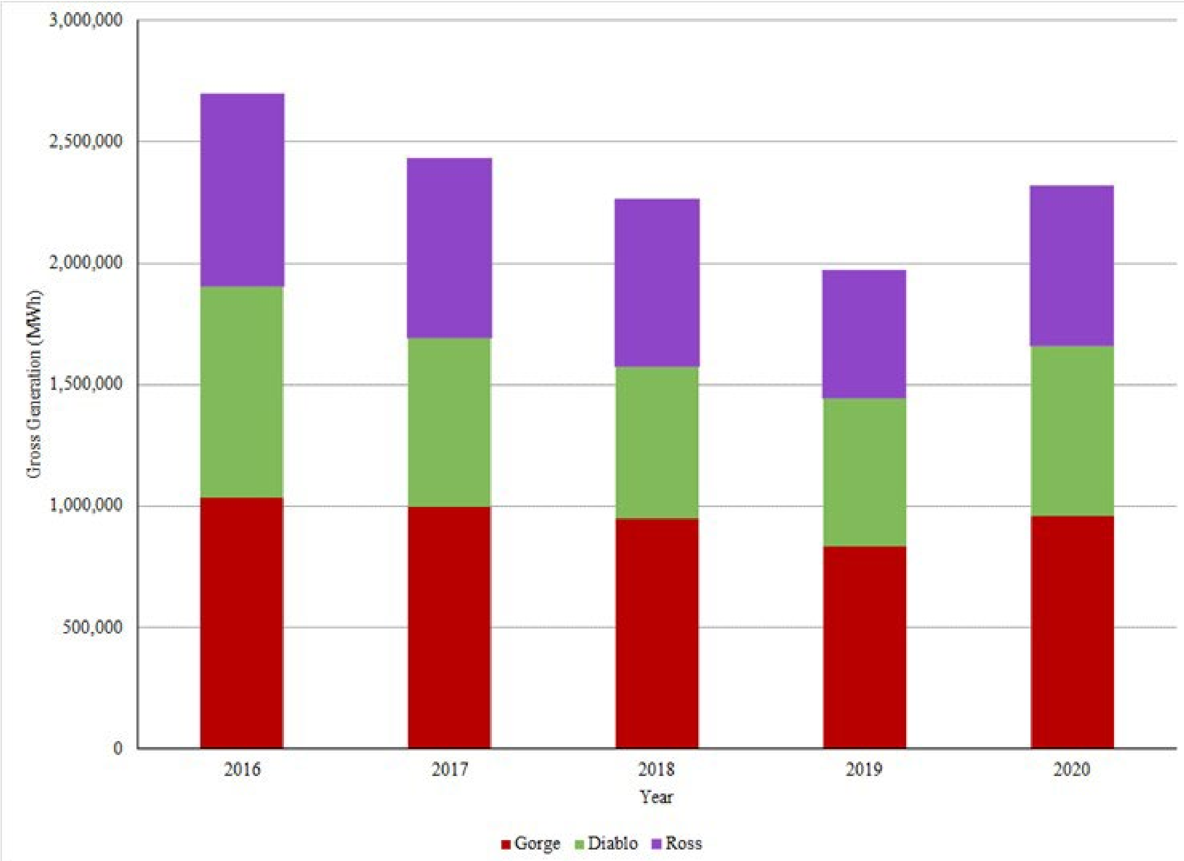


Figure 3.1-17. Average annual generation for the Skagit River Project by development (2016-2020).

To provide a consistent comparison among existing and alternate operations, hourly energy production (MWh) was simulated by the Skagit Operations Model. The Skagit Operations Model describes and simulates existing Project operations for purposes of relicensing, and which can be used to simulate potential future operations under a variety of operating scenarios.

Utilizing a daily average inflow as primary input, the Skagit River Project Operations Model simulates operations to allocate water between reservoir storage and required outflow constraints (physical, environmental, and operational) while permitting generation. The Skagit Operations Model encompasses an inflow dataset, including streamflows into Ross Lake, incremental inflows to Diablo and Gorge lakes, as well as incremental flows to nodes along the Skagit River downstream of the Gorge Development. The Gorge Development includes Gorge Powerhouse as well as the Gorge spillway, so the analysis is inclusive of flows through both. Flows from the Gorge spillway flow into the Gorge bypass reach. The Skagit Operations Model includes characteristics of the three Project reservoirs' powerhouses and water conveyance structures, as well as incremental tributary flows and hydraulic relationships at select nodes along the Skagit River. The Skagit Operations Model is intended to be used as a tool to assist in evaluating water quantity distribution between the available water conveyances due to changes in model inputs, including various operational modifications and physical plant modifications.

The estimated total average annual energy produced at the Project based on simulated Project operations for the period January 1, 2012 through December 31, 2020, which is the period since the implementation of the Revised FSA Flow Plan (City Light 2011), is approximately 2,842,900 MWh (Table 3.1-12). The actual average annual energy produced by the Project for the same period was approximately 2,474,900 MWh, which is a 14.9 percent difference relative to the estimated total average annual generation. Because the Skagit Operations Model is consistent in applying logic and unit optimization to historical inflows, the Operations Model does not exactly reproduce the historic day-to-day energy production due to variations in load demand, weather, operation and maintenance activities, emergency operations, and other operational decisions. As outlined in the Skagit Operations Model Logic and Validation Report (City Light 2022), the simulated Baseline scenario, which will be the basis for comparison of subsequent Skagit Operations Model scenarios, varies more from historical generation than the Verification scenarios, as this Baseline scenario assumes default unit dispatching and does not include historical unit outages.

Table 3.1-12. Skagit River Project average monthly and total annual generation (in MWh), modeled and actual (2012-2020).

Month	Historical Average	Simulated Average
January	259,452	305,740
February	253,414	303,185
March	244,345	301,066
April	183,433	208,884
May	169,517	161,075
June	211,844	264,458
July	215,401	264,248
August	132,451	140,709
September	169,827	173,884
October	191,685	202,069
November	215,589	258,330
December	227,986	259,230
Total	2,474,942	2,842,879

3.1.5.3 Outflow

The sequential configuration of the Project and the distinct roles of the three reservoirs is illustrated by the outflow data (Tables 3.1-13 through 3.1-15). 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 3.1-13. Monthly minimum, average, and maximum outflows (cfs) from Ross Lake (2016-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	Maximum	8,246	6,969	7,252	4,952	6,112	5,839	4,706	2,631	4,584	6,330	11,229	7,101	11,229
	Average	6,310	5,452	5,642	3,196	3,501	3,206	2,621	1,839	3,216	3,914	4,334	4,524	3,977
	Minimum	2,764	1,002	4,165	316	1,409	703	826	784	1,533	880	1,778	3,209	316
2017	Maximum	7,780	3,891	7,405	5,546	5,994	9,350	4,730	3,246	5,221	4,539	10,071	12,255	12,255
	Average	5,356	2,723	4,070	4,480	3,732	4,690	3,073	1,896	3,091	2,991	3,964	5,003	3,761
	Minimum	2,430	245	1,670	3,005	703	2,269	1,910	618	668	591	549	2,917	245
2018	Maximum	6,381	12,218	12,377	3,626	2,907	3,903	3,336	3,541	4,379	5,022	4,439	4,523	12,377
	Average	5,261	7,835	7,085	2,662	1,360	2,097	1,903	1,936	3,566	3,797	3,166	3,806	3,765
	Minimum	3,641	3,895	3,220	863	119	14	443	881	1,012	1,628	102	2,814	14
2019	Maximum	6,922	6,808	5,714	4,903	4,428	3,726	2,646	2,782	3,201	3,135	3,156	3,671	6,922
	Average	5,535	5,770	4,671	3,330	2,089	1,946	1,568	1,251	2,178	2,091	2,405	2,275	2,917
	Minimum	2,509	4,875	2,791	1,047	574	611	961	593	936	19	517	1,227	19
2020	Maximum	3,693	6,677	7,423	4,387	3,009	7,179	6,614	2,477	4,416	7,994	8,986	4,460	8,986
	Average	2,046	4,956	5,039	3,128	1,146	3,459	3,544	1,649	2,789	3,587	3,967	3,570	3,235
	Minimum	312	1,649	3,224	1,501	65	1,048	1,548	741	964	682	1,299	1,441	65
5-Year Summary	Maximum	8,246	12,218	12,377	5,546	6,112	9,350	6,614	3,541	5,221	7,994	11,229	12,255	12,377
	Average	4,902	5,345	5,301	3,359	2,451	3,086	2,565	1,714	2,968	3,276	3,570	3,836	3,531
	Minimum	312	245	1,670	316	65	14	443	593	668	19	102	1,227	14

Table 3.1-14. Monthly minimum, average, and maximum outflows (cfs) from Diablo Lake (2016-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	Maximum	7,264	7,096	7,167	4,585	6,144	6,229	5,835	3,345	4,550	6,831	10,526	7,306	10,526
	Average	6,650	6,103	6,004	4,136	4,640	4,581	3,913	2,760	3,811	4,880	5,074	4,749	4,772
	Minimum	5,174	2,938	4,176	2,932	3,414	3,208	3,214	2,027	2,316	3,514	3,520	4,079	2,027
2017	Maximum	7,456	4,102	7,424	6,077	6,202	10,256	6,259	4,336	4,628	5,057	10,293	12,570	12,570
	Average	5,511	3,150	4,590	4,951	5,295	6,652	4,630	3,106	3,684	3,576	4,812	5,369	4,618
	Minimum	2,873	1,514	2,772	3,689	3,804	4,617	3,400	1,756	1,596	1,936	2,918	3,986	1,514
2018	Maximum	6,863	12,217	12,185	3,574	4,324	4,218	5,344	4,566	4,479	4,497	5,064	4,496	12,217
	Average	5,642	8,312	7,318	3,198	3,020	3,518	3,584	3,103	4,083	4,245	3,875	4,120	4,532
	Minimum	4,017	5,008	3,878	2,547	1,592	2,535	2,179	2,049	1,720	3,645	2,112	3,781	1,592
2019	Maximum	6,664	6,944	5,686	4,804	4,594	3,976	2,795	2,584	3,273	3,125	3,206	2,974	6,944
	Average	5,829	5,944	4,840	3,865	3,173	3,039	2,519	2,238	3,046	2,766	2,789	2,602	3,546
	Minimum	3,551	5,079	4,062	2,577	2,243	2,354	2,045	2,074	2,636	1,236	1,597	1,728	1,236
2020	Maximum	3,370	6,510	6,431	3,832	3,247	8,863	6,864	3,930	4,372	8,581	10,191	4,710	10,191
	Average	2,614	5,468	5,210	3,559	2,503	4,945	4,905	2,623	3,643	4,460	4,798	4,012	4,056
	Minimum	1,440	3,062	4,082	2,574	1,632	3,176	3,097	2,089	1,841	3,021	3,168	3,091	1,440
5-Year Summary	Maximum	7,456	12,217	12,185	6,077	6,202	10,256	6,864	4,566	4,628	8,581	10,526	12,570	12,570
	Average	5,249	5,795	5,592	3,942	3,789	4,554	3,940	2,766	3,654	3,985	4,272	4,171	4,305
	Minimum	1,440	1,514	2,772	2,547	1,592	2,354	2,045	1,756	1,596	1,236	1,597	1,728	1,236

Table 3.1-15. Monthly minimum, average, and maximum outflows (cfs) from Gorge Lake (2016-2020).

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2016	Maximum	7,711	7,404	7,561	4,952	6,318	6,577	6,194	3,483	4,538	7,662	10,702	7,371	10,702
	Average	6,907	6,591	6,320	4,632	5,059	4,946	4,117	2,848	3,903	5,253	5,376	4,850	5,062
	Minimum	5,751	3,726	4,403	3,445	3,857	3,714	3,520	2,176	2,392	3,998	3,944	4,256	2,176
2017	Maximum	7,625	4,408	7,575	6,125	6,398	10,678	6,765	4,445	4,529	7,191	13,922	12,745	13,922
	Average	5,618	3,556	5,026	5,298	6,106	7,310	4,976	3,212	3,724	3,937	5,402	5,474	4,977
	Minimum	2,923	2,901	3,612	4,064	5,461	5,318	3,762	1,788	1,659	3,517	3,573	4,217	1,659
2018	Maximum	7,034	12,378	12,272	4,115	4,783	4,375	5,692	4,642	4,545	4,523	5,658	5,107	12,378
	Average	5,960	8,716	7,424	3,631	3,952	4,032	3,904	3,188	4,171	4,386	4,422	4,336	4,854
	Minimum	4,533	6,753	3,990	3,406	2,492	2,854	2,825	2,194	1,798	4,259	3,968	4,081	1,798
2019	Maximum	6,874	6,862	5,705	5,844	4,688	4,236	3,053	2,585	3,243	3,222	3,333	3,044	6,874
	Average	6,080	6,070	4,948	4,205	3,803	3,365	2,698	2,322	3,179	3,099	2,976	2,808	3,789
	Minimum	4,572	5,200	4,317	3,123	3,402	2,617	2,381	2,222	3,095	2,770	2,755	2,408	2,222
2020	Maximum	3,553	6,856	6,474	3,974	4,364	9,266	7,570	4,125	4,472	8,849	10,614	4,526	10,614
	Average	3,032	5,821	5,320	3,859	3,234	5,535	5,327	2,792	3,797	4,843	5,179	4,254	4,410
	Minimum	2,354	3,641	4,299	3,705	2,695	3,637	3,384	2,292	1,931	3,773	3,693	3,739	1,931
5-Year Summary	Maximum	7,711	12,378	12,272	6,125	6,398	10,678	7,570	4,642	4,545	8,849	13,922	12,745	13,922
	Average	5,519	6,151	5,808	4,326	4,476	5,044	4,236	2,873	3,755	4,304	4,673	4,345	4,619
	Minimum	2,354	2,901	3,612	3,123	2,492	2,617	2,381	1,788	1,659	2,770	2,755	2,408	1,659

3.1.6 Existing Resource Measures

The existing Project license consists of 21 articles related to operations as well as measures for mitigating effects on natural and cultural resources. The PME measures were developed by City Light and federal and state agencies, Indian Tribes and Canadian First Nations, and non-governmental organizations (NGOs) as part of a collaborative settlement agreement process. The articles related to environmental resources included in the license, as modified by the 1996 Rehearing Order, are briefly described below. Exhibit A of this DLA, and Section 4 of this Exhibit E below, provide addition details on these measures. Lastly, Appendix D of this Exhibit E includes an assessment of the effectiveness of the current license measures.

3.1.6.1 Geology and Soils

Article 409 requires the development and implementation of a Project Soil Erosion Control Plan. As described in Appendix D and Section 4.2.1.3 of this Exhibit E, the plan prioritizes sites based on potential for erosion effects to recreational, biological, or cultural resources. 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.

3.1.6.2 Water Resources

Article 301 of the current license requires City Light to draw down Ross Lake to a level that provides 60,000 acre-feet of storage for flood risk management by November 15 and 120,000 acre-feet by December 1, and to maintain this available storage through March 15. Additional details are provided in Section 3.1.4.1 of this Exhibit E.

Article 302 of the current license requires compliance with requests for flood risk management operational changes requested by the USACE and in compliance with the Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA (USACE 1967), which is incorporated into the Project license by reference. This document was updated in 2002 and provides the current guidance for Project operations under for flood risk management, as described in Section 3.1.4.1 of this Exhibit E.

3.1.6.3 Fish and Aquatics

Articles 401-408 of the current license comprise of measures including: (1) the instream flow plan (Flow Plan), which addresses spawning, incubation, rearing, and outmigration of salmonids; and (2) non-flow measures (Non-Flow Plan), which include the construction of off-channel habitats, Rainbow Trout stocking in Gorge and Diablo lakes, and Chinook Salmon and steelhead research programs. Additional details are provided in Appendix D, and Sections 3.1.4.2, and 4.2.3.3 of this Exhibit E.

Additionally, City Light currently removes potential upstream fish migration barriers at the mouths of Ross Lake tributaries, as stipulated by the 1991 Settlement Agreement. Although not a requirement of the current Project license, City Light also conducts stranding and trapping surveys in Gorge Lake if the reservoir's water surface elevation is drawn down below 873.51 feet NAVD 88 (867 feet CoSD). Additional details are provided in Appendix D and Section 4.2.3 of this Exhibit E.

3.1.6.4 Botanical Resources

There were no specific articles or PME measures in the current Project license that specifically addressed botanical resources.[11] However, over the years, City Light has collaborated with agencies, Indian Tribes, and NGOs to identify and implement measures to protect and benefit botanical resources in the Project vicinity. This includes land acquisition and management, weed management, and other collaborative efforts as described in Appendix D and Section 4.2.4.3 of this Exhibit E.

3.1.6.5 Wildlife Resources

Articles 410 and 411 of the current license requires City Light to comply with measures intended to protect avian and wildlife resources. Under the current Project license, City Light has developed and implemented wildlife-focused protection and enhancement measures in cooperation with NPS and other LPs, including the purchase and management of fish and wildlife mitigation lands, monitoring and education funds, and research grants. These efforts are further described in Section 4.2.5.3 of this Exhibit E. Additional details regarding the effectiveness of these efforts are further described in Appendix D of this Exhibit E.

3.1.6.6 Recreation and Land Use

Article 412 of the current license requires City Light to file a Project Recreation Plan implementing provisions for continuing, mitigative, and enhancement measures. As described in Appendix D and Section 4.2.6.3 of this Exhibit E, these measures include development and management of recreation facilities, providing education and interpretive facilities and services within the Project Boundary.

3.1.6.7 Aesthetic Resources

Article 413 of the current license requires City Light to file a Project Visual Quality Plan implementing measures to mitigate for the visual quality impacts of the Project. As described in Appendix D and Section 4.2.7.3 of this Exhibit E, these measures include Project facility improvements, landscaping, and ROW management visual quality improvements within the Project Boundary.

3.1.6.8 Tribal and Cultural Resources

Article 414 of the current license requires City Light to implement measures to mitigate and protect cultural resources, including the implementation of the Archeological Resources Mitigation and Management Plan and the Historic Resources Mitigation and Management Plan, further described in Appendix D and Section 4.2.8.3 of this Exhibit E.

3.2 Alternatives Considered but Eliminated from Detailed Study

Some alternatives to relicensing the Project were considered by City Light and eliminated from detailed study because they are not reasonable under the circumstances, or they are not advocated by any of the entities involved in this proceeding. These alternatives are: (1) federal government

[11] The Project Visual Quality Plan (Article 413) includes tasks related to botanical resources.

takeover of the Project; (2) issuance of a non-power license; and (3) Project decommissioning. The following sections provide the basis for the dismissal of these alternatives.

3.2.1 Federal Government Takeover of the Project

City Light is a municipal entity, and as such, federal takeover of the Project was barred by Congress in the Act of August 15, 1953, 67 Stat.587. Moreover, no party has suggested that federal takeover would be appropriate, and no federal agency has expressed an interest in operating the Project.

3.2.2 Non-Power License

A non-power license is a temporary license that FERC issues when it determines that a project should no longer be used to generate power. In Scoping Document 2 (SD2; FERC 2020), FERC stated that a non-power license is not a reasonable alternative to relicensing the Project. At this time, no governmental agency has suggested a willingness or ability to take over the Project. No party has sought a non-power license, and there is no basis for concluding that the Project should no longer be used to produce power. Therefore, City Light concurs with FERC that a non-power license is not a reasonable alternative to relicensing the Project.

3.2.3 Project Decommissioning

As FERC has previously held, decommissioning is not a reasonable alternative to relicensing in most cases. For the Skagit River Project, the Upper Skagit Indian Tribe and American Whitewater requested that decommissioning of Gorge Dam be included as a reasonable alternative to relicensing. In SD2, FERC found that: "City Light does not propose decommissioning, nor does the record to date demonstrate there are serious resource concerns that cannot be mitigated if the project is relicensing; as such, there is no reason, at this time, to include decommissioning as a reasonable alternative to be evaluated and studied as part of staff's NEPA analysis." City Light concurs with FERC's determination and does not include decommissioning as a reasonable alternative to relicensing the Project at this time. Additional information will be provided in the FLA.

3.3 Proposed Action

3.3.1 Proposed Project Operations

At this time, City Light proposes to operate the Project in a manner consistent with the current license. City Light will modify its proposal in the FLA based on the outcome of ongoing engagement with the LPs regarding appropriate measures to be included in the new license.

3.3.1.1 Estimates for Average Annual Energy and Dependable Capacity

As noted in Section 3.1.5.1 of this Exhibit E for existing Project capacity and production, the Project's dependable capacity would continue to be 805.4 MW and the estimated total average annual energy produced by the Project would continue to be approximately 2.4 million MWh.

3.3.2 Proposed Power Plant Equipment Upgrades, Other Improvements, and Maintenance Activities

Scheduled generator rewinds and turbine runner replacements will occur at all three Project developments over the course of the license (see Exhibit C of this DLA for approximate timeframes of implementation after license issuance). If, and how much, this standard work will impact generation capacity is currently unknown.

City Light anticipates undertaking other major and minor capital improvement projects (CIPs) as well as recurring O&M. Several of the potential projects would improve employee/public safety or emergency communications and response capabilities. Others involve compliance with either a City of Seattle mandate or previous mitigation commitments. The remainder under consideration would enhance operational efficiency, facilitate employee engagement, improve environmental conditions in and near Newhalem, or support public visitation. Most of the projects are only conceptual and will need additional design, cost/benefit analysis, and environmental and National Historic Preservation Act (NHPA) Section 106 review and consultation. See Exhibit C of this DLA for a complete list of potential projects under consideration at this time.

3.3.3 Proposed Resource Measures

3.3.3.1 Geology and Soils

Reservoir Shoreline Erosion Management Plan

To protect natural, cultural, and recreational resources from direct and indirect erosion impacts from Project O&M activities, City Light proposes to develop a Reservoir Shoreline Erosion Management Plan that will include treatment, monitoring, and reporting of identified erosion sites. City Light also proposes to include a schedule of monitoring and reporting regarding erosion effects to cultural sites (i.e., historic properties) in the Historic Properties Management Plan (HPMP). Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Project Roads and Transmission Line ROW Management Plan

To protect natural and cultural resources from direct and indirect impacts from Project Road and Transmission Line ROW O&M activities as well as indirect impacts due to recreational use of City Light roads and trails, City Light proposes to develop a Project Roads and Transmission Line ROW Management Plan that will include: (1) the identification, treatment, monitoring, and reporting of erosion sites on Project roads; (2) best management practice (BMP) measures for road and trail maintenance; and (3) measures to protect aquatic habitat. BMPs for these areas and activities will be consistent with guidance provided in the HPMP in order to avoid, minimize or mitigate potential effects to historic properties. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

3.3.3.2 Water Resources

Flood Risk Management

City Light anticipates including a proposal in the FLA to refine the flood risk management benefits of the Project. City Light is currently engaged in dialogue with the USACE and other LPs and will provide more information on these measures in the FLA.

Flows in Gorge Bypass Reach

To enhance cultural and other water quality resources, City Light proposes to establish a flow regime for the Gorge bypass reach. This flow regime will be developed in consultation with the Indian Tribes and federal and state resource agencies. Water releases into the spillway from Gorge Dam may be in excess of any minimum flows (which will be routed through the Gorge bypass reach) during maintenance or emergency shutdown periods, and when river flows exceed the capacity of the Gorge Powerhouse. This flow regime will commence after a variable flow release valve is installed at Gorge Dam. The flow release valve's engineering design and installation will be subject to FERC review and approval. The flow regime in the Gorge bypass reach will be coordinated with the flows from the Gorge Powerhouse to meet flow objectives below the Project. Additional details will be provided in the FLA.

Water Quality Monitoring and Data Management Plan

To ensure compliance with Washington State water quality standards, City Light proposes to develop a Water Quality Monitoring and Data Management Plan, for FERC and Ecology approval, that will include continued monitoring of water quality and measures related to water quality data management. Additional details will be provided in the FLA.

3.3.3.3 Fish and Aquatics

Fish Passage at Gorge Dam

NMFS, USFWS, the Treaty Tribes and others are evaluating as part of the ongoing relicensing whether fish passage should be included within the new license. This evaluation may include consideration of whether fish passage may meaningfully assist in bringing Skagit basin fish populations to healthy, harvestable, and sustainable levels in the Skagit River watershed without negatively impacting native Skagit basin fish populations and the Skagit River watershed ecosystem.

City Light anticipates implementing a Gorge Dam Fish Passage Program if a decision is made to proceed with fish passage at Gorge Dam. This program will be developed in consultation with NMFS, USFWS, Treaty Tribes and other LPs and will include a plan for safe, timely, and effective upstream and downstream fish passage at Gorge Dam. Upon FERC approval, City Light will implement this program.

City Light anticipates further dialogue with the LPs regarding fish passage at the Project, and such dialogue will be informed by the results of the FA-04 Fish Passage Technical Study, the FA-06 Reservoir Native Fish Genetics Baseline Study, the FA-07 Reservoir Tributary Habitat Assessment, relevant Agency guidance (e.g., Anderson et al. 2014, McClure et al. 2018), and other information as deemed appropriate. Additional details are being developed and will be provided in the FLA.

Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan

To enhance aquatic habitat downstream of the Project, City Light proposes to develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan that will include measures to address Limiting Factors and to enhance and improve the availability of mainstem, off-channel and side-channel habitats throughout the Skagit River downstream of the Gorge Powerhouse. The plan may include but not be limited to: (1) release of process flows; (2) restoration of existing off-channel habitat; (3) wood augmentation; (4) sediment augmentation; and (5) monitoring. If Project modifications have potential to create environmental impacts or adversely affect historic properties, environmental and the NHPA Section 106 review and consultation would be completed as required. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Aquatic Invasive Species Management Plan

To prevent the introduction of invasive species into the Project reservoirs and to detect aquatic invasive species (AIS) presence (should one or more AIS be inadvertently introduced into the area within the Project Boundary), City Light proposes to develop an AIS Management Plan that will include measures aimed at reducing the impact of any AIS that may be introduced. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Anadromous Fish Flow Plan

To enhance salmon and steelhead resources and minimize Project effects downstream of the Project, the FLA will include updates to the flow provisions within the current FSA Flow Plan (City Light 2011). The current FSA Flow Plan's flow measures and ramping rate restrictions are briefly described below.

- Salmon spawning and redd protection: (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 watered until fry emergence.
- Salmon fry protection: (1) limit daily down-ramp amplitude; (2) maintain minimum flows throughout the salmon fry protection period that are adequate to cover gravel bar areas commonly inhabited by salmon fry; and (3) limit down-ramping to nighttime hours except during periods of high flow.
- Steelhead spawning and redd protection: (1) limit maximum flow levels during spawning; (2) shape daily flows for uniformity over the extended spawning period; and (3) maintain minimum flows through the incubation period that are sufficient to keep redds covered until fry emergence.
- Steelhead fry protection: (1) limit daily down-ramp amplitudes and rates; and (2) maintain minimum flows to cover gravel bar areas commonly inhabited by steelhead fry.
- Steelhead and Chinook Salmon yearling protection: limit down-ramp rates to protect steelhead and Chinook Salmon yearlings.

City Light anticipates the updated flow plan will consider additional flood risk management measures, recreation and an adaptive management program to periodically evaluate flows using structured decision-making. Additional details will be provided in the FLA.

Early Action Measure: Short-Term Anadromous Fish Flow Plan

To continue to enhance salmon and steelhead resources and minimize Project effects downstream of the Project, City Light proposes to develop a short-term flow plan in consultation with the FCC to implement specific flow operations that may be needed to protect salmon and steelhead during the interim period prior to the issuance of the new license. City Light anticipates integrating effective measures into the Anadromous Fish Flow Plan in the new license.

Rainbow Trout Broodstock Program (Diablo Lake and Gorge Lake Stocking)

To continue to enhance recreational fishing opportunities at Diablo Lake and Gorge Lake, City Light proposes to continue funding the native Rainbow Trout broodstock program, which involves collection of fish from Ross Lake to produce hatchery fish to supplement the Gorge Lake and Diablo Lake Rainbow Trout fisheries. Additional details will be provided in the FLA.

Reservoir Tributary Barrier Removal Program

To continue to protect fisheries resources within Ross Lake, City Light proposes to continue removing potential upstream fish migration barriers at the mouths of Ross Lake tributaries. Additional details will be provided in the FLA.

Reservoir Fish Stranding and Trapping Program

To minimize risks of stranding and trapping of fish in Project reservoirs, City Light proposes to develop a Reservoir Fish Stranding and Trapping Program to prevent and minimize the potential for negative impacts of Project operational and maintenance activities on fisheries resources due to stranding and trapping in Ross, Diablo, and Gorge lakes. The program's objectives are to minimize stranding and trapping risk in Project reservoirs by monitoring problem water surface elevations associated with seasonally-identified stranding or trapping risk while minimizing impacts on Project operations. The objectives will be achieved through identified surveillance triggers and monitoring information that will support the development of future adaptive management actions to reduce risk (e.g., implementation of habitat modification measures). Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

3.3.3.4 Botanical Resources

Vegetation Management Plan

To manage vegetation within the Project Boundary, City Light proposes to develop a Vegetation Management Plan. This plan will address townsites and transmission line corridors.[12] This plan will also include measures to address special-status plant protection and protection of streams, wetlands, riparian areas, and other priority habitats. This plan would include BMPs consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties as required by the NHPA. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Invasive Plants Management Plan

To manage the establishment and spread of invasive, non-native plant species within the Project Boundary, City Light proposes to develop an Invasive Plants Management Plan which will address townsites, transmission line corridors, and fish and wildlife mitigation lands and include measures

[12] The Mitigation Lands Management Plan will incorporate applicable measures from the Vegetation Management Plan.

to address: (1) the introduction and spread of invasive plant species in the Project Boundary; (2) early detection and rapid response measures; (3) effective control measures; (4) monitoring and reporting; and (5) outreach, education and coordination measures. This plan would include BMPs consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties as required by the NHPA. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Wildfire Management Plan

To provide wildfire management for lands within the Project Boundary and to support regional wildfire management efforts, City Light proposes to develop a Wildfire Management Plan, in collaboration with the NPS, that addresses fire prevention and response as well as fuel management topics. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Ross Lake Wetland Habitat Enhancement Measures

City Light will implement management actions to protect or enhance wetland habitats along the Ross Lake shoreline that are consistent with woody debris management in the reservoir. City Light will consider NPS riparian restoration activities conducted along several hundred feet of Ross Lake shoreline in Dry Creek bay which 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. Additional details will be provided in the FLA.

3.3.3.5 Wildlife Resources

Wildlife Protection and Enhancement Plan

To protect wildlife species within the Project Boundary, City Light proposes to develop a Wildlife Protection and Enhancement Plan, which will include measures for (1) O&M actions and BMPs; (2) habitat management and enhancements; and (3) monitoring and reporting. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Avian Species Protection Plan

To protect avian species within the Project Boundary, City Light proposes to develop an Avian Species Protection Plan, which will include measures to protect avian species, including: (1) maintenance of bird flight diverters; (2) coordination with NPS on helicopter noise protection measures; and (3) BMP measures to avoid or minimize the disturbance of avian species. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Wildlife Mitigation Lands Management Plan

To continue its ongoing stewardship of wildlife mitigation lands, City Light proposes to include a Wildlife Mitigation Lands Management Plan that is currently being developed in collaboration with Treaty Tribes and other LPs. This management plan will include measures for management of the wildlife mitigation lands and management of invasive species on these lands. This plan would also include BMPs consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties as required by the NHPA. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Off-license Measure: Wildlife Monitoring and Education Funds

To enhance wildlife management and education, City Light will provide a fund with monetary contributions on an annual basis 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 will maintain an existing City Light building in Newhalem to serve as a wildlife research laboratory. The fund may be used in support of efforts to protect and monitor bald eagles in the Skagit River basin and for educational activities during winter bald eagle viewing events sponsored by USFS and Washington State Parks. Additional details will be provided in the FLA.

Off-license Measure: Wildlife Research Grants

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), City Light will continue to provide wildlife research grants to qualifying applicants on an annual basis. Additional details will be provided in the FLA.

3.3.3.6 Recreation and Land Use

Recreation Management Plan

To protect, mitigate, and enhance recreational resources, City Light proposes to develop a Recreation Management Plan in consultation with NPS and other LPs. This plan will include measures to address: (1) accessibility; (2) improved visitor use experience; (3) ongoing maintenance of Project recreation facilities; and (4) other recreation resource needs identified in coordination with LPs. This plan would include BMPs consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties as required by the NHPA. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Additionally, City Light proposes to continue existing measures related to the operation of the ELC, Skagit tours, ferry services, and Skagit Information Center, as well as maintenance of Ladder Creek Falls Trail and Garden and Trail of the Cedars. Additional details will be provided in the FLA.

3.3.3.7 Aesthetic Resources

Visual Resources Management Plan

To enhance visual resources and the scenic environment associated with lands and facilities within the Project Boundary, City Light proposes to develop a Visual Resource Management Plan. This plan will include environmentally sensible and economically feasible measures to mitigate for visual impacts of the Project over the new license period. These measures may pertain to the Project's built environment, including Project lighting; landscaping and vegetation management; and views of Ross Lake, among others. This plan would include BMPs consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties, including landscapes and viewsheds, as required by the NHPA. City Light will implement this plan upon FERC approval. Additional details will be provided in the FLA.

A key component of the Visual Resource Management Plan will be Lighting Management measures to reduce Project lighting impacts on night skies in the RLNRA while balancing Project lighting needs for City Light to safely and efficiently operate and maintain the Project.

Sound Protection BMPs

City Light anticipates including BMPs associated with Project noise generation. In addition, these BMPs will be consistent with guidance in the HPMP to avoid, minimize or mitigate adverse effects to historic properties. Additional details will be provided in the FLA.

3.3.3.8 Cultural Resources

Historic Properties Management Plan

To protect cultural and tribal resources, City Light proposes to develop a HPMP in consultation with Section 106 consulting parties. The HPMP will include measures to manage potential adverse effects on historic properties and potential historic properties (i.e., unevaluated cultural resources) within the Area of Potential Effects (APE). This plan will provide for trainings to promote reduction of risks to historic properties or unevaluated cultural resources, and outline BMPs for avoiding, minimizing, or mitigating effects to historic properties that can be included in other management plans to comply with the NHPA Section 106 review and consultation. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

3.3.3.9 Tribal Resources

City Light will propose measures for tribal resources that are being identified in ongoing consultation with Indian Tribes and Canadian First Nations. Other proposed measures identified for aquatic, botanical, wildlife, recreation, cultural, and other resources are expected to address tribal resources. City Light expects that these measures may include the development and implementation of various resource management plans that would be developed through consultation with Section 106 parties including Indian Tribes and Canadian First Nations. Tribal resources that are historic properties or potential historic properties will be considered and managed under the HPMP (as described in Section 4.2.8 of this Exhibit E). City Light continues to engage with participating Indian Tribes and Canadian First Nations regarding measures for tribal resources, including conducting the NHPA Section 106 consultation.

3.3.4 Proposed Changes to the Project Boundary

A proposed Project Boundary is still being prepared and will be filed as part of Exhibit G for the FLA. Exhibit G of this DLA includes the Exhibit K (Project Boundary maps) currently on file with FERC (dated July 2013).

3.3.5 Proposed New Project Facilities

The purpose of Skagit River Project facilities is to ensure efficient power generation operations, facilitate employee engagement, and support public visitation and education. The five proposed new facilities for the new license are intended to: (1) enhance employee/public safety; (2) improve emergency communications and response capabilities; or (3) comply with either a City of Seattle mandate or previous mitigation commitments. Any proposed new facilities or modifications to existing facilities with potential to impact environmental resources or adversely affect historic properties will require environmental and NHPA Section 106 review and consultation and will be subject to FERC review and approval. Further detail regarding the facilities, including maps showing locations of proposed Project facilities and conceptual designs, will be included in the Environmental Analysis (Section 4.2) of the FLA.

- Ross Powerhouse Concrete Pad for Spare Transformer – A spare transformer is currently being stored directly in front of Ross Powerhouse, which is a historic structure. In an agreement with the Washington Department of Archaeology and Historic Preservation (DAHP), City Light agreed to construct a containment pad for the transformer at a new, not yet identified, site that is away from the line of sight of the powerhouse yet still easily accessible.
- Diablo Lake Tour Dock – The existing Diablo Lake Tour Dock for Skagit Tours is approximately 0.5-miles from the ELC, which is currently, and will likely remain, the check-in site for the Skagit Tours. Tour participants either walk along a narrow road or take a shuttle bus. This project would involve construction of a new tour dock on the shoreline of Diablo Lake near the ELC. A new dock near the ELC would improve the tour experience for the elderly and participants with disabilities by improving access and safety. The existing tour dock would be removed, and the site repurposed for NPS use, potentially for a new boathouse/dock or otherwise restored.
- Diablo Lake Ferry Kiosk– This small structure would be installed in the parking area for the Diablo Lake Ferry to provide a place to post information on scheduled run times and other updates.
- Newhalem Radio/Microwave Base Station – This project would improve 911 call transfer and fire and other emergency communications. It would be done in conjunction with upgrades to the existing Babcock and Diablo Dam base stations.
- EV Charging Stations – The City of Seattle has mandated that all City departments, including City Light, transition to an all-electric fleet. Meeting this mandate will require installation of additional EV charging stations at Project facilities. While the number and locations have not yet been determined, likely sites include the powerhouses, Newhalem Service Yard, Diablo warehouse, and Diablo Lake and Ross Powerhouse boat houses. Additional chargers for public use may be installed as well.

Additionally, City Light may construct a second tunnel for the Gorge Development. This project, which would not use any additional water, has already undergone environmental review and consultation. It has been approved by FERC and is part of the existing Project license.

3.3.6 New Facilities Under Consideration

Several new facilities are under consideration during the new license term that would enhance operational efficiency or facilitate employee engagement. Most of the projects are only conceptual and will need additional design, cost/benefit analysis, and environmental and NHPA Section 106 review and consultation. Projects that proceed to the design/development phase would be proposed for FERC approval as needed and executed during the new license term.

- Diablo Firehouse – This project would involve building a new firehouse, built to modern standards, outside the residential area in Hollywood. Like the Newhalem Firehouse, this facility is critical to emergency response and fire control in the area.
- Newhalem Operations Building – This project would involve construction of a new, two story building on the site of the exiting Sickler Building in the Newhalem Service Yard. This would consolidate the administrative offices, shops, and warehouses in one area and improve operational and energy efficiency. It would also lower greenhouse gas emissions associated with Project operations by reducing vehicle trips between the existing Administration Building and the Service Yard. It would also free up other buildings (a house currently used by Communications and Cambridge House, now used as offices) for other uses.
- Newhalem Administration Building – Following construction of a new Operations Building, the existing Administration Building in Newhalem would be repurposed as offices for the security and fire/Emergency Management System departments. The security group currently occupies an apartment, which would be converted back to lodging.
- Newhalem Firehouse – This project would relocate the firehouse to an area outside the Newhalem residential area, possibly to the site of the existing Quonset Hut that currently serves as a basketball court. The new facility would be built to modern firehouse standards. The basketball court would be relocated to the Newhalem Operations Building.
- Newhalem Recreational Vehicle (RV)/Boat Storage – This project would involve developing an area west of SR 20 to store employee-owned RVs, boats, and large trucks to reduce clutter in the townsites and improve aesthetics. The site would be secured with fencing and screened with vegetation.
- Newhalem Service Yard Employee Parking Area – This project would create an employee parking area near the microwave building adjacent to the Service Yard. This new parking area would improve safety and create more space in the Service Yard for heavy equipment and large trucks.
- Newhalem Materials Storage Area – This project would redevelop approximately 3 acres of land west of SR 20 for materials and equipment that are currently stored at the Aggregate Storage Facility south of Newhalem. Moving aggregate storage to the west side of SR 20 would protect a sensitive riparian habitat area and be closer to Newhalem operations. The area proposed for redevelopment currently includes the sandblast building, the Lineman’s Warehouse, and old garages, and is near WSDOT’s aggregate storage yard.

4.0 ENVIRONMENTAL ANALYSIS

4.1 General Description of the River Basin

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 river mile (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.

4.1.1 Description of Skagit River

The Skagit River, which is located primarily in the northwest corner of the State of Washington (Figure 4.1-1), is the traditional territory of several Indian Tribes and Canadian First Nations. The ecosystem supports important runs of anadromous fish that are key to the cultural and economic health of the Tribes and the entire Puget Sound ecosystem, including the Southern Resident killer whale (*Orcinus orca*). The river is approximately 135 miles long, with a total drainage area of 3,115 square miles (sq. mi.; U.S. Army Corps of Engineers [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 (U.S. Geological Survey [USGS] 2019). The headwaters of the Skagit River are at Allison Pass in the Canadian Cascades.

The reach of the Skagit River from the U.S.-Canada border to Gorge Dam flows through the three Project reservoirs. Ross Dam (Project River Mile [PRM] 105.7 [USGS RM 105.1]) impounds Ross Lake, the uppermost Project reservoir, which has a drainage area of approximately 1,008 sq. mi. (USGS Hydrologic Unit Code [HUC] 12) and a length of 24 miles. Diablo Dam (PRM 101.6 [USGS RM 101.2]), located downstream of Ross Dam, impounds Diablo Lake, which is about 4.5 miles long, with a cumulative drainage area of about 1,135 sq. mi. (inclusive of the Ross Lake drainage area) (USGS HUC 12). Gorge Dam (PRM 97.2 [USGS RM 96.6]) is located about 4 miles downstream of Diablo Dam and impounds a 4.5-mile-long reservoir; it has a cumulative drainage area of 1,171.99 sq. mi. (USGS HUC 12).

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. Simulated hydraulic travel times from Gorge Dam to Concrete are shown in Table 4.1-1 (Annear and Stuart 2022).

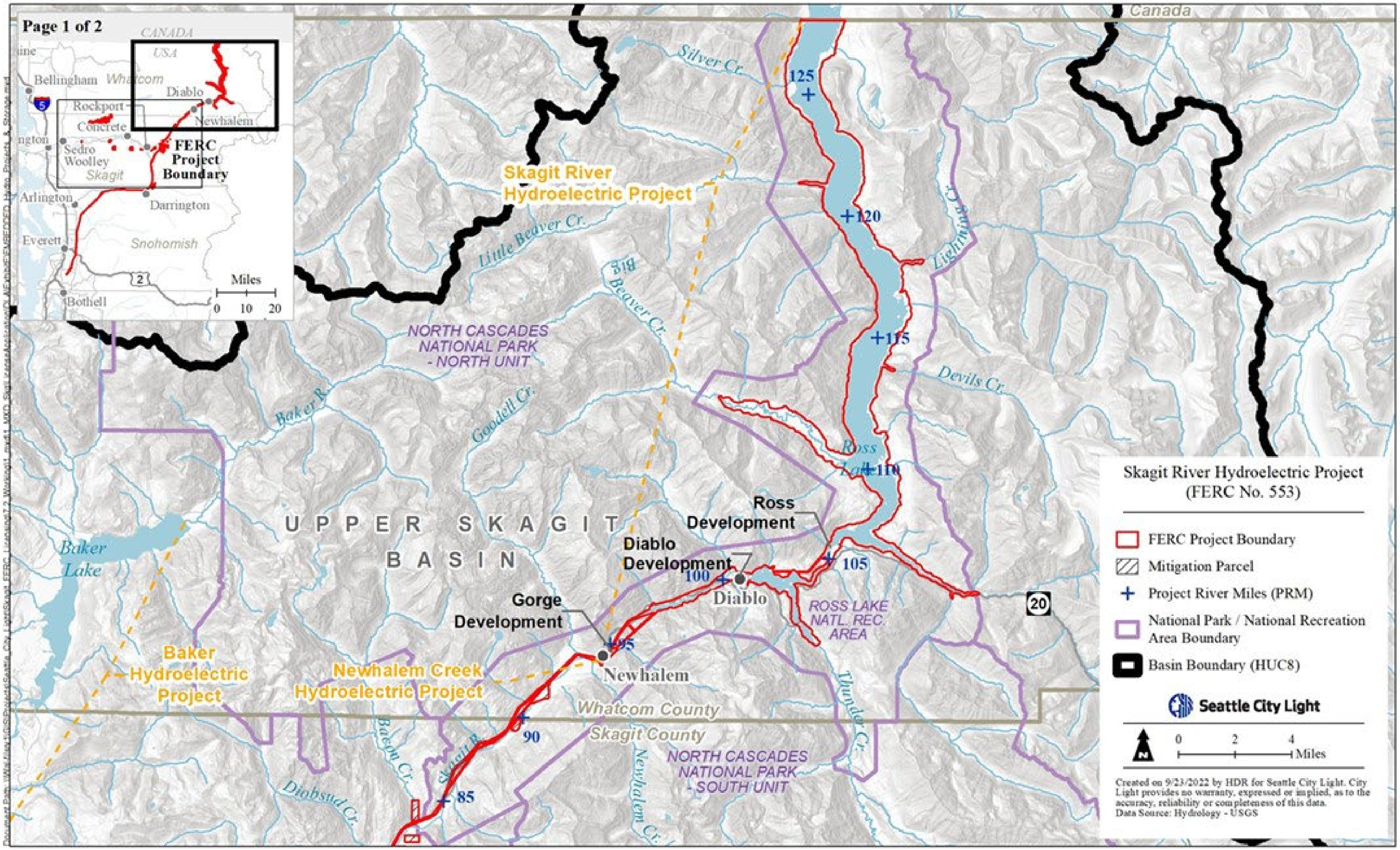


Figure 4.1-1. Location of the Skagit River basin, topography, and other hydroelectric projects in the basin (page 1 of 2).

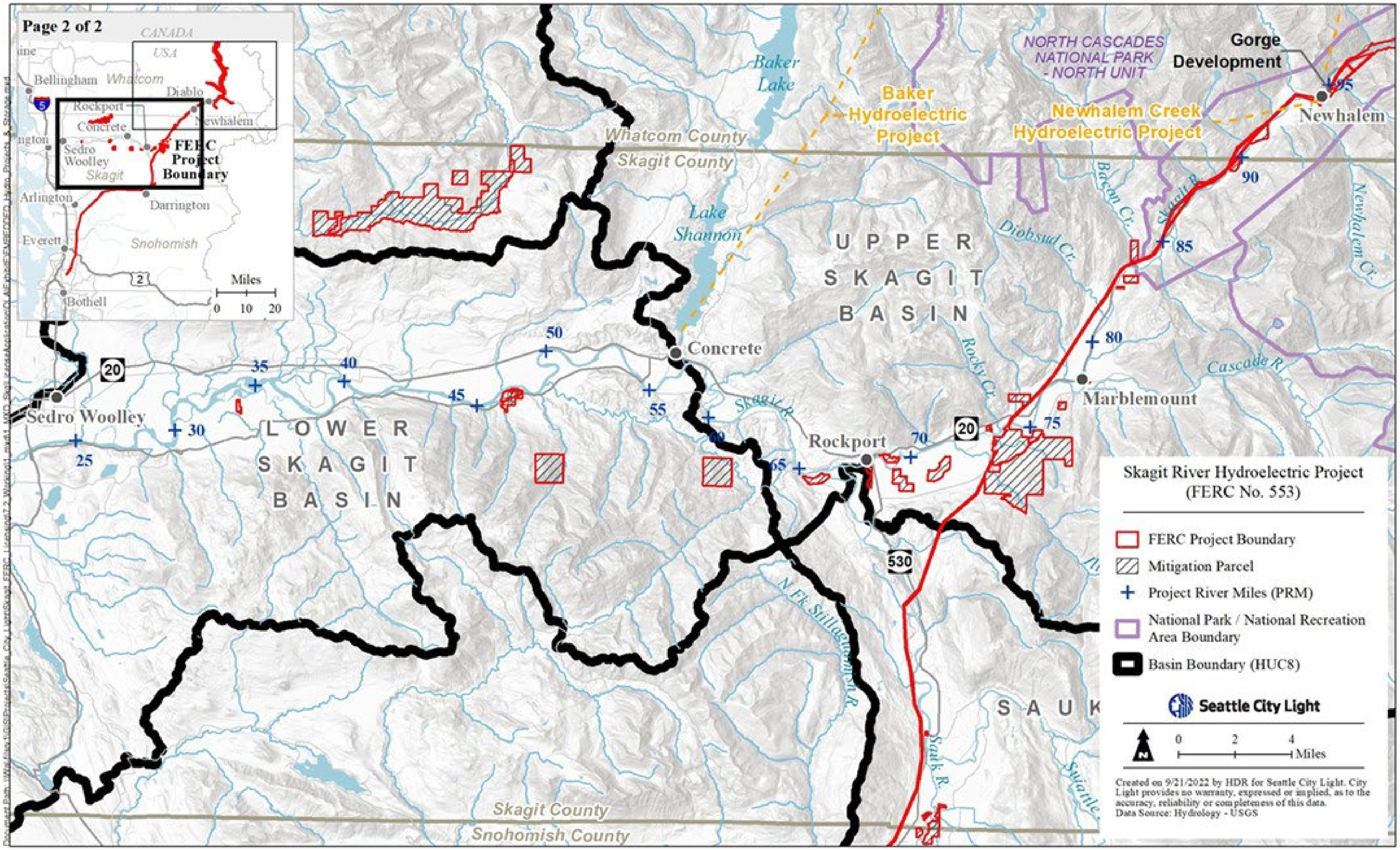


Figure 4.1-1. **Location of the Skagit River basin, topography, and other hydroelectric projects in the basin (page 2 of 2).**

Table 4.1-1. Simulated hydraulic travel times, by season, in the Skagit River between Gorge Dam and the Town of Concrete.

	Simulated Travel Time (hours) and Season		
Reach	**September**	**March**	**June**
Gorge Dam to Cascade River	5.7	4.8	4.5
Cascade River to Sauk River	4.4	3.9	3.8
Sauk River to Baker River	4.1	3.5	2.8
Total	14.2	12.2	11.1

Source: Annear and Stuart (2022).

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, which falls to nearly sea level, widens to a flat, fertile plain. Within this reach, there are numerous side channels, oxbows, and overbank erosion features that are relicts of past floods and gradual changes in channel position. The riverbed material shifts from gravel to sand around PRM 21, near Sedro-Woolley (GE-04 Skagit River Geomorphology between Gorge Dam and the Sauk River Study [Geomorphology Study], City Light 2022a). 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).

About 11 miles downstream of Sedro-Woolley, the channel bifurcates at the head of the delta, where the channel transitions to the estuary and tides begin to dominate channel forming processes (City Light 2022a). During moderate (10-year events) flood conditions, tidal influence extends about 7 miles upstream from Skagit 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. Much of the Skagit River downstream from Mount Vernon is confined by levees on both banks, as are the North Fork and South Fork distributaries until they approach Skagit Bay.

4.1.1.1 Topography

The upper Skagit River basin is located in the Cascade Mountains, west of the crest (Figure 4.1-1). 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 delta between 11 and 19 miles wide.

4.1.1.2 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 humid 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 East Pacific Ocean Subtropical High-pressure center (USACE 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 summer, the Skagit Valley is prone to gentle land breezes in the morning and strong sea breezes in the afternoon. 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 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. 2014). 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 phases of ENSO and the PDO produce warmer and drier winters in the Skagit River basin, whereas cool phases of the ENSO and PDO result in cooler, wetter conditions. When ENSO and the PDO are in phase, climate anomalies are intensified, and precipitation anomalies are increased by about a factor of two.

Monthly air temperature and precipitation at weather stations near Diablo Dam, Concrete, and Sedro-Woolley for the period 2000-2021 are shown in Table 4.1-2. 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 degrees Fahrenheit (°F) (38 degrees Celsius [°C]). Average precipitation totals during the colder months tend 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 4.1-2. Air temperature and precipitation at locations in the upper, middle, and lower Skagit River watershed (2000-2021).

	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)	32 (2006)	38.3	58 (2021)	10 (2004)	41.1	68 (2015)	13 (2004)
Feb	36.4	59 (2005)	29 (2004)	39.7	68 (2005)	16 (2011)	40.9	63 (2007)	13 (2019)
Mar	40.6	75 (2004)	31 (2016)	43.5	81 (2019)	19 (2009)	45.3	80 (2004)	20 (2009)
Apr	47.3	89 (2016)	37 (2016)	48.8	87 (2016)	29 (2008)	49.9	84 (2016)	27 (2012)
May	55.1	93 (2006)	43 (2005)	55.2	94 (2008)	32 (2006)	56.0	92 (2008)	32 (2011)
Jun	60.3	110 (2021)	46 (2006)	59.7	100 (2021)	41 (2008)	60.4	98 (2021)	39 (2007)
Jul	66.2	104 (2006)	52 (2021)	64.6	99 (2009)	43 (2017)	64.4	98 (2009)	41 (2004)
Aug	66.7	104 (2020)	52 (2014)	65.5	96 (2020)	43 (2008)	64.6	92 (2020)	36 (2006)
Sep	59.9	96 (2020)	44 (2020)	60.3	92 (2006)	38 (2019)	59.7	87 (2017)	33 (2006)
Oct	49.5	80 (2003)	40 (2014)	51.5	80 (2020)	27 (2002)	51.4	78 (2011)	27 (2006)
Nov	39.9	62 (2020)	32 (2016)	43.3	67 (2003)	14 (2010)	45.1	69 (2010)	7 (2014)
Dec	34.1	59 (2007)	29 (2004)	37.7	63 (2014)	7 (2021)	39.7	67 (2005)	7 (2021)
	Precipitation (inches)								
Jan	12.56	21.90 (2006)	5.23 (2017)	10.54	20.18 (2006)	5.83 (2017)	6.13	11.47 (2020)	2.61 (2017)
Feb	7.07	12.50 (2002)	1.61 (2004)	6.60	12.87 (2021)	1.90 (2005)	4.47	9.74 (2021)	1.26 (2005)
Mar	8.76	18.74 (2014)	1.10 (2019)	8.02	15.79 (2017)	1.98 (2019)	5.12	8.85 (2014)	2.45 (2019)
Apr	4.44	7.74 (2002)	1.16 (2004)	4.92	9.32 (2018)	0.93 (2004)	4.55	7.66 (2018)	1.78 (2021)
May	2.88	5.79 (2000)	0.62 (2018)	3.35	5.85 (2010)	0.73 (2018)	3.19	6.04 (2014)	0.41 (2018)
Jun	2.07	3.73 (2002)	0.42 (2003)	2.47	4.22 (2012)	0.55 (2015)	2.40	5.01 (2001)	0.27 (2009)
Jul	0.88	2.14 (2012)	0.00 (2017)	0.97	2.18 (2012)	0.00 (2021)	1.04	4.77 (2011)	0.01 (2013)
Aug	1.51	5.26 (2004)	0.00 (2017)	1.45	6.68 (2004)	0.01 (2012)	1.52	7.54 (2004)	0.03 (2012)
Sep	3.94	10.82 (2013)	0.33 (2012)	3.80	9.08 (2013)	0.33 (2012)	3.31	6.39 (2019)	0.20 (2012)
Oct	9.07	23.96 (2003)	0.36 (2002)	7.82	15.22 (2003)	1.36 (2002)	5.33	10.72 (2009)	1.41 (2002)
Nov	13.66	29.41 (2006)	4.53 (2019)	11.47	19.65 (2006)	4.78 (2000)	7.22	13.58 (2021)	2.41 (2000)
Dec	10.93	17.16 (2007)	4.77 (2013)	9.67	15.37 (2015)	4.25 (2000)	5.03	9.36 (2015)	1.84 (2009)
Annual	78.75			71.38			46.47		

Source: National Oceanic and Atmospheric Administration (NOAA) 2022.

Temperatures in Washington have generally increased since the early 1900s, particularly in winter, resulting in a lengthening freeze-free season (Abatzoglou et al. 2014). In the Project vicinity, records from the Cooperative Observer Program at Diablo Dam indicate that average annual temperature has increased 0.1 °F per decade since the 1950s, and summer temperatures have increased by about twice the average rate. Precipitation has changed less since the early 1900s, except for increases in spring (Abatzoglou et al. 2014). Total precipitation over the water year has increased about 1.2 inches per decade since 1920 (Mauger et al. 2016).

Rupp et al. (2016) projected increases in mean annual temperature of 5 to 9 °F in Washington, by the end of the 21st century (depending on human activities), when compared to 1979-1990. 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, total annual precipitation at Diablo Dam is projected to increase by about 5 inches, with increases in fall through spring, and decreases during summer (University of Idaho 2019). Inter-annual variability in precipitation is projected to increase, especially during fall. Greater variation in precipitation and more frequent dry days in summer will in turn result in greater inter-annual variation in water availability in Washington (Rupp et al. 2016; Polade et al. 2015; Kharin et al. 2013).

Since the mid-20th century, the lowest 25 percent of annual streamflows in the Pacific Northwest have been in decline, i.e., the driest years are becoming substantially drier (Luce and Holden 2009). Changes in streamflows are largely associated with declines in spring snow-water-equivalent (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. 2004) and potentially decreased mountain precipitation (Luce et al. 2014). 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 the potential future climate in Washington (Marlier et al. 2017). During 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 occur 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).

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 of Diablo Lake (Granshaw 2002). Warming associated with climate change has reduced the size of glaciers and is affecting glacial runoff patterns.

4.1.2 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 mitigation 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 ownership, with most of the federal ownership north of Marblemount.

The Project's generating facilities are located within the Ross Lake National Recreation Area (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". The Federal Energy Regulatory Commission (FERC or Commission) (formerly the Federal Power Commission [FPC]) also preserved and maintains jurisdiction over the Skagit River Hydroelectric Project, within the 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). National Park Service (NPS) manages the lands and waters of the RLNRA and ensures resource protection and provision of visitor services. The lands adjacent to the RLNRA are within North Cascades National Park, 93 percent of which is also part of the Stephen Mather Wilderness Area.

The Skagit River downstream of the Project supports all five species of Pacific salmon and steelhead. Federally recognized Indian Tribes with treaty reserved fishing rights harvest and rely upon these fish species to support their tribal fisheries and cultural practices related to fisheries. In addition, these fish species are important to non-Indian commercial and recreational fisheries. Much of the land adjacent to the river from Newhalem to Sedro-Woolley is managed to preserve riparian and wetland areas critical to the protection of aquatic habitat for salmonid spawning, rearing, and foraging.

Land uses between the 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 pastureland 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.

4.1.3 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 4.1-3; see Section 4.2 of this Exhibit E for more detail).

Table 4.1-3. Named tributaries that flow into the Skagit River Project reservoirs and the Skagit River to the Town of Concrete, WA.[1]

Tributary Name	Coordinates at Tributary Mouth	PRM
Tributaries to Ross Lake		
Skagit River	49.016484, -121.062636	129.3
Hozomeen Creek	48.986842, -121.071659	127.1
Silver Creek	48.970321, -121.103924	125.7
Little Beaver Creek	48.917841, -121.126283	121.2
Arctic Creek	48.902979, -121.075198	120.4
Noname Creek	48.894234, -121.063123	119.7
Lightning Creek	48.876296, -121.011004	117.5
Skymo Creek	48.851583, -121.035503	116.3
Dry Creek	48.853531, -121.013460	116.2
Devils Creek	48.823988, -121.031705	114.4
May Creek	48.786402, -121.029877	110.9
Big Beaver Creek	48.774879, -121.066489	110.3
Pierce Creek	48.772114, -121.066161	110.2
Roland Creek	48.769102, -121.024168	109.3
Berry Creek	48.721475, -121.010217	106.9
Lillian Creek	48.724102, -121.015708	106.9
Lone Tree Creek	48.722187, -121.006024	106.9
Ruby Creek	48.711306, -120.984976	106.9
Happy Creek	48.732068, -121.065492	105.8

Tributary Name	Coordinates at Tributary Mouth	PRM
Tributaries from Ross Dam to Diablo Dam		
Riprap Creek	48.729509, -121.073352	105.4
Horsetail Creek	48.721863, -121.071929	104.9
Colonial Creek	48.692100, -121.100518	102.9
Rhode Creek	48.689572, -121.095102	102.9
Thunder Creek	48.677634, -121.077118	102.9
Deer Creek	48.717630, -121.116239	102.1
Sourdough Creek	48.719350, -121.119820	102.1
Tributaries from Diablo Dam to Gorge Powerhouse		
Stetattle Creek	48.717082, -121.149531	100.4
Pyramid Creek	48.712831, -121.153656	100.0
Gorge Creek	48.700237, -121.208436	97.3
Tributaries from Gorge Dam to the Sauk River Confluence		
Ladder Creek	48.675407, -121.240445	94.7
Newhalem Creek	48.671376, -121.256080	93.8
Goodell Creek	48.672718, -121.264604	93.4
Babcock Creek	48.662470, -121.285029	92.1
Martin Creek	48.652921, -121.287166	91.4
Thornton Creek	48.648456, -121.304222	90.5
Sky Creek	48.629898, -121.327914	88.6
Damnation Creek	48.626058, -121.336772	88.1
Alma Creek	48.600021, -121.361291	85.6
Copper Creek	48.590653, -121.372832	84.4
Bacon Creek	48.585668, -121.393408	83.3
Diobsud Creek	48.559083, -121.412556	81.0
Taylor Creek	48.538696, -121.425637	79.4
Cascade River	48.521438, -121.431504	78.1
Olson Creek	48.526828, -121.446081	77.2
Corkindale Creek	48.504962, -121.485168	74.3
Rocky Creek	48.500800, -121.494661	73.8
Illabot Creek	48.498213, -121.504134	73.2
Sutter Creek	48.493538, -121.544098	71.0
Barr Creek	48.491919, -121.548903	70.8
Sauk River	48.481244, -121.605543	67.3
Tributaries between the Sauk River Confluence and Concrete		
Miller Creek	48.484660, -121.653636	64.7
Aldon Creek	48.491353, -121.654639	64.2
Cooper Creek	48.505558, -121.696410	61.1
Jackman Creek	48.523010, -121.717394	58.5
Baker River	48.534744, -121.738544	56.8

1 Some of the tributaries listed in this table are sub tributaries to other tributaries and do not have a PRM since they do not drain directly into the Skagit River. Sub tributaries were assigned the same PRM for the Skagit River tributary that they flow into.

4.1.4 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 4.1-1). Table 4.1-4 includes select data for these two projects.

Table 4.1-4. Select 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[1]	26.9	N/A
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

1 The Newhalem Creek Project has not been operational since 2010.

4.1.4.1 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 megawatts (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 cubic feet per second, the Project does not typically operate from late July through September. The Newhalem Creek Project was in active use until 2010, when a series of equipment and structural problems caused an extended shutdown. Based on an engineering and economic analysis of the necessary repairs, City Light filed an application to surrender its license and decommission the Project, which is currently pending in Project No. 2705.

4.1.4.2 Baker River Hydroelectric Project

The Baker River Hydroelectric Project (FERC No. 2150) 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; North American Vertical Datum of 1988 [NAVD 88]). Lake Shannon has a surface area of 2,278 acres at the normal maximum water surface elevation of 442.35 feet mean sea level (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).

4.2 Proposed Action and Action Alternatives

This section describes the anticipated impacts of the Proposed Action on environmental resources, including discussion of resources that would not be affected by the action. The following topics are addressed for each resource: Affected Environment; Environmental Analysis; Existing and Proposed Resource Measures and their effects on resources; and Unavoidable Adverse Impacts.

4.2.1 Geology and Soils

4.2.1.1 Affected Environment

This section summarizes the geology, soils, and geologic hazards of the Project vicinity and describes the characteristics of the shorelines surrounding Project reservoirs and the Skagit River. More specifically, this section provides information on (1) regional geology; (2) structural geology; (3) lithology; (4) glacial geology; (5) mineral resources; (6) geologic hazards; (7) soils of the Project area; (8) landforms; (9) reservoir shorelines and streambanks; and (10) sediment deposition in reservoirs affecting resource areas.

In support of relicensing the Project, Seattle City Light (City Light) conducted the following studies: (1) GE-01 Reservoir Shoreline Erosion Study, (2) GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-Of-Way (ROW) Study (Erosion and Geologic Hazards Study), (3) GE-03 Sediment Deposition in Reservoirs Affecting Resource Areas of Concern Study (Sediment Deposition Study), and (4) GE-04 Skagit River Geomorphology Between Gorge Dam and the Sauk River Study (Geomorphology Study). The first three studies are discussed in this section, while information from the Geomorphology Study is discussed in the Fish and Aquatic Resources Section (Section 4.2.3) of this Exhibit E.

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, City Light has engaged with Indian Tribes and Canadian First Nations regarding geology and soils to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While geology and soils are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in geology and soils as, or related to, tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Regional Geology

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 Range is a 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.

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 4.2.1-1 and Table 4.2.1-1).

Structural Geology

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 4.2.1-1; 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.

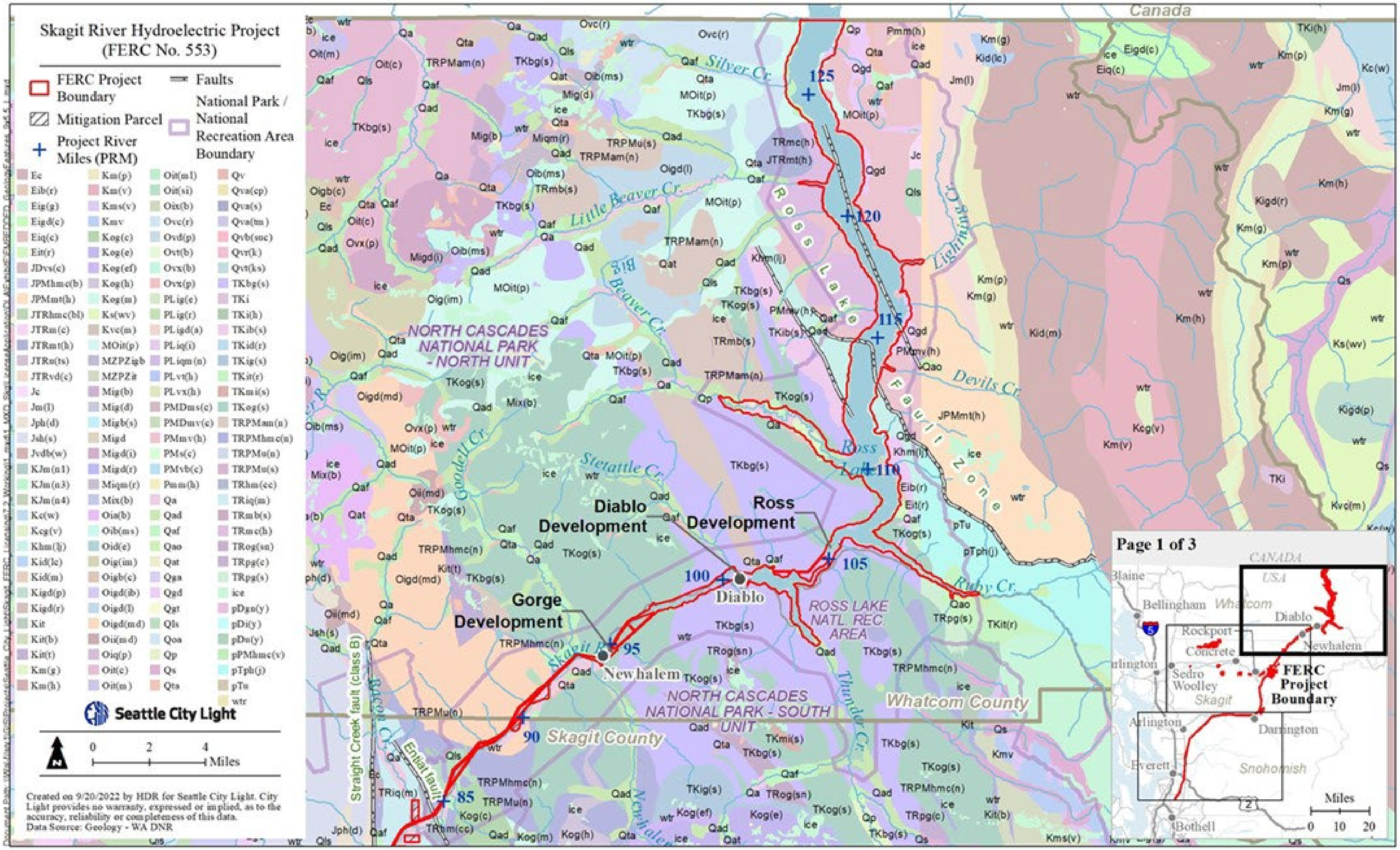


Figure 4.2.1-1. **Geologic features of the Project vicinity (page 1 of 3).**

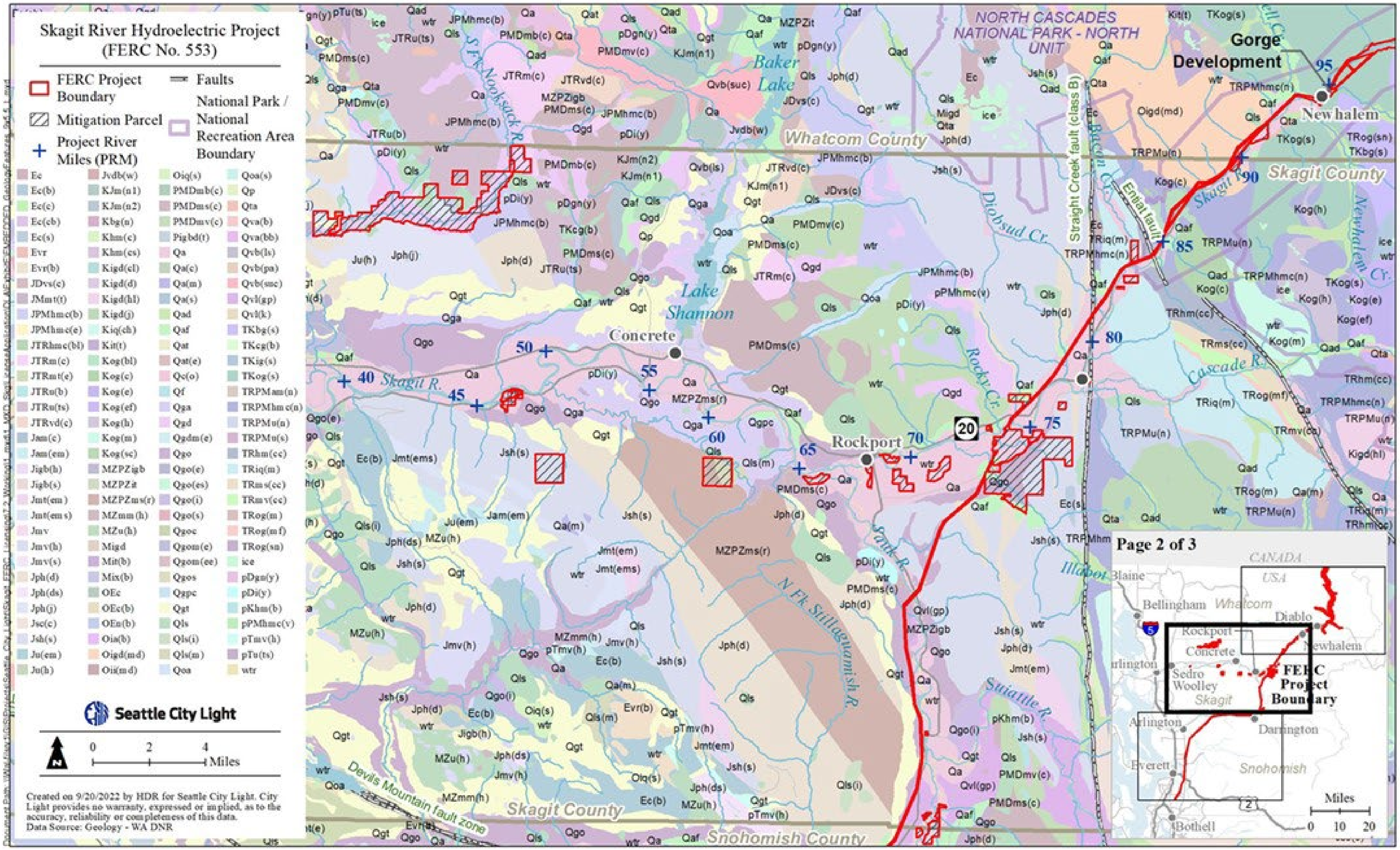


Figure 4.2.1-1. Geologic features of the Project vicinity (page 2 of 3).

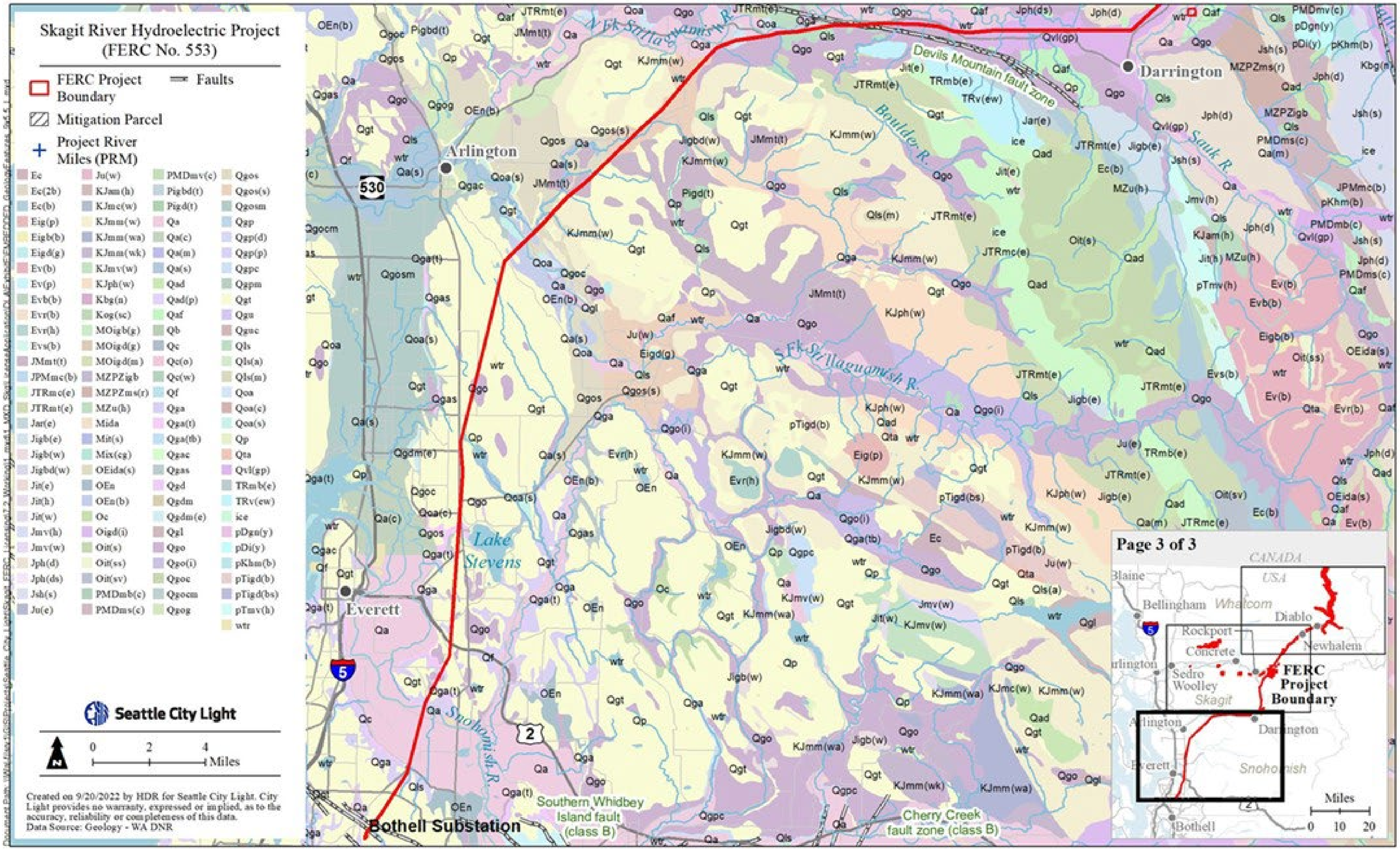


Figure 4.2.1-1. Geologic features of the Project vicinity (page 3 of 3).

Table 4.2.1-1. 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.

Lithology

Rocks of the <u>Western Domain</u> 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 (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 <u>Metamorphic Core Domain</u> 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 <u>Methow Domain</u> 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 archaeological record demonstrates Hozomeen Chert was quarried for use for tools and weapons by Native American and First Nation peoples.

In the Project vicinity, river valleys and the Puget Lowland are dominated by surficial deposits and 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.

Glacial Geology

Both local and regional drainage patterns have been altered by glaciation (Riedel et al. 2007). Continental and alpine glaciers covered much of the area in the Project vicinity during the Quaternary period, with several major advances of thick continental ice from the north and smaller alpine glaciers originating from mountain peaks. The North Cascade Range and Puget Lowland were inundated by the south-flowing Cordilleran Ice Sheet during the Fraser Glaciation 35,000 to 11,500 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). 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. 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 from draining into the Fraser River to flow south in its current configuration (Riedel et al. 2012).

Currently, the Skagit River watershed is the most heavily glaciated river valley in the lower 48 states with more than 390 glaciers. Overall, glaciers in the North Cascades have declined by approximately 50 percent since 1900 due to global trends of ice loss (Skagit Climate Science Consortium 2015). 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).

Mineral Resources

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. 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 U.S. Geological Survey (USGS) (The Diggings 2019). 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). A portion of mitigation land near Bacon Creek was used as a commercial gravel borrow pit prior to acquisition by City Light.

Geologic Hazards

Seismicity

The major fault zones in the region are shown above on Figure 4.2.1-1 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).

The two most recent large earthquakes affecting the North Cascades, occurring in 1872 (magnitude 7.3) and 1915 (magnitude 5.6), 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). Additional information describing large earthquakes in northwestern Washington since 1915 is included in the Pre-Application Document (PAD) (City Light 2020).

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 hazard to the Project from Mt. Baker is 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 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 4.2.1-2 shows lahar hazard zones originating from Glacier Peak (Cascades Volcano Observatory 2019).

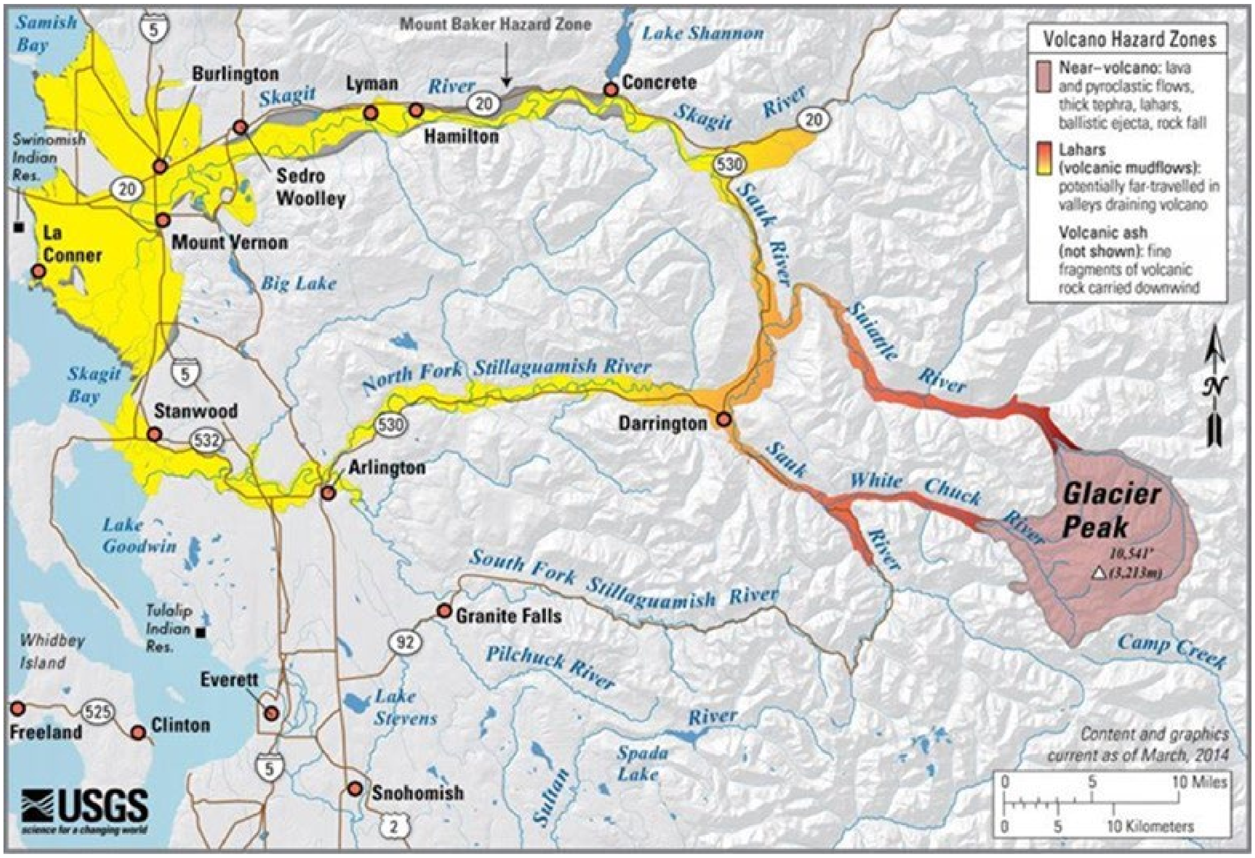


Figure 4.2.1-2. Lahar hazards from Glacier Peak.

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. 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. State Route (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).

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. Rockfall and debris avalanche hazards exist in steep areas of the transmission line corridor north of Newhalem. The highest spatial density of deep-seated landslides in the GE-02 Erosion and Geologic Hazards Study (mass wasting study area) occurs along the slopes that border the North Fork (NF) Stillaguamish River. Large slope failures are common both in the rocks that compose the upper slopes and in the glacial deposits that form broad and continuous benches that line the lower slopes both north and south of the NF Stillaguamish. Along the upper slopes on the north side of the valley, landslides are particularly concentrated where numerous tributaries of the NF Stillaguamish River have deeply incised into the rocks of the Helena-Haystack mélange and overlying glacial till. Landslides are also concentrated along the benches above the valley floor.

Details on mass wasting near the Project and a summary of results of the GE-02 Erosion and Geologic Hazards Study are included in Section 4.2.1.2 of this Exhibit E.

Flooding

Flooding in narrow canyons and on floodplains 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 transmission line ROW access 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 protected from bank erosion by 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.

Erosion and Geologic Hazards Study at the Project Facilities and Transmission Right-of-way (ROW)

The GE-02 Erosion and Geologic Hazards Study evaluated how Project operation and maintenance (O&M) may affect mass wasting, erosion, channel migration, and stream/riparian resources along the transmission line ROW.

The goals of the Erosion and Geologic Hazards Study were two-fold:

- Goal 1: to characterize where Project O&M activities are affecting erosion, mass wasting, and runoff that could affect the following resource areas—cultural; terrestrial; aquatic; fisheries; riparian; and rare, threatened, and endangered plants; and
- Goal 2: to determine where existing erosion, mass wasting, and channel migration/bank erosion have the potential to affect Project facilities.

Specific objectives supporting these goals included:

- Identify, map, inventory, and characterize areas of erosion, runoff, mass wasting, and culvert conditions that are affected by Project facilities, townsites, transmission towers, and study routes (Goal 1).
- Identify where Project maintenance activities (e.g., road grading, ditch maintenance, vegetation management, streambank protection) along the transmission line ROW and study routes have the potential to cause erosion or sedimentation or altered hydrologic connectivity to water bodies (Goal 1).
- Identify the current instream and riparian habitat conditions within and immediately upstream and downstream of transmission line stream crossings where channel migration, bank erosion, or mass wasting are potentially affected by Project operations (Goal 1).

- Identify mass wasting (landslide, rockfall) and channel erosion hazards (e.g., channel migration, bank erosion) that could affect Project facilities, transmission towers, or study routes (Goal 2).
- Characterize study route-stream crossing structures so that hydraulic capacity, erosion, and biological effects (e.g., fish passage) can be assessed (Goals 1 and 2).

Mass Wasting

Mass wasting includes landslides and rockfalls, including mapping past mass wasting within, originating from, or affecting areas within the Project Boundary. The study: (1) developed a Mass Wasting Inventory of existing mass wasting features (e.g., landslide and rockfall); and (2) provided a regional assessment of susceptibility of slopes to the dominant types of mass wasting based primarily on existing mass wasting features, slope characteristics, and local geology.

Methods

The analysis of mass wasting hazards included the compilation of reports, published maps, existing geospatial data, and similar studies relevant to the identification of unstable slopes in the mass wasting study area. Information was collected and interpreted according to a generally accepted protocol from the Washington Geological Survey (WGS) regarding compiling mass wasting feature inventories. The WGS protocol provides guidelines for identifying, characterizing, mapping, and inventorying landslides, fans, and rockfall by mapping geomorphic features including landslide deposits; landslide headscarps, flank scarps, and internal scarps; fan deposits; rockfall deposits and scarps; and recent landslides (typically less than 150 years since occurrence). In addition to mapping the features listed above, the protocol also extends to collecting additional quantitative and qualitative data of each feature including, but not limited to, material composition, movement type, identification confidence, and a general relative age of movement (e.g., pre-historic, historic, active). Field verification is being conducted in Fall 2022 for specific sites of interest.

Mass Wasting Summary

As part of the mass wasting inventory, 3,612 mass wasting features were identified (Table 4.2.1-2).

Table 4.2.1-2. Mass wasting features included in the Mass Wasting Inventory.

Mass Wasting Feature	Number	Median Area (Range) (square feet [ft^2])
Deep-seated Landslide	1,210 (1,210 scarps)	216,000 (2200 – 84,638,000)
Shallow Landslide	58 (58 scarps)	36,000 (3300 – 559,000)
Rockfall	567 talus piles (745 scarps)	193,000 (1200 – 27,792,000)
Debris Flood Fan	301	138,000 (1900 – 24,107,000)
Debris Flow Fan	813	61,000 (900 – 8,181,000)
Alluvial Fan	63	70,000 (1800 – 30,518,000)

Landslides, rockfall, and debris flows are generally prevalent within the mass wasting study area. However, the spatial distribution of these features is not uniform and, as demonstrated by the susceptibility analyses, slope failures tend to concentrate in areas that exhibit specific conditions that predispose a slope to fail. These conditions include, but are not limited to, specific combinations of geology type and slope geometries. Based on the Mass Wasting Inventory and the susceptibility analyses, some generalizations can be made about patterns of slope failures in the mass wasting study area and contributing factors, focusing on areas that overlap Project facilities.

Erosion and Runoff from Project-Related Townsites and Study Routes

The analysis of erosion and runoff from Project-related townsites and study routes includes compiling existing data and Geographic Information System layers; a pre-field analysis of routes and stream connectivity; a field inventory of study routes, culvert, and townsite erosion and runoff conditions (referred to as the Phase I Study Route Inventory); a culvert/bridge fish passage assessment (referred to as the Phase II Fish Passage Assessment); and a post-field summary and analysis.

During 2021, existing information was collected, and the Phase I Study Route Inventory was conducted, compiling information on routes, culverts, and townsite erosion and runoff conditions. The 2021 analysis of erosion and sedimentation along study routes and townsites included assessing:

- Hydrologic connectivity of study route segments;
- Erosion potential (surface erosion, gullying, and mass wasting);
- Culvert, bridge, and drainage structure characteristics and condition; and
- Project townsite runoff and erosion.

A field inventory of study routes, including townsite routes, and culvert conditions was made during the summer of 2021, and field measurements in 2022 were used to assess fish passage at road crossings over potential fish-bearing streams.

Channel Migration and Stream Crossings

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. 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 hydromodified 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.

The Channel Migration and Stream Crossings analysis component of GE-02 Erosion and Geologic Hazards Study will provide an analysis of the interaction of streams with the transmission line ROW and streamside facilities in Project-related townsites, including maintenance procedures near streams and bank protection. Most of this work including assessments of channel migration zones and aquatic/riparian habitat is in process or was not completed in time to be included in this Draft License Application. Results will be reported in the Updated Study Report (USR).

The channel migration and stream crossing part of the study includes four elements:

- Channel migration analysis;
- Compilation of transmission line maintenance procedures near stream crossings;
- Collecting information on Project-related townsite streambank conditions; and
- Collecting information on stream/riparian/bank conditions at channel migration and transmission line maintenance locations.

City Light's transmission line ROW vegetation, study route, and slash management practices include trail and road maintenance (grading, improving gravel surfaces, and ditch cleaning); vegetation management techniques to keep trees/shrub heights short enough that limbs are more than 20 feet from transmission lines; brush cutting and mowing, slash management, and bank protection around transmission line towers.

Newhalem and Diablo are the two townsites associated with Project facilities. Diablo includes two areas: Reflector Bar (north of the Diablo Powerhouse) and Hollywood (south of the Diablo Powerhouse and adjacent to Stetattle Creek). Information collected on streambank conditions in Project townsites include the presence and condition of hydromodifications (rip rap and slush-grouted rip rap). Boulders and coarse sediment line the banks of the Skagit River along the terrace adjacent to Newhalem, and rip rap protects short sections of the left bank around the Gorge Powerhouse. Hydromodifications in the Diablo/Hollywood areas include rip rap and older, more informal bank protection along portions of the Skagit River, and rip rap and shotcrete along the Stetattle Creek levee (Figure 4.2.1-3). Portions of the Stetattle Creek shotcrete are undercut in places.

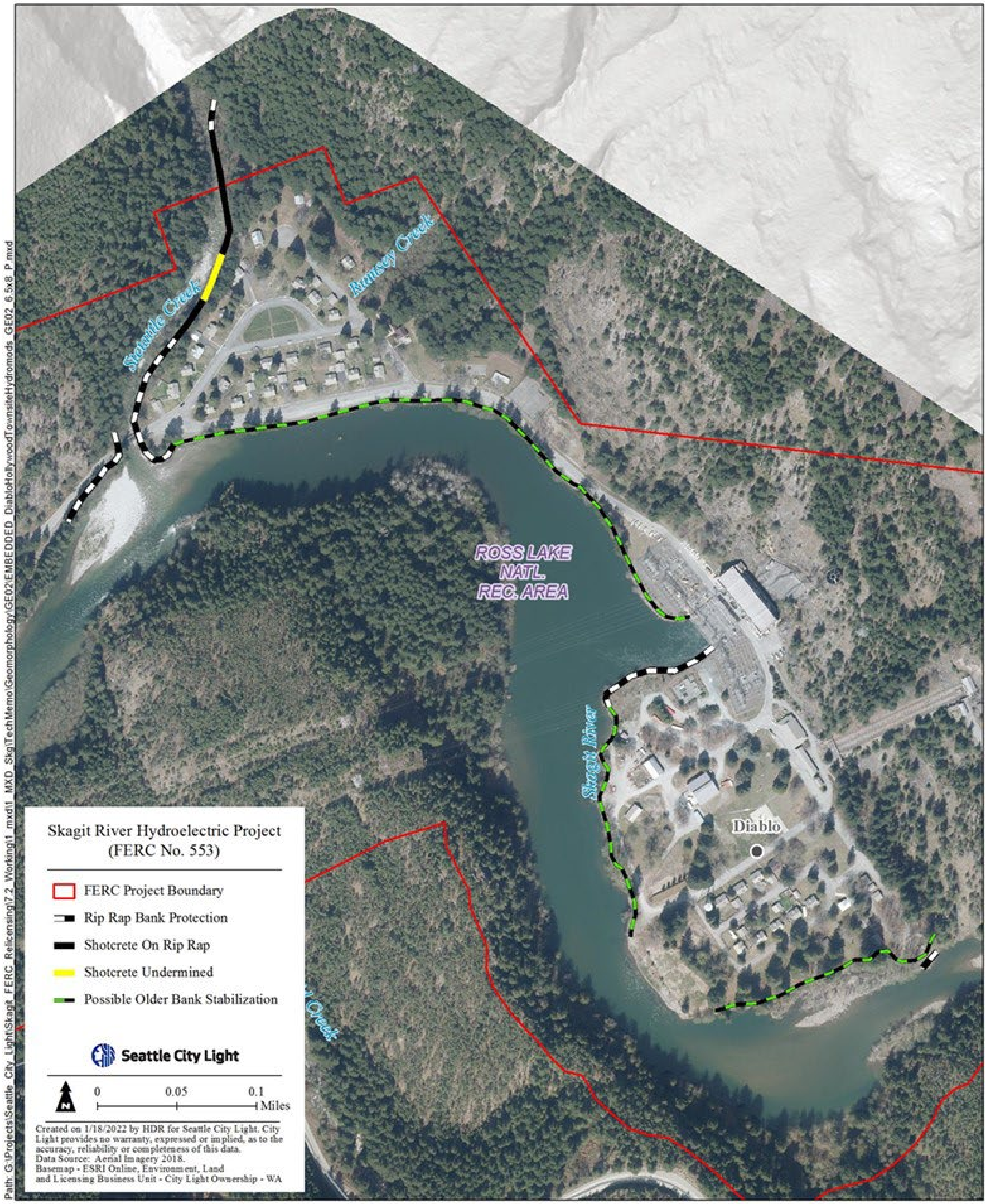


Figure 4.2.1-3. Diablo-Hollywood townsite area hydromodifications.

Soils of the Project Area

Soils in the Project vicinity reflect the underlying bedrock and landforms, 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 4.2.1-4, and characteristics within the Project Boundary and fish and wildlife mitigation lands are listed in Tables 4.2.1-3 and 4.2.1-4.

Dominant soils around Project reservoirs, dams, and the transmission line corridor down to Bacon Creek include (U.S. Department of Agriculture [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 colluvium 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 presents a 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 presents a slight erosion hazard on Tokul soils and a 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.

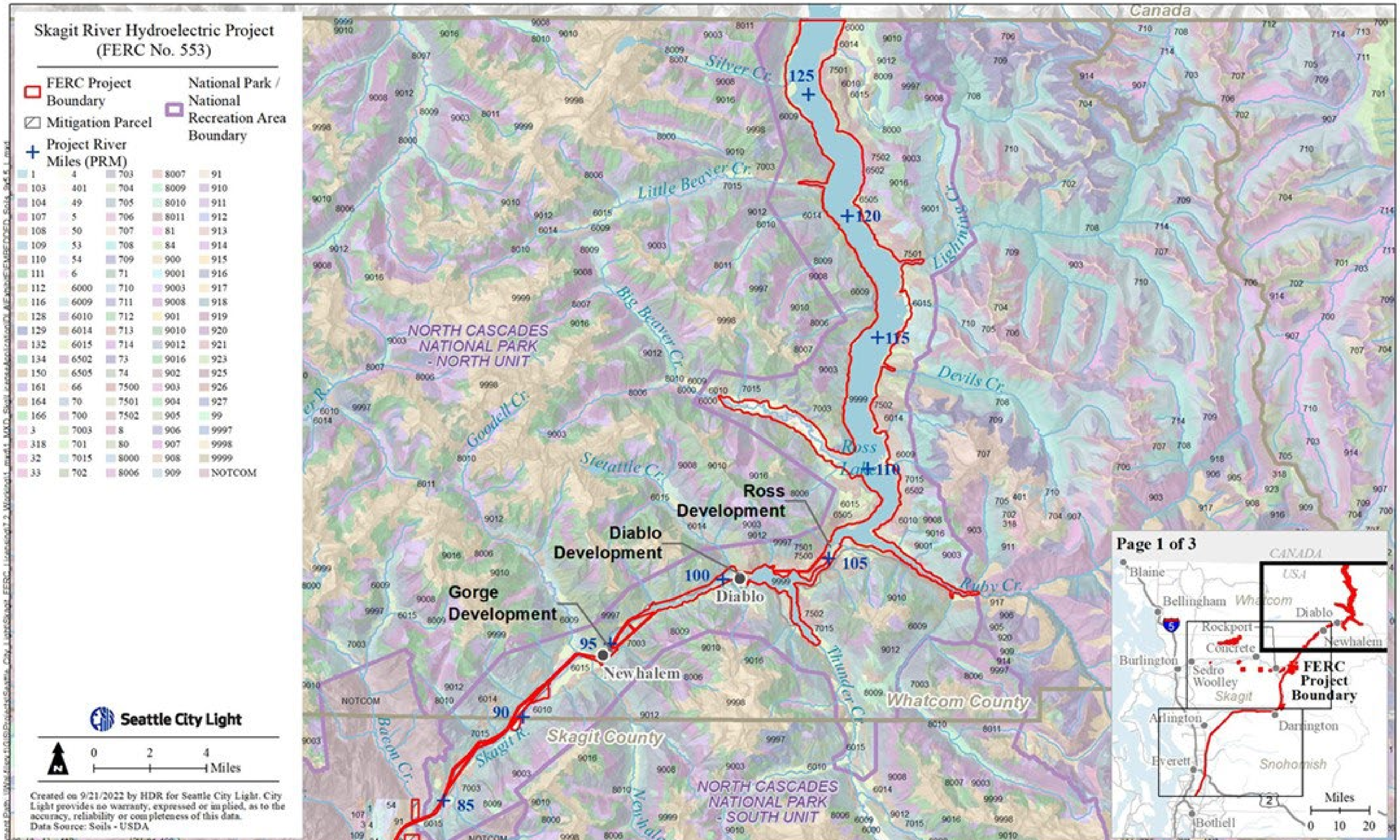


Figure 4.2.1-4. Soils in the Project vicinity (page 1 of 3).

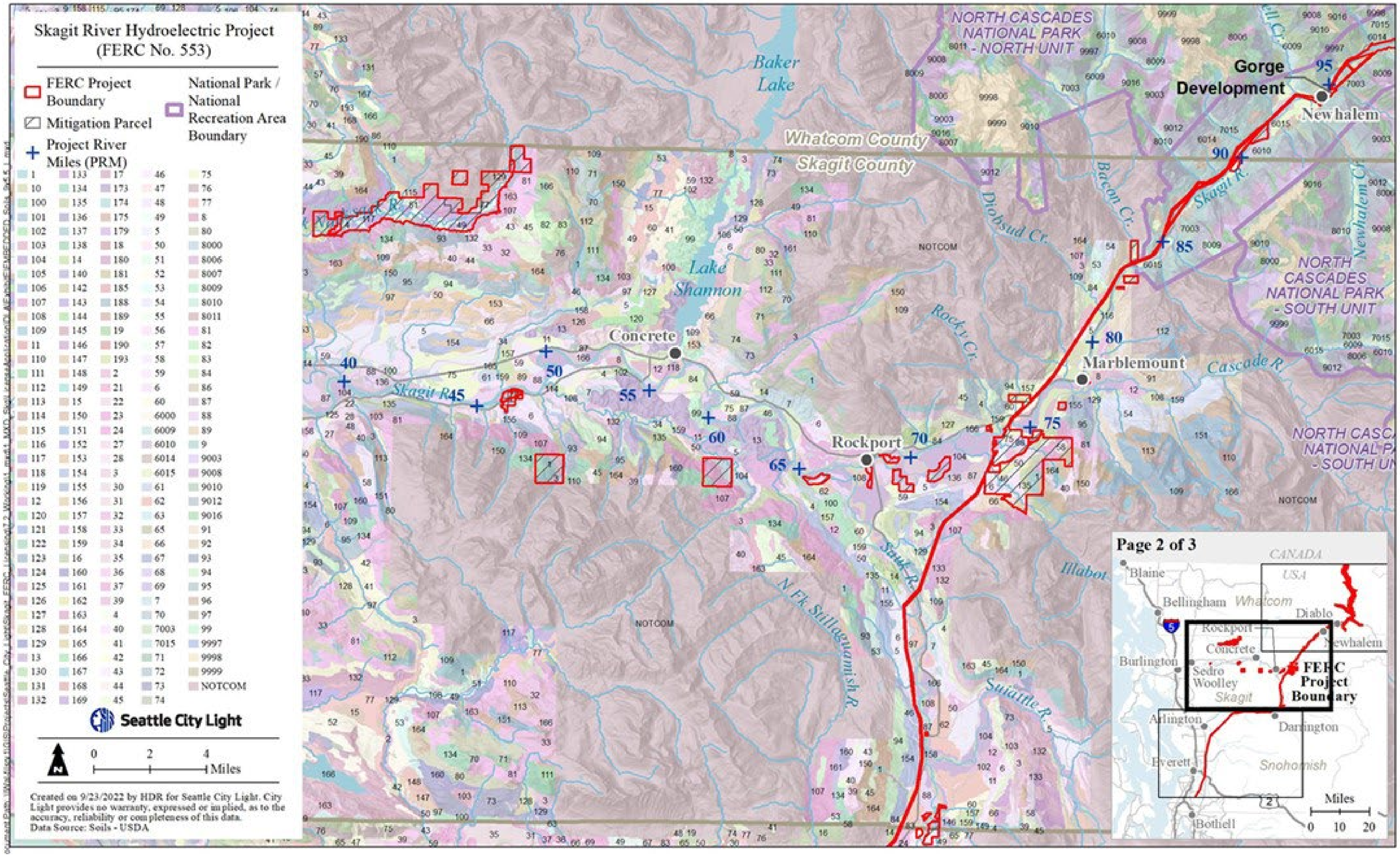


Figure 4.2.1-4. Soils in the Project vicinity (page 2 of 3).

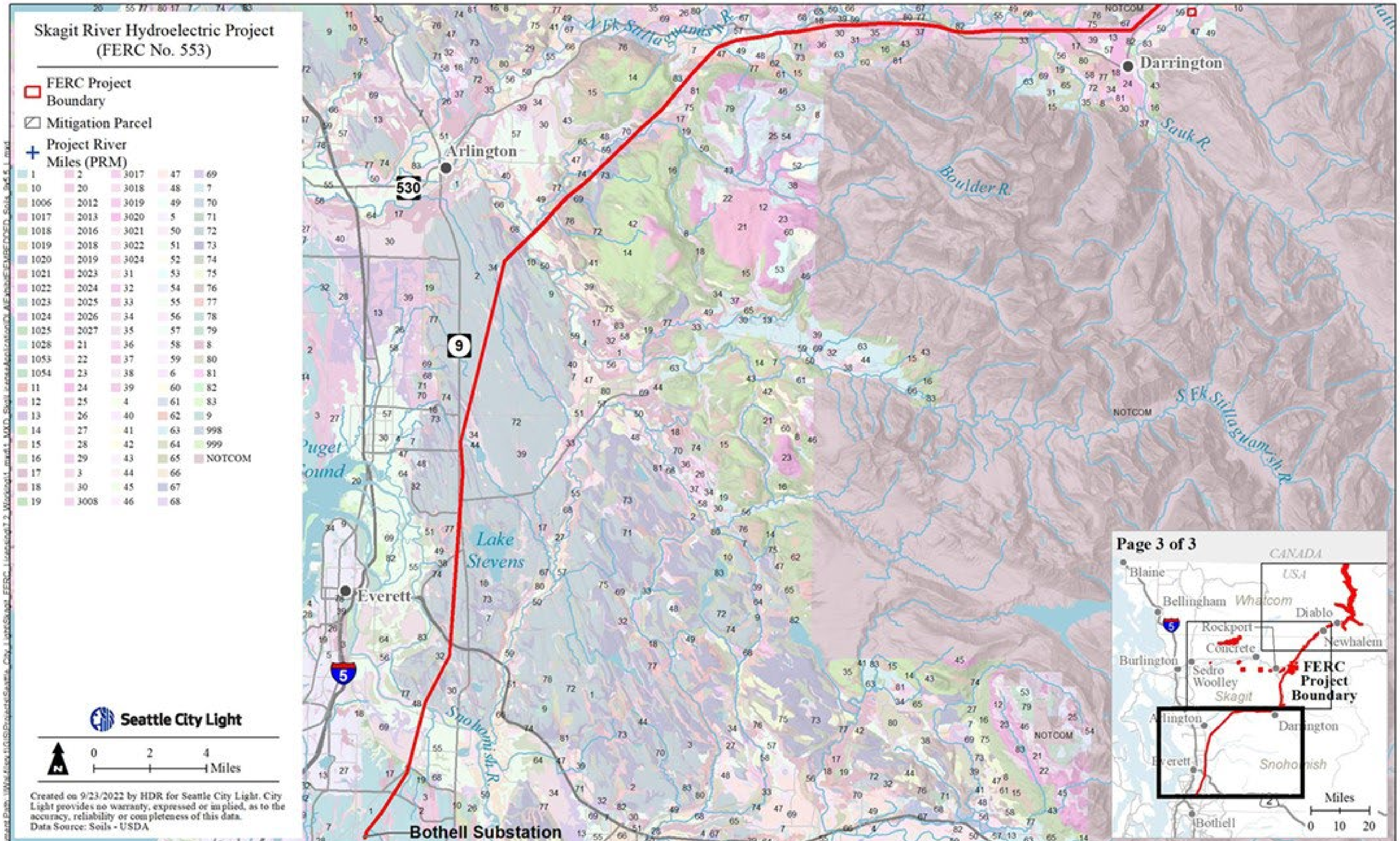


Figure 4.2.1-4. Soils in the Project vicinity (page 3 of 3).

Table 4.2.1-3. 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

Soil Name	Acres	Percent of Area	Average Slope Gradient (%)	Drainage Class	Erosion Potential
Roland-Skymo-Deerlick complex, 0 to 25 percent slopes	510	5.4%	10	Moderately well drained	Severe
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	1,475	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 4.2.1-4.

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 a 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 a 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 4.2.1-4. 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

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			
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
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

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			
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
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

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			
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
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

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			
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
Total	**4,412**		**326**		**1,632**		**4,239**				

Landforms

Landforms have been mapped by National Park Service (NPS) for areas within Ross Lake National Recreation Area (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 and includes features that are depositional in nature (e.g., moraines, alluvial fans) or erosional (horns, bedrock benches). Landform information is shown on Figure 4.3-5 of the PAD (City Light 2020).

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 Big and Little Beaver creeks are situated in classic U-shaped glacial valleys with flat valley bottoms, straight profiles, and low gradients. Other glacial characteristics of the valleys include over-steepened 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.

Reservoir Shorelines and Streambanks

Reservoir Shoreline Erosion – Previous Studies

Reservoir 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 eroded material is transported downslope and deposited in lower elevations of the reservoirs.

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 4.2.1-5). Much of the 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 a portion of the 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 4.2.1-5. Length (feet) and percentage of shoreline composed of various material.

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.

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 conditions at Ross, Diablo, and Gorge lakes varied considerably at the time of the 1990 report (Table 4.2.1-6). 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 2021). 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.

At Diablo Lake, 10 percent of the shoreline was eroding during the 1990 inventory; 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 in 1990, primarily from mass wasting due to waves undercutting areas of unstable soil.

Table 4.2.1-6. Number of erosion sites and length feet (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.

Reservoir Shoreline Erosion – Recent Study

The GE-01 Reservoir Shoreline Erosion Study (City Light 2022a) was carried out to characterize existing areas of erosion along Project reservoir shorelines and to identify any Project-related factors resulting in erosion at each locale. The results include pre-field analysis of existing information and two seasons of field work to inventory existing areas of shoreline erosion, and post-field analysis and report writing. The GE-01 Reservoir Shoreline Erosion Study Interim Report (City Light 2022a) includes a summary of the pre-field analysis of existing information and the first season (2021) of field work. Work carried out in the Spring of 2022 included the reservoir shoreline assessment for Gorge Lake and preliminary results from Ross Lake tree stump measurements. Additional study data and results from the Ross Lake drawdown/erosion analysis will be submitted with the USR. All finalized study results will be reported in the USR and summarized in the Final License Application (FLA).

The study area for the GE-01 Reservoir Shoreline Erosion Study included shorelines at and near normal maximum water surface elevation of Ross Lake (within waters of the United States), Diablo Lake, and Gorge Lake, and riverine sections between the three lakes (Figure 4.2.1-5).

Five additional sites where Riedel (1990) measured the depth of erosion within the Ross Lake drawdown zone (Table 7 in Riedel 1990) were added to the study area as recommended in the Federal Energy Regulatory Commission's (FERC or Commission) Study Plan Determination (SPD) to compare erosion as measured by stump/tree root exposure in the field when Ross Lake is likely at its lowest elevation (March/April 2022):

- 10 Mile Island;
- Lightning Creek;
- Big Beaver;
- Rowland Creek; and
- Arctic Creek.

In addition, the drawdown zone of Ross Lake was included in the GE-01 Reservoir Shoreline Erosion Study area (1,548.33 and 1,537.01 feet North American Vertical Datum of 1988 [NAVD 88; 1,542.07 and 1,530.75 feet City of Seattle datum (CoSD)]); erosion and deposition mapping took place in March/April 2022 to fulfill a commitment in the June 9, 2021 Notice, and that information will be presented in the USR.

Relevant existing reservoir erosion information from NPS, Light Detection and Ranging (LiDAR), landform mapping, geologic mapping, and aerial photographs were compiled for the GE-01 Reservoir Shoreline Erosion Study. A field inventory of reservoir shoreline areas at or near normal maximum water surface elevation was conducted to identify, map, and collect information on the status of erosion areas along the shorelines of Ross and Diablo lakes. The inventory was conducted by boat and foot under near normal maximum water surface elevation conditions. Relevant characteristics of each erosion site were collected as well as a comparison with erosion sites identified during the 1990 erosion inventory (Riedel 1990).

Six erosion processes were observed during the reservoir erosion inventory:

- **Undercut banks** – Undercut banks occur in locations where the soil or rock is consolidated enough to form steep, sometimes nearly vertical, banks. Erosion occurring at the base of a bank removes material, which results in an undercut bank. The undercutting proceeds until the weight of the overlying material exceeds the material strength, the bank topples or slides, and the process repeats. Roots and vegetation can provide additional strength to material at the top of the bank, which often results in overhanging vegetation, roots, and a thin surficial soil layer that is bound by roots.
- **Shallow translational slides** – Shallow translational slides occur on steep banks. The surficial soil layer (generally 3 to 5 feet thick) slides down the slope. Shallow translational slides can be initiated by removal of toe support or by saturated soils within or at the base of the slope.
- **Slumping** – Slumping is a rotational mass movement of material that often occurs in more homogeneous, fine-grained sediments. Slumping can be initiated by removal of toe support or saturated soils within or at the base of the slope.
- **Raveling** – Raveling is a loose, grain-by-grain movement of material downslope. It often occurs in unconsolidated material on steep slopes when vegetative cover is removed.
- **Rills/gullies** – Rills and gullies form when surface runoff is concentrated and has enough energy to erode and transport soil particles.
- **Trampling** – Trampling occurs in locations where people congregate, trample vegetation, travel up and down shorelines, and scuff underlying soils.

Surficial geology around Project reservoirs includes Quaternary and Holocene glacial deposits, alluvial fan/debris cone deposits, and colluvium derived from local soils and underlying geologic units. These surficial materials are generally unconsolidated and subject to shoreline erosion. Unconsolidated alpine till (material deposited in contact with glacial ice), outwash (glacial river deposits), lacustrine (lake) deposits as well as stream alluvium and fine-grained colluvium are the most erodible units observed along reservoir shorelines. Alluvial fan and debris fan deposits were rarely subject to shoreline erosion, likely due to the low gradient and coarse-grained nature of these deposits. Smaller thinner debris cone deposits at the base of small bedrock chutes were observed in several locations along portions of the reservoir in steep, narrow canyon areas (e.g., Diablo canyon, Thunder Creek canyon, Devil's canyon). These deposits were subject to shoreline erosion due to their precarious location on extremely steep canyon walls.

Field Inventory

The reservoir erosion inventory conducted in 2021/2022 identified a total of 306 erosion sites covering 74,272 feet (19 percent) of reservoir shoreline length in Ross Lake, 43 sites (4,556 feet or 4 percent of shoreline length) in Diablo Lake, and 13 sites (3,874 feet or 6 percent of the shoreline length) in Gorge Lake. These sites are shown on Figure 4.2.1-5. Note that the 2021 Reservoir Shoreline Erosion Sites Mapbook with detailed locations of erosion sites was included in the GE-01 Reservoir Shoreline Erosion Study Interim Report (City Light 2022a); the 2022 sites in Gorge Lake will be included in the USR. In Ross Lake, 87 of the sites shown on the 1990 map were stabilized, and 79 new sites were identified. In Diablo Lake, 49 of the 1990 sites were stabilized, and 15 new sites were mapped.

In Gorge Lake, 13 of the sites shown on the 1990 map were stabilized, four sites were categorized as eroding in both inventories, and nine new eroding sites were found in 2022. It should be noted that in Gorge Lake, the 2022 inventory included the area upstream from the SR 20 bridge crossing, including the riverine section up to Diablo Dam. This portion of the river was included as a riverine section rather than part of Gorge Lake in the 1990 inventory (Riedel 1990); no erosion sites were denoted in the 1990 data in this riverine area. Stabilized sites include those where erosion control measures have been implemented and sites that have re-vegetated.

Eroding banks were classified by the primary type of erosion observed. In 2021, undercut banks were the primary type of erosion in Ross Lake (86 percent of eroding length) with raveling (12 percent) and slumps/shallow slides (3 percent) comprising the remainder of the banks. Note that the erosion mechanism on undercut banks is by wave erosion of the toe of the slope followed by failure of the overlying material, most likely block failure or slumping. The majority of the undercut banks are in relatively consolidated deposits with an overlying mantle of vegetation/roots. On Diablo Lake, erosion mechanisms included undercut banks (48 percent of eroding length) and raveling (44 percent) with slumps and shallow slides on 8 percent of the eroding length. The higher proportion of raveling on Diablo Lake is likely due to the bank composition; much of Diablo Lake is situated in a narrower canyon with debris cones and shallow colluvium that are subject to ravel.

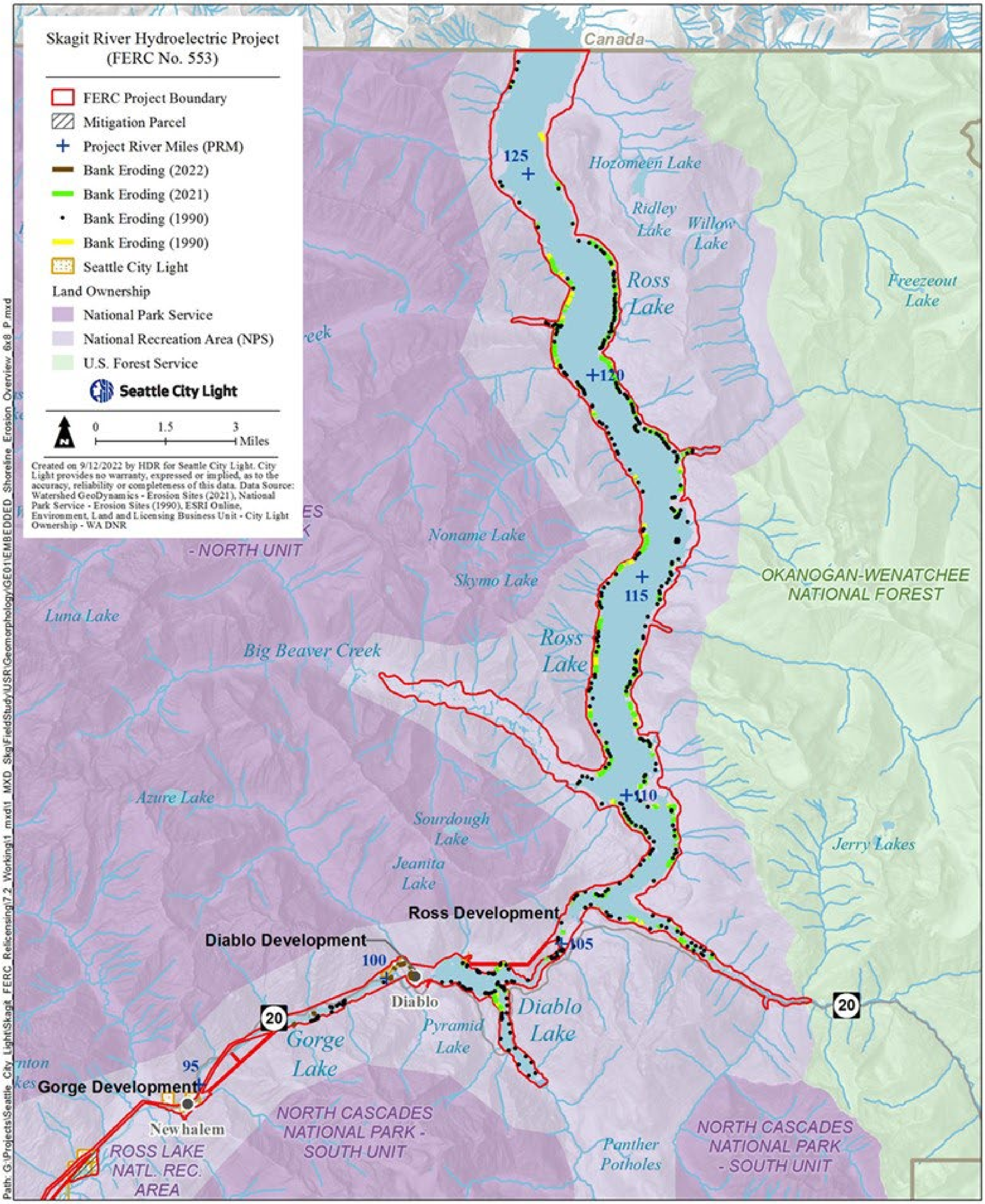


Figure 4.2.1-5. Reservoir shoreline erosion sites.

Sites with Existing Control Measures

Thirty-two sites where erosion control measures have been implemented were evaluated as part of the GE-01 Reservoir Shoreline Erosion Study inventory—29 sites on Ross Lake and three sites on Diablo Lake (Figure 4.2.1-6). Observations made at each site are included in Table 4.2.1-7. Erosion control measures included installation of rock walls, rock stairs to access the lake, log walls, wood cribbing, and rerouted sections of trails and log booms at boat-in campsites, along trails, and at other recreation facilities (trailheads, docks).

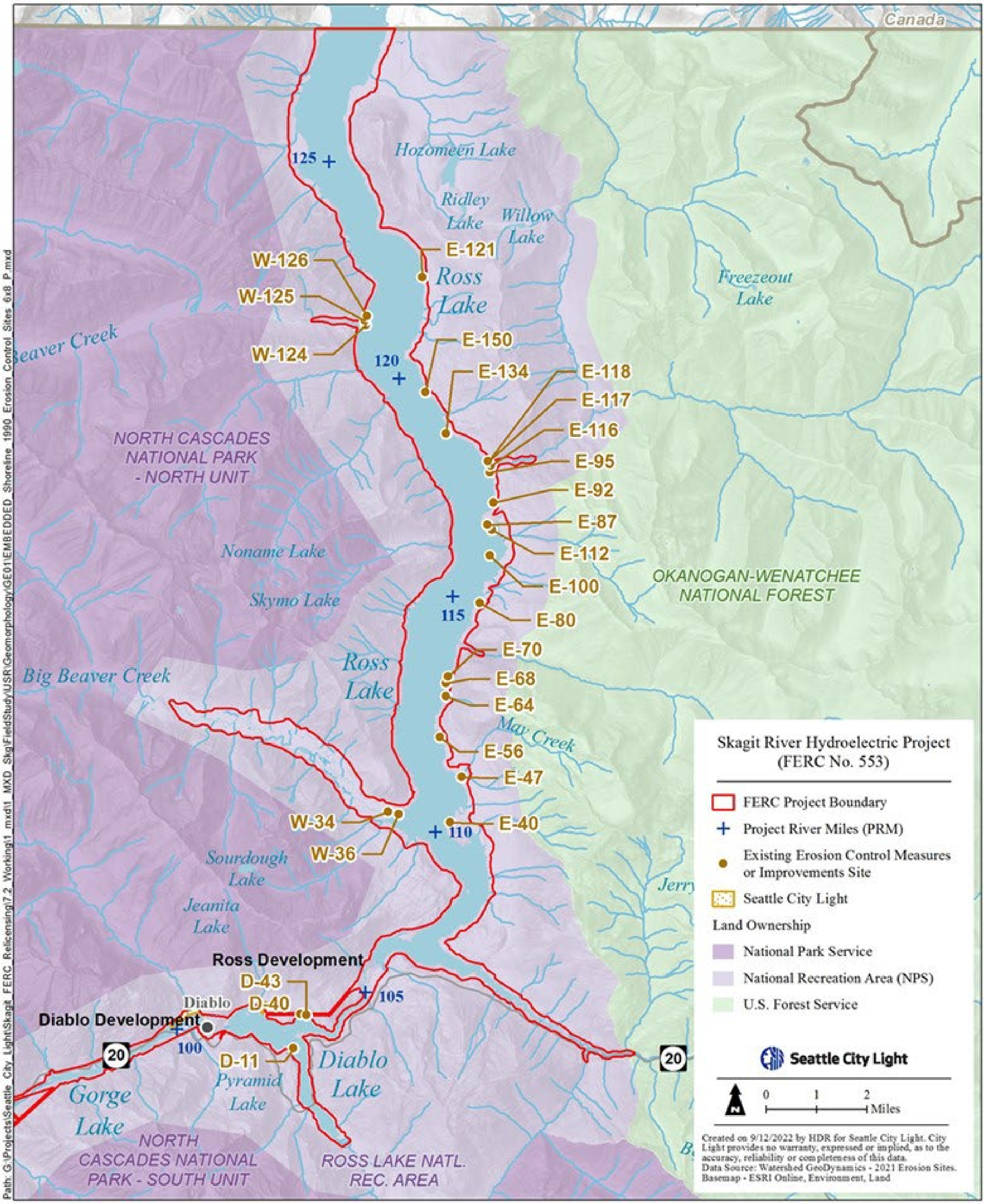


Figure 4.2.1-6. Existing erosion control site locations.

Table 4.2.1-7. Status of sites with existing erosion control measures or improvements.[1]

Reservoir	1990 Site Number	Name and Erosion Control Method	Year Constructed	Condition Assessment Summer 2021
Ross	E-40	McMillian - rock wall 33 ft x 3 ft	2004	Rock wall is a jumble (failing) but still providing erosion protection.
Ross	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	North side of wall needs fill around base rocks. South side good.
Ross	E-56	Rainbow Point - rock wall 170 ft x 4 ft	N/A	Not found. Note that there is piping of sediment from behind the Rainbow Point dock footings.
Ross	E-64	East Bank Trail - reroute 120 ft x 3 ft (height estimated)	2003	Not visited.
Ross	E-68	East Bank Trail - rock wall 80 ft x 4 ft	2003	Not found.
Ross	E-70 (A-1)	East Bank Trail - cribbing 30 ft x 60 ft	1995	Cribbing in good condition.
Ross	E-70 (A-lA)	East Bank Trail - cribbing	1997-98	Cribbing in good condition.
Ross	E-70 (A-2)	East Bank trail - cribbing upper tier: 35 ft x 6 ft Lower tier: 30 ft x 6 ft	1996-97	Cribbing in good condition.
Ross	E-70 (A-3)	East Bank trail - cribbing 100 ft x 15 ft	1998	Cribbing in good condition.
Ross	E-70 (A-4)	East Bank trail - cribbing 45 ft x 25 ft	2001	Cribbing in good condition.
Ross	E-70 (A-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	Cribbing in good condition.
Ross	E-70 (A-5A)	East Bank trail - cribbing	1997	Cribbing in good condition.
Ross	E-70 (A-6)	East Bank trail - cribbing No rebuild, only reveg. 2,000 sq ft	2000-2001	Cribbing in good condition.
Ross	E-80 (A)	Devils Junction - rock wall 103 ft x 4.5 ft	1992	Cribbing in good condition.
Ross	E-80 (B)	Devils Junction - rock wall 44 ft x 2 to 3 ft	2004	Cribbing in good condition.
Ross	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	Walls in good shape.
Ross	E-112	Dry Creek - rock wall & logs 23 ft x 3 ft (SE corner of campground) 45 ft x 4.5 ft (S shore of campground)	1999	Rock wall in good condition but could use fill around base rocks.
Ross	E-87	Ponderosa - rock wall 141 ft x 5 ft	2003	Wall to south side of stairs needs fill around base rocks.

Reservoir	1990 Site Number	Name and Erosion Control Method	Year Constructed	Condition Assessment Summer 2021
Ross	E-92	Lodgepole - two rock walls 10 ft x 3- 4 ft	2004	Walls not found; site eroding.
Ross	E-95	Lightning Horse - rock wall 287 ft x 4 ft faced with 2-3 ft diameter rocks	1998-99	Wall looks to be in good shape but could use fill around base rocks in a few spots.
Ross	E-116	Lightning Trail - reroute about 350 ft long	unknown	Trail re-route not found; large wood anchored along shoreline.
Ross	E-117	Lightning Trail - rock wall 60 ft x 2 to 3 ft	2000	New section of wall is in good shape; old section of wall is failing in spots because rocks are too small.
Ross	E-118A	Lightning Camp - log wall Two 20 ft x 1 ft walls	2000	In good shape; accumulating wood at base of wall.
Ross	E-118B	Lightning Camp - rock wall 45 ft x 1 ft	2000	In good shape; accumulating wood at base of wall.
Ross	E-134A	Cat Island - rock wall 18 ft x < 2 ft	2000	Wall generally in good shape, but a few rocks fallen off wall on east end. Logs cabled parallel to shoreline.
Ross	E-134B	Cat Island - rock wall 50 ft x 6 ft (W of dock) 68 ft x 3.5 ft (Further W of bedrock)	2001	Wall in good shape. Base of dock support is being undermined by waves.
Ross	E-150	Desolation Peak Trailhead rock wall	unknown	Rock wall has failed; not long enough, eroding.
Ross	E-181	Boundary bay - rock wall 155 ft x 4 to 5 ft	1993	Needs fill around base rocks in several locations. Raveling on north end of wall.
Ross	W-34	Big Beaver trail - rock wall 200 ft x 3 ft	1996	Wall generally in good shape. Needs fill around base rocks on east end.
Ross	W-36	Big Beaver - rock wall 50 ft x 2 ft	2002	In good shape.
Ross	W-124	Little Beaver - rock wall, steps, stairs are 25 ft section	1998	Rock wall and dock anchor are being undermined by wave action. Stairs are raveling.
Ross	W-125	Little Beaver - rock wall 70 ft x 5 to 6 ft	N/A	Rock wall not found. Log boom parallel to shore.
Ross	W-126	Little Beaver Trail - cribbing and dock removal	N/A	Not removed yet. Cribbing failing.
Diablo	D-11	Thunder Point - rock wall 290 ft x 2 to 3 ft	2005	Needs fill around base rocks along wall. Dock anchor wall being undermined.
Diablo	D-40	Power Line - rock & log boom 93 ft x 2-3 ft	2005	Log boom in good shape. Did not see wall; area not eroding.
Diablo	D-43	Buster Brown - rock wall 100 ft x 3.5 ft	2005	West end of wall is tumbling down because fill behind wall is eroded (piping through wall?). Wall could use fill under base rock in several places. Dock footings are in good shape.

1 Site Number, Erosion Control Method, and Year Constructed based on NPS data. Crib walls at Ross E-70 and E-80 are differentiated by letters in this table but shown as single locations on Figure 4.2.1-6 due to map scale.

Bank Retreat

Bank Retreat Rates (NPS Erosion Monitoring Transects)

As mentioned, NPS has monitored five 1990 Class I bank erosion sites (22 total transects) in Ross Lake as part of the Erosion Control Plan (Ebasco Environmental and NPS 1990). The 1990 Class I sites were assumed to have the highest erosion rates compared to Class II or III sites. The most recent monitoring occurred in 2021. Each of the five sites monitored has a different rate of erosion because of varying bank material, aspect, and slope (NPS 2022).

Of the 22 individual transects that were measured as part of the five erosion site areas, the majority had less than 10 feet of erosion over the 27-year monitoring period; the transect with the highest erosion rate had nearly 65 feet of bank retreat. This transect was located in an area of unconsolidated soil. The greatest total amount of bank recession is at three sites with thick unconsolidated glacial deposits (E9, E55, and W63), where erosion has a mean of 14 to 19 feet of bank retreat in 24 years. Relatively low rates of erosion were observed at the other two sites (sites E99 and W78) with a mean of less than 6 feet of erosion in 24 years. Site E99 is a rocky slope with colluvial soils, while site W78 has a shoreline composed of consolidated glacial till. Average annual bank retreat rates measured by NPS are shown in Table 4.2.1-8.

Table 4.2.1-8. National Park Service shoreline erosion monitoring on Ross Lake, 1994-2021.

NPS 1990 Site ID	Material type	Average annual bank retreat 1994-2021 (feet per year [ft/yr])
E-9	Glacial outwash (unconsolidated)	3.2
E-55	Glacial lake silt and clay	2.5
E-99	Colluvium over bedrock	0.8
W-63	Glacial till over glacial silt and clay	3.7
W-78	Dense glacial till (consolidated)	0.6

Source: NPS 2022.

Bank Retreat Rates (Aerial Photographs)

The shoreline position on the 1990 and 2018 aerial photographs was compared to determine if a measurement of bank retreat could be made using this method. No difference in shoreline location was seen along the majority of the reservoir shorelines; however, at 42 sites in Ross Lake, a difference in shoreline position could be seen. The maximum distance of bank retreat at these sites ranged from 7 to 80 feet but most of the occurrences had either no retreat or much less retreat than the maximum based on the aerial photograph comparison (Table 4.2.1-9).

Table 4.2.1-9. Bank retreat measured from 1990-2018 aerial photographs.

2021 Site ID	Maximum bank retreat (ft)	Geology	Bank height (ft)
2009	15	Till/outwash (unconsolidated)	20-30
2011	40	Till (unconsolidated)	20-50
2012	80	Till/outwash (unconsolidated)	150
2014	12	Till/outwash (unconsolidated)	3-7

2021 Site ID	Maximum bank retreat (ft)	Geology	Bank height (ft)
2019	15	Till (unconsolidated)	45
2029	18	Till (unconsolidated)	5-7
2031	9	Till (unconsolidated)	15-25
2034	7	Till (unconsolidated)	5-7
2045	20	Colluvium	3-5
2047	15	Till/colluvium mix	2-5
2048	8	Outwash	5-20
2064	20	Till	5-15
2069b	8	Colluvium	20
2070	10	Till (unconsolidated)	10-20
2071	23	Till (unconsolidated)	10-30
2072a	25	Till (unconsolidated)	20
2072c	15	Till (unconsolidated)	20
2072d	37	Till (unconsolidated)	25
2072e	45	Till (unconsolidated)	20
2072f	13	Till (unconsolidated)	20
2072g	45	Till (unconsolidated)	10-25
2073c	7	Till/colluvium (unconsolidated)	10-30
2074	17	Till (unconsolidated)	10-30
2082	12	Colluvium	5-7
2082g	7	Till	5-10
2082h	8	Till/colluvium (unconsolidated)	10
2083b	9	Colluvium	20
2084b	12	Till	5-7
2084c	28	Till/outwash (unconsolidated)	10-40
2085i	10	Till	5-10
2087f	15	Colluvium	15
2109	18	Till (unconsolidated)	30-35
2124a	10	Fine-grained colluvium	5-25
2124b	25	Fine-grained colluvium	25-40
2124c	20	Fine-grained colluvium	5-25
2128	10	Till (consolidated)	5-10
2132	15	Till	3-12
2133	10	Talus/colluvium	15
2134	8	Till/colluvium (unconsolidated)	20-30
2145	15	Till (unconsolidated)	5-15
2146	10	Till (mix)	5
2149	17	Till (unconsolidated)	5-15

Ross Lake Drawdown Study (2022 Field Study)

Erosion around exposed tree stumps was measured at 509 stumps at 31 transect locations in the Ross Lake drawdown zone (between 1,537.01 and 1,548.33 feet NAVD 88 [1,530.75 and 1,542.07 feet CoSD]) in April and May 2022 to comply with the FERC SPD for the GE-01 Reservoir Shoreline Erosion Study and the June 9, 2021 Notice commitment to measure erosion and deposition in the Ross Lake drawdown zone. See Table 4.2.1-10 for transect descriptions and number of stumps measured per transect.

<u>Methods</u>

At each stump, location, dominant/sub-dominant substrate, slope gradient, and root crown height were recorded. Root crown height was measured on four sides of each stump (uphill, left side looking downhill, downhill, and right side looking downhill). The root crown height was measured as the distance from a marker designating the top of the butt swell to the ground surface (Figure 4.2.1-7). In cases where a marker was not installed, the location of the butt swell was visually estimated to measure distance. Markers to designate the elevation of root crown height were installed where possible on each of the four sides of the stump where measurements were taken to aid in future monitoring. Field data were compiled and analyzed in ArcMap to assign elevation and aspect to each stump location based on 2018 Ross Lake LiDAR data (Table 4.2.1-10; Figure 4.2.1-8).

Figure 4.2.1-7. Measurement of erosion around exposed stumps.

Table 4.2.1-10. Stump erosion monitoring transects and number of stumps measured at each transect.

Transect	General Location	Number of Stumps Measured
101	Ruby Arm	21
102	Lightning Creek camp	5
103	Ponderosa	13
104	10 Mile Island	15
105	Big Beaver	15
106	Ruby Arm	12
107	Arctic Creek	18
108	West side of lake across from Devil's Creek	17
110	Rainbow Point	22
111	Ruby Arm	19
120	Silver Creek	28
121	Little Beaver	19
122	Boundary Bay	23

Transect	General Location	Number of Stumps Measured
B	Roland Point	12
C	Roland Creek	22
E	Big Beaver	15
F	Big Beaver	19
G	Spencer	20
H	Spencer	4
I	Dry Creek flats	35
J	Dry Creek	20
L	North of Lightning Creek	5
M	North of Lightning Creek	12
N	Cat Island	15
O	Cat Island	17
P	Cat Island-Desolation Peak trail	16
S	Hozomeen	21
T	Hozomeen	23
200	Near NPS Bank Monitoring Site E-55	8
201	Near NPS Bank Monitoring Site W-63	8
202	Near NPS Bank Monitoring Site W-63	10

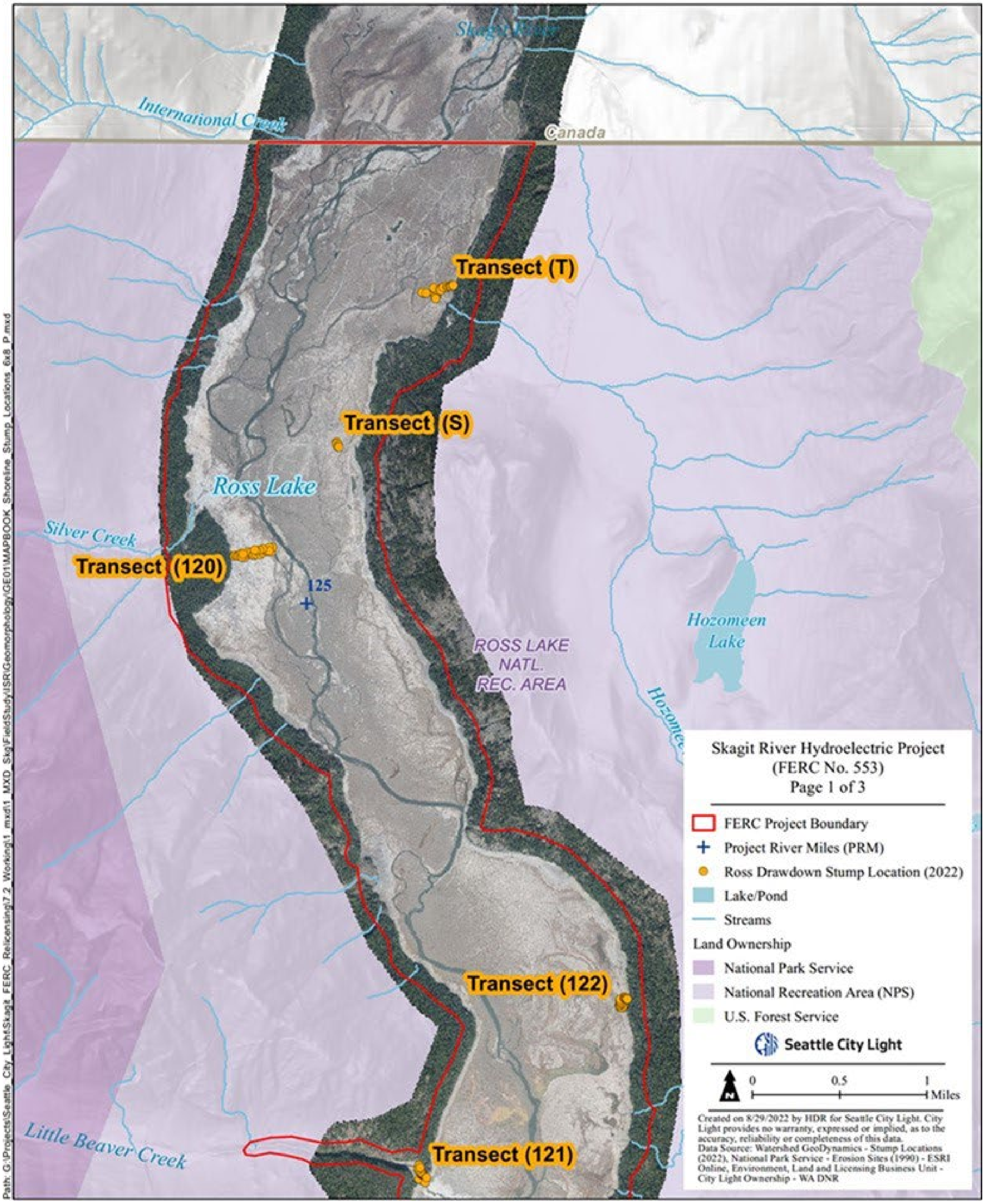


Figure 4.2.1-8. Stump transects in the Ross Lake drawdown area (Figure 1 of 3).

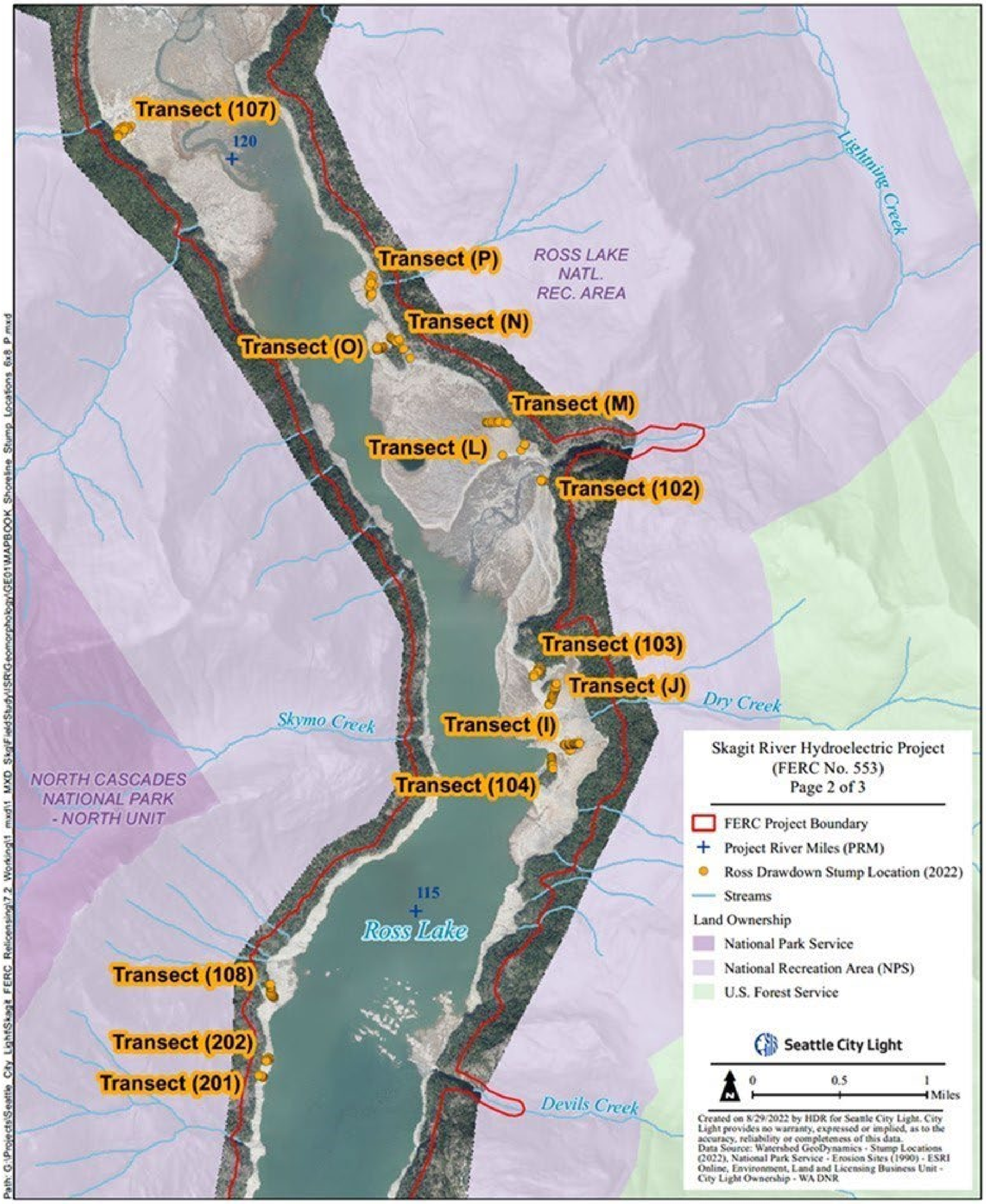


Figure 4.2.1-8. Stump transects in the Ross Lake drawdown area (Figure 2 of 3).

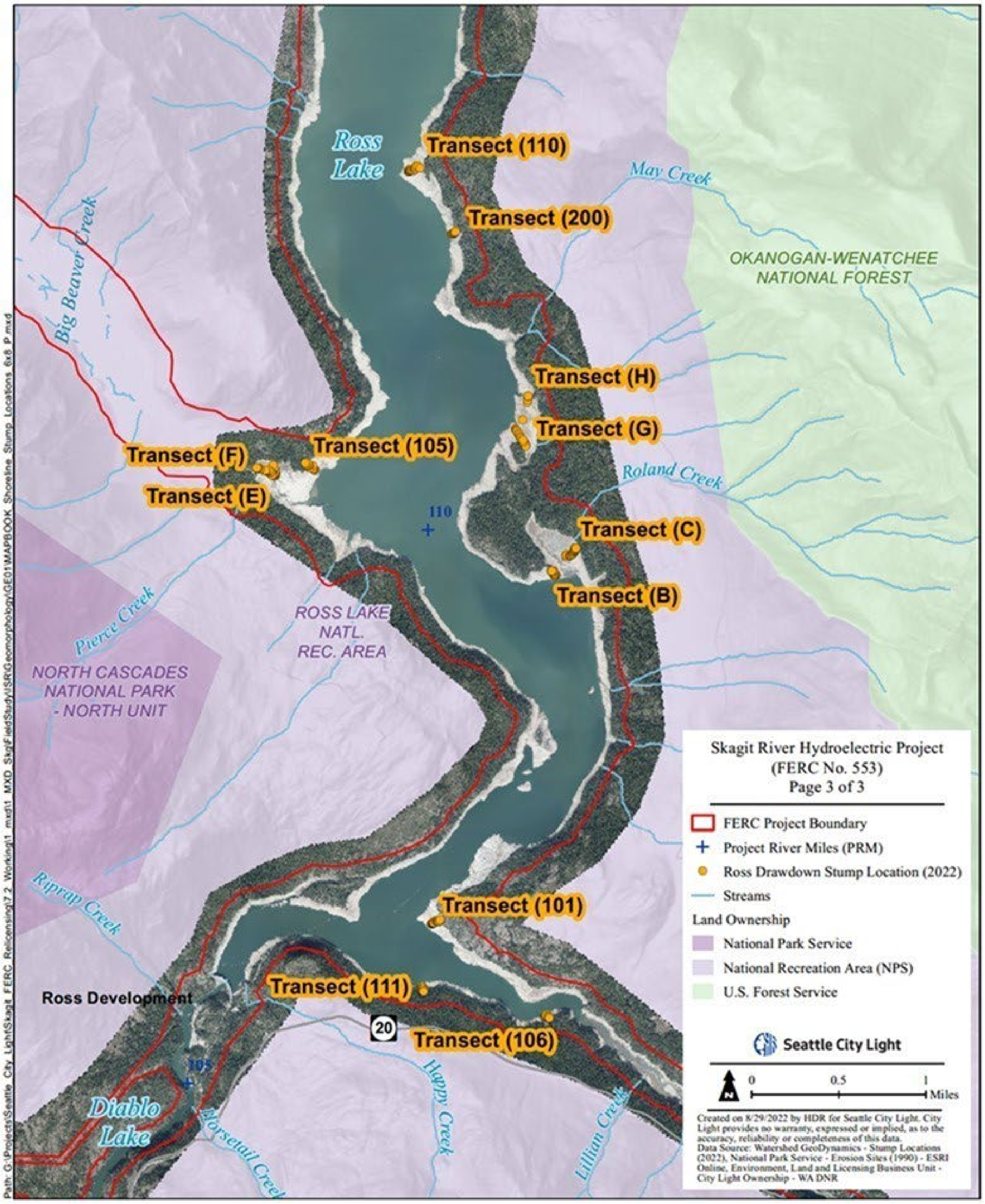


Figure 4.2.1-8. Stump transects in the Ross Lake drawdown area (Figure 3 of 3).

Results

The distance from the root crown height/top of butt swell to the current ground surface on exposed stumps provides a general indication of the depth of erosion that has taken place since Ross Lake was inundated in 1949 (see Figure 4.2.1-9). An average of 2.3 feet of erosion, measured as root crown height above current ground surface, was measured during the 2022 field work (average of 509 stumps, 4 measurements/stump).

Riedel (1990) reported the maximum depth of erosion at five locations in the Ross Lake drawdown zone based on measurements of exposed stumps in 1990. The FERC SPD requested that these measurements be repeated in 2022. The exact location of each of the stumps measured by Riedel is unknown, but stump transects with 5-21 stumps per transect were established at each of the 1990 sites. Comparison of the 1990 maximum erosion depth with 2022 maximum erosion measurement showed that the 2022 measurements were several feet less (e.g., less erosion measured) at three of the sites and higher (e.g., more erosion measured) at two of the sites (Table 4.2.1-11). The sites with less measured erosion are likely the result of stumps measured in 1990 having eroded away in the past 32 years, as stumps with 6-9 feet of erosion would have little grounded root structure remaining to hold them in place. The sites where 2022 measurements indicate more erosion than the 1990 measurements had relatively less erosion (3-5 feet) in 1990, so stumps likely did not erode away between 1990 and 2022. The measurements at these sites are more likely to reflect the amount of erosion that occurred from 1990 to 2022 (0.2 to 1.3 feet). The installation of markers and collection of accurate Global Positioning System GPS locations at the stumps during the 2022 field work will facilitate comparison of stump erosion measurements in the future and allow better comparison of erosion depths.

Table 4.2.1-11. Stump Erosion at FERC SPD sites.

Site Location (2022 transect)	1990 Erosion Depth (ft)[1]	2022 Maximum Erosion Measurement (ft)	2022 Average Erosion Depth (ft)
10 Mile Island (Transect 104)	9.2	5.6	2.3
Lightning Creek (Transect 102)	8.2	5.6	2.6
Big Beaver (Transect 105)	6.6	5.9	2.6
Rowland Creek (Transect B)	2.8	4.1	2.7
Arctic Creek (Transect 107)	4.9	5.1	2.6

1 Source: Riedel 1990, Table 7.

Comparisons of average stump erosion with substrate, slope gradient, aspect, and elevation were made to determine if any trends were apparent (Figure 4.2.1-10 through 4.2.1-13). Dominant substrate appears to be correlated with erosion depth, and erosion depth weakly increases with increasing slope gradient, but the amount of scatter in the data makes other correlations difficult to discern.

It is likely that dominant substrate (Figure 4.2.1-10) is actually an indicator of the amount of erosion that has taken place rather than reflective of substrate influencing erosion rates. Bedrock has the lowest root crown height, likely because once the shallow surficial soil that developed on the bedrock is removed no further erosion can occur. Root crown height decreases with decreasing dominant substrate size, likely because the substrate under the stumps is a lag deposit of material that is too large to be mobilized; only the largest material remains after all smaller material is removed. A larger amount of erosion would remove more soil, leaving only the largest particles behind.

Higher slope gradient or elevations where wave energy (e.g., lake water surface elevation) occurs most frequently would be assumed to have a higher rate of erosion, but the correlation between gradient and root crown height is weak (Figure 4.2.1-11), and there does not appear to be a correlation between elevation and crown height (Figure 4.2.1-13).

Figure 4.2.1-9. Living trees in the Ross Lake area (top photo) compared to exposed stumps (bottom photo) showing top of root crown/butt swell location.

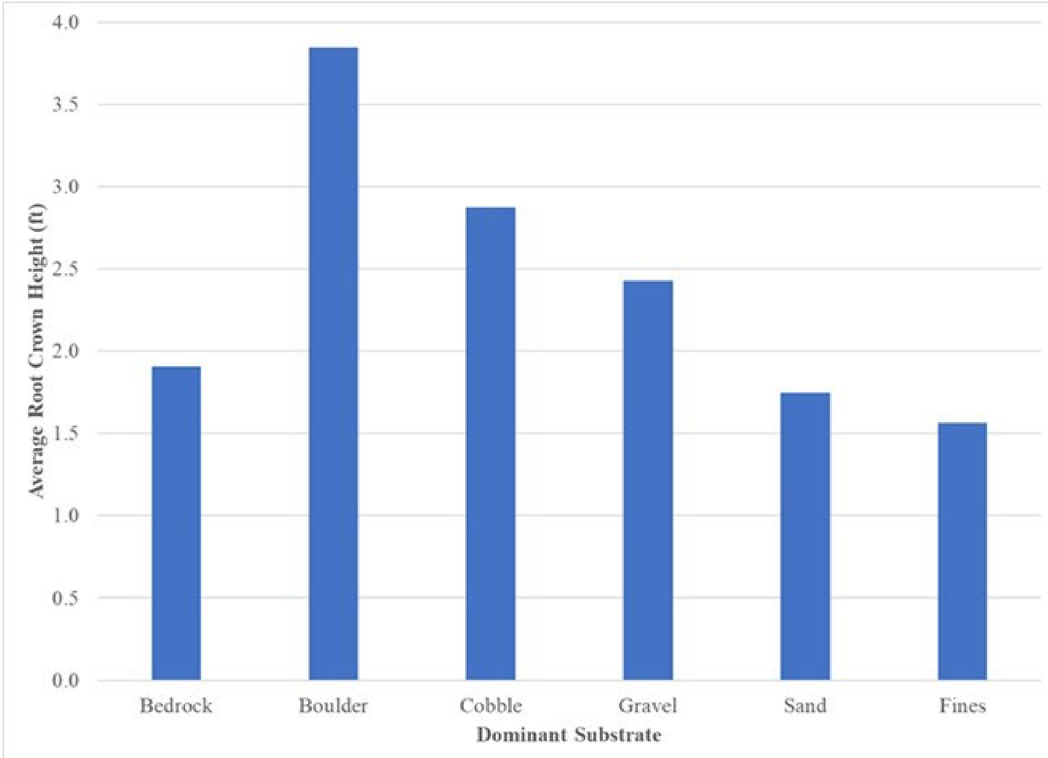


Figure 4.2.1-10. Dominant substrate versus root crown height.

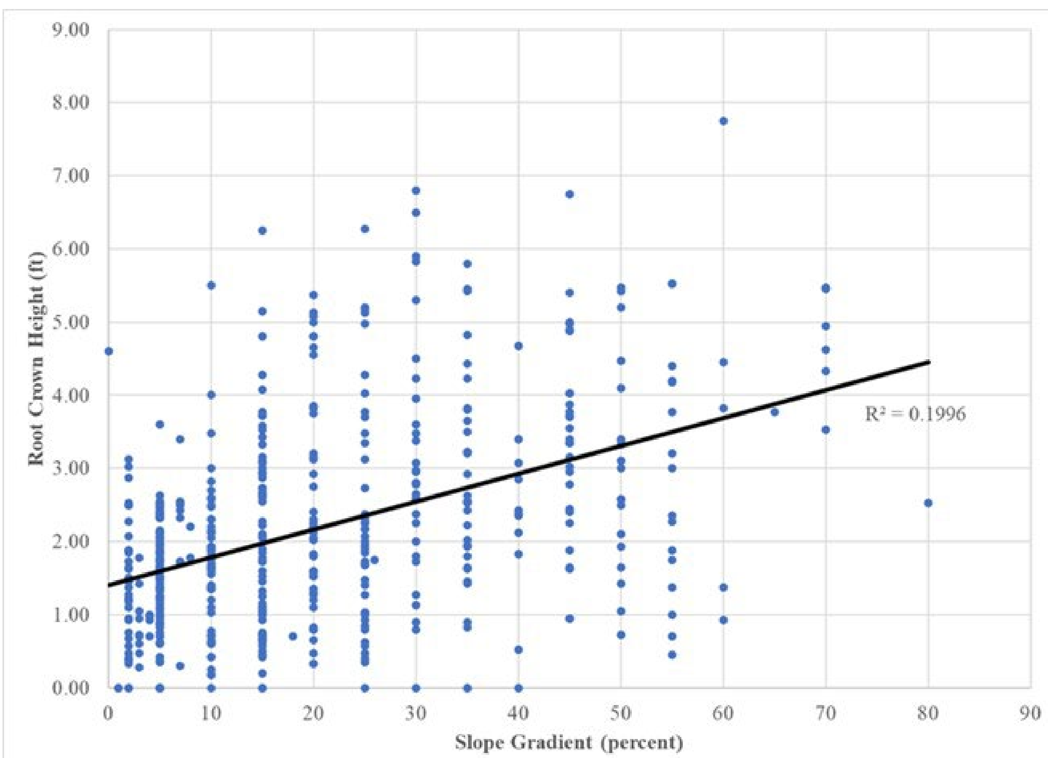


Figure 4.2.1-11. Slope gradient versus root crown height.

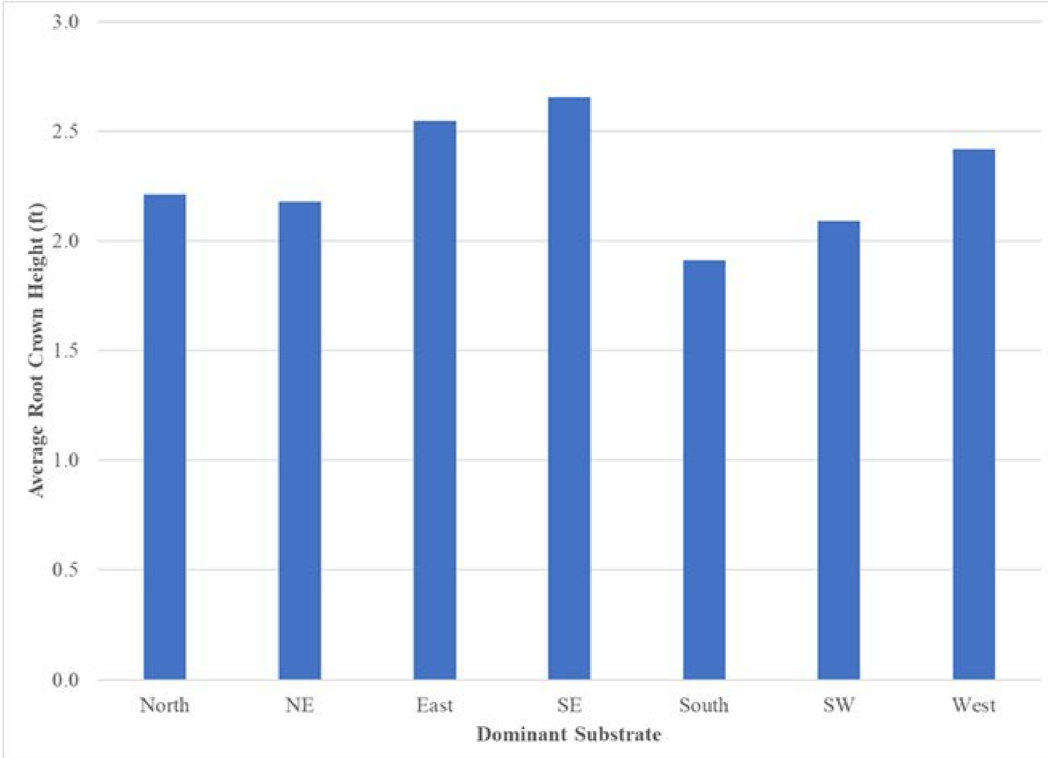


Figure 4.2.1-12. Aspect versus root crown height.

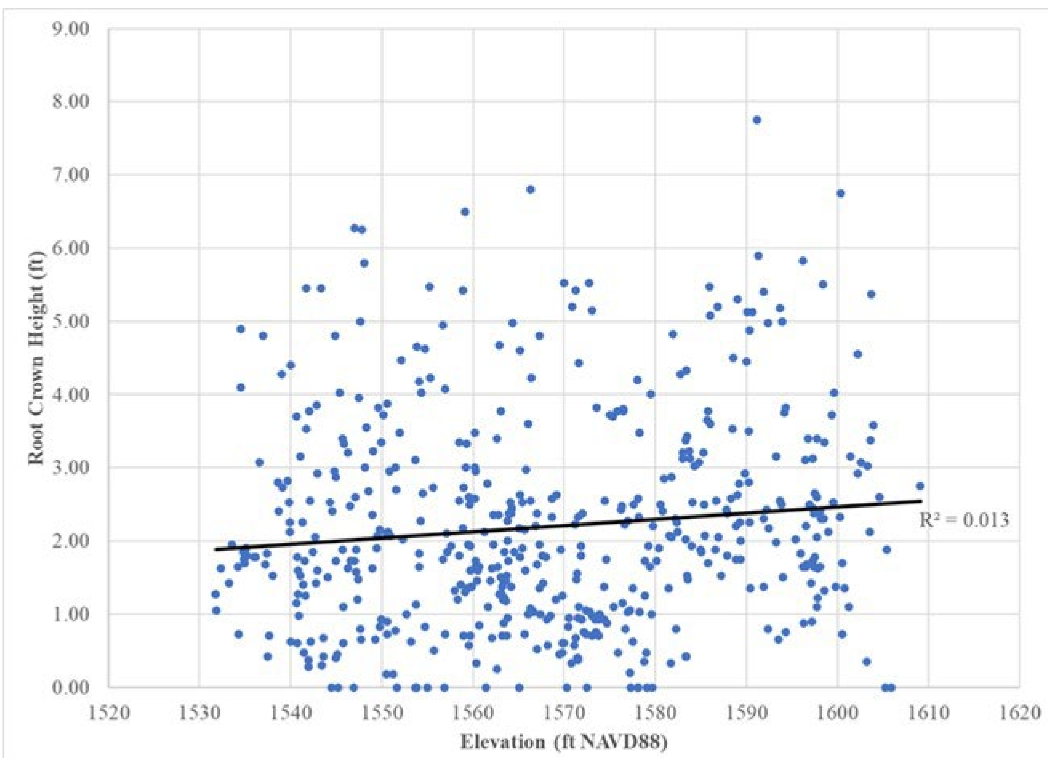


Figure 4.2.1-13. Elevation versus root crown height.

Sediment Deposition in Reservoirs Affecting Resource Areas of Concern

Introduction

The GE-03 Sediment Deposition Study was conducted to evaluate the effects of sediment deposition at four locations within Ross, Diablo, and Gorge lakes with identified recreational resources and/or Project operations impacts. The goal of the study is to develop an understanding of the physical conditions (rate of deposition, grain size of deposits) under which deposition occurs at the four locations.

The specific study areas include inlets/deltas at four locations with identified recreational or operational impacts in the Project Boundary are (Figures 4.2.1-14 through 4.2.1-17):

(1) **Hozomeen inlet at the head of Ross Lake** – recreational resource: Hozomeen and Winnebago Flats boat launches;

(2) **Thunder inlet in Diablo Lake** – recreational resource: Colonial Creek Boat Launch and Boat House;

(3) **Sourdough inlet in Diablo Lake** – Operational resources: City Light Boat Launch, City Light Boat House, City Light Dry Dock; recreational resources: West Ferry Landing, Environmental Learning Center (ELC) Canoe and Kayak Dock, Skagit Tour Dock; and

(4) **Stetattle Creek delta in Gorge Lake** – recreational resource: whitewater training and instruction, Gorge Lake Campground Boat Launch and Dock; operational resource: City Light Diablo Powerhouse Tailrace.

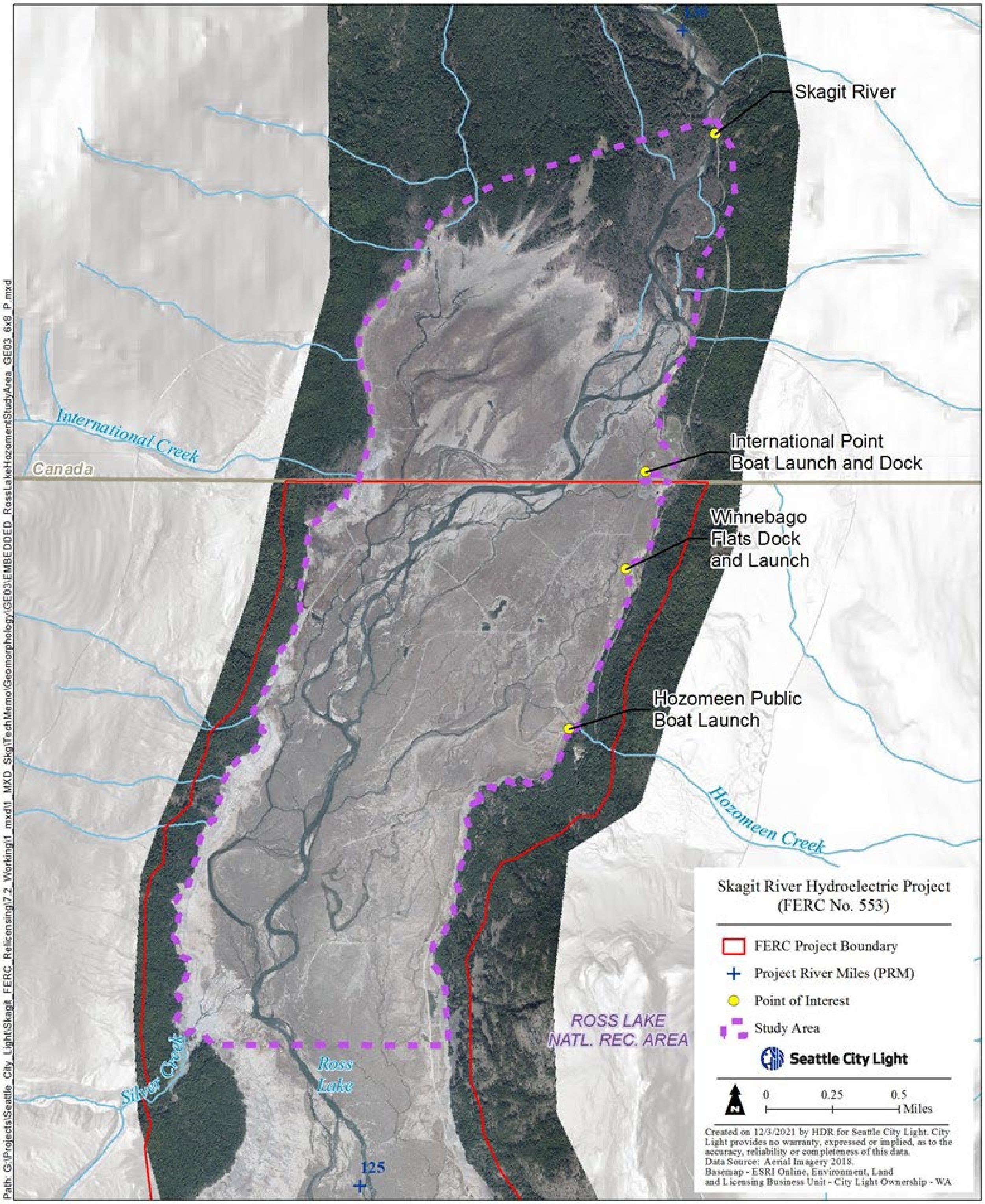


Figure 4.2.1-14. Study Area 1 – Ross Lake – Hozomeen inlet with Winnebago Flats Dock and Launch and Hozomeen Public Boat Launch.

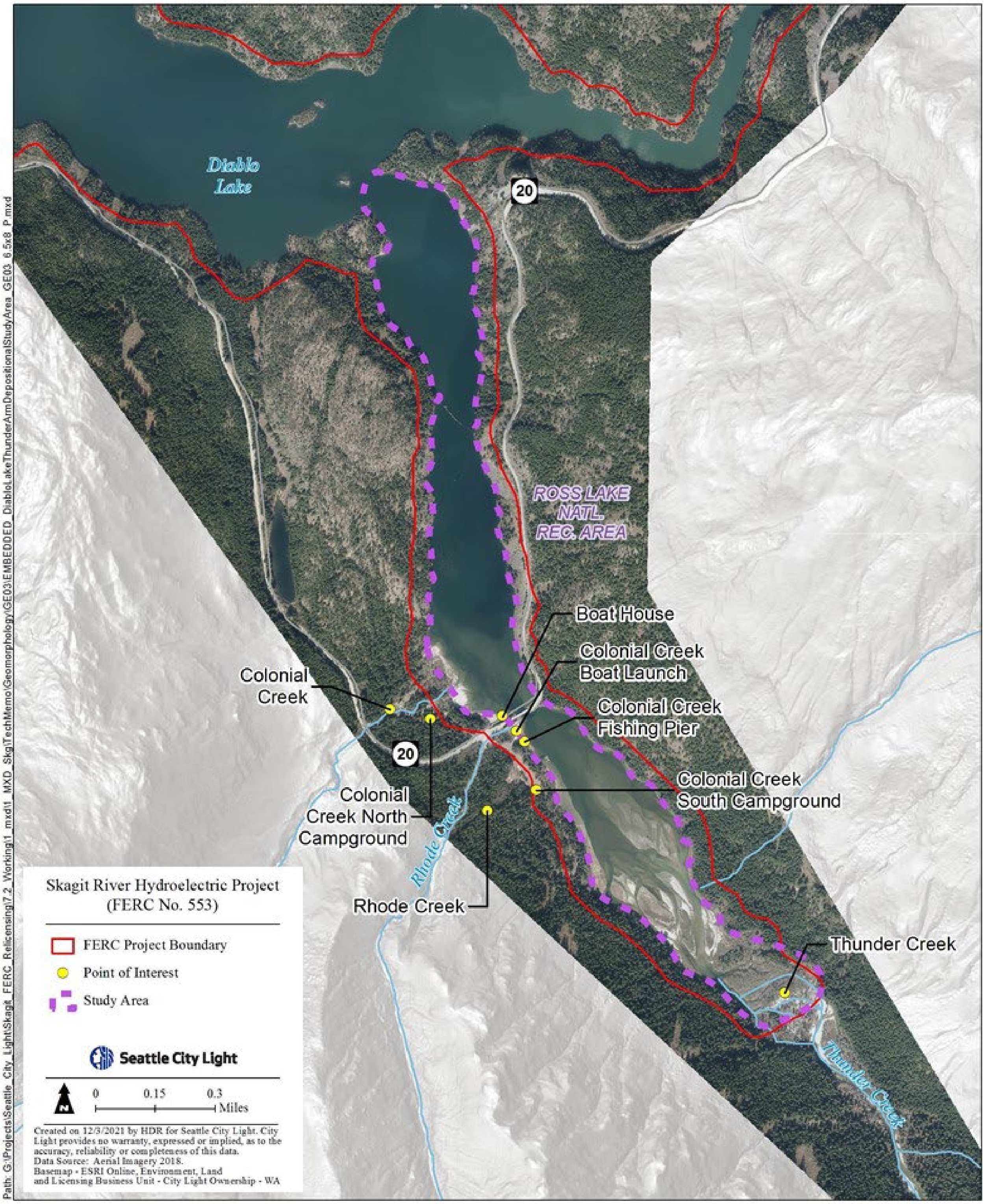


Figure 4.2.1-15. Study Area 2 – Diablo Lake – Thunder Arm inlet, with Colonial Creek Boat Launch/Dock.

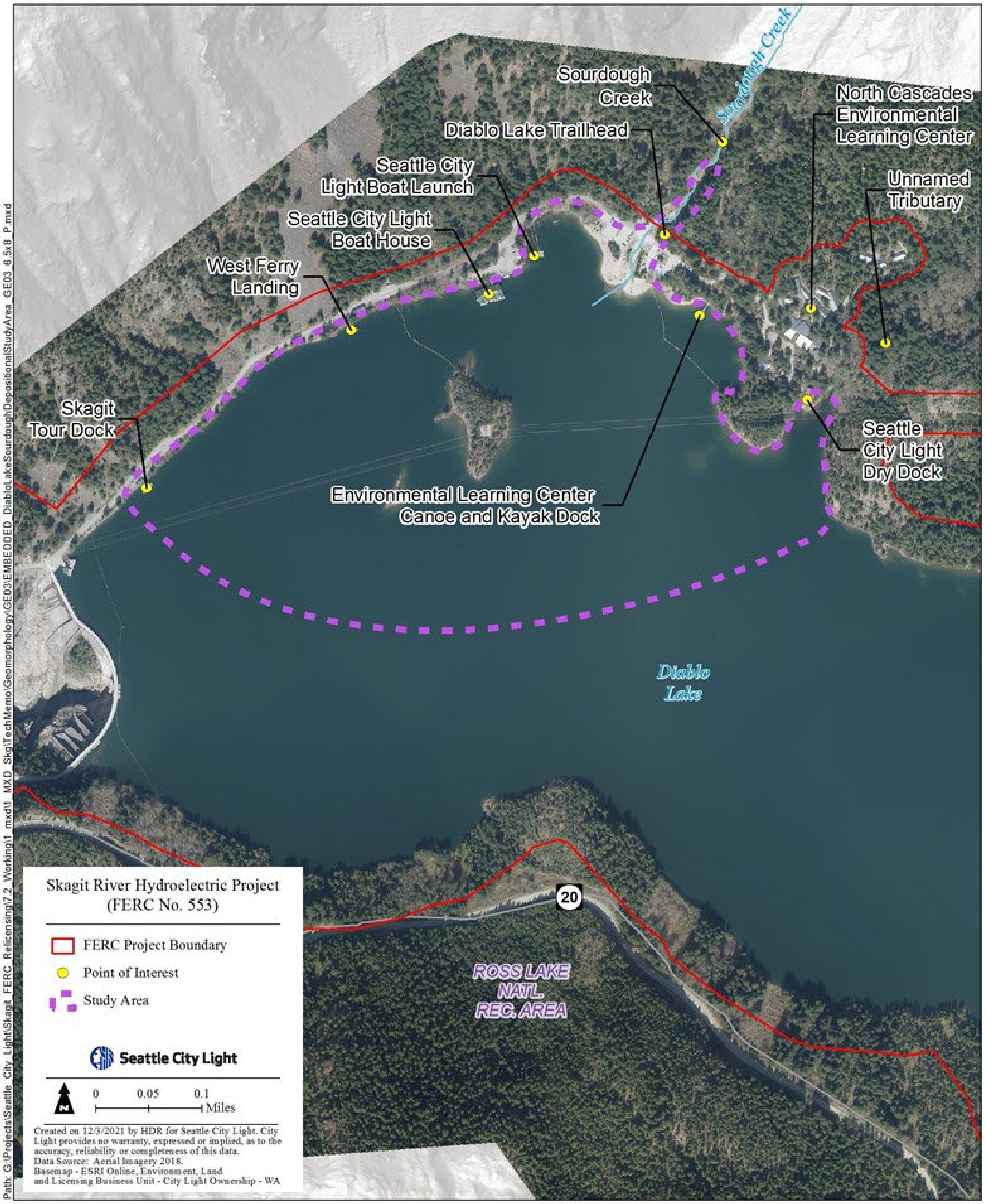


Figure 4.2.1-16. Study Area 3 – Diablo Lake – Sourdough Creek inlet with City Light Boat Launch, City Light Boat House, City Light Dry Dock, West Ferry Landing, Environmental Learning Center Canoe and Kayak Dock, and Skagit Tour Dock.

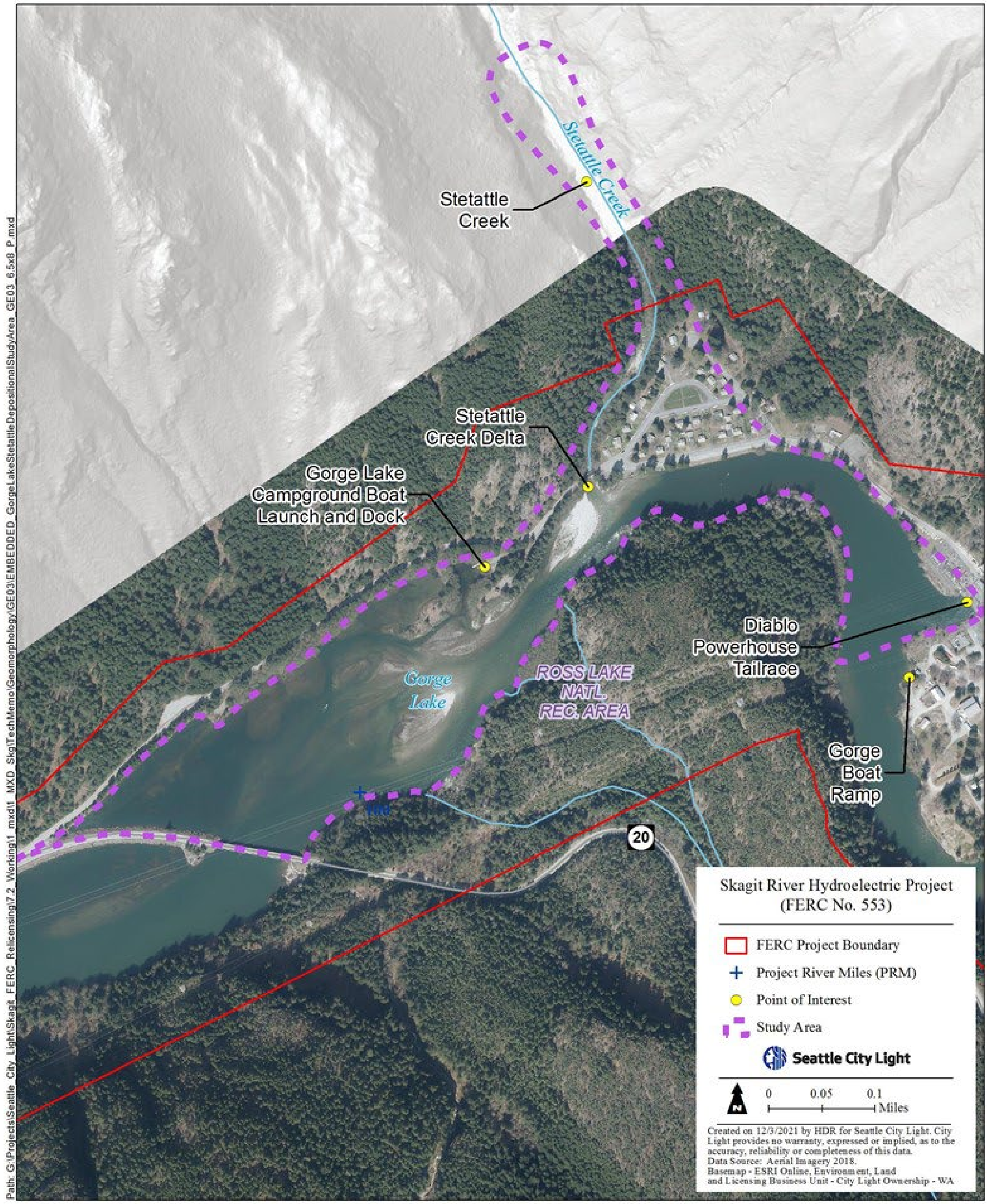


Figure 4.2.1-17. Study Area 4 – Gorge Lake - Stetattle Creek delta, with Gorge Lake Campground Boat Launch and Dock, Stetattle delta deposit, and Diablo Powerhouse tailrace.

Methods

Existing maps, data, historical aerial photographs, and LiDAR data were reviewed. Surficial sediment size was mapped during field visits based on visual observation for exposed sediment and areas in shallow water where substrate size could be observed. Dominant and sub-dominant size classes were recorded using the following categories: boulder, cobble, gravel, sand, and fines (silt/clay). The mapping was supplemented by pebble counts. Field data and LiDAR were used to develop longitudinal profiles of the streams.

Hozomeen Area – Hydrology and Sediment Description

Hydrology and Sediment

The Skagit River upstream from Ross Lake has a drainage area of approximately 380 square miles (sq. mi.). Flows are highest from May to July in response to snowmelt, with the highest peaks in June. Water surface elevation in Ross Lake varies seasonally in response to inflow, outflow, and power needs. Ross Lake is drawn down as much as 120 feet seasonally, with normal maximum water surface elevation generally maintained between July 31 and Labor Day each year.

Surficial substrate in the Hozomeen area is primarily fine-grained sediment (silt/clay) with areas of boulder/cobble/gravel around the margins of the lake that are subject to wave activity during the summer months (Figure 4.1.2-18). There is gravel, sand, and some cobble material in stream and river channels within the area. Based on observations of exposed tree stumps, most of the area showed little evidence of deposition or erosion (Figure 4.1.2-19). Fine-grained deposition of 1 foot to 4 feet was observed along the main Skagit River channel in two areas based on tree stump exposure.

The low levels of deposition at the upper end of Ross Lake suggest either that sediment input from the Skagit River is relatively low or that sediment is deposited at elevations lower than those during the field inventory (1,590.26 feet NAVD 88 [1,584 feet CoSD]).

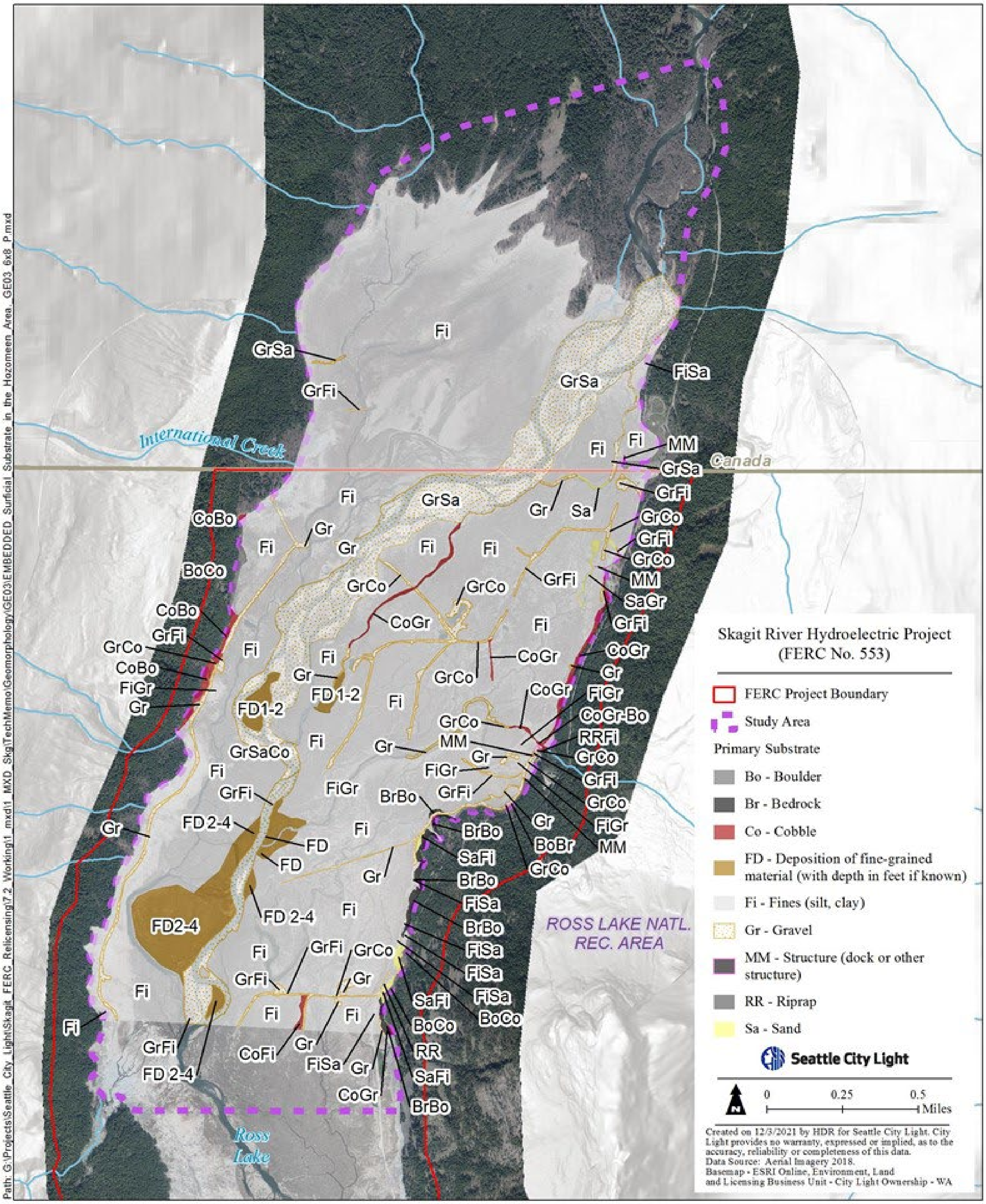


Figure 4.2.1-18. Surficial substrate in the Hozomeen area.


Fine-grained substrate with old gravel road in foreground


Deposition around tree stumps

Figure 4.2.1-19. Photos of substrate in the Hozomeen area.

Thunder Arm Area – Hydrology and Sediment Description

Hydrology and Sediment

Thunder Arm is a long, narrow embayment on the south side of Diablo Lake (Figure 4.1.2-20). The arm is crossed by SR 20. The Colonial Creek Campground is located on the western shore of Thunder Arm; sediment deposition limits usefulness of the boat launch and boat house within the campground complex.

There are three primary sources of inflow and sediment to Thunder Arm: Thunder Creek, Rhode Creek, and Colonial Creek. Thunder Creek drains a large watershed that includes runoff from 51 glaciers (12.8 percent of the basin; Chennault 2004). The glaciers contribute fine-grained sediment to the runoff, particularly during the summer and early fall. Rhode Creek and Colonial Creek are steep streams that have built alluvial fans on the western shores of Thunder Arm. The volume of sediment input and location of sediment deposition in Thunder Arm is dependent on incoming sediment carried by streams and lake levels in Diablo Lake.

Thunder Creek has a drainage area of approximately 105 square miles. Mean daily flows in Thunder Creek are highest from May through July in response to snowmelt. Glacial melt keeps flows relatively high through October in contrast to non-glacial streams in the Pacific Northwest. Lowest flows generally occur in February and March when much of the watershed is covered in snow. In addition to suspended sediment carried from glacial sources during normal daily flows, high flow events have enough energy to transport coarser gravel and cobble as bedload.

Surficial sediment in Thunder Arm is dominated by fine-grained sediment in the main part of the arm (Figure 4.2.1-21). The fine sediment grades in Thunder Arm upstream to sand and then gravel and cobble where Thunder Creek enters the lake forming a delta. The Rhode Creek alluvial fan is also building out into Diablo Lake and grades from boulder to cobble to gravel to sand in a downstream direction. Rhode Creek fan deposits occur on both sides of SR 20. Colonial Creek has a wider fan with cobble and gravel in areas that are currently active and gravel and sand in areas of past deposition.

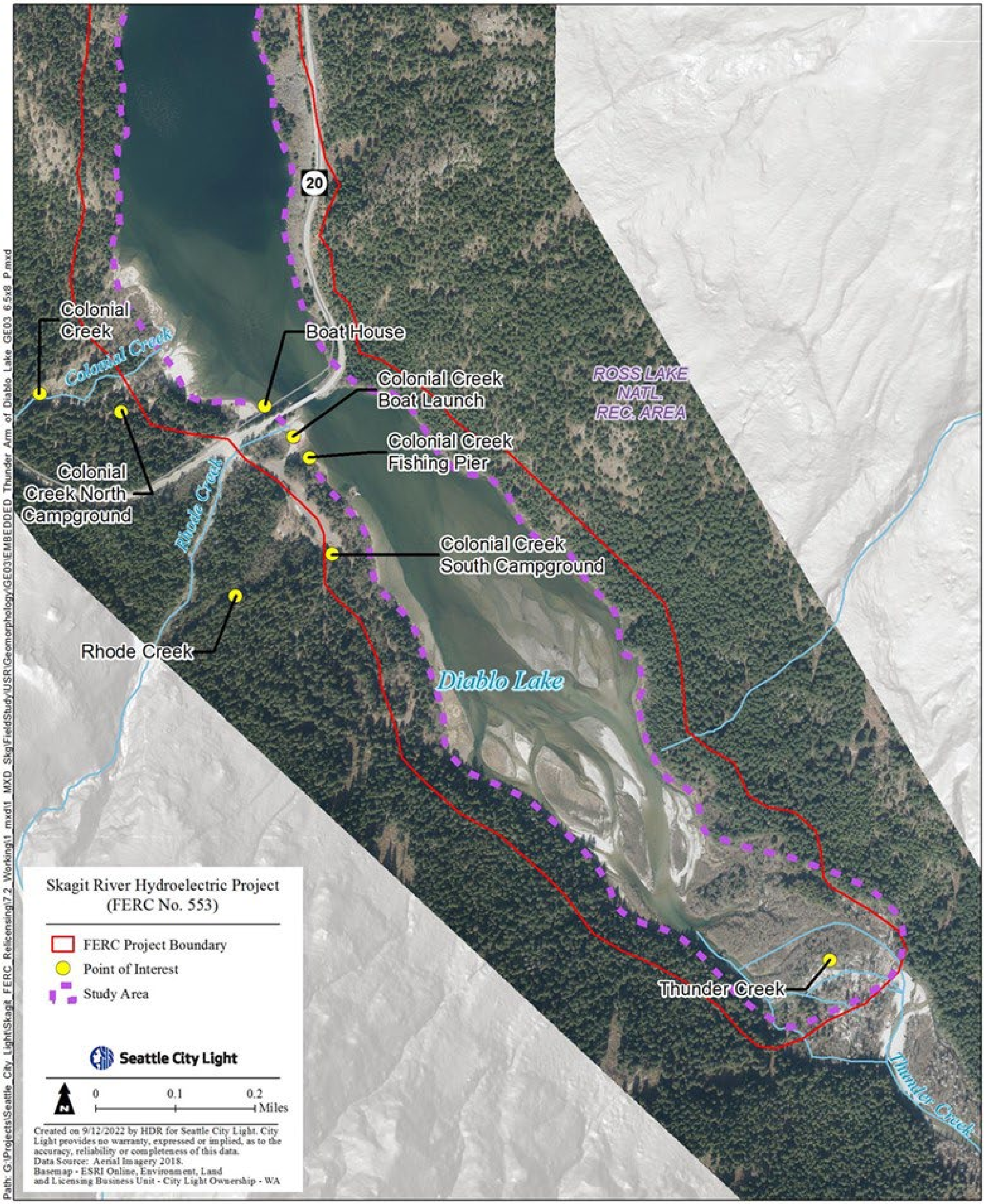


Figure 4.2.1-20. Thunder Arm of Diablo Lake.

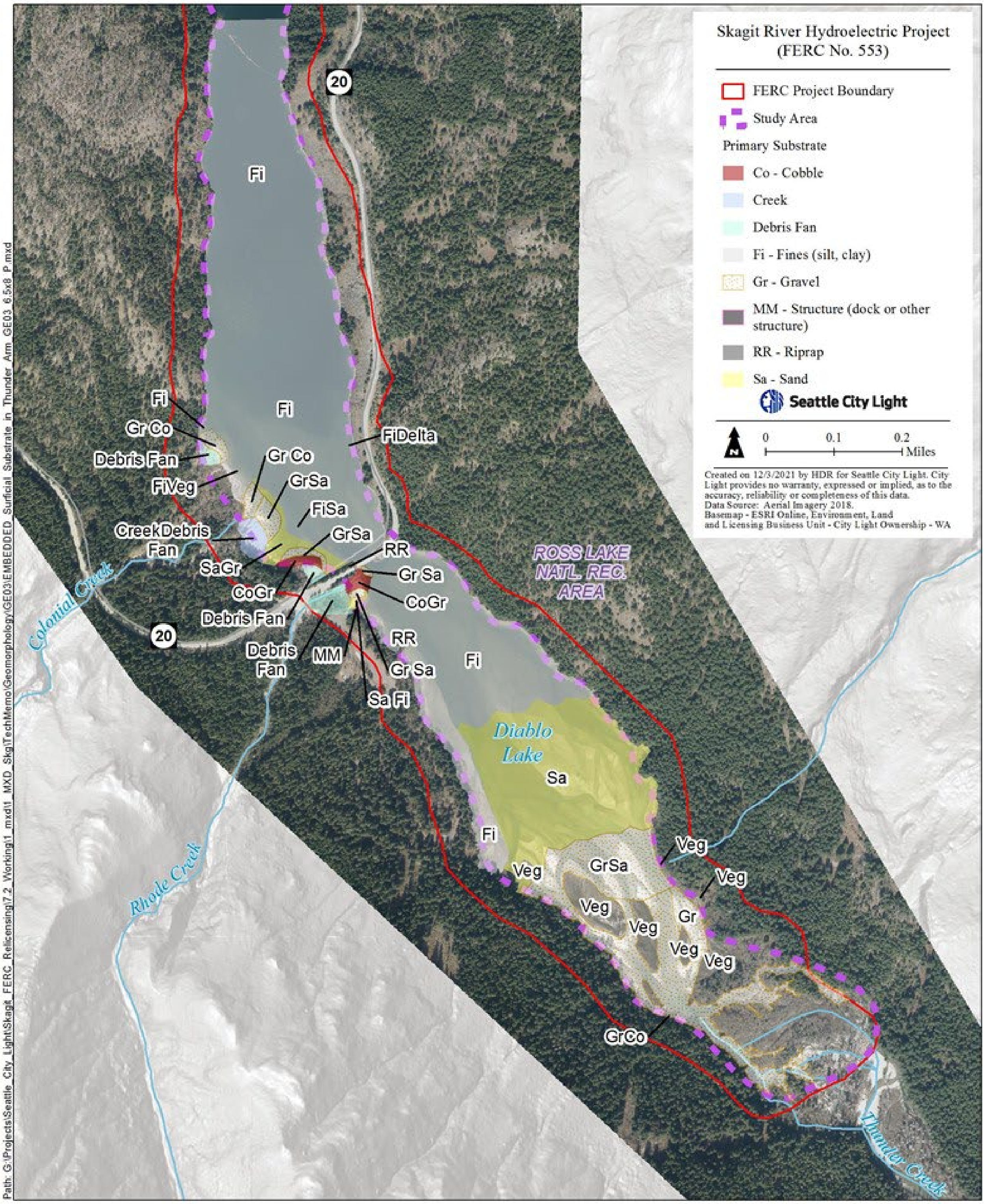


Figure 4.2.1-21. Surficial substrate in Thunder Arm.

Sourdough Creek – Hydrology and Sediment Description

Hydrology and Sediment

Sourdough Creek is a tributary to the north side of Diablo Lake between the City Light boathouse and the ELC. Facilities in the area include the City Light boathouse, boat ramp, and barge loading dock; parking areas for public use; and ELC boating facilities. Sourdough Creek is a high gradient (10 percent) stream that has formed an alluvial fan; the parking lots are built on past fan deposits (Figure 4.2.1-22). A vented ford was constructed across Sourdough Creek between 2006 and 2009 and is maintained by City Light through an amended Memorandum of Agreement with the NPS.

Surficial substrate in Sourdough Creek includes boulder, cobble, and gravel material and generally fines in a downstream direction from boulder/cobble upstream of the road crossing to gravel in Diablo Lake. Substrate becomes finer off the face of the delta, with sand grading to silt and clay in the main body of the lake. Pebble counts in Sourdough Creek and the delta confirmed the fining-downstream pattern and were dominated by cobble and gravel-sized particles with boulders in the stream and sand in the delta area. Median grain diameter ranged from 50 millimeters (mm) in the stream to 11 mm in the finer-grained delta sample.

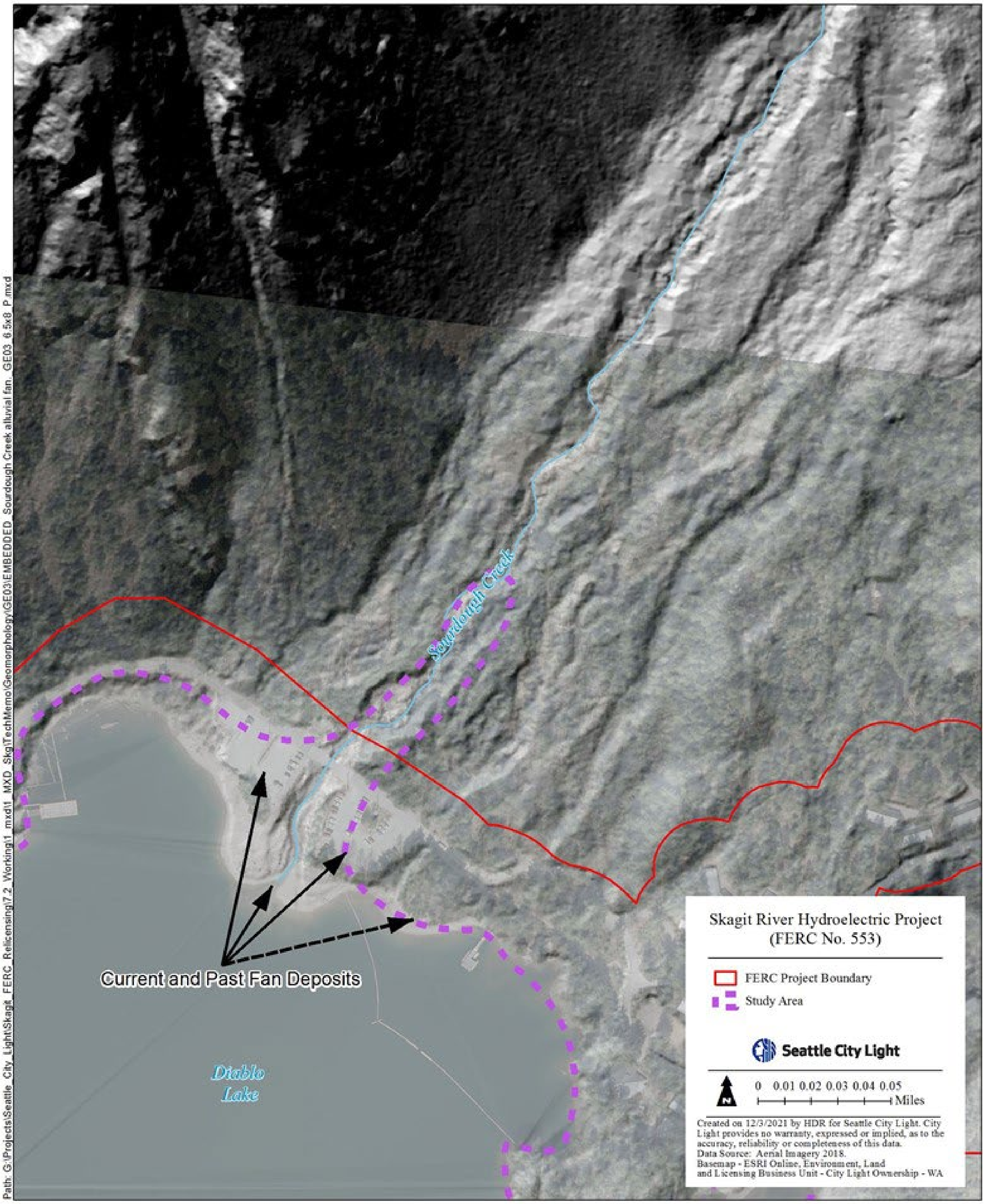


Figure 4.2.1-22. Sourdough Creek alluvial fan.

Stetattle Creek

Hydrology and Sediment

The Stetattle Creek watershed encompasses 22.8 square miles. The basin is within the RLNRA and is primarily undeveloped except for hiking trails and the Hollywood residential area, which is located on the historic alluvial fan at the mouth of the creek. Geologic units include gneiss, orthogneiss, and schist, which 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. Stetattle Creek is a relatively steep tributary to the Skagit River with an average gradient of 2 percent near the confluence with the Skagit River (Figure 4.2.1-23). Gradient generally increases in an upstream direction with an average gradient of 6 percent in the middle reaches and over 30 percent in the headwaters. The high gradient results in transport of coarse-grained material, up to boulder size, through the stream and into the Stetattle Creek delta in the Project vicinity. The Skagit River near the confluence with Stetattle Creek is relatively low gradient, with an average gradient of less than 0.1 percent between SR 20 and the powerhouse and with a local maximum gradient of 0.3 percent at the Stetattle Creek confluence.

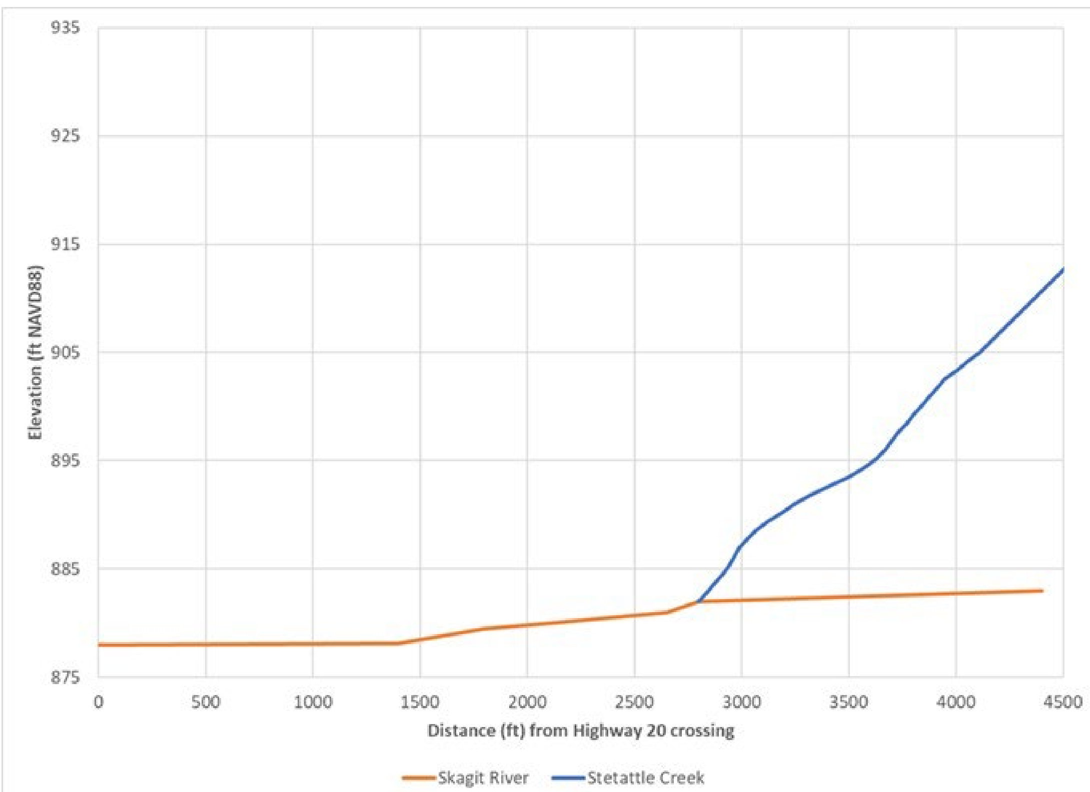


Figure 4.2.1-23. Skagit River and Stetattle Creek profiles (elevations in NAVD 88).

Transport and deposition of sediment in Stetattle Creek and the Skagit River is controlled by stream/river flow rates and the elevation of Gorge Lake. Mean monthly flows over the period of record (1933-1982) ranged from 100 cubic feet per second (cfs) in March to over 350 cfs in June and were generally highest during snowmelt (May-June-July) and lowest in September and March when either rainfall is lowest (September) or just prior to snowmelt (March). Daily flows in Stetattle Creek vary depending upon recent precipitation and snowmelt patterns, and they generally follow the mean monthly flow pattern with variations for rainfall or snowmelt events.

Bedload transport and geomorphic change occur primarily during high flow conditions when velocities are high enough to transport coarse-grained material on the streambed. Annual peak flows in Stetattle Creek for the period of record (1933-1982) ranged from less than 1,000 cfs to over 9,000 cfs, with the highest peak flows occurring in November and December as a result of rain-on-snow events and more moderate peak flows occurring as a result of rainstorms from October through February or snowmelt during June and July.

Gorge Lake elevation varies based on operations of Gorge Powerhouse. Under current conditions, Gorge Lake generally varies between approximate elevation of 876.5-882.5 feet NAVD 88 (approximately 870-876 feet CoSD).

<u>Sediment Transport Analysis - Stetattle Creek</u>

In Stetattle Creek, output from a two-dimensional (2-D) hydraulic model of the Project vicinity was used to calculate sediment transport potential based on critical shear stress of particles that could be entrained under a given flow within the lower 0.5 miles of Stetattle Creek and within the Skagit River near the confluence with Stetattle Creek.

4.2.1.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on geology and soils in the Project area. These effects include erosion, sedimentation, and mass wasting. The effects are organized below to address requests in FERC's Scoping Document 2 (SD2).

Reservoir Shoreline Erosion

Effects of any proposed project construction and recreation-related activities on soil erosion and sedimentation (FERC SD2).

Effects of existing and any potential changes in project facilities and operation on shoreline stability of the reservoirs and streambanks and aggradation and degradation of in-channel substrates of tributaries to the project reservoirs and the Skagit River (FERC SD2).

GE-01 Reservoir Shoreline Erosion Study Results

Ross Lake is drawn down seasonally up to 120 feet for flood risk management storage and to capture spring runoff. As a result, areas within the Ross Lake drawdown zone are subject to subaerial erosion processes and intermittent wave erosion. 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. As a result, areas below normal maximum water surface elevation in Diablo and Gorge are rarely subject to erosive forces.

Results of the GE-01 Reservoir Shoreline Erosion Study indicate that the primary erosive forces influencing reservoir shoreline erosion in the study area include wave action, reservoir fluctuations, frost heave/creep, saturated soils/seeps, recreation use/trampling, road runoff, and shoreline development.

Field Inventory Results

Erosion Sites

Eroding areas were classified by bank height (see Table 4.2.1-12), which was measured as height of bank above normal maximum water surface elevation. Bank heights ranged from 3 feet up to 150 feet at one large slide location. In both Ross and Diablo lakes, the majority of eroding shorelines were 5-15 feet high. Higher bank heights are generally indicative of higher volumes of past erosion, although in a few areas of raveling, thin layers of colluvium are raveling far up the slope and result in a high bank height without a large volume of past erosion.

Table 4.2.1-12. Number of erosion sites and length (ft) and percentage of total shoreline eroding in 2021-2022 by bank height category.

Bank Height Category	Ross Lake	Diablo Lake	Gorge Lake[1]
Over 15 feet	76 sites; 18,684 ft (5%)	13 sites; 1,164 (1%)	4 sites; 688 (1%)
5-15 feet	166 sites; 43,492 ft (11%)	30 sites; 3,392 (3%)	9 sites; 3,186 (5%)
Up to 5 feet	61 sites; 12,096 ft (3%)	0	0
Total	**306 sites; 74,272 ft (19%)**	**43 sites; 4,556 (4%)**	**13 sites; 3,874 (6%)**

1 Gorge Lake includes riverine shoreline upstream from Stetattle Creek. This area was not included in the 1990 survey. The riverine section adds 1,555 feet of eroding shoreline. Gorge shoreline length without riverine section is 1,728 feet.

Areas underlain by competent bedrock are not erodible; those underlain by unconsolidated deposits are most erodible. Many of the erosion sites in both Ross and Diablo lakes had a mix of unconsolidated and difficult-to-differentiate loose till, colluvium, and outwash—in these locations a primary geologic type was chosen, and second and third geologic types were also recorded. In some locations, the till was consolidated (e.g., lodgment till) and quite resistant to erosion, forming caves and vertical banks. In Ross Lake, till and colluvium dominated areas with eroding banks (96 percent of eroding length). Small amounts of talus on debris cones were also eroding, primarily along the edges of the cones. In Diablo Lake, till and colluvium dominated eroding banks (84 percent of eroding length). Road fill underlays 10 percent of the eroding banks with 4 percent talus and 2 percent stream alluvium. On Gorge Lake, road fill along the river shores in the Diablo/Hollywood townsites accounted for 55 percent of the eroding length, with alluvial fan/alluvial deltas (37 percent), colluvium (6 percent), and talus (2 percent) also eroding.

The primary cause of erosion in Ross and Diablo lakes is wave action, which removes material at the toe of banks and transports it down into the lake as reservoir water surface elevations fluctuate. As noted in the 1990 report, this movement of material from the toe of the bank during reservoir fluctuations does not allow a stable shoreline to develop, in some locations particularly in areas where there is a steep slope below the eroding bluff. The seasonal reservoir fluctuations in Ross Lake are likely a contributing factor to the ongoing shoreline erosion—there was little reduction in total eroding shoreline length between the 1990 and 2021 inventory in Ross Lake (3 percent decrease) compared to Diablo Lake, which has relatively stable water surface elevations and had a 76 percent decrease in length of eroding shoreline. On Gorge Lake, stream erosion was the dominant factor causing shoreline erosion; most eroding areas were in the riverine section of Gorge Lake or in recent alluvial fan deposits (likely from the November 2021 flood event) that were eroding. Reservoir fluctuations and wave action were contributing factors at a few locations.

In a few locations, recreational use, road runoff, shoreline development, and seepage contributed to bank erosion. It is likely that freeze-thaw activity also contributes to erosion, but since the sites were visited in the summer this mechanism was not observed directly.

Sites with Existing Erosion Control Measures

The GE-01 Reservoir Shoreline Erosion Study inventory evaluated thirty-two sites where erosion control measures have been implemented —29 sites on Ross Lake and 3 sites on Diablo Lake (see Figure 4.2.1-6 in Section 4.2.1.1 of this Exhibit E). Observations made at each site are included in Table 4.2.1-7 above. Except as noted below, the erosion control measures are in good condition and continue to function to minimize erosion with only minor maintenance required, such as providing fill around the base rocks at walls or dock footings.

Three sites need major repairs, including McMillan Campsite (site E-40; rock wall is failing); the Desolation Trailhead (site E-150; rock wall has almost totally failed and is eroding), and the rock wall and stairs at Little Beaver Campsite (site W-124 needs base support).

Bank Retreat Rates

The average bank retreat rates using the aerial photograph and NPS field measurement methods (described in Section 4.2.1.1 of this Exhibit E) were compared at the five NPS erosion monitoring sites (Table 4.2.1-13). There was relatively good agreement between the average rates using the two methods, which provides confidence that the bank retreat rates measured from aerial photographs can be applied to estimate total bank retreat between 1990 and 2018 at sites along the entire reservoir, and confidence that sites with no bank retreat measured from the aerial photograph analysis likely have very low erosion rates.

Table 4.2.1-13. Comparison of aerial photograph and NPS field measurements of bank retreat.

2021 Site ID	NPS 1990 Site ID	Geology	Average bank retreat from aerial photographs 1990-2018 (ft)	NPS field measured bank retreat 1994-2018 (ft)
2011	E9	Till (unconsolidated)	21	18
2072g	W63	Till (unconsolidated)	13	18
2084c	E55	Till/outwash (unconsolidated)	3-18	14
2163	E99	Colluvium	0	5
2077	W78	Till (consolidated)	0	1

<u>Ross Lake Drawdown Study (2022 Field Study)</u>

Observations during the field inventory suggest that there are site-specific factors, primarily small-scale topographic features, affecting erosion at most transects. These site-specific factors likely override any general trends when all the data are grouped together. Generally, the most erosion at a given transect was observed at higher elevations (where the lake surface intersects most frequently) or in parts of the drawdown zone that are exposed to long fetch distances. Deposition occurs at tributary deltas and below the normal low drawdown elevation. The most erosion/greatest root crown heights observed anywhere in the Ross Lake drawdown zone was at the shoulder of slopes where a flatter upper terrace curves downwards. These shoulder areas occur at any elevation and have a lower slope gradient than the adjacent steeper hillsides; inclusion of these data in the overall data set are likely one reason trends with elevation or slope gradient are indiscernible.

The stump transects/markers established during the 2022 field season will provide a more consistent method for monitoring future erosion in the Ross Lake drawdown zone. The lack of correlation among factors that are hypothesized to influence erosion using the entire root crown height dataset emphasizes the need for assessing site-specific factors at each area where erosion (or deposition) is a concern for other resources.

GE-02 Erosion and Geologic Hazards at the Project Facilities and Transmission line Right-of-Way

Effects of project operation and maintenance activities on soil erosion, sedimentation, and mass wasting along access roads and the transmission line corridor (FERC SD2).

Mass Wasting Study Results

A total of 67 sites were identified as Sites of Special Concern within the Project Boundary where Project facilities overlap or are located nearby multiple mapped mass wasting features and areas of high susceptibility. Where sites spatially cluster, zones called Zones of Special Concern were identified and included in Attachment E of the GE-02 Erosion and Geologic Hazards Study Interim Report (City Light 2022b). For example, two Zones of Special Concern delineate areas of high mass wasting feature concentrations that coincide with Project facilities. Slopes along the Skagit River between Rockport and City Light's Skagit River Project are mostly rocky and steep with local glacial and colluvial deposits concentrated in the catchment areas of drainages and swales. Based on the Mass Wasting Inventory, rockfall is the dominant mass wasting process along the Skagit slopes. However, steep drainages incised in the slopes provide effective debris flow chutes that rapidly transport colluvium from source areas near the ridge tops to the base of the slopes, where most infrastructure is concentrated, including SR 20 and the City Light transmission line.

Deep-seated landslides tend to be less common in the upper Skagit River Valley than in the rest of the mass wasting study area, but, where they have occurred, they often take the form of large, highly mobile rock avalanches, which are among the most damaging types of mass wasting events. In the Sauk River Valley, between Darrington and the Suiattle River, slopes composed of Darrington Phyllite or Chilliwack Group rocks are largely classified as moderate to high susceptibility. North of the Suiattle River, slopes along the west side of the Sauk River are classified as moderate susceptibility zones, although there are far fewer landslides.

To the south and west, mass wasting in the NF Stillaguamish River Valley reflects the unique signature of the area's glacial history. The NF Stillaguamish River Valley includes broad swaths of glacial deposits that tend to be susceptible to deep-seated landslides. The pattern of permeable sandy outwash over fine-grained glaciolacustrine soil generates a perched water table that has likely contributed to the hundreds of deep-seated landslide deposits that line the valley margins. The 2014 Oso landslide demonstrated the ability of glacial stratigraphy of the NF Stillaguamish River to generate catastrophic, extremely rapid flow-type landslides.

Erosion and Runoff from Project-Related Townsites and Study Routes Summary

Phase I Study Route Inventory

A total of 264 study route segments that drained to waterbodies were identified along with 303 culverts, 17 bridges, and 8 mass wasting sites along the study routes (four of the stream crossings were fords). Of the segments that drained to waterbodies, 138 drained directly to a waterbody, 114 drained to the forest floor within 100 feet of a waterbody, and 12 were between 100 and 200 feet away from a waterbody. The majority of these study route segments (167) drained to streams, 31 to lakes/ponds, 59 to wetlands, and the remainder to other locations, such as storm drains in townsites.

The culvert inventory included both stream crossing culverts and relief culverts. The majority were corrugated metal pipes or high-density polyethylene, but a few cast iron, concrete, and one wood stave pipe were found. There were also 3 arch pipes and 23 road drains inventoried. The majority of culverts were 18-inch diameter pipes, with 12-, 24-, 36-, 48-inch, and larger diameter pipes as well. The majority (67 percent) of culvert inlets were clear but 28 of the culverts had inlets that were over halfway blocked by debris or sediment. Outlet blockages were less common, with 79 percent of the culverts having no outlet blockage and seven percent (22 culvert outlets) that were over halfway blocked. Seventy-two percent of the culverts had no physical or functional issues. The most common issues were crushed inlets/outlets (10 percent), rusted pipes (10 percent), bent pipes (4 percent), catch basins full of sediment (7 percent), and negative slopes (2 percent; culverts sloping upstream).

No issues were noted at the 17 bridge locations.

Of the eight mass wasting locations identified along the inventoried study routes, six were active, with one inactive and one potential site noted. Three sites had a high treatment urgency. Potential treatments include revegetation, pulling back fill, replacing the retaining wall/buttress, and adding mesh to help control falling and raveling rocks. These mass wasting sites are generally small features on route cutslopes or fillslopes and are not large enough to be recognized in the regional-scale mass wasting analysis.

For the Washington Road Surface Erosion Model (WARSEM) analysis, study route segments were grouped by road/trail name or, in the case of the transmission line ROW, by general location area (Dubé et al. 2004). Study routes with the longest length draining directly to a stream, lake, or wetland were the transmission line ROW routes in the Darrington, Arlington, and Skagit areas and the study route system connecting Ross Dam to Diablo Lake. Study routes predicted to deliver the most sediment to streams were the Ross Dam to Diablo Lake Road (90-435 tons/year) and the ROW roads/trails in the Sauk (27.4 tons/year), Skagit (26.8 tons/year), Darrington (16.8 tons/year) areas (Table 4.2.1-14). Sediment input from all remaining 17 areas ranged from < 0.1 to 10.6 tons/year with most being < 2.1 tons/year (14 areas).

Table 4.2.1-14. Study route lengths hydrologically connected to waterbodies and estimated sediment delivery.

Study Route Location Area[1]	Study Route Segment Length (ft)			Estimated Average Annual Sediment Delivered to a Waterbody (tons/year)
	Drains Directly to Waterbody	1-100 ft from Waterbody	100-200 ft from Waterbody	
Newhalem Ponds	0	824	54	1.4
Babcock Creek	2,844	841	0	10.6
Diablo Dam	339	2,379	0	<0.1
Diablo Road	2	0	0	<0.1
Diablo Village	0	2,577	0	0.5
Gorge Dam Road West	0	121	817	1.2
Illabot Creek	2,722	228	0	8.3
Newhalem Facilities	0	201	0	1.1
Newhalem Trails	83	139	0	<0.1
Newhalem Village	0	1,964	0	<0.1
Ross Dam to Diablo Lake	5,960	470	190	90-435
Rumsey Creek	0	286	0	<0.1
Skagit Transmission Line ROW	8,546	10,011	426	26.8
Stetattle Creek/ Hollywood	0	1,138	0	<0.1
Transmission Line ROW Arlington	8,143	1,812	85	1.1
Transmission Line ROW Darrington	12,281	7,755	1,965	16.8
Transmission Line ROW Illabot	1,038	687	0	2.1
Transmission Line ROW Mill-Snohomish	1,138	0	0	1.4
Transmission Line ROW Sauk	4,135	0	0	27.4
Transmission Line ROW Stevens	636	1,609	0	0.1
Transmission Line ROW Ross-Diablo	2,984	0	69	10.2

1 Refer to maps in the GE-02 Erosion and Geologic Hazards Study Interim Report (City Light 2022b) for location areas.

GE-03 Sediment Deposition in Reservoirs Affecting Resource Areas of Concern

Hozomeen Area

Surficial substrate in the Hozomeen area is primarily fine-grained sediment (silt/clay) with areas of boulder/cobble/gravel around the margins of the lake that are subject to wave activity during the summer months as described in Section 4.2.1.1 of this Exhibit E. There is gravel, sand, and some cobble material in stream and river channels within the area. Based on observations of exposed tree stumps, most of the area showed little evidence of deposition or erosion.

The two public boat launches within the United States in the Hozomeen area were visited to determine if sediment deposition was occurring in the vicinity of the ramps. The end of the Hozomeen ramp has been excavated to allow boat access; there does not appear to be substantial recent deposition in the area.

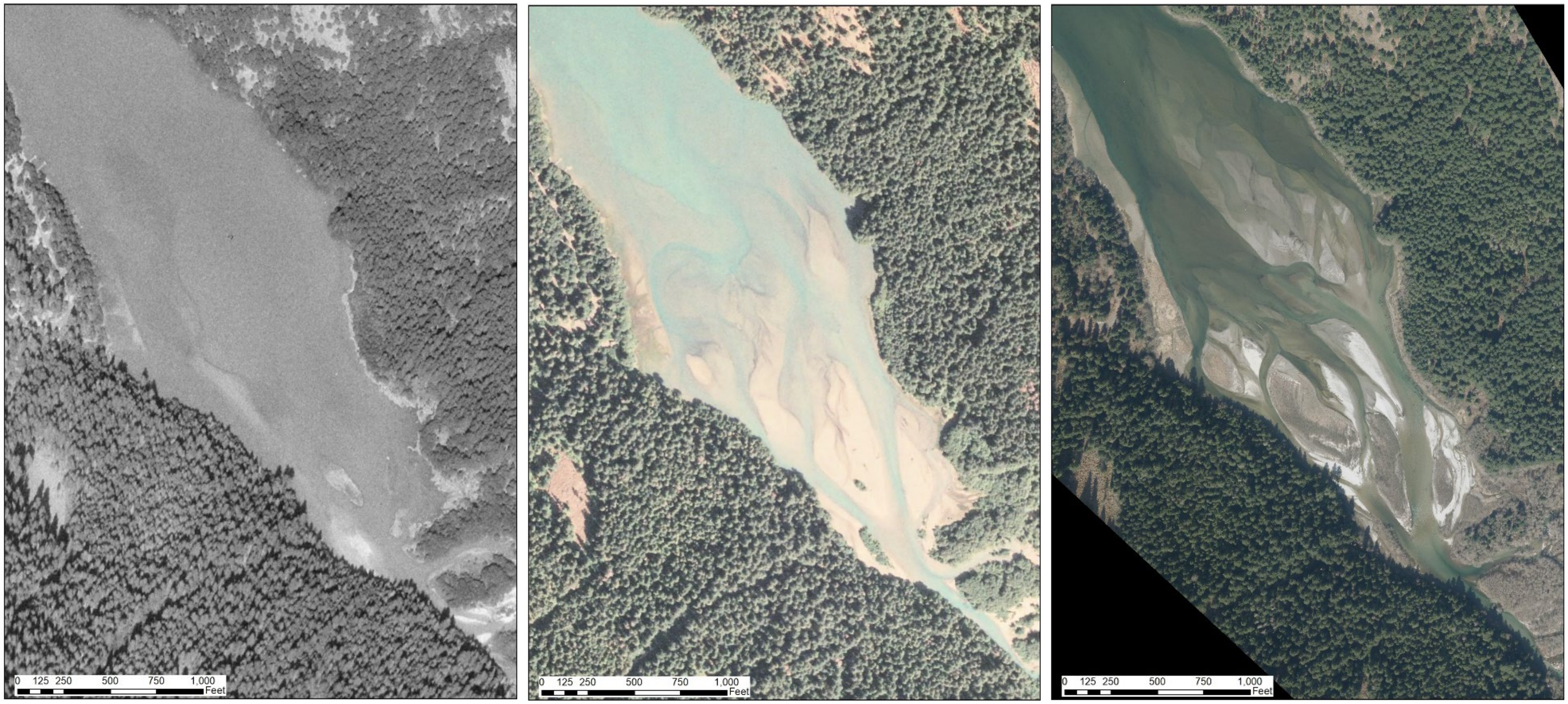
Thunder Arm Area

<u>Changes through Time</u>

Three sets of aerial photographs (1990, 2006, and 2018) were compared to determine how deposits in Thunder Arm changed through time. The October 20, 2003 peak flow event (17,800 cfs instantaneous peak—largest flow on record) resulted in substantial areas of deposition in Thunder Arm. Many bars developed in the Thunder Creek delta at the confluence of the creek and Diablo Lake, and a large log jam filled the northern meander bend at the mouth of the stream as seen in the 2006 aerial photographs. Deposition in the delta continued through time resulting in the formation of vegetated islands at the upper end of the delta and additional deposition in the delta by 2018 (Figure 4.2.1-24). The deposits from the 2003 flood appear to have resulted in aggradation within the stream. Some floodplain trees that were alive in the 1990 aerial photograph were dead in the 2006 photo. The zone of dead trees extends approximately 0.5 miles upstream from the high lake elevation and was mapped as North Pacific Lowland Riparian Forest and Woodland Group.

A longitudinal profile of Thunder Creek was compiled from 2018 LiDAR elevation data (Figure 4.2.1-25). The 2018 LiDAR includes topographic and bathymetric data, so it shows stream bed elevation including riffles and pools. The remnant 2006 sediment and wood deposits at the head of the lake can be seen between station 7,500 and 9,000. Future analysis of the extent of deposition and backwater effects in Thunder Creek is planned for 2022. Additional information will be provided in the USR and FLA.

Water surface elevation in Diablo Lake is generally held between 1,206.36 to 1,211.36 NAVD 88 (approximately 1,200 and 1,205 feet CoSD) and varies up to 5 feet daily in response to inflow, outflow, and power needs.



1990 2006 2018

Figure 4.2.1-24. Thunder Arm upper delta through time.

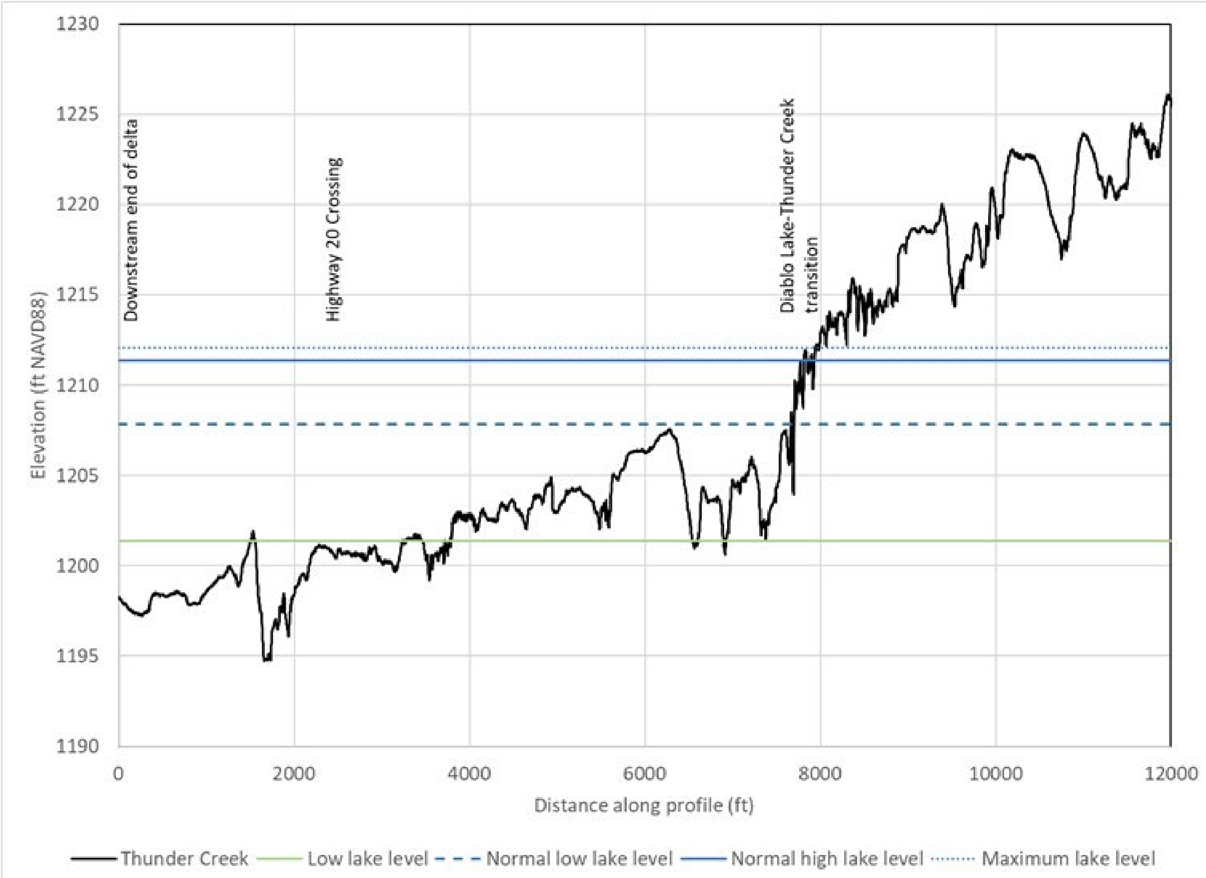


Figure 4.2.1-25. Thunder Creek profile (2018 LiDAR).

Colonial Creek Campground Boat House and Boat Ramp

Deposition at the Colonial Creek Campground Boat House and Boat Ramp limits the usefulness of these facilities, particularly at low lake levels. Observations at the facilities suggest that the primary source of sediment at both facilities is Rhode Creek. SR 20 and the Colonial Creek Campground southern entrance road are constructed in the depositional zone of the Rhode Creek fan. Alan Schoblom, the NPS Skagit District Maintenance Supervisor, has stated that during most fall/winter seasons sediment coming down Rhode Creek plugs the culvert under the campground entrance road (shown as an orange circle on Figure 4.2.1-26) and then splits, flowing over SR 20 toward the boathouse and over the campground access road toward the boat launch (Schoblom 2021). Typically, 50 to 100 cubic yards (cu yds) of sediment and debris are deposited during each event. Deposits in lake near the boathouse and boat ramp include gravel, sand, and fines (Figure 4.2.1-27).

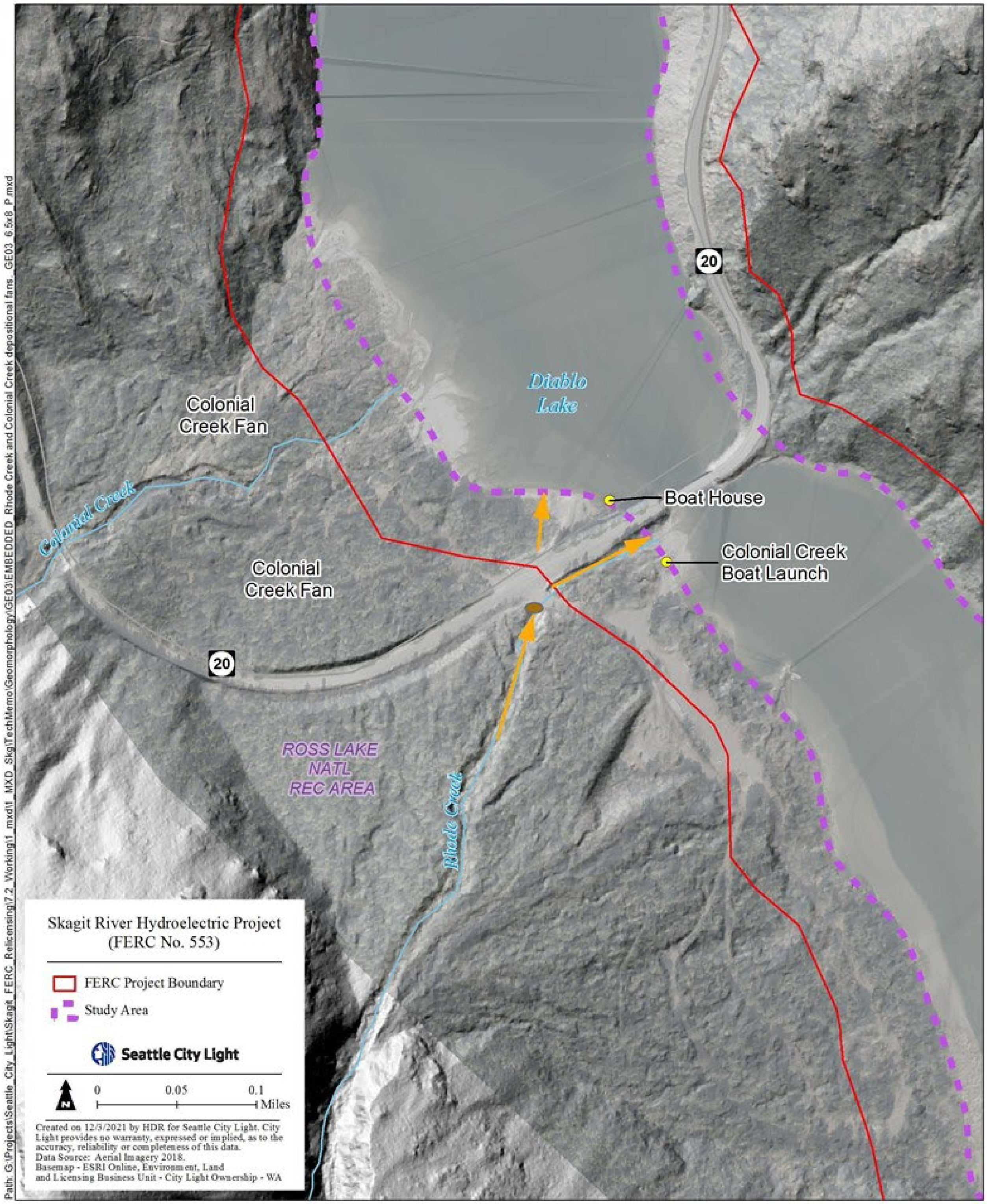


Figure 4.2.1-26. Rhode Creek and Colonial Creek depositional fans.

Figure 4.2.1-27. Rhode Creek deposition near the Colonial Creek boat ramp (photo dated 9/7/2021).

Sourdough Creek

Changes through Time

Three sets of aerial photographs were compared to determine how the Sourdough delta changes through time (Figure 4.2.1-28). The main Sourdough Creek channel has not substantially changed position since 1990. Between 2006 and 2019, a concrete crossing structure (vented ford) was constructed approximately 250 feet upstream from the mouth of Sourdough Creek with metal grates on the upstream side to help capture sediment and debris flows coming down the stream and to maintain vehicle access. This structure also provides a grade control. The stream has been confined to a single central channel since construction of the crossing structure and parking lots. NPS reports that most sediment and debris sluice through the structure, and it needs to be cleaned every few years (Schoblom 2021). A debris torrent and flooding event in fall 2021 caused extensive damage at and downstream of the vented ford on Sourdough Creek at the Project. Large volumes of small boulders, cobbles, and gravel were transported down Sourdough Creek in a debris torrent which filled the vented ford with sediment, covered the road, and caused a channel avulsion that damaged the shoreline access road and shoreline opposite the Diablo Boathouse. The event also caused changes in the alluvial fan and nearshore bathymetry in Diablo Lake. Debris blocked the road, which is the only access to the ELC, and flow through the vented ford.

City Light operations staff were later able to remove debris from the road and adjacent areas; however, this has not eliminated the risk of additional damage to the shoreline access road and shoreline areas from future flooding. The shoreline access road needs to be repaired to enable shoreline access for annual removal of large woody debris needed to ensure the continued safe operations of the Diablo Dam and Powerhouse.

1990 2006 2018

Figure 4.2.1-28. Changes through time, Sourdough delta.

A longitudinal profile of Sourdough Creek was compiled from LiDAR elevation data (upstream from the lake surface) supplemented with field-measured elevations within the lake since the available LiDAR data measured the surface elevation of Diablo Lake instead of the underwater portions of the delta (Figure 4.2.1-29). The steep gradient of the stream, coarse nature of the sediment supply, and grade control structure suggest that any backwater effects from Diablo Lake extend less than 100 feet upstream from the lake. No evidence of sediment or debris deposits were observed that suggest backwater effects extend farther upstream.

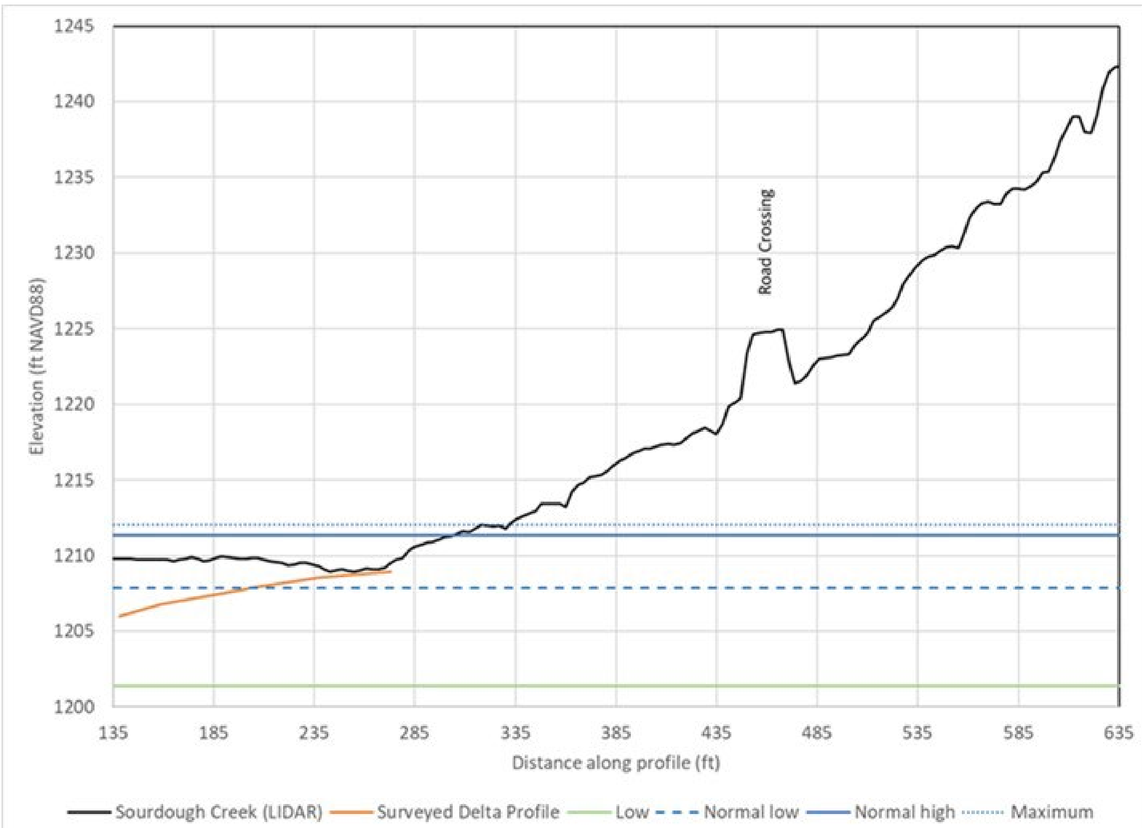


Figure 4.2.1-29. Sourdough Creek profile.

Stetattle Creek

<u>Diablo Powerhouse Flow and Spill</u>

Flow in the Skagit River at the confluence with Stetattle Creek is controlled by flow through the Diablo Powerhouse and spill over Diablo Dam.

Based on the 2-D hydraulic model, the current primary hydraulic control for the Diablo Dam tailwater is the constriction formed by the Stetattle Creek delta at the confluence with the Skagit River and, secondarily, the delta deposits formed further upstream of SR 20. The tailwater elevation has changed through time (Figure 4.2.1-30), with a substantial increase in tailwater elevation between 1999 and 2000 and another increase between 2003 and 2004. Both increases corresponded to large high flow events that likely caused a large input of sediment from Stetattle Creek that was deposited within the Skagit River. A high flow event in 2006 did not substantially change the tailwater elevation. Two test flushing spills occurred in June 2007 and resulted in a reduction in the tailwater elevation—a spill of 22,800 cfs on June 20, 2007 resulted in a 9-inch reduction in tailwater elevation, and a higher spill of 32,000 cfs on June 27, 2007 reduced the tailwater elevation by another 6 inches. The tailwater elevation has been declining slightly in the past few years.

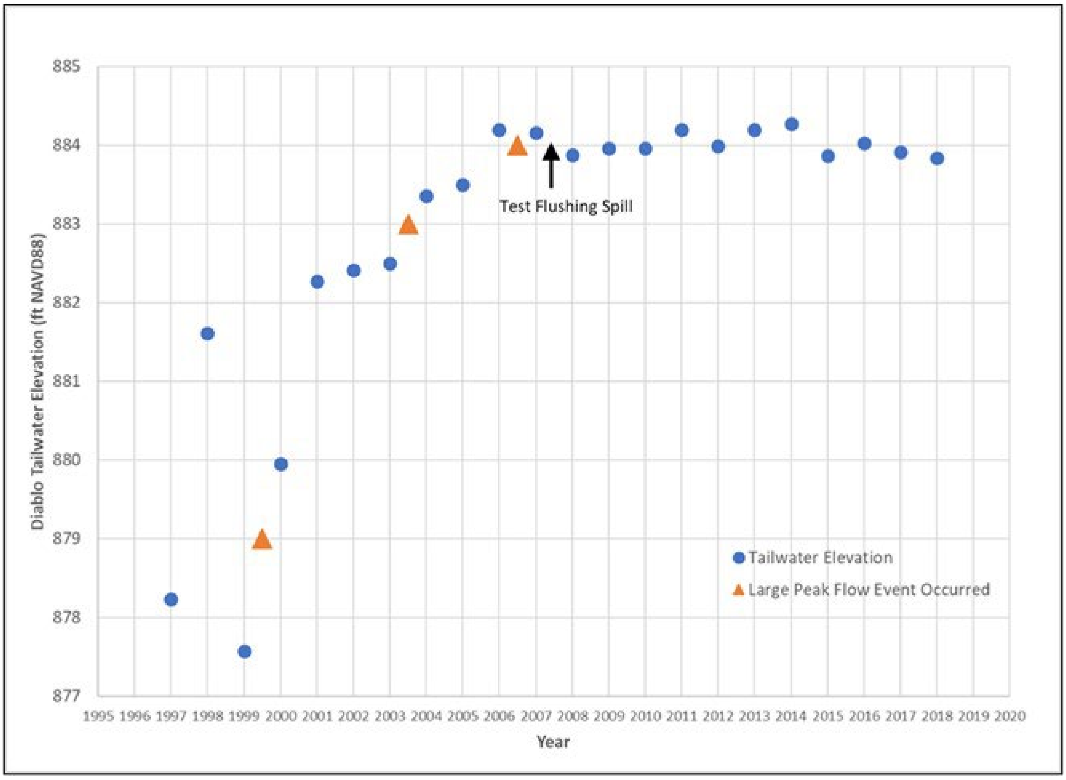


Figure 4.2.1-30. Changes in Diablo tailwater elevation (elevations in NAVD 88).

<u>Asynchronous Peak Flows in Stetattle Creek and the Skagit River</u>

Under normal operating conditions, large peak flows in Stetattle Creek and the Skagit River do not occur simultaneously. When a large storm is forecast for the region, system control operations generally draw down Gorge Lake to capture the anticipated high flows coming in from Stetattle Creek.

<u>Sediment Supply</u>

Sediment supply to the Stetattle Creek delta comes primarily from the Stetattle Creek watershed, although small amounts of sediment may be supplied from stored sediments in the riverine section of the Skagit River between Diablo Dam and the delta. The Stetattle Creek watershed has many unvegetated areas of mass wasting (rockfalls, landslides, debris torrents), avalanche chutes, and perennial ice that are actively contributing sediment to the drainage (Figure 4.2.1-31). Due to the underlying geology (primarily gneiss, alpine glacial deposits, and talus slopes) and steep topography, there is an abundant source of coarse sediment to Stetattle Creek. The gneiss underlying most of the watershed is a relatively hard rock that is not abraded very quickly by transport in the stream and that produces primarily sand-sized particles (rather than silt and clay) when it does break down. Evidence of local sediment inputs, such as discrete mass wasting events, can be seen within the Stetattle Creek streambed; angular particles have not been transported far from the source slide and are readily differentiated from rounded particles that have been transported from upstream sources or from alpine glacial deposits. The steep gradient and high peak flows in Stetattle Creek allow even boulder-sized rocks to be transported to the delta in the Skagit River.

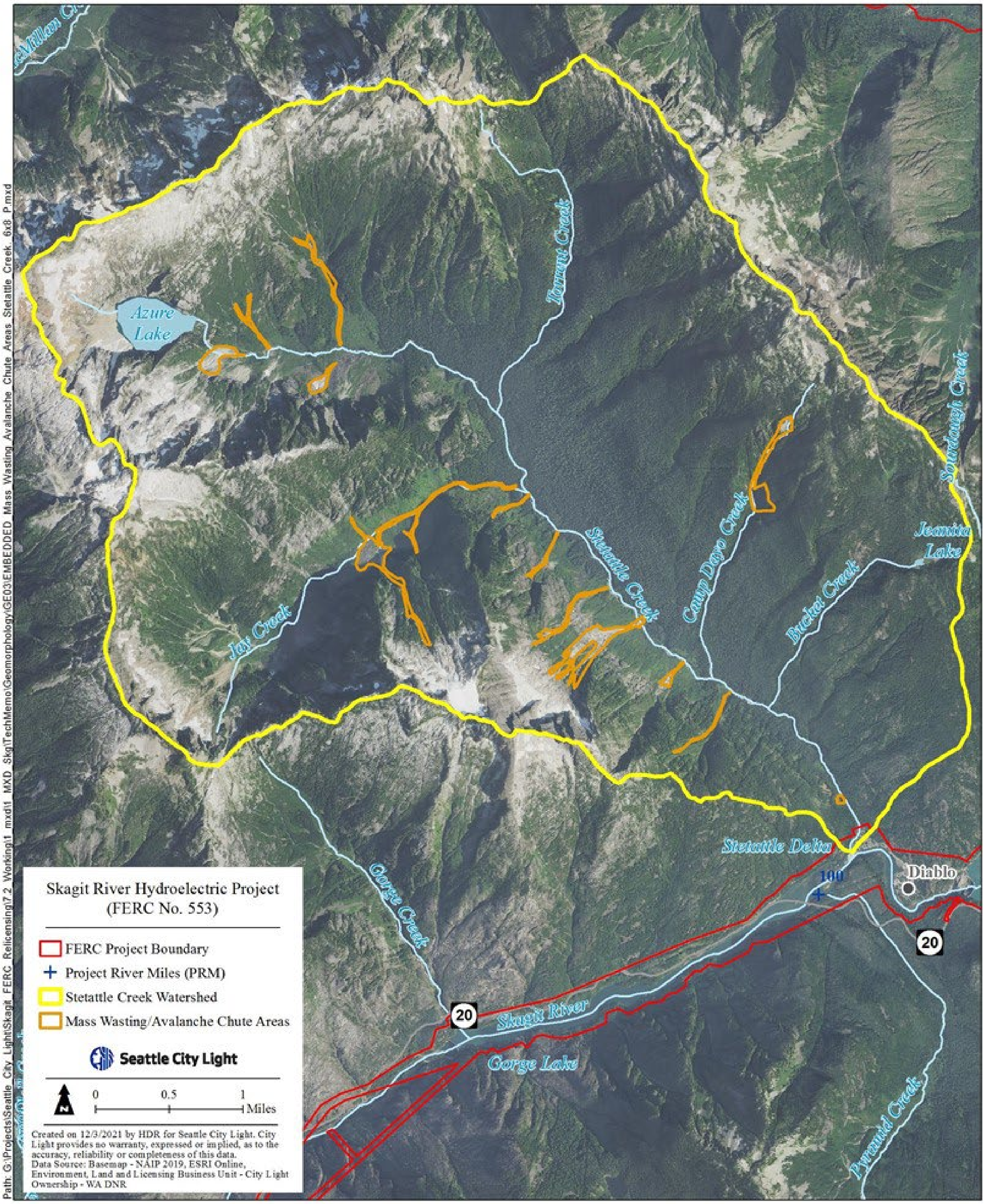


Figure 4.2.1-31. Mass wasting and avalanche chute areas contributing sediment to Stetattle Creek.

Estimated Stetattle Creek Sediment Load Based on Regional Sediment Yields

Based on the 1930-1936 sedimentation rate in Gorge Lake, Stetattle Creek could yield an average of 1,900 cubic yards per year (cu yds/yr) of sediment; this is likely a reasonable estimate of sediment yield under average flow conditions in years with no large peak flows.

Based on the range of regional sediment yields, the 22.8 sq. mi. watershed of Stetattle Creek could yield an average of 3,600 to 18,200 cu yds/yr of sediment. This estimate includes all grain sizes (boulders to clay particles) and is more representative of a long-term average that includes very large peak flow conditions (e.g., the 2003 or 2006 flood events) that episodically provide large volumes of sediment and markedly change the Stetattle delta configuration.

Comparison of Topography and Bathymetry in Stetattle Creek Delta

Based on Civil3D modelling of estimated topographic contours pre-construction compared to 2017 bathymetric data, at least 257,000 cu yds of sediment have been deposited in the upper reaches of Gorge Lake as of 2017. There are two significant deposition locations. The first is at the mouth of Stetattle Creek (upper delta), and the second is in the area between Stetattle Creek and the SR 20 causeway (lower delta). Approximately 32,000 cu yds have been deposited in the upper delta, and approximately 215,000 cu yds have been deposited in the lower delta.

It is noteworthy that the estimate of 257,000 cu yds accumulated between 1961 (when Gorge High Dam was completed) and 2017 (56 years), which is an average of 4,590 cu yds/yr. It is similarly noteworthy that this does not include the majority of the silt and clay portion of the load from Stetattle Creek (or any fine sediment from Diablo Lake); however, this estimate is within the range of 3,600 to 18,200 cu yds/yr calculated using regional estimates.

Stetattle Creek Delta Development

Construction and operation of the Skagit River Project and the levee protecting the Hollywood residential area have altered sediment deposition patterns in the lower 0.5 miles of Stetattle Creek and at the confluence of Stetattle Creek and the Skagit River. Current Stetattle Creek deposits in the Skagit River include the relatively coarse-grained delta that is evident at the mouth of Stetattle Creek, as well as the gravel and sand deposits that are accumulating at the head of Gorge Lake in the area just upstream from the SR 20 crossing and the finer-grained sediment that is accumulating over the historic Davis Ranch area and near the Gorge campground boat launch. The location and timing of deposition of the sediment coming from Stetattle Creek is controlled by a relatively complex interaction of flow and sediment input rates from Stetattle Creek, flow in the Skagit River, and the elevation of Gorge Lake.

Changes in the lower part of Stetattle Creek can be seen by comparing photos (see City Light [2022c] for photos) from the early 1900s through 2018, all taken from or near the bridge crossing at the mouth of the creek. Growth of the Stetattle Creek delta at the confluence with the Skagit River and the secondary deposits downstream can be seen in the photos and maps. Prior to the construction of Gorge High Dam in 1961, the primary delta at the confluence of Stetattle Creek and the Skagit River grew as the coarsest bedload sediment (boulders) were deposited in the lower gradient Skagit River. Smaller cobble and gravel material was transported downstream in the Skagit River to the head of Gorge Lake, which was much farther downstream than the current lake location. Since 1961, a secondary delta of cobble, gravel, and sand has been building upstream of the SR 20 bridge crossing. This can be seen as a growth of a series of mid-channel islands, which are currently diverting the main flow of the river toward the left and right banks approximately half way between Stetattle Creek and the bridge. Bank erosion is occurring on the left bank at this location, as the main flow is directed at erodible areas of the shoreline.

Surficial Substrate

Stetattle Creek is a high gradient system that transports up to boulder-sized material to the mouth of the stream. Pebble count and grab sample data taken during this and previous studies show surficial grain size in the delta area varies greatly between different areas. Substrate within the lower portions of Stetattle Creek include boulder, cobble, and gravel material. The mid-channel bar that has been building between 400-800 feet upstream from the confluence has a median (d_{50}) grain size of 159 mm and is primarily boulder and cobble material (Figure 4.2.1-32).

Substrate on the primary delta at the confluence of Stetattle Creek and the Skagit River is very coarse-grained on the western (downstream) side, with median grain size of 90-200 mm. There are finer-grained deposits building into the deep pool on the eastern (upstream) side of the delta that have a median grain size of 3-21 mm and are composed primarily of sand and gravel.

No grain size samples were taken on the secondary delta, but visual estimates showed these deposits are composed primarily of gravel and sand.

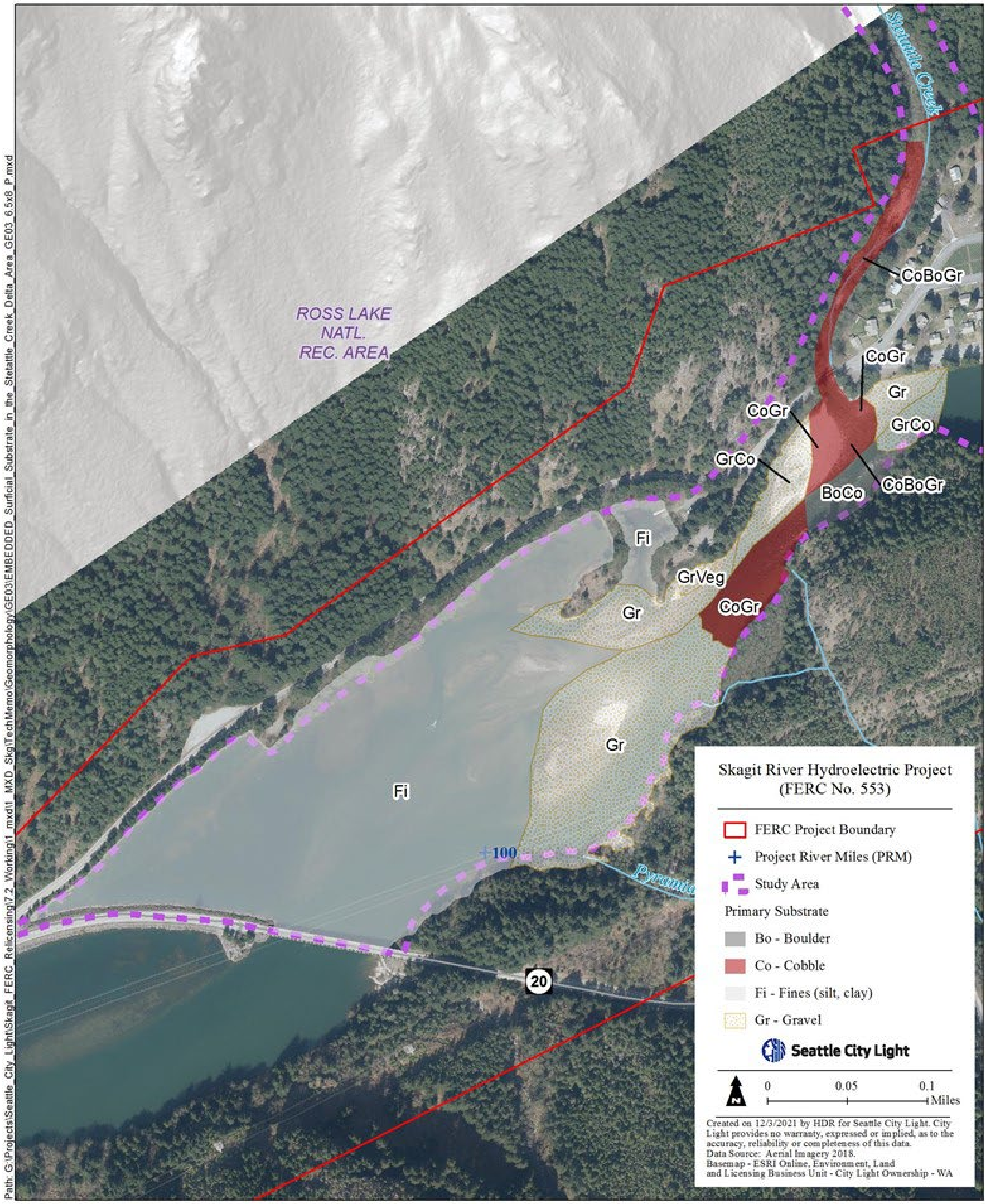


Figure 4.2.4-32. Surficial substrate in the Stetattle Creek delta area.

Sediment Transport Analysis

Sediment movement in lower Stetattle Creek and the delta area was assessed during the GE-03 Sediment Deposition Study using the output from the 2-D hydraulic model to predict the critical grain size of sediment that could be picked up and transported under a variety of flows in Stetattle Creek and the Skagit River. Since peak flows in Stetattle Creek and the Skagit River are asynchronous, the model was run with either peak flows in Stetattle Creek and low flows (3,500 cfs) in the Skagit River or high flows in the Skagit River and lower flows (500 cfs) in Stetattle Creek.

Critical grain size analyses were conducted (see GE-03 Sediment Deposition Study Interim Report [City Light 2022c] for figures) and indicate that Stetattle Creek has a much higher competence to transport material than the Skagit River under existing conditions. Stetattle Creek can carry larger-sized material than the Skagit River, resulting in deposition of cobble and boulder material on the primary delta and gravel and finer material on the secondary delta.

Growth of the primary delta toward the opposite (left) bank of the Skagit River is limited due to the bedrock on the left bank that forms an immovable constriction and results in a narrow, high velocity chute that minimizes deposition. As a result, the delta is growing upstream and downstream from the confluence as material is deposited in the upstream deep pool and downstream secondary delta.

Gorge Lake Boat Launch

The Gorge Lake boat launch is located in an embayment on the north side of Gorge Lake near the campground. This embayment is a location of fine sediment deposition. In addition, gravel deposition in the secondary delta area results in very shallow water depths at the outlet to the boat launch embayment, which precludes many large boats from using the launch to reach the lake, particularly when Gorge Lake levels are low.

Analyses to be included in the USR

The USR will report on 2022 field work and analysis to meet the Revised Study Plan (RSP) study objectives and the June 9, 2021 Notice commitments. Specific work completed in 2022 to meet the RSP objectives and deliverables includes:

- Finalizing the analysis of reservoir deposition amounts and rates (estimated volume/year) in three detailed study areas (Hozomeen area, Thunder Arm, Sourdough Creek) based on a comparison of pre-Project topographic mapping and bathymetry data and watershed-level sediment yield relationships. (Note: this task for Stetattle Creek has been completed.) Shaded relief maps of accumulated sediments will be produced and estimates of volume by grain size category will be made.
- Further analysis of sediment transport/deposition zones and backwater effects in the Hozomeen, Thunder Arm, and Sourdough Creek tributary streams.
- A qualitative assessment of future deposition amount and patterns for the four detailed study areas to help assess impacts to recreational resources and operations.

In order to meet the commitments in the June 9, 2021 Notice, City Light will complete the following tasks for the USR:

- An estimate of total sediment deposition in the three Project reservoirs based on:
  - A comparison of available pre-Project topographic mapping and recent bathymetry data.
  - Sediment yield relationships based on measured fine sediment yield from basins in the North Cascades and Canada and a statistical predictive relationship using basin characteristics like geology, slope gradient, etc.
- Estimates of percent of total reservoir deposits by grain size category (e.g., boulder, cobble, gravel, sand, silt/clay).
- Mapping of erosion and deposition areas in the Ross Lake drawdown zone.
- An assessment of the Diablo Lake backwater extent in Thunder Creek using Hydrologic Engineering Center River Analysis System or similar hydraulic modeling.

4.2.1.3 Existing Resource Measures

Under the current license, City Light implements the following measures related to geology and soil resources:

- 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 prioritizes 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).
- Since 1995, 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). Sites are assessed annually and maintained as needed and are in fair to excellent condition (see Table 4.3-8 in the PAD).
- In addition to the work done by the NPS along the reservoirs, City Light addresses erosion sites along the roads identified in the Erosion Control Plan. These include the Ross Dam Access Road, the Buster Brown Road along Diablo Lake, and several transmission line access roads in the RLNRA between Newhalem and Bacon Creek. Work at high priority sites has included installation of water bars, culverts, bridges, berms, dikes and ditches, and vegetation planting along exposed steep slopes. Lower priority sites are monitored with plans for specific measures developed as needed. Erosion control sites along Project powerline roads in the RLNRA are periodically assessed by NPS and City Light staff, with corrective measures identified and implemented where needed.

4.2.1.4 Proposed Resource Measures

City Light anticipates potential modifications to current operations and additional proposed protection, mitigation, and enhancement measures to be informed by on-going studies and discussions with licensing participants prior to its FLA submittal in April 2023. Anticipated measures are briefly described below and will be further refined in the FLA.

Reservoir Shoreline Erosion Management Plan

To protect natural, cultural, and recreational resources from direct and indirect erosion impacts from Project O&M activities, City Light proposes to develop a Reservoir Shoreline Erosion Management Plan that will include treatment, monitoring, and reporting of identified erosion sites. City Light also proposes to include a schedule of monitoring and reporting regarding erosion effects to cultural sites (i.e., historic properties) in the Historic Properties Management Plan (HPMP). Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Project Roads and Transmission Line ROW Management Plan

To protect natural and cultural resources from direct and indirect impacts from Project Road and Transmission Line ROW O&M activities as well as indirect impacts due to recreational use of City Light roads and trails, City Light proposes to develop a Project Roads and Transmission Line ROW Management Plan that will include: (1) the identification, treatment, monitoring, and reporting of erosion sites on Project roads; (2) best management practice (BMP) measures for road and trail maintenance; and (3) measures to protect aquatic habitat. BMPs for these areas and activities will be consistent with guidance provided in the HPMP in order to avoid, minimize or mitigate potential effects to historic properties. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

4.2.1.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to geology and soils have been identified at this time.

4.2.2 Water Resources

4.2.2.1 Affected Environment

This section describes water resources associated with the Project, i.e., within the Project Boundary and in the Skagit River to various locations downstream of the Project, depending on the water resources topic. Conditions in select tributaries to Ross Lake are also discussed. Topics addressed include: (1) drainage basin hydrology; (2) Project streamflow and reservoir elevation data; (3) existing and proposed uses of Project waters; (4) groundwater conditions; and (5) water quality.

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, City Light has engaged with Indian Tribes and Canadian First Nations regarding water resources to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While water resources are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in water resources as, or related to, tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Drainage Basin Hydrology

Watershed Description

The Skagit River originates in the Cascade Range and flows approximately 135 miles to Skagit Bay (U.S. Army Corps of Engineers [USACE] 2013). The northern end of the basin extends about 28 miles into Canada (USACE 2013). The Skagit River drainage basin (Figure 4.2.2-1) has a total area of approximately 3,115 square miles (sq. mi.) (USACE 2013), with about 381 sq. mi. of this total located in British Columbia (U.S. Geological Survey [USGS] 2019a).

Annual precipitation ranges from 50 inches in the area of Ross Lake to as much as 130 inches at higher elevations (Washington Department of Ecology [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 cubic feet per second (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 (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,[13] 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). El Niño–Southern Oscillation (ENSO) and Pacific Decadal Oscillation (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

13 Although the Skagit River is not in the Columbia River drainage, these patterns are indicative of conditions in the Pacific Northwest region.

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 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 is also expected to increase, leading to heavier precipitation, and such days are expected to 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).

Since the mid-20th century, the lowest 25 percent of annual streamflows in the Pacific Northwest have been in decline, i.e., 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. 2004) and potentially decreased mountain precipitation (Luce et al. 2014). 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).

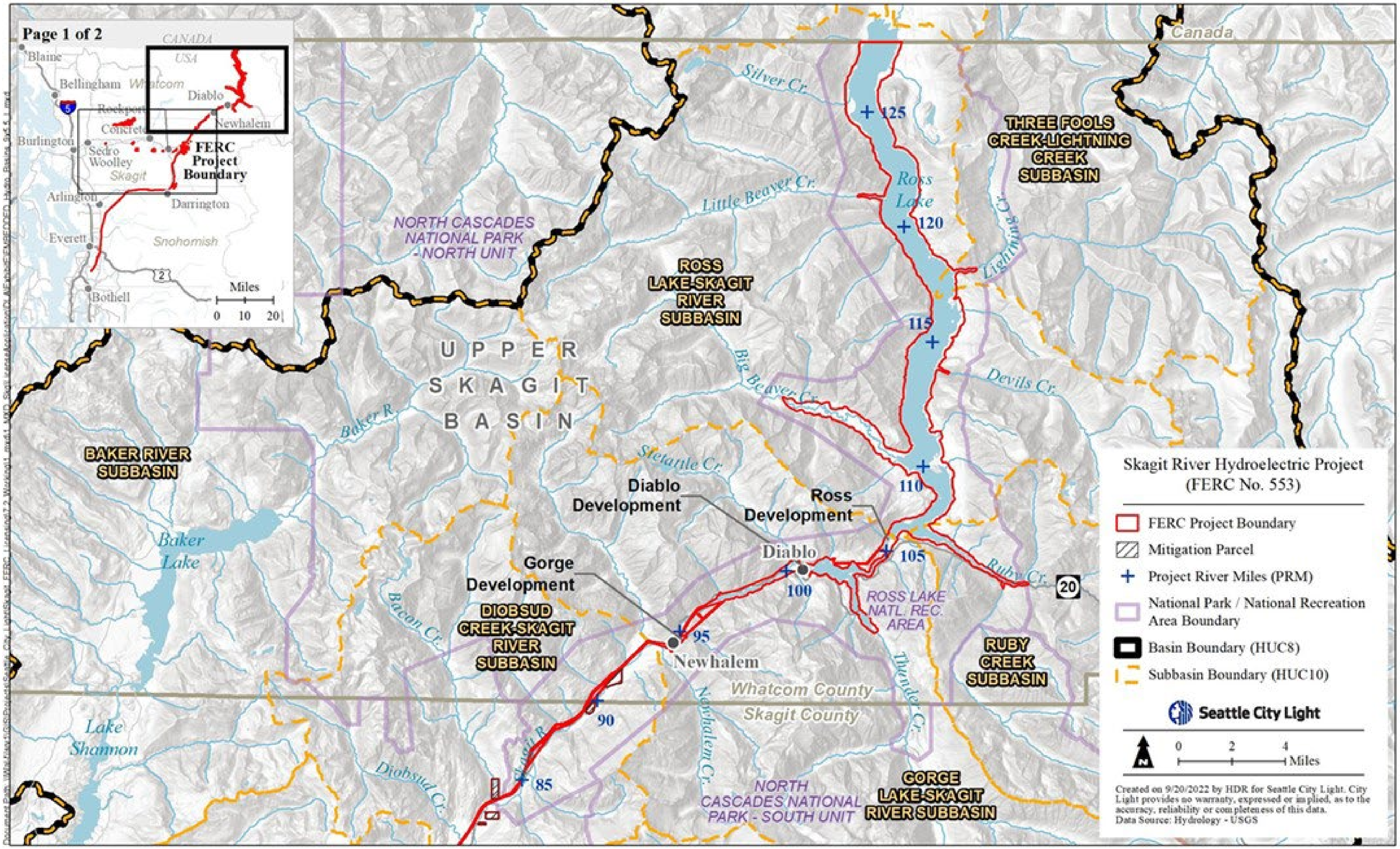


Figure 4.2.2-1. Boundaries of the Skagit River drainage basin and its major subbasins upstream of approximately PRM 20 (page 1 of 2).

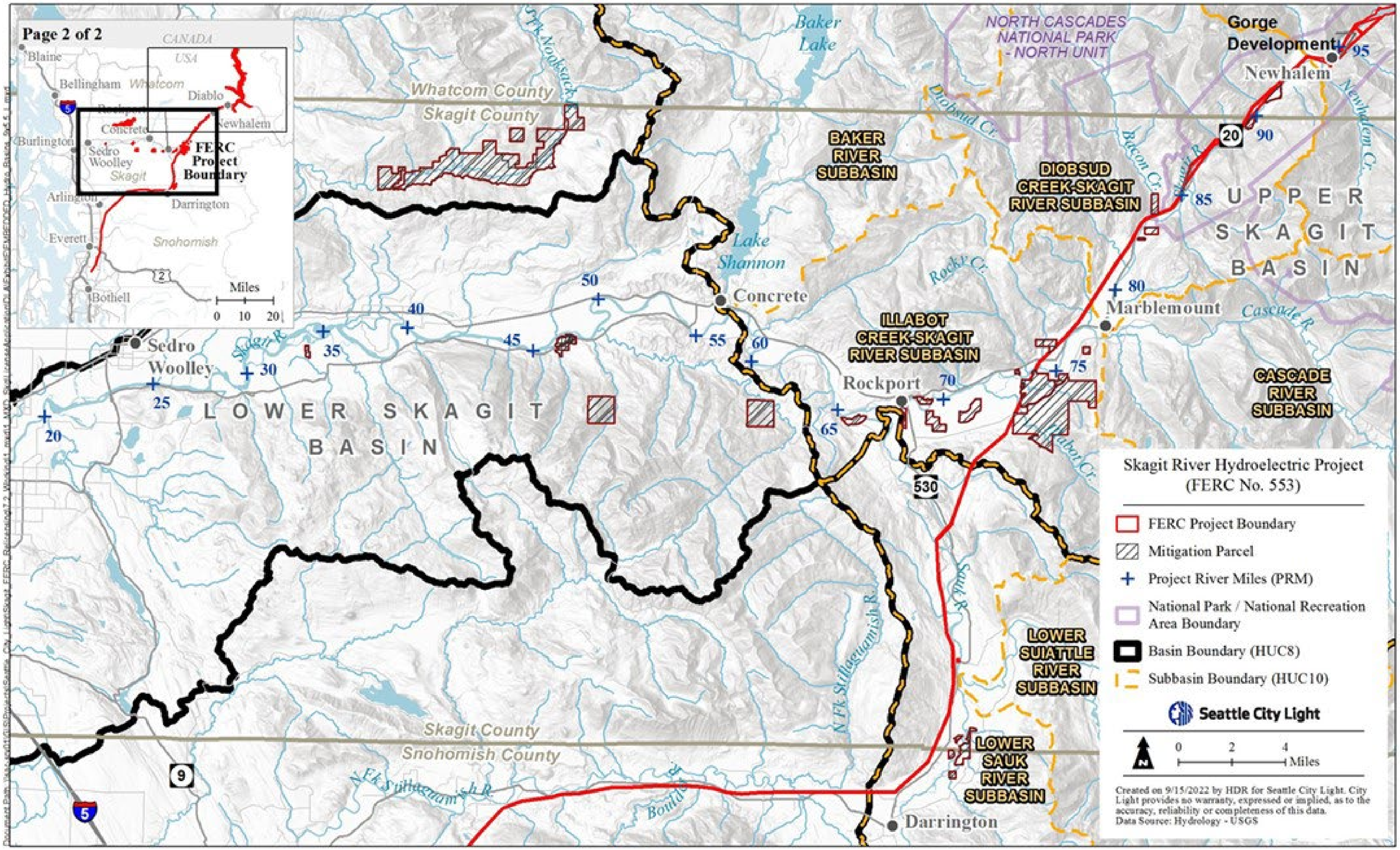


Figure 4.2.2-1. Boundaries of the Skagit River drainage basin and its major subbasins upstream of approximately PRM 20 (page 2 of 2).

The snow drought of 2015 has been considered a possible precursor of the potential future climate in Washington (Marlier et al. 2017). During 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 degrees Fahrenheit [°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 an approximately 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 occur 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[14] 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 risk management 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).

Reservoirs

The Project consists of three power generating developments on the Skagit River: Ross, Diablo, and Gorge, located between Project River Mile (PRM) 94.7 and PRM 105.7 (USGS River Miles [RMs] 94-105.1). Operations at the three Project developments are hydraulically coordinated.

<u>Ross Lake</u>

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 approximately 1 mile north of the U.S.-Canada border. It has a surface area of 11,725 acres, with approximately 500 acres located in British Columbia, and a gross storage volume of 1,432,000 acre-feet at the normal maximum water surface elevation of 1,608.76 feet NAVD 88 (1,602.5 feet City of Seattle datum [CoSD]). The reservoir's usable storage is 1,063,000 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 Light Detection and Ranging); 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

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

proportions of these materials are provided in Section 4.2.1.1 of this Exhibit E). 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 Project reservoirs, is approximately 4.5 miles long, with an average width of 1,323 feet. It has a drainage area of approximately 1,125 sq. mi. (inclusive of the Ross Lake drainage area) and a surface area of approximately 905 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 88,800 acre-feet at the normal maximum water surface elevation of 1,211.36 feet NAVD 88 (1,205 feet CoSD); the reservoir’s usable storage is 6,200 acre-feet. Reservoir detention time is 9.4 days (Connor 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 4.2.1.1 of this Exhibit E).

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, the most glaciated basin in the lower 48 United States (with 12 percent ice cover), runs 15 RMs to Diablo Lake, approximately 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 Ross Lake National Recreation Area (RLNRA) and North Cascades National Park. Thunder Creek provides approximately 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 approximately 4.5 miles long, with an average width of 450 feet. Gorge Lake has a surface area of approximately 235 acres and a gross storage volume of 8,200 acre-feet at a normal maximum water surface elevation of 881.51 feet NAVD 88 (875 feet CoSD); the reservoir’s usable storage is 1,600 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 approximately 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 (Connor 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 4.2.1.1 of this Exhibit E).

Skagit River and its Major Tributaries

The reach of the Skagit River between Gorge Dam and Gorge Powerhouse, referred to as the Gorge bypass reach, is approximately 2.5 miles long. Under the 1995 Skagit River Project license,[15] City Light is not required to release any flow into the Gorge bypass reach. 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 Gorge Powerhouse, the floodplain broadens, and the channel is less confined. A stream gradient profile is provided in Figure 4.2.2-2. Major tributaries include the Cascade, Sauk, and Baker rivers, which enter the Skagit River near the towns of Marblemount, Rockport, and Concrete, respectively.

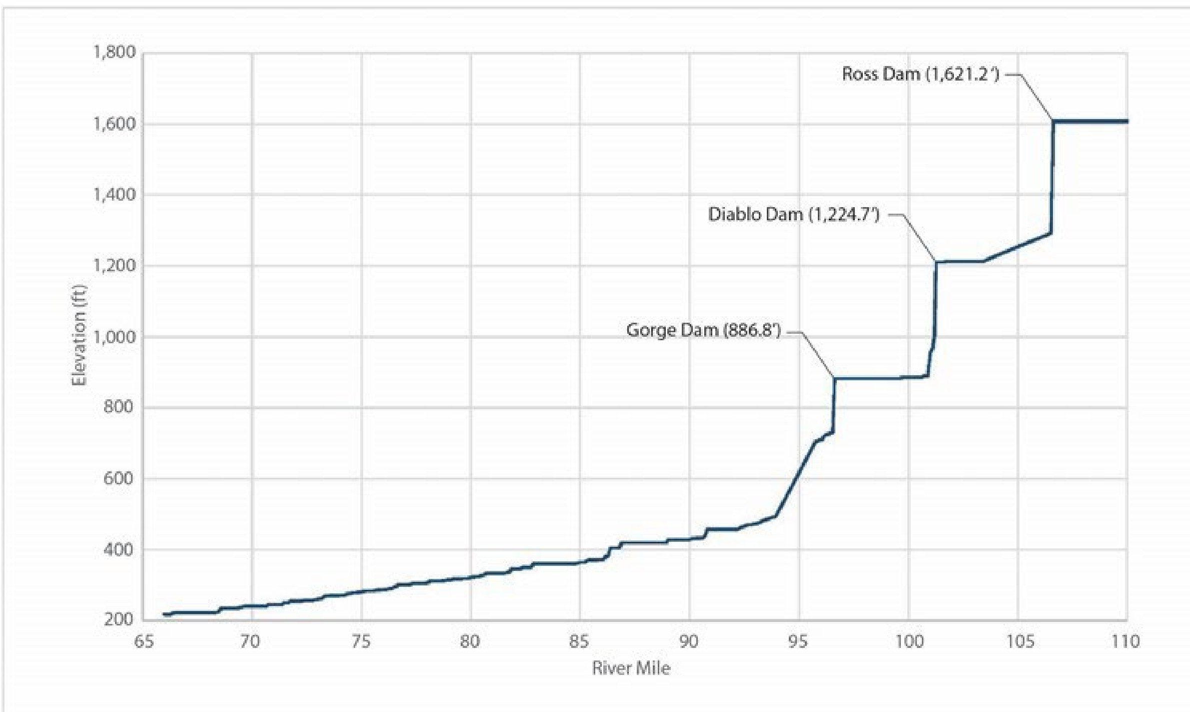


Figure 4.2.2-2. Gradient profile of the Skagit River from Ross Dam to the confluence of the Skagit and Sauk rivers and the heights of the three Project dams (elevations in North American Vertical Datum of 1988 [NAVD 88]).

The Cascade River, which runs for 29 RMs to its confluence with the Skagit River at PRM 78.25 (USGS 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

15 May 16, 1995 Order Accepting Settlement Agreement, Issuing New License, and Terminating Proceeding (71 ¶ 61,159).

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 PRM 66.8 (USGS 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).

The Baker River is the second largest tributary to the Skagit River, with a watershed of approximately 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 PRM 56.8 (USGS 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 Puget Sound Energy (PSE).

Project Streamflow Data

Current and Historic USGS Gaging Stations

The USGS operates water level and discharge gaging stations on the mainstem Skagit River and several of its larger tributaries. Active long-term USGS gages in the area between Gorge Dam and the Sauk River are listed in Table 4.2.2-1. In addition to these long-term gages, the USGS installed six new automatic water level recorders (Table 4.2.2-2) at key locations throughout the study area over a six-month period from June through November 2020 (Figure 4.2.2-3). Water level data from these recently installed gages will supplement water level data available from the three long-term mainstem Skagit River USGS gages at Newhalem, Marblemount, and Rockport and from a mainstem water level gage approximately 1 mile upstream from the Sauk River confluence operated by the Skagit River System Cooperative (SRSC). Water levels at these gages are recorded continuously at either a 5-minute or 15-minute interval depending on gage location.

The locations for the new automatic water level recorders were selected considering hydraulic model requirements, locations of existing long-term mainstem gages, locations of tributary inflows, local hydraulic conditions, and access. The gages were installed by and are being operated and maintained by the USGS under agreement with Seattle City Light (City Light). One of the gages was installed at the former location of the USGS gage Skagit River above Alma Creek (USGS 12179000), with the goal of reestablishing a stage-discharge rating and, hence, having the ability to obtain continuous stage and discharge data at this location. The installation of these gages was identified by City Light as an early action item to ensure the gages were in place to capture any high flow events in the late spring/early summer 2020 snowmelt runoff period or during fall/early winter 2020 rainfall events to support development and calibration of the Upper Skagit

Hydraulic Model starting in spring 2021 (see Sections 4.3 through 4.5 of the FA-02 Instream Flow Model Development Study Interim Report, City Light 2022a). The Skagit River above Miller Creek gage (USGS 12189700) also provides the downstream boundary of the Upper Skagit Hydraulic Model (see Section 4.3.3 of City Light 2022a). The locations of all gages are shown in Figure 4.2.2-3.

Table 4.2.2-1. Active long-term USGS stream gages in the area between Gorge Dam and Concrete, WA (see Figure 4.2.2-3 for gage locations between Gorge Dam and the Sauk River confluence).

Gage ID	Name	Period of Record	Drainage Area (sq. mi.)
12178000	Skagit River at Newhalem, WA	Dec 1908 to May 1914 Oct 1920 to present	1,175
12178100	Newhalem Creek near Newhalem, WA	Feb 1961 to present	27.9
12179900	Bacon Creek below Oakes Creek near Marblemount, WA	Aug 1943 to Sep 1950 Oct 1998 to present	49.7
12181000	Skagit River at Marblemount, WA	Sep 1943 to Jul 1944 Oct 1946 to Sep 1951 May 1976 to present	1,381
12182500	Cascade River at Marblemount, WA	Oct 1928 to Oct 1979 Jun 2006 to present	172
12184700[1]	Skagit River near Rockport, WA	Sep 2015 to present	1,655
12189500	Sauk River near Sauk, WA	Jul 1928 to present	714

1 Gage height only.

Table 4.2.2-2. Recently installed USGS stream gages in the area between Gorge Dam and the Sauk River (see Figure 4.2.2-3 for gage locations).

Gage ID	Name	Available Period[1]	Parameters
12178600	Skagit River below Babcock Cr	Nov 2020 to Dec 2021	Stage
12178900	Skagit River below Damnation Cr	Sep 2020 to Sep 2021	Stage
12179000	Skagit River above Alma Cr	Jun 2020 to Dec 2021	Stage, Flow
12180300	Skagit River above Diobsud Cr	Jun 2020 to Dec 2021	Stage
12183900	Skagit River at Corkindale	Jun 2020 to Dec 2021	Stage
12189700	Skagit River above Miller Cr	May 2020 to Dec 2021	Stage

1 Gage data are downloaded at discrete intervals, available period is reported to the most recent download.

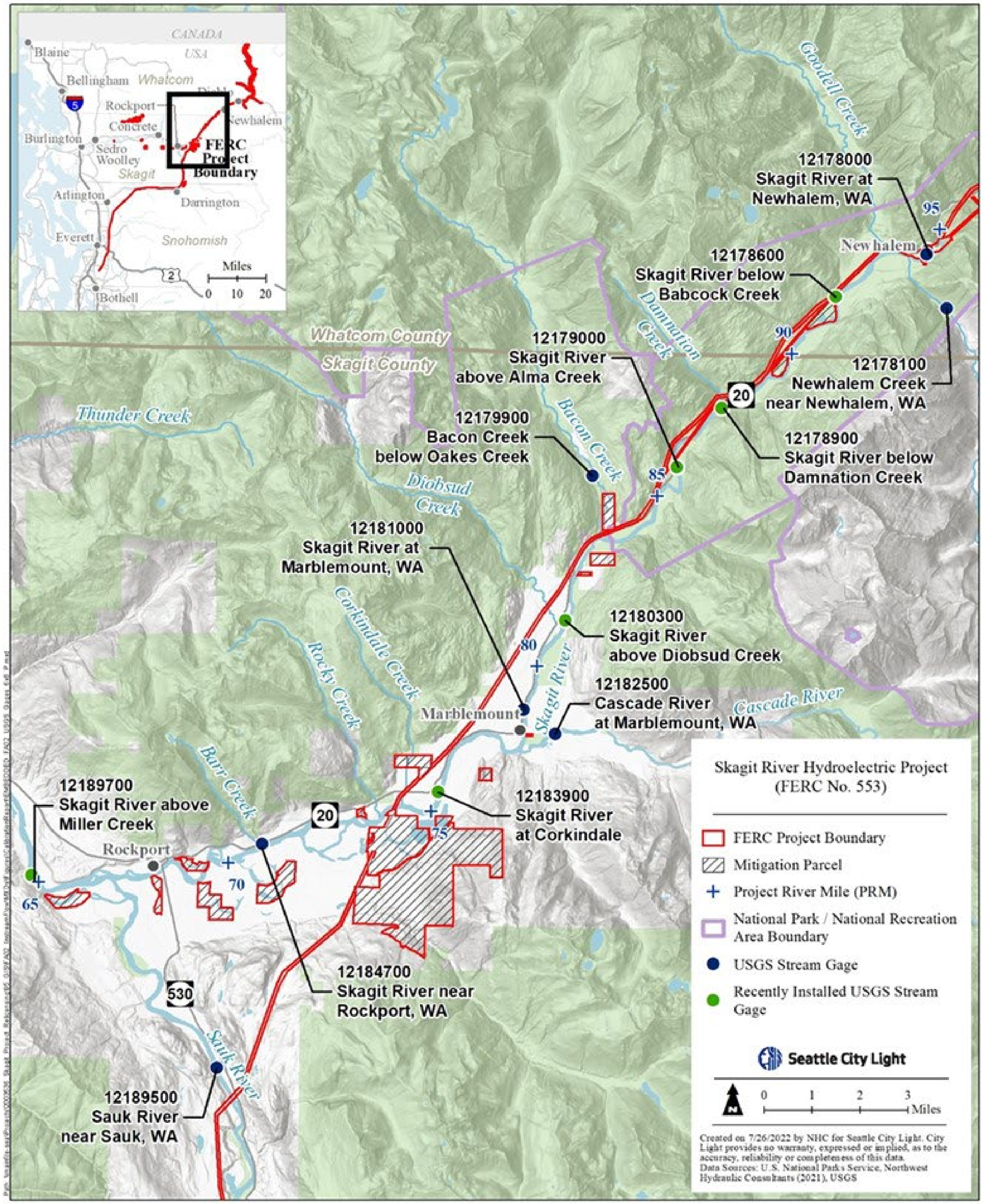


Figure 4.2.2-3. Active long-term and recently installed USGS stream gages within the Upper Skagit Hydraulic Model domain (City Light 2022a).

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[16] – present, and October 1, 1930 – present.

Project Outflows

The minimum and maximum daily and monthly average outflows from Ross, Diablo, and Gorge lakes for the period 1988-2020 are provided in Tables 4.2.2-3 through 4.2.2-5. This period is sufficiently long to account for operations under a range of hydrologic conditions. Ross Lake outflows ranged from a low of 2 cfs in May 1988 to a high of 27,494 cfs in October 2003 (Table 4.2.2-3). 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 4.2.2-4).[17] Gorge Lake outflows ranged from a low of 1,316 cfs in June 1988 to a high of 32,446 cfs in October 2003 (Table 4.2.2-5).[18]

16 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.

17 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.

18 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 4.2.2-3. Monthly minimum, average, and maximum outflows (cfs) from Ross Lake (1988-2020).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	5,643	5,902	5,753	4,082	4,451	4,176	4,440	3,410	3,608	6,797	5,984	4,270	6,797
	Average	3,057	3,946	4,165	1,873	1,411	2,180	2,688	2,391	2,611	3,083	4,148	3,432	2,946
	Minimum	1,069	1,909	2,930	88	2	103	507	1,808	1,059	865	1,191	1,791	2
1989	Maximum	7,848	9,143	6,877	2,707	2,934	3,631	5,223	3,168	3,323	2,944	7,493	12,946	12,946
	Average	5,629	6,046	2,838	1,320	1,307	1,772	2,614	2,178	2,236	2,202	4,524	4,492	3,118
	Minimum	3,464	4,114	1,364	59	70	302	37	714	1,449	1,172	341	2,162	37
1990	Maximum	7,099	8,064	7,292	3,871	3,902	5,401	6,109	4,375	3,797	5,664	23,326	13,084	23,326
	Average	5,174	6,318	5,318	2,688	2,086	1,246	3,657	1,920	2,741	2,348	11,471	5,031	4,156
	Minimum	2,060	4,351	2,910	1,367	504	116	635	215	816	231	4,517	1,489	116
1991	Maximum	7,301	14,052	7,206	7,376	5,944	5,526	13,933	5,767	6,047	3,617	4,350	4,450	14,052
	Average	5,470	8,614	6,158	5,003	4,314	3,008	7,026	3,695	2,671	2,525	2,400	3,071	4,476
	Minimum	3,250	2,420	3,127	2,637	2,845	545	3,044	1,118	750	1,318	256	1,516	256
1992	Maximum	6,723	7,097	7,053	4,516	1,409	1,336	4,092	3,457	2,377	6,903	6,351	4,569	7,097
	Average	5,010	6,047	4,877	2,630	718	553	2,811	2,200	1,313	2,507	3,915	3,219	3,117
	Minimum	3,169	3,862	3,153	207	19	26	18	562	198	1,144	1,767	1,228	18
1993	Maximum	5,604	4,704	2,622	2,930	1,315	1,297	3,775	3,442	2,649	2,687	5,770	4,193	5,770
	Average	3,558	3,533	2,007	1,827	486	520	1,984	1,863	2,052	2,144	3,781	3,006	2,410
	Minimum	1,676	2,039	1,448	1,213	28	13	40	932	770	765	1,214	1,834	13
1994	Maximum	6,209	5,962	4,321	4,423	2,986	2,723	3,387	3,695	3,262	3,142	4,626	4,423	6,209
	Average	3,941	3,856	3,009	3,266	1,505	1,265	1,777	2,219	2,484	1,982	2,776	3,224	2,611
	Minimum	1,994	603	1,651	1,965	270	533	614	1,138	1,720	908	1,303	1,697	270
1995	Maximum	7,314	5,994	6,641	6,184	4,476	3,920	3,000	3,506	2,759	3,071	17,666	24,445	24,445
	Average	5,255	4,780	5,633	3,936	2,241	1,518	1,105	2,140	1,898	1,793	7,980	8,311	3,915
	Minimum	3,693	2,261	4,380	1,476	533	206	116	1,134	1,105	553	988	1,514	116
1996	Maximum	7,190	7,873	6,089	5,802	5,193	4,831	4,856	3,230	4,033	4,547	4,706	4,796	7,873
	Average	4,778	4,203	4,916	4,185	3,927	2,900	2,989	1,683	1,966	2,145	3,062	3,347	3,341
	Minimum	1,725	1,484	3,388	2,146	2,545	1,620	1,213	667	983	591	1,646	1,857	591

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1997	Maximum	7,166	6,791	7,051	6,932	6,892	17,336	13,376	4,204	3,158	9,949	9,465	5,068	17,336
	Average	4,478	5,541	5,804	5,286	4,503	6,853	6,271	2,214	1,474	3,364	4,727	3,580	4,499
	Minimum	307	3,819	2,284	2,916	1,522	1,921	2,897	991	56	903	1,919	2,522	56
1998	Maximum	7,598	4,710	5,758	5,322	2,015	1,629	3,946	4,342	3,346	3,512	3,467	5,829	7,598
	Average	4,747	3,909	4,364	3,838	902	588	1,923	1,960	2,361	2,629	2,483	2,926	2,735
	Minimum	2,886	3,161	3,184	1,343	42	51	228	304	1,409	1,356	1,132	416	42
1999	Maximum	6,377	6,962	7,159	5,467	5,196	5,568	10,173	9,086	4,065	3,809	13,557	5,002	13,557
	Average	5,188	6,136	5,181	3,978	3,580	2,996	5,343	4,759	2,927	2,897	5,694	3,620	4,352
	Minimum	2,092	4,924	2,957	1,644	616	371	2,409	1,466	2,127	349	1,798	1,490	349
2000	Maximum	7,036	6,037	5,351	4,018	3,871	2,884	4,648	3,692	3,905	3,366	6,615	5,320	7,036
	Average	5,959	5,283	4,312	2,697	1,660	1,129	3,250	2,266	2,480	2,488	3,501	3,139	3,204
	Minimum	4,519	4,441	3,204	1,841	28	164	1,775	703	200	366	2,178	1,642	28
2001	Maximum	4,125	3,316	2,874	2,233	1,392	1,344	2,457	3,676	3,103	2,677	2,934	4,060	4,125
	Average	2,440	2,199	2,093	1,500	811	524	1,517	2,250	1,951	1,945	1,701	2,651	1,888
	Minimum	747	1,291	1,496	55	165	34	547	648	735	1,288	53	970	34
2002	Maximum	7,172	7,144	7,290	5,856	6,577	5,585	10,424	2,920	3,287	3,587	3,107	3,225	10,424
	Average	5,412	5,456	5,979	3,684	4,261	3,157	5,549	2,034	1,735	1,941	2,183	1,935	3,605
	Minimum	69	942	4,437	5	990	544	1,549	370	904	1,126	468	797	5
2003	Maximum	5,916	6,167	5,191	4,540	4,296	5,452	4,360	3,227	3,644	27,494	7,583	6,939	27,494
	Average	4,069	3,807	2,817	3,147	2,610	2,543	2,068	1,931	2,254	4,943	5,287	3,701	3,263
	Minimum	1,071	1,068	469	1,885	95	137	296	992	1,280	262	1,586	2,547	95
2004	Maximum	6,988	7,150	4,246	3,072	1,610	7,366	3,794	3,859	3,592	6,061	6,503	6,063	7,366
	Average	5,507	6,326	2,414	2,038	783	2,475	2,139	1,844	2,203	3,024	4,460	3,579	3,053
	Minimum	2,140	3,346	1,517	849	12	15	812	174	144	793	148	929	12
2005	Maximum	6,730	7,109	4,039	2,573	2,970	1,861	2,008	1,967	3,167	4,048	6,727	4,646	7,109
	Average	4,831	4,737	2,411	1,638	1,219	1,104	910	1,013	2,375	2,341	4,787	3,387	2,567
	Minimum	1,060	2,719	1,455	48	59	179	155	478	692	801	2,943	329	48
2006	Maximum	6,966	6,951	7,479	2,808	2,103	1,930	4,251	1,849	2,715	2,379	21,842	4,359	21,842
	Average	4,905	6,140	5,690	1,888	1,152	936	2,024	1,208	2,033	1,586	7,017	3,555	3,185
	Minimum	1,768	3,810	1,891	640	23	117	215	745	1,052	565	828	2,111	23

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2007	Maximum	7,391	7,538	6,485	6,085	4,362	7,583	7,877	3,202	3,471	6,687	4,538	4,821	7,877
	Average	5,776	6,170	5,219	4,604	1,955	4,822	4,670	1,557	2,384	3,297	3,226	3,546	3,919
	Minimum	2,922	5,138	2,935	2,849	521	1,139	1,649	375	533	1,328	1,532	1,286	375
2008	Maximum	7,516	7,711	6,441	4,644	2,428	2,844	9,918	3,237	4,293	3,564	4,387	4,644	9,918
	Average	5,705	5,368	4,539	3,109	874	1,300	4,184	1,998	2,878	2,838	2,489	3,567	3,237
	Minimum	3,997	2,693	2,754	1,129	241	249	1,122	614	1,840	1,437	60	2,374	60
2009	Maximum	4,433	4,902	3,361	4,662	1,861	7,372	4,494	3,762	3,426	3,633	8,958	6,308	8,958
	Average	3,164	3,914	2,678	2,552	1,073	3,419	2,658	1,696	1,732	2,169	6,230	4,601	2,978
	Minimum	1,366	2,605	1,854	1,329	356	312	986	393	593	421	1,960	3,383	312
2010	Maximum	5,328	5,699	3,719	3,958	3,491	5,701	6,341	3,922	4,368	7,995	4,537	5,183	7,995
	Average	4,059	3,819	3,033	2,913	2,213	2,350	4,698	2,150	2,433	4,730	2,829	3,113	3,196
	Minimum	3,239	2,415	2,035	1,841	618	437	2,855	1,322	994	698	1,376	2,042	437
2011	Maximum	7,104	7,335	7,708	5,326	5,984	5,903	8,338	5,663	4,160	3,458	6,626	4,198	8,338
	Average	4,852	6,387	5,959	4,247	3,257	3,745	5,870	3,698	2,742	2,866	3,939	3,657	4,257
	Minimum	1,961	4,995	3,306	2,906	1,847	1,344	3,673	1,854	1,200	1,696	1,367	2,357	1,200
2012	Maximum	5,804	6,995	7,446	4,708	5,144	10,598	9,832	5,025	3,713	3,249	9,829	5,382	10,598
	Average	4,687	6,255	5,149	2,931	3,854	6,192	6,699	2,747	2,312	2,065	5,779	4,515	4,430
	Minimum	2,884	5,643	3,165	560	2,404	1,350	2,640	843	1,507	14	3,145	3,908	14
2013	Maximum	7,746	6,849	4,926	4,632	3,815	4,853	4,668	3,678	3,882	7,507	4,612	4,767	7,746
	Average	6,103	5,332	3,741	3,528	2,325	3,187	2,980	2,207	2,602	5,101	3,794	4,239	3,754
	Minimum	4,756	4,653	2,950	2,244	635	1,708	709	1,087	1,221	2,449	3,294	3,085	635
2014	Maximum	4,566	5,650	5,066	5,610	5,010	9,671	9,276	3,973	4,234	5,043	10,128	13,690	13,690
	Average	3,764	4,262	4,020	4,463	3,170	5,199	5,471	2,105	2,775	2,761	4,756	6,243	4,079
	Minimum	2,793	3,231	1,481	3,703	1,414	2,308	1,817	645	1,525	1,361	955	3,729	645
2015	Maximum	7,614	7,782	7,315	4,104	2,799	4,198	3,212	1,589	4,404	4,868	6,674	6,045	7,782
	Average	6,075	6,426	4,598	3,074	1,473	1,781	1,763	1,078	3,038	3,446	3,906	4,998	3,456
	Minimum	2,312	2,172	1,694	2,143	103	345	434	335	592	1,366	2,284	2,477	103
2016	Maximum	8,246	6,969	7,252	4,952	6,112	5,839	4,706	2,631	4,584	6,330	11,229	7,101	11,229
	Average	6,310	5,452	5,642	3,196	3,501	3,206	2,621	1,839	3,216	3,914	4,334	4,524	3,977
	Minimum	2,764	1,002	4,165	316	1,409	703	826	784	1,533	880	1,778	3,209	316

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2017	Maximum	7,780	3,891	7,405	5,546	5,994	9,350	4,730	3,246	5,221	4,539	10,071	12,255	12,255
	Average	5,356	2,723	4,070	4,480	3,732	4,690	3,073	1,896	3,091	2,991	3,964	5,003	3,761
	Minimum	2,430	245	1,670	3,005	703	2,269	1,910	618	668	591	549	2,917	245
2018	Maximum	6,381	12,218	12,377	3,626	2,907	3,903	3,336	3,541	4,379	5,022	4,439	4,523	12,377
	Average	5,261	7,835	7,085	2,662	1,360	2,097	1,903	1,936	3,566	3,797	3,166	3,806	3,765
	Minimum	3,641	3,895	3,220	863	119	14	443	881	1,012	1,628	102	2,814	14
2019	Maximum	6,922	6,808	5,714	4,903	4,428	3,726	2,646	2,782	3,201	3,135	3,156	3,671	6,922
	Average	5,535	5,770	4,671	3,330	2,089	1,946	1,568	1,251	2,178	2,091	2,405	2,275	2,917
	Minimum	2,509	4,875	2,791	1,047	574	611	961	593	936	19	517	1,227	19
2020	Maximum	3,693	6,677	7,423	4,387	3,009	7,179	6,614	2,477	4,416	7,994	8,986	4,460	8,986
	Average	2,046	4,956	5,039	3,128	1,146	3,459	3,544	1,649	2,789	3,587	3,967	3,570	3,235
	Minimum	312	1,649	3,224	1,501	65	1,048	1,548	741	964	682	1,299	1,441	65
33-Year Summary	Maximum	8,246	14,052	12,377	7,376	6,892	17,336	13,933	9,086	6,047	27,494	23,326	24,445	27,494
	Average	4,791	5,198	4,407	3,179	2,259	2,681	3,345	2,108	2,411	2,833	4,267	3,844	3,446
	Minimum	69	245	469	5	2	13	18	174	56	14	53	329	2

Table 4.2.2-4. Monthly minimum, average, and maximum outflows (cfs) from Diablo Lake (1988-2020).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	5,295	5,911	5,937	3,946	4,550	5,265	5,579	4,340	3,679	5,535	5,870	4,391	5,937
	Average	3,181	4,101	4,452	2,790	2,106	3,579	4,000	3,379	3,314	3,837	4,597	3,798	3,614
	Minimum	1,821	2,827	3,095	1,869	1,177	924	2,344	2,857	2,616	2,559	1,961	3,066	924
1989	Maximum	6,769	7,008	6,444	3,482	3,828	3,896	7,444	4,073	3,279	3,168	6,741	15,002	15,002
	Average	5,829	6,280	3,014	2,089	2,206	3,199	3,897	3,183	2,758	2,524	5,360	5,140	3,794
	Minimum	3,547	5,000	1,941	1,220	1,265	2,037	2,147	1,835	1,734	1,877	3,399	3,134	1,220
1990	Maximum	7,032	7,042	6,843	3,862	3,264	5,395	9,346	5,615	4,013	6,068	25,587	13,517	25,587
	Average	5,576	6,546	5,579	3,528	2,783	2,795	5,472	3,295	3,513	3,027	13,276	5,549	5,069
	Minimum	3,218	5,800	3,275	3,188	1,497	1,263	2,615	1,697	2,441	1,965	6,164	3,142	1,263

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1991	Maximum	7,013	14,857	6,934	7,109	5,599	5,840	16,061	6,696	6,528	3,394	5,063	4,144	16,061
	Average	5,807	9,414	6,409	5,419	5,222	4,269	8,892	5,130	3,430	2,823	2,908	3,421	5,241
	Minimum	3,928	4,810	3,616	3,312	4,763	2,452	4,931	2,704	2,649	1,972	1,526	2,307	1,526
1992	Maximum	6,225	7,016	7,000	4,636	2,791	2,596	5,470	4,444	3,030	4,997	5,126	4,205	7,016
	Average	5,542	6,466	5,268	3,135	1,863	2,245	4,250	3,462	2,043	2,679	4,137	3,444	3,806
	Minimum	3,760	5,440	3,659	1,489	1,537	1,944	1,960	2,128	1,476	1,663	2,809	1,789	1,476
1993	Maximum	5,568	4,937	2,672	2,554	1,879	1,757	4,813	3,603	3,605	2,888	5,772	4,258	5,772
	Average	3,702	3,698	2,241	2,094	1,452	1,463	2,913	2,722	2,566	2,550	3,946	3,220	2,845
	Minimum	2,244	2,241	1,982	1,902	814	1,054	1,887	1,801	1,733	2,160	2,531	2,162	814
1994	Maximum	5,680	5,811	4,734	4,432	3,225	2,644	3,672	3,689	3,460	3,164	4,279	4,348	5,811
	Average	4,175	4,059	3,437	3,796	2,545	2,161	3,158	3,155	3,152	2,263	2,969	3,423	3,194
	Minimum	2,485	1,680	2,459	2,934	2,135	1,774	2,026	2,283	2,582	1,513	1,973	2,037	1,513
1995	Maximum	6,750	6,495	6,819	6,441	4,636	4,724	3,785	3,780	3,215	3,169	19,196	27,201	27,201
	Average	5,490	5,499	5,994	4,164	3,443	2,951	2,798	3,084	2,597	2,485	9,968	8,973	4,810
	Minimum	3,763	4,469	4,844	3,218	1,809	2,073	2,183	1,593	1,731	1,538	2,470	2,306	1,538
1996	Maximum	7,024	6,837	6,288	5,667	5,208	4,789	6,489	4,333	3,290	3,335	4,746	4,323	7,024
	Average	5,262	4,779	5,290	4,787	4,533	4,136	4,550	2,761	2,690	2,727	3,565	3,608	4,055
	Minimum	2,829	2,032	3,935	3,884	4,108	3,086	2,407	1,887	1,923	1,918	2,224	2,438	1,887
1997	Maximum	7,126	6,811	7,025	6,867	6,759	21,831	19,297	6,511	3,183	12,564	10,842	4,138	21,831
	Average	5,018	5,859	6,410	5,961	6,098	8,861	8,247	3,722	2,551	4,214	5,312	3,834	5,503
	Minimum	1,768	4,394	4,014	3,573	5,208	5,775	4,463	1,997	1,714	1,944	2,916	3,020	1,714
1998	Maximum	6,562	5,048	5,720	5,273	2,303	2,588	6,144	4,534	4,198	3,416	3,437	5,142	6,562
	Average	4,995	4,115	4,553	4,196	1,968	2,021	3,552	3,102	3,122	2,921	2,855	3,389	3,413
	Minimum	3,427	3,368	3,922	2,424	1,573	1,618	1,969	2,200	1,417	2,200	1,634	1,563	1,417
1999	Maximum	6,619	6,631	6,475	5,299	5,750	5,934	12,885	12,199	4,211	3,966	14,464	5,739	14,464
	Average	5,659	6,368	5,426	4,367	4,404	4,685	7,435	6,543	3,577	3,400	6,608	4,124	5,210
	Minimum	2,798	5,956	4,024	3,166	3,191	3,165	4,657	3,586	3,045	2,627	2,263	2,528	2,263
2000	Maximum	6,987	6,284	5,502	4,291	3,336	5,912	6,263	5,451	3,926	3,434	5,612	4,848	6,987
	Average	6,149	5,465	4,601	3,337	2,629	3,036	4,937	3,559	3,229	3,040	3,713	3,289	3,926
	Minimum	4,953	4,887	4,074	2,871	1,771	1,697	3,603	2,063	2,143	1,804	2,958	2,215	1,697

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2001	Maximum	4,459	2,670	2,491	2,373	1,641	1,873	3,093	4,183	3,579	2,942	3,258	4,210	4,459
	Average	2,671	2,305	2,252	1,797	1,312	1,233	2,742	3,544	2,671	2,286	2,258	2,963	2,406
	Minimum	1,703	1,974	1,931	1,277	942	887	2,440	2,932	1,588	1,566	1,215	2,162	887
2002	Maximum	7,086	6,984	6,891	5,880	6,746	8,301	13,308	4,095	3,822	3,301	3,229	3,195	13,308
	Average	6,035	5,830	6,254	4,269	5,330	5,333	7,615	3,196	2,425	2,172	2,450	2,082	4,413
	Minimum	2,467	4,096	4,648	1,698	3,294	2,662	3,424	2,463	1,534	1,571	1,642	1,678	1,534
2003	Maximum	5,817	6,501	4,770	4,235	3,966	6,606	5,799	3,998	3,721	31,471	7,433	7,517	31,471
	Average	4,554	4,106	3,240	3,602	3,459	4,308	3,705	3,152	3,061	6,765	5,624	3,937	4,121
	Minimum	2,227	2,176	1,544	2,857	2,257	2,279	2,743	2,189	2,353	2,401	3,039	3,108	1,544
2004	Maximum	7,120	7,050	4,779	2,847	2,011	9,894	6,252	4,832	3,721	6,094	6,987	6,918	9,894
	Average	5,759	6,557	2,634	2,494	1,707	3,801	3,585	3,273	3,088	3,507	5,144	4,272	3,805
	Minimum	3,566	3,907	2,250	2,042	1,368	1,287	2,397	1,867	1,981	2,191	2,906	3,074	1,287
2005	Maximum	7,062	6,796	3,946	2,323	2,484	2,320	2,626	2,372	3,278	4,488	6,786	4,492	7,062
	Average	5,732	5,056	2,693	2,032	2,051	1,909	2,105	2,094	2,822	2,963	5,282	3,874	3,225
	Minimum	2,347	3,918	2,149	1,411	1,402	1,636	1,794	1,916	2,253	1,559	3,926	2,098	1,402
2006	Maximum	7,000	7,081	7,071	2,730	3,377	3,419	5,566	2,502	2,934	2,375	23,478	4,442	23,478
	Average	5,418	6,393	5,855	2,237	2,119	2,590	3,610	2,082	2,617	1,822	8,105	3,813	3,888
	Minimum	2,282	3,748	2,705	1,551	1,767	2,047	2,396	1,928	2,024	1,570	1,657	2,693	1,551
2007	Maximum	7,071	6,912	6,958	5,982	4,763	9,161	10,420	3,293	3,206	6,861	4,370	5,393	10,420
	Average	6,063	6,388	6,011	5,167	3,307	6,213	6,505	2,606	2,831	3,767	3,539	4,060	4,694
	Minimum	3,944	5,273	3,337	4,055	2,544	3,409	3,300	1,999	2,200	1,983	3,279	3,504	1,983
2008	Maximum	7,569	7,276	6,828	3,967	3,910	5,237	13,517	4,815	4,343	3,599	4,601	4,343	13,517
	Average	5,846	5,480	4,754	3,346	2,312	2,648	5,942	3,355	3,453	3,260	3,269	3,801	3,957
	Minimum	4,314	3,135	3,218	2,841	1,402	1,388	2,543	1,657	2,984	1,514	1,696	2,900	1,388
2009	Maximum	5,176	5,272	3,298	3,447	2,979	9,195	5,699	5,174	4,245	5,817	10,434	6,784	10,434
	Average	3,608	4,076	2,852	2,897	2,053	5,028	4,113	2,832	2,657	2,850	6,878	4,912	3,720
	Minimum	2,216	2,711	2,632	2,067	1,417	2,147	2,430	2,075	1,914	2,070	3,188	3,840	1,417
2010	Maximum	5,378	5,706	3,531	3,439	3,260	7,070	7,763	4,375	4,342	7,779	4,202	4,381	7,779
	Average	4,376	3,983	3,195	3,194	2,949	3,874	6,103	3,145	3,315	5,277	3,230	3,551	3,853
	Minimum	3,434	2,767	2,896	2,897	2,392	2,301	4,220	2,155	1,624	2,172	2,230	2,740	1,624

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2011	Maximum	7,235	7,416	7,282	5,458	4,830	7,316	10,282	7,958	4,227	4,049	6,429	4,381	10,282
	Average	5,443	6,783	6,238	4,540	4,064	5,322	7,626	5,026	3,658	3,456	4,379	3,953	5,033
	Minimum	3,618	5,620	4,693	2,850	2,748	3,198	5,294	3,032	2,921	2,950	3,020	3,323	2,748
2012	Maximum	5,735	6,935	7,082	4,613	5,765	12,128	12,488	6,247	3,317	3,788	10,252	5,204	12,488
	Average	5,010	6,501	5,363	3,554	4,921	7,810	9,003	4,108	2,939	2,970	6,558	4,803	5,296
	Minimum	3,001	5,844	3,231	2,139	4,146	4,491	4,142	2,493	1,959	1,707	4,274	4,322	1,707
2013	Maximum	7,495	6,941	4,950	4,751	4,345	6,510	5,887	4,894	5,475	8,088	4,434	4,878	8,088
	Average	6,280	5,474	4,062	4,042	3,632	4,697	4,354	3,447	3,838	5,479	4,048	4,444	4,478
	Minimum	5,101	4,857	3,430	3,167	2,800	3,776	2,640	2,279	2,739	3,792	3,561	3,793	2,279
2014	Maximum	4,435	5,704	5,291	5,392	5,198	11,860	11,392	4,473	3,720	5,417	11,496	14,575	14,575
	Average	4,064	4,452	4,568	4,892	4,359	6,688	7,437	3,377	3,514	3,554	5,705	6,952	4,965
	Minimum	3,664	3,943	2,836	4,143	3,739	4,293	3,740	2,353	2,904	2,949	2,089	4,446	2,089
2015	Maximum	7,325	7,700	7,398	3,782	2,848	4,285	3,419	2,786	4,410	4,323	5,644	6,415	7,700
	Average	6,714	7,119	5,084	3,519	2,552	3,238	3,148	2,238	3,866	4,000	4,736	5,577	4,300
	Minimum	4,664	5,009	3,761	2,755	2,244	2,322	2,883	1,923	2,459	3,517	3,640	3,892	1,923
2016	Maximum	7,264	7,096	7,167	4,585	6,144	6,229	5,835	3,345	4,550	6,831	10,526	7,306	10,526
	Average	6,650	6,103	6,004	4,136	4,640	4,581	3,913	2,760	3,811	4,880	5,074	4,749	4,772
	Minimum	5,174	2,938	4,176	2,932	3,414	3,208	3,214	2,027	2,316	3,514	3,520	4,079	2,027
2017	Maximum	7,456	4,102	7,424	6,077	6,202	10,256	6,259	4,336	4,628	5,057	10,293	12,570	12,570
	Average	5,511	3,150	4,590	4,951	5,295	6,652	4,630	3,106	3,684	3,576	4,812	5,369	4,618
	Minimum	2,873	1,514	2,772	3,689	3,804	4,617	3,400	1,756	1,596	1,936	2,918	3,986	1,514
2018	Maximum	6,863	12,217	12,185	3,574	4,324	4,218	5,344	4,566	4,479	4,497	5,064	4,496	12,217
	Average	5,642	8,312	7,318	3,198	3,020	3,518	3,584	3,103	4,083	4,245	3,875	4,120	4,532
	Minimum	4,017	5,008	3,878	2,547	1,592	2,535	2,179	2,049	1,720	3,645	2,112	3,781	1,592
2019	Maximum	6,664	6,944	5,686	4,804	4,594	3,976	2,795	2,584	3,273	3,125	3,206	2,974	6,944
	Average	5,829	5,944	4,840	3,865	3,173	3,039	2,519	2,238	3,046	2,766	2,789	2,602	3,546
	Minimum	3,551	5,079	4,062	2,577	2,243	2,354	2,045	2,074	2,636	1,236	1,597	1,728	1,236
2020	Maximum	3,370	6,510	6,431	3,832	3,247	8,863	6,864	3,930	4,372	8,581	10,191	4,710	10,191
	Average	2,614	5,468	5,210	3,559	2,503	4,945	4,905	2,623	3,643	4,460	4,798	4,012	4,056
	Minimum	1,440	3,062	4,082	2,574	1,632	3,176	3,097	2,089	1,841	3,021	3,168	3,091	1,440

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
33-Year Summary	Maximum	7,569	14,857	12,185	7,109	6,759	21,831	19,297	12,199	6,528	31,471	25,587	27,201	31,471
	Average	5,158	5,519	4,718	3,673	3,309	4,155	4,923	3,285	3,141	3,408	4,905	4,213	4,198
	Minimum	1,440	1,514	1,544	1,220	814	887	1,794	1,593	1,417	1,236	1,215	1,563	814

Table 4.2.2-5. Monthly minimum, average, and maximum outflows (cfs) from Gorge Lake (1988-2020).

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1988	Maximum	5,266	6,147	6,203	4,112	4,761	5,927	5,852	4,599	3,771	5,675	6,078	4,711	6,203
	Average	3,304	4,281	4,698	3,346	2,627	4,123	4,454	3,562	3,483	4,095	4,932	4,008	3,921
	Minimum	2,230	3,201	3,289	2,421	1,722	1,316	2,886	2,916	2,559	2,676	3,406	3,212	1,316
1989	Maximum	6,950	7,286	6,617	4,411	4,857	4,367	8,072	4,230	3,331	3,234	9,599	15,649	15,649
	Average	6,023	6,426	3,184	2,626	2,743	3,813	4,258	3,390	2,853	2,675	6,000	5,447	4,116
	Minimum	3,666	5,312	2,272	1,934	1,637	2,977	2,602	2,023	1,867	2,035	3,751	3,280	1,637
1990	Maximum	7,171	7,457	6,892	4,302	3,474	5,852	10,422	5,824	4,075	6,542	26,489	13,808	26,489
	Average	5,791	6,684	5,777	4,068	3,172	3,391	5,953	3,470	3,591	3,461	14,283	5,804	5,445
	Minimum	3,328	5,901	3,418	3,209	2,139	1,858	3,187	2,035	2,495	2,444	6,731	3,164	1,858
1991	Maximum	7,200	15,719	7,175	7,484	6,047	6,277	17,185	7,132	6,867	3,575	5,638	4,326	17,185
	Average	6,040	10,050	6,606	5,807	5,723	4,791	9,524	5,520	3,607	2,901	3,294	3,600	5,599
	Minimum	4,023	6,812	3,766	3,728	5,489	3,094	5,067	3,181	2,782	2,093	1,853	2,589	1,853
1992	Maximum	6,409	7,333	7,237	4,817	3,249	3,019	5,771	4,600	3,162	5,098	5,299	4,213	7,333
	Average	5,842	6,753	5,465	3,480	2,182	2,575	4,452	3,584	2,173	2,811	4,338	3,563	4,023
	Minimum	3,899	5,864	3,741	1,986	1,968	2,136	2,520	2,223	1,587	1,683	3,530	1,963	1,587
1993	Maximum	5,565	4,939	3,202	2,655	2,773	2,532	5,113	4,729	3,677	3,014	5,934	4,450	5,934
	Average	3,808	3,891	2,434	2,326	2,029	1,883	3,191	2,890	2,645	2,704	4,066	3,434	3,043
	Minimum	2,567	2,429	2,310	2,294	1,700	1,457	2,318	2,031	1,775	2,275	2,616	2,284	1,457
1994	Maximum	5,966	6,009	4,960	4,692	3,531	3,539	4,122	3,704	3,604	3,304	4,610	4,804	6,009
	Average	4,499	4,268	3,786	4,194	3,033	2,561	3,439	3,264	3,272	2,418	3,120	3,713	3,467
	Minimum	2,825	2,596	2,634	3,679	2,488	2,225	2,317	2,352	2,773	1,792	2,148	2,355	1,792

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1995	Maximum	6,866	6,996	7,008	6,604	5,457	5,221	4,228	4,518	3,362	3,620	22,178	28,047	28,047
	Average	5,688	6,075	6,216	4,370	4,161	3,466	3,135	3,305	2,699	2,871	11,043	9,349	5,218
	Minimum	3,877	5,319	5,072	3,454	2,555	2,495	2,557	1,820	1,763	1,738	3,553	2,430	1,738
1996	Maximum	7,236	7,111	6,251	5,822	5,381	5,467	6,802	4,458	3,449	3,828	5,526	4,362	7,236
	Average	5,616	5,242	5,492	5,194	4,883	4,582	4,960	2,942	2,842	3,004	3,906	3,739	4,363
	Minimum	3,241	2,504	4,044	4,435	4,358	3,440	2,730	1,922	2,018	2,199	2,547	2,525	1,922
1997	Maximum	7,438	7,097	7,377	7,248	8,103	23,085	21,829	6,881	3,369	14,034	11,363	4,412	23,085
	Average	5,445	6,132	6,819	6,415	6,929	9,655	8,905	4,017	2,829	4,694	5,640	4,025	5,955
	Minimum	2,391	4,699	4,303	3,777	6,306	6,309	4,816	2,084	2,196	2,622	3,306	3,086	2,084
1998	Maximum	6,690	5,172	5,861	5,319	3,136	2,991	6,406	4,603	4,283	3,539	4,071	5,287	6,690
	Average	5,203	4,309	4,754	4,444	2,475	2,520	3,827	3,199	3,183	3,042	3,186	3,688	3,663
	Minimum	3,657	3,642	4,168	3,078	2,288	2,256	2,417	2,256	1,797	2,403	2,045	2,231	1,797
1999	Maximum	6,822	6,771	6,708	5,465	6,297	6,619	13,611	13,754	4,382	4,037	14,891	6,118	14,891
	Average	5,959	6,546	5,632	4,668	4,881	5,366	8,224	7,078	3,790	3,698	7,114	4,437	5,610
	Minimum	3,298	6,329	4,290	3,730	3,963	4,167	5,637	4,084	3,396	3,368	3,288	3,197	3,197
2000	Maximum	7,070	6,446	5,510	4,526	3,602	6,677	6,683	5,796	4,303	4,404	5,768	5,011	7,070
	Average	6,267	5,601	4,750	3,753	3,122	3,704	5,412	3,799	3,427	3,249	3,816	3,378	4,196
	Minimum	5,133	4,974	4,254	3,101	2,348	2,494	4,216	2,218	2,388	1,858	2,926	2,306	1,858
2001	Maximum	4,568	2,692	2,570	2,465	1,955	2,052	3,152	4,201	3,628	3,022	4,873	4,115	4,873
	Average	2,835	2,392	2,401	2,014	1,665	1,608	2,986	3,721	2,770	2,529	2,680	3,157	2,622
	Minimum	2,369	2,176	2,360	1,920	1,499	1,482	2,655	3,343	1,621	1,745	1,756	2,305	1,482
2002	Maximum	8,890	7,095	7,126	5,999	6,908	9,655	14,168	4,553	4,054	3,516	3,306	3,288	14,168
	Average	6,427	6,124	6,424	4,734	5,875	6,197	8,223	3,440	2,549	2,238	2,641	2,210	4,754
	Minimum	2,588	5,350	5,005	2,869	3,748	3,378	3,443	2,570	1,736	1,788	1,800	1,897	1,736
2003	Maximum	6,483	6,516	4,861	4,480	4,202	7,046	6,318	4,179	3,791	32,446	8,138	7,598	32,446
	Average	4,950	4,285	3,589	3,917	3,880	4,795	3,989	3,279	3,142	7,494	6,001	4,085	4,445
	Minimum	2,429	2,510	2,305	3,218	3,173	2,759	2,984	2,313	2,391	2,564	2,428	3,397	2,305
2004	Maximum	7,353	7,259	4,738	3,071	2,539	10,527	6,516	4,903	4,047	6,269	7,229	6,989	10,527
	Average	5,990	6,714	2,889	2,871	2,267	4,310	3,847	3,472	3,479	3,711	5,619	4,679	4,140
	Minimum	3,643	3,985	2,668	2,700	2,052	1,949	2,695	2,260	2,267	2,692	3,810	3,820	1,949

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2005	Maximum	9,872	7,101	4,013	2,500	2,794	2,617	2,678	2,470	3,364	4,727	7,127	4,603	9,872
	Average	6,264	5,254	2,872	2,383	2,465	2,206	2,315	2,195	2,890	3,271	5,595	4,178	3,498
	Minimum	3,456	4,142	2,453	2,295	1,930	2,037	2,044	2,113	2,363	2,089	4,262	2,717	1,930
2006	Maximum	7,515	7,136	7,223	2,941	5,268	3,542	5,956	2,775	2,995	2,407	24,819	4,545	24,819
	Average	5,824	6,585	5,976	2,552	2,651	3,251	3,979	2,203	2,703	1,893	8,813	4,023	4,197
	Minimum	2,694	3,992	2,816	2,329	2,162	2,788	2,657	2,123	1,951	1,678	2,150	3,103	1,678
2007	Maximum	7,126	7,014	9,313	6,124	5,163	9,842	11,271	3,481	3,292	6,999	4,436	7,464	11,271
	Average	6,298	6,635	6,586	5,541	3,874	6,898	7,091	2,771	2,928	4,140	3,832	4,339	5,068
	Minimum	4,328	5,561	3,714	4,384	3,415	4,655	3,579	2,244	2,384	2,984	3,446	3,678	2,244
2008	Maximum	7,571	7,316	6,885	4,138	6,151	6,598	15,244	5,168	4,316	3,668	4,552	4,513	15,244
	Average	5,929	5,590	4,928	3,549	3,255	3,262	6,570	3,718	3,599	3,465	3,780	3,932	4,300
	Minimum	4,436	3,359	3,584	3,066	2,293	2,194	2,959	2,104	2,982	1,842	1,871	3,048	1,842
2009	Maximum	6,273	5,456	3,469	3,647	3,997	9,563	6,013	5,852	4,404	6,505	11,165	7,254	11,165
	Average	4,012	4,199	2,957	3,140	2,526	5,527	4,381	2,978	2,780	3,183	7,332	5,063	3,997
	Minimum	2,745	2,953	2,811	2,691	1,945	2,671	2,786	2,247	2,228	2,558	4,568	4,079	1,945
2010	Maximum	5,515	5,789	3,664	3,528	3,401	7,475	8,251	4,451	4,376	7,888	4,514	5,797	8,251
	Average	4,612	4,092	3,287	3,368	3,248	4,389	6,432	3,274	3,515	5,427	3,665	3,843	4,100
	Minimum	3,501	3,107	3,008	3,092	2,720	2,880	4,543	2,254	1,752	2,237	2,615	2,899	1,752
2011	Maximum	7,771	7,676	7,479	5,592	4,899	7,752	10,932	8,542	4,439	4,264	6,770	4,506	10,932
	Average	5,826	7,035	6,404	4,740	4,435	5,857	8,318	5,464	3,894	3,707	4,653	4,174	5,368
	Minimum	4,026	6,017	5,086	3,016	2,983	3,579	5,776	3,773	3,272	2,868	3,288	3,388	2,868
2012	Maximum	6,145	7,220	7,305	4,838	6,046	13,000	13,468	6,726	3,347	5,726	10,445	5,247	13,468
	Average	5,321	6,771	5,511	3,972	5,442	8,485	9,806	4,485	3,068	3,590	7,092	4,953	5,709
	Minimum	3,255	6,337	3,384	2,700	4,495	5,307	4,770	2,652	2,136	3,075	4,773	4,617	2,136
2013	Maximum	7,740	7,084	5,184	4,862	5,250	6,925	6,202	5,045	6,668	8,391	4,372	4,841	8,391
	Average	6,414	5,611	4,344	4,432	4,216	5,245	4,838	3,617	4,124	5,686	4,157	4,566	4,767
	Minimum	5,192	5,036	3,764	3,701	3,638	4,439	2,981	2,403	2,876	3,887	3,564	4,288	2,403
2014	Maximum	4,545	5,760	5,566	5,621	5,480	12,938	12,102	4,689	3,744	6,063	12,243	14,991	14,991
	Average	4,304	4,574	4,943	5,236	5,051	7,378	8,045	3,572	3,624	3,908	6,428	7,284	5,365
	Minimum	3,972	4,091	4,208	4,515	4,368	5,185	4,134	2,504	3,000	3,442	4,338	4,769	2,504

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2015	Maximum	8,082	8,207	7,532	3,940	3,212	4,382	3,316	3,588	4,387	5,325	6,269	6,804	8,207
	Average	7,084	7,512	5,377	3,791	2,937	3,472	3,228	2,332	4,049	4,200	5,131	5,875	4,564
	Minimum	4,883	6,608	4,312	3,028	2,732	2,839	3,086	2,178	3,299	3,616	4,053	5,365	2,178
2016	Maximum	7,711	7,404	7,561	4,952	6,318	6,577	6,194	3,483	4,538	7,662	10,702	7,371	10,702
	Average	6,907	6,591	6,320	4,632	5,059	4,946	4,117	2,848	3,903	5,253	5,376	4,850	5,062
	Minimum	5,751	3,726	4,403	3,445	3,857	3,714	3,520	2,176	2,392	3,998	3,944	4,256	2,176
2017	Maximum	7,625	4,408	7,575	6,125	6,398	10,678	6,765	4,445	4,529	7,191	13,922	12,745	13,922
	Average	5,618	3,556	5,026	5,298	6,106	7,310	4,976	3,212	3,724	3,937	5,402	5,474	4,977
	Minimum	2,923	2,901	3,612	4,064	5,461	5,318	3,762	1,788	1,659	3,517	3,573	4,217	1,659
2018	Maximum	7,034	12,378	12,272	4,115	4,783	4,375	5,692	4,642	4,545	4,523	5,658	5,107	12,378
	Average	5,960	8,716	7,424	3,631	3,952	4,032	3,904	3,188	4,171	4,386	4,422	4,336	4,854
	Minimum	4,533	6,753	3,990	3,406	2,492	2,854	2,825	2,194	1,798	4,259	3,968	4,081	1,798
2019	Maximum	6,874	6,862	5,705	5,844	4,688	4,236	3,053	2,585	3,243	3,222	3,333	3,044	6,874
	Average	6,080	6,070	4,948	4,205	3,803	3,365	2,698	2,322	3,179	3,099	2,976	2,808	3,789
	Minimum	4,572	5,200	4,317	3,123	3,402	2,617	2,381	2,222	3,095	2,770	2,755	2,408	2,222
2020	Maximum	3,553	6,856	6,474	3,974	4,364	9,266	7,570	4,125	4,472	8,849	10,614	4,526	10,614
	Average	3,032	5,821	5,320	3,859	3,234	5,535	5,327	2,792	3,797	4,843	5,179	4,254	4,410
	Minimum	2,354	3,641	4,299	3,705	2,695	3,637	3,384	2,292	1,931	3,773	3,693	3,739	1,931
33-Year Summary	Maximum	9,872	15,719	12,272	7,484	8,103	23,085	21,829	13,754	6,867	32,446	26,489	28,047	32,446
	Average	5,429	5,769	4,944	4,025	3,851	4,696	5,336	3,482	3,284	3,680	5,321	4,431	4,516
	Minimum	2,230	2,176	2,272	1,920	1,499	1,316	2,044	1,788	1,587	1,678	1,756	1,897	1,316

Flow Duration Curves

Annual outflow duration curves for Ross Lake, Diablo Lake, and Gorge Lake (1988-2020) are provided in Figures 4.2.2-4 through 4.2.2-6. Monthly flow duration curves for the same locations and period of record are included in Exhibit B, Appendix B of this Draft License Application. Dependable capacity for the Project is discussed in Section 3.1.5.1, above.

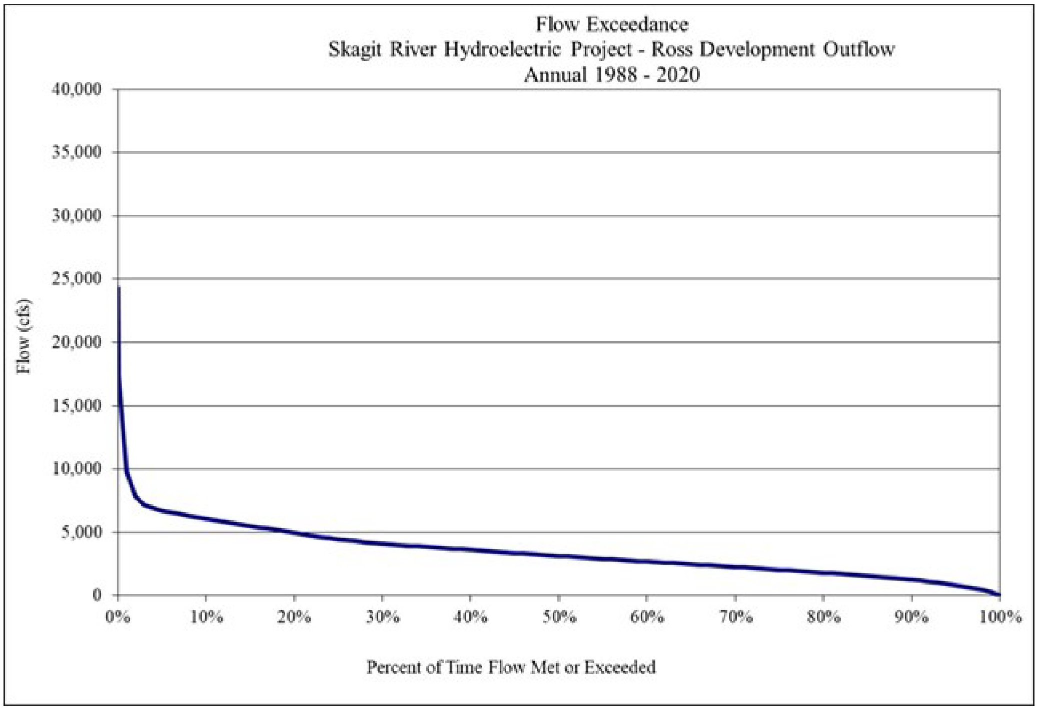


Figure 4.2.2-4. Ross Lake annual outflow duration curve (1988-2020).

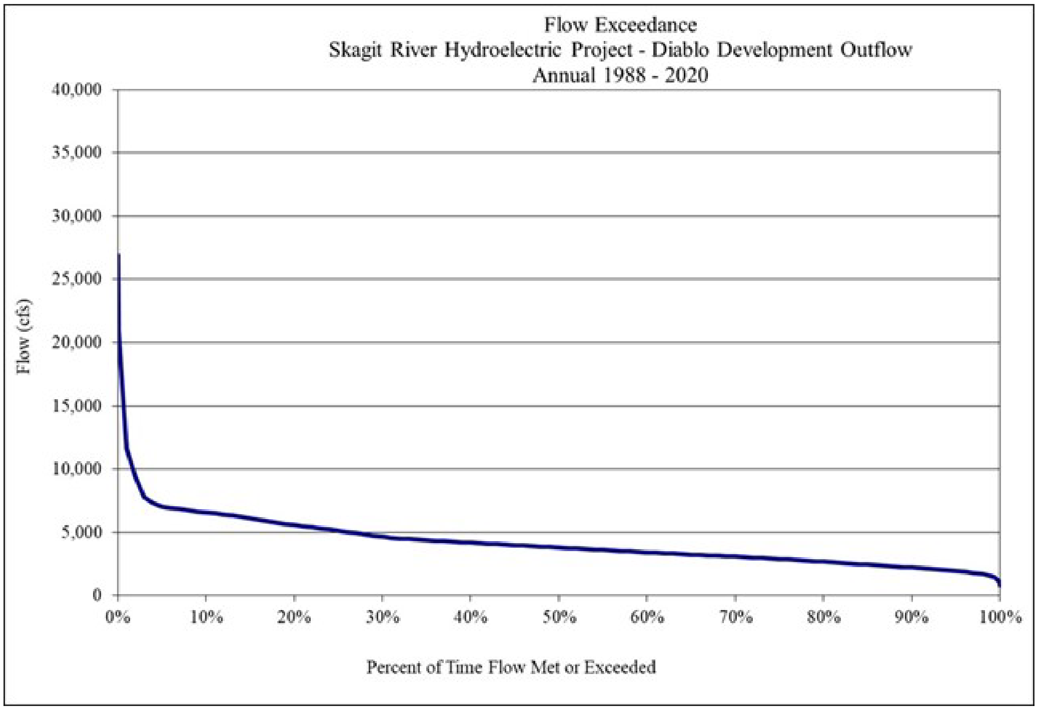


Figure 4.2.2-5. Diablo Lake annual outflow duration curve (1988-2020).

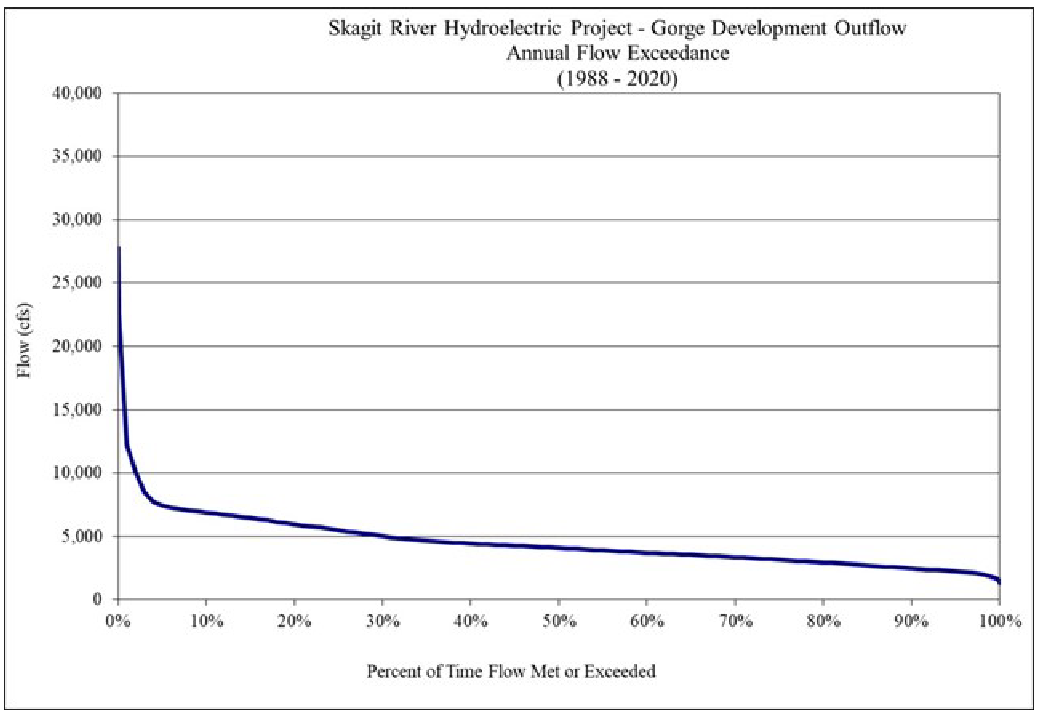


Figure 4.2.2-6. Gorge Lake annual outflow duration curve (1988-2020).

Reservoir Surface Elevation Curves

Annual percent exceedance curves of water surface elevations for Ross Lake, Diablo Lake, and Gorge Lake from 1988-2020 are provided in Figures 4.2.2-7 through 4.2.2-9. These illustrate the role of Ross Lake for storage and flood risk management and the relative stability of the other two reservoirs. See Section 3.1 of this Exhibit E for more detail on reservoir operations.

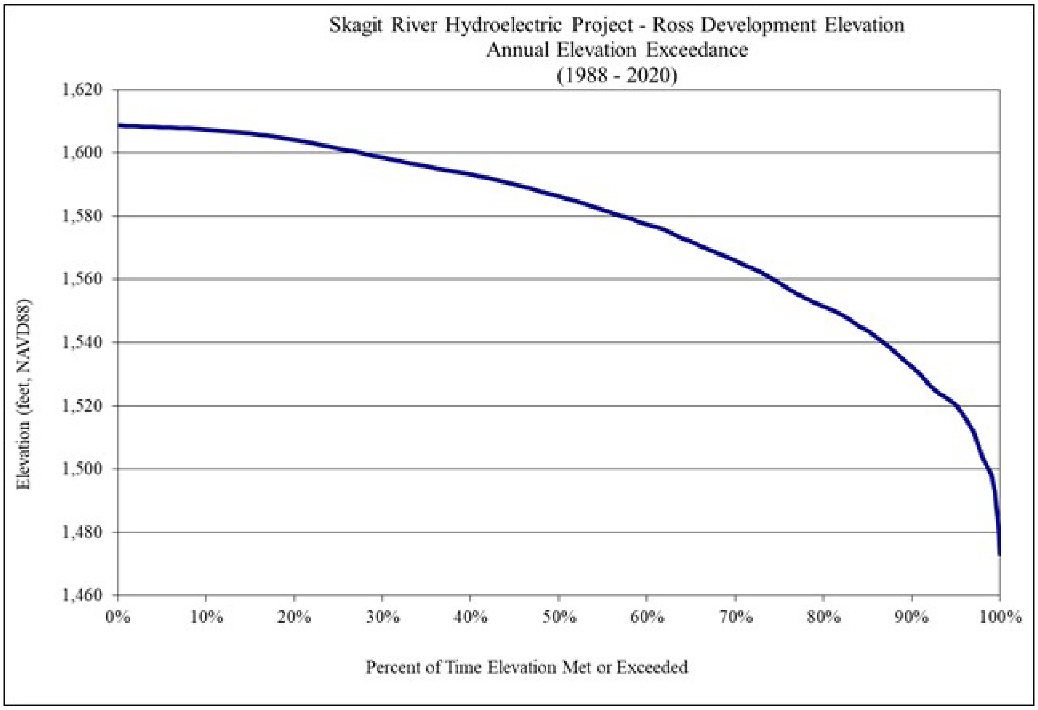


Figure 4.2.2-7. Annual percent exceedance curve of water surface elevations for Ross Lake, based on the period 1988-2020.

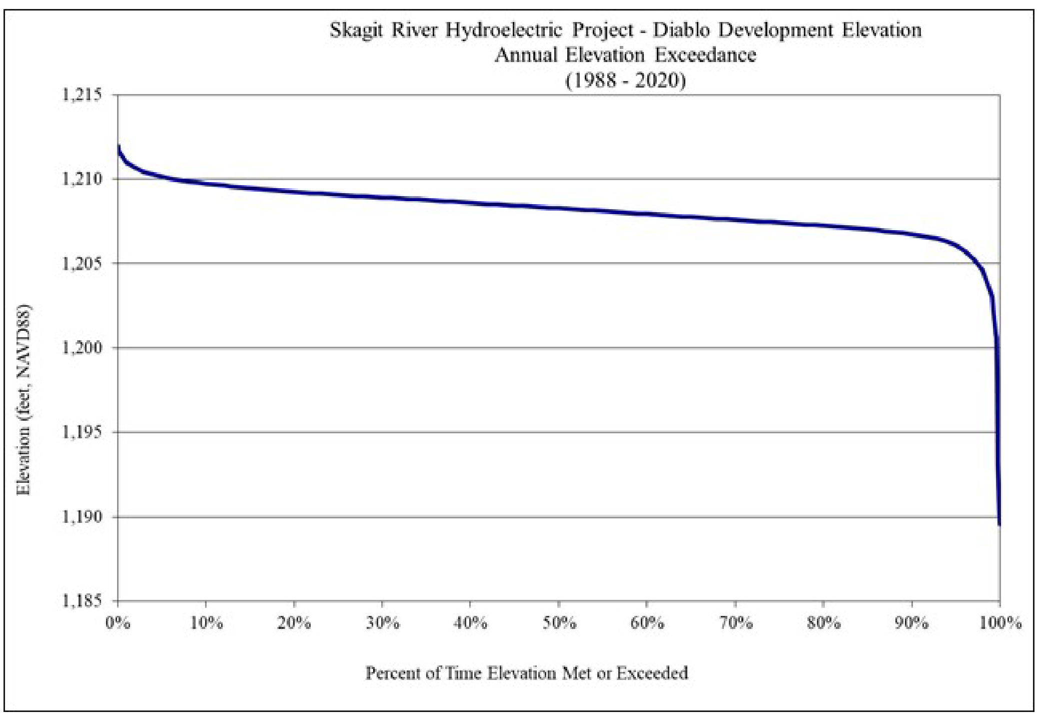


Figure 4.2.2-8. Annual percent exceedance curve of water surface elevations for Diablo Lake, based on the period 1988-2020.

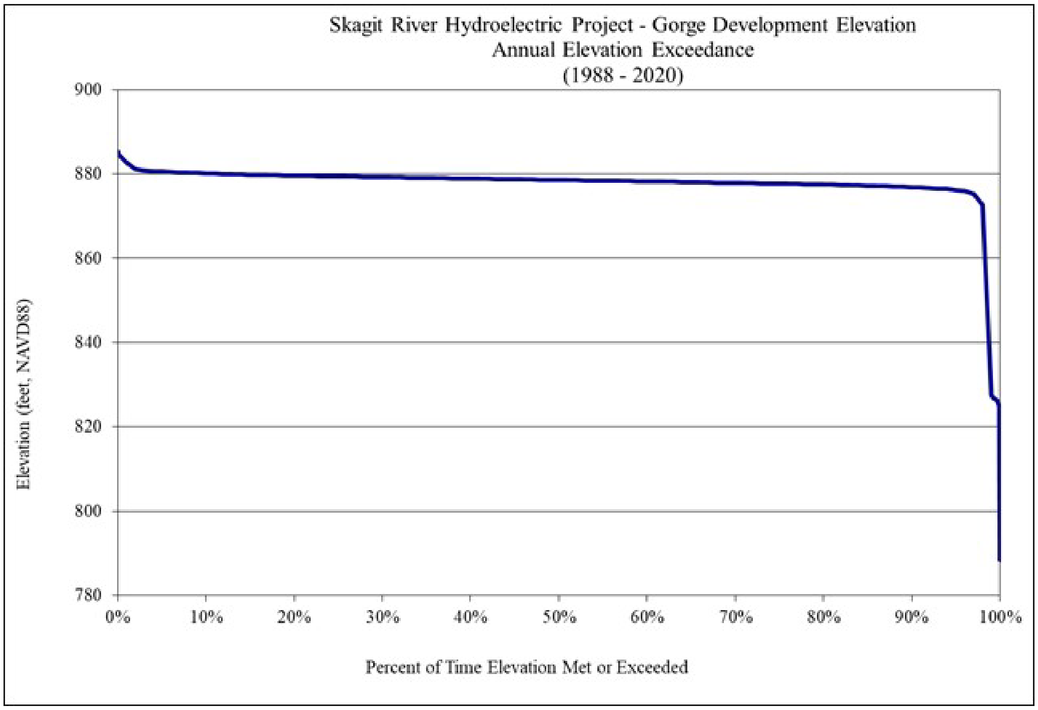


Figure 4.2.2-9. Annual percent exceedance curve of water surface elevations for Gorge Lake, based on the period 1988-2020.

Existing and Proposed Water Uses

Designated uses for waterbodies in the Project vicinity (Table 4.2.2-6) were taken from Washington Administrative Code (WAC) 173-201A-602, Water Quality Standards for Surface Waters of the State of Washington, Table 602 (Use designations for fresh waters by Water Resources Inventory Area [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 salmonid spawning, rearing, and migration, 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 4.2.2-6 apply to these two waterbodies.

Table 4.2.2-6. Designated uses of water in the Skagit River and designated WRIA 4 tributaries.

	Aquatic Life Uses						Recreational Uses			Water Supply Uses				Misc. Uses				
Water Body	**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 4.2.2-10).

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 is intended to protect 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 are subject to the rule and must be mitigated to prevent impairment of instream flows. Water uses established after the rule was adopted are interruptible when the river's minimum flows are not met, i.e., junior water rights can be regulated and forced to shut off until the river's senior water rights are fulfilled.

With the exception of two water 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 three pending water right applications currently on file with Ecology (Table 4.2.2-7): (1) 6,500 cfs power discharge at Ross Dam, which will bring the full discharge into alignment with the full turbine 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 (the two preceding applications are for non-consumptive uses). The third pending water right application is for a 0.55 cfs diversion from the penstock immediately upstream of Gorge Powerhouse for irrigation of Ladder Creek Gardens. This 1998 application is no longer needed and is planned for withdrawal.

Currently, City Light anticipates not applying for new consumptive uses of surface water or groundwater during the new 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 R1-*13081CWRIS) is the primary use of the water release. The secondary use certificate (S1-28885), issued by Ecology on September 16, 2021, 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 among 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 use (perfection). Water rights in the vicinity of the Project, on file with Ecology's Water Resources Program, are shown in Table 4.2.2-7.

Table 4.2.2-7. Water rights in the vicinity of the Skagit River Hydroelectric Project, on file with Ecology's Water Resources Program (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	Consumptive	Instantaneous	Q_a	Status	Source
S1-*00433CWRIS	Gorge	City Light	06/07/1920	Power	No	3,500 cfs	--	Active	Skagit River
S1-*00632CWRIS	Gorge	City Light	07/21/1920	Domestic Supply	Yes	20 cfs		Active	Ladder Creek
S1-27994[1]	Newhalem	City Light	08/20/1998	Domestic/ Irrigation	No	0.55 cfs	--	Application Pending	Ladder Creek
S1-*02644CWRIS	Gorge	City Light	07/20/1929	Power	No	1,000 cfs	--	Active	Skagit River
G1-00489CWRIS	Newhalem	City Light	12/13/1971	Domestic Supply	Yes	600 gpm	312	Active	Groundwater
G1-23722CWRIS	Newhalem	City Light	11/26/1980	Domestic Supply	Yes	200/600 gpm	21/312	Active	Groundwater
S1-*02645CCWRIS	Diablo	City Light	07/20/1929	Power	No	4,200 cfs	--	Active	Skagit River
S1-*03987CWRIS	Diablo	City Light	06/16/1934	Domestic Multiple	Yes	1.78 cfs	--	Active	Pyramid Creek
S1-*16925CWRIS	Diablo	City Light	09/25/1961	Power	No	3,000 cfs	--	Active	Skagit River
S1-*16926CWRIS	Gorge	City Light	09/25/1961	Power	No	3,000 cfs	--	Active	Skagit River
G1-00490ALCWRIS	Diablo	City Light	12/13/1971	Domestic Multiple	Yes	300 gpm	90	Active	Groundwater
S1-00742CWRIS	Ross	City Light	06/07/1920	Power	No	3,500 cfs	--	Active	Ross Lake
S1-*04465CWRIS	Ross	City Light	09/17/1937	Domestic Multiple	Yes	5 cfs	--	Change of Use Pending	Happy Creek
S1-00741CWRIS	Ross	City Light	09/25/1961	Power	No	6,000 cfs	--	Active	Ross Lake
S1-27546	Ross	City Light	10/04/1994	Power	No	6,500 cfs	--	Application Pending	Skagit River
S1-27751	Ross	City Light	07/11/1996	Municipal	No	0.08 cfs	55	Application / Subject to Pending CS1-*04465CWRIS	Ross Lake
CS1-*04465CWRIS	Ross	City Light	05/27/2016	Domestic	Yes	0.5 cfs	10	Application Change of Use Pending	Ross Lake

Water Rights						Amount of Appropriation			
Record Number	Location/ Development	Water Right Holder/Applicant	Priority Date	Purposes	Consumptive	Instantaneous	Q_a	Status	Source
S1-*00394CWRIS	Newhalem Creek	City Light	03/10/1920	Power	No	75 cfs		Active	Newhalem Creek
S1-*18374CWRIS	Avalanche Creek	U.S. Forest Service Mount Baker	03/04/1964	Domestic Multiple	Yes	0.1 cfs	--	Active	Avalanche Creek
S1-047905CL	Hozomeen Creek	WA State Department of Game	Not Indicated	Domestic General	No	4 gpm	1	Active	Hozomeen Creek
S1-*00532CWRIS	Stetattle Creek	Davis F E	11/22/1920	Domestic Single/ Power/ Irrigation	Yes/No/Yes	5.5 cfs	--	Active	Stetattle Creek
Reservoir Storage Rights									
R1-*13081CWRIS	Gorge	City Light	08/17/1954	Reservoir Storage (Gorge)	No	--	8,350	Active	Skagit River
R1-*01592AWCWRIS	Diablo	City Light	01/12/1926	Reservoir Storage (Diablo)	No	--	90,000	Active	Ruby Creek,[2] Thunder Creek, Skagit River[2]
R1-135	Ross	City Light	11/06/1926	Reservoir Storage (Ross)	No	--	3,800,000	Active	Skagit River

1 City Light plans to withdraw this water right.
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.

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 4.2.1.1 of this Exhibit E, 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 connectivity are assumed to be relatively high in most areas, with a high degree of groundwater-surface water interaction 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.[19]

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 (gpm) 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 gpm 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 connectivity 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 Seattle Pacific University (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).

Water Quality

Applicable Water Quality Standards

Designated uses established by the state of Washington (WAC 173-201A-602) are discussed above (Table 4.2.2-6). Water quality criteria for the Project vicinity are shown in Table 4.2.2-8, 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 4.2.2-8) apply to Diablo (detention time = 9.4 days) and Gorge (detention time = 0.8 days) lakes.

[19] As part of the GE-04 Geomorphology Study (City Light 2022b), 20 water level loggers have been installed in off-channel areas and side channels to expand on information being gathered as part of the existing network of six logger sites maintained by SRSC. Results of level logger monitoring, and any associated implications pertaining to groundwater dynamics, will be provided in the Updated Study Report (USR) and Final License Application FLA.

Ross Lake, with a detention time of 189.4 days, is subject to the lake criteria identified in Table 4.2.2-8. In addition to the criteria shown in the table, Ecology has identified supplemental spawning and incubation criteria for specific reaches within WRIA 4 (Figure 4.2.2-10). Finally, the Skagit River from Gorge Dam (RM 96.5) downstream to Gorge Powerhouse (i.e., the Gorge bypass reach) has a special condition status under State water quality standards (WAC 173-201A-600): water temperatures are not to exceed 21 degrees Celsius (ºC) as a result of anthropogenic activities.

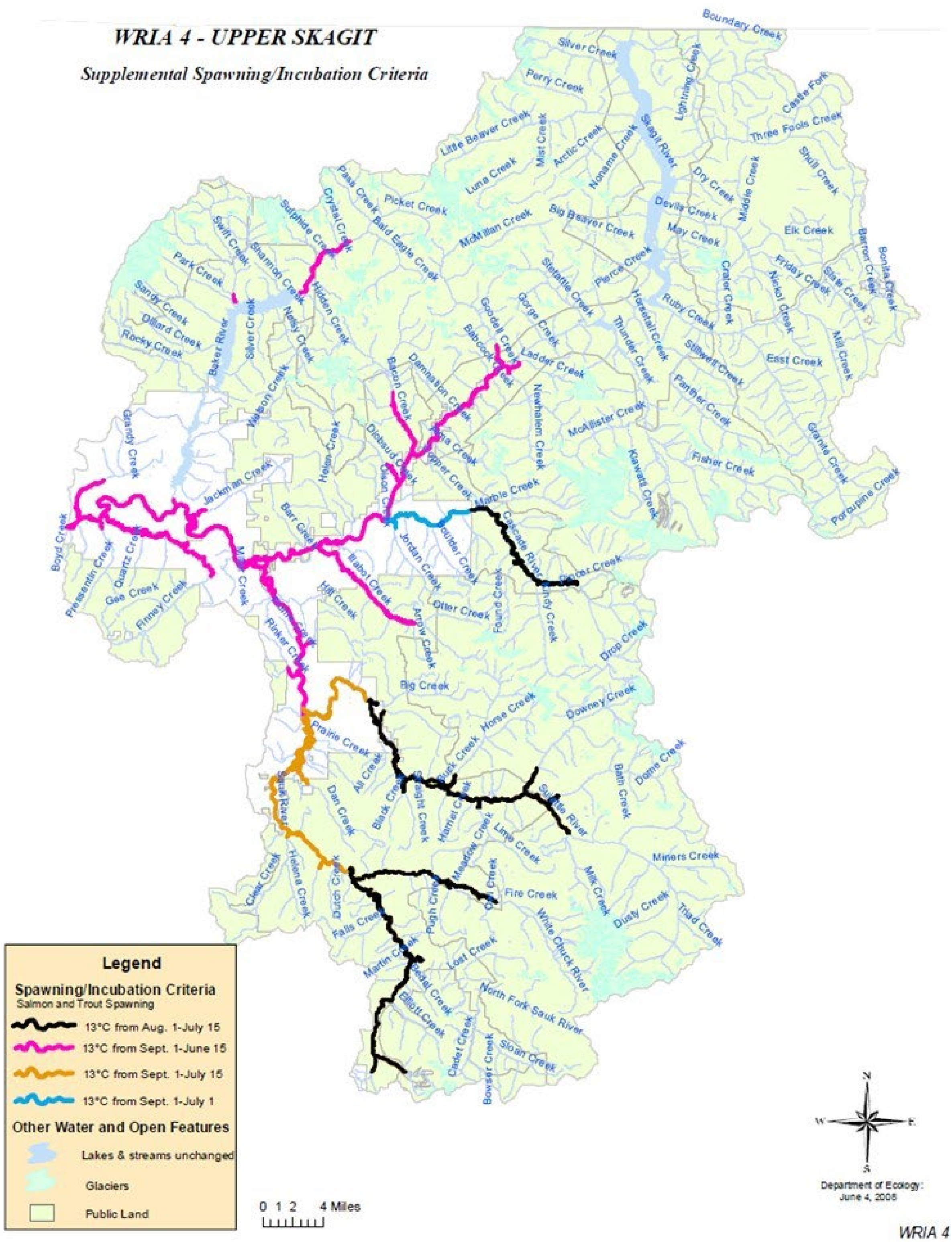
Table 4.2.2-8. Water quality criteria for the Project vicinity (except as shown in Figure 4.2.2-10).

Parameter	Water Quality Criteria
E. coli	*E. coli* organism levels within an averaging period must not exceed a geometric mean value of 100 colony forming units (CFU) or most probable number (MPN) per 100 milliliter (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 (DO)	Lowest 1-Day Minimum[1,2] Char Spawning and Rearing: 10.0 milligrams per liter (mg/L) or 90% saturation Core summer salmonid habitat: 10.0 mg/L or 95% saturation Salmonid spawning, rearing, and migration: 10.0 mg/L or 90% saturation[3]
	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 When DO is lower than the criteria (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L.

2 Intragravel DO criteria may be used for compliance; intragravel DO (1-day minimum) concentration must be 8.0 mg/L or greater, and the DO water column (1-day minimum) concentration must be 9.0 mg/L or greater. Intragravel DO must be measured as a spatial median within the same habitat area.



Source: Ecology 2011.

Figure 4.2.2-10. Supplemental spawning and incubation protection temperature criteria for WRIA 4 Upper Skagit River basin.

303(d) Listed Waterbodies

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 the Environmental Protection Agency (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[20] (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 toxicants. Ecology's website states, "Fish tissue data from the most recent year showed that the FTEC [fish tissue equivalent concentration][21] was met; therefore, the Assessment Unit [i.e., Ross Lake] meets the requirements for a Category 1 determination."

Based on Ecology (2014), there are currently no stream segments of the mainstem Skagit river that have a prepared TMDL, other than the Lower Skagit Basin Bacterial TMDL (WRIA 3), and there are only two segments within WRIA 4 that are on the 303(d) list, i.e., shown as "Category 5" in Table 4.2.2-9, and these are not influenced by the Project or its operation. Ecology's website provides the following statement (below) regarding the segment of the Sauk River identified in Table 4.2.2-9; 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."

Ecology's website provides the following statements regarding temperature listings in the lower Skagit River (WRIA 3) identified in Table 4.2.2-9:

- Skagit River (Listing ID 8017) (Location ID 03A080, Skagit River above Sedro Woolley): "In 2005, 2 of 4 samples (50%) showed an excursion of the criteria (16ºC) for this waterbody."
- Skagit River (Listing ID 14495) (Location ID SRRBR, Skagit River at River Bend Road): "In 2004, 2 of 24 samples (8%) showed an excursion of the criteria (16ºC) for this waterbody."
- Skagit River (Listing ID 73541) (Location ID SRCHR, Skagit River at Cape Horn Road): "In 2006, 1 of 18 samples (6%) showed an excursion of the criteria (13ºC) for this waterbody; (Supplemental Spawning Period). In 2004, 1 of 15 samples (7%) showed an excursion of the criteria (13ºC) for this waterbody; (Supplemental Spawning Period)."
- Skagit River (Listing ID 73560) (Location ID 03A060, Skagit River near Mount Vernon): "In 2005, 2 of 13 (17%) showed an excursion of the criteria (16ºC) for this waterbody."

[20] 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.

[21] 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."

Table 4.2.2-9. Relevant waterbodies/stream segments from the current EPA-approved water quality assessment list: WRIA 4 (Upper Skagit) including mainstem Skagit River and tributaries and WRIA 3 (Lower Skagit) mainstem, temperature only.

Parameter	Category[1]	Waterbody	Listing ID
Temperature	1	Skagit River (WRIA 4)	6564
	2	Diobsud Creek (WRIA 4)	74028
	5	Sauk River (WRIA 4)	72516
	2	Skagit River (WRIA 3)	8017, 14495, 73541, 73560
Dissolved Oxygen	2	Stetattle Creek, Goodell Creek (WRIA 4)	15453, 15455
	3	Skagit River (WRIA 4)	10568
pH	2	Newhalem Creek (WRIA 4)	71171
	3	Skagit River, S.F. Cascade River (WRIA 4)	10567, 71170
Bacteria	1	Sauk River, Skagit River, Sauk River (WRIA 4)	16419, 16421, 46390
	5	Prairie Creek (WRIA 4)	42075
Mercury (tissue)	1	Sauk River, Ross Lake (WRIA 4)	79480, 79516
PCBs (tissue)	1	Ross Lake, Sauk River (WRIA 4)	78954, 78959
Instream Flow	4c	Newhalem Creek (WRIA 4)	6186
Ammonia-N	1	Skagit River, Sauk River, Sauk River (WRIA 4)	10563, 10569, 71722
Total Phosphorous	3	Gorge Lake (WRIA 4)	70671
Chloride	1	Newhalem Creek (WRIA 4)	77187
	3	Diobsud Creek, S.F. Cascade River (WRIA 4)	77185, 77197

Source: Ecology 2014.

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.

Existing Water Quality within the Project Boundary and Project Vicinity

This section characterizes water quality in Ross, Diablo, and Gorge lakes, their respective tributaries, the Gorge bypass reach, and the mainstem Skagit River downstream of the Project to the Sauk River, or, for some constituents, to Concrete, WA (PRM 54.5) or the State Route (SR) 9 Bridge (PRM 23.25). Water quality parameters addressed below include water temperature, DO, pH, TDG, turbidity and total suspended solids (TSS), bacteria, nutrients and productivity, and contaminants. Sampling of riverine and lacustrine benthic macroinvertebrates (BMI), macroinvertebrate drift, zooplankton, phytoplankton, and periphyton is also discussed.

Results reported in the following sections reflect (1) data gathered by multiple entities prior to or outside the context of Project relicensing (see source attributions in the tables and figures in the following sections; also see FA-01a WQ Monitoring Study Interim Report [City Light 2022c],

Appendix E of this Exhibit E, for more detailed information and a site map) (2) data collected beginning in 2021 as part of the relicensing proceedings, i.e., the sampling plan outlined in the Revised Study Plan (RSP), as well as the additions of turbidity measurements at the mouths of Ross Lake tributaries, per a request made by the Federal Energy Regulatory Commission (FERC or Commission) in its Study Plan Determination, and TDG sampling at bridges downstream of the Gorge bypass reach (see Table 4.2.2-10 and the mapbook in Appendix E of this Exhibit E), and (3) an expanded scope of water quality data collection agreed to by City Light and licensing participants (LPs) following the filing of the Initial Study Report.

The aforementioned water quality scope expansion includes two types of monitoring: (1) data needed for the development and calibration of the CE-QUAL-W2 water quality model (FA-01b Water Quality Model Development Study [WQ Model Development Study], City Light 2022d), in large measure to enable the modeling of nutrients and productivity (Table 4.2.2-10) and (2) a comprehensive BMI and invertebrate drift data collection program designed to explore Project effects in the reservoirs and the Skagit River and to establish baseline data to which potential future sampling results can be compared (Table 4.2.2-11).

Table 4.2.2-10. FA-01 Water Quality Monitoring Study sampling parameters, frequency, and methodology by location (sites ordered upstream to downstream).

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Ross Lake							
Skagit River at International Boundary (1)	TRIB1	49.00022/ -121.074	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	2
USGS site at International Boundary (1)	-	48.99865/ -121.07790	Baseline conditions, model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Near Hozomeen (77)	ROSS7	48.98681/ -121.07361	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Silver Creek Confluence (128)	TRIB2	48.97023/ -121.104	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Ross Lake Shoreline Erosional Area North (79)	ROSS4	48.94838/ -121.08508	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (Surface Transect)	Turbidity, total suspended solids	15
Little Beaver (71)	ROSS3	48.9274/ -121.0625	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Little Beaver Creek Confluence (81)	TRIB3	48.91536/ -121.077	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Little Beaver Creek near mouth (81)	TRIB3A	48.91473/ -121.07505	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Near Little Beaver Boat Access Camp (80)	ROSS9	48.91784/ -121.12628	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Ross Lake Shoreline Erosional Area Central (82)	ROSS5	48.89389/ -121.04398	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (Surface Transect)	Turbidity, total suspended solids	15
Near Lightning Creek Boat Access Camp (83)	ROSS10	48.87629/ -121.01100	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Lightning Creek Confluence (85)	TRIB4	48.87443/ -121.018	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Lightning Creek near mouth (85)	TRIB4A	48.87590/ -121.01570	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Dry Creek Confluence (86)	TRIB5	48.85340/ -121.014	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Skymo (84)	ROSS2	48.8547/ -121.0308	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Devil's Creek Confluence (95)	TRIB6	48.82411/ -121.033	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Pumpkin Mountain (87)	ROSS1	48.7904/ -121.0496	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Ross Lake Shoreline Erosional Area South (88)	ROSS6	48.76682/ -121.04427	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (Surface Transect)	Turbidity, total suspended solids	15
May Creek Confluence (90)	TRIB7	48.78624/ -121.030	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Near Big Beaver Boat Access Camp (89)	ROSS1	48.77487/ -121.06649	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Big Beaver Creek Confluence (9)	TRIB8	48.77418/ -121.06419	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Big Beaver Creek near mouth (9)	TRIB8A	48.77508/ -121.06697	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Pierce Creek Confluence (91)	TRIB9	48.77242/ -121.066	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Roland Creek Confluence (93)	TRIB10	48.76913/ -121.024	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4
Ruby Creek Arm (94)	TRIB11	48.73004/ -121.02532	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (1m, tributary)	Turbidity, total suspended solids	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Ruby Creek near mouth (94)	TRIB11	48.71476/ -120.99338	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Ross Lake log boom (7)	ROSS12	48.73721/ -121.05439	Model development	Monthly from May-Oct; 1-2 samples in winter at three depths	Grab sample/*In situ* measurement, depending on parameter (3 depths)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	24
Near Ross Lake Resort (162)	ROSS8	48.73890/ -121.06072	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Diablo Lake							
Upstream End at Boathouse (28)	DIABLO1	48.72961/ -121.07244	Baseline monitoring, model development	Monthly	*In situ* measurement (Vertical Profile)	Temperature, dissolved oxygen, pH	12 (0 Edge)
Upstream End (28)	DIABLO1	48.72961/ -121.07244	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Main Pool (189)	TBD	48.71301/ -121.11405	Model development	Monthly from May-Nov	Tow net	Zooplankton1	12 (0 Edge)
Environmental Learning Center (98)	DIABLO5	48.71690/ -121.11940	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Thunder Creek Arm, Colonial Creek Confluence (102)	DIABLO6	48.69215/ -121.10045	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (Surface Transect)	Turbidity, total suspended solids	15
Thunder Creek Arm, Rhode Creek Confluence (99)	DIABLO3	48.69101/ -121.09552	Drawdown monitoring, model development	Once in fall and once in winter/spring	Grab sample (Surface Transect)	Turbidity, total suspended solids	15
Thunder Creek Arm (100)	DIABLO4	48.69101/ -121.09552	Recreational impact	Monthly in Jun, Jul, Aug, and Sep	Grab sample (Surface)	Fecal coliform	4
Thunder Creek Arm (134)	TRIB12	48.66826/ -121.06931	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Forebay (96)	DIABLO2	48.71489/ -121.13171	Baseline monitoring, model development	Monthly	*In situ* measurement (Vertical Profile)	Temperature, dissolved oxygen, pH	12 (0 Edge)
Forebay (96)	DIABLO2	48.71489/ -121.13171	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Forebay (34)	DIABLO2	48.71421/ -121.13134	Model development	Monthly from May-Oct; 1-2 samples in winter at three depths	Grab sample/*In situ* measurement, depending on parameter (3 depths)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	24

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Gorge Lake							
Upstream End (97)	GORGE1	48.71188/ -121.14317	Baseline monitoring, model development	Monthly	*In situ* measurement (Vertical Profile)	Temperature, dissolved oxygen, pH	12 (0 lab)
Upstream End (97)	GORGE1	48.71188/ -121.14317	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Reflector Bar (181)	GORGE1X	48.71179278/ -121.1425531	Model development	Monthly from May-Nov	Tow net	Zooplankton[1]	12 (0 Edge)
Below Diablo Dam (97)	GORGE3	48.71188/ -121.14317	Baseline monitoring	Continuous	Installation of a sonde/probe (Below Compensation Depth)	Total dissolved gas	N/A
Stetattle Creek (46)	STET1	48.71694051/ -121.1496877	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Gorge Lake downstream of Stetattle (191)	GORGE5	48.71335476/ -121.1547201	Model development	Monthly from May-Nov	Tow net	Zooplankton[1]	12 (0 Edge)
Log Boom (43)	GORGE7	48.70020/ -121.19311	Model development	Monthly from May-Nov	Tow net	Zooplankton[1]	12 (0 Edge)

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Log Boom (43)	GORGE7	48.69755/ -121.20745	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Gorge Lake Forebay (108)	GORGE2	48.69777/ -121.20672	Baseline monitoring, model development	Monthly	*In situ* measurement (Vertical Profile)	Temperature, dissolved oxygen, pH	12 (0 lab)
Gorge Lake Forebay (108)	GORGE2	48.69777/ -121.20672	Baseline monitoring, model development	Monthly	Grab sample (1m, 5m)	Turbidity, total suspended solids	24
Gorge Lake Forebay (108)	GORGE4	48.69777/ -121.20672	Baseline monitoring	Continuous	Installation of a sonde/probe (Below Compensation Depth)	Total dissolved gas	N/A
Gorge Bypass Reach							
Below Gorge Dam in Plunge Pool (109)	BYPASS1	48.69783/ -121.20898	Baseline monitoring	Episodic[2]	*In situ* measurement (Below Compensation Depth)	Temperature, dissolved oxygen, turbidity, total dissolved gas	N/A
Gorge Dam Access Bridge (192)	BYPASS4	48.6966169/ -121.2131147	Spill monitoring	Opportunistically	*In situ* measurement (Below Compensation Depth)	TDG	N/A
≈ 1.5 miles above Gorge Powerhouse (111)	BYPASS2	48.69030/ -121.22680	Baseline monitoring	Episodic[2]	*In situ* measurement (Below Compensation Depth)	Temperature, dissolved oxygen, turbidity, total dissolved gas	N/A
≈ 0.6 miles above Gorge Powerhouse (110)	BYPASS3	48.68415/ -121.24216	Baseline monitoring	Episodic[2]	*In situ* measurement (Below Compensation Depth)	Temperature, dissolved oxygen, turbidity, total dissolved gas	N/A

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Gorge Powerhouse Access Bridge (174)	BYPASS5	48.6757123/ -121.2416487	Spill monitoring	Opportunistically	*In situ* measurement (Below Compensation Depth)	TDG	N/A
Skagit River - Newhalem Area							
Ladder Creek Falls Bridge (113)	LADDER1	48.67507/ -121.24010	Spill monitoring	Opportunistically	*In situ* measurement (Below Compensation Depth)	TDG	N/A
Immediately below Gorge Powerhouse, right bank (112)	PHOUSE1	48.67520/ -121.24052	Baseline monitoring	Continuous	Installation of a sonde/probe (Below Compensation Depth)	Temperature, dissolved oxygen, turbidity, total dissolved gas, pH	N/A
Immediately below Gorge Powerhouse, right bank (112)	PHOUSE2	48.67520/ -121.24052	Baseline monitoring	Opportunistically	Grab sample (1m)	Total suspended solids	3
Immediately below Gorge Powerhouse, right bank (112)	PHOUSE1	48.67520/ -121.24052	Model development	Monthly from May-Nov	Drift net	Zooplankton	8 (0 Edge)
Below Gorge Powerhouse (112)	PHOUSE1	48.67520/ -121.24052	Model development	Monthly from May-Nov	Grab sample (Bottom)	Periphyton	8 (0 Edge)
Bridge to Trail of the Cedars (69)	CEDARS1	48.67153/ -12124600	Spill monitoring	Opportunistically	*In situ* measurement (Below Compensation Depth)	TDG	N/A
Newhalem Creek near mouth (68)	NEWCG	48.67132/ -121.25633	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Bridge at Newhalem Campground (161)	NEWCG1	48.67238/ -12126104	Spill monitoring	Opportunistically	*In situ* measurement (Below Compensation Depth)	TDG	N/A
Skagit River within National Park Boundary							
River mile 91.1 (114)	SKAGIT2	48.65122/ -121.29099	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Side Channel Habitat near river mile 91.1 (163)	SKAGIT2SC	48.641660/ -121.309870	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
River mile 85.6 (145)	SKAGIT3	48.60422/ -121.35973	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Above Alma Creek (145)	SKAGIT3	48.60439/ -121.35964	Model development	Continuous, three 3-week durations, May-Oct	Installation of a sonde/probe (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity	N/A
Above Alma Creek (145)	SKAGIT3	48.60439/ -121.35964	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Above Alma Creek (145)	SKAGIT3	48.60439/ -121.35964	Model development	Monthly from May-Nov	Grab sample (Bottom)	Periphyton	7
Skagit River downstream of National Park Boundary							
Skagit River at Marblemount (148)	MARB1	48.53267148/ -121.4295083	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample (1m)	Chlorophyll *a*, phytoplankton, alkalinity	8

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Cascade River at Marblemount (154)	CASC1	48.53267148/ -121.4256403	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
PRM 75.6 (118)	SKAGIT4	48.50647162/ -121.4686583	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Side Channel Habitat near river mile 75.6 (165)	SKAGIT4SC	48.496670/ -121.53117	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Skagit downstream of Marblemount (118)	SKAGIT4	48.50647162/ -121.4686583	Model development	Continuous, three 3-week durations, May-Oct	Installation of a sonde/probe (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity	N/A
Skagit downstream of Marblemount (118)	SKAGIT4	48.50647162/ -121.4686583	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Skagit downstream of Marblemount (118)	SKAGIT4	48.50647162/ -121.4686583	Model development	Monthly from May-Nov	Grab sample (Bottom)	Periphyton	7

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Side Channel Habitat near river mile 75.6 (119)	SKAGIT4SC	48.496670/ -121.53117	Baseline monitoring, model development	Continuous	Installation of a sonde/probe	Temperature	N/A
PRM 69.3 (122)	SKAGIT5	48.48548973/ -121.5734032	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Skagit upstream of Sauk (122)	SKAGIT5	48.48548973/ -121.5734032	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
PRM 60.8 (124)	SKAGIT6	48.504480/ -121.706440	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Side Channel Habitat near river mile 60.8 (171)	SKAGIT6SC	48.518206/ -121.713024	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Baker River (156)	BAKER1	48.53889474/ -121.7430003	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
PRM 54.5 (155)	SKAGIT7	48.52555049/ -121.7718681	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Skagit near Concrete (155)	SKAGIT7	48.52555049/ -121.7718681	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Skagit near Concrete (155)	SKAGIT7	48.52555049/ -121.7718681	Model development	Continuous, three 3-week durations, May-Oct	Installation of a sonde/probe (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity	N/A
Skagit near Concrete (155)	SKAGIT7	48.52555049/ -121.7718681	Model development	Monthly from May-Nov	Grab sample (Bottom)	Periphyton	7
Sauk RM 5.4 (120)	SAUK1	48.41997441/ -121.5646661	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Sauk WQ (120)	SAUK1	48.41997441/ -121.5646661	Model development	Monthly from May-Oct; 1-2 samples in winter	Grab sample/*In situ* measurement, depending on parameter (1m)	Temperature, dissolved oxygen, pH, specific conductance, turbidity, total suspended solids, nutrients, chlorophyll *a*, phytoplankton, carbon, alkalinity	8
Sauk upstream of Suiattle River (166)	SAUK2	48.328771/ -121.547220	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type (depth)	Parameter	Number of Samples
Sauk upstream of Suiattle River (166)	SAUK2	48.328771/ -121.547220	Baseline monitoring, model development	Quarterly	Grab sample (1m)	Nutrients	4
Side Channel Habitat Sauk upstream of Suiattle River (176)	SAUK2SC	48.328857/ -121.547570	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Skagit near Hamilton (167)	SKAGIT8	48.5183921/ -121.9596186	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Side Channel Habitat near Skagit near Hamilton (170)	SKAGIT8SC	48.52018351/ -121.9596939	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A
Skagit near SR 9 Bridge (168)	SKAGIT9	48.48130834/ -122.2471543	Baseline monitoring, model development	Continuous	Installation of a sonde/probe (1m)	Temperature	N/A

Notes:
Nutrients = NH4, NOx, TKN/TN, Orthophosphate, TP
Carbon = TOC, POC, DOC, CBOD
1 Zooplankton in Diablo and Gorge lakes will be sampled by the National Park Service (NPS).
2 Given the loss of monitoring equipment due to flood flows in November 2021, and the highly dynamic condition of the Gorge bypass reach, continuous monitoring has been replaced with episodic monitoring; monitoring planning also accounts for the safety of field personnel. Methods for episodic monitoring are under discussion as of the drafting of this Exhibit E.

Table 4.2.2-11. FA-01 Water Quality Monitoring Study macroinvertebrate sampling methods and frequency by location (sites ordered upstream to downstream).

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Ross Lake							
Skagit Mainstem Confluence (185)	TRIB1X	49.00022/ -121.074[1]	Examine mainstem inflow prey communities at international border	Once, in May 2023	Tributary Benthic	Kick Net	6
Skagit Mainstem Confluence (185)	TRIB1X	49.00022/ -121.074[1]	Examine mainstem inflow prey communities at international border	Once, in May 2023	Tributary Benthic	Drift Net	4
Hozomeen (186)	HOZO1X	48.98699/ -121.0717[1]	Examine tributary prey communities	Once, in May 2023	Tributary Benthic	Kick Net	6
Hozomeen (186)	HOZO1X	48.98699/ -121.0717[1]	Examine tributary prey communities	Once, in May 2023	Tributary Benthic	Drift Net	4
Hozomeen (213)	Hoz-Ponar-HiVar	48.938236/ -121.080353	Examine prey communities in high varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Hozomeen (214)	Hoz-Ponar-LowVar	48.941086/ -121.080858	Examine prey communities in low varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Hozomeen (215)	Hoz-Ponar-PermIn	48.941861/ -121.080458	Examine prey communities in inundated zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Hozomeen (201)	Hoz-Basket-HiVar	48.940542/ -121.080783	Explore colonization rate and composition in high varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Hozomeen (202)	Hoz-Basket-LowVar	48.941114/ -121.080192	Explore colonization rate and composition in low varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Hozomeen (203)	Hoz-Basket-PermIn	48.941753/ -121.078786	Explore colonization rate and composition in low varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Silver (128)	TRIB2X	48.96965112/ -121.1045833[1]	Examine tributary prey communities above full pool and lower end of varial zone during drawdown	Once, in May 2023	Tributary Benthic	Kick Net	6
Silver (128)	TRIB2X	48.96965112/ -121.1045833[1]	Examine tributary prey communities above full pool and lower end of varial zone during drawdown	Once, in May 2023	Tributary Benthic	Drift Net	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Little Beaver (81)	TRIB3X	48.91536/ -121.077[1]	Examine tributary prey communities above full pool and lower end of varial zone during drawdown	Once, in May 2023	Tributary Benthic	Kick Net	6
Little Beaver (81)	TRIB3X	48.91536/ -121.077[1]	Examine tributary prey communities above full pool and lower end of varial zone during drawdown	Once, in May 2023	Tributary Benthic	Drift Net	4
Desolation (210)	Des-Ponar-HiVar	48.889569/ -121.039903	Examine prey communities in high varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Desolation (211)	Des-Ponar-LowVar	48.889103/ -121.040539	Examine prey communities in low varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Desolation (212)	Des-Ponar-PermIn	48.887781/ -121.040031	Examine prey communities in inundated zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Desolation (198)	Des-Basket-HiVar	48.888878/ -121.040158	Explore colonization rate and composition in high varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Desolation (199x)	Des-Basket-LowVar	48.888944/ -121.040461	Explore colonization rate and composition in low varial zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Desolation (200)	Des-Basket-PermIn	48.889131/ -121.041947	Explore colonization rate and composition in inundated zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Lightning (187)	TRIB4X	48.87443/ -121.018[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Kick Net	6
Lightning (187)	TRIB4X	48.87443/ -121.018[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Drift Net	4
Dry(86)	TRIB5X	48.85341738/ -121.0135648[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Kick Net	6
Dry (86)	TRIB5X	48.85341738/ -121.0135648[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Drift Net	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Pumpkin (207)	Pump-Ponar-HiVar	48.784842/ -121.051972	Examine prey communities in high varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Pumpkin (208)	Pump-Ponar-LowVar	48.785553/ -121.051794	Examine prey communities in low varial zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Pumpkin (209)	Pump-Ponar-PermIn	48.786847/ -121.052403	Examine prey communities in inundated zone of reservoir	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Pumpkin (195)	Pump-Basket-HiVar	48.785169/ -121.051811	Explore colonization rate and composition in high varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Pumpkin (196)	Pump-Basket-LowVar	48.785453/ -121.051547	Explore colonization rate and composition in low varial zone of reservoir	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Pumpkin (197)	Pump-Basket-PermIn	48.785778/ -121.051303	Explore colonization rate and composition in inundated zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Big Beaver (92)	TRIB8X	48.77470409/ -121.0645115[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Kick Net	6
Big Beaver (92)	TRIB8X	48.77470409/ -121.0645115[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Drift Net	4
Roland (93)	TRIB10X	48.7691443/ -121.0241022[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Kick Net	6
Roland (93)	TRIB10X	48.7691443/ -121.0241022[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Drift Net	4
Ruby (94)	TRIB11X	48.71476302/ -120.9933835[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Kick Net	6
Ruby (94)	TRIB11X	48.71476302/ -120.9933835[1]	Examine tributary prey communities above full pool and lower end of varial zone	Once, in May 2023	Tributary Benthic	Drift Net	4
Ruby (204)	Ruby-Ponar-HiVar	48.731608/ -121.039194	Characterize prey communities in high varial zone	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Ruby (205)	Ruby-Ponar-LowVar	48.731625/ -121.039183	Characterize prey communities in low varial zone	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Ruby (206)	Ruby-Ponar-PermIn	48.731650/ -121.039169	Characterize prey communities in inundated zone	Every 6 weeks, May – Oct (4x/year) 2022	Lentic Grab	Ponar	8
Ruby (190)	Ruby-Basket-HiVar	48.736542/ -121.039864	Colonization rate and composition in high varial zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Ruby (193)	Ruby-Basket-LowVar	48.735997/ -121.040211	Colonization rate and composition in low varial zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Ruby (194)	Ruby-Basket-PermIn	48.735394/ -121.040236	Colonization rate and composition in inundated zone	Deployment at full pool. Removal of control and treatment will depend on pool levels and will target near full-pool, mid-pool, and low-pool conditions	Benthic Colonization	Rock Basket	4
Number of samples in Ross Lake							234
Diablo Lake							
Skagit Arm (217)	SKA-Ponar-PermIn	48.728644/ -121.072558	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12
Thunder South (216)	THS-Ponar-PermIn	48.691233/ -121.094581	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Thunder North (218)	THN-Ponar-PermIn	48.709875/ -121.099950	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12
Main Basin (219)	MNB-Ponar-PermIn	48.717344/ -121.100558	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12
Thunder Creek (134)	TRIB12X	48.66826/ -121.06931[1]	Characterize tributary prey communities	Every 6 weeks, Aug – Oct (4x/year)	Tributary Benthic	Kick Net	8
Thunder Creek (134)	TRIB12X	48.66826/ -121.06931[1]	Characterize tributary prey communities	Every 6 weeks, Aug – Oct (4x/year)	Tributary Benthic	Drift Net	8
Number of samples in Diablo Lake							64
Gorge Lake							
Reflector Bar (181)	GORGE1X	48.71179278/ -121.1425531	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12
Stetattle Confluence (183)	GORGE6X	48.716667/ -121.148925	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar or Kick Net	12
Stetattle (182)	STET1X	48.717181/ -121.149881	Characterize tributary prey communities	Every 6 weeks, May – Oct (4x/year)	Tributary Benthic	Kick Net	8
Stetattle (182)	STET1X	48.717181/ -121.149881	Characterize tributary prey communities	Every 6 weeks, May – Oct (4x/year)	Tributary Benthic	Drift Net	8
West Zone (108)	GORGE2X	48.69777/ -121.20672	Characterize prey communities in inundated zone	Monthly, Mar – Oct (6x/year)	Lentic Grab	Ponar	12
Number of samples in Gorge Lake							52

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Gorge Bypass Reach							
≈ above Gorge Powerhouse, below first passage impediment (173)	BYPASS3X	48.676745/ -121.242275	Characterize bypass reach prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Kick Net	5
≈ above Gorge Powerhouse, below first passage impediment (173)	BYPASS3X	48.676745/ -121.242275	Characterize bypass reach prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Drift Net	10
Number of samples in the Bypass Reach							15
Skagit River within National Park Boundary							
PRM 91.6 (164)	SKAGIT2X	48.64175/ -121.30958	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Kick Net	5
PRM 91.6 (164)	SKAGIT2X	48.64175/ -121.30958	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Drift Net	10
Side Channel Habitat near PRM 91.1 (163)	SKAGIT2SC	48.641660/ -121.309870	Characterize side channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	Side-Channel Benthic	Ponar or Kick Net, site dependent	5
PRM 85.6 (117)	SKAGIT3X	48.60422/ -121.35973	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Kick Net	4
PRM 85.6 (117)	SKAGIT3X	48.60422/ -121.35973	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Drift Net	8
Number of samples in the Skagit River within the National Park Boundary							32

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Skagit River downstream of National Park Boundary							
PRM 75.6 (175)	SKAGIT4X	48.50647162/ -121.4686583	Compare BMI in regulated vs unregulated systems	Every 2 weeks, July – October (9x); Every 4 weeks, March – June, Nov – Dec (6x)	Intensive River Benthic	Kick Net Transect	75
PRM 75.6 (175)	SKAGIT4X	48.50647162/ -121.4686583	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Drift Net	10
Side Channel Habitat near PRM 75.6 (119)	SKAGIT4SC	48.496670/ -121.53117	Compare BMI in regulated vs unregulated systems	Every 2 weeks, July – October (9x); Every 4 weeks, March – June, Nov – Dec (6x)	Intensive Side-Channel Benthic	Ponar or Kick Net, site dependent	45
PRM 69.3 (123)	SKAGIT5X	48.48548973/ -121.5734032	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Kick Net	4
PRM 69.3 (123)	SKAGIT5X	48.48548973/ -121.5734032	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Drift Net	8
PRM 60.8 (125)	SKAGIT6X	48.504480/ -121.706440	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Kick Net	5
PRM 60.8 (125)	SKAGIT6X	48.504480/ -121.706440	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x), once in winter (1x)	River Benthic	Drift Net	10
Side Channel Habitat near PRM 60.8 (171)	SKAGIT6SC	48.518206/ -121.713024	Characterize side channel prey communities	Every 6 weeks, May – Oct (4x/year)	Side-Channel Benthic	Ponar or Kick Net, site dependent	4
PRM 54.5 (127)	SKAGIT7X	48.52555049/ -121.7718681	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Kick Net	4
PRM 54.5 (127)	SKAGIT7X	48.52555049/ -121.7718681	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Drift Net	8

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Skagit near Hamilton (167)	SKAGIT8X	48.5183921/ -121.9596186	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Kick Net	4
Skagit near Hamilton (167)	SKAGIT8X	48.5183921/ -121.9596186	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Drift Net	8
Side Channel Habitat near Skagit near Hamilton (170)	SKAGIT8SC	48.52018351/ -121.9596939	Characterize side channel prey communities	Every 6 weeks, May – Oct (4x/year)	Side-Channel Benthic	Ponar or Kick Net, site dependent	4
Skagit near SR 9 Bridge (168)	SKAGIT9X	48.48130834/ -122.2471543	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Kick Net	4
Skagit near SR 9 Bridge (168)	SKAGIT9X	48.48130834/ -122.2471543	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	River Benthic	Drift Net	8
Number of samples in Skagit River							201
Sauk River							
Sauk RM 5.4 (121)	SAUK1X	48.4081692/ -121.5558766	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	Tributary Benthic	Kick Net	4
Sauk RM 5.4 (121)	SAUK1X	48.407934/ -121.556501	Characterize main channel prey communities	Every 6 weeks, May – Oct (4x/year)	Tributary Benthic	Drift Net	8
Sauk upstream of Suiattle River (176)	SAUK2X	48.328771/ -121.547220	Compare BMI in regulated vs unregulated systems	Every 2 weeks, July – October (9x); Every 4 weeks, March – June, Nov – Dec (6x)	Intensive Tributary Benthic	Kick Net Transect	75
Side Channel Habitat Sauk upstream of Suiattle River (166)	SAUK2SC	48.328857/ -121.547570	Compare BMI in regulated vs unregulated systems	Every 2 weeks, July – October (9x); Every 4 weeks, March – June, Nov – Dec (6x)	Intensive Side-Channel Benthic	Ponar or Kick Net, site dependent	45

Location (Mapbook Location Number)	Sample Identification	Approximate Lat./Lon.	Purpose	Sampling Frequency	Sampling Method/Type	Method	Number of Samples
Number of samples in Sauk River							132
Number of BMI samples							730
Number of duplicate samples (kick samples downstream of Gorge Dam only)							30
Total Number of Samples							**760**

Water Temperatures in Project Reservoirs and Their Tributaries[22]

Ross Lake

Continuously measured temperatures in the Skagit River and two of its tributaries upstream of Ross Lake (various measurement periods from 2001-2019) are shown in Figure 4.2.2-11 (data for other tributaries are presented subsequently). Monthly average temperatures in the Klesilkwa River ranged from approximately 2°C to 12°C. Other Skagit River sites shown in Figure 4.2.2-11 exhibited less variability. Monthly averages calculated for individual years at the Swing Bridge location, about 0.5 miles upstream of the northern extent of Ross Lake, varied over a range of approximately 2°C, indicating moderate interannual variability in Skagit River temperatures entering Ross Lake.

Vertical temperature profiles measured from 2017-2018 at the Little Beaver (48.936547, -121.07666), Skymo (48.86725, -121.033389), and Pumpkin Mountain (48.787917, -121.051278) sampling locations in Ross Lake and at the log boom in the Ross Dam forebay (48.737218, -121.054392) are shown in Figures 4.2.2-12 – 4.2.2-15. At Little Beaver, surface temperatures increased from 15°C in May to 22°C in August and then decreased to 7°C in December (Figure 4.2.2-12). A difference in temperature between the "Surface" and "Middle" depths existed in spring but disappeared by September. During summer, surface water temperatures were up to 11°C warmer than bottom water temperatures. During and after autumn overturn, this difference was 1°C.

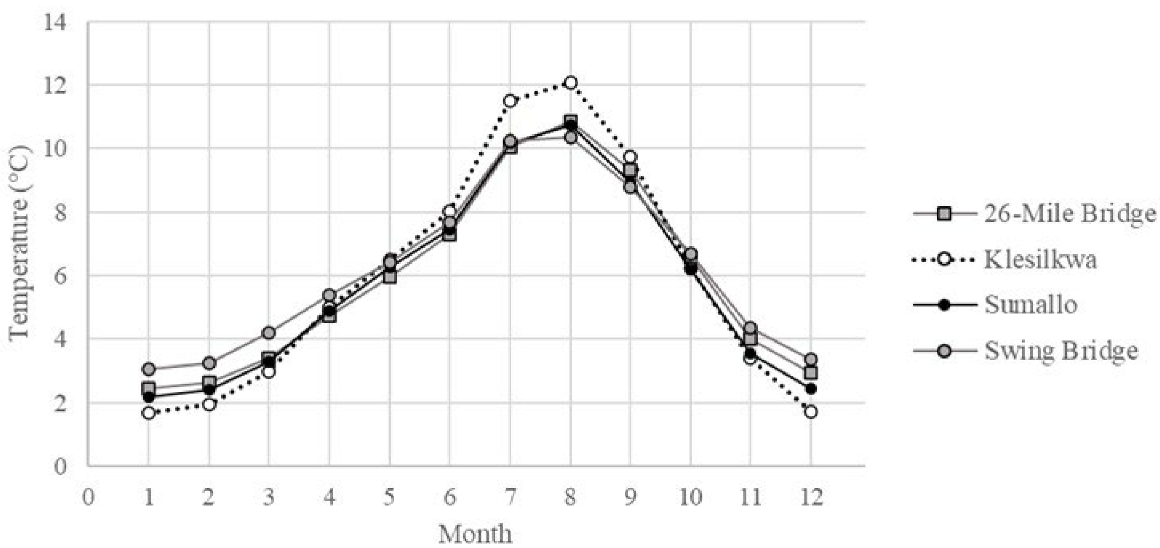


Figure 4.2.2-11. Monthly averages of continuous temperature data measured at select Skagit River locations (26-Mile Bridge [2001-2019] and Swing Bridge [2002-2019]) and tributaries (the Klesilkwa [2001-2019] and Sumallo rivers [2003-2018]) upstream of Ross Lake. Source: Seattle City Light.

22 Some data provided in this section are representative of a more comprehensive dataset provided in Appendix D to the FA-01a WQ Monitoring Study Interim Report (City Light 2022c).

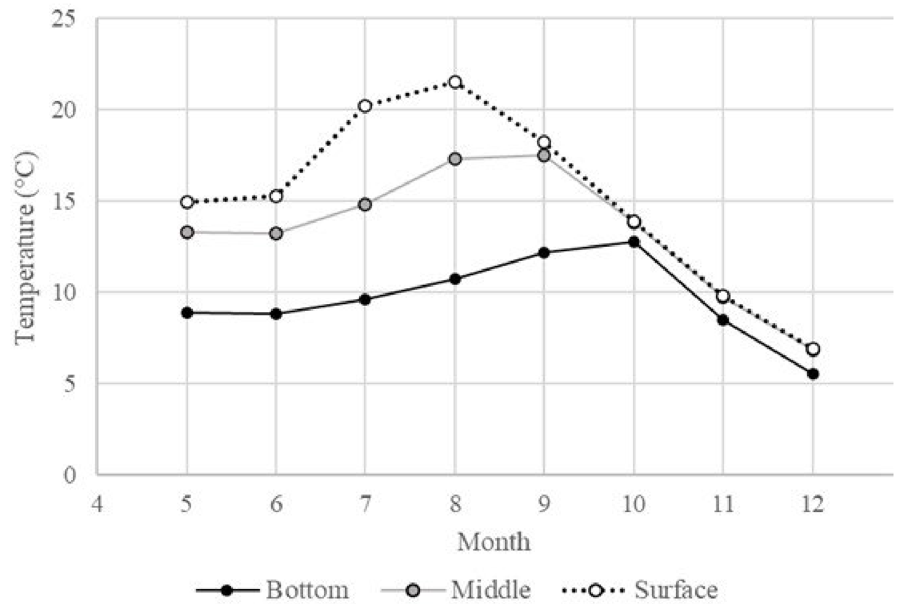


Figure 4.2.2-12. Monthly average water temperature at Surface, Middle, and Bottom depths at the Little Beaver monitoring location in Ross Lake (2017-2018). Source: North Coast and Cascades Inventory & Monitoring Network (NCCN).

The temporal pattern at Skymo resembled that of Little Beaver, although temperatures were slightly cooler at all depths between May and September, with a maximum surface water temperature of 21°C (Figure 4.2.2-13). Temperatures in October through December were close to those at Little Beaver.

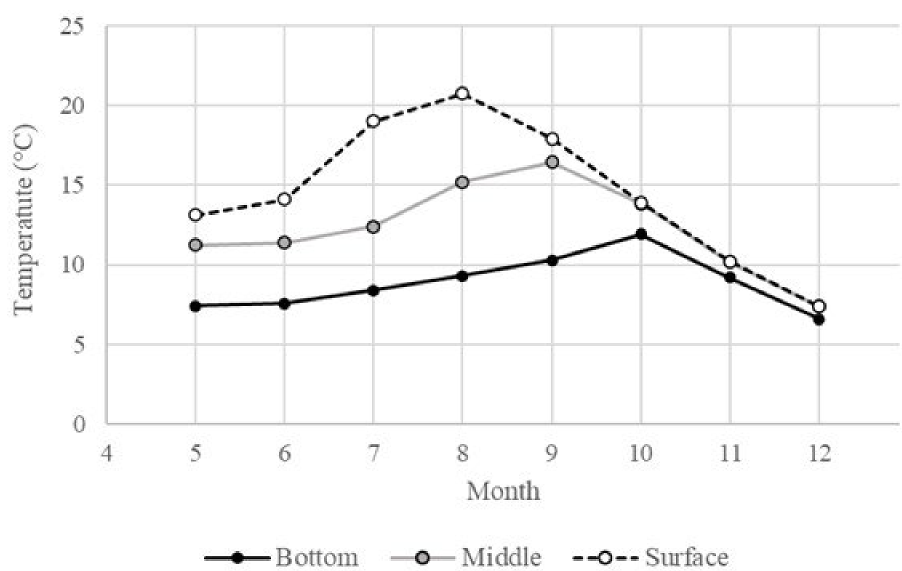


Figure 4.2.2-13. Monthly average water temperature at Surface, Middle, and Bottom depths at the Skymo monitoring location in Ross Lake (2017-2018). Source: NCCN.

At Pumpkin Mountain, the monthly pattern of surface water temperatures (Figure 4-2.2-14) was similar to and slightly cooler than that of Little Beaver upstream. Middle depth temperatures were slower to rise during summer, because the "Middle" depth at Pumpkin Mountain is deeper than at upstream sites. The greater depth at Pumpkin Mountain likely accounts for the nearly constant bottom water temperatures throughout the year.

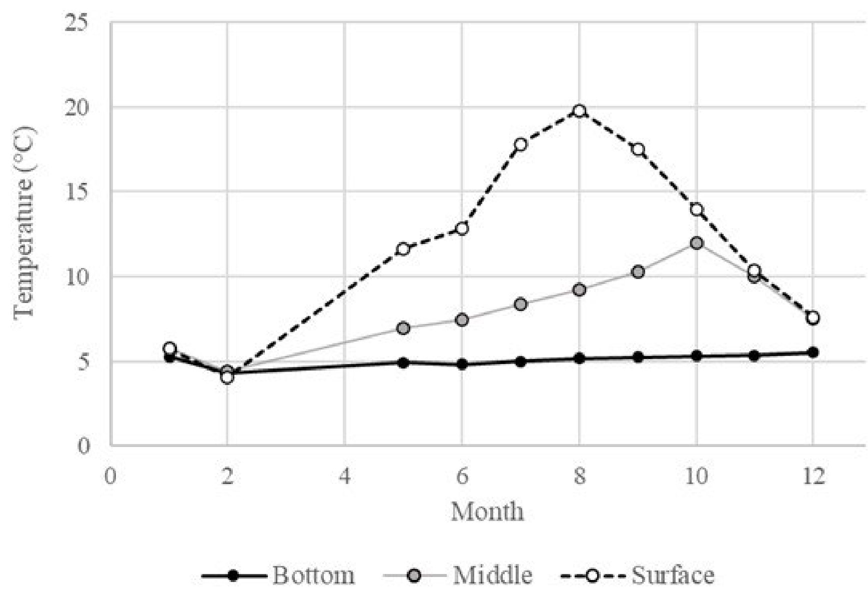


Figure 4.2.2-14. Monthly average water temperature at Surface, Middle, and Bottom depths at the Pumpkin Mountain monitoring location in Ross Lake (2017-2018). Source: NCCN.

At the log boom in Ross Dam forebay, where monitoring occurred over a larger number of smaller depth increments (and over a greater number of years, 2001-2019[23]), monthly average surface temperatures ranged from slightly below 4°C to 18.5°C (Figure 4.2.2-15). Temperatures at 200 ft increased from 4°C to almost 8°C by November. Monthly average temperatures at the log boom show that stratification begins in April and persists through August, and vertical mixing of the water column occurs from fall through early winter until the water column is isothermal to a depth of 200 ft by January.

Surface temperatures in Ross Lake were significantly higher than those measured in the Skagit River at Swing Bridge. Surface water temperatures were slightly warmer at Little Beaver (northernmost) than the Skymo and Pumpkin Mountain (southernmost) locations. Maximum reservoir surface temperatures exceeded 20°C, whereas maximum river temperatures reached only about 12°C, indicating that warming of Ross Lake is due to solar radiation, not river inflows. When Ross Lake was stratified, mechanical mixing of the surface layer due to wind appears to be more pronounced at the upstream locations than near Ross Dam, where a mixed surface layer was not observed (see the relative thermal resistance to mixing [RTRM] plots in the FA-01a WQ Monitoring Study Interim Report, Appendix E, City Light 2022c).

23 Continuous temperature monitoring along depth profiles at the Ross Lake log boom is ongoing, and additional data will be presented in future reports.

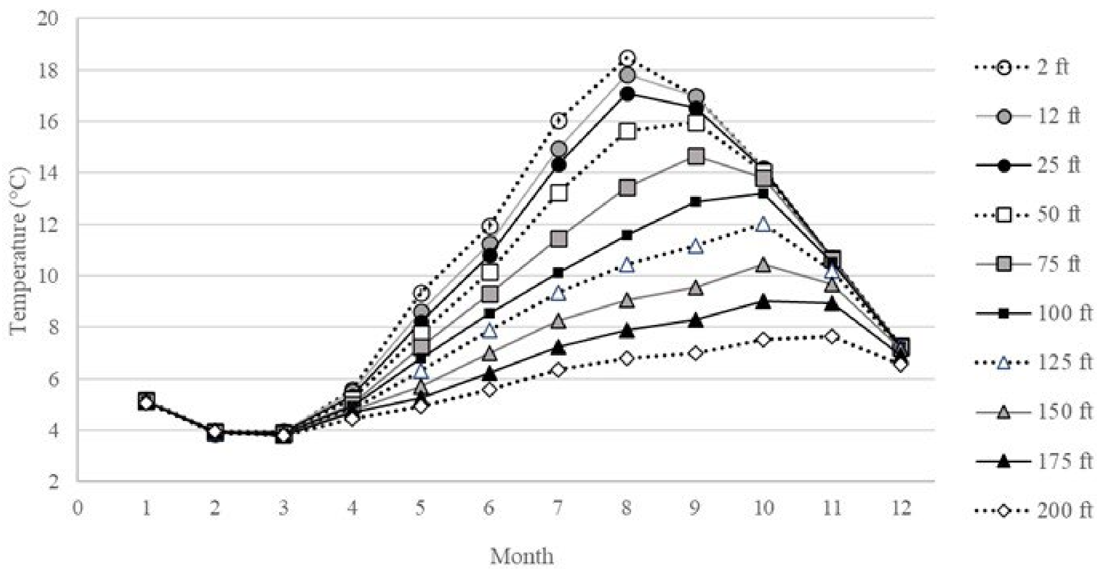


Figure 4.2.2-15. Monthly average water temperature at 10 depths at the log boom monitoring location in Ross Lake (2001-2019). Source: Seattle City Light.

Monthly average temperatures in select tributaries (other than the upper Skagit River, which is discussed above) to Ross Lake[24] (various recording periods from 2000-2020) (Figure 4.2.2-16) ranged from less than 2°C (Devil's Creek in February) to nearly 12°C (Ruby Creek in August). These two creeks had the coldest winter monthly average temperatures, whereas Big Beaver Creek, Lightning Creek, and Hozomeen Creek had slightly warmer temperatures in winter. Little Beaver Creek, Hozomeen Creek, and Big Beaver Creek had the coolest summer temperatures, peaking at less than 10°C in August during the measurement periods.

24 Tributaries are monitored at consistent locations over time. See FA-01a WQ Monitoring Study, Appendix D, (City Light 2022c) for maps and coordinates of sampling locations.

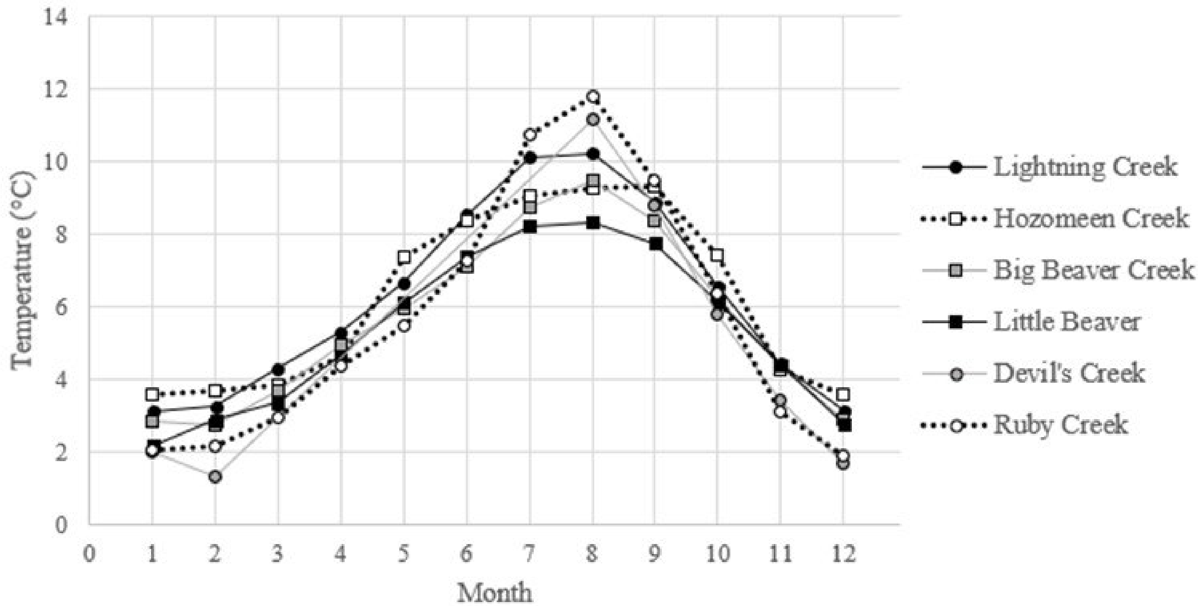


Figure 4.2.2-16. **Monthly averages of continuous temperatures measured in select tributaries to Ross Lake: Lightning Creek (2000-2017), Hozomeen Creek (2019-2020), Big Beaver Creek (2000-2020), Little Beaver Creek (2001-2019), Devil's Creek (2000-2002), and Ruby Creek (2000-2018). Source: Seattle City Light.**

Diablo Lake

At the log boom in the Diablo Dam forebay (2014-2019), monthly average surface temperatures ranged from approximately 4°C to 14°C (Figure 4.2.2-17). Stratification began in April, and overturn began in September. Diablo Lake's maximum depth is usually > 300 ft, so the deepest temperature data recorded (i.e., at 85 ft) were at an intermediate depth. Thermistor chains at other locations near Diablo Dam showed similar results (see the FA-01a WQ Monitoring Study Interim Report, Appendix E, City Light 2022c).

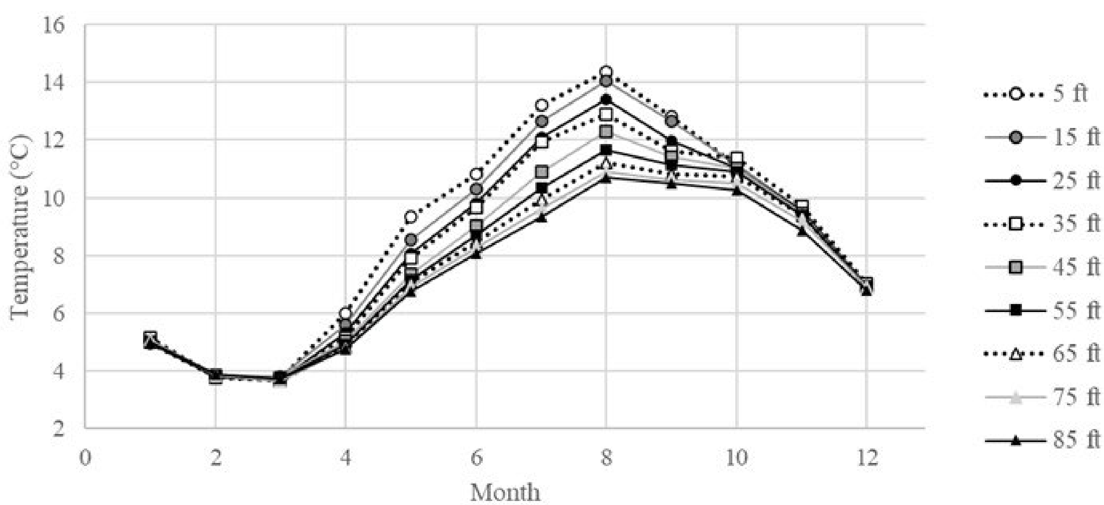


Figure 4.2.2-17. **Monthly average water temperature at nine depths at the log boom monitoring location in Diablo Lake (2014-2019). Source: Seattle City Light.**

Beginning in June 2021, as part of relicensing studies, *in situ* vertical profile measurements of temperature were collected at the upper end of Diablo Lake, just downstream of the Ross Powerhouse (DIABLO1) and near the Diablo Dam intake along the northern side of the forebay log boom (DIABLO2). Profiles in Diablo Lake were measured at water surface elevations (WSEs) ranging from approximately 1,207-1,211 feet North American Vertical Datum 1988 (NAVD 88; approximately 1,201-1,206 feet CoSD). Average elevation over the 28-year period, 1991-2018, was approximately 1,208 feet NAVD 88 (1,202 feet CoSD) (City Light 2020).

Surface water temperatures near Ross Powerhouse (DIABLO1) increased from approximately 7°C in June 2021 to approximately 15°C in July 2021 (Figure 4.2.2-18). With the exception of July, water temperatures were generally isothermal throughout the water column at this site. A thermal gradient is seen in the July profile from the surface, at approximately 15°C, to approximately 10°C at a depth of 4 meters (m) (13.1 ft) (Figure 4.2.2-18). Despite the short detention time (9.4 days) in Diablo Lake (City Light 2020), thermal stratification is evident at the deeper, downstream site at the forebay (DIABLO2), particularly in July when water temperature in the upper 2 m (6.6 ft) was 24.5°C[25] on July 21, 2021 (Figure 4.2.2-18).

Temperature profiles measured in 2022, and reported in this Exhibit E, extend through June 2022 (Figure 4.2.2-19). Profile measurements are ongoing, and additional data will be provided in the USR and FLA. At DIABLO1, below Ross Powerhouse, temperatures were slightly warmer in June 2022 than in June 2021 (about 1°C). In the Diablo Dam forebay (DIABLO2), surface temperatures during June 2022 were significantly cooler than in June 2021, with maxima around 11 and 14°C, respectively (Figures 4.2.2-18 and 4.2.2-19). These differences reflect ambient weather conditions: June 2021 was an inordinately warm year, whereas air temperatures in spring 2022 were below average. For all other months in 2022, thermal profiles were isothermal, or nearly so.

[25] Air temperatures during the 2021 monitoring period were at times substantially above normal based on data from the National Weather Service (NWS) (normal data are averages over the period 1991-2020). For example, the maximum air temperature recorded at Newhalem on June 29, 2021 was 45°C (113ºF), 22°C (40ºF) above the normal maximum of 23°C (73ºF) for this date. As a result, the high surface water temperature measured in July 2021 should not be considered representative of normal conditions.

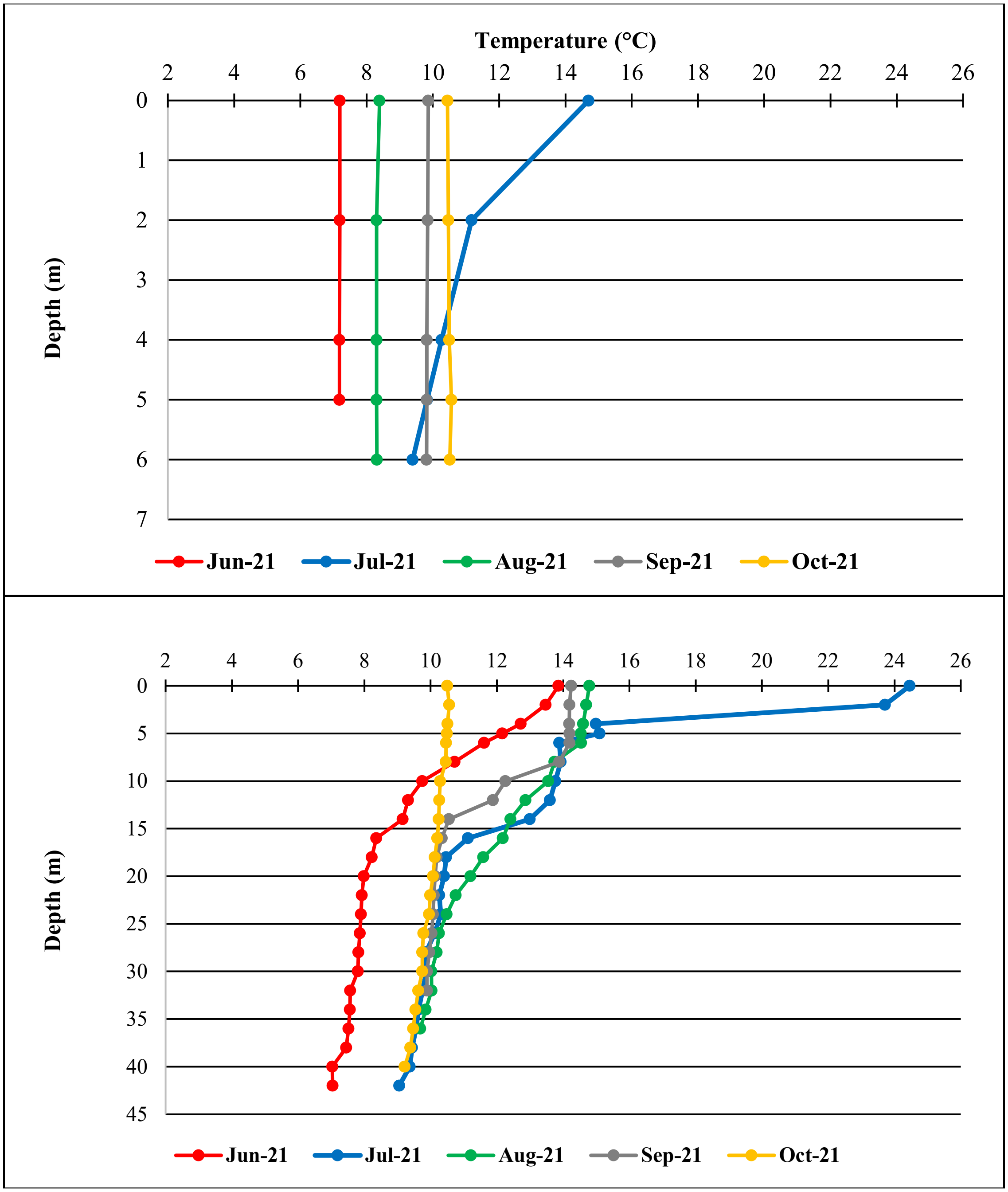


Figure 4.2.2-18. Temperature profile near Ross Powerhouse (DIABLO1) (top) and Diablo Dam forebay (DIABLO2) (bottom) (June-October 2021). Source: Seattle City Light.

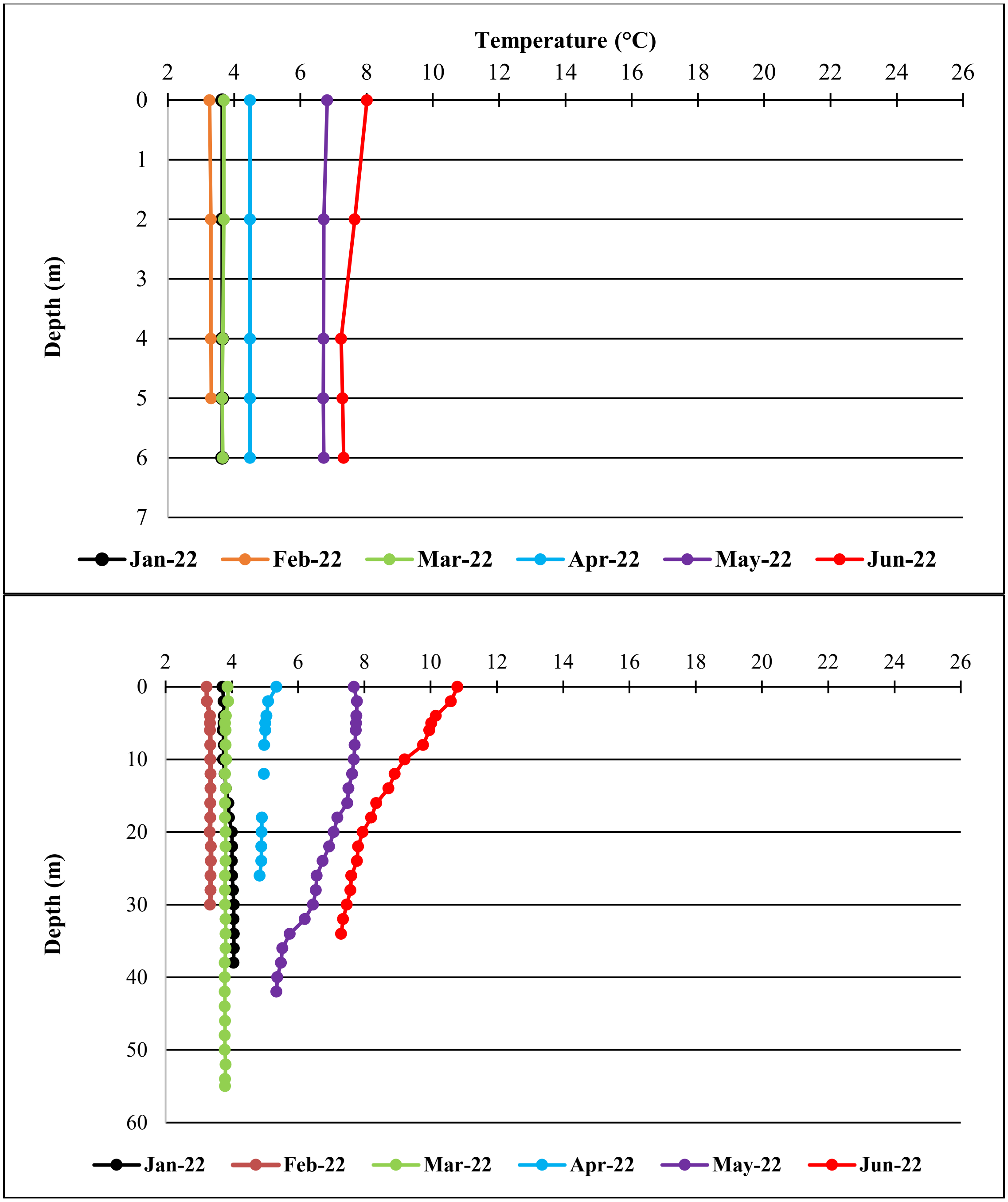


Figure 4.2.2-19. Temperature profile near Ross Powerhouse (DIABLO1) (top) and Diablo Dam forebay (DIABLO2) (bottom) (January-June 2022). Source: Seattle City Light.

Temperature patterns varied among Diablo Lake tributaries (2014-2017), with greater annual variability in West Fork Creek and Fisher Creek, which had similar seasonal patterns, than in McAllister Creek (Figure 4.2.2-20). Insufficient temperature data were available to evaluate annual temperature variation in Thunder Creek.

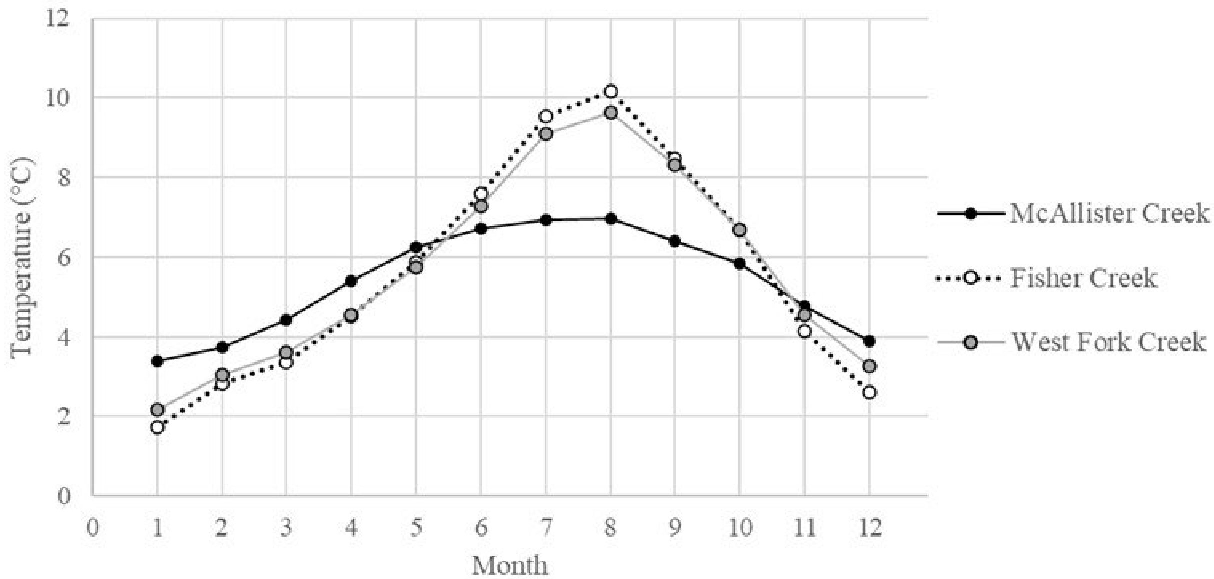


Figure 4.2.2-20. Monthly averages of continuous temperature data in select tributaries to Diablo Lake: McAllister Creek (2014-2017), Fisher Creek (2014-2017), and West Fork Creek (2014-2017). Source: Seattle City Light.

Gorge Lake

Data from 2014-2019 show that Gorge Lake was colder than Diablo Lake, with similar minimum temperatures but with summer maximum temperatures only slightly above 12°C (Figure 4.2.2-21). The Gorge Lake water column was nearly isothermal to a depth of 80 ft during most of the year, with a peak difference of approximately 1°C between surface water and water at 80 ft during summer. The summer maxima observed in Gorge Lake from 2014-2019 are higher than the monthly average temperatures measured at the Skagit River inflow at Swing Bridge from 2002-2019 (see Figure 4.2.2-11).

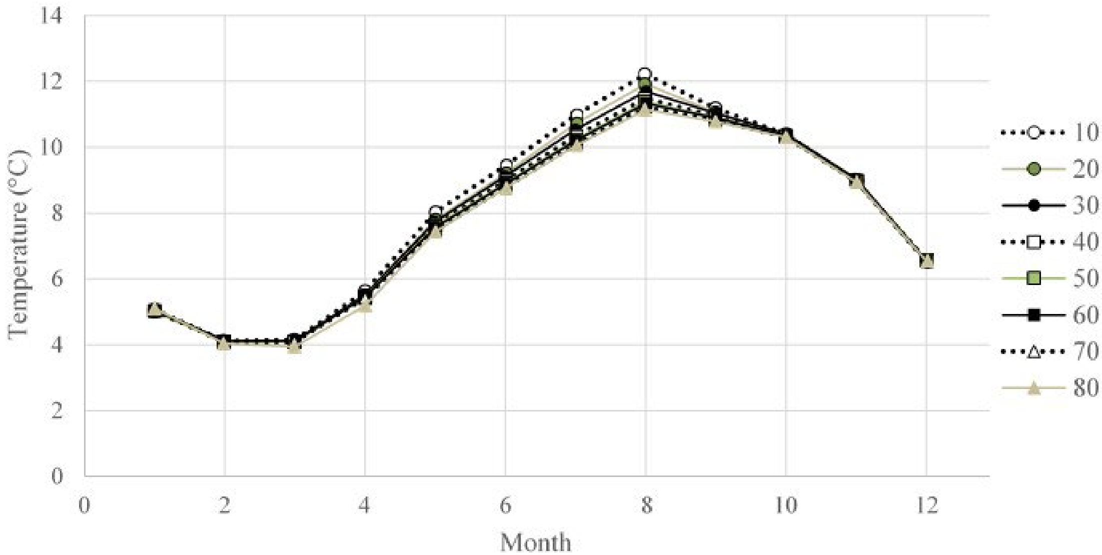
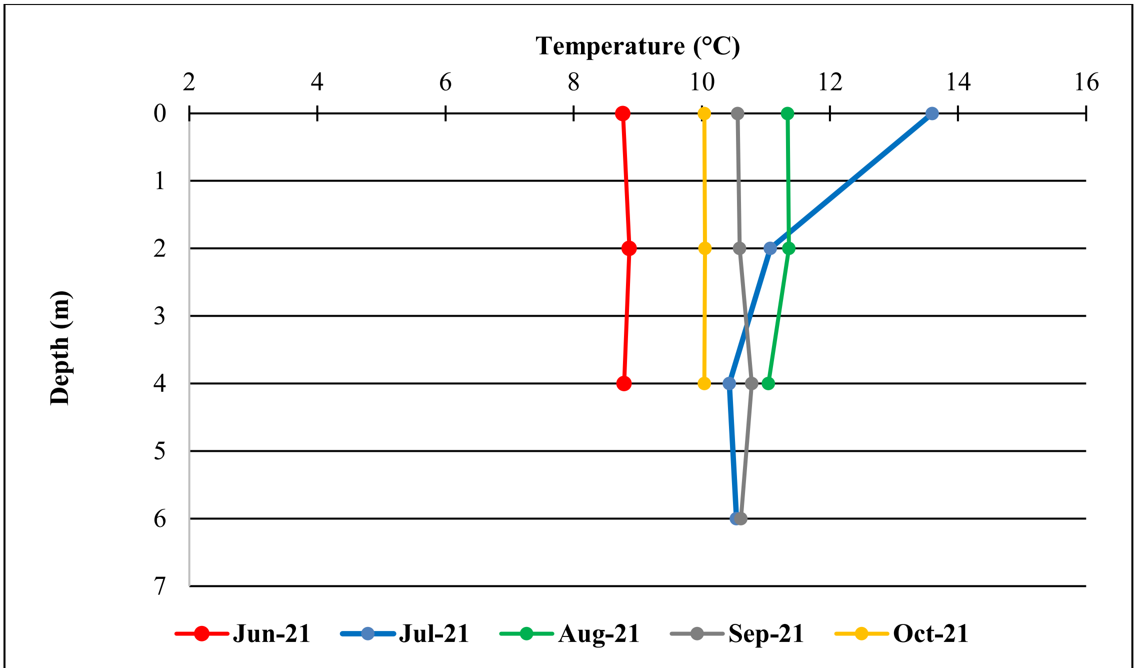


Figure 4.2.2-21. Monthly average water temperature at 8 depths at the log boom monitoring location in Gorge Lake (2014-2019). Source: Seattle City Light.

Beginning in June 2021, *in situ* vertical profile measurements of temperature were made at the upstream end of Gorge Lake at Reflector Bar, across from the Diablo Powerhouse (GORGE1) and near the Gorge Dam intake along the southern side of the forebay log boom (GORGE2). Surface temperatures were highest in July at Reflector Bar (13.6°C) and in August at the forebay (12.8°C). Weak stratification is seen in July at the upper end of Gorge Lake and in June and July in the forebay (Figure 4.2.2-22), although there was also a thermal gradient evident in the forebay in August. Vertical profiles in Gorge Lake were conducted at elevations of approximately 877-881 feet NAVD 88 (871.5-874.5 feet NAVD 88). In 2022, temperatures increased from approximately 3°C to 8.5°C from January through June. All profiles were isothermal or nearly so, with no apparent thermal gradients driven by a warming surface layer (Figure 4.2.2-23). Profile measurements are ongoing, and additional data will be provided in the USR and FLA.



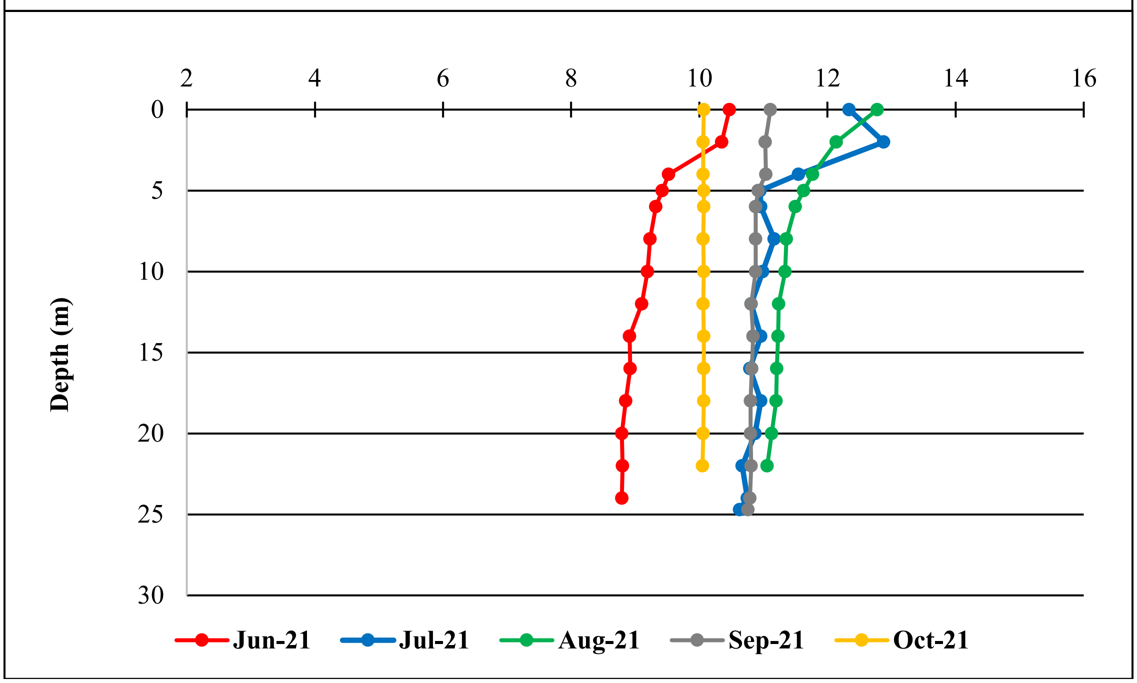


Figure 4.2.2-22. Temperature profile at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (June-October 2021). Source: Seattle City Light.

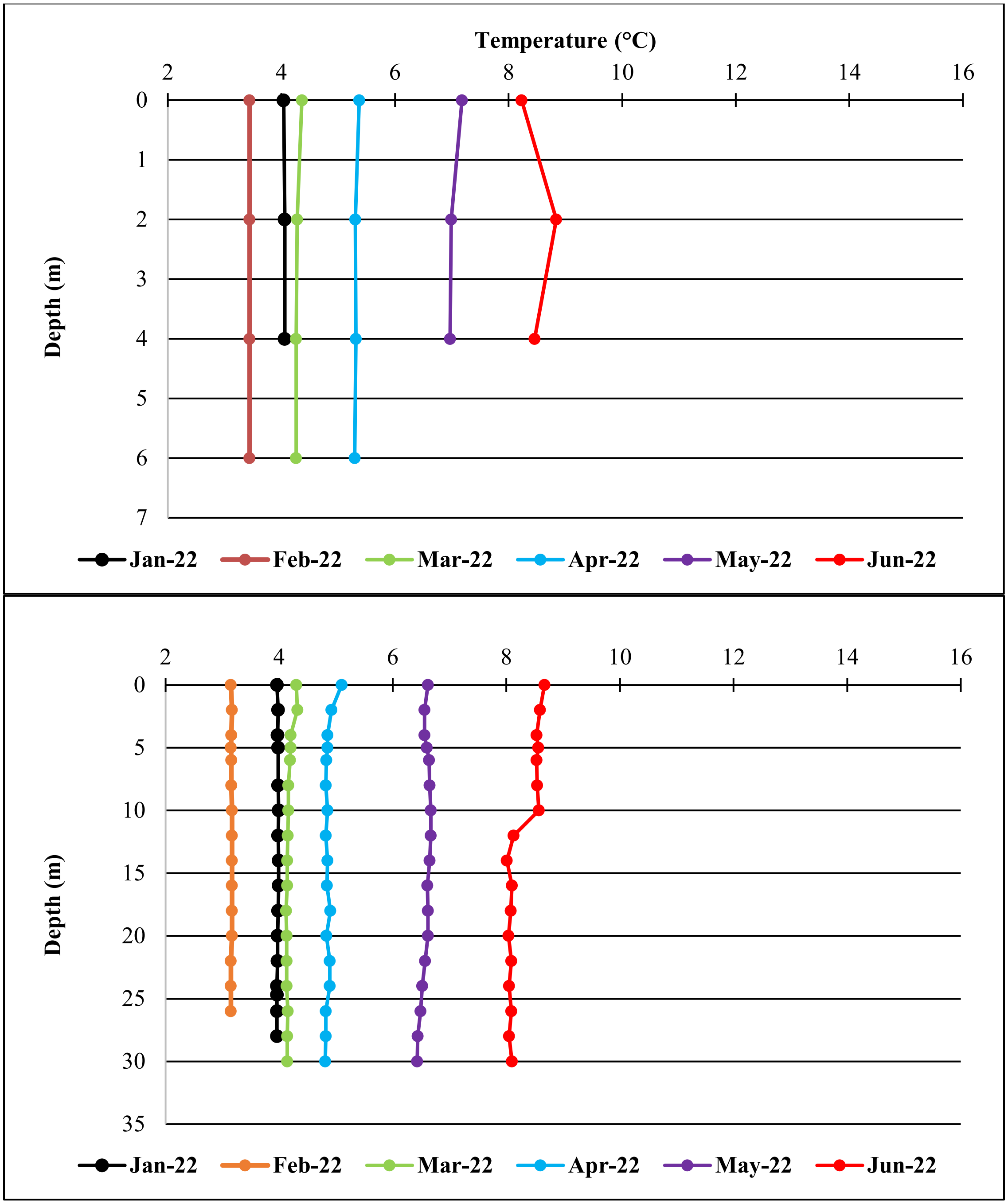


Figure 4.2.2-23. Temperature profile at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (January-June 2022). Source: Seattle City Light.

Stetattle Creek was the only Gorge Lake tributary monitored (2005-2019), and it had a minimum monthly average temperature of 3°C in February and a maximum monthly average temperature of nearly 12°C in August (Figure 4.2.2-24).

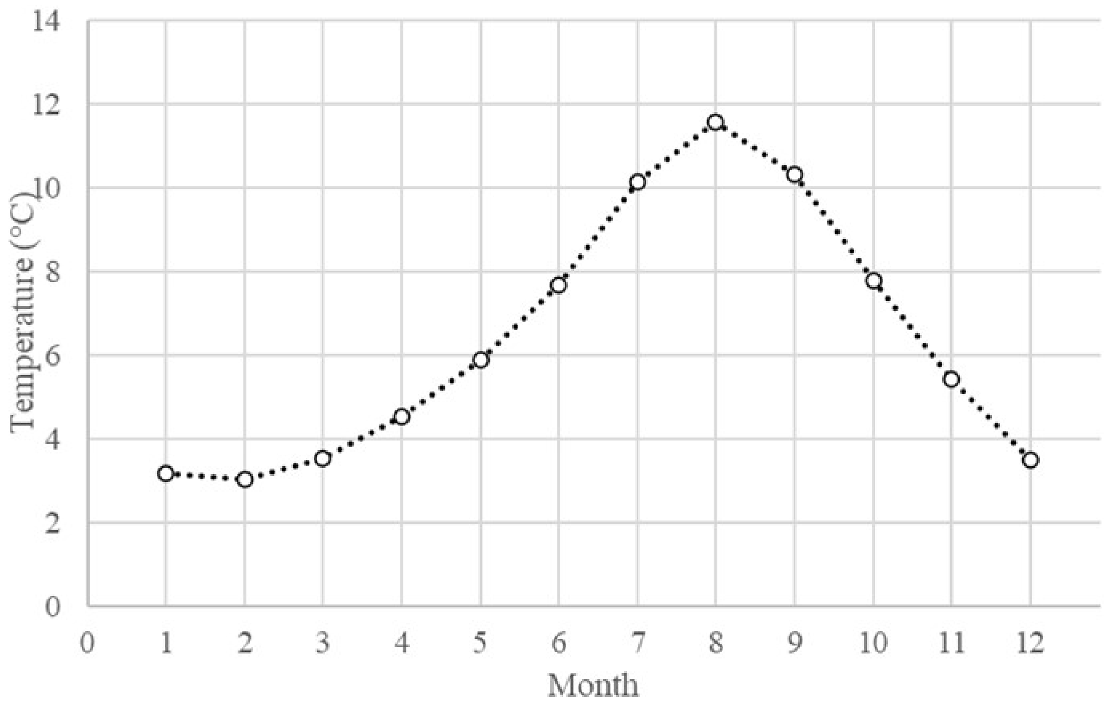


Figure 4.2.2-24. Monthly average of continuous temperature data measured in Stetattle Creek (2005-2019). Source: Seattle City Light.

Dissolved Oxygen and pH in Project Reservoirs

Ross Lake

DO and pH profiles measured in Ross Lake during 2018 at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites are shown in Figures 4.2.2-25 through 4.2.2-30. Each profile represents data collected on a single day, as indicated in the respective figure captions.

- DO varied between 9.0 and 11.0 mg/L at all locations in June and July, except at Little Beaver in July where DO fell slightly below 9.0 mg/L.
- DO varied between 8.0 and 10.0 mg/L from August through October, with some lower values (7.0-7.5 mg/L at ≥ 100 ft depth at Skymo in September; 7.5-8.0 mg/L between 100 and 150 ft depth at Pumpkin Mountain in October).
- DO varied between 10.0 and 11.0 mg/L in November, except at ≥ 125 ft depth at Pumpkin Mountain where it ranged from 8.5-10.0 mg/L.
- pH ranged from approximately 7.0 to 8.5 throughout all sampling periods, except some values in November fell below 7.0 at Pumpkin Mountain at depths > 150 ft.

Values shown in Figures 4.2.2-25 through 4.2.2-30 are generally representative of those measured in other years, i.e., 2015-2017 at the same locations (see the FA-01a WQ Monitoring Study Interim Report, Appendix E for profiles at all three locations from 2015-2017, City Light 2022c). One notable exception was October 2016, when pH values measured at the Pumpkin Mountain site ranged from 6.0-7.0 at depths ≥ 60 ft.

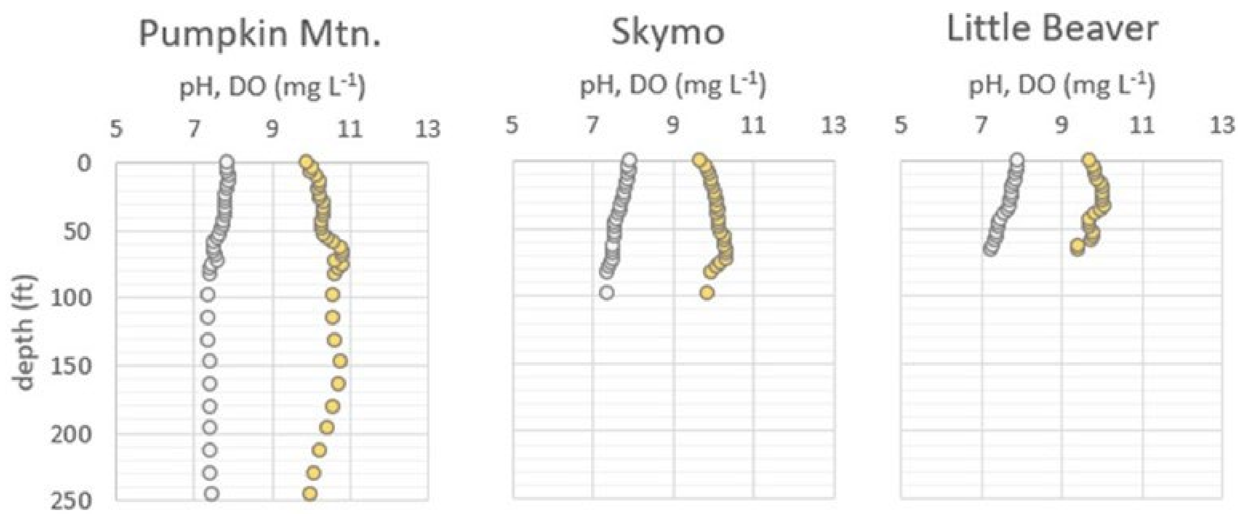


Figure 4.2.2-25. **pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on June 18, 2018. Source: NCCN.**

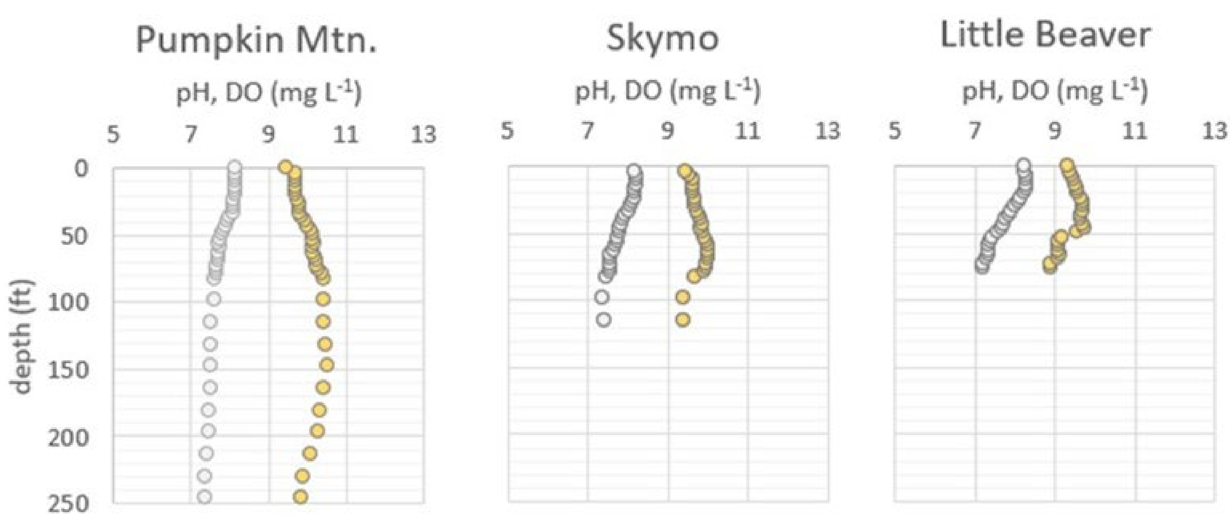


Figure 4.2.2-26. **pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on July 12, 2018. Source: NCCN.**

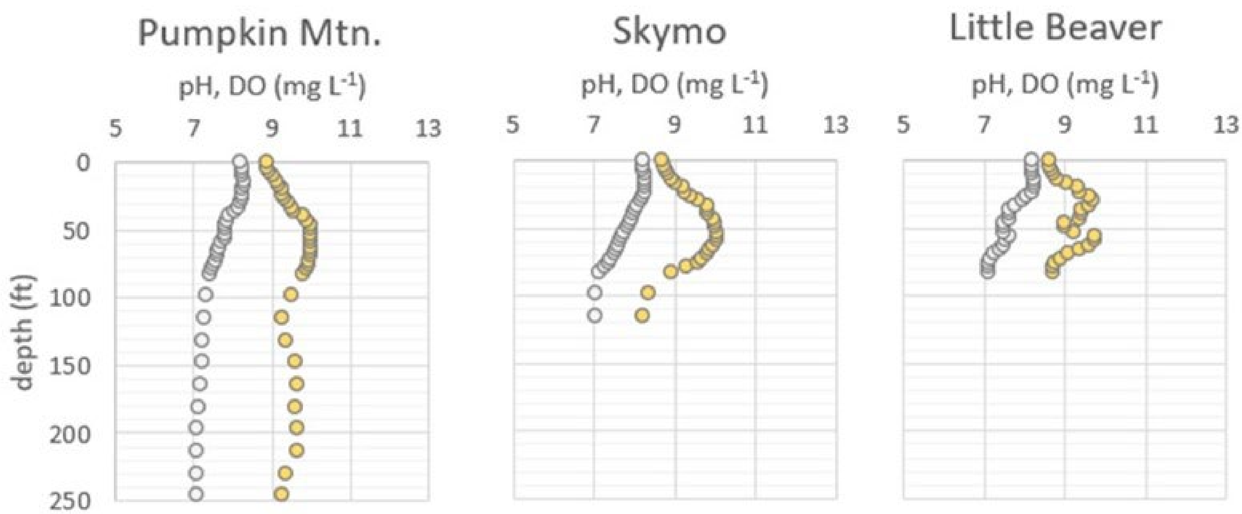


Figure 4.2.2-27. pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on August 16, 2018. Source: NCCN.

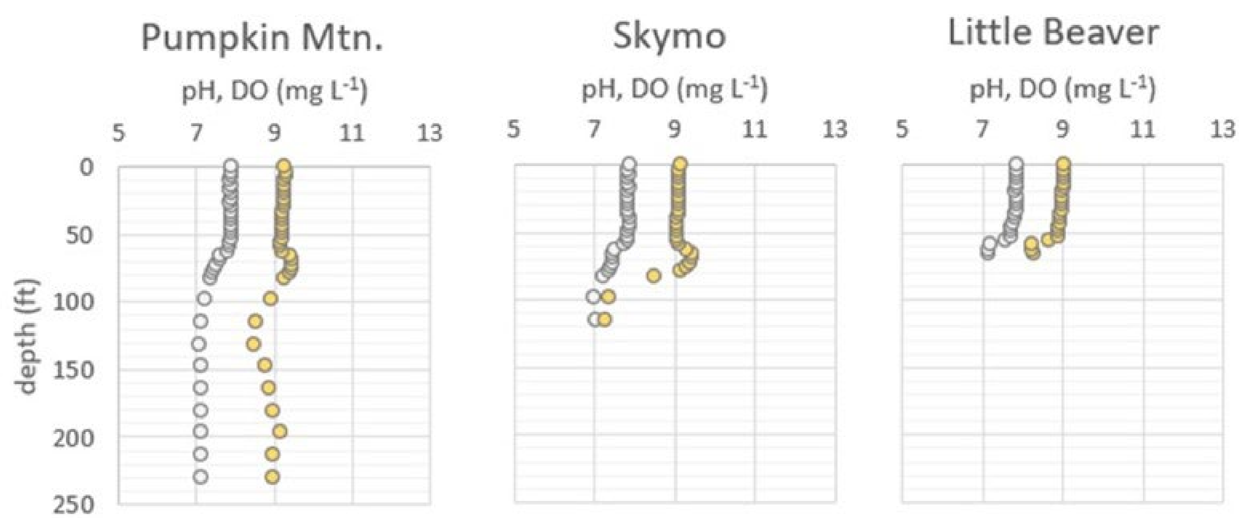


Figure 4.2.2-28. pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on September 19, 2018. Source: NCCN.

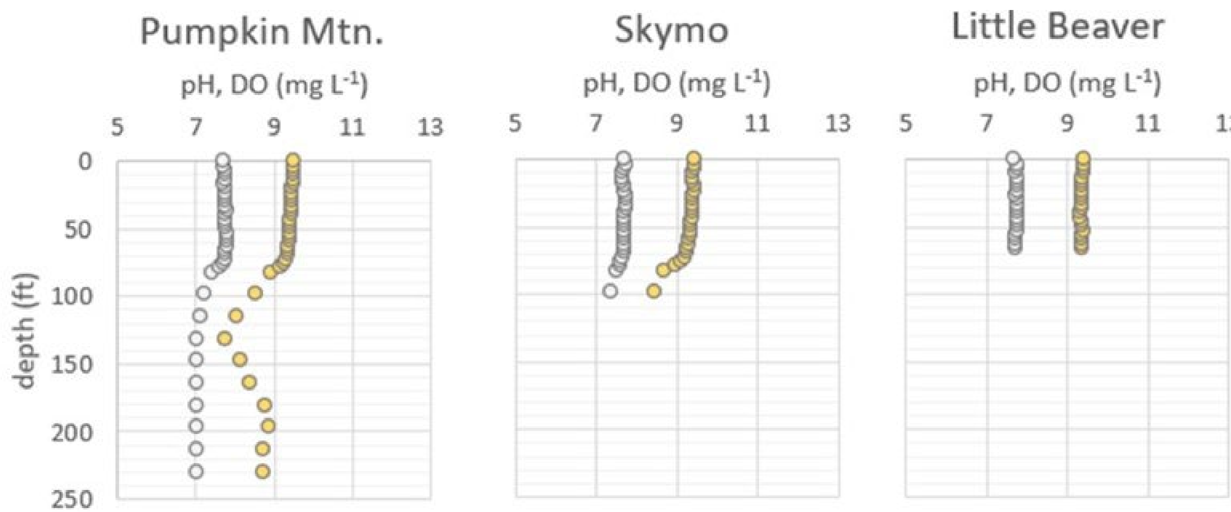


Figure 4.2.2-29. **pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on October 15, 2018. Source: NCCN.**

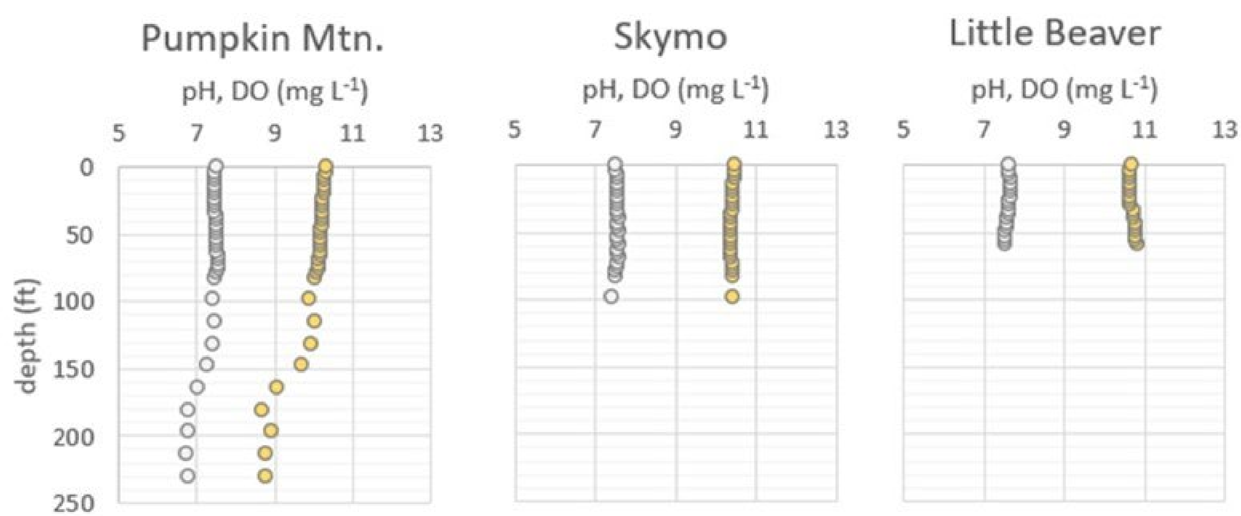


Figure 4.2.2-30. **pH (white/left) and dissolved oxygen (yellow/right) profiles measured in Ross Lake at the Pumpkin Mountain, Skymo, and Little Beaver sampling sites on November 19, 2018. Source: NCCN.**

Diablo Lake

DO profiles (June-October 2021) measured at the upper end of Diablo Lake (DIABLO1) and the Diablo Dam forebay (DIABLO2) are shown in Figure 4.2.2-31. At the upper end of the reservoir, surface values were lowest during July and highest in June. Surface DO was 9.5 mg/L in July, increasing to 11.5 mg/L at 4 m (13.1 ft). In June, surface DO was 13.6 mg/L, with values remaining approximately uniform to the bottom depth of 5 m (16.4 ft). These minimum and maximum DO concentrations correspond to 98 percent and 118 percent saturation, respectively, based on temperatures at the time of data collection and assuming a reservoir elevation of 1,211.36 feet

NAVD 88 (1,205 feet CoSD), as reported in the Pre-Application Document (PAD [City Light 2020]). In the forebay (DIABLO2), minimum DO was 7.8 mg/L at the surface in July, corresponding to a calculated saturation of 98 percent at the corresponding recorded surface water temperature of 24.5°C. From July through September, DO concentrations increased, in some cases only slightly, through the mid-water column as temperatures decreased.

In June 2022, DO measurements at the DIABLO2 profile site varied less than they did in 2021 (Figure 4.2.2-32), possibly reflecting the narrower range of temperatures measured in 2022. In 2022, DO profiles at DIABLO1 ranged from 12 to 13.5 mg/L. DO profiles at DIABLO2 were similar across months in 2022, with the exception of the June profile that ranged from approximately 11 to 12.5 mg/L (Figure 4.2.2-32). The uniformity of the 2022 DO measurements throughout the water column reflect the fact that measurements were made during cooler months when Diablo Lake is isothermal. As noted above, profile measurements are ongoing, and additional data will be provided in the USR and FLA.

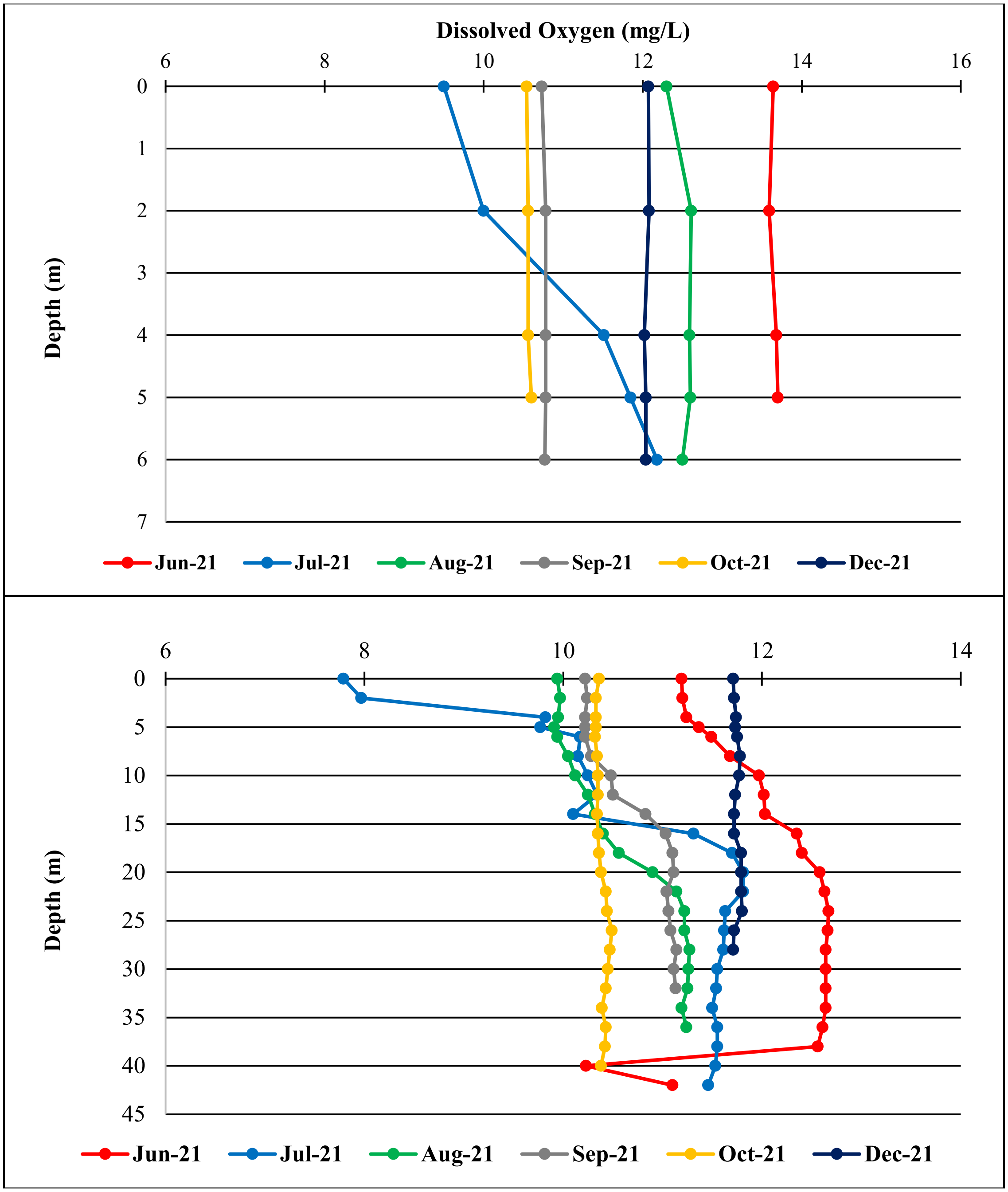


Figure 4.2.2-31. Diablo Lake dissolved oxygen profile at Ross Powerhouse (DIABLO1) (top) and the forebay (DIABLO2) (bottom) (June-October 2021). Source: Seattle City Light.

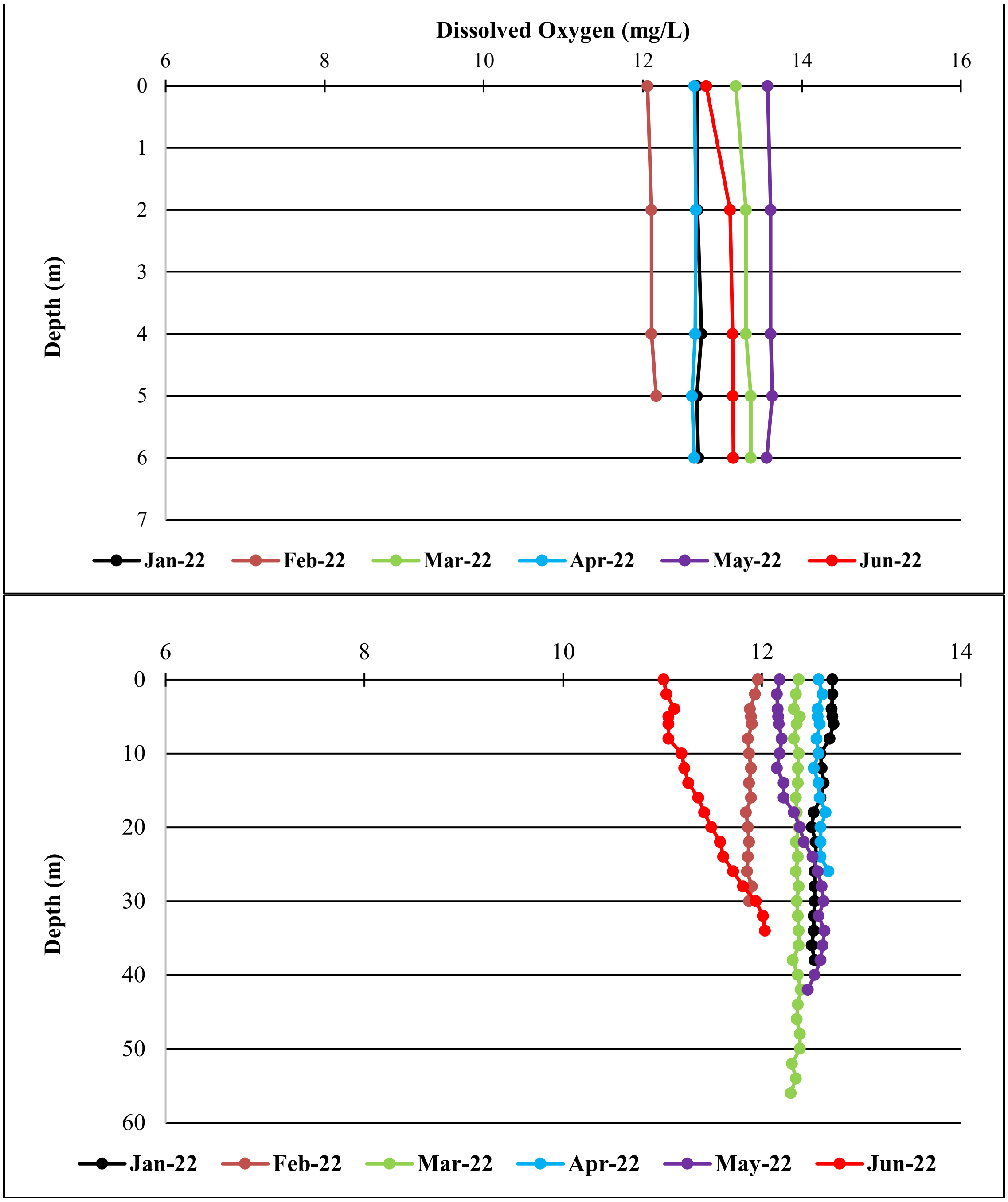
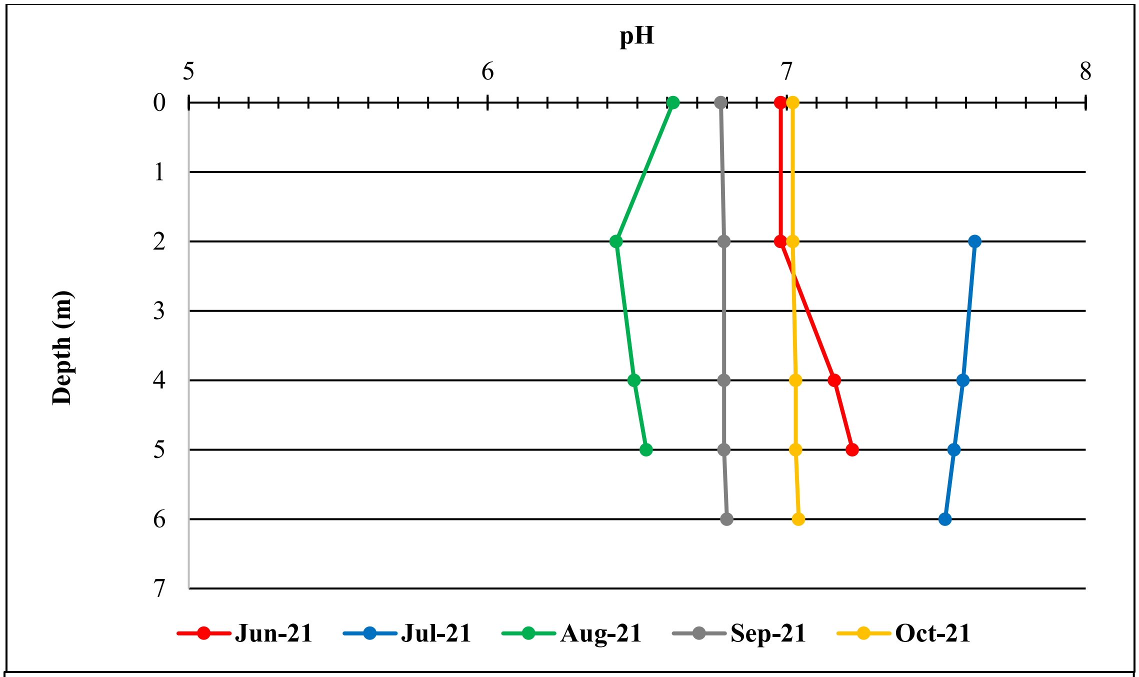
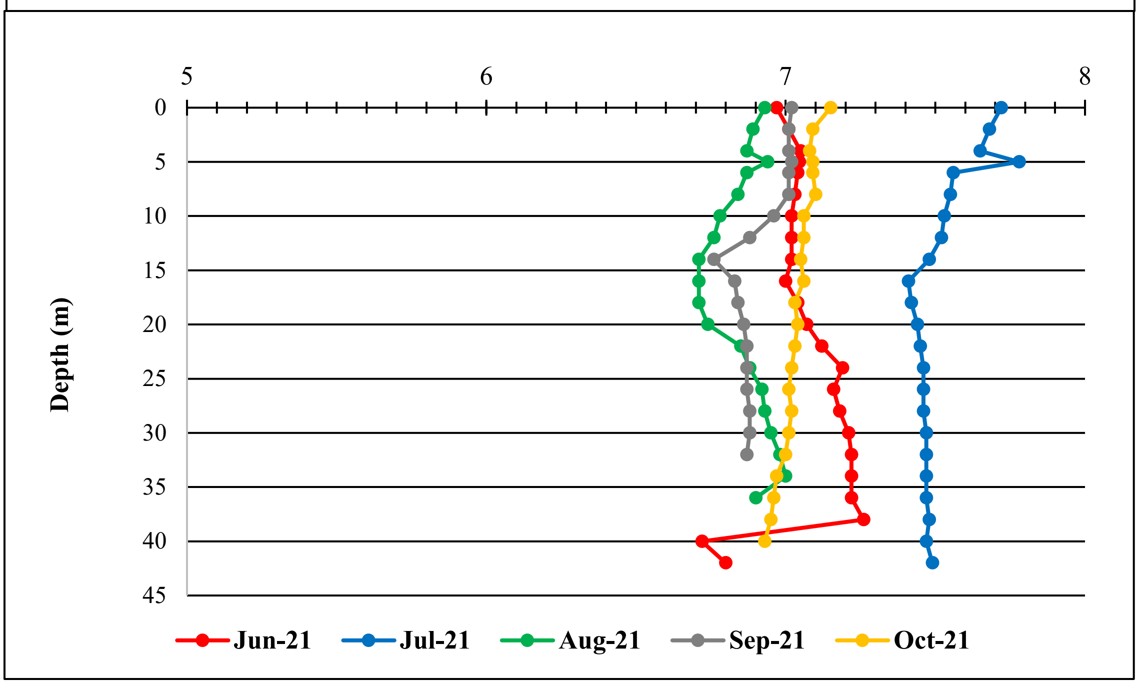


Figure 4.2.2-32. Diablo Lake dissolved oxygen profile at Ross Powerhouse (DIABLO1) (top) and the forebay (DIABLO2) (bottom) (January-June 2022). Source: Seattle City Light.

Figure 4.2.2-33 shows pH profiles measured at the upper end of Diablo Lake (DIABLO1) and the Diablo Dam forebay (DIABLO2). Slightly larger differences were seen in pH values among months at the upper end of the reservoir than in the forebay, likely due to a more stable water column near the forebay log boom. In 2022, March, April, and June pH profiles at DIABLO2 show a pronounced pH gradient in the upper 10 meters (33 ft) of the water column; it is currently unclear what may have caused this pattern (Figure 4.2.2-34). As noted above, profile measurements are ongoing, and additional data will be provided in the USR and FLA.





Note: The pH measurement at the surface at DIABLO1 during July was removed during QA/QC evaluation.

Figure 4.2.2-33. pH profile at the upper end of Diablo Lake (DIABLO1) (top) and the Diablo Dam forebay (DIABLO2) (bottom) (June-October 2021). Source: Seattle City Light.

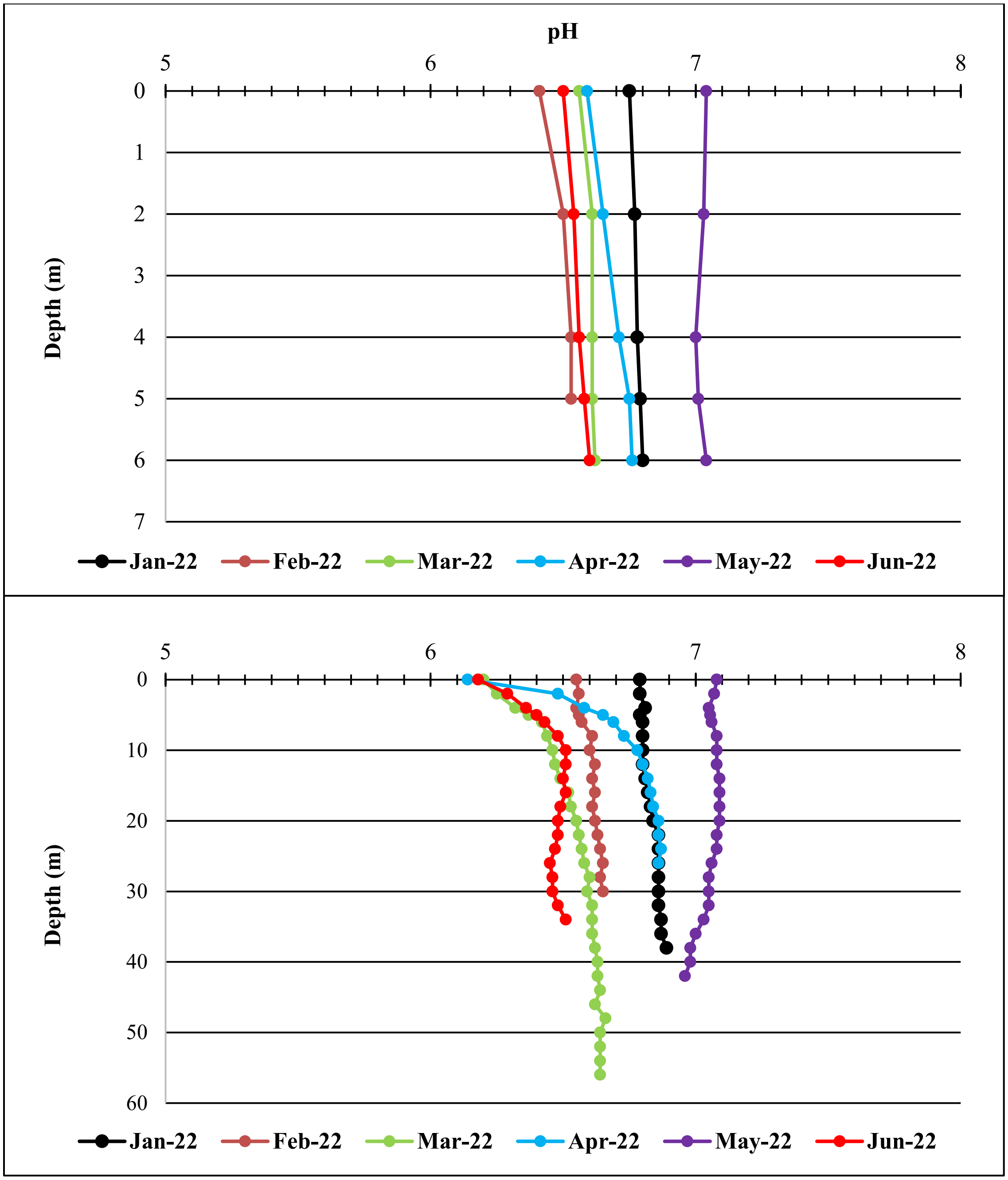


Figure 4.2.2-34. pH profile at the upper end of Diablo Lake (DIABLO1) (top) and the Diablo Dam forebay (DIABLO2) (bottom) (January-June 2022). Source: Seattle City Light.

Gorge Lake

In 2021, DO profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) and in the forebay (GORGE2) are shown in Figure 4.2.2-35. Values were generally between 10 and 11 mg/L at Reflector Bar, with the exception of slightly higher values in June of 12.5 mg/L, corresponding to a DO saturation of 111 percent, based on ambient temperature and a reservoir elevation of 881.51 feet NAVD 88 (875 feet (CoSD), as reported in the PAD (City Light 2020). In the forebay, minimum DO was 10.4 mg/L at the surface in July, corresponding to a calculated saturation of 100 percent. Remaining profile measurements in the forebay were generally 10.0 to 11.5 mg/L throughout the water column, except during June, when concentrations were near 12.0 mg/L throughout the water column.

In 2022, DO profiles at Reflector Bar (GORGE1) and in the Gorge Lake forebay (GORGE2) were similar during respective months (Figure 4.2.3.36); minimum values occurred in June when water temperatures were highest, with concentrations of approximately 11.5 mg/L throughout the water column (calculated saturation of 102 percent). DO concentrations throughout the water column in January 2022, approximately 15 mg/L, were supersaturated (calculated saturation of 116 percent). Profile measurements are ongoing, and additional data will be provided in the USR and FLA.

In 2021, pH profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) and in the forebay (GORGE2) were between 7.0 and 7.5 (Figure 4.2.2-37); pH was very similar from surface to bottom. In June 2022, pH values measured along vertical profiles at both sampling locations were comparatively low (pH 6.5-6.8), possibly due to heavy rainfall (Figure 4.2.2-38). Profile measurements are ongoing, and additional data will be provided in the USR and FLA.

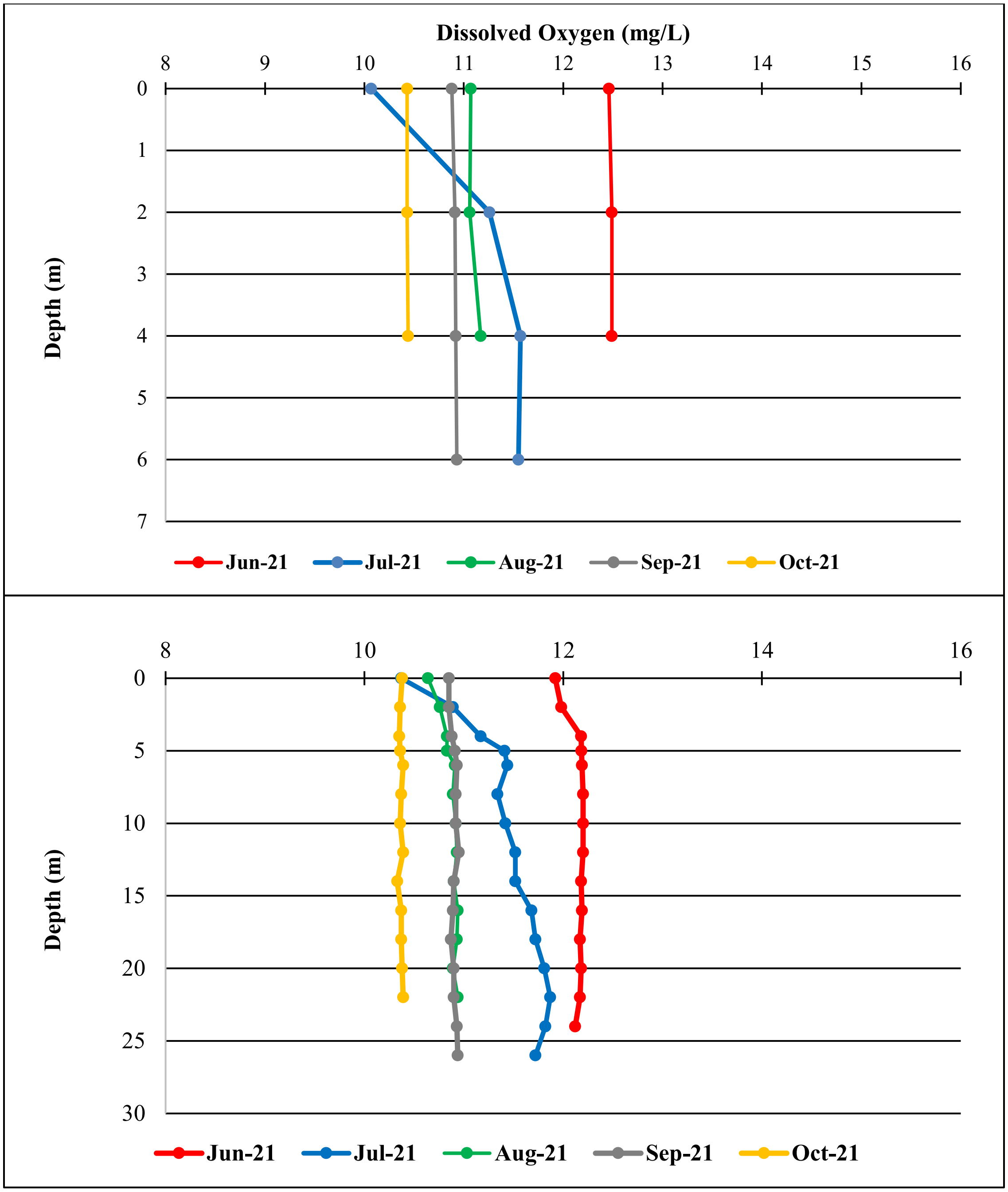


Figure 4.2.2-35. Dissolved oxygen profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (June-October 2021). Source: Seattle City Light.

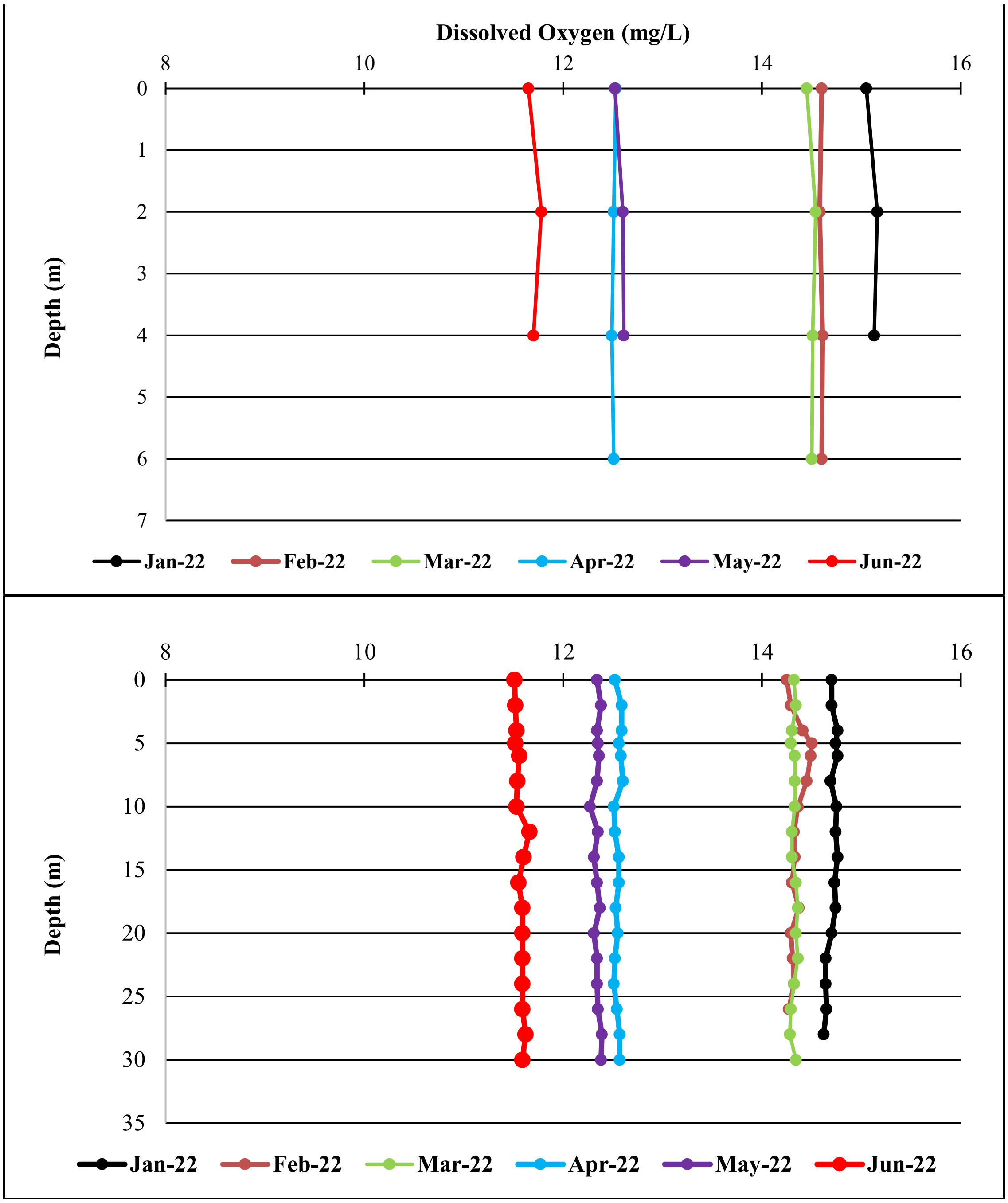
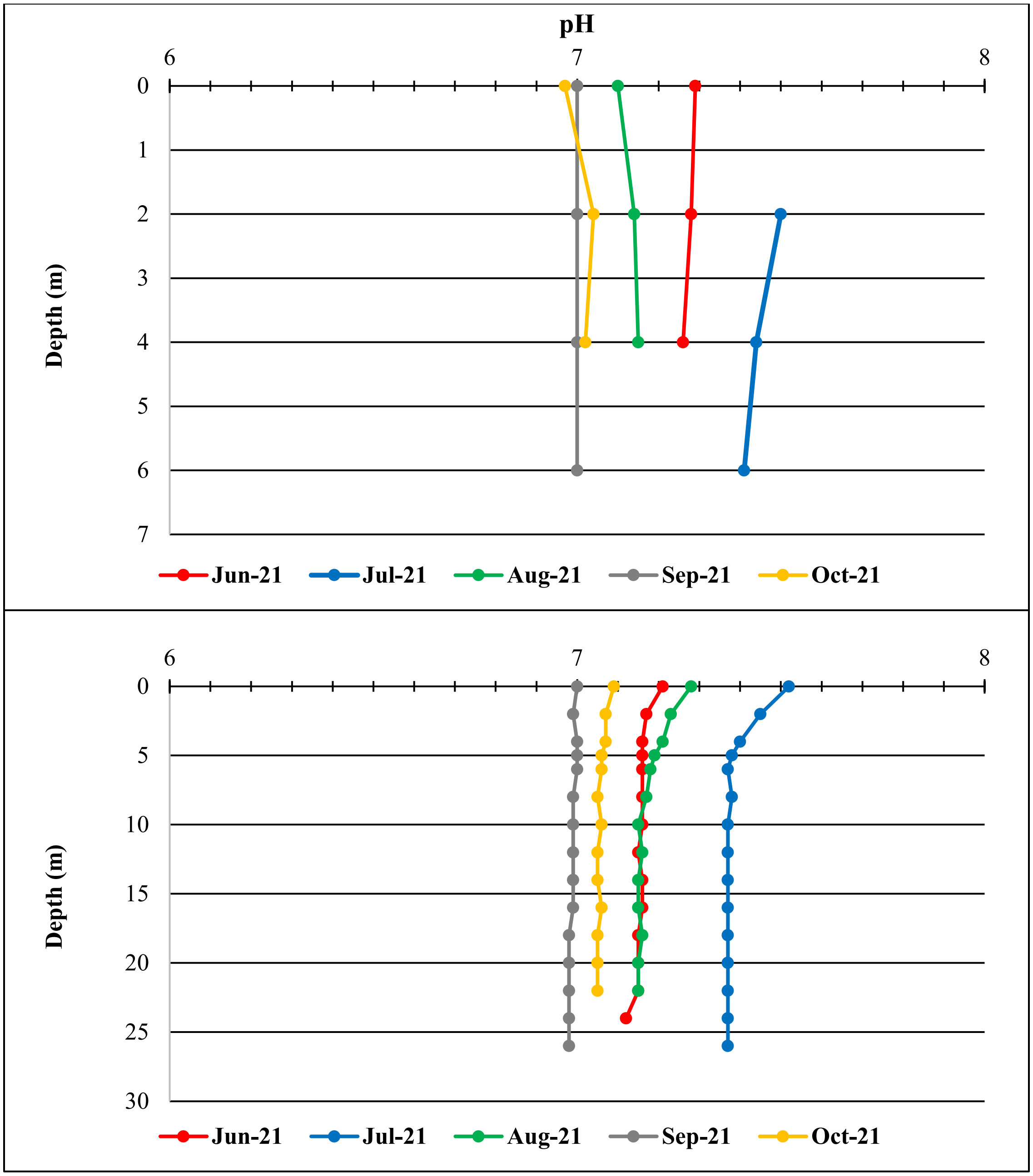


Figure 4.2.2-36. Dissolved oxygen profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (January-June 2022). Source: Seattle City Light.



Notes: The pH measurement at the surface at GORGE1 during the July profile was removed during QA/QC.

Figure 4.2.2-37. pH profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (June-October 2021). Source: Seattle City Light.

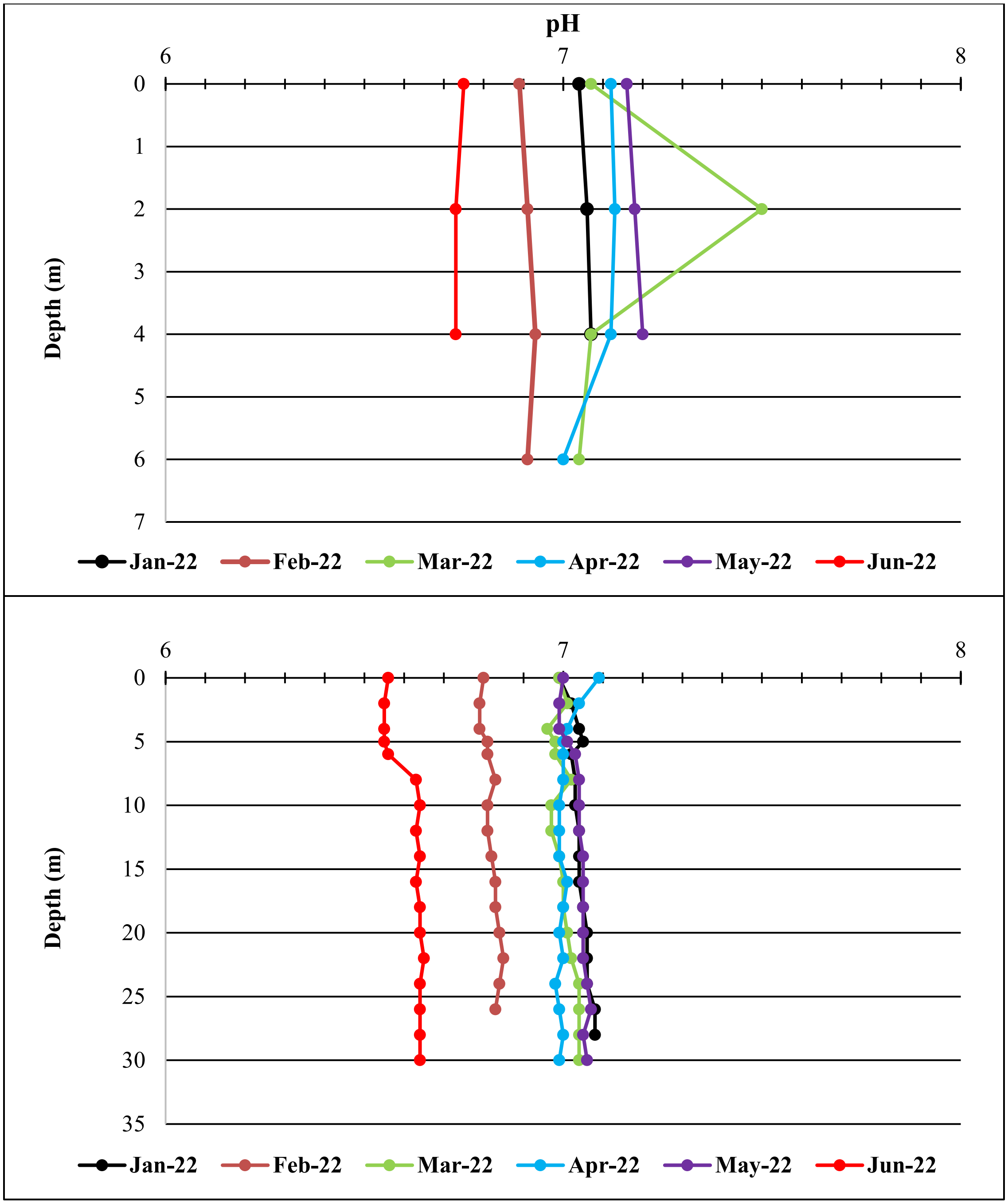


Figure 4.2.2-38. pH profiles at the upstream end of Gorge Lake at Reflector Bar (GORGE1) (top) and in the forebay (GORGE2) (bottom) (January-June 2022). Source: Seattle City Light.

<u>Total Dissolved Gas in Gorge Lake</u>

Continuous monitoring of TDG in Gorge Lake below Diablo Dam, across the lake from the Diablo Powerhouse outflow (GORGE3, see Table 4.2.2-10 and map in Appendix E of this Exhibit E, i.e., site 97), and in the Gorge Lake forebay (GORGE4) began in September 2021. The sonde installed below Diablo Dam is anchored to a fixed substrate, so logging depth varies with water surface elevation. The sonde in the forebay is attached to the floating log boom and maintains a depth of approximately 3 m (9.8 ft) regardless of water surface elevation. Both sondes record TDG at 30-minute intervals.

TDG data collected in Gorge Lake from September 9–October 5, 2021 and corresponding flow data from Diablo Powerhouse during the same period are presented in Figure 4.2.2-39. TDG greater than 110 percent saturation was observed below Diablo Dam on September 18 (112 percent) and again on September 30 (114 percent). However, values in the Gorge Dam forebay remained near 105 percent throughout this period. Closer examination of the September 18 and September 30 data below Diablo Dam suggests that periods of higher TDG concentrations correspond to reduced flows at Diablo Powerhouse (> 1,000 cfs). Substituting generation (megawatt [MW]) for flow, peak TDG corresponded to generation of less than 20 MW during each of these two periods (Figures 4.2.2-40 and 4.2.2-41). Elevated TDG levels below Diablo Dam appear to be linked to the operation of an air admission system on two turbines at the Diablo Powerhouse (U31 and U32). Both units have systems in place that admit air from about 30-90 MW, allowing the units to run more smoothly and improve operational efficiency at low generation (Gordon 2021).

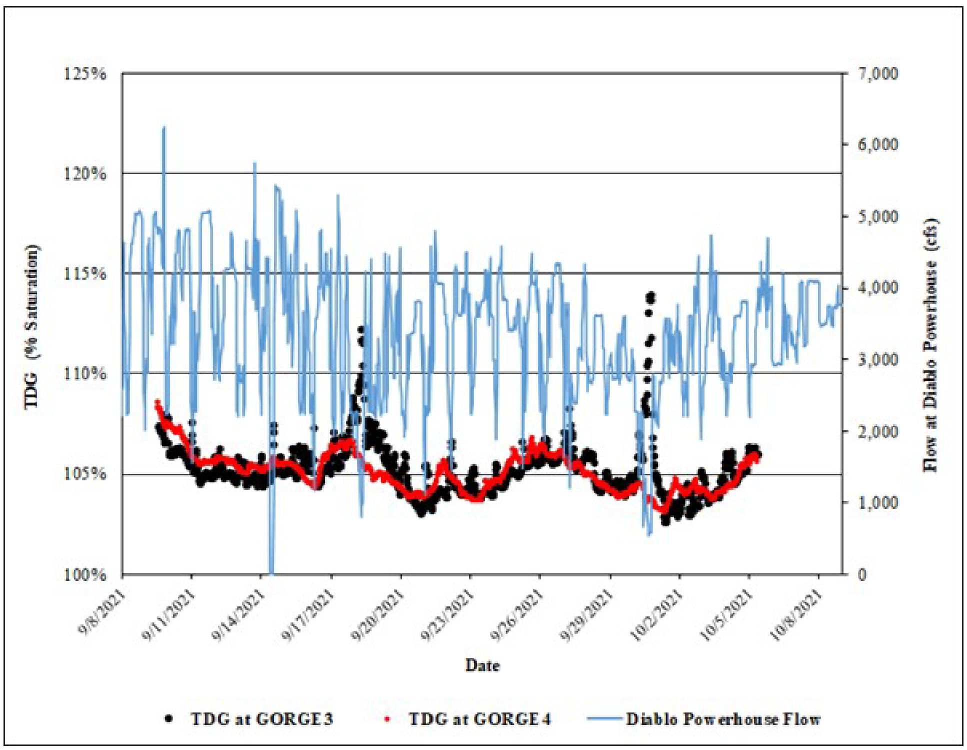


Figure 4.2.2-39. Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) (September-October 2021) and flow at Diablo Powerhouse (cfs). Source: Seattle City Light.

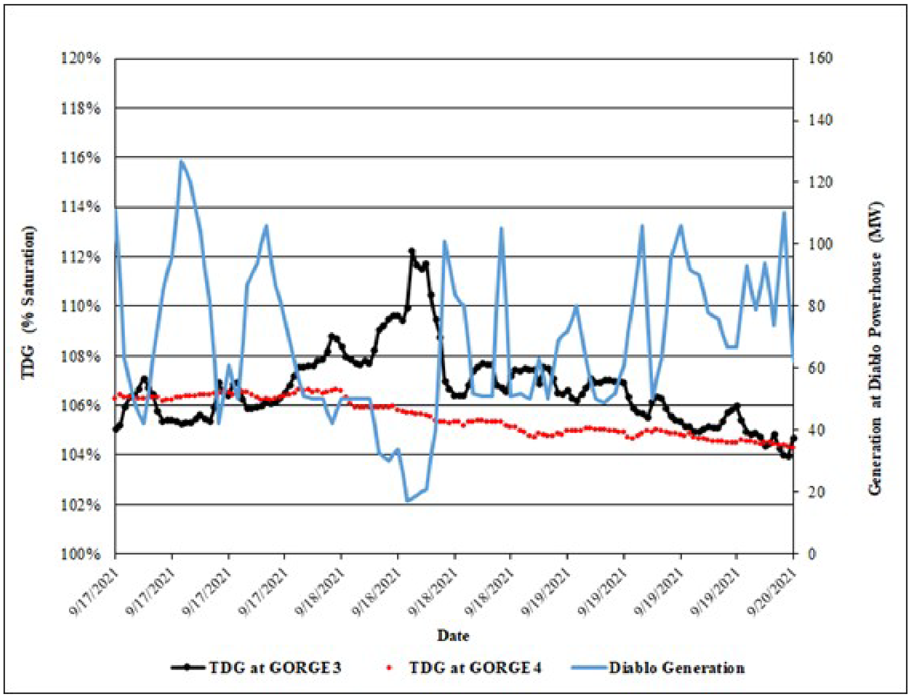


Figure 4.2.2-40. **Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) (September 17-September 20, 2021) and generation at Diablo Powerhouse (MW). Source: Seattle City Light.**

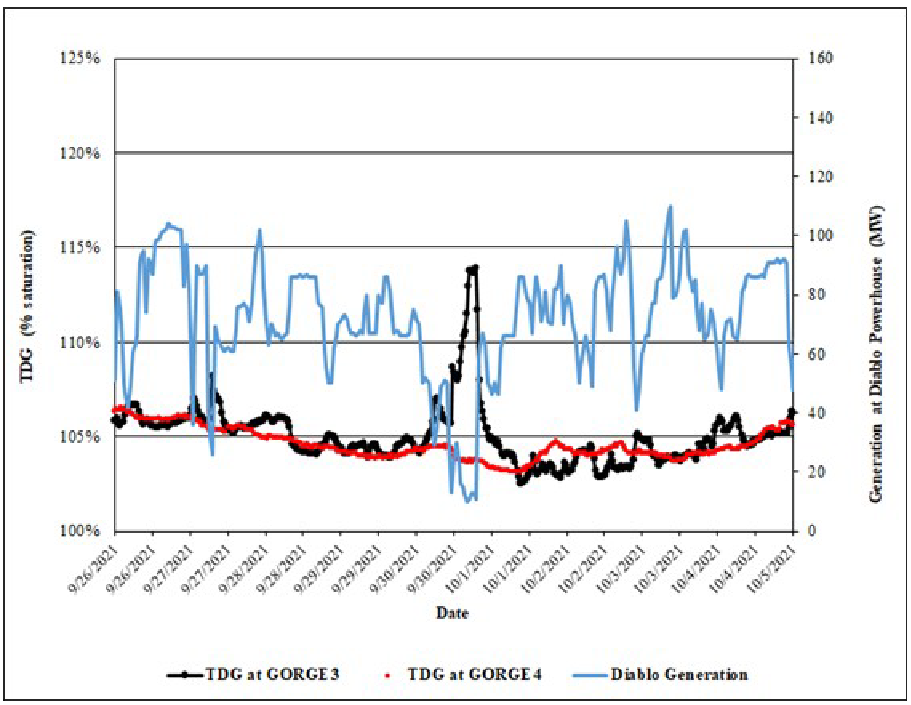


Figure 4.2.2-41 **Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) (September 26–through October 5, 2021) and generation at Diablo Powerhouse (MW). Source: Seattle City Light.**

TDG monitoring continued below Diablo Dam (GORGE3), in the Gorge Dam forebay (GORGE4), and below Gorge Powerhouse (PHOUSE1) during October-December 2021, a period that included multiple spill events at Diablo Dam. TDG values at all three sites closely tracked spill, reaching 119 percent at GORGE3 on November 6 and 116 percent at GORGE4 on November 9 (Figure 4.2.2-42). TDG levels at Gorge Powerhouse also exceeded 110 percent at times but were typically between 100 and 110 percent during this period.

Maximum TDG at GORGE4 occurred during a week-long spill in mid-November. Flows at the USGS Gage at Newhalem at this time reached 34,800 cfs on November 16, far exceeding the 7Q10 flow of 17,282 cfs, which was empirically calculated by City Light (Figure 4.2.2-42). Flows in excess of the 7Q10 occurred from November 14-23 and from November 29-December 4.

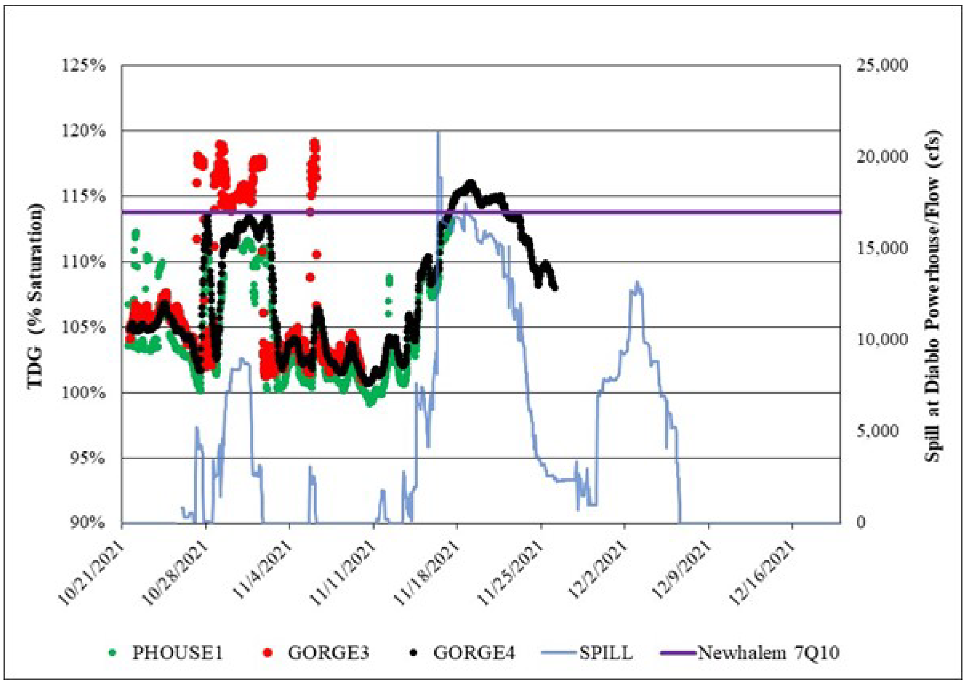


Figure 4.2.2-42. Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) (October 21, 2021-December 7, 2021) and Gorge Powerhouse and spill at Diablo Powerhouse (cfs). The horizontal line indicates the calculated 7Q10 flow at USGS Newhalem Gage (12178000). Source: Seattle City Light.

Data collected in 2022 indicate that spill at Diablo Dam continued to cause elevated TDG at the below Diablo Dam (GORGE3) and Gorge Dam forebay (GORGE4) sampling locations (Figures 4.2.2-43 and 4.2.3-44). TDG levels reached 123 percent saturation on February 19, 2022 and again on March 12, 2022. In addition, TDG measured at Gorge Powerhouse (PHOUSE1) reached 121 percent on March 13, 2022, apparently as a result of spill at Diablo Dam.

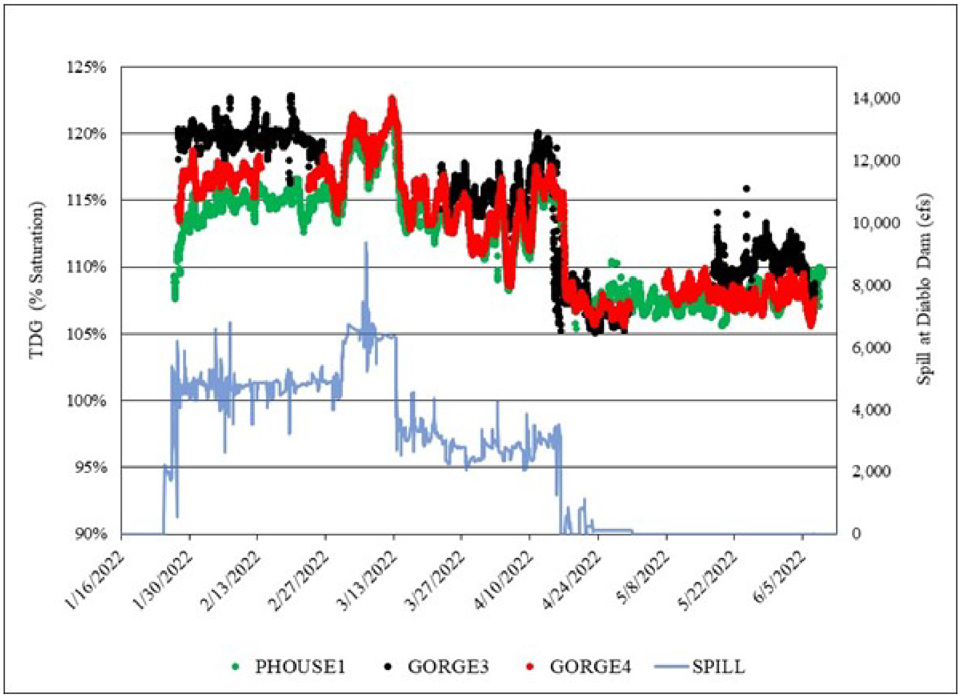


Figure 4.2.2-43. Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) and at Gorge Powerhouse tailrace (PHOUSE1) (January 16, 2022-June 7, 2022) and spill at Diablo Dam (cfs). Source: Seattle City Light.

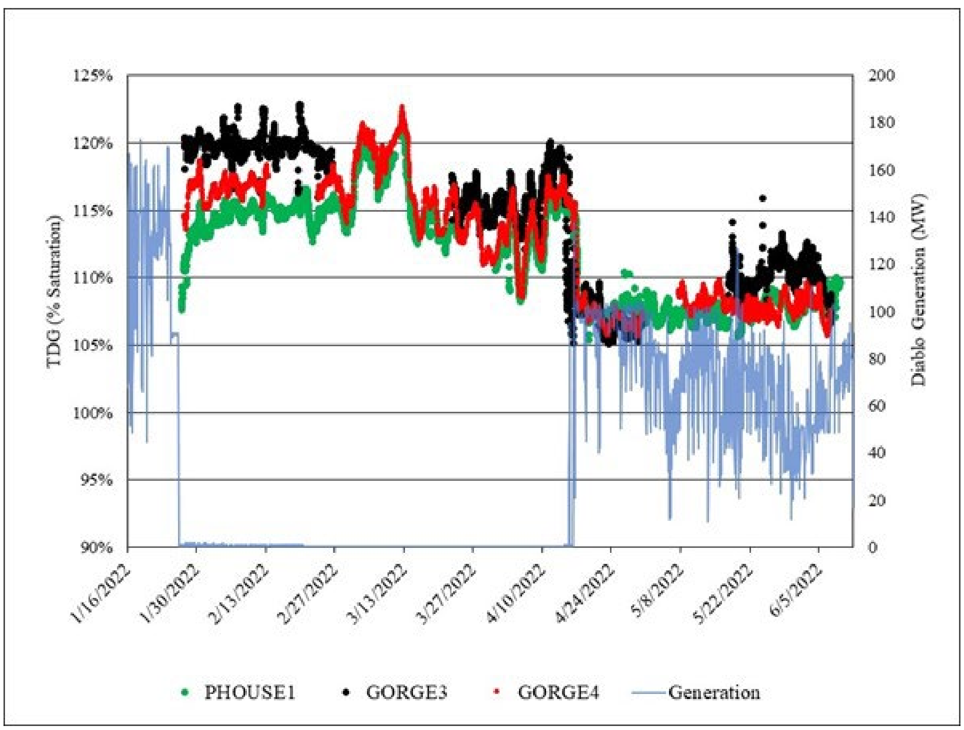


Figure 4.2.2-44 Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3, and Gorge Dam forebay, GORGE4) and at Gorge Powerhouse tailrace (PHOUSE1) (January 16, 2022-June 7, 2022) and generation at Diablo Dam (cfs). Source: Seattle City Light.

Elevated TDG in Gorge Lake persisted, with levels remaining > 110 percent from mid-January through most of April 2022. The Diablo powerhouse was offline for a period that corresponded closely with measurements of elevated TDG at all three monitoring sites, suggesting that the lack of powerhouse flows and their associated turbulence in the Diablo Dam tailrace prevented off-gassing and allowed TDG generated by spill at Diablo Dam to remain elevated in the water column. TDG levels dropped quickly when the powerhouse began operating and spill ceased in mid-April 2022.

The operational effects on TDG that were observed in 2021 (i.e., effects of operating an air admission system on U31 and U32) appeared to be recurring in 2022: increased TDG corresponded to reduced generation from May 18-25, 2022 (Figure 4.2.2-45). TDG data collection is ongoing, and additional information will be provided in the USR and FLA.

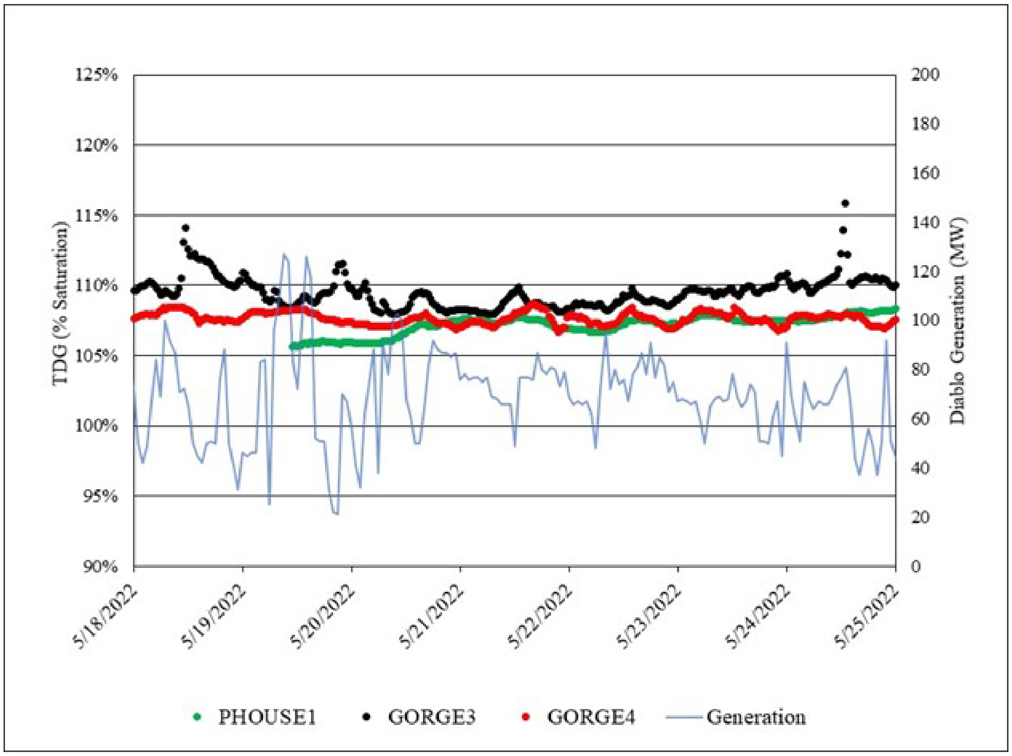


Figure 4.2.2-45. Total dissolved gas at Gorge Lake sites (below Diablo Dam, GORGE3 and Gorge Dam forebay, GORGE4) and at Gorge Powerhouse tailrace (PHOUSE1) (May 18-25, 2022) and generation at Diablo Dam (cfs). Source: Seattle City Light.

Turbidity/TSS in Project Reservoirs

Ross Lake

TSS concentrations and turbidity[26] in Ross Lake, measured from June-October 2021, were generally low, with many measurements either below or close to the respective method reporting limits (Table 4.2.2-12). Turbidity values were above the method reporting limit of 0.1

26 June turbidity values were based on *in situ* measurements, all other turbidity values were determined in the laboratory. Given that the *in situ* turbidity measurements were all very low, the laboratory measurements are reported in Table 4.2.2-12 (except for June) because they are all slightly higher, and therefore, more conservative.

nephelometric turbidity units (NTU) from July–September but typically below 1 NTU. The highest turbidity levels in 2021 occurred in November, with values of 13.0, 10.0, and 6.7 NTU at a depth of 1 m (3.3 ft) at the Pumpkin Mountain, Skymo, and Little Beaver sites, respectively. In February, March, May, and June 2022, turbidity values were less than those measured in November 2021 but somewhat higher than the rest of the sampling months in 2021. In all cases, 2022 measurements showed that water in Ross Lake was clear (≤ 4.3 NTU).

From June-September 2021, TSS was above the method detection limit twice, at 5 m (16.4 ft) depth at the Skymo and Little Beaver sampling sites. In November 2021, TSS was detectable at all sites, but was always ≤ 4 mg/L. TSS measurements made in 2022 were overall slightly higher than in 2021, but still often below the method reporting limit and always ≤ 4 mg/L.

Table 4.2.2-12. Ross Lake monthly turbidity and total suspended solids sampling results at 1- and 5-m (3.3 and 16.4 ft) depths, June-November 2021 and February, March, May, and June 2022.

Date	Reservoir Elevation (ft) (NAVD 88)	Pumpkin Mountain (ROSS1)				Skymo (ROSS2)				Little Beaver (ROSS3)			
		Turbidity (NTU)		TSS (mg/L)		Turbidity (NTU)		TSS (mg/L)		Turbidity (NTU)		TSS (mg/L)	
		1 m	5 m	1 m	5 m	1 m	5 m	1 m	5 m	1 m	5 m	1 m	5 m
6/29/21	1.606.2	0 (0)	0	ND (ND)	ND	0	0	ND	ND	0	0	ND	ND
7/26/21	1,607.6	0.4	0.48	ND	ND	0.59 (0.42)	0.66	ND (ND)	ND	0.31	0.17	ND	ND
8/17/21	1,607.8	0.39	0.41	ND	ND	0.32	0.43	ND	2.0	0.25 (0.30)	0.22	ND (ND)	3.0
9/14/21	1,602.3	0.94 (0.78)	1.1	ND (ND)	ND	0.94	0.86	ND	ND	0.73	1.1	ND	ND
10/28/21	1,593.4	0.46	0.35	ND	ND	0.35 (0.46)	0.48	ND (ND)	ND	0.5	0.33	ND	ND
11/30/21	1,591.1	13.0	13.0	4.0	4.0	10.0	10.0	3.0	3.0	6.7	6.5	2.0	2.0
2/24/22	1,557.25	4.1	4.3	ND	ND	3.0	3.3	ND	ND	2.1 (2.1)	2.2	ND (ND)	ND
3/16/22	1,538.61	2.5	2.5	ND	ND	2.0 (2.1)	1.8	ND (2)	ND	3.7	4.0	3.0	4.0
5/11/22	1,533.70	1.0	1.1	ND	ND	1.6 (1.7)	2.1	2.0 (2)	2.0	3.0	3.5	3.0	2.0
6/22/22	1,595.20	3.0	3.0	3.0	2.5	2.2 (2.1)	2.1	2.0 (2)	3.0	1.7	1.5	4.0	ND

Source: Seattle City Light.
Notes:
NAVD 88 = North American Vertical Datum of 1988.
Samples measured below the method reporting limit (TSS = 2 mg/L. turbidity = 0.1 NTU) are reported as ND.
Field duplicate results are shown in parenthesis.
June turbidity data are from *in situ* measurements, while turbidity from other months is based on laboratory measurements.

TSS and turbidity were measured along three 400-m transects (erosional areas north, central, and south) in Ross Lake (see mapbook in Appendix E of this Exhibit E) to characterize conditions adjacent to areas of shoreline erosion during reservoir drawdown, when erosional faces of the littoral fringe were exposed. Transect sampling is ongoing, being conducted three times between fall and spring (2021-2022 and 2022-2023) for a total of six transect sampling events.

Turbidity sampling results in December 2021 were consistent along individual transects (Table 4.2.2-13). Values ranged from 7.2 to 16 NTU and from non-detect to 6 mg/L for turbidity and TSS, respectively. These values were comparable to the samples collected at the monthly turbidity/TSS stations in the reservoir (discussed above) at the same time, i.e., November 30, 2021 (compare Tables 4.2.2-12 and 4.2.2-13). The ROSS5 transect had slightly lower turbidity (7.5-9.3 NTU) and largely non-detect values for TSS compared to transects ROSS4 and ROSS6.

Turbidity measurements made along transects in May 2022 were comparable to measurements made in December 2021 (i.e., relatively low), but variability along individual transects was more pronounced in May 2022 (Table 4.2.2-13). However, TSS concentrations were notably higher in May 2022 than in December 2021 at the ROSS5 and ROSS6 sites. Overall, turbidity and TSS were much higher in March 2022 than in the other two sampling months (Table 4.2.2-13) and substantially more variable along individual transects. For example, turbidity measurements made at the ROSS5 site in March 2022 ranged from 2.3-130 NTU. The elevated values measured in March 2022 apparently reflect sediment suspended as the result of reservoir drawdown for flood risk management, because measured turbidity was low at the mid-water sites, Pumpkin Mountain, Skymo, and Little Beaver, at the same time (Table 4.2.2-12).

TSS and turbidity samples were also collected under drawdown conditions at the mouths of 11 tributaries[27] to Ross Lake; sampling locations at tributary mouths are (1) at a point corresponding to normal maximum water surface elevation and (2) either slightly upstream or downstream of where the tributary is flowing into the reservoir. Results from turbidity and TSS sampling in Ross Lake tributary mouths during 2021 and 2022 are shown in Table 4.2.2-14 (see mapbook in Appendix E of this Exhibit E for sampling locations).

[27] Sampling at the mouths of 11 tributaries to Ross Lake is being conducted twice between fall and spring (2021-2022 and 2022-2023) for a total of at least four sampling events.

Table 4.2.2-13. Ross Lake turbidity and total suspended solids transect results (December 1, 2021, March 17, 2022, and May 11, 2022).

Date	Distance along Transect (m)	Ross Lake Erosional Area North (ROSS4)		Ross Lake Erosional Area Central (ROSS5)		Ross Lake Erosional Area South (ROSS6)	
		Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)
12/1/21	0	14.0	6.0	7.2	3.0	16.0	4.0
	100	12.0	ND	8.3	ND	15.0	6.0
	200	12.0	4.0	8.9	ND	15.0	ND
	300	12.0	3.0	8.9	ND	16.0	4.0
	400	11.0	3.0	9.3	ND	16.0	2.0
3/17/22	0	9.2	8.0	19.0	18.0	9.6	13.0
	100	65.0	151	130.0	89.0	16.0	24.0
	200	70.0	70.0	21.0	23.0	70.0	98.0
	300	22.0	26.0	2.3	2.0	3.2	2.0
	400	23.0	24.0	3.2	2.0	2.6	ND
5/11/22	0	5.1	3.0	16.0	22.0	6.1	22.0
	100	3.0	2.5	4.5	6.0	5.5	12.0
	200	4.5	3.5	6.8	7.0	18.0	39.0
	300	14	18.0	2.0	ND	18.0	41.0
	400	3.1	3.0	2.4	2.0	10.0	19.0

Source: Seattle City Light.

Notes:

Reservoir elevation at the time of transect sampling: 12/1/21 = 1,591.1 feet NAVD 88; 3/17/22 = 1,537.96 feet NAVD 88, 5/11/22 = 1,533.70 feet NAVD 88.

Samples measured below the method reporting limits (TSS = 2 mg/L, turbidity = 0.1 NTU) are reported as ND.

TSS method reporting limit was 2 mg/l. Turbidity method reporting limit was 0.1 NTU.

In November-December 2021, the highest values were measured in the Skagit River at the international boundary site (TRIB1) and Ruby Arm (TRIB11) (Table 4.2.2-14). Stations TRIB2-5 and TRIB8 had intermediate values, with turbidity ranging from 4 to 17 NTU and TSS from 3 to 31 mg/L. Pierce Creek (TRIB9) and Roland Creek (TRIB10) were the least turbid, with values of < 2 NTU and non-detect for TSS.

In March 2022, turbidity and TSS values were low for all sites, except the Little Beaver Creek Lake site (TRIB3-B), Lightning Creek Lake site (TRIB4-B), Dry Creek mouth (TRIB5-B), and Ruby Arm (TRIB11); turbidity and TSS at Ruby Arm in March 2022 were 60 NTU and 145 mg/L, respectively (Table 4.2.2-14). Values were low at all measured locations in May 2022, except at the Dry Creek mouth (TRIB5-B) site. At the sites that were measured in June 2022, turbidity and TSS were mildly elevated at the Lightning Creek inlet (TRIB4-A) Big Beaver Creek upstream (TRIB8-A), and Ruby Arm (TRIB11) sites.

Table 4.2.2-14. Results from turbidity and total suspended solids sampling in Ross Lake tributary mouths, 2021-2022.

			11/30/21-12/1/21		3/16/22-3/17/22		5/11/22		5/24/22[1]		6/22/22[1]	
Site ID	Site Name	Depth (m)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)
TRIB1	Skagit River at International Boundary	<1	100 (100)	88 (86)	3.5	3	5.7	7	5.7 (5.9)	5 (7)	5.6	3.5
TRIB2-A	Silver Creek - Mouth[2]	<1	1.1	ND	-	-	-	-	-	-	-	-
TRIB2-B	Silver Creek - Lake[2]	<1	17	24	-	-	-	-	-	-	-	-
TRIB3-A	Little Beaver Creek - Inlet	<1	17	31	0.43	ND	1.1	ND	1.3	2	1.4 (1.5)	ND (2)
TRIB3-B	Little Beaver Creek - Lake	<1	17	27	38	93	1.2	ND	-	-	-	-
TRIB4-A	Lighting Creek - Inlet	<1	15	12	0.51	3	0.76	ND	1.6	2	7.6	10.5
TRIB4-B	Lightning Creek - Lake	<1	12	8	9.5	14	1.2	3	-	-	-	-
TRIB5-A	Dry Creek - Upstream	<1	4.1	3	0.42	ND	0.83	ND	-	-	-	-
TRIB5-B	Dry Creek - Mouth	<1	<1	8	5.6	17	36	84	-	-	-	-
TRIB6	Devil's Creek[3]	<1	-	-	0.51	2	0.98	ND	-	-	-	-
TRIB7-A	May Creek - Inlet[4]	<1	-	-	0.22	ND	0.34	ND	-	-	-	-
TRIB7-B	May Creek – Mouth[4]	<1	-	-	1.1	ND	2	2	-	-	-	-
TRIB8-A	Big Beaver Creek - Upstream[5]	<1	7	18	0.56	ND	-	-	1.1	ND	5.2	9.5
TRIB8-B	Big Beaver Creek - Mouth	<1	8	19	0.41	ND	0.86	2	-	-	-	-
TRIB9-A	Pierce Creek - Upstream[5]	<1	1.2	ND	0.21	ND	-	-	-	-	-	-

			11/30/21-12/1/21		3/16/22-3/17/22		5/11/22		5/24/22[1]		6/22/22[1]	
Site ID	**Site Name**	**Depth (m)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**	**Turbidity (NTU)**	**TSS (mg/L)**
TRIB9-B	Pierce Creek - Mouth	<1	1.2	ND	0.15	ND	0.87	ND	-	-	-	-
TRIB10-A	Roland Creek - Upstream	<1	1.4	ND	0.29	ND	0.21	ND	-	-	-	-
TRIB10-B	Roland Creek - Mouth	<1	1.4	ND	0.47	ND	1.1	2	-	-	-	-
TRIB11	Ruby Arm[6]	<1	18	8	60	145	1.1	ND	1.5	ND	13	12.5
		5	40	39	-	-	-	-	-	-	-	-

Source: Seattle City Light.

Notes:

Samples measured below the method reporting limit (TSS = 2 mg/L. turbidity = 0.1 NTU) are reported as ND.

Field duplicate results shown in parenthesis.

1 Tributary sampling events on May 24, 2022 and June 2, 2022 were done at a limited set of tributaries to provide inputs for the model development, separate from the fall-spring tributary sampling that was completed under the RSP, as amended by FERC. Tributary mouth sampling was not required under the RSP for 5/24/22 and 6/22/22 at TRIB2-A/B, TRIB3-B, TRIB4-B, TRIB7-A/B, TRIB8-B, TRIB9-A/B, TRIB10-A/B, and TRIB11 at 5 ft depth.

2 Silver Creek - Mouth (TRIB2-A) and Silver Creek - Lake (TRIB2-B) were not sampled in March 16-17, 2022, and May 11, 2022 because the stream's flow was subterranean during these events.

3 Devil's Creek (TRIB6) - Sampling occurred only at the mouth because the upstream location is inaccessible by boat or by foot. During the 11/30/21 – 12/1/21 event a sample could not be collected even at the mouth because the tributary was inaccessible by boat due to a log jam.

4 May Creek - Inlet/Mouth (TRIB7-A/B) were not sampled during the Nov 30 – Dec 1, 2021 event because TSS/turbidity was collected in the vicinity (ROSS6) as part of Ross Transect survey.

5 Big Beaver Creek - Upstream (TRIB8-A) and Pierce Creek - Upstream (TRIB9-A) were not sampled during the May 11, 2022 event because of site safety conditions (bear activity in the vicinity).

6 Ruby Arm (TRIB11) - The upstream sample ("trib") required under the RSP could not be collected during the 11/30/21-12/1/2021 and 3/16/22-3/17/22 sampling events because the upstream location was inaccessible due to high flows and unsafe site conditions. An additional sample was collected from within Ruby Arm at 5 ft depth during the 11/30/21-12/1/21 event as a substitute for the upstream sample.

Diablo Lake

Results of turbidity and TSS sampling at the upper end of Diablo Lake (DIABLO1) and the Diablo Dam forebay (DIABLO2) are shown in Table 4.2.2-15. Turbidity ranged from 0.3-14.0 NTU at DIABLO1 and 0.7-12.0 NTU at DIABLO2. Turbidity was generally low throughout the sampling period, but levels in winter, when turbidity is elevated in some tributary inflows, were higher than during the remainder of the year (see Table 4.4-14). There were no significant depth-related differences in turbidity, and temporal trends observed at 1- and 5-m (3.3-16.4 ft) depths mirrored one another. Both locations showed similar seasonal patterns as well. TSS values were usually below the 2 mg/L method reporting limit at both sites (maximum of 4.5 mg/L at DIABLO1 in June 2022 and 3.0 mg/L at DIABLO2 in August and December 2021).

Table 4.2.2-15. Turbidity and total suspended solids at the upper end of Diablo Lake (DIABLO1) and the Diablo Dam forebay (DIABLO2) at 1- and 5-m depths (June 2021-June 2022).

	Upper Diablo Lake (DIABLO1)				Diablo Dam Forebay (DIABLO2)			
	Turbidity (NTU)		TSS (mg/L)		Turbidity (NTU)		TSS (mg/L)	
Date	1-m	5-m	1-m	5-m	1-m	5-m	1-m	5-m
6/24/21	3.00	2.50	1	3	2.00	1.70	2	2
7/22/21	1.10	0.71	ND	ND	2.90	3.10	ND	2
8/18/21	0.68	1.10	ND	ND	4.60	4.40	3	3
9/9/21	0.54	0.30	ND	ND	1.40	1.20	ND	ND
10/6/21	2.90	2.20	2	ND	2.90	3.10	ND	ND
12/17/21	14.00	14.00	3	3	12.00	10.00	3	3
1/27/22	8.10	7.90	2	ND	8.30	8.40	2	ND
2/23/22	5.50	5.10	ND	2	5.20	5.60	ND	ND
3/22/22	3.10	2.90	ND	ND	2.60	2.90	ND	ND
4/20/22	0.75	0.75	ND	ND	0.92	0.80	ND	ND
5/17/22	0.75	0.69	ND	ND	0.71	0.85	ND	ND
6/7/22	4.30	6.40	3	4.5	1.20	2.00	ND	ND

Source: Seattle City Light.
Notes:
Samples measured below the method reporting limit (TSS = 2 mg/L. turbidity = 0.1 NTU) are reported as ND.

Results of turbidity and TSS measurements made along transects in Diablo Lake during December 2021 and March 2022 are shown below (Table 4.2.2-16). Samples were collected at 25-m (82 ft) intervals along the two 100-m (328 ft) transects. As shown in the mapbook in Appendix E of this Exhibit E, both transects are in the Thunder Arm of Diablo Lake. DIABLO3 is approximately center channel on the south side of the North Cascades Highway bridge, and DIABLO6 is parallel to and roughly 40 m (131 ft) from the mouth of Colonial Creek.

During both measurement periods, the water was very clear. TSS measurements along both transects were all less than the laboratory method reporting limit, except for one measurement at DIABLO6 in March 2022. Turbidity was less than 1 NTU at all sites, except for values of 1.7 and 1.4 NTU at DIABLO6 on December 17, 2021 and March 18, 2022, respectively.

Table 4.2.2-16. Turbidity and total suspended solids at DIABLO3 and DIABLO6 transects (December 17, 2021 and March 18, 2022).

Date	Distance along Transect (m)	DIABLO3		DIABLO6	
		Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)
12/17/21	0	0.47	ND	0.66	ND
	25	0.54	ND	0.51	ND
	50	0.65	ND	0.56	ND
	75	0.56	ND	0.62	ND
	100	0.63	ND	1.7	ND
3/18/22	0	0.32	ND	0.21	ND
	25	0.34	ND	1.4	9
	50	0.22	ND	0.32 (0.4)	ND (ND)
	75	0.85	ND	0.77	ND
	100	0.39	ND	0.45	ND

Source: Seattle City Light.
Notes:
DIABLO3 = Thunder Creek Confluence at Bridge/Colonial Creek Campground at Rhode Creek.
DIABLO6 = Thunder Creek Confluence at Bridge/Colonial Creek Confluence.
Reservoir WSE at the time of the 2021 transect measurements was 1,207.10 feet NAVD 88, and in 2022 WSE was 1,214.74 feet NAVD 88.
Samples measured below the method reporting limit (TSS = 2 mg/L. turbidity = 0.1 NTU) are reported as ND.

Gorge Lake

Measurements of turbidity and TSS at the upstream end of Gorge Lake (GORGE1) and in the Gorge Dam forebay (GORGE2) are shown in Table 4.2.2-17. Turbidity was < 3.1 NTU throughout the year, except from October 2021-February 2022, when values ranged from 5.1-9.8 NTU. The higher turbidity levels measured in winter are correlated with elevated levels in tributary inflows. There were no significant depth-related differences in turbidity, and temporal trends observed at 1- and 5-m (3.3-16.4 ft) depths mirrored one another. Both locations showed similar seasonal patterns as well. When comparing turbidity at Gorge and Diablo lakes, differences during October 2021 were the most notable and may reflect higher suspended sediment levels (reduced settling) due to the lower detention time in Gorge Lake (0.8 days) or greater sediment contribution from tributaries, primarily Stetattle Creek. TSS values at the Gorge Lake sampling locations were low (2-4 mg/L) but more often detectable than at the Diablo Lake sampling locations.

Table 4.2.2-17. Turbidity and total suspended solids at the upstream end of Gorge Lake (GORGE1) and Gorge Dam forebay (GORGE2) at 1- and 5-m depths (June 2021-June 2022).

Date	Upper Gorge Lake (GORGE1)				Gorge Dam Forebay (GORGE2)			
	Turbidity (NTU)		TSS (mg/L)		Turbidity (NTU)		TSS (mg/L)	
	1-m	5-m	1-m	5-m	1-m	5-m	1-m	5-m
6/24/21	3.10	2.30	2	3	1.70	2.30	1	3
7/22/21	1.80	2.00	2	ND	1.90	1.90	2	2
8/18/21	2.60	2.80	3	3	2.70	3.10	2	2
9/9/21	0.88	1.40	ND	ND	0.87	1.30	ND	ND
10/6/21	6.00	5.80	3	ND	6.40	6.80	3	3
12/17/21	No Data[1]							
1/27/22	9.60	9.80	2	2	9.40	9.40	4	ND
2/23/22	5.30	5.20	ND	2	5.10	5.40	2	ND
3/22/22	2.60	2.60	ND	ND	2.50	2.50	ND	ND
4/20/22	0.82	0.79	ND	ND	0.88	0.84	ND	ND
5/17/22	1.10	0.79	ND	ND	0.95	0.80	ND	ND
6/7/2022	1.60	1.30	ND	ND	1.20	1.10	ND	ND

Source: Seattle City Light.
Notes:
Samples measured below the method reporting limit (TSS = 2 mg/L. turbidity = 0.1 NTU) are reported as ND.
1 The boat ramp was inaccessible in December 2021.

Nutrients and Productivity in Project Reservoirs and Their Tributaries

Ross Lake

Nitrogen concentrations, based on NCCN grab samples collected before 2021 (May-November, 2015-2018), were low in Ross Lake (Table 4.2.2-18) (see FA-01a WQ Monitoring Study Interim Report, Appendix E, City Light 2022c). The maximum total dissolved nitrogen concentration was 0.11 mg of nitrogen per liter ([mg N]/L); most samples were a fraction of this value. The maximum nitrate+nitrite concentration was 0.08 (mg N)/L, and the maximum nitrate concentration was 0.03 (mg N)/L. No clear seasonal trends were discernable. Nearly all ammonia concentrations were negligible. When phosphate (PO_4) and uridine-5'-triphosphate (UTP) were measurable, they each ranged from 0.002 mg of phosphorus per liter ([mg P]/L) to 0.004 (mg P)/L. Sulfate concentrations ranged from 1.45 mg of sulfur per liter ([mg S]/L) to 1.82 (mg S)/L, with a median of 1.62 (mg S)/L. No trends across years, seasons, or locations were observed.

Table 4.2.2-18. Nutrient concentration (mg/L) ranges in Ross Lake from monitoring conducted prior to relicensing.

Cation	Number of Samples	Number of Samples above Detection Limit	Maximum Concentration (mg/L)
Total Dissolved Nitrogen	106	104	0.11
Nitrate + Nitrite	64	42	0.08
Nitrate	24	10	0.03
Ammonia	99	2	0.003
Phosphate	89	37	0.004
Uridine-5'-Triphosphate	95	25	0.004
Sulfate	88	88	1.82

Source: NCCN.

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling in the forebay of Ross Lake and at the mouths of select tributaries to Ross Lake. The parameters selected, as well as the sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model. Samples were collected in the reservoir's forebay at three depth intervals to represent the epilimnion, metalimnion, and hypolimnion.

Levels of nitrogen and phosphorus in the Ross Lake forebay (ROSS12) and select tributaries during May and June 2022 were very low (mostly below the method detection limit) (Table 4.2.2-19 and Table 4.2.2-20, respectively). Overall, the observed low nutrient levels are consistent with previous monitoring results, which indicate that Ross Lake and its tributaries constitute an oligotrophic system.

Table 4.2.2-19. Nitrogen, phosphorus, and alkalinity sampling results for the Ross Dam forebay (ROSS12), May-June 2022.

Date	Stratified Layer	Depth (m)	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/25/2022	Epilimnion	20	ND	0	0.32	ND	ND	32.5
	Metalimnion	45	ND	0.1	ND	ND	ND	35
	Hypolimnion	86	ND	0.1	ND	ND	ND	36.4
6/30/2022	Epilimnion	5	ND	0	ND	0.01	ND	28.8
	Metalimnion	32	ND	0	ND	0.01	0.01	22.2
	Hypolimnion	100	ND	0.1	ND	0.01	ND	35.4

Source: Seattle City Light.
Notes:
NH3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
Samples measured below the method reporting limit (NH_3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01 mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Table 4.2.2-20. Nitrogen, phosphorus, and alkalinity sampling results for the mouths of select Ross Lake tributaries, May-June 2022.

Date	Site ID	Site Name	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/24/2022	TRIB01	Skagit River at International Boundary	ND (ND)	0.05 (0.05)	ND (ND)	0.01 (0.01)	0.011 (0.011)	42.1 (41.7)
	TRIB03A	Little Beaver Creek - Inlet	ND	0.11	ND	ND	ND	7.2
	TRIB04A	Lighting Creek - Inlet	ND	0.05	ND	ND	ND	42.3
	TRIB08A	Big Beaver Creek - Upstream	ND	0.13	ND	ND	ND	9.2
	TRIB11	Ruby Arm	ND	0.07	ND	ND	ND	27.8
6/22/2022	TRIB01	Skagit River at International Boundary	ND	0.03	ND	0.01	ND	38
	TRIB03A	Little Beaver Creek - Inlet	ND (ND)	0.03 (0.03)	ND (ND)	ND (ND)	ND (ND)	34.7 (34.2)
	TRIB04A	Lighting Creek - Inlet	ND	0.02	ND	ND	0.015	33.9
	TRIB08A	Big Beaver Creek - Upstream	ND	0.05	ND	ND	0.017	6.9
	TRIB11	Ruby Arm	ND	0.03	ND	0.01	0.021	20.2

Source: Seattle City Light.
Notes:
NH3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (NH_3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01 mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Dissolved organic carbon (DOC) data collected prior to relicensing (Table 4.2.2-21) ranged from 0.2 mg of carbon per liter ([mg C]/L) to 9.5 (mg C)/L with a median of 1.4 (mg C)/L. The median and the 75th percentile were higher in 2016 than in other years; the maximum was much lower in 2018 than in other years. Compared to the magnitude of the higher of the two blank samples, which was 0.75 (mg C)/L, distribution statistics of the three Ross Lake locations (Pumpkin Mountain, Skymo, and Little Beaver sites) were indistinguishable.

Table 4.2.2-21. Distribution statistics of dissolved organic carbon ([mg C]/L) in Ross Lake.

Percentile	2015	2016	2017	2018
Maximum	9.3	8.9	9.5	3.9
75th Percentile	2.3	3.7	1.8	2.1
Median	1.1	2.4	1.5	1.3
25th Percentile	1.0	1.1	1.2	1.0
Minimum	0.8	0.9	0.8	0.2

Source: NCCN.

Levels of carbon in the Ross Lake forebay (ROSS12) and select tributaries during May and June 2022 are shown in Table 4.2.2-22 and Table 4.2.2-23, respectively. Organic carbon concentrations (dissolved and particulate) were generally low (approximately 1.5 mg/L or less) in Ross Lake and its tributaries, also indicating the low productivity within the system.

Table 4.2.2-22. Results of carbon sampling in the Ross Dam forebay (ROSS12), May-June 2022.

Date	Stratified Layer	Depth (m)	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/25/2022	Epilimnion	20	ND	0.98	1.2	7.56
	Metalimnion	45	ND	0.82	0.9	8.34
	Hypolimnion	86	ND	0.85	0.9	8.57
6/30/2022	Epilimnion	5	ND	0.98	0.9	6.41
	Metalimnion	32	ND	1.03	1	4.9
	Hypolimnion	100	ND	0.91	1.1	8.16

Source: Seattle City Light.

Notes:

CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.

Samples measured below the method reporting limit (CBOD = 1.0 mg/L) are reported as ND.

Field duplicate results are shown in parenthesis.

Table 4.2.2-23. Results of carbon sampling in the mouths of select Ross Lake tributaries, May-June 2022.

Date	Site ID	Site Name	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/24/2022	TRIB01	Skagit River at International Boundary	ND (ND)	0.82 (0.82)	0.83 (0.83)	9.92 (9.95)
	TRIB03A	Little Beaver Creek - Inlet	ND	0.81	0.82	1.95
	TRIB04A	Lighting Creek - Inlet	ND	0.8	0.82	9.95
	TRIB08A	Big Beaver Creek - Upstream	10	0.68	0.69	2.5
	TRIB11	Ruby Arm	2	0.98	0.99	6.93
6/22/2022	TRIB01	Skagit River at International Boundary	3	1.32	1.46	8.75
	TRIB03A	Little Beaver Creek - Inlet	ND (ND)	0.99 (0.97)	0.96 (0.97)	7.54 (7.53)
	TRIB04A	Lighting Creek - Inlet	ND	0.92	0.92	7.43
	TRIB08A	Big Beaver Creek - Upstream	ND	0.66	0.67	1.88
	TRIB11	Ruby Arm	ND	1	1.05	4.45

Source: Seattle City Light.
Notes:
CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (CBOD = 1.0 mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Pre-relicensing chlorophyll *a* data were available from 2015-2017. Concentrations ranged from 0.1 micrograms per liter (µg/L) to 1.1 µg/L, with a median of 0.4 µg/L. Maxima during each year and at each of the Little Beaver, Skymo, and Pumpkin Mountain sampling locations were considerably higher than the 75th percentiles at these times and locations (Table 4.2.2-24). No trend was observed relative to year or location. Seasonally, maxima occurred in June, July, and August, although July and August had distribution statistics comparable to other months (Table 4.2.2-25). Medians were highest in June and October, which may indicate increases in primary productivity due to nutrient input in June (runoff) and the onset of autumn turnover in October. However, these increased medians were only marginally higher than those of August and September, indicating that seasonal variation in productivity is minimal.

Table 4.2.2-24. Distribution statistics of chlorophyll *a* (µg/L) by year and location for all months in a given year or location.

Percentile	2015	2016	2017	Little Beaver	Skymo	Pumpkin
Maximum	0.89	1.07	0.73	0.89	0.73	1.07
75th Percentile	0.59	0.41	0.48	0.59	0.48	0.41
Median	0.40	0.33	0.40	0.40	0.40	0.33
25th Percentile	0.34	0.28	0.32	0.33	0.32	0.29
Minimum	0.20	0.07	0.21	0.20	0.21	0.07

Source: NCCN.

Table 4.2.2-25. Distribution statistics of chlorophyll *a* by month (µg/L) for all locations and years.

Percentile	May	June	July	August	September	October	November
Maximum	0.47	0.83	0.89	1.07	0.56	0.68	0.65
75th Percentile	0.38	0.62	0.49	0.45	0.46	0.45	0.38
Median	0.28	0.42	0.32	0.39	0.38	0.40	0.33
25th Percentile	0.25	0.31	0.29	0.34	0.32	0.35	0.28
Minimum	0.07	0.17	0.16	0.30	0.21	0.25	0.22

Source: NCCN.

Concentrations of chlorophyll-*a* and pheophyton-*a* (indices of primary productivity) in the Ross Lake forebay (ROSS12) and select tributaries during May and June 2022 are shown in Table 4.2.2-26 and Table 4.2.2-27, respectively. Chlorophyll-*a* and pheophyton-*a* results for Ross Lake during May 2022 consisted of non-detects and, in June 2022, a mixture of low concentrations (≤ 0.50 milligrams per cubic meter [mg/m^3]) and non-detects. Tributary samples also showed consistently low chlorophyll-*a* and pheophyton-*a* concentrations in May and June 2022 (≤ 0.70 mg/m^3).

Table 4.2.2-26. Results of chlorophyll-*a* and pheophyton-*a* sampling in the Ross Dam forebay (ROSS12), May-June 2022.

Date	Stratified Layer	Depth (m)	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/25/2022	Epilimnion	20	ND	ND
	Metalimnion	45	ND	ND
	Hypolimnion	86	ND	ND
6/30/2022	Epilimnion	5	0.50	0.22
	Metalimnion	32	0.14	ND
	Hypolimnion	100	ND	ND

Source: Seattle City Light.
Notes:
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.

Table 4.2.2-27. Results of chlorophyll-*a* and pheophyton-*a* sampling in the mouths of select Ross Lake tributaries, May-June 2022.

Date	Site ID	Site Name	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/24/2022	TRIB01	Skagit River at International Boundary	0.70 (ND)	ND (ND)
	TRIB03A	Little Beaver Creek - Inlet	ND	ND
	TRIB04A	Lighting Creek - Inlet	ND	ND
	TRIB08A	Big Beaver Creek - Upstream	0.70	ND
	TRIB11	Ruby Arm	ND	ND
6/22/2022	TRIB01	Skagit River at International Boundary	0.11	ND
	TRIB03A	Little Beaver Creek - Inlet	0.33	0.20
	TRIB04A	Lighting Creek - Inlet	0.17	0.15
	TRIB08A	Big Beaver Creek - Upstream	0.16	0.21
	TRIB11	Ruby Arm	0.17	0.14

Source: Seattle City Light.
Notes:
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.
Field duplicate results are shown in parenthesis.

Zooplankton sampling in Ross Lake was conducted at three locations, i.e., Little Beaver, Skymo, and Pumpkin Mountain. Data for the Little Beaver and Skymo locations are available for the period 2015-2018. Data for Pumpkin Mountain are available for 2015-2020 (but data collection is ongoing). Samples were collected monthly between May and November. In July 2015, one zooplankton sample was collected at the Ross Dam forebay log boom. A typical sample consisted of two replicate tows.

Zooplankton density, expressed as organisms per cubic meter (org/m^3), was calculated for each species within each sample. Average densities for each zooplankton species were calculated between replicates. Species dominance varied over time, with total zooplankton density typically peaking in late spring and summer (Figure 4.2.2-46). Zooplankton densities at the Pumpkin Mountain location were overall much higher in 2019 and 2020 than during previous years[28]. In all years, maximum densities were considerably higher than densities for other samples collected during the same year (Table 4.2.2-28).

[28] C. Archambault (2022), of the NPS, confirmed that a change to zooplankton sampling gear had been made prior to the collection of the 2019-2020 samples reported herein. A new net was deployed, which resulted in "increased ease of flow through the net." The net type, diameter, length, and mesh size did not change. It is possible that more water was actually filtered in 2019-2020, resulting in apparent, although spurious, increases in zooplankton densities.

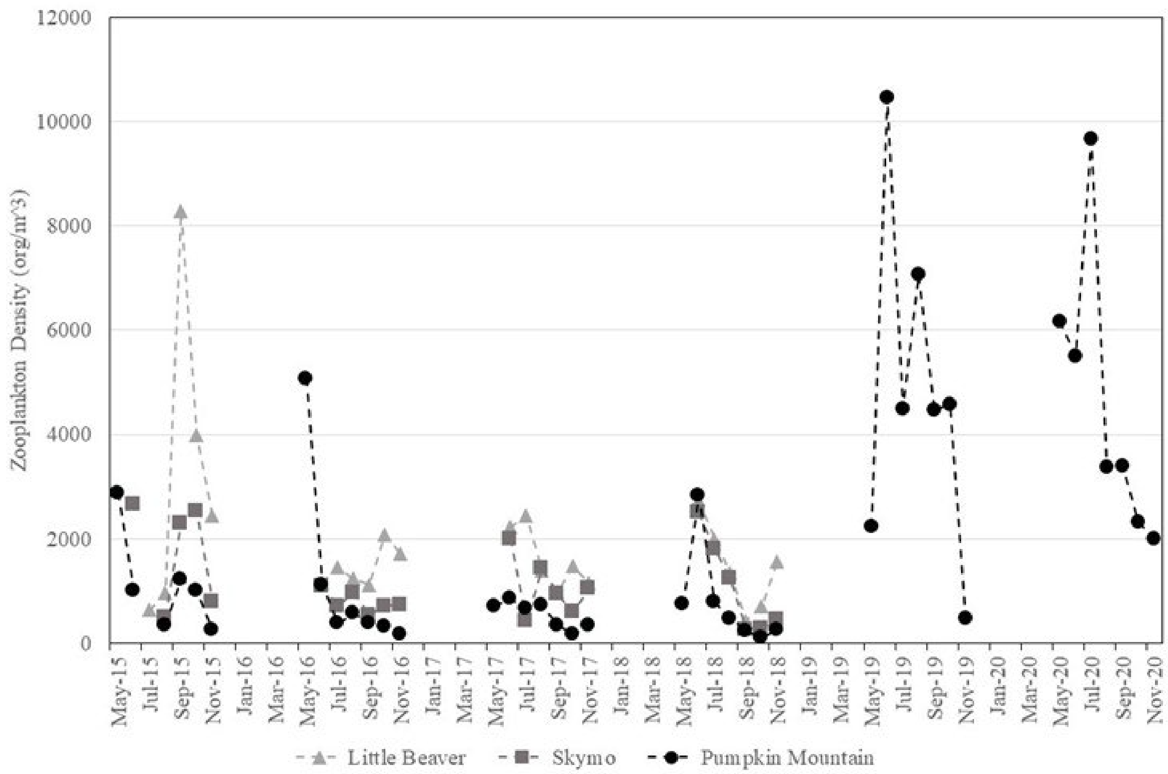


Figure 4.2.2-46. Total zooplankton density in Ross Lake, May 2015-November 2020. Source: NCCN.

Table 4.2.2-28. Distribution statistics of zooplankton density (org/m^3) in Ross Lake, by year, for all locations. Source: NCCN.

Percentile	2015	2016	2017	2018	2019[1]	2020[1]
Maximum	8,290	5,070	2,447	2,839	10,459	9,654
75th Percentile	2,650	1,234	1,477	2,002	5,823	5,827
Median	1,004	963	939	737	4,485	3,392
25th Percentile	637	574	658	429	3,348	2,841
Minimum	103	160	163	100	466	1,999

2019 and 2020 data are for the Pumpkin Mountain sampling location only.

Samples were analyzed for 196 species of zooplankton. Of these 196 species, 57 species were observed at least once in the samples collected (Figure 4.2.2-47). Among all organisms sampled, 10 taxa[29] made up 85 percent of the organisms present, by number, ranging from 75-95 percent depending on season. The following four species made up over 60 percent of the organisms present:

- *Kellicottia longispina*, accounting for 19 percent of sampled organisms.

29 *Kellicottia longispina*, *Polyarthra vulgaris*, *Conochilus unicornis*, *Synchaeta* sp., *Bosmina longirostris*, *Daphnia rosea*, *D. pulicaria*, *Asplanchna priodonta*, Calanoida, copepod nauplii.

- *Polyarthra vulgaris*, accounting for 18 percent of sampled organisms.
- *Conochilus unicornis*, accounting for 13 percent of sampled organisms.
- *Synchaeta* sp., accounting for 13 percent of sampled organisms.

All four of these species are rotifers, which are small and have large populations in Ross Lake. Although relative dominance of each species varied seasonally, these four species were consistently the most abundant species observed.

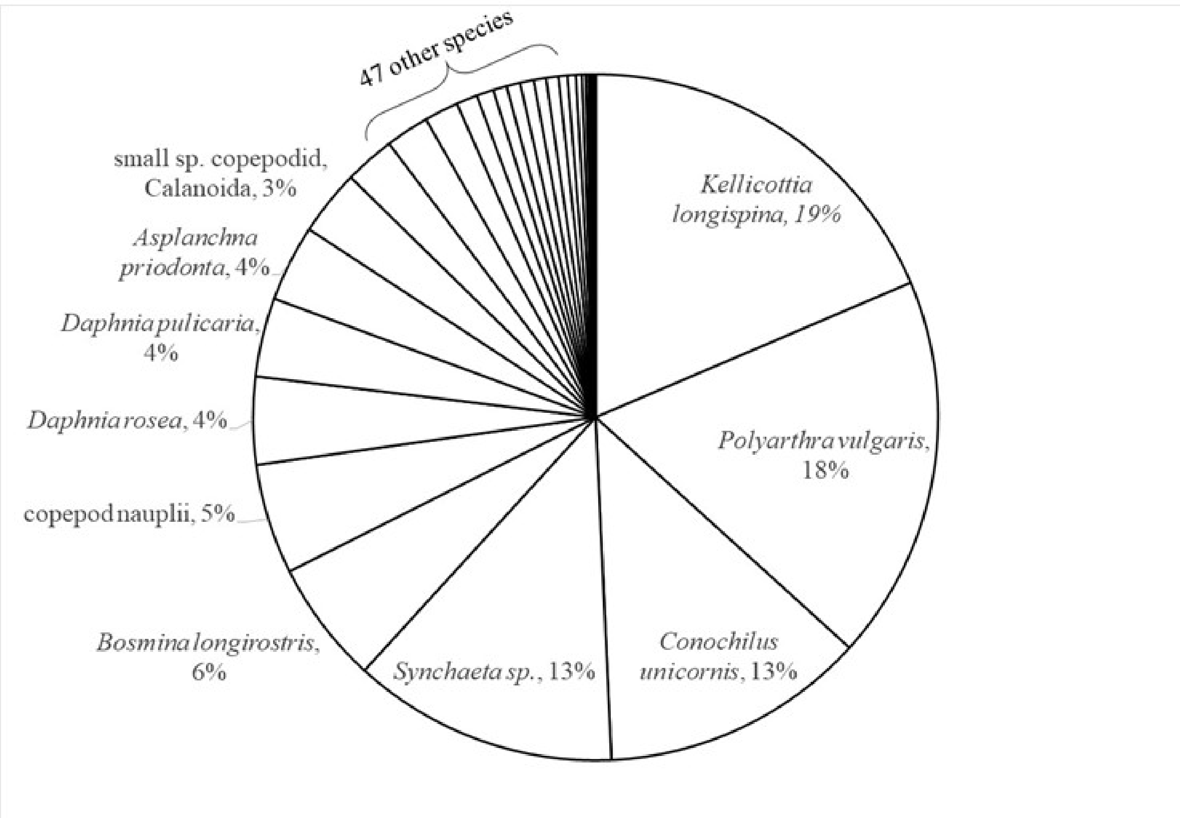


Figure 4.2.2-47. Percent, by number, of total zooplankton organisms sampled. Source: NCCN.

The relative dominance of these four species varied over time, but no spatial patterns were observed. The percentages of sampled organisms identified as *K. longispina* at the Little Beaver, Skymo, and Pumpkin Mountain locations in all samples were 24.2, 23.4, and 16.4, respectively. The percentage of sampled organisms identified as *K. longispina* at all locations over time typically peaked in summer or early fall (Figure 4.2.2-48).

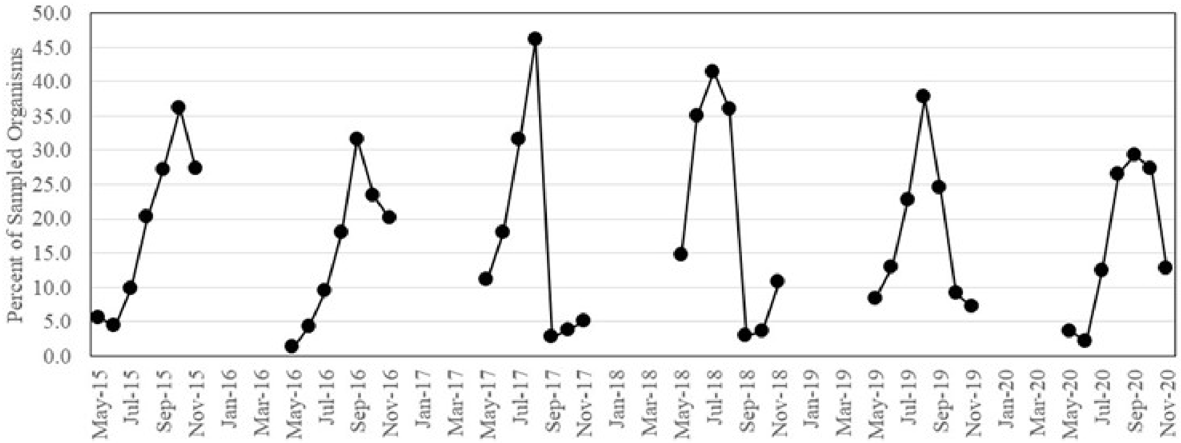


Figure 4.2.2-48. Relative dominance of *Kellicottia longispina* over time. Source: NCCN.

Similarly, the relative dominance of *P. vulgaris* did not vary significantly among locations. The percentages of sampled organisms identified as *P. vulgaris* at Little Beaver, Skymo, and Pumpkin Mountain were 19.9, 20.1, and 17.4, respectively. The percentage of sampled organisms identified as *P. vulgaris* at all locations over time reached a minimum in the summer (Figure 4.2.2-49).

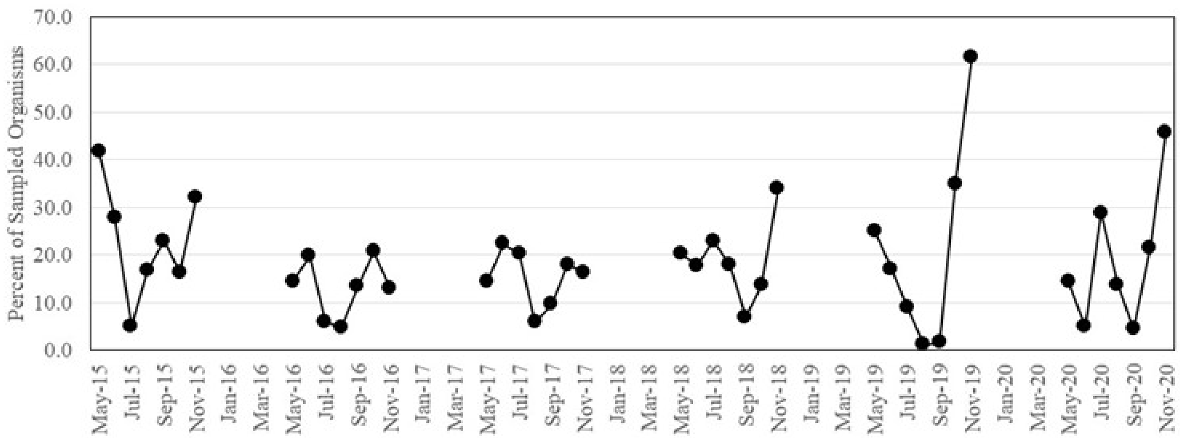


Figure 4.2.2-49. Relative dominance of *Polyarthra vulgaris* over time. Source: NCCN.

C. unicornis had slight variations in relative dominance among locations. The percentages of organisms identified as *C. unicornis* at Little Beaver, Skymo, and Pumpkin Mountain were 5.4, 9.8, and 14.6, respectively. The percentage of sampled organisms identified as *C. unicornis* typically peaked in the spring, except in 2018 (Figure 4.2.2-50).

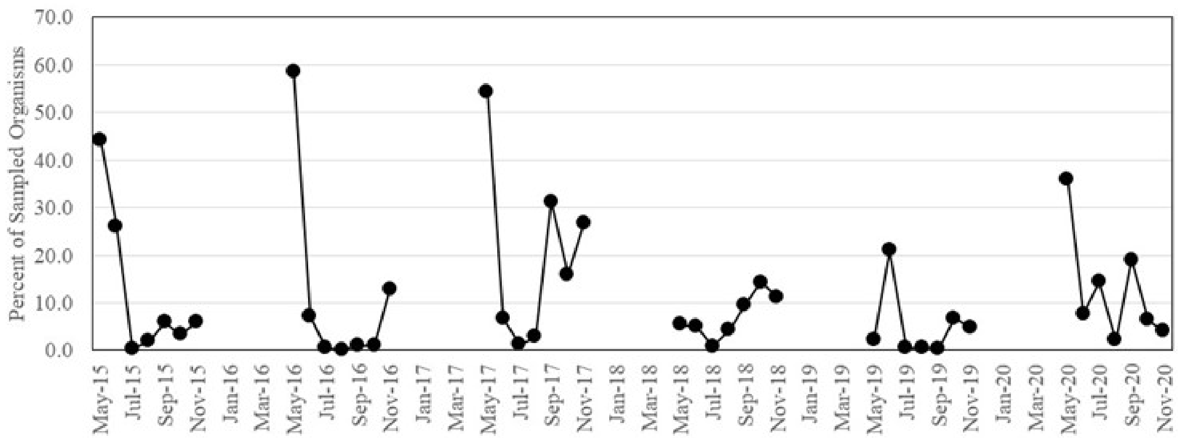


Figure 4.2.2-50. Relative dominance of *Conochilus unicornis* over time. Source: NCCN.

Synchaeta sp. also had slight variations in relative dominance among locations. The percentages of organisms identified as *Synchaeta* sp. at Little Beaver, Skymo, and Pumpkin Mountain were 4.1, 7.0, and 15.4, respectively. The percentage of sampled organisms at all locations identified as *Synchaeta* sp. peaked in late spring and summer (Figure 4.2.2-51).

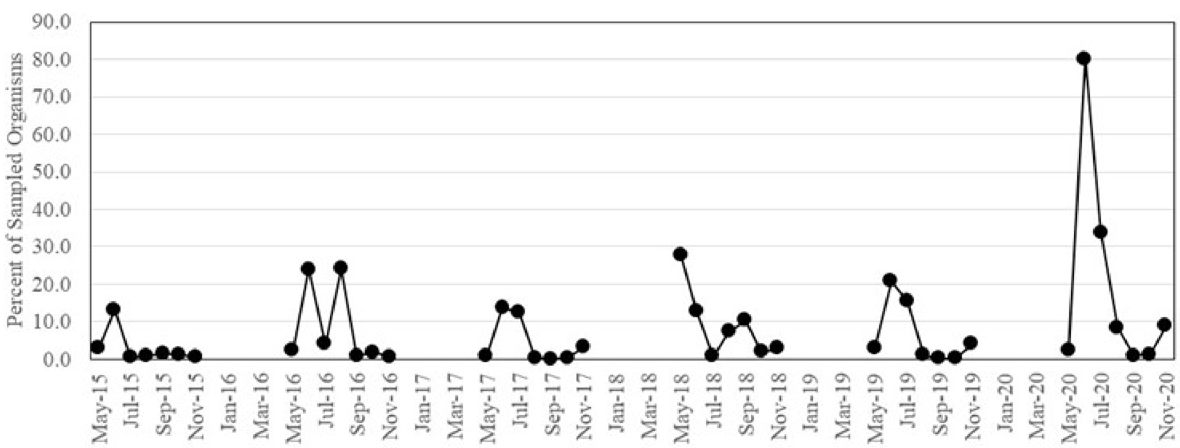


Figure 4.2.2-51. Relative dominance of *Synchaeta* sp. over time. Source: NCCN.

Diablo Lake

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling in the forebay of Diablo Lake (DIABLO2) and at the mouth of Thunder Creek. Parameters selected, and the sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model. Samples were collected in the reservoir's forebay at three depth intervals to represent the epilimnion, metalimnion, and hypolimnion.

Levels of nitrogen and phosphorus in the Diablo Lake forebay (DIABLO2) and at the mouth of Thunder Creek during May and June 2022 were very low (mostly below the method detection limit) (Table 4.2.2-29 and Table 4.2.2-30, respectively). Overall, the observed low nutrient levels are consistent with previous monitoring results within the Project Boundary, indicating that the Project reservoirs and their tributaries constitute an oligotrophic system.

Table 4.2.2-29. Nitrogen, phosphorus, and alkalinity sampling results for the Diablo Dam forebay (DIABLO2), May-June 2022.

Date	Stratified Layer	Depth (m)	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/25/2022	Epilimnion	5	0.01	0.1	ND	ND	ND	27.9
	Metalimnion	35	ND	0.1	ND	ND	ND	32.1
	Hypolimnion	56	0.01	0.1	ND	ND	ND	33.6
6/30/2022	Epilimnion	5	ND	0	ND	0.01	ND	13
	Metalimnion	22	ND	0	ND	0.01	ND	24.4
	Hypolimnion	57	ND	0.1	ND	0.01	ND	32.3

Source: Seattle City Light.
Notes:
NH3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
Samples measured below the method reporting limit (NH_3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01/mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Table 4.2.2-30. Nitrogen, phosphorus, and alkalinity sampling results for the mouth of Thunder Creek, May-June 2022.

Date	Site ID	Site Name	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/26/22	TRIB12	Thunder Creek Mouth	0.01	0.12	ND	ND	ND	42.1 (41.7)
6/30/22	TRIB12	Thunder Creek Mouth	ND	0.03	0.92	ND	ND	7.2

Source: Seattle City Light.
Notes:
NH3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (NH_3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01/mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Levels of carbon in the Diablo Lake forebay (DIABLO2) and Thunder Creek during May and June 2022 are shown in Table 4.2.2-31 and Table 4.2.2-32, respectively. Organic carbon concentrations (dissolved and particulate) were generally low (≤ 1 mg/L) in Diablo Lake and its tributaries, which also indicates the low productivity within the system.

Table 4.2.2-31. Results of carbon sampling in the Diablo Dam forebay (DIABLO2), May-June 2022.

Date	Stratified Layer	Depth (m)	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/26/2022	Epilimnion	5	ND	0.89	1	6.3
	Metalimnion	35	ND	0.9	0.9	7.42
	Hypolimnion	56	ND	0.87	0.9	7.87
6/30/2022	Epilimnion	5	2	0.78	0.7	3.52
	Metalimnion	22	ND	0.94	1	5.55
	Hypolimnion	57	1	0.9	0.9	8.17

Source: Seattle City Light.
Notes:
CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.
Samples measured below the method reporting limit (CBOD = 1.0 mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Table 4.2.2-32. Results of carbon sampling in the mouths of Thunder Creek, May-June 2022.

Date	Site ID	Site Name	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/26/2022	TRIB12	Thunder Creek Mouth	ND	0.85	0.89	3.09
6/30/2022	TRIB12	Thunder Creek Mouth	ND	0.54	0.53	2.19

Source: Seattle City Light.
Notes:
CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (CBOD = 1.0 mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.

Concentrations of chlorophyll-*a* and pheophyton-*a* (indices of primary productivity) in the Diablo Dam forebay (DIABLO2) and at the mouth of Thunder Creek during May and June 2022 are shown in Table 4.2.2-33 and Table 4.2.2-34, respectively. Chlorophyll-*a* and pheophyton-*a* results for Diablo Lake in May 2022 consisted of non-detects and, in June 2022, non-detects and concentrations ≤ 0.23 mg/m^3. Chlorophyll-*a* and pheophyton-*a* results for the mouth of Thunder Creek in May 2022 consisted of non-detects and, in June 2022, concentrations ≤ 0.17 mg/m^3.

Table 4.2.2-33. Results of chlorophyll-*a* and pheophyton-*a* sampling for the Diablo Dam forebay (DIABLO2), May-June 2022.

Date	Stratified Layer	Depth (m)	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/26/2022	Epilimnion	5	ND	ND
	Metalimnion	35	ND	ND
	Hypolimnion	56	ND	ND
6/30/2022	Epilimnion	5	0.23	0.13
	Metalimnion	22	0.19	0.13
	Hypolimnion	57	ND	ND

Source: Seattle City Light.
Notes:
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.

Table 4.2.2-34. Results of chlorophyll-*a* and pheophyton-*a* sampling for the mouth of Thunder Creek, May-June 2022.

Date	Site ID	Site Name	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/26/22	TRIB12	Thunder Creek Mouth	ND	ND
6/30/22	TRIB12	Thunder Creek Mouth	0.17	0.16

Source: Seattle City Light.
Notes:
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.
Field duplicate results are shown in parenthesis.

As part of the expanded water quality monitoring scope, the NPS has agreed to assist City Light by conducting zooplankton tows in Diablo Lake. Sampling was conducted monthly from May through November 2022 (see Table 4.2.2-10 and Appendix E of this Exhibit E for sample locations). Results of zooplankton sampling in Diablo Lake will be provided in the USR and FLA.

Gorge Lake

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling at the log boom in Gorge Lake (GORGE7) (see Appendix E of this Exhibit E for location) and at the mouth of Stetattle Creek. Parameters selected, and the sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model. In Gorge Lake, data were collected at a depth of 1 m (3.3 ft) using a Van Dorn sampler. In Stetattle Creek, grab samples were collected in flowing water at depths ≤ 1m.

Levels of nitrogen and phosphorus in Gorge Lake (GORGE7) at the log boom and at the mouth of Stetattle Creek during May and June 2022 were very low (mostly below the method detection limit) (Table 4.2.2-35). Overall, the observed low nutrient levels are consistent with previous monitoring results, indicating that the Project reservoirs and their tributaries constitute an oligotrophic system.

Table 4.2.2-35. Nitrogen, phosphorus, and alkalinity sampling results for Gorge Lake (GORGE7) at the log boom and the mouth of Stetattle Creek, May-June 2022.

Date	Site ID	Site Name	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/17/22	GORGE7	Gorge Lake	ND	0.05	ND	0.004	0.003	26
	STET1	Stetattle Creek	ND	0.07	ND	ND	ND	4.8
6/8/22	GORGE7	Gorge Lake	ND	0.06	ND	ND	ND	17.7
	STET1	Stetattle Creek	ND	0.03	ND	ND	ND	4.1

Source: Seattle City Light.

Notes:

NH3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.

All samples were collected at depths of ≤ 1 m.

Samples measured below the method reporting limit (NH3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01/mg/L) are reported as ND.

Field duplicate results are shown in parenthesis.

Levels of carbon in Gorge Lake (GORGE7) at the log boom and at the mouth of Stetattle Creek during May and June 2022 are shown in Table 4.2.2-36. Organic carbon concentrations (dissolved and particulate) were generally low (about 1 mg/L or less), indicating low productivity within the system.

Table 4.2.2-36. Results of carbon sampling for Gorge Lake (GORGE7) at the log boom and the mouth of Stetattle Creek, May-June 2022.

Date	Site ID	Site Name	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/17/22	GORGE7	Gorge Lake	1	0.98	1.13	6.15
	STET1	Stetattle Creek	3	0.89	0.83	1.38
6/8/2022	GORGE7	Gorge Lake	2	0.88	0.87	-
	STET1	Stetattle Creek	1	0.76	0.76	-

Source: Seattle City Light.

Notes:

CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.

All samples were collected at depths of ≤ 1 m.

Field duplicate results are shown in parenthesis.

Concentrations of chlorophyll-*a* and pheophyton-*a* (indices of primary productivity) in Gorge Lake (GORGE7) at the log boom and at the mouth of Stetattle Creek during May and June 2022 are shown in Table 4.2.2-37. Chlorophyll-*a* and pheophyton-*a* results for May 2022 consisted of non-detects (i.e., indicating low productivity) and, for June, low concentrations ≤ 0.64 mg/m^3.

Table 4.2.2-37. Results of chlorophyll-*a* and pheophyton-*a* sampling for Gorge Lake and the mouth of Stetattle Creek, May-June 2022.

Date	Site ID	Site Name	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/17/22	GORGE7	Gorge Lake	ND	ND
	STET1	Stetattle Creek	ND	ND
6/8/2022	GORGE7	Gorge Lake	0.24	0.16
	STET1	Stetattle Creek	0.64	0.31

Source: Seattle City Light.
Notes:
All samples were collected at depths of ≤ 1 m.
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.
Field duplicate results are shown in parenthesis.

As part of the expanded water quality monitoring scope, the NPS has agreed to assist City Light by conducting zooplankton tows in Gorge Lake. Sampling was conducted monthly from May through November 2022 (see Table 4.2.2-10 and Appendix E of this Exhibit E for sample locations). Results of zooplankton sampling in Gorge Lake will be provided in the USR and FLA.

Fecal Coliform/*E. coli* in Project Reservoirs

Ross Lake

Fecal coliform concentrations[30] in Ross Lake were typically below method reporting limits during the June-September 2021 recreation season, although several samples did contain detectable CFU (Table 4.2.2-38). The highest fecal coliform concentrations were recorded in June 2021: 600 CFU/100 mL at the sampling site near Ross Lake Resort (ROSS8) and 3 CFU/100 mL at Hozomeen (ROSS7) and at the Lightning (ROSS10) and Big Beaver (ROSS11) boat-in campsites. Only the Hozomeen and Ross Lake Resort sites had detectable fecal coliform concentrations in August and September 2021. Results from June 2022 bacterial sampling ranged from non-detects to 5 CFU/mL, that is, showing no strong signature of contamination (Table 4.2.2-38).

[30] *E. coli* concentrations were measured at ROSS8 beginning in August 2021 and at all sites beginning in September 2021.

Table 4.2.2-38. Ross Lake monthly fecal coliform and *E.coli* sampling results (June-October 2021 and June 2022). Source: Seattle City Light.

Date	Reservoir Elevation (NAVD 88)	Hozomeen (ROSS7)		Ross Lake Resort (ROSS8)		Boat-in Campsites					
						Little Beaver (ROSS9)		Lightning Creek (ROSS10)		Big Beaver (ROSS11)	
		FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*	FC	*E. coli*
6/30/21	1,606.2	3 (5)	-	600	-	ND	-	3	-	3	-
7/26/21	1,607.6	ND	-	ND (ND)	-	ND	-	ND	-	ND	-
8/17/21	1,607.8	2	-	2	2	ND (ND)	-	ND	-	ND (ND)	-
9/14/21	1,602.3	2	ND	11	2	ND	ND	ND (ND)	ND (ND)	ND	ND
6/21/22	1,593.8	ND	ND	5	4	ND	ND	5	5	1 (ND)	1 (ND)

Source: Seattle City Light.
Notes:
Results are in CFU/100 mL.
Samples measured below the method reporting limit (1 CFU/100 mL) are reported as ND.
Field duplicate results are shown in parenthesis.
E. coli was measured at ROSS8 beginning in August 2021 and at all sites beginning in September 2021.

Diablo Lake

Results of bacterial analyses in Diablo Lake are shown in Table 4.2.2-39. The maximum fecal coliform concentration was reported in June 2021 at the Thunder Creek Confluence at Bridge/Colonial Creek Campground **(**DIABLO4) (104 CFU/100 mL). Fecal coliform and *E. coli* were detectable in August 2021 at Colonial Creek Campground. Fecal coliform was detectable in June and September 2021 (*E. coli* in September) at the Environmental Learning Center. Bacterial levels in June 2022 were at or just above the method reporting limit, that is, showing no strong signature of contamination (Table 4.2.2-39).

Table 4.2.2-39. Diablo Lake monthly fecal coliform and *E. coli* sampling results (June-September 2021).

Date	Reservoir Elevation (NAVD 88)	Colonial Creek Campground (DIABLO4)		Environmental Learning Center (DIABLO5)	
		FC	*E. coli*	FC	*E. coli*
6/30/21	1,209.2	104	-	52	-
7/26/21	1,207.4	ND	-	ND	-
8/17/21	1,208.6	-	-	ND	-
8/20/21	1,207.4	13 (15)	11	-	-
9/14/21	1,209.1	ND	ND	2	2
6/21/22	1,208.2	2	1	ND	ND

Source: Seattle City Light.
Notes:
Results are in units of CFU/100 mL.
Samples measured below the method reporting limit (1 CFU/100 mL) are reported as ND.
Field duplicate results are shown in parenthesis.
E. coli was measured only at DIABLO4 beginning in August 2021, and at both sites beginning in September 2021.

Other Water Quality Parameters Measured in Ross Lake

Grab samples of total dissolved solids (TDS), acid neutralizing capacity (ANC), and DOC were collected at the Little Beaver, Skymo, and Pumpkin Mountain locations from May-November in 2015-2018 (a total of about 80 grab samples).

TDS ranged from 26-58 mg/L with an interquartile range of 39-51 mg/L and a median of 44 mg/L (Table 4.2.2-40). Concentrations were higher in 2015 and 2018, but no trend over time was observed. The Little Beaver, Skymo, and Pumpkin Mountain locations had nearly identical distribution statistics for TDS.

Table 4.2.2-40. Distribution statistics of total dissolved solids (mg/L) in Ross Lake.

Percentile	2015	2016	2017	2018
Maximum	58	42	52	57
75th Percentile	55	41	43	53
Median	50	39	39	51
25th Percentile	46	38	36	49
Minimum	39	35	26	40

Source: NCCN.

ANC samples showed minimal variation among the Little Beaver, Skymo, and Pumpkin Mountain locations, with the 75th percentiles, median, and 25th percentiles of the data at each location differing by no more than 13 microequivalents per liter (µeq/L). Data showed a slight decreasing trend with time (Table 4.2.2-41).

Table 4.2.2-41. Distribution statistics of acid neutralizing capacity (mg/L) in Ross Lake.

Percentile	2015	2016	2017	2018
Maximum	640	600	640	560
75th Percentile	570	550	515	520
Median	520	500	490	485
25th Percentile	455	450	440	443
Minimum	370	360	280	360

Source: NCCN.

Chloride ranged from 0.48 mg/L to 0.92 mg/L with a median of 0.55 mg/L. No clear trends could be determined with regard to year or sampling location. Cations in Ross Lake were dominated by calcium, whose concentrations were roughly an order of magnitude higher than those of sodium, magnesium, and potassium (Table 4.2.2-42).

Table 4.2.2-42. Cation concentrations in Ross Lake (mg/L).

Cation	Minimum	Median	Maximum
Sodium	1.0	1.2	1.4
Magnesium	1.2	1.3	1.6
Potassium	0.3	0.4	0.4
Calcium	8.6	11.0	12.6

Source: NCCN.

Benthic Macroinvertebrates and Invertebrate Drift in Project Reservoirs and Their Tributaries

As explained previously, City Light has expanded its BMI sampling program over what was outlined in the FERC-approved RSP. Sampling locations, methods, and frequencies are outlined in Table 4.2.2-11. Sampling underway or completed now includes: (1) benthic grab samples using a Ponar dredge in reservoirs; (2) kick-net sampling of BMI in reservoir tributaries; (3) invertebrate drift sampling in reservoir tributaries; and (4) placement of rock baskets in Ross Lake to assess BMI colonization rates in the varial zone. BMI and invertebrate drift sampling results for the Project reservoirs and their tributaries will be provided in the USR and FLA.

For all three reservoirs, these forms of sampling will provide an understanding of the contribution of invertebrates from reservoir tributaries and the abundance and diversity of invertebrates in the lentic zones of the reservoirs (i.e., below the normal minimum WSE that defines the lower end of the varial zone; rock baskets discussed in next paragraph). Invertebrate drift samples will be collected within each of the target tributaries (see Table 4.2.2-11) just above the maximum reservoir WSE and in the stream channel within the varial zone just above the point where the tributary enters the reservoir. This will allow for a comparison of invertebrates in water flowing into and out of the varial zone to assess potential losses within the varial zone.

In Ross Lake, WSE fluctuation is much more extensive than it is in the downstream reservoirs, largely due to storage and release patterns undertaken to minimize downstream flood risk. Rock baskets were deployed in the lentic and varial zones of Ross Lake to evaluate BMI colonization rates, which can be used as an indicator of the degree to which Project operations influence benthic productivity in the reservoir.

Rock baskets were positioned in the (1) upper varial zone (just below the maximum WSE); (2) lower varial zone (near the midpoint WSE in the drawdown zone); and (3) lentic zone (below the normal low WSE) (Figure 4.2.2-52) at each of the following sites in Ross Lake: Hozomeen, Desolation, Pumpkin, and Ruby (see mapbook in Appendix E of this Exhibit E for locations). At each of the four sampling sites, 12 baskets were deployed in July 2022 (i.e., at full pool), four in each zone (Figure 4.2.2-53). At each sampling site, two baskets were removed from each of the three zones twice: two baskets were removed after four weeks and two baskets after 10 weeks (Figure 4.2.2-53). The samples removed after two weeks are intended to provide data on early colonization, and the samples removed after 10 weeks provide information on colonization over a longer period.

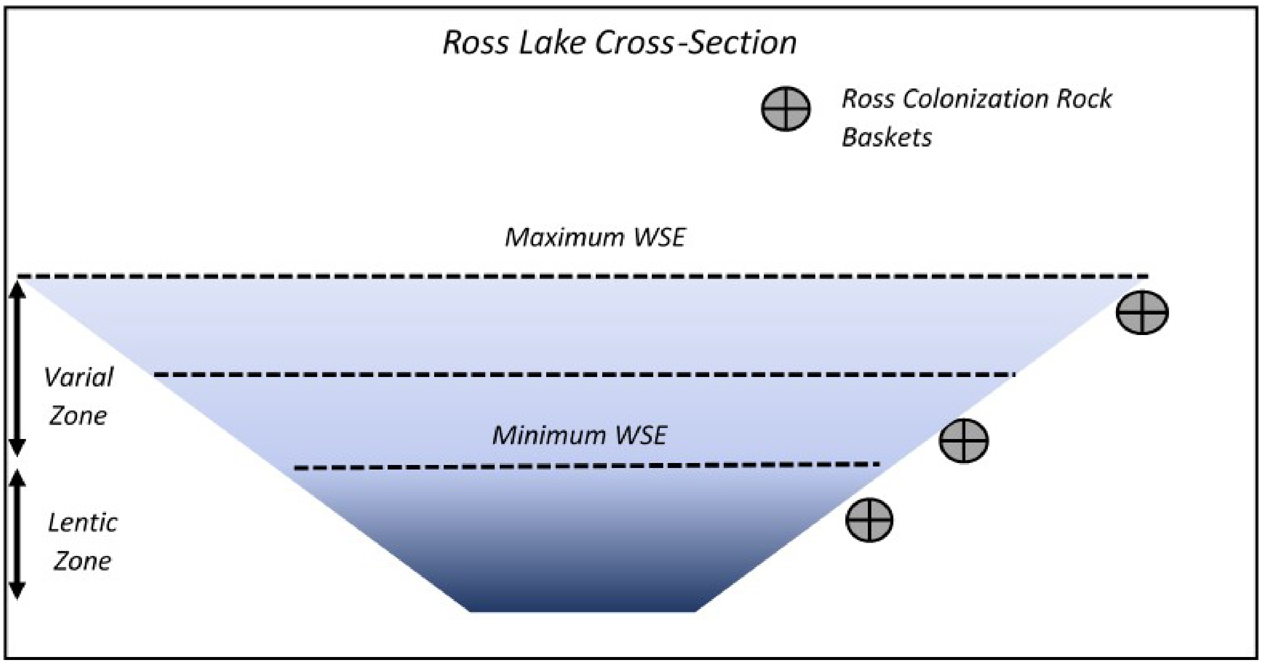


Figure 4.2.2-52. Position of BMI colonization rock baskets deployed within and below the varial zone in Ross Lake.

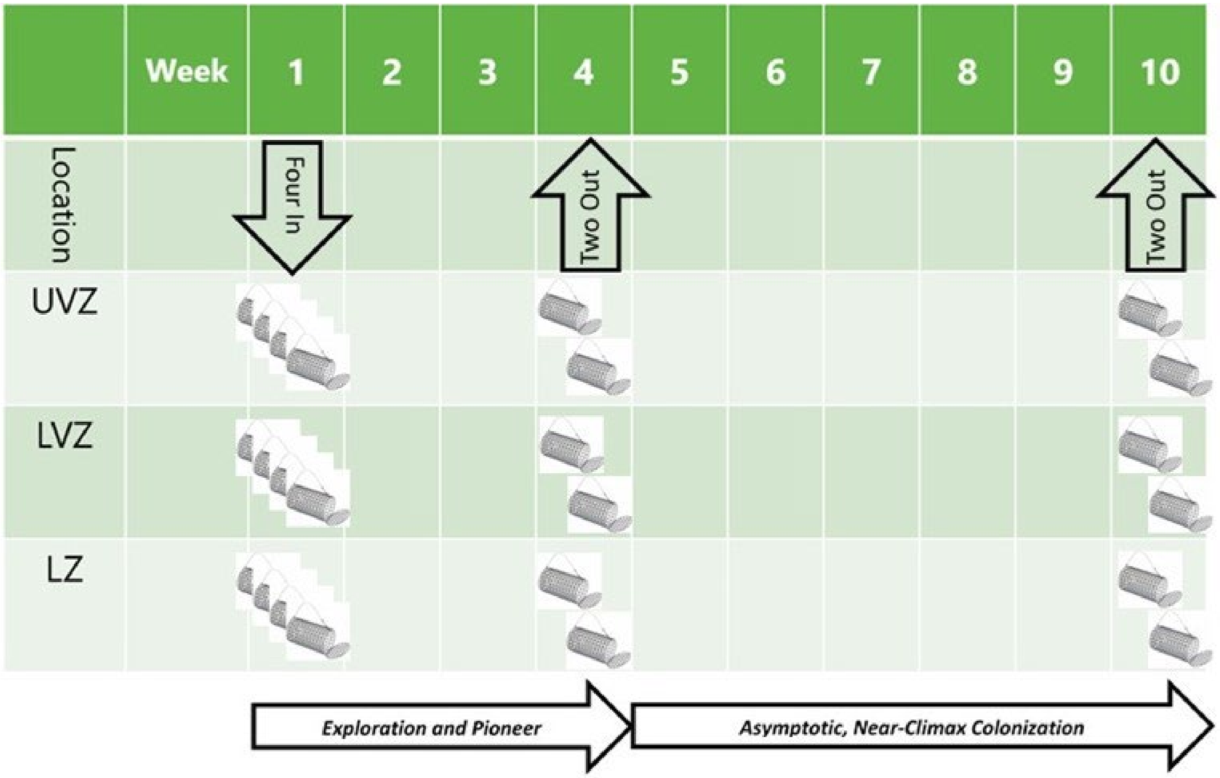


Figure 4.2.2-53. Schedule for retrieval of BMI colonization rock baskets from Ross Lake; UVZ, LVZ, and LZ are the upper varial zone, lower varial zone, and lentic zone, respectively.

Contaminants in Project Reservoirs

Seiders and Deligeannis (2018) reported on contaminant concentrations in fish tissue collected by the NPS in Ross Lake as part of Ecology's Freshwater Fish Contaminant Monitoring Program. The authors state that contaminant concentrations were 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 Trout and Rainbow Trout tissue collected from Ross Lake (in 2007 and 2012) showed that polychlorinated biphenyls (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 contaminant concentrations in Ross Lake remained low. The 2015 results were derived from tissue taken from 70 Rainbow Trout and native char collected by the 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)..."*

As noted previously, the current EPA water quality assessment for WRIA 4 (Upper Skagit) includes 2014 category listings for toxic substances[31] (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."[32]

Description of Monitoring in the Gorge Bypass and at Gorge Powerhouse

Continuous water quality monitoring (temperature [ºC], DO [mg/L], turbidity [NTU], pH, and TDG [percent saturation]) was conducted in 2021 at three locations in the Gorge bypass reach and at one location just downstream of Gorge Powerhouse (Figure 4.2.2-54). The elevations of these sites range from approximately 725 feet NAVD 88 at BYPASS1 (plunge pool below Gorge Dam) to approximately 490 feet NAVD 88 at PHOUSE1 (immediately below Gorge Powerhouse). Monitoring at the BYPASS1 and BYPASS3 sites began on January 28, 2021, and, at PHOUSE1, monitoring began on February 11, 2021. Monitoring at BYPASS2 began on August 2, 2021. Each site was accessed every 3-4 weeks for datasonde maintenance, data transfer, and repositioning if a datasonde became dewatered or dislodged during the prior period.

During fall 2021, datasondes in the Gorge bypass reach were displaced during large spill events. Two of these units (BYPASS2 and BYPASS3) were dislodged and never recovered, and the unit in the plunge pool below Gorge Dam (BYPASS1) was irreparably damaged (though data were recoverable). To reduce safety risks to field staff and avoid additional loss of equipment and data, City Light has modified its approach and is now sampling episodically in the bypass reach during baseflows and spill. Data are being collected at four locations: (1) Gorge Dam access bridge, located just below the Gorge Dam plunge pool; (2) Gorge Powerhouse access bridge, which is located just above the mixing zone where waters from the bypass reach and Gorge Powerhouse merge; and (3) two locations in the Skagit River downstream of Gorge Powerhouse, Ladder Creek Bridge, and the suspension bridge to Trail of the Cedars.

Episodic monitoring in the bypass reach includes temperature, DO, turbidity, and pH and is being conducted under baseline conditions, i.e., every six weeks from June through October and once

[31] 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.

[32] 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."

during winter (if logistically feasible and safe in winter). Opportunistic TDG sampling is being conducted during episodes of planned and unplanned spills ≥ 3,000 cfs (see TDG results below for the basis of the 3,000 cfs threshold), to the extent logistically feasible, i.e., if there is sufficient lead time to mobilize field crews, and there are no safety hazards or access limitations. Water quality (i.e., temperature, DO, TDG, turbidity) will continue to be monitored continuously with a datasonde deployed near the Gorge Powerhouse Tailrace.

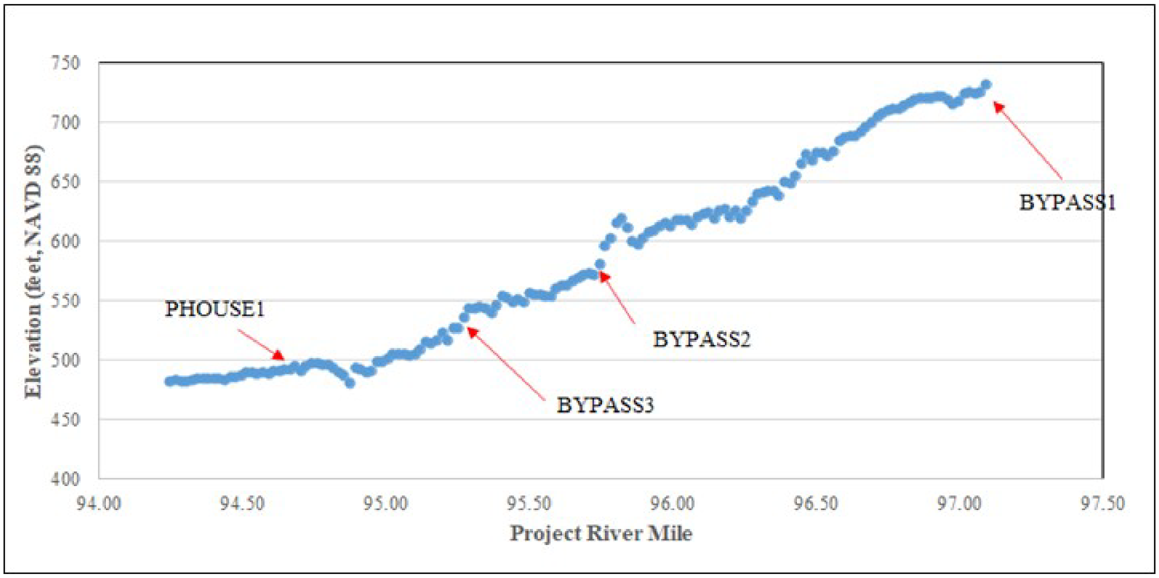


Figure 4.2.2-54. Gorge bypass reach and Powerhouse monitoring locations by Project River Mile and their elevations (NAVD 88).

Temperatures in the Gorge Bypass Reach and at Gorge Powerhouse

Time-series and box-and-whisker[33] plots showing water temperatures recorded at each of the Gorge bypass reach sites in 2021 are shown in Figures 4.2.2-55 and 4.2.2-56, respectively. Maximum water temperatures at these sites ranged from 12.2ºC below Gorge Powerhouse (PHOUSE1) to 24.6ºC immediately below Gorge Dam (BYPASS1). As expected, water temperatures below the powerhouse were less variable and usually cooler than the temperatures recorded at the three bypass sites.

Air temperatures during the monitoring period were at times substantially above normal based on data from the National Weather Service (NWS) (normal data are averages over the period 1991-2020). For example, the maximum air temperature recorded at Newhalem on June 29, 2021 was 45°C (113ºF), 22°C (40ºF) above the normal maximum of 23°C (73ºF) for this date. Associated glacial melting during this heat wave resulted in spill at Gorge Dam.

[33] Box-and-whisker plots show six statistics for each dataset: the minimum, first quartile (lower edge of box), median (horizontal line inside the box), average (*x* inside the box), third quartile (upper edge of box) and maximum. Whiskers above and below the box indicate the smallest and largest observations that fall within the 1.5 interquartile range (IQR, the difference between the first and third quartiles, or the height of the box).

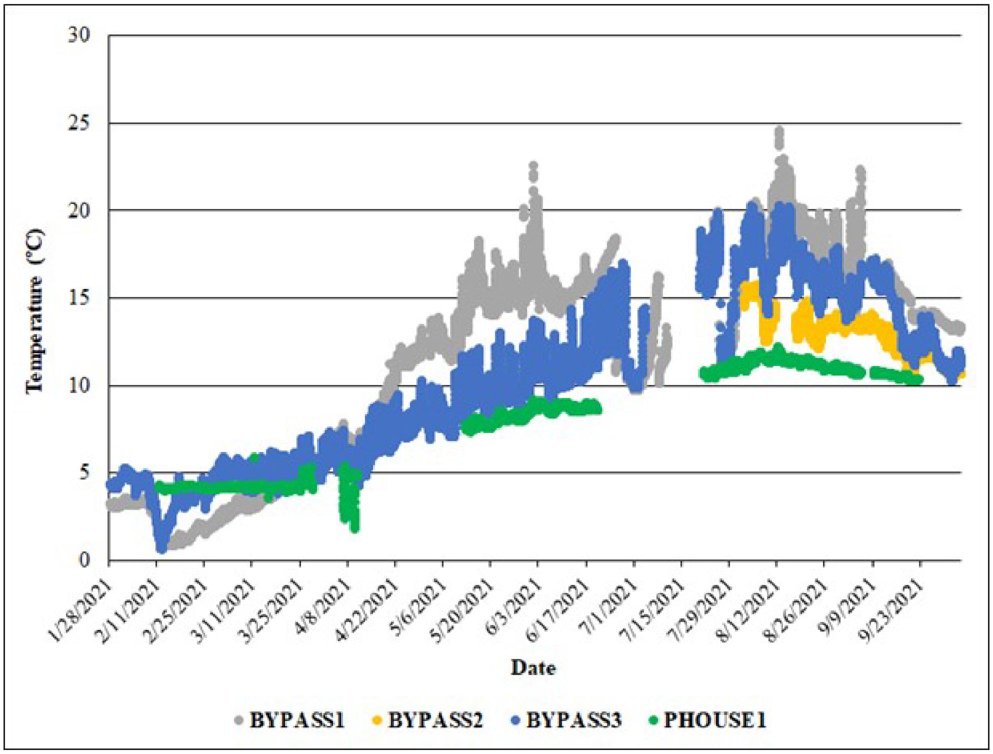


Figure 4.2.2-55. Time series of water temperatures at Gorge bypass reach and Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

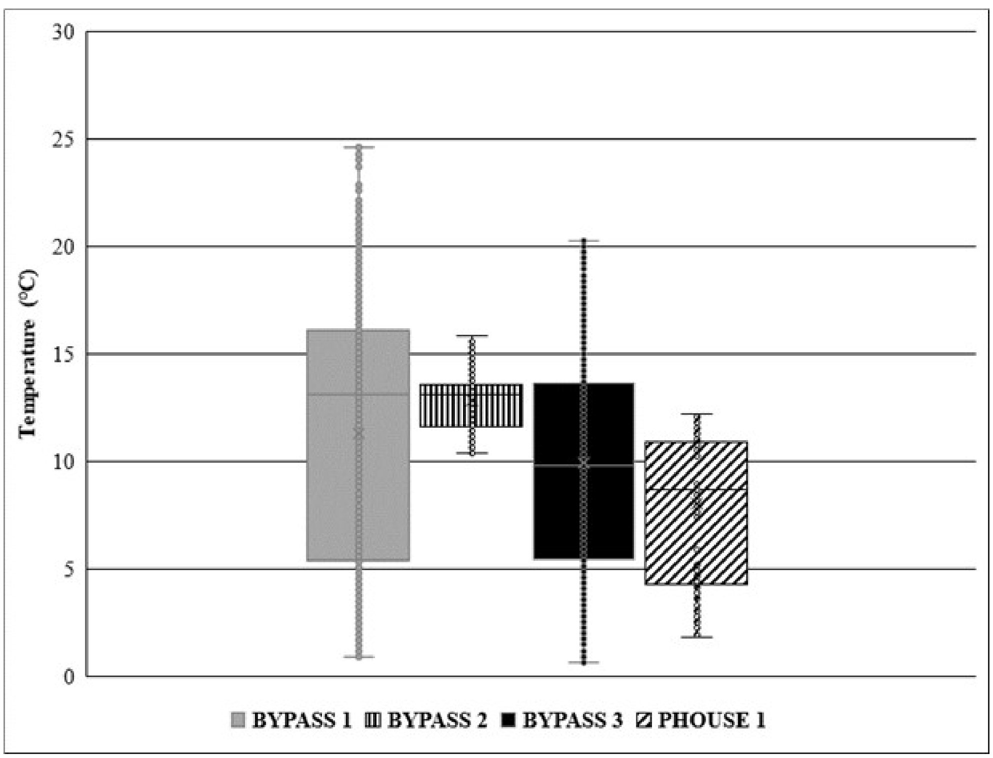


Figure 4.2.2-56. Box-and-whisker plot showing water temperature at the Gorge bypass reach and Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

Dissolved Oxygen and pH in the Gorge Bypass Reach and at Gorge Powerhouse

Time-series and box-and-whisker plots of DO concentration in and immediately below the Gorge bypass reach are shown in Figures 4.2.2-57 and 4.2.2-58, respectively. DO concentrations at the BYPASS1 and BYPASS2 sites gradually decreased throughout the monitoring period as temperatures increased. DO concentrations below the Gorge Powerhouse tailrace (PHOUSE1) were generally higher (water temperatures were lower) than at the bypass sites and demonstrated comparatively little diel variability. Average DO ranged from 9.7 mg/L at BYPASS2 (3,071 observations) to 11.6 mg/L at PHOUSE1 (9,011 observations). Minimum DO was 7.3 mg/L at both BYPASS1 and BYPASS2, 8.4 mg/L at BYPASS3, and 10.6 mg/L at PHOUSE1.

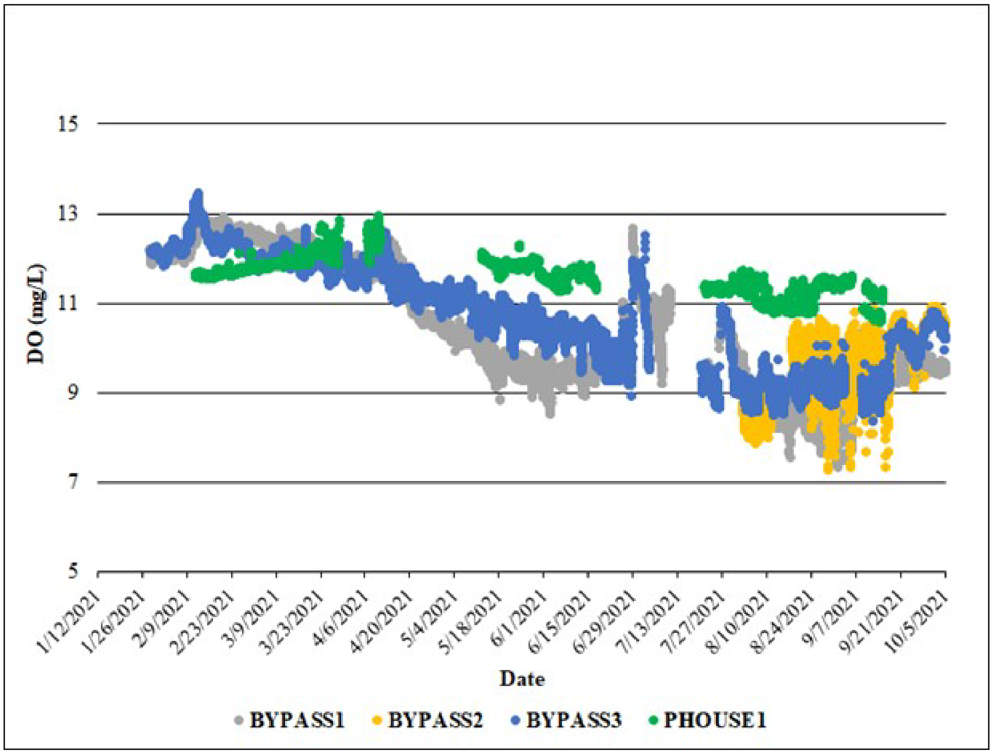


Figure 4.2.2-57. Time-series of dissolved oxygen at the Gorge bypass reach and Gorge Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

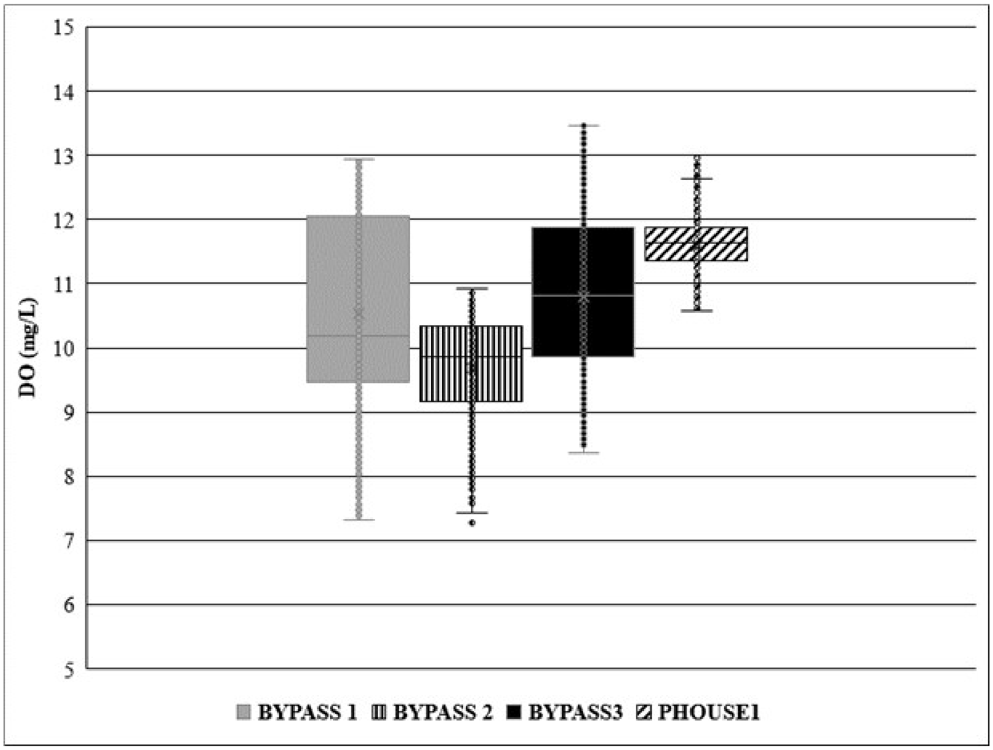


Figure 4.2.2-58. Box-and-whisker plot of dissolved oxygen at the Gorge bypass reach and Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

Monitoring of pH at PHOUSE1 began on July 21, 2021. pH values averaged 7.5 with a range of 7.2 to 7.7[34] (Figure 4.2.2-59).

34 The pH results align with others reported in the basin, for example, those measured by Ecology at Marblemount (see below), but all pH data were qualified based on exceedance of performance check thresholds over three successive visits (August, September, and October). Discussion with the manufacturer (Hach®) suggests that performance of the pH probe and decreasing values may have been due to leakage of the potassium chloride reference solution in the pH probe. Steps were taken to remedy this issue.

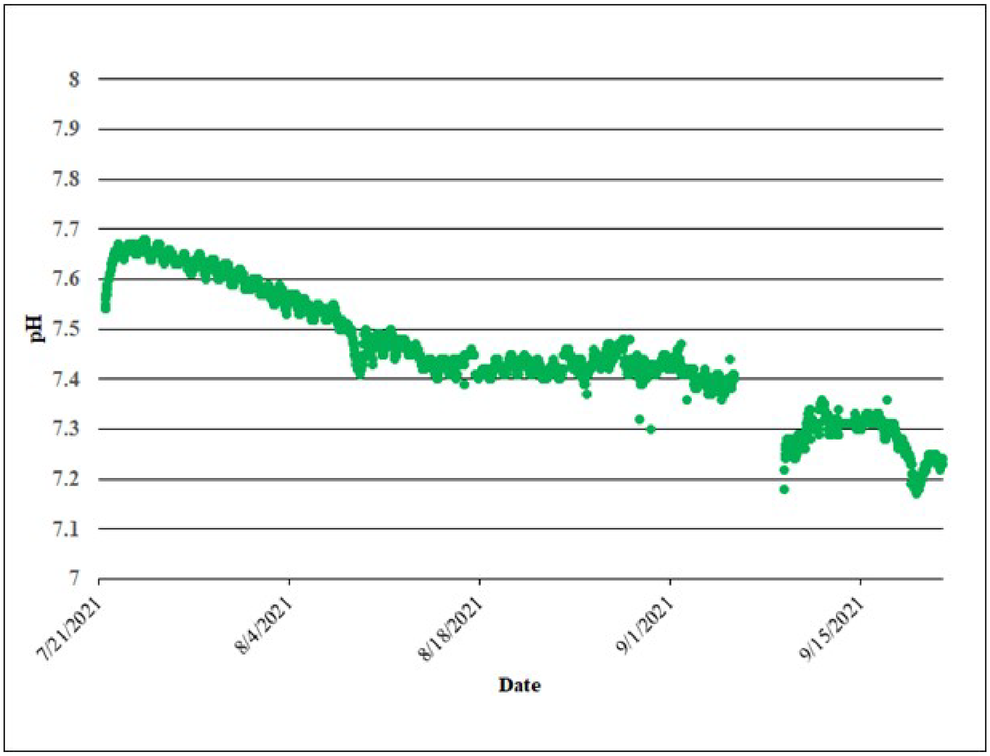


Figure 4.2.2-59. pH at the Gorge Powerhouse site (PHOUSE1) (July 22 – October 5, 2021). Source: Seattle City Light.

<u>TDG in the Gorge Bypass and at Gorge Powerhouse</u>

Time-series and box plots of TDG data collected continuously during 2021 at the three Gorge bypass reach sites and the Gorge Powerhouse tailrace are shown in Figures 4.2.2-60 and 4.2.2-61. Median values for all sites were between 101 and 105 percent saturation. Maximum percent saturation was 124 percent in the Gorge Dam plunge pool (BYPASS1) during a spill event in late June 2021. Values were also elevated during this same event at BYPASS3. TDG was elevated at PHOUSE1 in August and briefly at GORGE3 in the first half of September. TDG levels downstream of the PHOUSE1 measurement location (i.e., measurement sites at bridges below the Project) are addressed below.

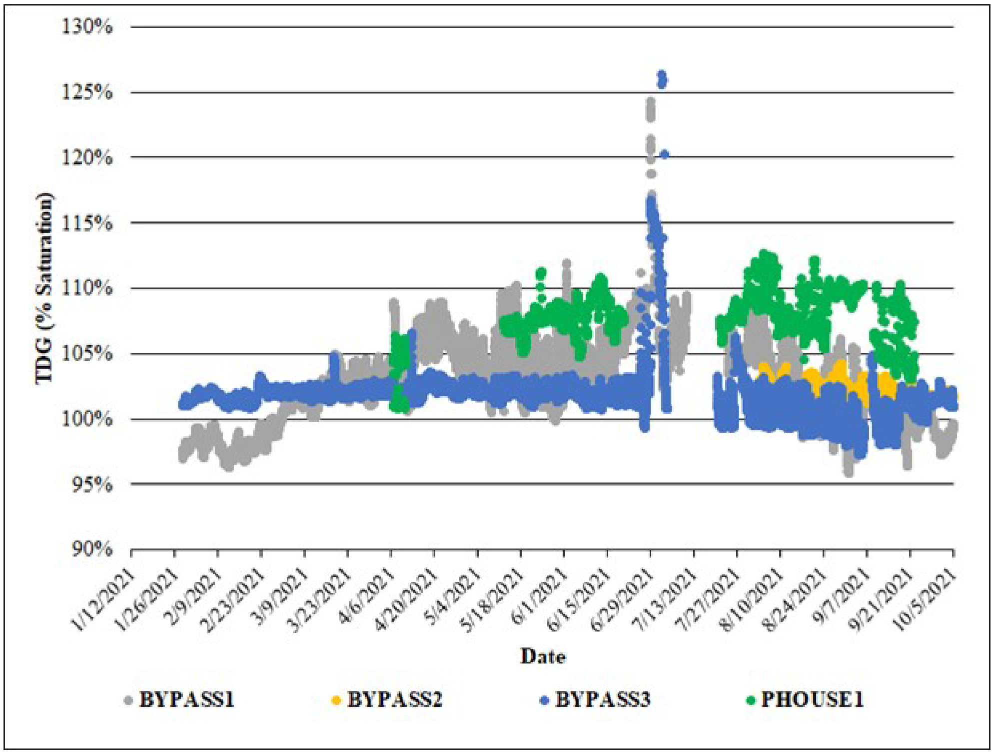


Figure 4.2.2-60. Time-series of total dissolved gas at the Gorge bypass reach and Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

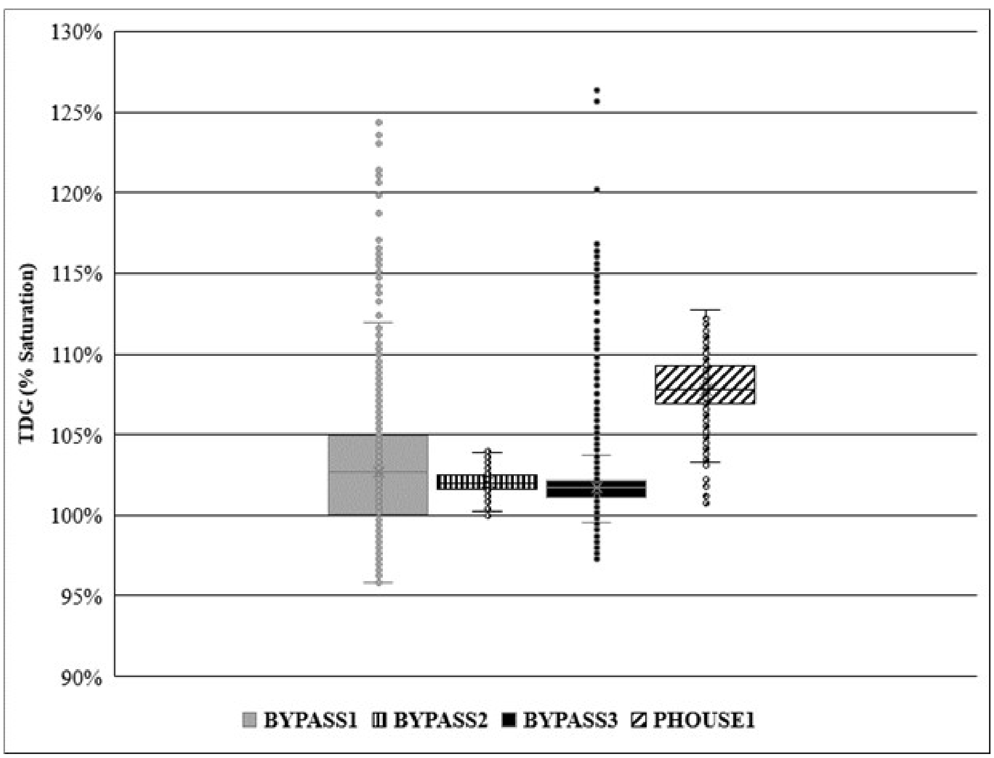


Figure 4.2.2-61. Box-and-whisker plots of total dissolved gas at the Gorge bypass reach and Powerhouse sites (2021). Source: Seattle City Light.

As noted, the maximum TDG concentration observed at the bypass monitoring sites to date, 124 percent saturation, was recorded at the Gorge Dam plunge pool (BYPASS1) during a sustained spill at Gorge Dam in late June 2021, which followed a record heatwave. Spills over the last 24 years have primarily occurred from May through August but also during fall (Figure 4.2.2-62). City Light records indicate that the maximum daily average spill in June 2021 was approximately four times greater than the median spill for the period 1997-2021 (Figure 4.2.2-63).

TDG levels in the bypass rose quickly in response to rapid increases in spill from June 25 through 28 (increases of 2,900 and 2,650 cfs, respectively, over 1-hour periods) (Figure 4.2.2-64). TDG levels at BYPASS3 increased by about 7 percent over those prior to spill, whereas effects at BYPASS1 are less pronounced. With the onset of the much larger spill on June 29, TDG concentrations rose steeply: values reached 124 percent saturation at BYPASS1 and 117 percent at BYPASS3. Changes in TDG concentrations at BYPASS1 tracked spill levels closely, whereas values downstream at BYPASS3 were not as closely correlated. As spill declined, TDG at BYPASS3 decreased more gradually than at BYPASS1, possibly due to reaeration as water flowed through the cascade located upstream of BYPASS3. TDG at both sites remained above 110 percent until spill decreased to about 4,000 cfs (Figure 4.2.2-65).

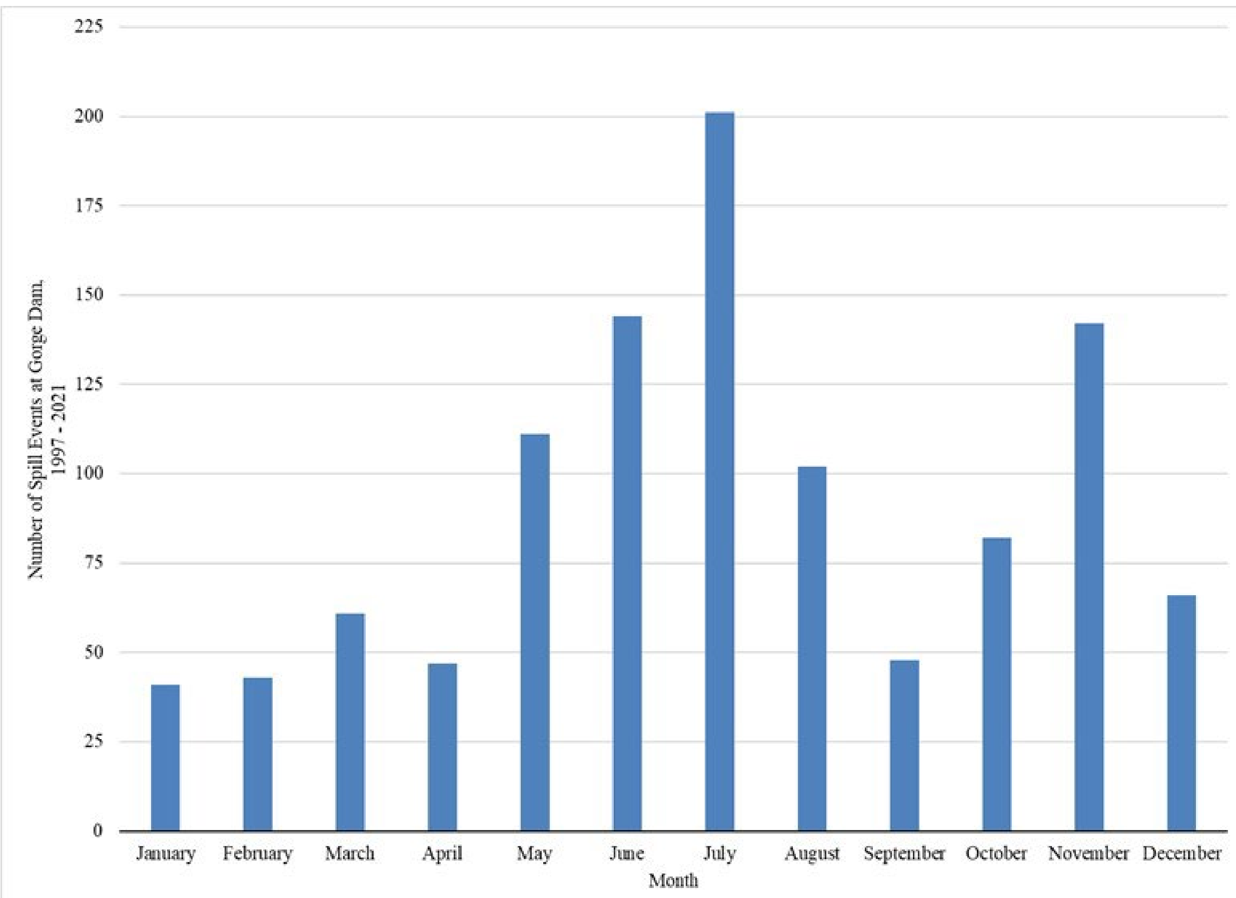


Figure 4.2.2-62. Monthly spill events at Gorge Dam (1997-2021). Source: Seattle City Light.

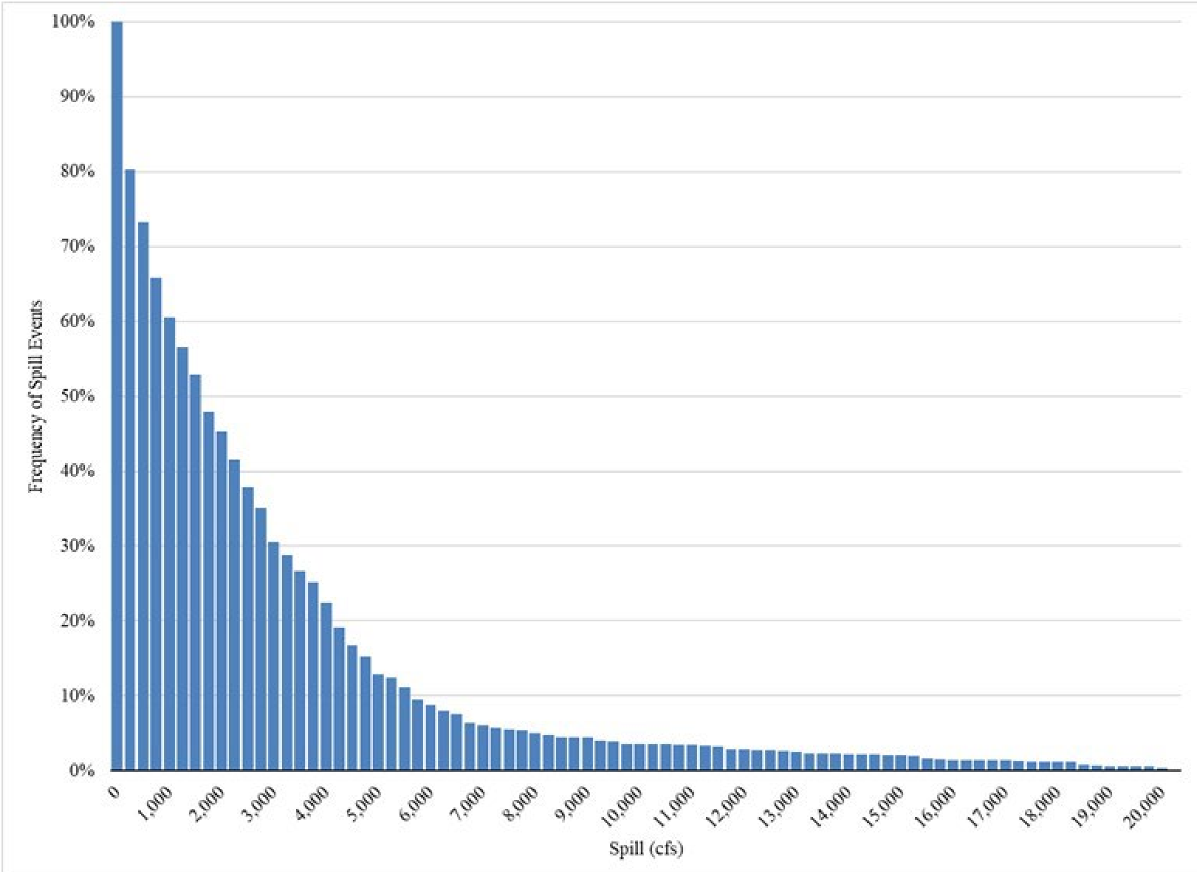


Figure 4.2.2-63. Frequency distribution of spill volume at Gorge Dam (1997-2021). Source: Seattle City Light.

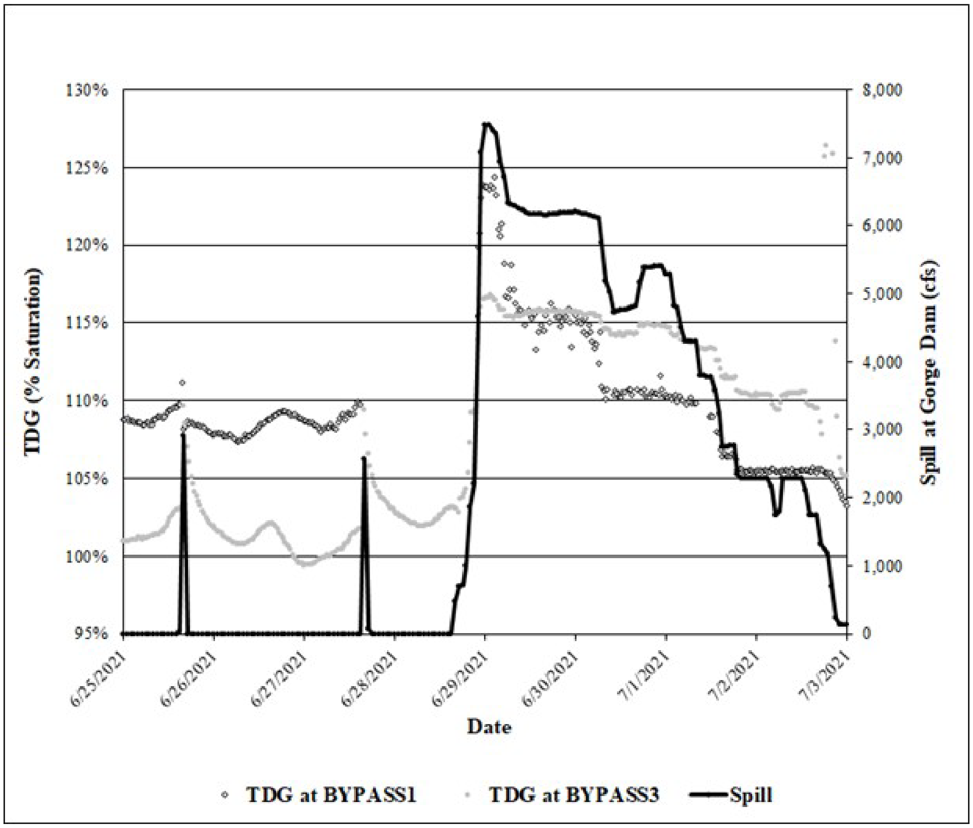


Figure 4.2.2-64. Total dissolved gas and spill in the Gorge bypass reach (June-early July 2021). Source: Seattle City Light.

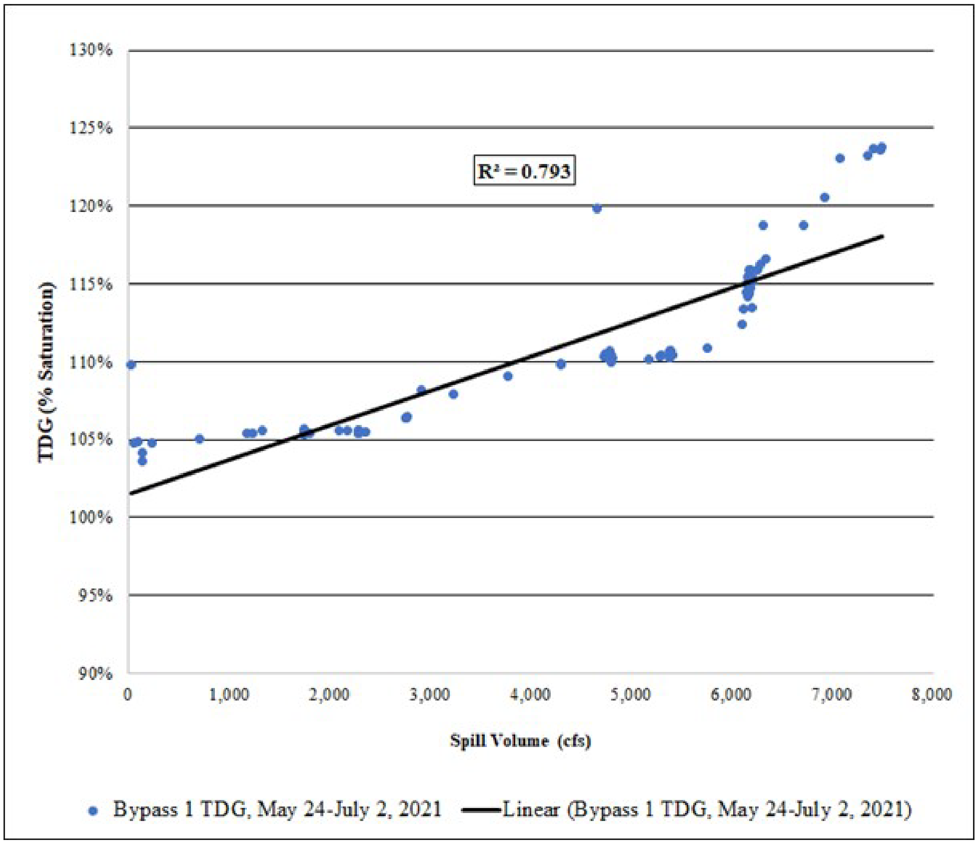


Figure 4.2.2-65. Regression of total dissolved gas at BYPASS1 versus spill at Gorge Dam (May 24-July 2, 2021. Source: Seattle City Light.

City Light released a planned spill in July 2021 as a component of the FA-05 Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development Study (Bypass Instream Flow Model Development Study, City Light 2022e). Stable daily flows of approximately 1,200, 500, 250, and 50 cfs were targeted for July 26-29, 2021. Pre-spill TDG levels at BYPASS3 were between 100 and 103 percent, increasing to 106 percent with the onset of the 1,200 cfs release (Figure 4.2.2-66). TDG at BYPASS3 returned to pre-spill levels as flows were reduced over the next three days. TDG observed at BYPASS1 remained near 105 percent over the four-day release.

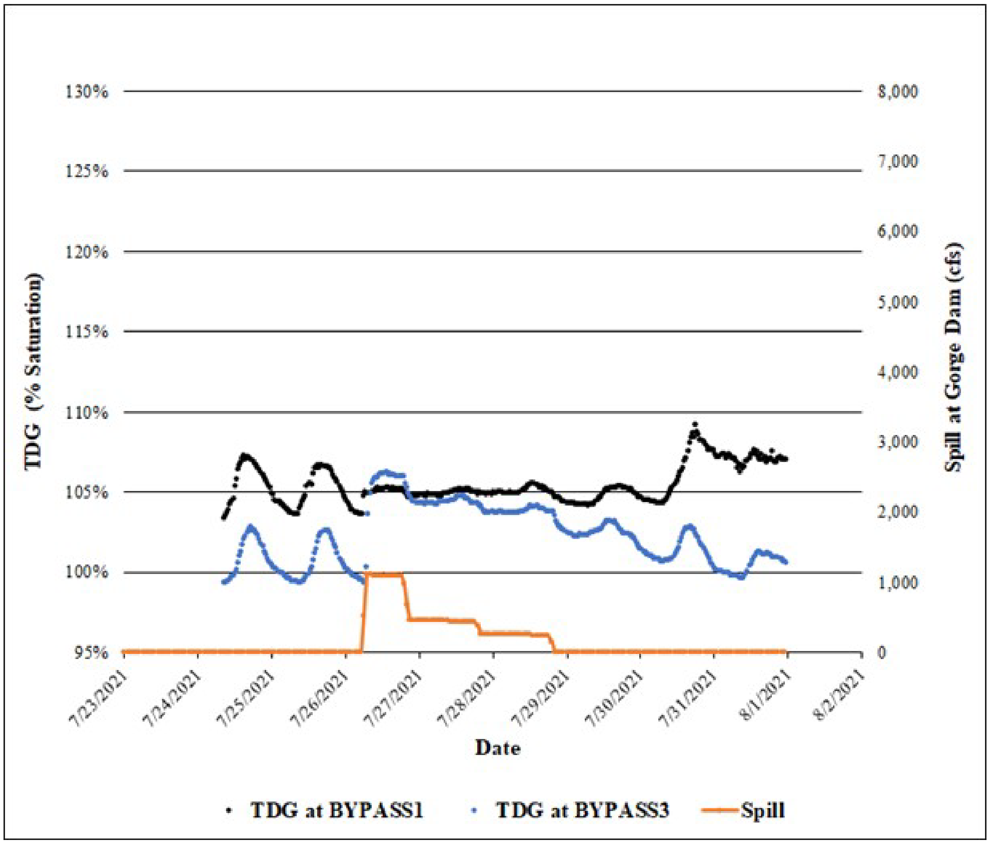


Figure 4.2.2-66. Total dissolved gas at BYPASS1 and BYPASS3 during planned spill at Gorge Dam (July 2021). Source: Seattle City Light.

<u>Turbidity and TSS in the Gorge Bypass and at Gorge Powerhouse</u>

Turbidity was generally very low at all monitoring sites in the Gorge bypass reach and below Gorge Powerhouse, averaging near or less than 1 NTU (Figure 4.2.2-67). However, turbidity at BYPASS3 during late June increased to nearly 120 NTU, likely in response to the late June spill at Gorge Dam. Values were also higher at PHOUSE1 on several occasions in August and early September (103 NTUs on August 10, 129 NTUs on August 29, and 93 NTUs on September 2) and BYPASS3 in late September. Review of USGS data at the Newhalem gage (USGS Gage 12178000) indicates flows were relatively stable during this August-September period, suggesting that debris accumulation or algae was interfering with the datasonde’s optical sensor.

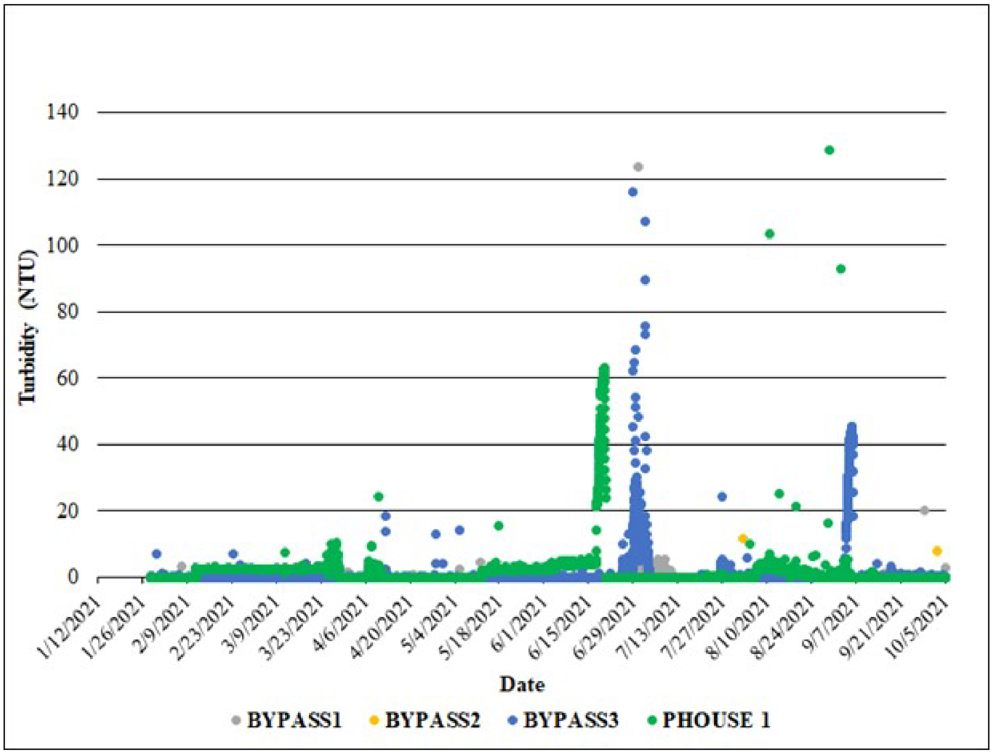


Figure 4.2.2-67. Turbidity at the Gorge bypass reach and Powerhouse sites (January 28-October 5, 2021). Source: Seattle City Light.

Per the FA-01 WQ Monitoring Study RSP, TSS is to be measured opportunistically downstream of Gorge Powerhouse. City Light collected a TSS sample for analysis on July 22, 2021, and the resulting TSS concentration was 2 mg/L. Powerhouse flows at the time and over the previous several days were relatively stable at approximately 3,000 cfs. Given the relatively low and constant flows, the 2 mg/L TSS likely represents a baseline value.

Benthic Macroinvertebrates in the Gorge Bypass Reach

As explained previously, City Light has significantly expanded its BMI sampling program over what was outlined in the FERC-approved RSP. Sampling locations, methods, and frequencies are outlined in Table 4.2.2-11. BMI and drift sampling are now being conducted in the Gorge bypass reach just upstream of Gorge Powerhouse (BYPASS3X). BMI samples were collected with a kick-net, per Ecology protocol, every six weeks from June through October 2022 and will be collected once in winter 2022, if it is safe and feasible to enter the bypass during winter. Drift samples are being collected at the same locations and times as the BMI samples. BMI and invertebrate drift sampling results for the Gorge bypass reach will be provided in the USR and FLA.

Temperatures in the Skagit River below the Project

Temperatures in the Skagit and Sauk rivers downstream of the Project are being measured continuously with Onset® temperature loggers (thermographs) at the locations shown in Table 4.2.2-10 and the mapbook included as Appendix E of this Exhibit E (12 locations in the Skagit River and three locations in the Sauk River). Monitoring sites are located well downstream of tributaries and reflect conditions within the mainstems of the two rivers. Only the thermograph deployed at PRM 60.8 (SKAGIT6) is in an area that is not well mixed, and where large woody debris has racked on the shoreline. Since deployment, smaller branches and fine sediment have accumulated to form a small backwater pool at this site, which may have caused localized warming at lower river flows. Much of the sediment was washed out during high flow events. Relocation of this thermograph is under evaluation.

Data from a subset (Table 4.2.2-43) of these thermographs have been downloaded and processed. Monthly minimum, mean, and maximum water temperatures for each of these sites during the monitoring period (as of the drafting of this Exhibit E) are reported in Table 4.2.2-44, and the 30-minute water temperature regimes for these monitoring sites are presented in Figure 4.2.2-68. Data from all monitoring locations, collected over a longer time period, will be presented in the USR and FLA.

Table 4.2.2-43. A subset of continuous temperature monitoring locations in the Skagit River downstream of Gorge Powerhouse and in the Sauk River (a larger dataset, spatially and temporally, will be presented in USR and FLA).

Sample ID	Location[1]	Description	Date of Thermograph Deployment
SKAGIT2	PRM 91.6	Within North Cascades National Park at the USGS gage[1]	9/23/2020
SKAGIT3	PRM 85.9	Within North Cascades National Park at USGS gage[2]	9/23/2020
SKAGIT4	PRM 75.6	Private property in Marblemount, at USGS gage[1]	9/23/2020
SKAGIT5	PRM 69.3	City Light property in Rockport	6/23/2021
SKAGIT6	PRM 60.8	City Light property in Van Horn	6/17/2021
SKAGIT7	PRM 54.5	City Light property at the Concrete-Sauk Valley Road bridge, at USGS gage 12194000	6/23/2021
SAUK1	Sauk River	RM 5.4, at USGS gage 12189500	6/23/2021

1 Thermographs have been deployed at additional sites (see Table 4.2.2-10); data for all locations will be reported in the USR and FLA.
2 New USGS gage installed in 2020; no official gage number has been assigned.

With one exception, thermographs deployed in September 2020 and June 2021 are operable. High flows and subsequent erosion in fall/winter 2021 dislodged the original and redeployed thermographs at SKAGIT5. The thermograph deployed at this location in July 2022, at a site just downstream of the original location, remains in place.

Table 4.2.2-44. Monthly minimum, mean, and maximum hourly water temperatures recorded at lower Skagit River and Sauk River monitoring sites (June 2021-May 2022).

Month	Site ID	Location	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
2021					
June	SKAGIT2	PRM 91.6	7.7	9.0	12.3
	SKAGIT3	PRM 85.9	7.8	9.3	12.5

Month	Site ID	Location	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
	SKAGIT4	PRM 75.6	7.2	9.7	13.3
	SKAGIT5	PRM 69.3	9.5	11.7	13.6
	SKAGIT6	PRM 60.8	9.0	11.3	13.8
	SKAGIT7	PRM 54.5	10.1	12.0	13.4
	SAUK1	Sauk River	9.0	11.7	14.5
July	SKAGIT2	PRM 91.6	9.6	10.7	12.2
	SKAGIT3	PRM 85.9	9.8	11.0	13.3
	SKAGIT4	PRM 75.6	10.2	11.8	14.6
	SKAGIT5	PRM 69.3	10.6	12.9	16.3
	SKAGIT6	PRM 60.8	10.7	13.7	13.8
	SKAGIT7	PRM 54.5	11.2	13.6	15.5
	SAUK1	Sauk River	10.4	13.8	16.4
August	SKAGIT2	PRM 91.6	10.6	11.5	12.7
	SKAGIT3	PRM 85.9	10.7	11.7	13.7
	SKAGIT4	PRM 75.6	10.5	12.5	15.4
	SKAGIT5	PRM 69.3	10.8	13.3	16.7
	SKAGIT6	PRM 60.8	11.7	14.6	18.9
	SKAGIT7	PRM 54.5	12.5	14.2	15.4
	SAUK1	Sauk River	11.2	14.9	17.2
September	SKAGIT2	PRM 91.6	9.9	10.6	11.7
	SKAGIT3	PRM 85.9	10.0	10.7	12.4
	SKAGIT4	PRM 75.6	9.7	11.5	14.8
	SKAGIT5	PRM 69.3	10.0	11.7	14.4
	SKAGIT6	PRM 60.8	10.3	12.8	19.3
	SKAGIT7	PRM 54.5	11.1	13.1	15.2
	SAUK1	Sauk River	9.7	12.9	17.3
October	SKAGIT2	PRM 91.6	8.1	9.7	10.3
	SKAGIT3	PRM 85.9	8.2	9.8	10.6
	SKAGIT4	PRM 75.6	8.0	9.6	11.6
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	7.3	9.4	12.0
	SKAGIT7	PRM 54.5	7.9	10.6	12.6
	SAUK1	Sauk River	5.4	8.7	12.5
November	SKAGIT2	PRM 91.6	6.5	8.2	9.4
	SKAGIT3	PRM 85.9	6.7	8.2	9.4
	SKAGIT4	PRM 75.6	6.5	8.0	9.2
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	6.5	7.4	8.8
	SKAGIT7	PRM 54.5	6.8	7.9	9.3
	SAUK1	Sauk River	4.5	6.7	8.4
December	SKAGIT2	PRM 91.6	3.8	5.6	7.4

Month	Site ID	Location	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
	SKAGIT3	PRM 85.9	3.4	5.5	7.5
	SKAGIT4	PRM 75.6	1.7	5.2	7.6
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	1.1	4.8	7.5
	SKAGIT7	PRM 54.5	1.7	5.6	8.2
	SAUK1	Sauk River	0.3	5.3	7.4
2022					
January	SKAGIT2	PRM 91.6	3.3	4.1	4.6
	SKAGIT3	PRM 85.9	2.8	4.0	4.6
	SKAGIT4	PRM 75.6	1.6	4.2	5.1
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	2.0	4.0	5.2
	SKAGIT7	PRM 54.5	2.5	4.2	5.3
	SAUK1	Sauk River	0.8	3.8	5.3
February	SKAGIT2	PRM 91.6	3.1	3.9	4.4
	SKAGIT3	PRM 85.9	3.0	4.0	4.6
	SKAGIT4	PRM 75.6	2.6	4.3	5.3
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	2.1	4.4	5.7
	SKAGIT7	PRM 54.5	3.3	4.6	5.5
	SAUK1	Sauk River	1.1	4.3	6.4
March	SKAGIT2	PRM 91.6	3.5	4.2	5.9
	SKAGIT3	PRM 85.9	3.4	4.3	6.3
	SKAGIT4	PRM 75.6	3.5	5.0	7.5
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	3.3	5.4	7.9
	SKAGIT7	PRM 54.5	4.3	5.6	7.2
	SAUK1	Sauk River	2.8	5.8	8.9
April	SKAGIT2	PRM 91.6	4.2	5.2	6.4
	SKAGIT3	PRM 85.9	4.1	5.3	7.0
	SKAGIT4	PRM 75.6	4.1	5.9	8.2
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	4.4	6.4	9.1
	SKAGIT7	PRM 54.5	5.4	6.6	8.0
	SAUK1	Sauk River	3.8	6.6	10.1
May	SKAGIT2	PRM 91.6	5.7	6.8	8.4
	SKAGIT3	PRM 85.9	5.8	6.6	8.0
	SKAGIT4	PRM 75.6	5.9	7.1	9.2
	SKAGIT5	PRM 69.3	-	-	-
	SKAGIT6	PRM 60.8	6.1	7.9	10.5
	SKAGIT7	PRM 54.5	7.0	7.7	8.5

Month	Site ID	Location	Min Water Temp (°C)	Mean Water Temp (°C)	Max Water Temp (°C)
	SAUK1	Sauk River	6.0	7.8	10.6

Source: Seattle City Light.

Thermographs are generally deployed at a depth of around 1 m (3.3 ft). However, river stage fluctuations occasionally exposed loggers to air, most notably at the PRM 75.6 site (SKAGIT4), which was dewatered from July 18, 2021 through August 22, 2021 (data reflecting air temperatures have been removed from computations in tables and figures reported herein). This site is located in a campground near a boat launch, and dewatering could have been the result of river stage fluctuation or members of the public pulling the thermograph from the water.

In 2021, the highest 30-minute water temperature recorded was 19.3°C at the PRM 60.8 site (SKAGIT6) on September 6, 2021. The highest 30-minute water temperature recorded between January and May 2022 was 10.6°C at the Sauk River site (SAUK1) on May 22, 2022.

Time series of 7-DADMax temperatures at Skagit River and Sauk River sites are shown in Figure 4.2.2-69, along with Ecology's applicable temperature criteria for this section of the Skagit River. The core summer salmonid habitat standard is 16°C and applies from June 15 to September 15. The supplemental spawning/incubation standard is 13°C and applies from September 16 to June 14. The highest 7-DADMax water temperature recorded during the monitoring period was 17.2°C (at SKAGIT6 [PRM 60.8] at the end of August 2021) (Table 4.2.2-45).

The 7-DADMax temperatures at the three sites initially deployed in 2020 (SKAGIT2, 3, and 4 [PRMs 91.6, 85.9, and 75.6, respectively]) were nearly identical from the end of September through February in both 2021 and 2022, after which temperatures began to diverge with distance downstream. Temperatures at the four downstream sites (added in June 2021) were warmer, with the greatest variability among sites occurring in late summer.

In the Skagit River between the Project and the Sauk River confluence, 7-DADMax water temperatures were below Ecology's relevant criteria throughout the 2021-2022 monitoring period (through May 2022) (Figure 4.2.2-69). Downstream of the Sauk River, temperatures above the core summer salmonid habitat criterion occurred only at the SKAGIT6 site (PRM 60.8), and temperatures exceeded the salmon and trout spawning criterion for only a short period at the SKAGIT7 site (PRM 54.5). The elevated 7-DADMax water temperatures recorded at SKAGIT6 are unique to this location and are not evident at the upstream and downstream sites, PRM 69.3 and 54.5, respectively. These elevated temperatures may reflect localized pooling caused by sediment deposition around the deployment site. As noted above, relocation of the SKAGIT6 thermograph is under evaluation.

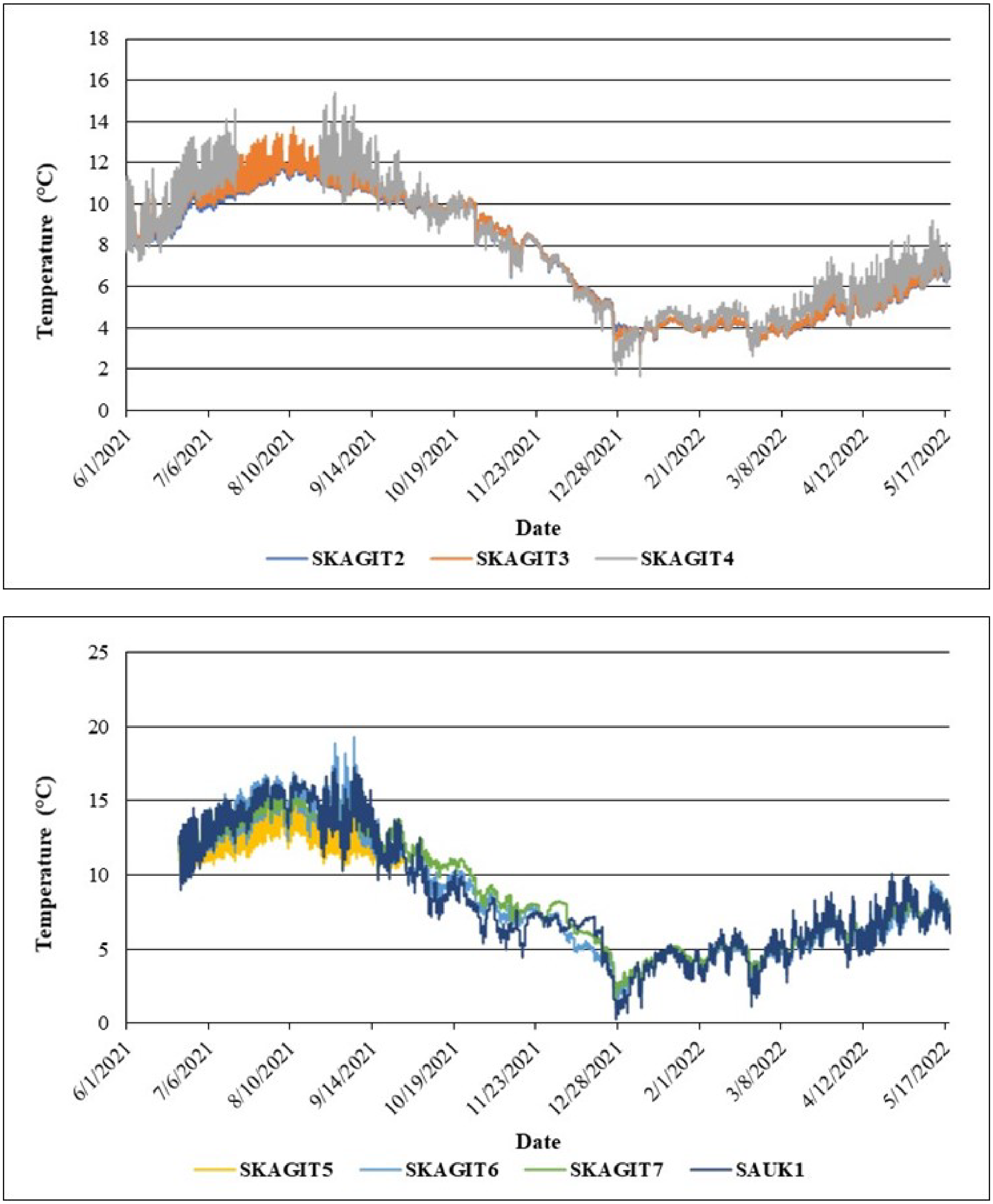
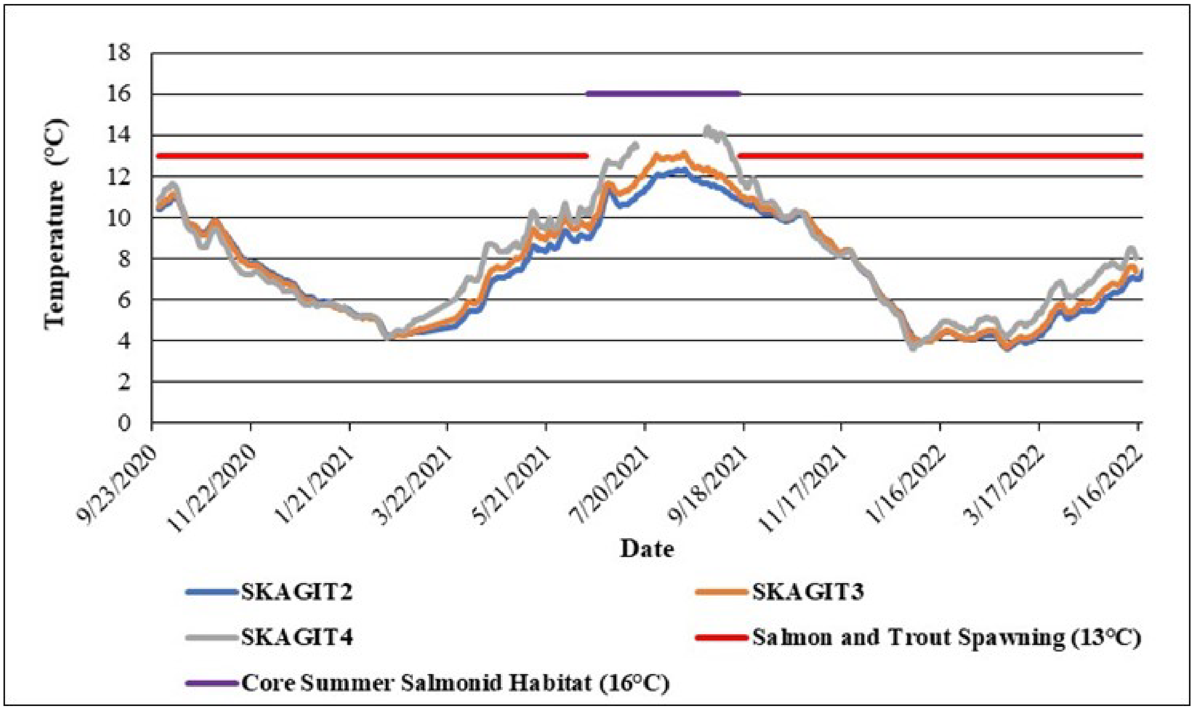


Figure 4.2.2-68. **30-minute water temperatures at Skagit River sites upstream of Marblemount (SKAGIT2-4), June 2021 through May 2022 (top) and sites downstream of Marblemount and the Sauk River (SKAGIT5-7, SAUK1), June 2021-May 2022.**



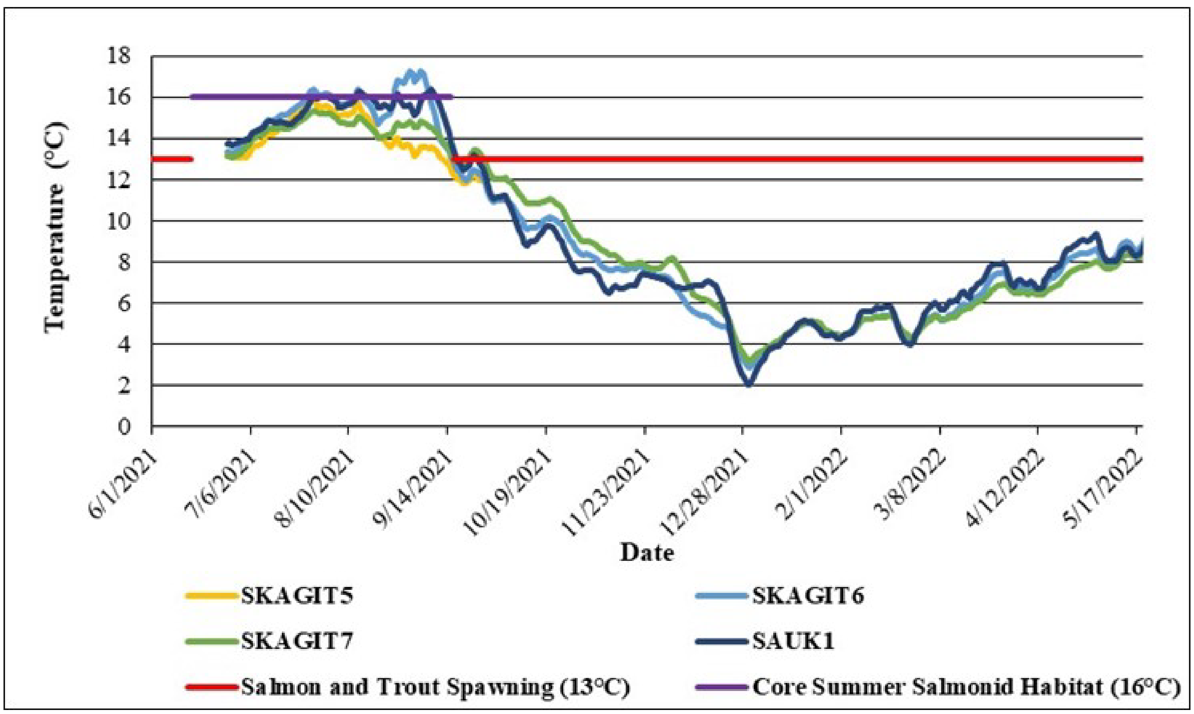


Figure 4.2.2-69. 7-DADMax water temperatures at Skagit River sites upstream from Marblemount (SKAGIT2-4), September 2020-May 2022 (top), 7-DADMax water temperatures at Skagit River sites from Marblemount to Concrete, and the Sauk River site (SKAGIT5-7, SAUK1), June 2021-May 2022. Horizontal lines show Ecology's applicable temperature criteria.

Table 4.2.2-45. The highest 7-DADMax water temperature recorded at each lower Skagit River site during the 2020-2022 monitoring period (see preceding figure).

Site ID	Location	Highest 7-DADMax Water Temperature Recorded (°C)	Date
SKAGIT2	PRM 91.6	12.34	8/12/21
SKAGIT3	PRM 85.9	13.15	8/12/21
SKAGIT4	PRM 75.6	14.36	8/27/21
SKAGIT5	PRM 69.3	16.0	7/27/21
SKAGIT6	PRM 60.8	17.2	8/31/21
SKAGIT7	PRM 54.5	15.4	7/28/21
SAUK1	Sauk River	16.4	9/8/21

Source: Seattle City Light.

To support development and calibration of the CE-QUAL-W2 water quality model, City Light deployed continuous monitoring instrumentation at three locations in the Skagit River: SKAGIT3, SKAGIT4, and SKAGIT7, located at PRMs 85.9, 75.6, and 54.5, respectively (see map in Appendix E of this Exhibit E), over a 3-week period in June 2022. Monitoring was conducted at 30-min intervals for temperature, DO (concentration/percent saturation), specific conductance, pH, and turbidity (results for each parameter are provided in the respective sections below). The June 2022 monitoring period was the first of three monitoring events scheduled for summer 2022 (see Table 4.2.2-10); results for subsequent monitoring periods will be provided in the USR and FLA. Instrumentation used for this monitoring was calibrated according to manufacturer's specifications. Deployment times for the June monitoring event are shown in Table 4.2.2-46.

Table 4.2.2-46. Continuous water quality monitoring locations and deployment times, June 2022.

Site	Project River Mile	Location	Start	End
SKAGIT3	PRM 85.9	Within North Cascades National Park at USGS gage[1]	6/2/2022 10:00	6/22/22 13:30
SKAGIT4	PRM 75.6	Skagit River downstream of Marblemount	6/2/2022 10:00	6/22/22 14:00
SKAGIT7	PRM 54.5	City Light property at the Concrete-Sauk Valley Road bridge, at USGS gage 12194000	6/2/2022 10:00	6/22/22 14:30

1 New USGS gage installed in 2020; no official gage number has been assigned.

Skagit River flows at Marblemount during the first week of the June 2022 continuous monitoring period ranged from 7,000-10,000 cfs, increasing rapidly to 16,000 cfs on June 10. Flows during the second week of monitoring dropped steadily to near 6,000 cfs on June 16, and were variable over the final five days (between about 5,500-8,000 cfs). A similar pattern was seen at the USGS Newhalem gage, including sharp increases on June 8 and 10 (to about 6,000 and 7,000 cfs, respectively) (Figure 4.2.2-70). Spill at Gorge Dam was not a factor during the monitoring period, with a few short-term events on June 6 of less than 1,000 cfs.

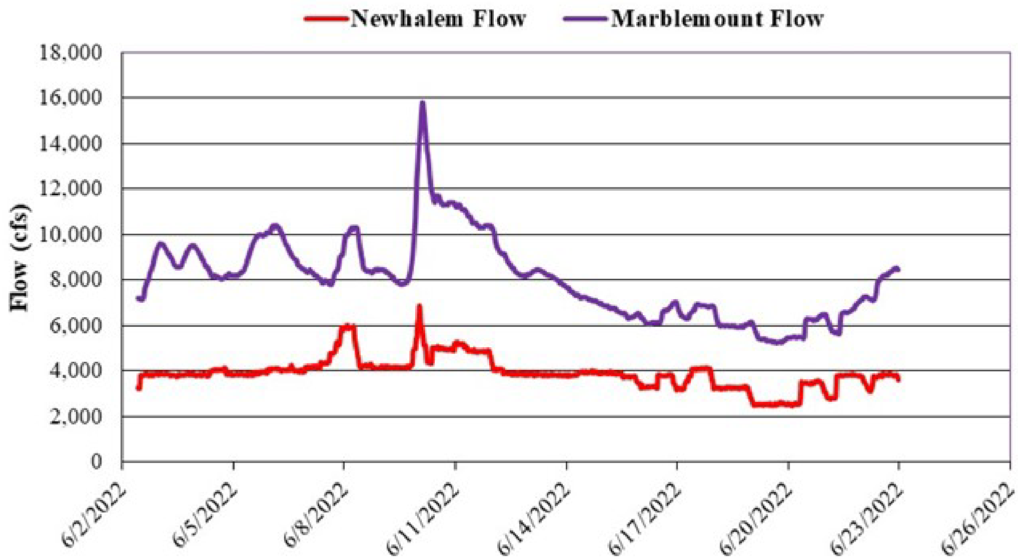


Figure 4.2.2-70. Flow in the Skagit River at Newhalem and Marblemount USGS gages, June 2-22, 2022. Source: USGS.

Water temperatures at SKAGIT3, the uppermost of the three sites and within North Cascades National Park, were cooler and often exhibited smaller diel fluctuation (daily ranges) than temperatures at the other two sites. Median temperatures over the period were warmest at SKAGIT4 (median of 8.9°C) and coolest at SKAGIT3 (7.9°C) (Figures 4.2.2-71 and 4.2.2-72).

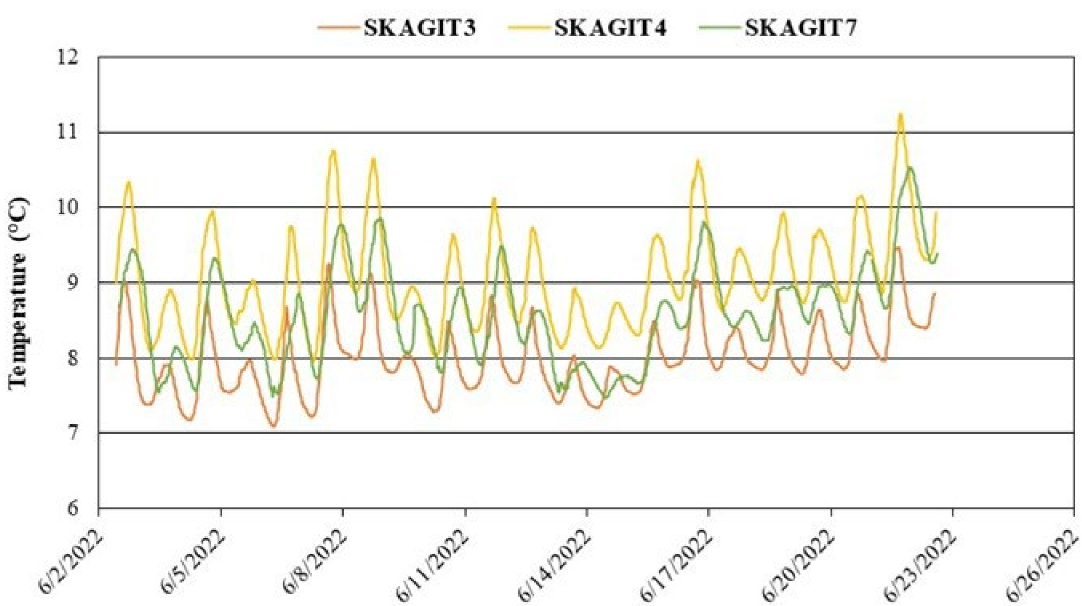


Figure 4.2.2-71. Continuously measured water temperature (°C) at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

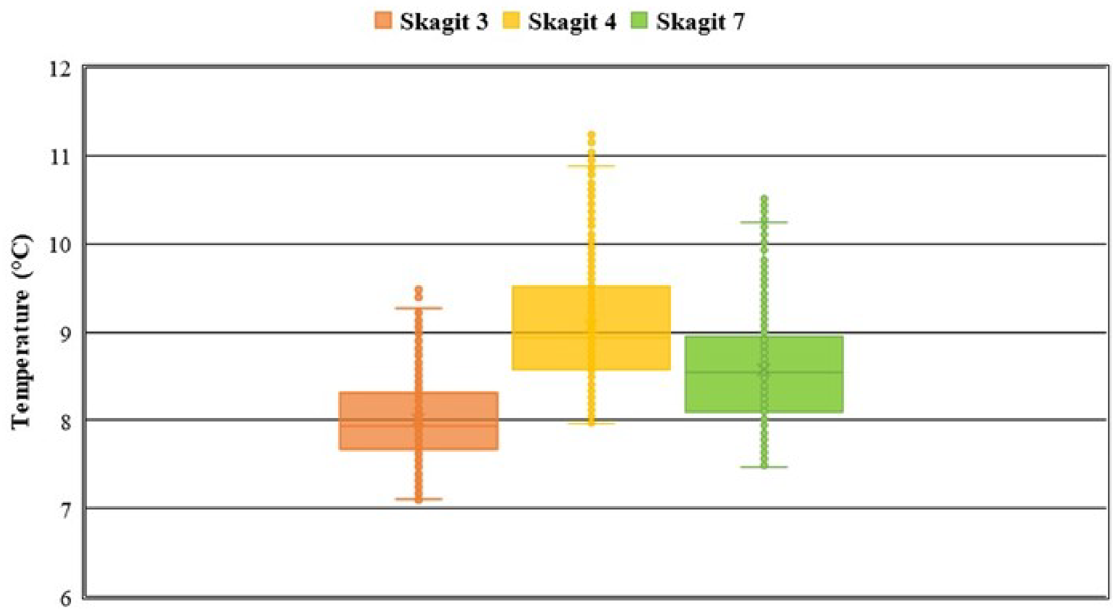


Figure 4.2.2-72. Box-and-whisker plot showing water temperature (°C) at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

<u>DO and pH in the Skagit River below the Project</u>

Monthly averages of DO concentrations in the Skagit River at Marblemount (PRM 78.5), based on data collected by Ecology, ranged from 10.8 mg/L (August) to 12.8 mg/L (March) for the period 2009-2022 (Table 4.2.2-47). The lowest measured value in Ecology's dataset is 9.8 mg/L, measured on August 19, 2009. The next lowest value was 10.0 mg/L, measured on August 19, 2014.

As noted above, to support development and calibration of the CE-QUAL-W2 water quality model, City Light deployed continuous monitoring instrumentation at three locations in the Skagit River: SKAGIT3, SKAGIT4, and SKAGIT7, at PRMs 85.9, 75.6, and 54.5, respectively (see map in Appendix E of this Exhibit E), over a 3-week period in June 2022 (see Table 4.2.2-46).

DO concentrations at SKAGIT3, SKAGIT4, and SKAGIT7 ranged from 11 to 13 mg/L over the June 2022 monitoring period (Figure 4.2.2-73 and 4.2.2-74), with saturation generally between 100 and 105 percent (Figure 4.2.2-75). Similar to the pattern seen for temperature, DO concentrations at SKAGIT3 exhibited a tighter range, between about 12.0 and 12.6 mg/L, than that seen at the other two sites. Median DO concentrations were 12.3, 11.8, and 12.2 mg/L at SKAGIT3, SKAGIT4, and SKAGIT7, respectively. Maximum DO concentrations generally occurred during the afternoon at SKAGIT3 and SKAGIT4, suggesting an influence of primary production. However, the DO pattern at SKAGIT7 differed: values were generally highest at night, possibly due to tributary influences, including flows from the Baker River.

Table 4.2.2-47. Results of monthly water quality measurements made by Ecology in the Skagit River at Marblemount, 2009-2022 (except alkalinity, which was only measured during 2014-2020). 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	12.5 (±0.4)	7.4 (±0.1)	1.9 (±2.4)	0.01 (N/A)	0.008 (±0.004)	1.4 (±1.1)	62 (±7.5)	26.6 (N/A)
February	12.7 (±0.5)	7.4 (±0.1)	1.2 (±1.3)	0.01 (N/A)	0.007 (±0.002)	1.6 (±1.4)	64 (±4.7)	22.2 (N/A)
March	12.8 (±0.4)	7.5 (±0.2)	0.9 (±0.8)	0.01 (N/A)	0.007 (±0.002)	1.3 (±1.1)	65 (±6.2)	28.8 N/A)
April	12.5 (±0.3)	7.4 (±0.1)	0.7 (±0.4)	0.01 (N/A)	0.006 (±0.002)	1.3 (±0.7)	60 (±7.3)	25.4 (N/A)
May	12.0 (±0.5)	7.3 (±0.2)	1.3 (±0.6)	0.01 (N/A)	0.006 (±0.001)	2.2 (±2.1)	46 (±7.5)	17.1 (N/A)
June	11.6 (±0.6)	7.4 (±0.1)	2.0 (±1.1)	0.01 (N/A)	0.008 (±0.004)	3.0 (±2.2)	42 (±4.7)	13.8 (N/A)
July	11.1 (±0.3)	7.4 (±0.1)	1.6 (±1.0)	0.01 (N/A)	0.007 (±0.002)	3.1 (±3.8)	44 (±3.5)	16.3 (±1.3)
August	10.8 (±0.5)	7.4 (±0.2)	1.0 (±0.3)	0.01 (N/A)	0.007 (±0.002)	2.9 (±3.2)	48 (±2.7)	19.4 (N/A)
September	11.1 (±0.3)	7.3 (±0.2)	2.0 (±1.3)	0.02 (±0.04)	0.008 (±0.003)	5.6 (±5.8)	48 (±8.1)	20.2 (N/A)
October	11.1 (±0.5)	7.4 (±0.3)	2.6 (±2.1)	0.02 (±0.02)	0.014 (±0.015)	4.5 (±2.9)	50 (±7.5)	16.4 (±2.2)
November	11.5 (±0.7)	7.4 (±0.2)	5.5 (±7.1)	0.01 (<0.01)	0.014 (±0.010)	5.8 (±9.1)	45 (±8.7)	14.5 (±4.4)
December	12.0 (±0.4)	7.4 (±0.2)	9.1 (±18.7)	0.01 (<0.01)	0.020 (±0.034)	2.2 (±1.8)	54 (±9.5)	17.4 (N/A)

Source: Ecology 2022.

1 No dissolved oxygen data were reported for November 2013, July 2018, April – July 2020, September 2020, December 2021, and April – August 2022; 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, April – June 2020, September 2020, December 2021, and April – August 2022.

3 No data were reported for December 2013, April – June 2020, September 2020, December 2021, and April – August 2022; 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 N/A = 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." No data were reported for April – June 2020, September 2020, and April – August 2022.

5 No data were reported for January 2012, May 2016, October 2018, April – June 2020, September 2020, December 2021, and April – August 2022; 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, October 2018, April – June 2020, September 2020, December 2021, and April – August 2022; the result from September 7, 2021, i.e., 110/100 mL appeared to be an outlier and was not included when computing the average or SD.

7 No data were reported for January 2014, February 2015, April – June 2020, September 2020, December 2021, April – August 2022.

8 Data were only reported for October – December 2014, January – November 2015, October – December 2017, January – September 2018, July 2020; N/A = no SD was computed for months with only two measurements.

Note: µmhos/cm = micromhos per centimeter.

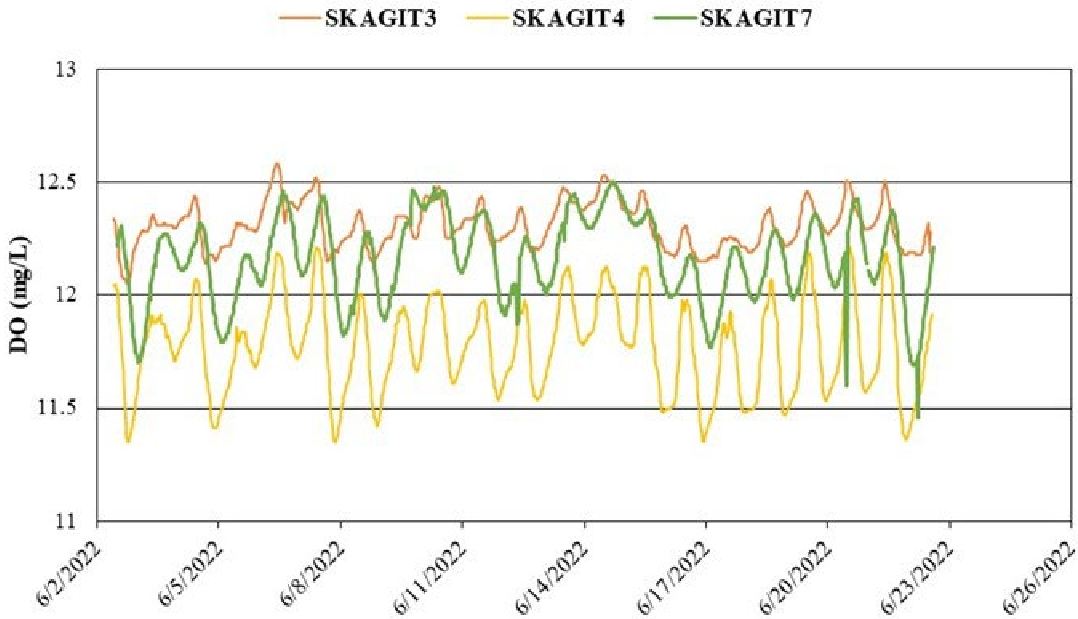


Figure 4.2.2-73. Continuously measured DO (mg/L) at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

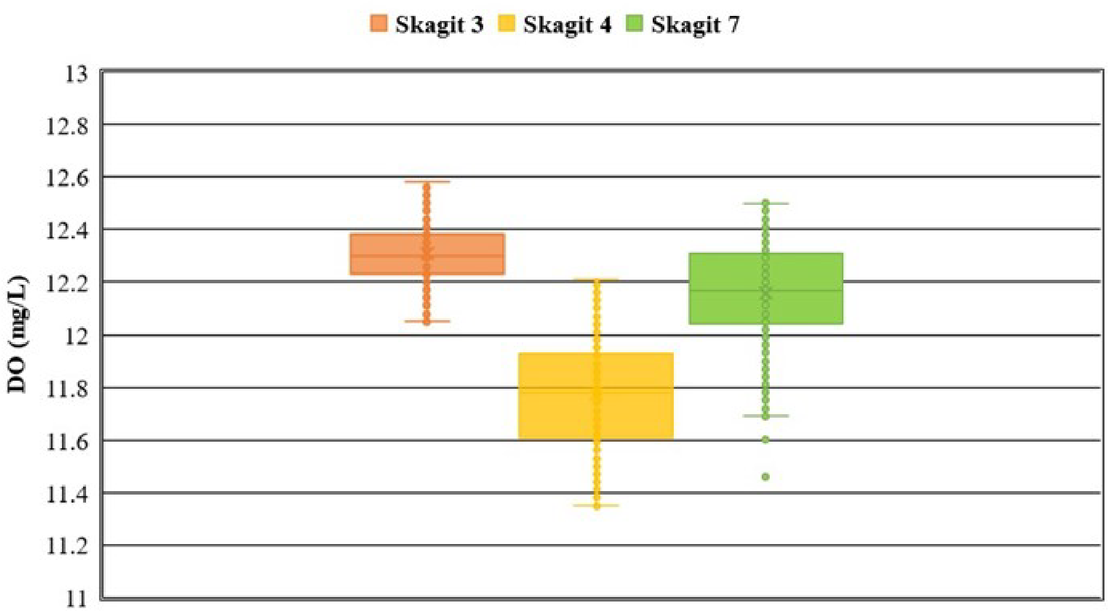


Figure 4.2.2-74. Box-and-whisker plot showing DO (mg/L) at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

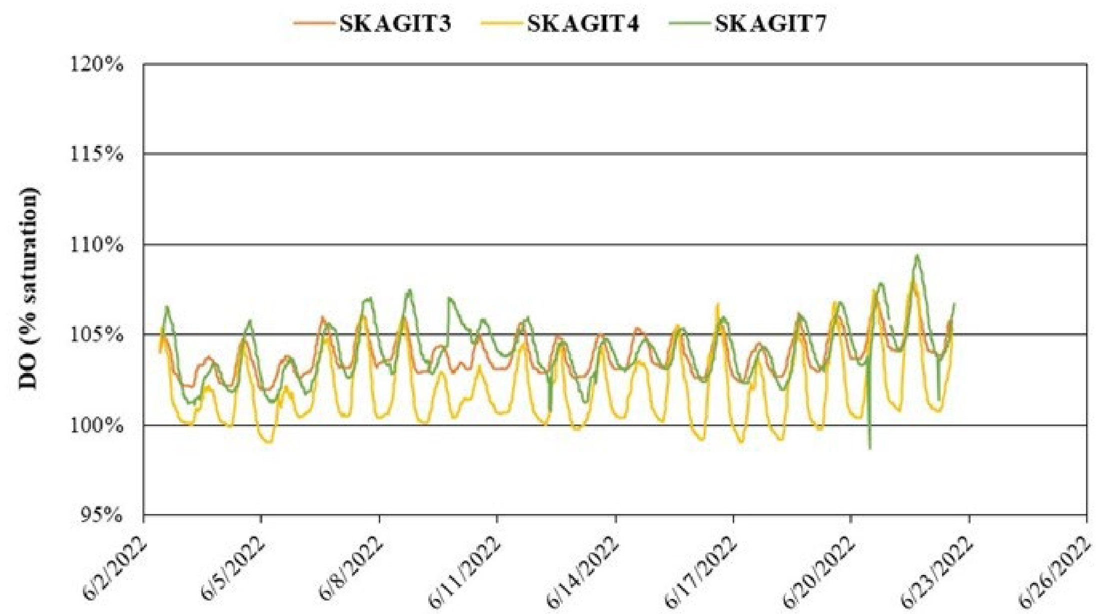


Figure 4.2.2-75. Continuously measured DO (percent saturation) at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

Monthly pH values measured at Marblemount for the period 2009-2022 were near neutral, ranging from 7.3-7.5 (Table 4.2.2-47); pH was highly consistent within months and throughout each year.

Values of pH at SKAGIT3, SKAGIT4, and SKAGIT7 ranged from 7.0 to 7.5 mg/L over the June 2022 monitoring period, with diel changes most pronounced at SKAGIT4 (Figures 4.2.2-76 and 4.2.2-77). As noted for DO, pH values were highest during the afternoon at SKAGIT3 and SKAGIT4, suggesting an influence of primary production at these sites. Also, similar to the pattern seen for DO, maximum pH at SKAGIT7 occurred at night, a pattern to be further evaluated in the USR, following the July and August continuous monitoring events.

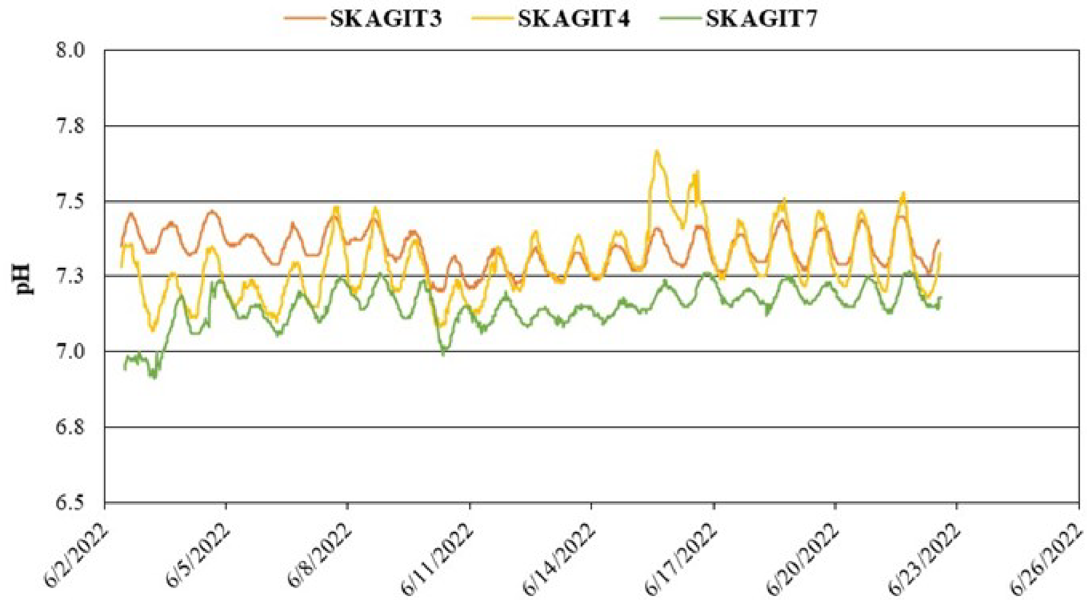


Figure 4.2.2-76. Continuously measured pH at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

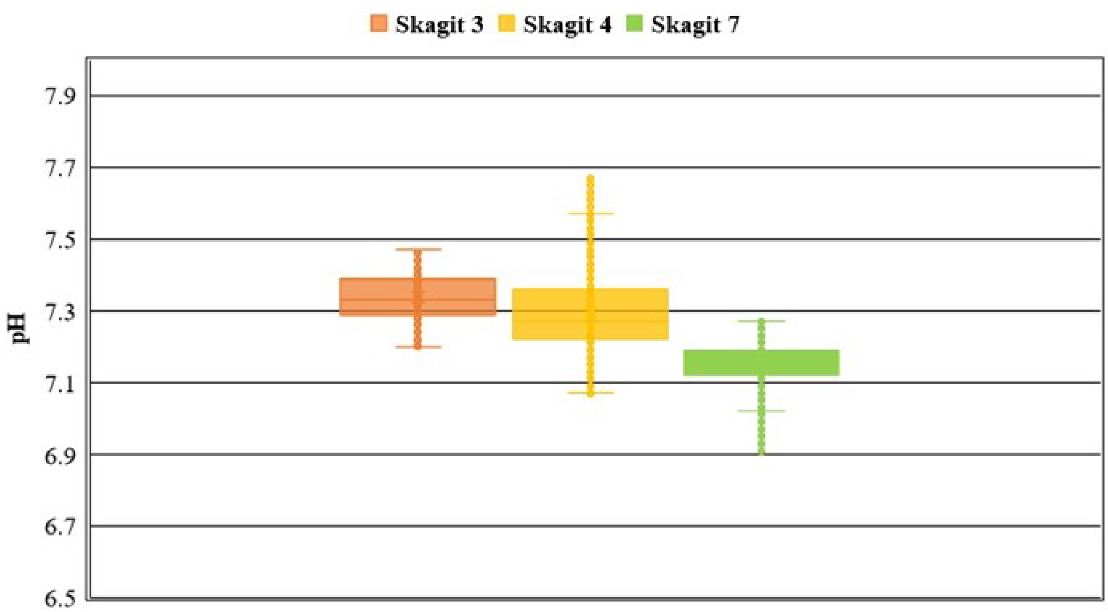


Figure 4.2.2-77. Box-and-whisker plot showing pH at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

TDG in the Skagit River below the Project

On October 26, 2021, opportunistic TDG monitoring[35] in response to spill was conducted at the Ladder Creek Falls bridge (LADDER1), the suspension bridge to Trail of the Cedars (CEDARS1), and the bridge at Newhalem Campground (NEWCG1). Beginning on October 25, 2021, and extending through October 31, 2021, City Light conducted a planned operational spill to evacuate water out of Ross Lake to achieve a safer margin between the reservoir's elevation and the flood control curve. The target flow at Newhalem during this period was 9,000 cfs. Assuming maximum discharge through the generators at Gorge Powerhouse, planned spill at Gorge Dam over this period was 2,000 cfs.

Start and end times and Skagit River flows at the USGS Newhalem gage during the TDG monitoring periods are shown in Table 4.2.2-48. Skagit River flow (Gorge Powerhouse generation and spill combined), and spill at Gorge Dam remained constant at approximately 8,500 cfs and 2,000 cfs, respectively.

TDG at all three bridge sites remained at or near 105 percent saturation throughout the monitoring period (Figure 4.2.2-78). Hydrolab datasondes recording TDG data in the Gorge bypass reach could not be accessed at the time due to a combination of high flows, landslides, and road closures. As noted above, these units were displaced due to flood flows and not recovered.

Table 4.2.2-48. Locations, times, and Skagit River flows at the USGS Newhalem Gage during total dissolved gas monitoring (October 26, 2021).

Site ID	Start Time	End Time	Flow at Newhalem (cfs)
LADDER1	09:00	11:00	8,580 – 8,640
CEDARS1	11:30	13:30	8,610 – 8,530
NEWCG1	14:00	16:00	8,560 – 8,610

Source: Seattle City Light.

TDG was also measured at the three bridges on November 6, 2021 during normal operations at Gorge Powerhouse. TDG at all three sites remained between 102 and 104 percent saturation during this event (10:00 to 14:30). Flows recorded at the USGS Newhalem gage (Gage 12178000) during the monitoring period were between 4,500 and 4,600 cfs.

[35] Opportunistic TDG monitoring is conducted over 2-hour periods at 2-minute intervals at each site, at a depth of approximately 2 m (6.6 ft). Monitoring is conducted using a calibrated Hydrolab® DS-5 datasonde.

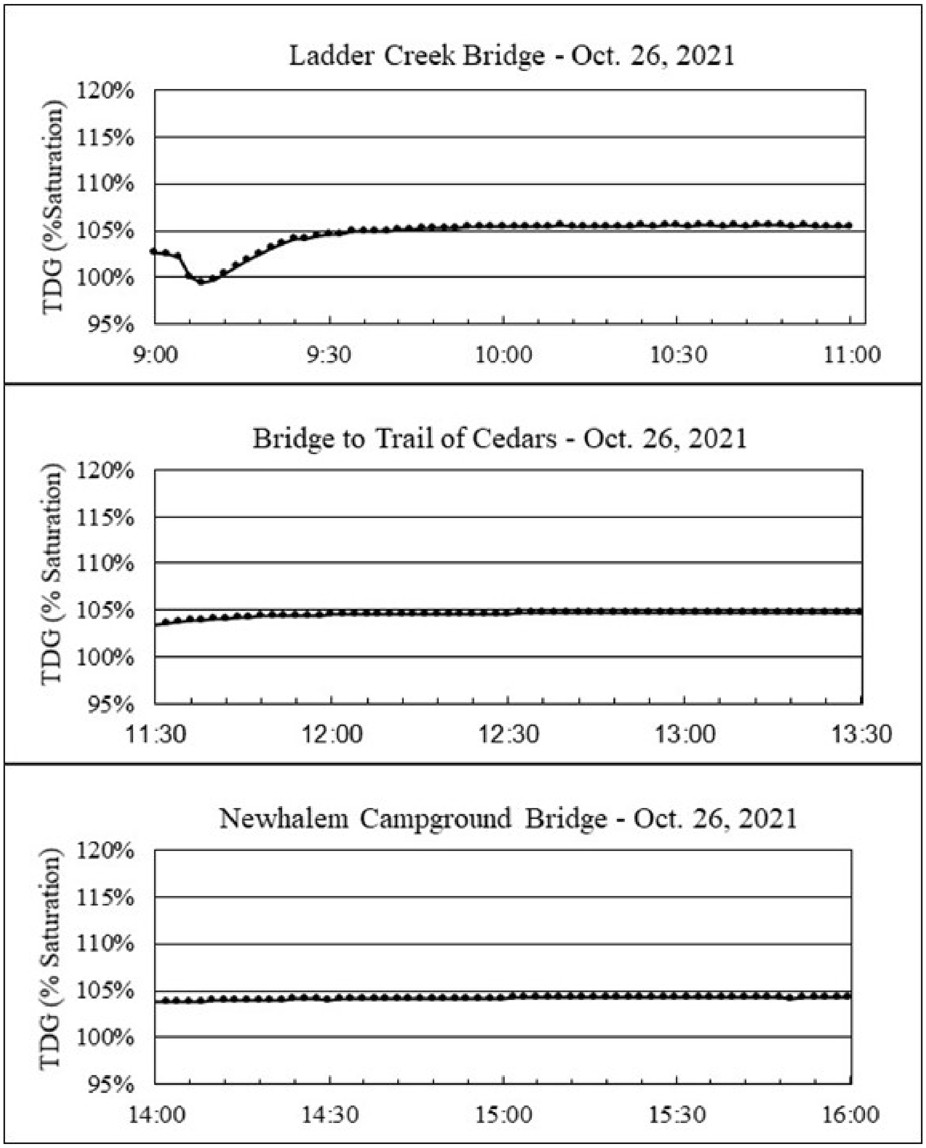


Figure 4.2.2-78. Total dissolved gas measured at three bridges downstream of Gorge Powerhouse during planned spill (October 26, 2021). Source: Seattle City Light.

TDG was again measured at bridges during spill on July 5, 2022. Because of the loss or damage of the Hydrolab datasondes in the Gorge bypass reach during fall 2021 spill events, including the datasonde at the Gorge Dam plunge pool (BYPASS1), City Light added the Gorge Dam access bridge near the upstream end of the bypass reach as a location for opportunistic TDG sampling during spill. Other sites monitored on July 5, 2022 included the Gorge Powerhouse access bridge, Ladder Creek bridge, and the bridge to Trail of the Cedars. The latter two were also monitored in 2021, and the Gorge Powerhouse access bridge was added to measure TDG closer to the downstream end of the bypass reach. Spill at Gorge Dam on July 5 averaged 5,400 cfs and was fairly constant throughout the day.

TDG monitoring results for July 5, 2022 are shown in Figure 4.2.2-79. Levels were highest at the Gorge Dam access bridge, the upstream site in the bypass reach, where TDG remained between

110 and 115 percent saturation for most of the monitoring period. TDG remained close to but less than 110 percent at the three downstream bridges.

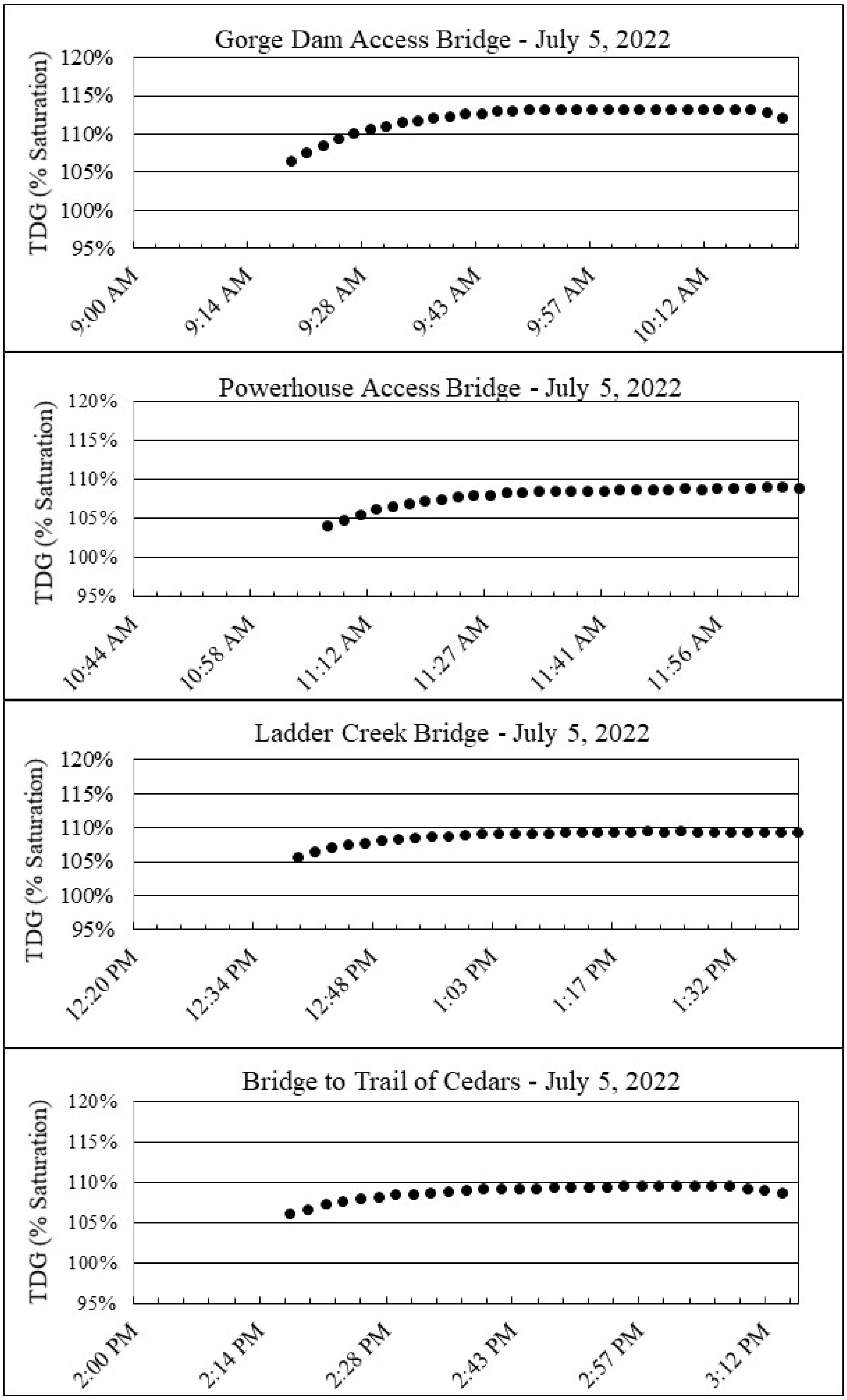


Figure 4.2.2-79. Total dissolved gas measured at the Gorge Dam access bridge (in the Gorge bypass reach) and three bridges downstream of Gorge Powerhouse during planned spill (July 5, 2022). Source: Seattle City Light.

Turbidity/TSS in the Skagit River below the Project

Average monthly turbidity values measured from 2009-2022 by Ecology at Marblemount (Table 4.2.2-47) were very low from January-October (average monthly values ranged from 0.7-2.6 NTU). Values for November and December were slightly higher, although still relatively low (5.5-9.1 NTU), reflecting isolated spikes in turbidity associated with high-flow events. The highest turbidity values, 28 NTU, 60 NTU, and 25 NTU, were recorded on December 11, 2014; December 9, 2015; and November 29, 2017, respectively. These elevated turbidity levels were correlated with high flows that occurred before and during the time when the turbidity measurements were made. Maximum daily flows for the months during which elevated turbidity levels were observed are shown in Table 4.2.2-49. Precipitation totals for the Town of Concrete are provided in Table 4.2.2-50 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 about 23 miles downstream of Marblemount, and precipitation totals likely differ at the two locations, the general precipitation patterns should be similar.

Table 4.2.2-49. Maximum daily flows (cfs) measured at the USGS gage at Marblemount, WA (USGS 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 4.2.2-50. 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
12/10/14	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.

As noted above, to support development and calibration of the CE-QUAL-W2 water quality model, City Light deployed continuous monitoring instrumentation at three locations in the Skagit River: SKAGIT3, SKAGIT4, and SKAGIT7, at PRMs 85.9, 75.6, and 54.5, respectively (see map in Appendix E of this Exhibit E), over a 3-week period in June 2022 (see Table 4.2.2-46).

Turbidity values at SKAGIT3, SKAGIT4, and SKAGIT7 during the June 2022 monitoring period are shown in Figure 4.2.2-80. Baseline turbidity, i.e., during periods apparently unaffected by changes in Skagit River flows, was between 0-20 NTUs. However, spikes in turbidity were common at all three sites, to over 100 NTUs, notably from June 8-10, indicating that turbidity at the three monitoring sites is affected by Skagit River flows, as seen in Figure 4.2.2-80 (as noted, spill volumes released at Gorge Dam during the June 2022 monitoring period were relatively small).

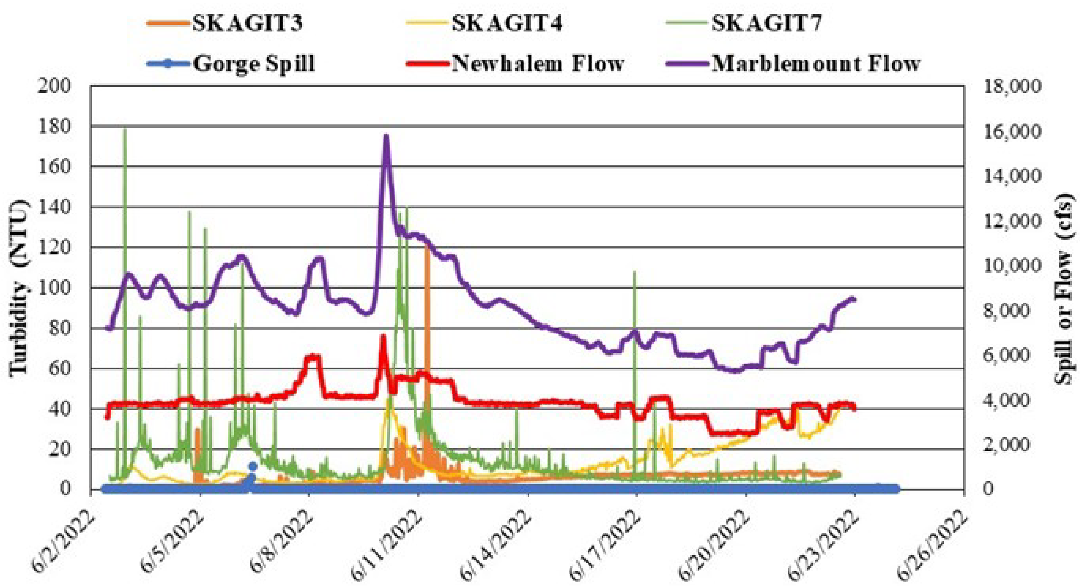


Figure 4.2.2-80. Turbidity (NTU) measured continuously at three locations (SKAGIT3 [PRM 85.9], SKAGIT4 [PRM 75.6], and SKAGIT7 [PRM 54.5]) in the Skagit River, June 2-22, 2022. Source: Seattle City Light.

Turbidity grab samples collected longitudinally in the Skagit River downstream of the Project during May and June 2022 are shown in Table 4.2.2-51 (see Table 4.2.2-10 and Appendix E of this Exhibit E for site locations). Turbidity at mainstem Skagit River sites SKAGIT3, 4, and 5 was less than 3 NTUs in both months, while turbidity at the farthest downstream site, SKAGIT7, was 5 and 7.2 NTUs in May and June, respectively, but still indicative of clear water.

Table 4.2.2-51. Turbidity (NTU) grab samples collected in the Skagit River downstream of the Project in May and June 2022.

Date	Turbidity (NTU)			
	SKAGIT3	SKAGIT4	SKAGIT5	SKAGIT7
5/17/22	0.91	1.2	1.2	5.0
6/8/22	1.50	2.2	2.5	7.2

Turbidity values in Skagit River tributaries downstream of the Project, i.e., Newhalem Creek, and the Sauk and Baker rivers, are shown in Table 4.2.2-52 (see Table 4.2.2-10 and Appendix E of this Exhibit E for site locations). Turbidity values in Newhalem Creek were less than 2 NTUs in both May and June. The highest, although still low, turbidity levels observed during the May-June 2022 grab sampling events were in the Baker River (BAKER1) in May (9.1 NTUs) and the Sauk River (SAUK1) in June (9 NTUs).

Table 4.2.2-52. Turbidity (NTU) grab samples collected in tributaries to the Skagit River downstream of the Project in May and June 2022.

Date	Turbidity (NTU)			
	Newhalem Creek (NEWCG)	Cascade River (CASC1)	Sauk River (SAUK1)	Baker River (BAKER1)
5/17/22	0.49	1.3	2.4	9.1
6/8/22	0.91	4.5	9.0	3.9

<u>Nutrients and Productivity in the Skagit River below the Project</u>

Results of monthly ammonia and total phosphorous measurements made by Ecology in the Skagit River at Marblemount, 2009–2022 are presented in Table 4.2.2-47. For the overwhelming majority of the measurements, 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.

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling at locations in the Skagit River and at the mouths of select tributaries downstream of the Project. Parameters selected, and the sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model.

Levels of nitrogen and phosphorus in the Skagit River and its tributaries during May and June 2022 were very low, mostly below the method detection limit, with no concentrations exceeding 0.21 mg/L (Table 4.2.2-53 and Table 4.2.2-54, respectively). Overall, the observed low nutrient levels are consistent with previous monitoring results, which indicate that the Skagit River and its tributaries are oligotrophic systems.

Table 4.2.2-53. Nitrogen, phosphorus, and alkalinity sampling results for the Skagit River downstream of the Project, May-June 2022.

Date	Site ID	Site Name	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/17/2022	SKAGIT3	Skagit 3 (PRM 85.6)	ND	0.06	ND	ND	ND	20.7
	SKAGIT4	Skagit 4 (PRM 75.6)	ND	0.06	ND	ND	ND	19
	SKAGIT5	Skagit 5 (PRM 69.3)	ND (ND)	0.06 (0.06)	ND (ND)	ND (ND)	ND (ND)	19.4 (19.4)
	SKAGIT7	Skagit 7 (PRM 54.5)	ND	0.05	ND	ND	ND	18.1
6/8/2022	SKAGIT3	Skagit 3 (PRM 85.6)	ND	0.06	0.21	ND	0.011	14.2
	SKAGIT4	Skagit 4 (PRM 75.6)	ND	0.05	ND	ND	ND	12.3
	SKAGIT5	Skagit 5 (PRM 69.3)	ND	0.05	ND	ND	ND	13.6
	SKAGIT7	Skagit 7 (PRM 54.5)	ND	0.04	ND	ND	0.019	13.5

Source: Seattle City Light.
Notes:
NH_3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (NH3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01/mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.
SKAGIT3 = road mile 113; SKAGIT4 = Glacier Peak; SKAGIT5 = Howard Miller Steelhead Park; SKAGIT7 = Concrete.

Table 4.2.2-54. Nitrogen, phosphorus, and alkalinity sampling results for the mouths of select tributaries to the Skagit River downstream of the Project, May-June 2022.

Date	Site ID	Site Name	NH_3-N (mg/L)	NO_x (mg/L)	TKN (mg/L)	PO_4^{-3} (mg/L)	TP (mg/L)	Alkalinity (mg $CaCO_3$/L)
5/17/2022	NEWCG	Newhalem Creek	ND	0.09	0.13	ND	ND	6.9
	CASC1	Cascade River 1	ND	0.08	ND	ND	ND	15.4
	SAUK1	Sauk River	ND	0.03	ND	ND	ND	16.7
	BAKER1	Baker River	ND	0.06	ND	0.01	ND	20.7
6/8/2022	NEWCG	Newton	ND	0.04	ND	ND	ND	4.8
	CASC1	Cascade 1	ND	0.05	ND	ND	ND	10.4
	SAUK1	Sauk River	ND	0.02	ND	ND	0.019	12
	BAKER1	Baker River	ND (ND)	0.04 (0.04)	ND (ND)	ND (ND)	0.018 (ND)	15.9 (15.7)

Source: Seattle City Light.
Notes:
NH_3-N = ammonia-N; NO_x = total nitrate+nitrite as N; TKN = total Kjeldahl nitrogen as N; PO_4^{-3} = orthophosphate; TP = total phosphorus.
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (NH3-N = 0.01 mg/L; TKN = 0.2 mg/L; PO_4^{-3} = 0.01 mg/L; TP = 0.01/mg/L) are reported as ND.
Field duplicate results are shown in parenthesis.
NEWCG = Newhalem Creek below bridge near Rock Shelter Trail; CASC1 = Cascade River at Wagon Wheel Campground; SAUK1 = Sauk River USGS gage; BAKER1 = Baker River at WDFW access site.

Levels of carbon in the Skagit River and its tributaries downstream of the Project during May and June 2022 are shown in Table 4.2.2-55 and Table 4.2.2-56, respectively. Organic carbon concentrations (dissolved and particulate) were low (≤ 1.2 mg/L), consistent with the low productivity within the system.

Table 4.2.2-55. Results of carbon sampling for the Skagit River downstream of the Project, May-June 2022.

Date	Site ID	Site Name	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/17/2022	SKAGIT3	Skagit 3 (PRM 85.6)	1	0.84	0.86	5.1
	SKAGIT4	Skagit 4 (PRM 75.6)	-	-	-	-
	SKAGIT5	Skagit 5 (PRM 69.3)	1	0.82	0.87	4.53
	SKAGIT7	Skagit 7 (PRM 54.5)	1 (1)	0.80 (0.85)	0.84 (0.86)	4.64 (4.62)
6/8/2022	SKAGIT3	Skagit 3 (PRM 85.6)	1	0.92	0.88	4.44
	SKAGIT4	Skagit 4 (PRM 75.6)	1	0.88	0.86	-
	SKAGIT5	Skagit 5 (PRM 69.3)	-	-	-	-
	SKAGIT7	Skagit 7 (PRM 54.5)	1	0.84	0.9	-

Source: Seattle City Light.
Notes:
CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.
All samples were collected at depths of < 1 m.
Field duplicate results are shown in parenthesis.
SKAGIT3 = road mile 113; SKAGIT4 = Glacier Peak; SKAGIT5 = Howard Miller Steelhead Park; SKAGIT7 = Concrete.

Concentrations of chlorophyll-*a* and pheophyton-*a* (indices of primary productivity) in the Skagit River and mouths of select tributaries downstream of the Project during May and June 2022 are shown in Table 4.2.2-57 and Table 4.2.2-58, respectively. Chlorophyll-*a* and pheophyton-*a* results consisted of non-detects in the Skagit River, Newhalem Creek, and the Cascade River. In May 2022, chlorophyll-*a* was detected in the Sauk River (1.79 mg/m^3), and pheophyton-*a* was detected in the Baker River (2.60 mg/m^3). Overall, productivity was low in the Skagit River and its tributaries, which is consistent with previous findings.

Table 4.2.2-56. Results of carbon sampling for the mouths of select tributaries to the Skagit River downstream of the Project, May-June 2022.

Date	Site ID	Site Name	CBOD (mg/L)	DOC (mg/L)	TOC (mg/L)	TIC (mg/L)
5/17/2022	NEWCG	Newhalem Creek	1	1.09	1.06	1.69
	CASC1	Cascade River 1	1	0.83	0.86	3.51
	SAUK1	Sauk River	4	0.79	0.86	3.95
	BAKER1	Baker River	1	0.82	1.17	5.08
6/8/2022	NEWCG	Newton	2	1.02	1	-
	CASC1	Cascade 1	1	0.78	0.81	-
	SAUK1	Sauk River	1	0.81	0.88	-
	BAKER1	Baker River	1 (1)	0.75 (0.82)	0.83 (0.80)	-

Source: Seattle City Light.
Notes:
CBOD = carbonaceous biological oxygen demand; DOC = dissolved organic carbon; TOC = total organic carbon; TIC = total inorganic carbon.
All samples were collected at depths of < 1 m.
Field duplicate results are shown in parenthesis.
NEWCG = Newhalem Creek below bridge near Rock Shelter Trail; CASC1 = Cascade River at Wagon Wheel Campground; SAUK1 = Sauk River USGS gage; BAKER1 = Baker River at WDFW access site.

Table 4.2.2-57. Results of chlorophyll-*a* and pheophyton-*a* sampling for the Skagit River downstream of the Project, May-June 2022.

Date	Site ID	Site Name	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/17/2022	SKAGIT3	Skagit 3 (PRM 85.6)	ND	ND
	SKAGIT5	Skagit 5 (PRM 69.3)	ND	ND
	SKAGIT7	Skagit 7 (PRM 54.5)	ND (ND)	ND (ND)
6/8/2022	SKAGIT3	Skagit 3 (PRM 85.6)	ND	ND

Source: Seattle City Light.
Notes:
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.
Field duplicate results are shown in parenthesis.
SKAGIT3 = road mile 113; SKAGIT4 = Glacier Peak; SKAGIT5 = Howard Miller Steelhead Park; SKAGIT7 = Concrete.

Table 4.2.2-58. Results of chlorophyll-*a* and pheophyton-*a* sampling for the mouths of select tributaries to the Skagit River downstream of the Project, May 2022.

Date	Site ID	Site Name	Chlorophyll-*a* (mg/m^3)	Pheophyton-*a* (mg/m^3)
5/17/2022	NEWCG	Newhalem Creek	ND	ND
	CASC1	Cascade River 1	ND	ND
	SAUK1	Sauk River	1.79	ND
	BAKER1	Baker River	ND	2.60

Source: Seattle City Light.
Notes:
All samples were collected at depths of < 1 m.
Samples measured below the method reporting limit (Chlorophyll-*a* = 0.1 mg/m^3; Pheophyton-*a* = 0.1 mg/m^3) are reported as ND.
Chlorophyll-*a* and pheophytin-*a* samples from June 2022 were still being analyzed by the laboratory as of 08/03/2022.
Field duplicate results are shown in parenthesis.
NEWCG = Newhalem Creek below bridge near Rock Shelter Trail; CASC1 = Cascade River at Wagon Wheel Campground; SAUK1 = Sauk River USGS gage; BAKER1 = Baker River at WDFW access site.

Benthic Macroinvertebrates and Drift in the Skagit River below the Project

Provided below are the results of BMI sampling conducted in August 2021 (at sites identified in the RSP) and May 2022 at a subset of the locations identified in City Light's expanded water quality monitoring scope (described previously), i.e., the samples that could be processed by the analytical laboratory in time for inclusion in this Exhibit E. Additional BMI sampling results, and results of invertebrate drift sampling, will be provided in the USR and FLA.

In August 2021, BMI sampling was conducted near each of the six continuous temperature monitoring sites in the Skagit River downstream of Gorge Powerhouse and one site in the lower Sauk River (see Table 4.2.2-43). BMI sampling locations were selected because they had wadable riffle habitat and were close the thermograph locations. In May 2022, BMI were sampled at four of the sites: SKAGIT5X, 6X, and 7X and the Sauk River. In May 2022, the two sites within the North Cascades National Park (SKAGIT2X and 3X) had not yet been permitted for sampling by the NPS, and SKAGIT 4X has now been designated an "intensive monitoring" site (i.e., sampling along transects, as explained below). Sampling has been and is being conducted according to Ecology's standard operating procedure (except at the intensive sampling sites, which do not involve composite sampling, but instead rely on single kick-net samples analyzed individually to differentiate between locations along the transects). A range of BMI metrics are presented in Table 4.2.2-59. Additional data and interpretation will be provided in the USR.

Sampling locations, methods, and frequencies for the expanded BMI and invertebrate drift data collection program are outlined in Table 4.2.2-11. The number of samples collected longitudinally in the Skagit River has been expanded from six locations to eight locations, resulting in not only a greater overall number of locations but also extending the study area farther downstream, to the SR 9 Bridge (PRM 23). Three of the longitudinal sampling sites include both mainstem and side channel sampling. The site in the lower Sauk River (RM 5.4) will continue to be sampled. The increased scope of longitudinal sampling will provide a more detailed characterization of river-wide patterns in macroinvertebrate densities and diversity, which can be used to assess potential

Project impacts, including potential attenuation of impacts with increasing distance downstream of the Project.

The expanded scope also includes “intensive” BMI sampling at paired sites in the Skagit River (regulated) at PRM 75.6 and the Sauk River (unregulated), just upstream of the confluence with the Suiattle River. The paired sites were selected to be as similar as possible to each other in terms of elevation and channel characteristics. At each intensive sampling site, BMI samples are collected with a kicknet at intervals along a transect that runs from the shoreline, through a side channel, and into the mainstem toward the thalweg to the maximum wadable depth. Sampling at these intensive transect sites is being conducted every two weeks from July-October 2022 and every four weeks from November-December 2022 and from March-June 2023. Data from the two intensive sampling sites will be compared in an attempt to discern whether there are apparent effects of the Project on the invertebrate community at the Skagit River (regulated) site.

Thermographs have been deployed to continuously monitor temperature at each macroinvertebrate sampling site. At the sampling site in the Sauk River, nutrient data (grab samples) are being collected quarterly to allow for a comparison of conditions before and after the influx of marine-derived nutrients from spawned-out salmon and steelhead carcasses.

Table 4.2.2-59. Benthic macroinvertebrate metrics for sample locations in the Skagit and Sauk rivers, August 2021 and May 2022.

Metric	SKAGIT 2X		SKAGIT 3X		SKAGIT 4X		SKAGIT 5X		SKAGIT 6X		SKAGIT 7X		SAUK 1X	
	8/2021	5/2022	8/2021	5/2022	8/2021	5/2022	8/2021	5/2022	8/2021	5/2022	8/2021	5/2022	8/2021	5/2022
Total Taxa Richness	3.45	ND[1]	6.55	ND[1]	6.21	ND[2]	7.59	1.38	7.24	5.17	6.21	8.28	7.24	6.9
Ephemeroptera (mayfly) Richness	4.29	ND[1]	8.57	ND[1]	5.71	ND[2]	10	10	8.57	10	8.57	10	10	10
Plecoptera (stonefly) Richness	2.86	ND[1]	10	ND[1]	5.71	ND[2]	10	1.43	2.86	0	5.71	2.86	5.71	4.29
Trichoptera (caddisfly) Richness	3.75	ND[1]	3.75	ND[1]	2.5	ND[2]	3.75	3.75	8.75	7.5	8.75	7.5	10	6.25
Intolerant Taxa Richness	7.14	ND[1]	10	ND[1]	8.57	ND[2]	10	7.14	5.71	5.71	5.71	5.71	10	10
Clinger Taxa Richness	4.71	ND[1]	6.47	ND[1]	5.88	ND[2]	8.82	4.12	10	10	9.41	10	10	7.06
Long-lived Taxa Richness	1.25	ND[1]	1.25	ND[1]	0	ND[2]	1.25	0	2.5	0	0	0	5	0
Percent Tolerant Individuals	8.72	ND[1]	9.25	ND[1]	9.47	ND[2]	9.59	9.83	9.55	9.18	9.69	9.15	9.82	9.92
Percent Predator Individuals	5.3	ND[1]	1.4	ND[1]	3.78	ND[2]	1.75	10	1.64	2.82	0.55	2.13	5.42	2.86
Percent Dominant Taxa (top 3)	6.54	ND[1]	0.25	ND[1]	9.25	ND[2]	8.25	2.52	8.45	1.56	8.17	3.71	5.47	2.72

1 At the time of data collection in May 2022, the NPS permit was pending, so sampling could not be undertaken.
2 Beginning in 2022, the SKAGIT4 site was converted to a transect sampling locations (see text for an explanation of the transect methods).

Fecal coliform in the Skagit River below the Project

Results of monthly fecal coliform measurements made by Ecology in the Skagit River at Marblemount, 2009-2022, are presented in Table 4.2.2-47. Measured values were very low (well below 50 colonies/100 mL), indicating a lack of contamination from upstream sources.

Contaminants in the Skagit River below the Project

Ecology measured dissolved metals at Marblemount in 1994 and 1995 and from 2019-2021 (Table 4.2.2-60). Eight metals were measured in samples collected on four occasions in 1994 and twice in 1995; nine metals were measured in samples collected in 2019-2021. For metals reported in Table 4.2.2-60, toxicity values for all but chromium and mercury are hardness dependent. However, there are no hardness data available or cation (Ca or Mg) results that would allow calculation of hardness necessary to apply Ecology's acute and freshwater criteria, as shown in Ecology's Table 240 (WAC 173-201A-240).

EPA's Aquatic Life Ambient Freshwater Quality Criteria for Copper lists chronic concentrations (causing potential adverse effects due to long-term exposure) for a wide range of species and hardness values (EPA 2007). For copper, chronic exposure values are 8.3-13.0 µg/L (hardness of 26 mg/L) for caddisflies and 12-22 µg/L (hardness of 160-180 mg/L) for Rainbow Trout. Based on alkalinity data reported in Table 4.2.2-47, the chronic criteria identified for caddisflies can reasonably be applied to the Skagit River at Marblemount. Fourteen of the 17 copper values reported in Table 4.2.2-60 are < 0.5 µg/L, and although one reported value was 12 µg/L, it was a qualified value, a clear outlier, and likely not applicable. All of the detectable mercury values were significantly less than the 0.012 µg/L chronic concentration listed in Ecology's Table 240. With regard to lead, the concentration of 0.067 µg/L (measured on 5/17/1994) was well below the chronic toxicity threshold for three species of aquatic invertebrates, i.e., 12-194 µg/L (Grosell et al. 2006). The value of 20 µg/L (measured on 1/17/95) falls within the lower end of this range, but the reported value is also qualified and likely inapplicable. Measured lead concentrations from 2019-2021 are all very low. There are no contaminants-related 303(d) listings for WRIA 4.

Table 4.2.2-60. Dissolved (unless indicated as total recoverable) metals concentrations (µg/L) measured in water samples in the Skagit River at Marblemount (1994-1995 and 2019-2021).

Date	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	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]
2019									
10/8	0.46	0.1[2]	0.32	0.57	0.1	0.0007	0.39	0.1[2]	5[2]
12/3	0.53	0.1[2]	0.18[2]	0.35	0.1[2]	0.0005[2]	0.22	0.1[2]	5[2]
2020									
2/4	0.54	0.2[2]	0.50	0.49	0.1[2]	0.0006	0.58	0.1[2]	5[2]
8/4	0.39	0.1[2]	0.20[2]	0.40[2]	0.1[2]	0.0005[2]	0.19	0.1[2]	6[2]
10/6	0.44	0.1[2]	0.20[2]	0.40[2]	0.1[2]	0.0005[2]	0.20	0.1[2]	5[2]
12/8	0.66	0.1[2]	0.34	0.61	0.1[2]	0.0012	0.40	0.1[2]	5[2]
2021									
2/2	0.53	0.1[2]	0.20	0.40[2]	0.1[2]	0.0008	0.23	0.1[2]	5[2]
4/6	0.53	0.1[2]	0.29	0.40[2]	0.1[2]	0.0009	0.22	0.1[2]	5[2]
6/8	0.33	0.1[2]	0.23	0.40[2]	0.1[2]	0.0005[2]	0.21	0.1[2]	5[2]
8/3	0.41	0.1[2]	0.20[2]	0.40[2]	0.1[2]	0.0012[3]	0.32	0.1[2]	5[2]

Source: Ecology 2022.
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.

4.2.2.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on water quantity and quality. The effects are organized below to address requests in FERC's Scoping Document 2 (SD2).

Water Quantity

Effect of Project operation on flood risk management in the Skagit River (FERC SD2).

Project operation under the current license is designed to meet and prioritize four objectives: (1) flood risk management; (2) salmon and steelhead protection flows downstream of Gorge Powerhouse; (3) recreation; and (4) power generation. To achieve these objectives, City Light complies with applicable current license articles for Ross Lake levels and for streamflows and ramping rates downstream of Gorge Powerhouse.

Under existing operations, Ross Lake is drawn down on a yearly basis during winter to capture flows from spring runoff and to provide for downstream flood risk management. The drawdown typically begins the Tuesday after Labor Day and continues until the lake reaches its lowest level in late March or early April. Article 301 of the current license requires City Light to draw down Ross Lake to a level that provides 60,000 acre-feet of storage for flood risk management by November 15 and 120,000 acre-feet by December 1, and to maintain this available storage through March 15. City Light must also comply with Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA (USACE 1967), which is incorporated into the Project license by reference. This document was updated in 2002 and provides the current guidance for Project operations for flood risk management.

Flood risk management operations are initiated by the Seattle District, USACE, Reservoir Control Center whenever it receives a flood forecast from the National Weather Service (NWS), Northwest River Forecast Center (NWRFC), or a flood forecast prepared internally indicating that natural flows at Concrete will reach 90,000 cfs in 8 hours on a rising flood. The Reservoir Control Center notifies City Light and initiates an official flood risk management operation at that time. This flood notification is referred to as an "Official Flood Control Notice (OFCN)." The OFCN is logged by the Reservoir Control Center and City Light at the time it is issued/received. The Reservoir Control Center also notifies the System Control Center (SCC) and cancels the OFCN when the flood risk management operation is ended. During the flood period through which the Reservoir Control Center controls operations of the Project, City Light retains the right to discharge up to 5,000 cfs from Ross (plus or minus 20 percent allowances for operational latitude) as such flows are necessary for normal generation at the other two Project developments. Additionally, Ross Lake may be surcharged if the water surface elevation reaches 1,608.76 feet NAVD 88 (1,602.5 feet CoSD) before flood recession occurs to provide the additional reduction of release downstream.

The Fisheries Settlement Agreement (FSA) Flow Plan (City Light 2011) (see Section 4.2.3.2 of this Exhibit E for a description of how the FSA Flow Plan is implemented) establishes, (1) requirements for flows downstream of Gorge Powerhouse; (2) flow releases and limits to protect salmon and steelhead spawning, egg incubation, and juvenile rearing; (3) operations during dry water (adverse) years and periods of flooding (high water); (4) advance scheduling of hourly generation; and (5) field monitoring. City Light implements the operational requirements of the current license, including the FSA Flow Plan, to balance essential Project benefits, flood risk management, and provision of flows for fish and aquatic resources. As discussed in Section 4.2.3.2 of this Exhibit E, assessments of the FSA Flow Plan's effectiveness have shown that benefits to aquatic habitat, which in turn benefit salmon and steelhead, are evident in the reach of the Skagit River downstream of the Project. In addition, City Light has developed flow-habitat models (see Sections 4.2.3.1 and 4.2.3.2 of this Exhibit E) to further assess potential Project effects on fish in the Skagit River. These flow-habitat models will be applied in conjunction with the Operations Model and, to the extent appropriate, the CE-QUAL-W2 temperature and water quality models to assess the effects of current Project operations and potential alternative Project operating scenarios, which will account for flood risk management. These efforts are underway and updates on the analyses and modeling will be provided in the USR and FLA.

Effects of reservoir drawdown, particularly that of Ross Lake, which is driven primarily by the flood-control requirements of the current Project license (as explained above), are being assessed by City Light as described in the Water Quality Section (immediately below). City Light conducted a Geographic Information System (GIS)-Based Reservoir Littoral Zone Evaluation (City Light 2022f) to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and WSE for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes).

Water Quality

Effects of existing and any potential changes in project facilities and operation on water quality in the three project reservoirs, including: nutrients, water temperatures, metals, fecal coliform, and turbidity levels in Ross Lake, and nutrients, water temperatures, metals, dissolved oxygen, and pH levels in Diablo and Gorge Reservoirs (FERC SD2).

Upstream of Gorge Dam

Temperature

Ross Lake exhibits yearly vertical circulation patterns typical of a deep, clear, temperate-latitude lake, with pronounced thermal stratification in summer and vertical overturn in fall. Some winter stratification appears to occur in some but not all years near Ross Dam, where wind-induced mixing of surface waters is significantly less than at locations farther upstream in the reservoir. In summer, solar heating increases the temperature of surface water well above that of the Skagit River inflow from May through November.

Despite the elevated maximum temperatures near the surface of Ross Lake, there is a large volume of cold water in the reservoir throughout summer and fall. Although surface temperatures can be as high as 22°C (e.g., as recorded at Little Beaver in August, Figure 4.2.2-12), they are generally slightly lower with increasing distance downstream in the reservoir. At all locations, however, cooler water persists at depth throughout the year (Figures 4.2.2-12 through 4.2.2-14).

Although summer stratification occurs in Diablo Lake near the dam, summertime maximum temperatures are typically lower than those in Ross Lake. This is the result of both the short residence time in Diablo Lake and moderate inflow temperatures of water withdrawn at depth in Ross Lake. Water temperatures in Diablo Lake generally remain below 16°C, and there is abundant cold water throughout the year (Figures 4.2.2-17 through 4.2.2-19). An exception to this pattern occurred in July 2021, when the surface temperature of Diablo Lake reached 24.5°C; this increase occurred following record-high air temperatures in the basin, as noted in Section 4.2.2-1, above.

Significant stratification does not occur in Gorge Lake (although minor vertical thermal gradients are observed during summer in the forebay) due to its short residence time (< 1 day). Average daily water temperatures in Gorge Lake very rarely exceed 13°C (Figures 4.2.2-21 through 4.2.2-23), and temperature profile measurements show that conditions are nearly always vertically isothermal.

Dissolved Oxygen and pH

DO in Ross Lake is generally high, i.e., 8.0-11.0 mg/L (although values at depth sometimes range from about 7.0-7.5 mg/L), and pH ranges from about 7.0 to 8.5 (except one month, October 2016, when pH measured at the Pumpkin Mountain site ranged from 6.0-7.0 at depths ≥ 60 ft). Even when DO falls below 8 mg/L at depth, there are still well-oxygenated conditions throughout much of the water column. Lower DO concentrations at depth are often observed in natural lakes and reservoirs during periods of stratification.

In Diablo Lake, DO concentrations measured during 2021 and 2022 were generally between 10 and 14 mg/L, with surface measurements ranging from 8-10 mg/L in July 2021. DO concentrations measured in Diablo Lake were at or near saturation. In 2021, pH in Diablo Lake ranged from 6.5 to 8.0, with only a single value < 6.0 (in August at the upper end of Diablo Lake at a depth of 6 m [20 ft]). In 2022, March, April, and June pH profiles at DIABLO2 show a pronounced pH gradient in the upper 10 meters (33 ft) of the water column.

Dissolved oxygen in Gorge Lake varied between 10 and 12 mg/L throughout the 2021 measurement period and 11.5-15 mg/L from January-June 2022. Values of pH ranged from 7.0-7.5 and 6.5-7.5, in 2021 and 2022, respectively, although in 2022 most values were above 7.0. Based on data collected to date, Project operations have no apparent effect on DO and pH in the Project reservoirs.

Total Dissolved Gas

TDG data collected in Gorge Lake during 2021 reveal TDG concentrations above 110 percent saturation below Diablo Dam on September 18 (112 percent) and again on September 30 (114 percent). TDG values in the Gorge Dam forebay at these times remained near 105 percent. These periods of elevated TDG correspond to low flows (< 1,000 cfs) at Diablo Powerhouse, i.e., when generation was less than 20 MW (Figures 4.2.2-40 and 4.2.2-41). The observed elevated TDG levels appear to be linked to the operation of an air admission system on two turbines at the Diablo Powerhouse (U31 and U32). Both units have systems in place that admit air to allow the units to run more smoothly and improve operational efficiency at low generation (Gordon 2021). The operational effects on TDG observed in 2021 (i.e., operating an air admission system on U31 and U32) recurred in 2022: increased TDG corresponded to reduced generation from May 18-May 25, 2022 (Figure 4.2.2-45). Continued monitoring is underway to further evaluate the temporal extent of TDG exceedances in Gorge Lake and the relationship between TDG concentrations and generation (flow release) at the Diablo Powerhouse.

Data collected in 2022 show that spill at Diablo Dam caused elevated TDG below Diablo Dam and in the Gorge Dam forebay. TDG levels reached 123 percent saturation on February 19, 2022 and again on March 12, 2022. In addition, TDG measured at Gorge Powerhouse (PHOUSE1) reached 121 percent on March 13, 2022, apparently as a result of spill at Diablo Dam. Elevated TDG persisted, with levels remaining > 110 percent from mid-January through much of April 2022. TDG levels dropped quickly when the powerhouse came back into operation and spill ceased in mid-April 2022.

Turbidity and Total Suspended Solids

In 2021, turbidity and TSS levels in Ross Lake appeared to reflect those measured at tributary confluences with the reservoir, largely reflecting response to rainfall in the basin. Turbidity and TSS values collected adjacent to shoreline erosional areas on November 30-December 1, 2021 were comparable to background levels measured in the open water at the Pumpkin Mountain, Skymo, and Little Beaver sites. The increase in turbidity and TSS observed between September and November at the three reservoir sites was correlated with elevated levels of turbidity measured at tributary inflows, especially the upper Skagit River inflow (100 NTU) and Ruby Creek (40

NTU). Because the upper Skagit River is the largest single contributor of flow to Ross Lake, it is not surprising that high levels of turbidity associated with the Skagit River inflow would affect observed levels in the reservoir. In addition, storms that occurred during the data collection period washed out Silver Skagit Road in Canada, which parallels the Skagit River upstream of Ross Lake, likely contributing sediment loads that exceeded what would normally occur.

Turbidity measurements made along transects in Ross Lake during May 2022 were comparable to measurements from December 2021 (i.e., relatively low). However, turbidity and TSS were notably higher in March 2022 than in the other two sampling months (see Table 4.2.2-13) and much more variable along individual transects. For example, turbidity measurements made along the ROSS5 central basin shoreline transect in March 2022 ranged from 2.3-130 NTU. The elevated values measured in March 2022 may reflect sediment suspended as the result of reservoir drawdown related to flood risk management, coupled with local shoreline features with variable wave impingement erosional forces, because measured turbidity was low at the mid-water sites–Pumpkin Mountain, Skymo, and Little Beaver–at the same time (see Table 4.2.2-12).

In 2021 and 2022, turbidity and TSS levels were low in Diablo Lake, both in background samples collected at the upper and lower ends of the reservoir and at transects sampled in the Thunder Arm. TSS measurements along both transects were all less than the laboratory method reporting limit, except for one measurement at DIABLO6 (Thunder Arm) in March 2022. Turbidity was less than 1 NTU at all sites, except for values of 1.7 and 1.4 NTU at DIABLO6 on December 17, 2021 and March 18, 2022, respectively. Although water was clear during the measurement periods, turbidity can be very high in the Thunder Arm of Diablo Lake during snowmelt runoff and rain-on-snow events.

Turbidity was low in Gorge Lake: < 3.1 NTU throughout the year, except from October 2021-February 2022, when values ranged from 5.1-9.8 NTU.

Taken together, the results of sampling conducted through June 2022 suggest that background levels of turbidity and TSS in Project reservoirs are largely driven by tributary inputs and are unrelated to the operation of the Project. The exception was elevated levels measured in March 2022 at sampling transects in Ross Lake. These localized increases apparently reflect sediment suspended as the result of reservoir drawdown for flood risk management, coupled with wind-driven wave action impinging on the shoreline, because measured turbidity was low at the mid-reservoir sites at the same time. Additional sampling is underway and will be used to further assess any potential relationships between turbidity and TSS and inflows and water surface elevation.

Nutrients and Productivity

Nutrient concentrations in Ross Lake, measured by NCCN prior to relicensing (May-November, 2015-2018, see Table 4.2.2-18), were either undetectable or slightly above detection limits and did not vary significantly, either temporally or spatially. Concentrations of DOC and chlorophyll-*a* measured during the same period were low and also showed little spatial variability in the reservoir (see Tables 4.2.2-21, 4.2.2-24, and 4.2.2-25).

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling in the Project reservoirs and their tributaries.

Parameters selected, and sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model.

Results of City Light's nutrient and productivity monitoring conducted in 2022 show that levels of nitrogen, phosphorus, organic carbon, and chlorophyll-*a* in the reservoirs and their tributaries were very low, typically below the method detection limit. These findings are consistent with previous monitoring results and confirm that these systems are strongly oligotrophic. All data appear to reflect natural background conditions and do not suggest any Project-related effects.

As explained in Section 4.2.2.1 of this Exhibit E, City Light has expanded its BMI sampling program for the Project reservoirs over what was outlined in the FERC-approved RSP. Sampling locations, methods, and frequencies are outlined in Table 4.2.2-11. Sampling underway or completed includes: (1) benthic grab sampling using a Ponar dredge in reservoirs; (2) kick-net sampling of BMI in reservoir tributaries; (3) invertebrate drift sampling in reservoir tributaries; and (4) placement of rock baskets in Ross Lake to assess BMI colonization rates in the varial zone. Additional BMI and invertebrate drift sampling results for the Project reservoirs and their tributaries will be provided in the USR and FLA.

Ponar grab sampling will provide a pilot-scale understanding of the abundance and diversity of invertebrates in soft sediments in the lentic zones of all the reservoirs under baseline operations, and within the varial zone of Ross Lake, where the WSE fluctuation is much more extensive than in the downstream reservoirs. Invertebrate drift and kick net samples will be collected within each of the target tributaries of the reservoirs (see Table 4.2.2-11), just above the maximum reservoir WSE and in the stream channel within the varial zone just above the point where the tributary enters the reservoir. This will allow for a comparison of invertebrates in water flowing into and out of the varial zone to assess potential losses within the varial zone during low WSE conditions. Rock baskets were deployed in the lentic and varial zones of Ross Lake to evaluate BMI colonization rates, which can be used as an indicator of the degree to which operations associated with flood risk management influence benthic productivity in the reservoir.

Rock baskets were positioned in the (1) upper varial zone (just below the maximum WSE); (2) lower varial zone (near the midpoint WSE in the drawdown zone); and (3) lentic zone (below the normal low WSE) (see Figure 4.2.2-52) at each of the following geomorphic regions of Ross Lake: Hozomeen, Desolation, Pumpkin, Ruby (see mapbook in Appendix E of this Exhibit E for locations). At each of the four sampling sites, 12 baskets were deployed in July 2022 (i.e., at full pool), four in each zone (Figure 4.2.2-53). At each sampling site, two baskets were removed from each of the three zones twice: two baskets were removed after four weeks and two baskets after 10 weeks (Figure 4.2.2-53). The samples removed after two weeks are intended to provide data on early colonization, and the samples removed after 10 weeks provide information on colonization over a longer period.

As described in Section 4.2.3.1 of this Exhibit E, City Light conducted a GIS-Based Reservoir Littoral Zone Evaluation (City Light 2022f) to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and WSE for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes). The extent of light penetration, i.e., the depth of the euphotic zone, which is proportional to water clarity, dictates the area of the littoral zone, which varies spatially and temporally (Zhang et al. 2006).

Littoral zone habitat in Ross Lake is concentrated near tributary inputs and at the upstream end of the reservoir. The littoral zone, which is estimated to be between about 24 and 65 feet deep in Ross Lake, may be fully dewatered under normal permitted flood-control operations, as the elevation range of the varial zone spans 128 feet (see Table 4.2.3-8 in the Fish and Aquatic Resources section).

Based on minimum and maximum depths, the total area of the Ross Lake littoral zone at normal maximum WSE is about 1,586-3,875 acres. At 25 percent drawdown, 2,082 acres of littoral zone habitat are dewatered, resulting in a submerged littoral zone area of 0-1,793-acre (a 45.6-100 percent dewatering of the littoral zone) (Table 4.2.3-9 in the Fish and Aquatic Resources section). Overall, the Ross Lake littoral zone is rapidly dewatered during the early phase of reservoir drawdown, and the rate of littoral zone dewatering varies throughout drawdown. All habitat dewatered by drawdown is lost to productivity until rewatering occurs. To develop an understanding of baseline conditions in Ross Lake,[36] the rate at which the rewatered varial zone returns to productivity is being explored with the deployment of the BMI colonization rock baskets described above. WSE fluctuations, and as a result effects on the littoral zone, are less pronounced in the two downstream reservoirs.

<u>Fecal Coliform and *E. coli*.</u>

There is no apparent effect of Project operations on fecal coliform/*E. coli* concentrations in Ross Lake. Fecal coliform concentrations in Ross Lake were typically below method reporting limits during the June to September (2021) recreation season, although several samples did contain detectable CFU. *E. coli* concentrations mirrored the fecal coliform results. The highest concentration was recorded in June 2021 near Ross Lake Resort, a non-Project facility (600 CFU/100 mL). However, the elevated concentration observed near Ross Lake Resort appears to have been an isolated incident, as values declined to undetectable levels the following month and were not elevated again during the 2021 sampling period (June-September). Fecal coliform/*E. coli* concentrations at the three sampled boat-in campsites were very low throughout the sampling season. In 2022, fecal coliform/*E. coli* concentrations in Ross Lake ranged from non-detects to 5 CFU/mL, i.e., low levels showing no signature of contamination issues.

In Diablo Lake, maximum fecal coliform concentrations were reported in June 2021 at the Thunder Creek Confluence at Bridge/Colonial Creek Campground (104 CFU/100 mL); measurements of both fecal coliform and *E. coli* were also detectable in August at Colonial Creek Campground and in September at the Environmental Learning Center (ELC). The remainder of samples collected during the 2021 recreation season (June-September) were low to undetectable. The isolated elevated levels were associated with recreational facilities and do not appear to be linked to the Project's operation. In 2022, fecal coliform/*E. coli* concentrations in Diablo Lake ranged from non-detects to 5 CFU/mL, indicating that contamination was not an issue.

[36] The effects of large drawdowns in Ross Lake on BMI, and as a result system productivity, are being studied per requests from LPs. Results reflect existing baseline conditions that are due overwhelmingly to flood-control measures required by the license rather than the operation of City Light's hydroelectric facilities.

Contaminants

As part of Ecology's Freshwater Fish Contaminant Monitoring Program, Seiders and Deligeannis (2018) state that analyses of Bull Trout and Rainbow Trout tissue collected from Ross Lake (in 2007 and 2012) show 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). Also, the current EPA water quality assessment for WRIA 4 (Upper Skagit) includes 2014 category listings for toxic substances[37] (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 toxicants; 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."[38]

Downstream of Gorge Dam

Effects of existing and any potential changes in project facilities and operation on water quality in the upper Skagit River downstream of Gorge Dam (i.e., bypassed reach and full-flow reach below the powerhouse), including nutrients, water temperatures, dissolved oxygen, total dissolved gas, and turbidity levels (FERC SD2).

Temperature

Under the current Project license, there are no minimum flow requirements for the Gorge bypass reach, and the reach has special condition status under State standards requiring that water temperatures do not exceed 21°C 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 groundwater accretion, spill-gate seepage, tributary input, and precipitation runoff.

As discussed above, maximum water temperatures immediately below Gorge Dam were as high as 24.6°C, but maxima at the other bypass sites (at the middle and lower end of the bypass reach) never exceeded 21ºC. Temperatures below the Gorge Powerhouse tailrace were less variable and usually cooler than the temperatures recorded at the three bypass sites. In 2021, water temperatures in the bypass were affected by excessive air temperatures (up to 45°C [113ºF]) driven by the historic heat wave (i.e., heat dome) that affected the Pacific Northwest in late June and early July 2021, and, as a result, the observed elevated water temperature appears to represent an anomalous condition, although one that could become more common in the future as the effects of climate change progress. Temperature monitoring in the Gorge bypass reach is ongoing, and additional data will be reported in the USR and FLA.

In the Skagit River between the Project and the Sauk River confluence, 7-DADMax water temperatures were below Ecology's relevant criteria throughout the 2021-2022 monitoring period (through May 2022). Downstream of the Sauk River, temperatures above the core summer salmonid habitat criterion occurred only at the SKAGIT6 site (PRM 60.8), and temperatures

[37] 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.

[38] 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."

slightly exceeded the salmon and trout spawning criterion for only a short period at the SKAGIT7 site (PRM 54.5), a site that is well downstream of the Project. The elevated 7-DADMax water temperatures recorded at SKAGIT6 (i.e., higher than the *core summer salmonid habitat criterion*) are unique to this location and are not evident at the upstream and downstream sites, PRM 69.3 and 54.5, respectively. These elevated temperatures may reflect localized pooling caused by sediment deposition around the deployment site. As noted above, relocation of the SKAGIT6 thermograph is under evaluation. The CE-QUAL-W2 temperature model will be employed to identify the rate at which the Project's effects on lower river temperatures are attenuated and the location, or zone, where atmospheric warming overrides any effects of Project flow releases on riverine temperatures. Model simulations are expected to be presented in the FLA.

Although 7-DADMax temperatures did not exceed Ecology's criteria above the Sauk River confluence, water temperatures in the Skagit River at Newhalem are less variable and exhibit lower summer maxima and higher winter minima than those in the Skagit River at Swing Bridge (the measurement location nearest to the upper end of Ross Lake). This implies that despite significant solar heating at the surface of Ross Lake during summer, and significant variability in the water temperature of the Skagit River's tributaries downstream of Gorge Dam, the Project dampens water temperature variation for some distance in the reach downstream of Gorge Powerhouse. The CE-QUAL-W2 model will be used to simulate this effect over the modeling period, thereby providing a better understanding of the Project's influence on the temperature regime immediately below Gorge Powerhouse and, as noted above, the attenuation of any effects with increasing distance downstream of the Project.

Dissolved Oxygen and pH

DO monitoring shows that water discharged from Gorge Powerhouse is oxygen rich throughout the year. DO concentrations within the Gorge bypass reach gradually decreased throughout the 2021 monitoring period as water temperatures increased. Minimum DO was 7.3 mg/L at both BYPASS1 and BYPASS2 and 8.4 mg/L at BYPASS3, although average DO concentrations were significantly higher at these sites. DO concentrations below the Gorge Powerhouse tailrace (PHOUSE1) were generally higher (and water temperatures were lower) than at the bypass sites and demonstrated comparatively little diel variability. At PHOUSE1, the minimum DO concentration was 10.6 mg/L, and the average DO concentration was 11.6 mg/L.

Monthly averages of DO concentrations in the Skagit River at Marblemount (PRM 78.5), based on data collected by Ecology, ranged from 10.8 mg/L (August) to 12.8 mg/L (March) for the period 2009-2022. The lowest measured value in Ecology's dataset is 9.8 mg/L, measured on August 19, 2009. The next lowest value is 10.0 mg/L, measured on August 19, 2014. The observed values indicate that water is well oxygenated.

Continuous monitoring at SKAGIT3, SKAGIT4, and SKAGIT7 (PRMs 85.9, 75.6, and 54.5, respectively), over a 3-week period in June 2022 showed that DO values ranged from approximately 11 to 13 mg/L, with saturation generally between 100 and 105 percent. DO concentrations at SKAGIT3 exhibited a tighter range, between approximately 12.0 and 12.6 mg/L, than that seen at the other two sites, which are farther downstream and characterized by greater variability in temperature. Median DO concentrations were 12.3, 11.8, and 12.2 mg/L at SKAGIT3, SKAGIT4, and SKAGIT7, respectively. Maximum DO concentrations generally occurred during the afternoon at SKAGIT3 and SKAGIT4, suggesting a possible influence of primary production.

Monitoring of pH below the Gorge Powerhouse tailrace (PHOUSE1) began on July 21, 2021; pH at this location averaged 7.5 with a range of 7.2 to 7.7. Monthly pH values measured at Marblemount for the period 2009-2022 (data collected by Ecology) were near neutral, ranging from 7.3-7.5; pH was highly consistent within months and throughout each year. Values of pH at SKAGIT3, SKAGIT4, and SKAGIT7 during the June 2022 continuous monitoring period ranged from 7.0 to 7.5 mg/L, with diel changes most pronounced at SKAGIT4.

<u>Total Dissolved Gas</u>

Based on monitoring to date, the Project's effect on TDG downstream of Gorge Dam appears to be limited to the bypass reach, with measurements immediately downstream of the Gorge Powerhouse falling below Ecology's relevant criterion.

TDG levels above 110 percent saturation (up to 124 percent saturation in the Gorge Dam plunge pool in June 2021) occurred in the Gorge bypass reach when spill flow at Gorge Dam exceeded approximately 4,000 cfs. City Light records indicate that the maximum daily average spill in November 2021 (20,231 cfs on November 18) was an uncommon event, approximately 20 times greater than the median daily average spill flow that occurred between January 1, 1997 and December 1, 2021.

TDG monitoring was conducted downstream of Gorge Powerhouse–at the Ladder Creek Falls bridge, the suspension bridge to Trail of the Cedars, and the bridge at Newhalem Campground–in October 2021 during a spill of 2,000 cfs. At that time, TDG at all three bridges remained at or near 105 percent saturation. TDG was also measured at the three bridges on November 6, 2021, during normal operations at Gorge Powerhouse; TDG at all three sites remained between 102 and 104 percent saturation during this sampling event.

TDG was again measured at bridges during spill on July 5, 2022. Because of the loss or damage of the Hydrolab datasondes in the Gorge bypass reach during fall 2021 spill events, including loss of the datasonde at the Gorge Dam plunge pool (BYPASS1), City Light added the Gorge Dam access bridge near the upstream end of the Bypass Reach as a location for opportunistic TDG sampling during spill. Other sites monitored on July 5, 2022 included the Gorge Powerhouse access bridge, Ladder Creek Bridge, and the Bridge to Trail of the Cedars. The latter two were also monitored in 2021, and the Gorge Powerhouse access bridge was added to measure TDG closer to the downstream end of the bypass reach.

Spill at Gorge Dam on July 5, 2022 averaged 5,400 cfs and was fairly constant throughout the day. Monitoring results for July 5, 2022 show that TDG remained between 110 and 115 percent saturation at the Gorge Dam access bridge (upstream end of the bypass reach) for most of the monitoring period. TDG remained close to but less than 110 percent at the three bridges downstream of the bypass. TDG monitoring is ongoing, and additional results will be provided in the USR and FLA.

<u>Turbidity and Total Suspended Solids</u>

Turbidity was generally very low at all monitoring sites in the Gorge bypass reach and below Gorge Powerhouse, averaging near or less than 1 NTU. However, turbidity at the downstream end of the Gorge bypass reach during late June increased to nearly 120 NTU, likely in response to a late June spill at Gorge Dam. Values were also higher downstream of Gorge Powerhouse at times in August and early September 2021. Flows were relatively stable during this period, suggesting that debris accumulation or algae was interfering with the datasondes' optical sensors.

Sporadic, slightly elevated turbidity values measured by Ecology at Marblemount appear to be linked to precipitation-induced flow increases in the Skagit River basin. There is no indication that the Project's existence or operation contributed to these isolated increases in turbidity. Average monthly turbidity values measured at Marblemount from 2009-2022 ranged from 0.8-2.6 NTU during the January–October period and were slightly higher, although still relatively low (6.5-11.0 NTU), for November–December. The highest turbidity values, 28 NTU, 60 NTU, and 25 NTU, were recorded on December 11, 2014, December 9, 2015, and November 29, 2017, respectively, and were correlated with rain-induced high flows.

Continuous monitoring over a three-week period in June 2022 at SKAGIT3, SKAGIT4, and SKAGIT7 (PRMs 85.9, 75.6, and 54.5, respectively) showed that baseline turbidity, i.e., during periods apparently unaffected by changes in Skagit River flows, was low, between 0-20 NTUs. However, spikes in turbidity occurred at all three sites, to over 100 NTUs, notably from June 8-10. Turbidity at the three monitoring sites is influenced by Skagit River flows, as seen in Figure 4.2.2-80 (spill volumes released at Gorge Dam during the June 2022 monitoring period were relatively small). Results of turbidity grab samples collected by City Light in May and June 2022 at multiple locations in the Skagit River downstream of the Project, and in Newhalem Creek and the Sauk and Baker rivers, all show that water clarity was high during the sampling periods.

Nutrients and Productivity

As part of its expanded scope of water quality monitoring (Table 4.2.2-10), City Light has undertaken nutrient and productivity sampling in the Skagit River and at the mouths of select tributaries downstream of the Project. Parameters selected, and sampling locations and timing, were identified to provide data needed to construct and calibrate the CE-QUAL-W2 water quality model.

Results of City Light's nutrient and productivity monitoring conducted in 2022 show that levels of nitrogen, phosphorus, organic carbon, and chlorophyll-*a* downstream of the Project were very low, typically below the method detection limit. These results are consistent with monthly ammonia and total phosphorous measurements made by Ecology (2009–2022) in the Skagit River at Marblemount (approximately 20 miles downstream of the Project). Overall, the observed low nutrient, carbon, and chlorophyll-*a* levels are consistent with previous monitoring results, which indicate that the Skagit River and its tributaries are oligotrophic systems. All data appear to reflect natural background conditions and do not suggest any Project-related effects.

Benthic Macroinvertebrates

A table of BMI metrics (Table 4.2.2-59) for kick-net samples collected in the Skagit River mainstem is provided in Section 4.2.2.1 of this Exhibit E. Additional data and interpretation will be provided in the USR.

As stated above, sampling locations, methods, and frequencies for the expanded BMI and invertebrate drift data collection program are outlined in Table 4.2.2-11. The number of samples collected longitudinally in the Skagit River was expanded from six locations to eight locations, resulting in not only a greater overall number of sampling locations but also extending the study area farther downstream, to the SR 9 Bridge (PRM 23). Three of the longitudinal sampling sites include both mainstem and side channel sampling. The sampling site in the Sauk River at RM 5.4 continues to be sampled along with the longitudinal sampling in the Skagit River. The increased scope of longitudinal sampling will provide a more detailed characterization of river-wide patterns in macroinvertebrate densities and diversity.

The expanded scope also includes "intensive" BMI sampling at paired sites in the Skagit River (regulated) at PRM 75.6 and the Sauk River (unregulated) just upstream of its confluence with the Suiattle River, thereby avoiding the confounding influence of high sediment loads contributed by the Suiattle River. The paired sites were selected to be as similar as possible to each other in terms of elevation and channel characteristics. At each intensive sampling site, BMI samples are collected with a kicknet at intervals along a transect that runs from the shoreline, through a side channel, and into the mainstem toward the thalweg to the maximum wadable depth. Sampling at these intensive transect sites is being conducted every two weeks from July-October 2022 and every four weeks from November-December 2022 and from March-June 2023. Data from the two intensive sampling sites will be compared in an attempt to discern whether there are apparent differences in the invertebrate community between the regulated portion of the Skagit River affected by the Project and the unregulated Sauk River.

Thermographs have been deployed to continuously monitor temperature at each macroinvertebrate sampling site. At the sampling site in the Sauk River, nutrient data (grab samples) are being collected quarterly to allow for a comparison of conditions before and after the influx of marine-derived nutrients from spawned-out salmon and steelhead carcasses.

<u>Fecal Coliform and *E. coli*.</u>

Fecal coliform concentrations in the Skagit River at Marblemount, based on Ecology's data collected from 2009-2022, were low (monthly averages were ≤ 5.5 CFU/100 mL) and reflect the relatively undisturbed conditions of the watershed and low human population density along the river corridor upstream of the sampling location. There is no indication of anthropogenic effects on fecal coliform concentrations, and hence, no signature of the Project, which is located about 20 miles upstream of Marblemount.

<u>Contaminants</u>

Ecology measured dissolved metals at Marblemount in 1994 and 1995 and from 2019-2021. Observed concentrations were relatively low (see Section 4.2.2.1 of this Exhibit E), and there are no contaminants-related 303(d) listings for WRIA 4.

4.2.2.3 Existing and Proposed Resource Measures

Article 301 of the current license requires City Light to draw down Ross Lake to a level that provides 60,000 acre-feet of storage for flood risk management by November 15 and 120,000 acre-feet by December 1, and to maintain this available storage through March 15. City Light must also comply with Details of Regulation for Use of Storage Allocated for Flood Control in Ross

Reservoir, Skagit River, WA (USACE 1967), which is incorporated into the Project license by reference. This document was updated in 2002 and provides the current guidance for Project operations for flood risk management.

Flood risk management operations are initiated by the Seattle District, USACE, Reservoir Control Center whenever it receives a flood forecast from the NWS, NWRFC, or a flood forecast prepared internally indicating that natural flows at Concrete will reach 90,000 cfs in 8 hours on a rising flood. The Reservoir Control Center notifies City Light and initiates an official flood risk management operation at that time. This flood notification is referred to as an OFCN. The OFCN is logged by the Reservoir Control Center and City Light at the time it is issued/received. The Reservoir Control Center also notifies the SCC and cancels the OFCN when the flood risk management operation is ended. During the flood period through which the Reservoir Control Center controls operations of the Project, City Light retains the right to discharge up to 5,000 cfs from Ross (plus or minus 20 percent allowances for operational latitude) as such flows are necessary for normal generation at the other two Project developments. Additionally, Ross Lake may be surcharged if the water surface elevation reaches 1,608.76 feet NAVD 88 (1,602.5 feet CoSD) before flood recession occurs to provide the additional reduction of release downstream.

City Light does not currently implement water quality related protection, mitigation, and enhancement (PME) measures. The following PME measures are proposed at this time (below), although City Light anticipates ongoing studies and discussions with LPs could inform and possibly lead to modifications of current Project operations and other PME measures that City Light would include in its FLA submittal.

Flood Risk Management

City Light anticipates including a proposal in the FLA to refine the flood risk management benefits of the Project. City Light is currently engaged in dialogue with the USACE and other LPs and will provide more information on these measures in the FLA.

Flows in Gorge Bypass Reach

To enhance cultural and other water quality resources, City Light proposes to establish a flow regime for the Gorge bypass reach. This flow regime will be developed in consultation with the Indian Tribes and federal and state resource agencies. Water releases into the spillway from Gorge Dam may be in excess of any minimum flows (which will be routed through the Gorge bypass reach) during maintenance or emergency shutdown periods, and when river flows exceed the capacity of the Gorge Powerhouse. This flow regime will commence after a variable flow release valve is installed at Gorge Dam. The flow release valve’s engineering design and installation will be subject to FERC review and approval. The flow regime in the Gorge bypass reach will be coordinated with the flows from the Gorge Powerhouse to meet flow objectives below the Project. Additional details will be provided in the FLA.

Water Quality Monitoring and Data Management Plan

To ensure compliance with Washington State water quality standards, City Light proposes to develop a Water Quality Monitoring and Data Management Plan, for FERC and Ecology approval, that will include continued monitoring of water quality and measures related to water quality data management. Additional details will be provided in the FLA.

4.2.2.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to water quantity or quality in Project reservoirs or downstream of the Project have been identified at this time.

4.2.3 Fish and Aquatic Resources

4.2.3.1 Affected Environment

This section describes fish populations and aquatic habitat in Ross, Diablo, and Gorge lakes, the Gorge bypass reach, and the Skagit River between Gorge Dam and the Sauk River confluence. This section also describes the rare, threatened, and endangered (RTE) fish species found within the Project vicinity and their federally designated critical habitat. Essential fish habitat (EFH)[39] is addressed for those salmonid species found in 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 Act (MSA). This section is organized by the following topics: (1) existing fish and aquatic communities (anadromous fish, native resident fish, non-native fish, and aquatic invasive species); (2) aquatic habitat (Ross, Diablo, and Gorge lakes, Gorge bypass reach, mainstem Skagit River from Gorge Powerhouse to Sauk River confluence, and Skagit River tributary habitat upstream of the Sauk River confluence); (3) RTE aquatic species; (4) steelhead recovery planning; and (5) federally designated critical habitat.

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, Seattle City Light (City Light) has engaged with Indian Tribes and Canadian First Nations regarding fish and aquatic resources to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While fish and aquatic resources are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in fish and aquatic resources as, or related to, tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Existing Fish and Aquatic Communities

The Skagit River and its tributaries between the Gorge Development and the Sauk River confluence provide important spawning, migration, and rearing habitat for seven anadromous fish species including Chinook (*Oncorhynchus tshawytscha*), Coho (*O. kisutch*), Pink (*O. gorbuscha*), and Chum (*O. keta*) salmon; steelhead (*O. mykiss*), Coastal Cutthroat Trout (*O. clarki*), and Bull Trout (rearing and migration only in the mainstem) (*Salvelinus confluentus*) (Table 4.2.3-1). Native Chinook Salmon, steelhead, and Bull Trout in the Project vicinity are listed as threatened under the Endangered Species Act (ESA). White Sturgeon (*Acipenser transmontanus*) can be found holding in deep pools in the lower Skagit River (near Mount Vernon). Pacific Lamprey

[39] 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.

(*Entosphenus tridentatus*) appear to be uncommon in the Skagit River (e.g., Hayes et al. 2013)[40] and are seldom observed upstream of the Sauk River. The Pacific Lamprey 2021 Regional Implementation Plan for the Washington Coast/Puget Sound (Plumb and Blanchard 2021) includes a map (Figure 4 in the report) of the distribution of Pacific Lamprey, which indicates the species currently occurs only in the lower Skagit River basin; the presumed historical distribution, also shown on the map, extends into the upper basin. Sockeye salmon (*O. nerka*) rear primarily in lakes but also occur irregularly in the Skagit River upstream of the Sauk River confluence near County Line Ponds, in Bacon Creek, and at other locations.

Resident fish species in the Project vicinity include Bull Trout, Dolly Varden (*S. malma*), Cutthroat Trout, Rainbow Trout (*O. mykiss*), Brook Trout (*S. fontinalis*), Redside Shiner (*Richardsonius balteatus*), Mountain Whitefish (*Prosopium williamsoni*), sculpin (*Cottis* spp.), Salish Sucker (*Catostomus* sp.), Largescale Sucker (*C. 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 upstream of Gorge Dam. These six resident species are found in all three Project reservoirs and some of the reservoirs' tributaries. Of these six species, only Bull Trout, Rainbow Trout, and Dolly Varden are native to the Skagit River above the Skagit River Gorge (see *Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin*, below).

Under existing conditions, the Skagit River basin supports the largest run of Chinook Salmon in the Puget Sound Evolutionarily Significant Unit (ESU) 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 (U.S. Fish and Wildlife Service [USFWS] 2013). A 2007 regional decline in Chum Salmon was found to be partially linked to marine productivity (Malick et al. 2017). Some Chum stocks have now rebounded, although not the Skagit River run (Ruff 2019).

Tribes with treaty fishing rights currently operate commercial, ceremonial, and subsistence salmon and steelhead fisheries in the Skagit River, and there are substantial recreational fisheries for hatchery spring 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 (National Marine Fisheries Service [NMFS] 2014). The Marblemount and Baker Lake hatcheries, which currently operate within the Skagit River basin, produce summer and spring Chinook, Coho, and Sockeye salmon to augment the natural production of these species[41] (NMFS 2015). The Upper Skagit Indian Tribe and Sauk-Suiattle Indian Tribe also collect Chum Salmon broodstock in the basin. Fisheries for Sockeye and Coho salmon are primarily supported by a combination of hatchery and natural-origin populations. The spring Chinook fishery consists

[40] Hayes et al. (2013) found Pacific Lamprey in 11 Puget Sound watersheds but found zero in the Skagit River watershed. Ostberg et al. (2018) detected Pacific Lamprey in the Skagit River during spring 2015 eDNA surveys, but these samples were collected in the lower Skagit River just upstream of where the channel divides into distributaries.

[41] 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).

of a targeted harvest on a hatchery stock, and the summer Chinook hatchery program is relatively small and operated as an indicator stock program[42] (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 4.2.3-1 provides a summary of their current statuses and distributions in the Skagit River upstream of the Sauk River confluence. A review of key habitat requirements and life histories is presented in Tables 4.2.3-2 and 4.2.3-3. 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 presented later in the Fish and Aquatic Resources section of this Exhibit E. benthic macroinvertebrate (BMI) and zooplankton that reside in these waterbodies are discussed in the Water Resources section (Section 4.2.2 of this Exhibit E).

Table 4.2.3-1. 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, Candidate	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	P	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	N
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

42 Indicator stocks are used to model the effects of mixed stock fisheries on wild salmon populations.

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.)
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[3]	P

Source: Lowery 2019.

1 Native fish are those species that are indigenous to the local area. Non-native 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).

3 If sculpin occupy the Gorge bypass reach, it is likely that they occur only downstream of Existing Feature 1.

Table 4.2.3-2. 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	Near deep pools and in areas with abundant instream cover, gravel, and sub-gravel flow.	Mid-July through September	Fry either move directly into the estuary or take up residence in the lower velocity margins of the stream or river, side channels, or off-channel habitats. Fry also enter and occupy habitats in non-natal streams. These often contain instream cover (wood, root wads, overhanging vegetation or undercut banks).	12 to 14 degrees Celsius (°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.
Summer Chinook		Late August through early October			
Fall Chinook		Late September through October			
Coho Salmon	Low-gradient areas throughout the watershed, mainstem side channels, small and large tributaries, and low-gradient spawning habitat within high-gradient mountain streams.	October through April	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.	November through early January	Emerge from the gravel in the spring and migrate to saltwater almost immediately following emergence. However, they may reside for up to a month in freshwater, estuaries, and tidal marsh channels.	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 and Baker Lake), typically in areas of upwelling groundwater. Also spawn in side channels and spring-fed ponds.	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. Although much less common than lake rearing, some Sockeye Salmon rear in rivers.	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	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-July 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.	May through 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 tail-outs.	January through June	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	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	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-July 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 tail-outs. Typically in upper reaches of accessible tributary habitats.	September through 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 tail-outs.	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.	April through July	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 through 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 through 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.	March through August	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.

Table 4.2.3-3. Life-history periodicities for key fish species in the Project vicinity.

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead	Adult												
	Spawning			Eval	License Req'd Spawning Period		Eval						
	Juvenile												
Chinook Salmon	Spawning									License Required	Eval		
	Fry			Salmon Fry Protection Period									
	Juvenile												
Skagit Pink Salmon	Spawning								Evaluate		License Req'd		
Chum Salmon	Spawning									Evaluate		License Req'd	
	Fry			Salmon Fry Protection Period									
Coho Salmon	Spawning												
	Fry			Salmon Fry Protection Period									
	Juvenile												
Sockeye Salmon	Spawning												
Rainbow Trout	Adult												
	Spawning												
	Fry												
	Juvenile												
Bull Trout/Dolly Varden	Spawning												
	Fry												
	Juvenile												
Sea-Run Bull Trout	Spawning												
Cutthroat Trout	Adult												
	Spawning												
	Fry												
	Juvenile												
Sea-run Cutthroat Trout	Spawning												

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mountain Whitefish	Adult												
	Spawning												
	Fry												
	Juvenile												
Pacific Lamprey	Spawning												
Lamprey (generic)	Juvenile												
Western Brook Lamprey	Spawning												
Western River Lamprey	Spawning												
Salish Sucker	Spawning												
Salish Sucker	Juvenile												
White Sturgeon	Spawning												

Note: Evaluate (or Eval) indicates Lower Skagit observations and carcass recoveries and/or technical group interest in evaluating effects of extending license required protection periods.

Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin

Both local and regional drainage patterns in the Skagit River basin have been altered by glaciation (Armstrong et al. 1965, Mathews 1968, Waitt 1977, Porter and Swanson 1998, Riedel 2007, Riedel et al. 2020). The North Cascade Range and Puget Lowlands were covered by the south-flowing Cordilleran Ice Sheet during the Fraser Glaciation 35,000 to 11,500 years ago. The Cordilleran Ice Sheet that advanced into the area from the north was greater than 1 mile thick at Ross Lake and the Puget Lowlands (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. During this time, the upper Skagit River and Fraser River were connected[43], and for a period the Fraser River flowed through the Skagit Valley, eroding the Skagit River basin to its current elevation (Riedel et al. 2020). When the ice sheet retreated, the Skagit River and nearby creeks were redirected from draining into the Fraser River to flow south in their current configuration (Riedel et al. 2020).

Smith (2019) indicated that Bull Trout populations in the Upper Skagit Core Area (which includes the Project reservoirs above Gorge Dam) are descendants 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 (Smith 2010), 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 was through the upper Skagit River from the Fraser River; this pathway is corroborated by Riedel et al. (2020). Genetics studies have shown that both Bull Trout and Rainbow Trout below Gorge Dam are genetically distinct from those in the upstream reservoirs (Smith 2010; Small et al. 2013, 2016, 2020a, 2020b), and Dolly Varden only occur upstream of the Skagit River Gorge. Rainbow Trout in Stetattle Creek are genetically distinct from steelhead in the Skagit River below Gorge Dam (Kassler and Warheit 2012, as cited in Pflug et al. 2013; Small et al. 2020a). 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. Historically, gene flow between the upper Skagit and lower Skagit River was likely unidirectional (upstream to downstream) following the redirection of the Skagit River's flow to the south approximately 15,000 years ago.

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 and in the footnote below), the Skagit River flowed south through high drops and cascades in the gorge. Two high-gradient features within the Gorge bypass reach (Existing Feature 1 and Existing Feature 2) have been identified to potentially impede upstream migration of fishes (Envirosphere 1989). Existing Feature 1, the downstream feature, is located approximately 0.6 miles upstream of Gorge Powerhouse at Project River Mile [PRM] 95.7 (U.S. Geological Survey [USGS] River Mile [RM] 95.2) and consists of fields of large boulders and granitic blocks in narrow sections of the

[43] Riedel (2007) states, "overflow of proglacial lakes at the southern margin of the Cordilleran Ice Sheet breached the North Cascades crest at Skagit Gorge, causing lower Skagit River to capture upper Skagit River and its tributaries. Thunder Creek was once the headwaters of the north-draining upper Skagit system, which flowed to Fraser River via Klesilkwa Pass or Sunshine Valley…Capture of this drainage by lower Skagit River resulted in a large drop in base level and incision of lower Thunder Creek and other Skagit tributaries entering Skagit Gorge."

stream channel. The effective height[44] of Existing Feature 1 is approximately 20 feet. Existing Feature 2 is located farther upstream at PRM 96.2 (USGS RM 95.7) and also consists of fields of large boulders and granitic blocks in narrow sections of the stream channel. The effective height of Existing Feature 2 is 42 feet. Additional constrictions and falls farther upstream likely represented insurmountable barriers to anadromous fish passage. Historical records supporting the conclusion that anadromous fish distribution likely did not extend upstream of the present location of Gorge Lake prior to the construction of the Project include Gibbs (1858), Smith and Anderson (1921), Lane and Lane (1977), and Envirosphere (1989).

Fish survey results in the Gorge bypass reach (Envirosphere 1989; Upper Skagit Indian Tribe 2016) support the conclusion that Existing Feature 1, approximately 0.6 miles upstream of the Gorge Powerhouse, often blocks upstream movement of salmonids. In 2016, live steelhead, steelhead redds, and Coho Salmon fry were seen below Existing Feature 1, whereas juvenile Rainbow Trout were found throughout the Gorge bypass reach (Upper Skagit Indian Tribe 2016).[45] Further field reconnaissance on October 24, 2019, by a team of City Light, WDFW, Upper Skagit Indian Tribe, and National Park Service (NPS) biologists observed no adult steelhead in the Gorge bypass reach (as expected given 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 Existing Feature 1. In contrast, several juvenile Rainbow Trout, Brook Trout, and native char were angled or electrofished upstream of Existing Feature 2 (located approximately 1.3 miles upstream of the Gorge Powerhouse).

Recent surveys conducted by WDFW and the Upper Skagit Indian Tribe in 2021 and 2022, respectively, documented the presence of salmonids in various segments of the Gorge bypass reach. WDFW conducted a survey of the bypass reach on November 4, 2021 (WDFW 2021) (see Table 4.2.3-4 for a description of reach delineations used during the survey). WDFW snorkelers observed adult Coho (n = 138), Pink (n = 196), Chinook (n = 2), and Sockeye (n = 4) salmon in the reach downstream of the 0.54-mile cascade (full survey results are shown in Table 4.2.3-5). Locations of Pacific salmon and *O. mykiss* observed by WDFW, i.e., anadromous or potentially anadromous fish, are shown, along with the survey reach delineations and the locations of Existing Feature 1 and Existing Feature 2 in Figure 4.2.3-1 (Figure 4.2.3-1 also shows the locations of Pacific salmon and *O. mykiss* observed during 2022 surveys, described below, conducted by the Upper Skagit Indian Tribe). The feature identified as "0.54-mile cascade" in WDFW (2021), which

44 Effective heights are represented by the total elevation difference between surveyed ground elevations measured at the upstream and downstream boundary of each feature.

45 Surveys of the Gorge 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 Gorge 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 Existing Feature 1 located 0.6 miles upstream of the Gorge Powerhouse. No adult steelhead or redds were observed upstream of Existing Feature 1. Numerous Coho Salmon fry were observed in the Gorge bypass reach up to about 0.6 miles upstream of the Gorge Powerhouse; no Coho fry were observed above Existing Feature 1, located 0.6 miles above the Gorge Powerhouse. Seven juvenile Rainbow Trout/steelhead were observed in pools below and within Existing Feature 1 at 0.6 miles upstream of the Gorge Powerhouse, and five juvenile Rainbow Trout/steelhead were observed in a pool located immediately upstream of Existing Feature 1; 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 (*Salvelinus fontinalis*) were observed above the barrier in June.

is the downstream end of survey Reach 3, corresponds to Existing Feature 1 described in City Light's reports and this Exhibit E; the "landslide obstacle," which is the downstream end of survey Reach 4, corresponds to Existing Feature 2 (see Figure 4.2.3-1). Of the 196 Pink Salmon observed by WDFW in 2021, 77 were dead. In the reaches between the 0.54-mile cascade (Existing Feature 1) and the concrete railway abutment, snorkelers identified 118 live adult Coho Salmon (Table 4.2.3-5). However, the vast majority of these (n=111) were seen downstream of Existing Feature 2. WDFW personnel observed that Pink and Sockeye salmon were "actively spawning" downstream of the 0.54-mile cascade.

Table 4.2.3-4. Reach descriptions and Global Positioning System (GPS) locations of the top and bottom of each WDFW (2021) survey reach. Reach establishment and recording of GPS locations were conducted by NPS staff in 2021.

Reach Number	Bottom of reach Description	Latitude	Longitude	Top of Reach Description	Latitude	Longitude
1	Gorge powerhouse bridge	48.675747	-121.241655	Top of backwater area	48.68106	-121.24334
2	Top of backwater area	48.68106	-121.24334	0.54-mile cascade	48.683099	-121.241766
3	0.54-mile cascade[1]	48.683099	-121.241766	Bottom of landslide obstacle	48.687411	-121.23542
4	Bottom of landslide obstacle[2]	48.687411	-121.235420	Slide pool outlet	48.687405	-121.233259
5	Slide pool outlet	48.687405	-121.233259	Top of slide pool	48.689219	-121.228385
6	Top of slide pool	48.689219	-121.228385	Concrete railway abutment	48.69028	-121.225413
7	Concrete railway abutment	48.69028	-121.225413	Beginning of long hydromodification	48.693603	-121.21861
8	Beginning of long hydromodification	48.693603	-121.21861	Bottom of pool below Gorge Dam bridge	48.696502	-121.213561
9	Bottom of pool below Gorge Dam bridge	48.696502	-121.213561	Gorge Dam plunge pool outlet	48.697292	-121.210529
10	Gorge Dam plunge pool outlet	48.697292	-121.210529	Gorge Dam	48.697994	-121.208806

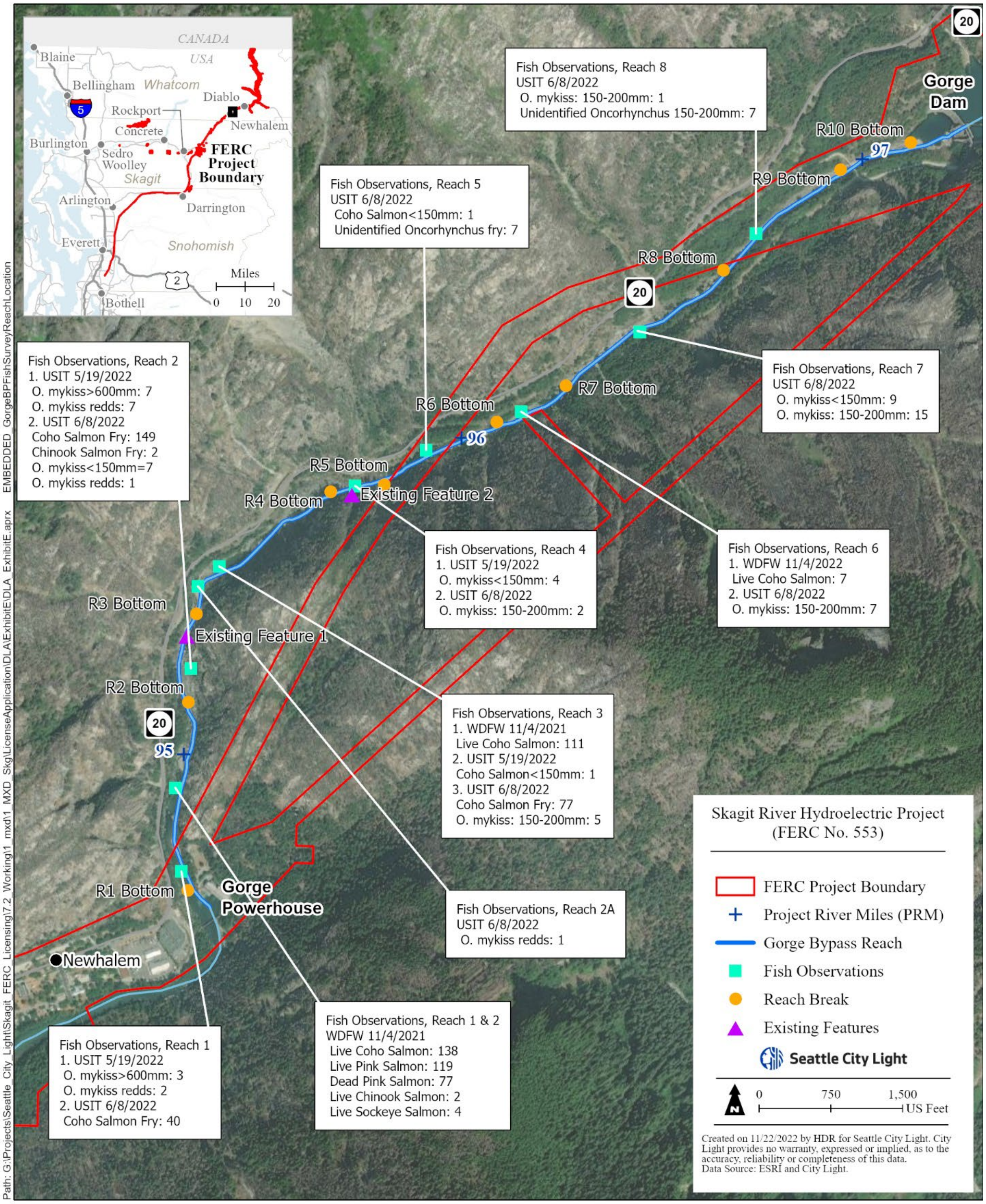
Source: WDFW 2021.

1 The "0.54-mile cascade" corresponds to Existing Feature 1.

2 The "landslide obstacle" corresponds to Existing Feature 2.

Surveys of the Gorge bypass reach were conducted by the Upper Skagit Indian Tribe in May and June 2022 (The Upper Skagit Indian Tribe also used the reach delineations identified in Table 4.2.3-4). On May 19, 2022, Upper Skagit Indian Tribe snorkelers observed 14 *O. mykiss* and one Coho Salmon in the Gorge bypass reach downstream of the "slide pool outlet" (Upper Skagit Indian Tribe 2022a) (full survey results are shown in Table 4.2.3-6 and Figure 4.2.3-1). Ten of the *O. mykiss*, all observed downstream of the 0.54-mile cascade (Existing Feature 1), were > 600 millimeters (mm) in length and considered to be steelhead. Four of the *O. mykiss*, all observed upstream of the 0.54-mile cascade (Existing Feature 1), were < 150 mm long. The single Coho

Salmon, observed upstream of the 0.54-mile cascade (Existing Feature 1), was < 150 mm in length. No fish were collected, and no genetics analysis results were reported. The snorkelers documented nine redds–considered to have been constructed by steelhead given the timing of the survey– all located downstream of the 0.54-mile cascade (Existing Feature 1).



Source: WDFW 2021 and Upper Skagit Indian Tribe 2022a, 2022b.

Figure 4.2.3-1. WDFW (2021) and Upper Skagit Indian Tribe (2022a, 2022b) fish survey results and reach delineations in the Gorge bypass reach. Fish species included in the map are Pacific salmon and *O. mykiss*, i.e., fish that are either anadromous or potentially anadromous.

Table 4.2.3-5. Summary of fish observations made by WDFW staff in the Gorge bypass reach on November 4, 2021. All fish observed were adults. Flow was noted as continuous if no dewatered segments existed in the reach.

Reach	Flow Conditions	Species	Live Fish Observed	Dead Fish Observed	Comments
1-2	Continuous	Coho Salmon	138	0	
		Pink Salmon	119	77	
		Chinook Salmon	2	0	
		Sockeye Salmon	4	0	
3	Continuous	Coho Salmon	111	0	
4	Continuous		0	0	No fish observed
5	Continuous		0	0	No fish observed
6	Continuous	Coho Salmon	7	0	Coho in pool with old bridge pilings at top of reach
7	Continuous		0	0	No fish observed
8	Continuous		0	0	No fish observed
9	Intermittent		0	0	No fish observed
10	Continuous		--	--	Did not survey due to poor visibility

Source: WDFW 2021.

Table 4.2.3-6. Summary of fish observations made by the Upper Skagit Indian Tribe in the Gorge bypass reach on May 19, 2022. Flow was noted as continuous if no dewatered segments existed in the reach.

Reach	Flow Conditions	Species	Number Observed	Fish Size Class (mm)	Number of Redds
1	Continuous	*O. mykiss*	3	>600	2
2	Continuous	*O. mykiss*	7	>600	7
3	Intermittent	Coho Salmon	1	<150	
4	Intermittent	*O. mykiss*	4	<150	
5	Continuous				
6	Continuous				
7	Intermittent				
8	Intermittent				

Source: Upper Skagit Indian Tribe 2022a.

On June 8, 2022, Upper Skagit Indian Tribe snorkelers observed fish in the Gorge bypass reach downstream of the “bottom of pool below Gorge Dam Bridge” (Upper Skagit Indian Tribe 2022b) (The Upper Skagit Indian Tribe used the reach delineations identified in Table 4.2.3-4, except a reach was inserted: Reach 2A, i.e., from the bottom of 0.54-mile cascade to the top of 0.54-mile cascade). Surveyors observed salmonid fry, which were judged to be Coho (n = 267) and Chinook (n = 2) (full survey results are shown in Table 4.2.3-7 and Figure 4.2.3-1). No fish were collected, and no genetics analysis results were reported. All salmon fry were observed downstream of the bottom of landslide obstacle (Existing Feature 2), and most Coho Salmon fry and both Chinook

Salmon fry were seen below the 0.54-mile cascade (Existing Feature 1). Also observed were *O. mykiss* (n = 46), Cutthroat Trout (n = 1), char species (n = 7), and Brook Trout (n = 1), all of which were < 200 mm in length, and char species (lengths unspecified). The snorkelers documented two redds, both considered to have been constructed by steelhead given the timing of the survey, located within or downstream of the 0.54-mile cascade (Existing Feature 1).

Table 4.2.3-7. Summary of fish observations made by the Upper Skagit Indian Tribe in the Gorge bypass reach on June 8, 2022. Flow was noted as continuous if no dewatered segments existed in the reach.

Reach	Flow Conditions	Species	Number Observed	Fish Size Class (mm)	Number of Redds
1	Continuous	Coho Salmon	40	Fry	
2	Continuous	*O. mykiss*	7	<150	1
		Coho Salmon	149	Fry	
		Chinook Salmon	2	Fry	
2A	Continuous	Westslope Cutthroat Trout	1	150 - 200	1
3	Intermittent	*O. mykiss*	5	150 - 200	
		Coho Salmon	77	Fry	
4	Intermittent	*O. mykiss*	2	150 - 200	
		Brook Trout	1	150 - 200	
5	Continuous	Coho Salmon	1	<150	
		Unidentified *Oncorhynchus*	7	Fry	
		Char species	7		
6	Continuous	*O. mykiss*	7	150 - 200	
7	Intermittent	*O. mykiss*	9	<150	
		O. mykiss	15	150 - 200	
8	Intermittent	Unidentified *Oncorhynchus*	7	150 - 200	
		O. mykiss	1	150 - 200	

Source: Upper Skagit Indian Tribe 2022b.

No observations of the following species were recorded in the Gorge bypass reach during the 2021 and 2022 surveys: Chum Salmon, Sea-run Cutthroat Trout, Dolly Varden, Bull Trout (although "char species" (n = 7) were observed in Reach 5, see Table 4.2.3-7), Salish Sucker, and Pacific Lamprey.

Anadromous Fish

<u>Chinook Salmon</u>

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). Beamer et al. (2005a) identified three freshwater rearing strategies based on body size at out-migration: fry (≤ 45 mm fork length), subyearling parr (46-100 mm fork length), and yearling smolts (> 100 mm fork length). Chinook that rear in freshwater for a year or more before migrating to sea undertake extensive offshore migrations and return to their natal rivers in spring, summer, or fall. Those that migrate to sea in their first year of life, usually only a few months after emergence, remain in nearby coastal areas and typically return to their natal rivers in late summer or fall, shortly before spawning.

Chinook Salmon that migrate to sea earlier tend to spawn in the lower and middle mainstem areas of large rivers, whereas those that rear in freshwater tend to spawn in the middle and upper reaches of smaller mainstem rivers and larger tributaries (Healey 1991). Spawning sites are typically located near deep pools in areas with abundant instream cover. Adequate spawning area and sub-gravel flow are important in the choice of redd sites. Incubating salmon eggs require a relatively stable stream channel, adequate intragravel percolation rates (i.e., limited siltation), high dissolved oxygen (DO) 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.

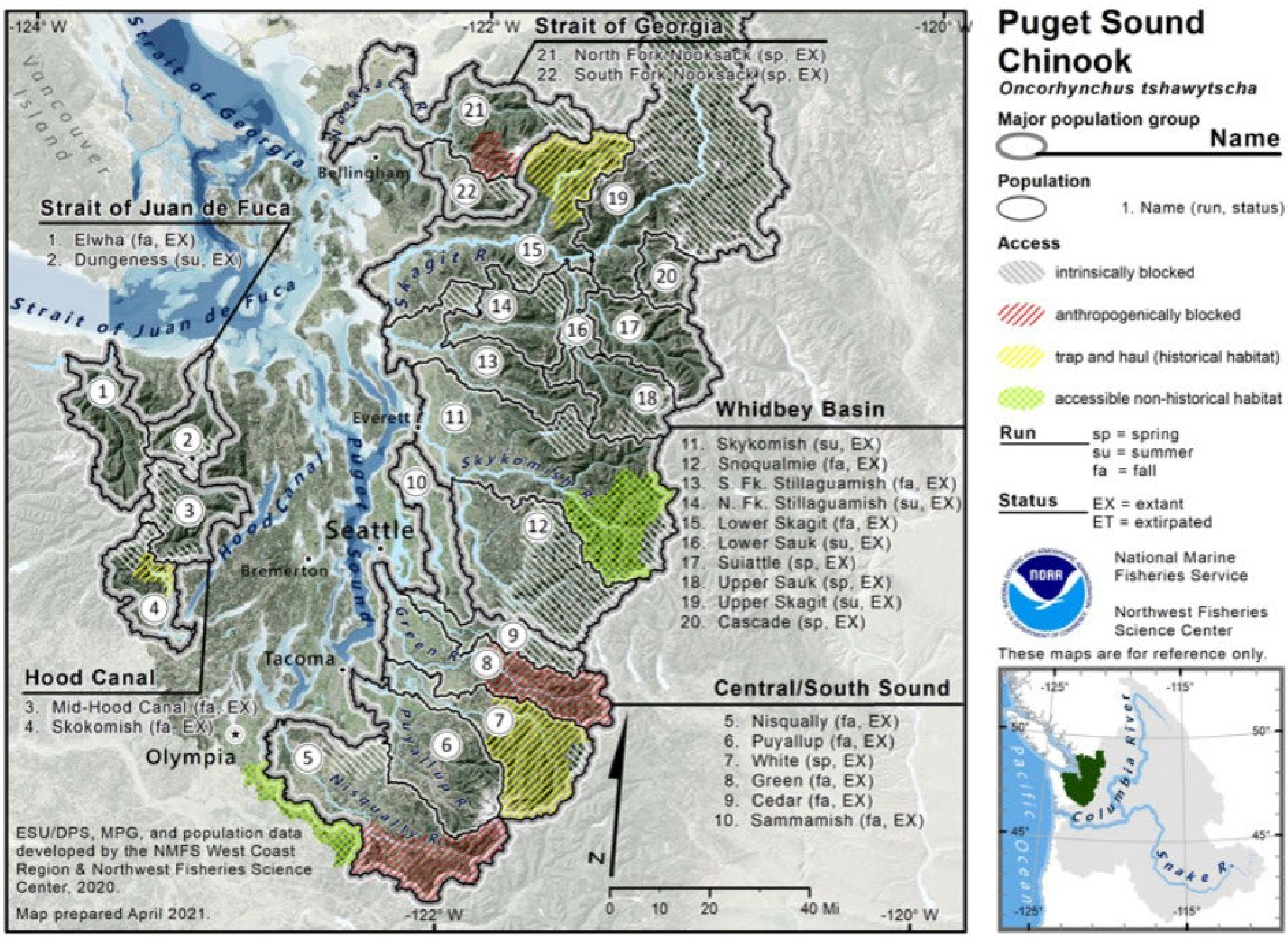
Following emergence, Chinook fry swim or are displaced downstream, where they move directly into estuaries or reside in the margins of streams or rivers. The low-velocity areas they occupy often contain wood, root wads, overhanging vegetation, or undercut banks (Healey 1991). As juvenile Chinook grow, they move into the deeper, higher velocity areas (Myers et al. 1998).

Naturally produced ocean-type Chinook usually migrate to the estuary during one of three distinct phases: immediately after yolk reabsorption, 60-150 days after yolk absorption, or after a 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, although 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).

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 ESU (Ruckelshaus et al. 2006) (Figure 4.2.3-2). 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. Each is considered a "demographically independent population" (DIP) (Puget Sound Technical Recovery Team [PSTRT] 2005). The Skagit River and its tributaries upstream of the Sauk River support the 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 (Washington Department of Fish and Wildlife [WDFW] 2019).

Ford et al. (2011) concluded that Puget Sound Chinook Salmon escapement levels were generally below the range needed for recovery, ***except*** for the Skagit River system populations (Ford 2022). In 2015, the Northwest Fisheries Science Center (NWFSC) concluded that all Puget Sound Chinook Salmon populations were still well below escapement levels needed to support recovery and found that hatchery-origin spawners were present in high fractions in most populations outside the Skagit River watershed (Ford 2022). In recent years, only five populations have had productivities above zero: the Lower and Upper Skagit, Lower and Upper Sauk, and Suiattle rivers in the Whidbey Basin major population group (MPG) (Ford 2022). Overall, the Puget Sound Chinook Salmon ESU remains at “moderate” risk of extinction, and viability is largely unchanged from the 2015 NWFSC status review (Ford 2022).



Source: Ford 2022.

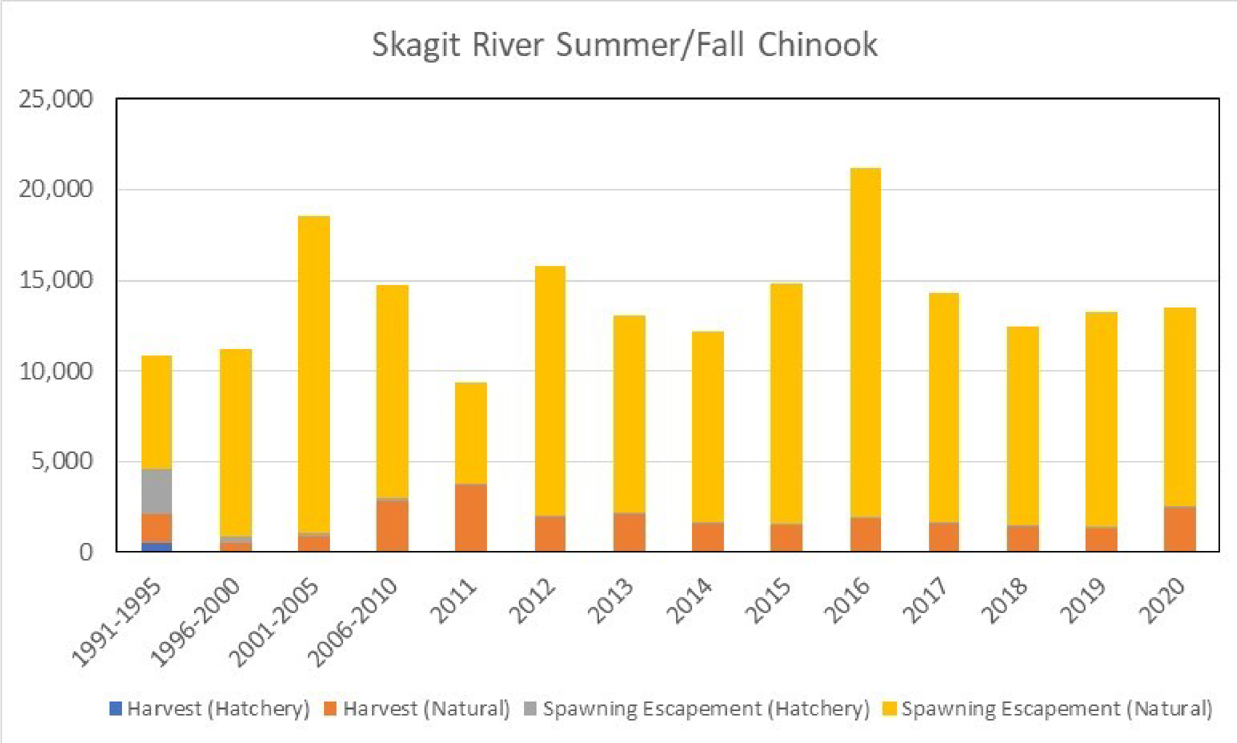
Figure 4.2.3-2. Puget Sound Chinook Salmon populations.

Ford (2022) states that abundance across the Puget Sound Chinook Salmon ESU has generally increased since the NWFSC 2015 status review (NWFSC 2015), with only two of the 22 populations (Cascade River and North and South Fork Stillaguamish rivers) exhibiting a negative percent change in the five-year geometric mean for natural-origin spawner abundances. Fifteen-year trends computed for two time periods (1990-2005, 2004-2019) indicate that natural-origin spawner abundance had declined across most MPGs. The populations with the highest fractions of natural-origin spawners from 1980-2018 are the six Skagit River populations (Ford 2022).

Habitat protection and restoration in all watersheds have improved stream and estuary habitat, despite substantial increases over the last 20 years in the size of the human population in the Puget Sound region (Ford 2022). However, according to Ford (2022), the Salmon Science Advisory Group of the Puget Sound Partnership found that monitoring results reveal no strong link between restoration and large-scale fish response (Puget Sound Partnership 2021).

Puget Sound Chinook Salmon are harvested in ocean fisheries, Puget Sound fisheries, and terminal river fisheries. Because they migrate north, most ocean fishery impacts occur in Canada and Alaska. Some populations are also harvested at lower rates in the coastal fisheries off Washington and Oregon. For populations in the Whidbey Basin (Snohomish, Stillaguamish, and Skagit rivers), harvest in the northern fisheries accounts for a large portion of the exploitation rate (Ford 2022). Harvest rates for Chinook Salmon in Puget Sound generally declined in the 1990s but have been stable or increasing since then.

The Pacific Fishery Management Council (PFMC) conducted a review of Pacific Coast salmon fisheries, including the Skagit River Summer/Fall Chinook stocks, to assess management performance, stock status, and socioeconomic impacts (PFMC 2021). The PFMC examined the Skagit Summer/Fall Chinook run to assess system-wide conservation and whether management objectives were being met. Total ocean harvest by commercial net and troll (treaty Indian and non-Indian) fisheries and escapement to spawning grounds of hatchery and natural-origin fish are shown in Figure 4.2.3-3 (PFMC 2021). Harvest and escapement for Lower Skagit, Upper Skagit, and Sauk River Chinook Salmon 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 the combined Chinook stocks.



Source: PFMC 2021.

Figure 4.2.3-3. Ocean commercial net harvest and spawning escapement of hatchery and natural Summer/Fall Chinook Salmon in the Skagit River, 1991-2020.

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 1991-2020 was 13,937 hatchery and natural origin fish (PFMC 2021). The median over the same time period was 13,351, ranging from a single-year terminal run size of 9,317 in 2011 to 21,210 in 2016 (PFMC 2021). The average Puget Sound run size for the most recent five-year period (2016-2020) was 14,916 (range = 12,406-21,210) (PFMC 2021). The number of commercial net catches for Skagit River Summer/Fall Chinook ranged from a single-year high of 3,713 hatchery- and natural-origin fish in 2011 to a single year low of 1,023 in 2017 (PFMC 2021).

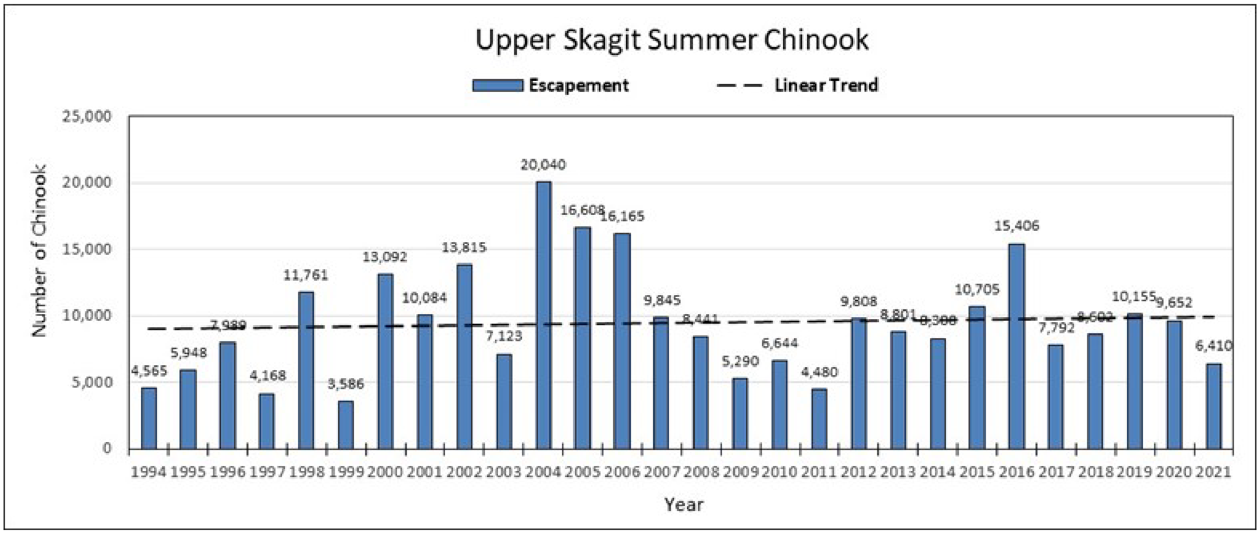
Harvest of the Skagit Summer/Fall Chinook run available to Puget Sound net fisheries (spawning escapement plus ocean commercial net catches), not including fish caught by troll and recreational fisheries in Puget Sound, ranged from a single-year-high of 39.8 percent in 2011 to a single-year low of 8.7 percent in 2016 (PFMC 2021). Harvest percentages were also low over the 1996-2000 (4.5 percent) and 2001-2005 (4.4 percent) periods (PFMC 2021). Average harvest percentage of Skagit River Summer/Fall Chinook from 1991 to 2020 was 14.4 percent (PFMC 2021). The number of commercial net catches for Skagit River Summer/Fall Chinook for the most recent five-year period (2016-2020) was 1,727 (range = 1,307-2,477) (PFMC 2021).

Upper Skagit Summer Chinook Salmon

Upper Skagit Summer Chinook Salmon spawn in the Skagit River mainstem and its tributaries upstream of the Sauk River confluence (Skagit River System Cooperative [SRSC] and WDFW

2005; WDFW 2002). Important tributaries include the lower Cascade River, and Illabot, Diobsud, Bacon, and Goodell creeks. Spawning occurs primarily in September to early October, which is earlier than Lower Skagit Fall Chinook Salmon. The upstream extent of spawning is near Gorge Powerhouse.

Data[46] collected since the issuance of the current Project license indicate the Upper Skagit Summer Chinook Salmon population had a geometric mean escapement of 8,652 fish for return years 1994-2021, and 9,304 fish for return years 2016-2021 (Figure 4.2.3-4).



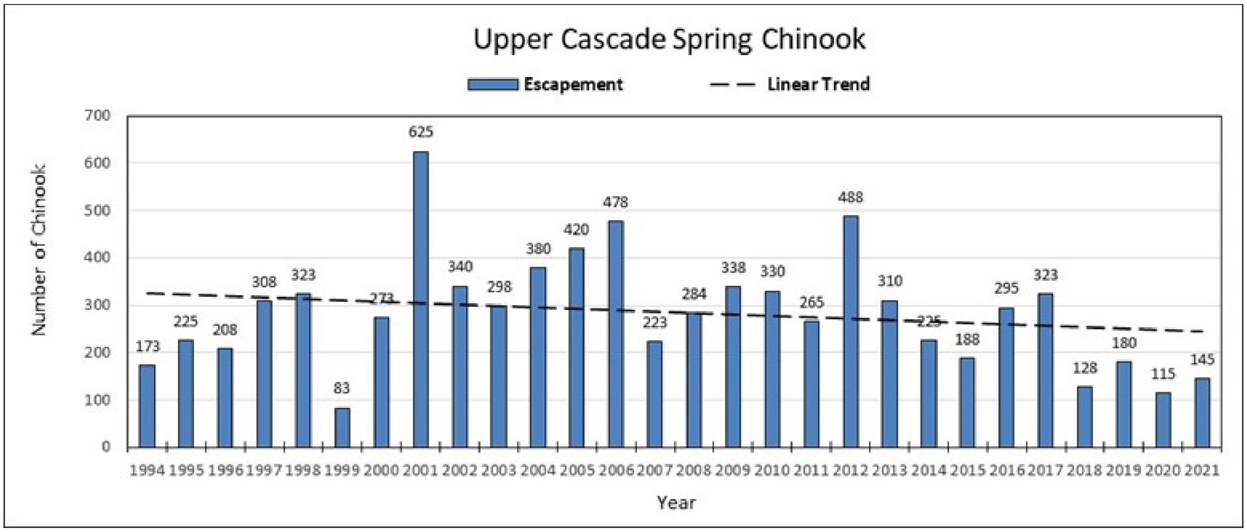
Source: WDFW 2022.

Figure 4.2.3-4. Upper Skagit Summer Chinook Salmon spawning escapement (1994-2021); 2021 estimates are preliminary.

Upper Cascade Spring Chinook Salmon

Upper Cascade Spring Chinook Salmon spawn in the Cascade River and its larger tributaries upstream of RM 7.8 and the end of the canyon near Lookout Creek (SRSC and WDFW 2005; WDFW 2002). Spring Chinook Salmon may spawn in 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 (Washington Department of Fisheries [WDF] 1975; WDFW 2002). River entry from saltwater begins in April, and spawning occurs in mid-July through mid-September (Table 4.2.3-3). Geometric mean escapement for return years 1994-2021 and 2016-2021 was 259 and 182 fish, respectively (Figure 4.2.3-5).

[46] 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 2022.

Figure 4.2.3-5. Upper Cascade Spring Chinook Salmon spawning escapement (1994-2021); 2021 estimates are preliminary.

Coho Salmon

General Life History and Habitat Requirements

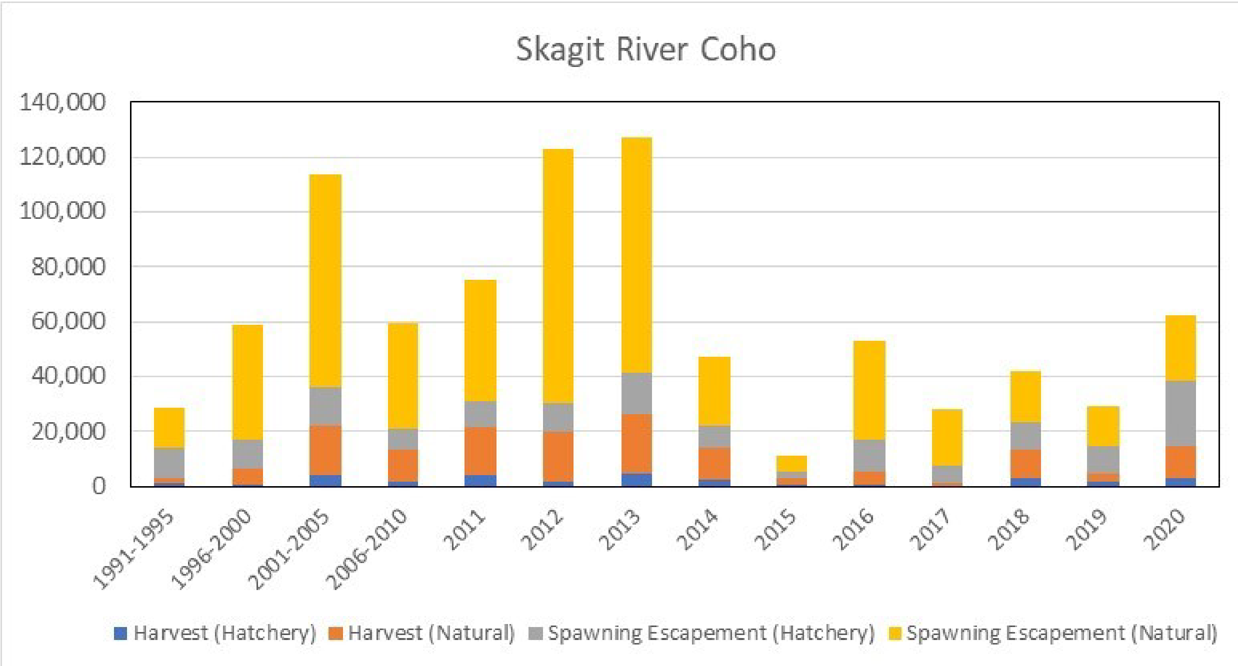
In Washington, Oregon, and California, over 95 percent of Coho Salmon mature at age 3 and enter their natal streams in late summer and fall. Spawning typically occurs from early September through February. After emergence, juvenile Coho spend one to two years in freshwater before migrating to saltwater. Coho usually rear in the ocean for about 18 months, although some males (jacks) return to freshwater after only five to seven months in the ocean (Weitkamp et al. 1995).

Coho Salmon usually spawn in gravelly transitions between pools and riffles, often close to cover. Winter floods with substantial bedload movement, low flows, and heavy silt loads reduce egg survival. Following emergence from the gravel, Coho fry form schools and move into shallow, low velocity areas (Reeves et al. 1989), often close to cover such as overhanging or submerged logs, undercut banks, overhanging vegetation, or large substrate. As fry grow, they begin to occupy areas of open shoreline and progressively move into areas of higher velocity (Sandercock 1991; Reeves et al. 1989). During winter, juvenile Coho move into side channels and backwater channels, especially those with groundwater influence.

Distribution, Abundance, and Demographics in the Skagit River Basin

Coho Salmon are native to the Skagit River basin, and WDFW has identified two stocks within the Project vicinity: Skagit River Coho and Baker River Coho (WDF 1975, WDFW 2002, and WDF, WDW, and Western Washington Treaty Indian Tribes [WWTIT] 1994). Skagit River Coho generally spawn from early October through mid-February in tributaries, 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.

PFMC (2021) assessed how system-wide conservation and management objectives were being met for Skagit River Coho Salmon. The assessment summarized total ocean harvest by commercial net and troll (treaty Indian and non-Indian) fisheries and escapement to spawning grounds of both hatchery- and natural-origin Coho (Figure 4.2.3-6). Harvest and escapement numbers represent Coho Salmon from the entire Skagit River, including the Baker River population.



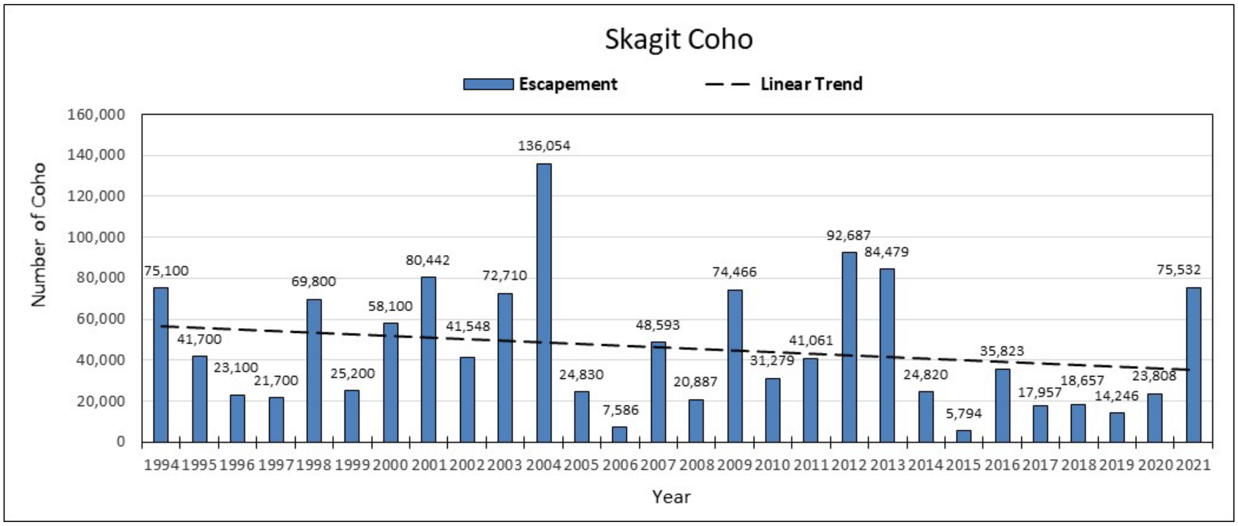
Source: PFMC 2021.

Figure 4.2.3-6. Ocean commercial net harvest and spawning escapement of hatchery and natural Coho Salmon in the Skagit River, 1991-2020.

The average terminal run size of Skagit River Coho Salmon from 1991-2020 was 67,351 hatchery- and natural-origin fish. The median over the same time period was 59,027, ranging from a single-year terminal run size low of 17,171 in 2015 to a single-year high of 143,853 in 2013 (PFMC 2021). The average Puget Sound terminal run size for the most recent five-year period (2016-2020) was 48,282 (range = 28,058-71,802) (PFMC 2021).

The number of commercial net catches for Skagit River Coho Salmon ranges from a single-year high of 26,533 hatchery- and natural-origin fish in 2013, to a low of 1,043 fish in 2017, with an average of 12,086 from 1991-2020 (PFMC 2021). Commercial net catches 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 28.0 percent in 2018 to a low of 3.7 percent in 2017. The average commercial net catch of terminal Coho Salmon in the Skagit River was 16.2 percent from 1991-2020.

The geometric mean escapement of Skagit River Coho for return years 1994-2021 was 37,098 fish (Figure 4.2.3-7). The geometric mean escapement for return years 2016-2021 was 29,297 fish.



Source: WDFW 2022.

Figure 4.2.3-7. Skagit River Coho Salmon spawning escapement (1994-2021); 2021 estimates are preliminary; Coho escapement for 2019 was calculated using a regression equation derived from escapements estimated by Skagit System Cooperative tag studies from 1986-1990.

Pink Salmon

General Life History and Habitat Requirements

Pink Salmon have an obligate two-year life cycle and relatively small size, averaging 4 pounds at maturity (Wydoski and Whitney 2003). They use freshwater almost exclusively for spawning and incubation and migrate to the ocean or estuary shortly after emergence. In Washington and southern British Columbia, river entry usually occurs from July-October, and spawning occurs from August-October (Heard 1991).

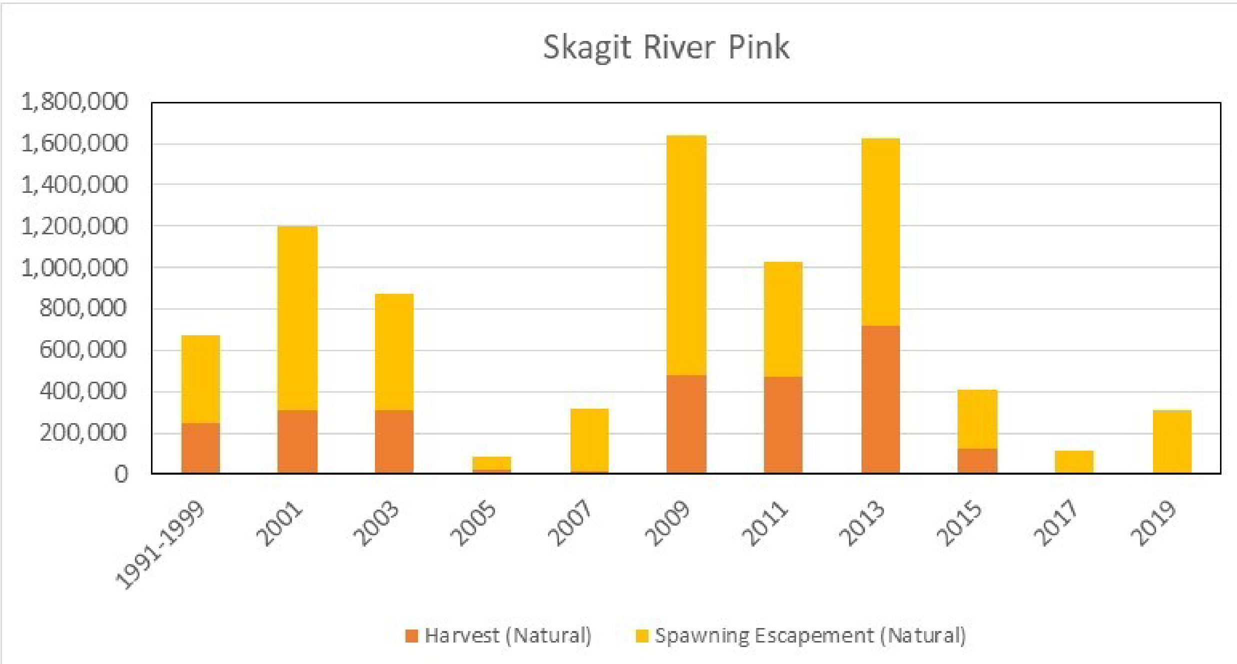
Pink Salmon spawn in fast-flowing, shallow water in the lower reaches of rivers and streams and in intertidal areas (Hard et al. 1996). Most spawning occurs in riffles, typically at depths of 0.9-3.3 feet (Heard 1991). Eggs hatch in early to mid-winter. Following emergence, fry migrate downstream to saltwater during a short outmigration that peaks in late winter through May (Heard 1991). After a short residence in estuaries and nearshore habitats, Pink Salmon move offshore, where they remain for 12-16 months (Heard 1991).

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.[47] Spawning generally occurs from September-October from Sedro-Woolley to Newhalem, with the heaviest spawning between Marblemount and Newhalem (Federal Energy Regulatory Commission [FERC] 2006). On October 4, 1995, NMFS concluded that Skagit River Pink Salmon were not at risk of extinction and proposed no ESA-listing for the ESU (60 FR 51928).

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

PFMC (2021) estimated total Skagit River Pink Salmon harvest by commercial net and troll (treaty Indian and non-Indian) fisheries and escapement to spawning grounds of both hatchery- and natural-origin Pink Salmon (Figure 4.2.3-8). Commercial net catches 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 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 3.0 percent in 2019, with an average of 26.3 percent from 1991-2019.

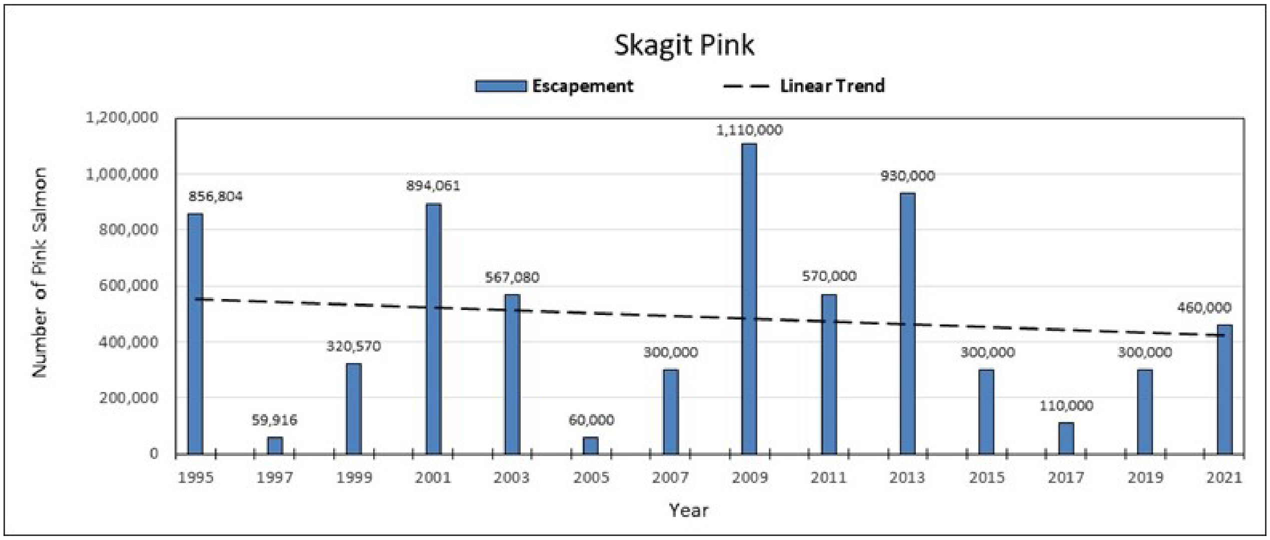


Source: PFMC 2021.

Figure 4.2.3-8. Ocean commercial net harvest and spawning escapement of hatchery and natural Pink Salmon in the Skagit River, 1991-2019.

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 1991-2019 was 752,184 fish. The median over the same time period was 670,856, ranging from a single-year terminal run size low of 85,191 in 2005 to a single-year high of 1,638,121 in 2009 (PFMC 2021).

The geometric mean escapement for return years 1995-2021 was 349,296 fish for the Skagit River Pink Salmon populations (Figure 4.2.3-9). The geometric mean escapement for return years 2015 to 2021 was 259,776 fish.



Source: WDFW 2022.

Figure 4.2.3-9. Skagit River Pink Salmon spawning escapement (1994-2021); 2021 estimates are preliminary.

<u>Chum Salmon</u>

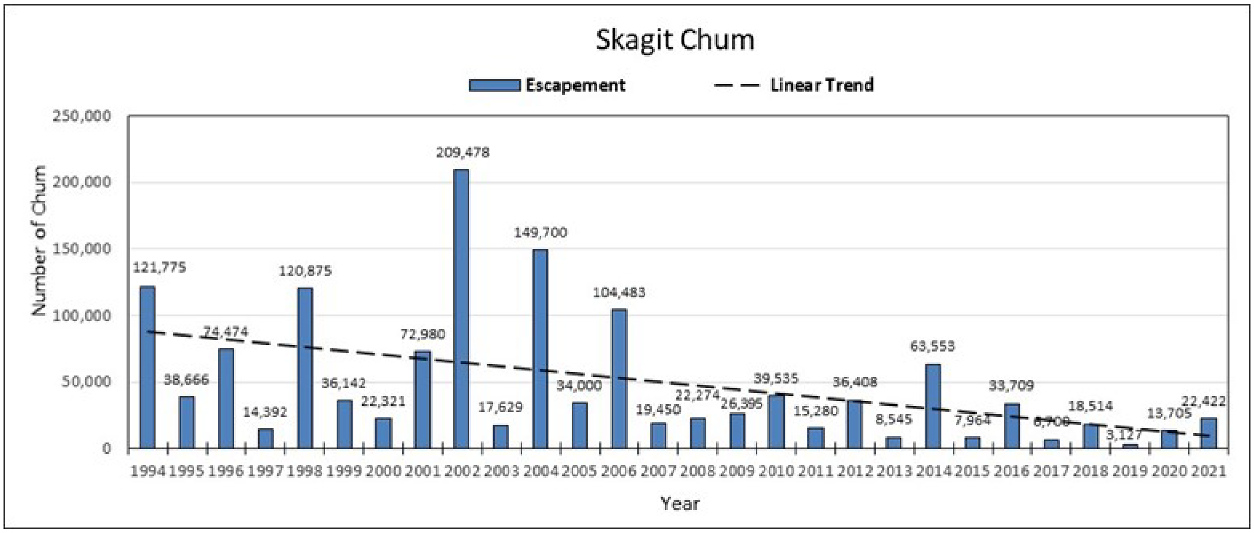
General Life History and Habitat Requirements

Summer, fall, and winter runs of Chum Salmon occur in Washington, but fall-run fish predominate. Most Chum Salmon mature between three and five years of age, enter freshwater beginning in June (Salo 1991), and spawn from early November to mid-January in mainstem and side-channel habitats, often just above tidal influence. WDFW reported that Chum Salmon in Washington do not appear to select areas of upwelling groundwater for redd construction but most commonly use areas at the heads of riffles (Johnson et al. 1997). Eggs hatch in 2-18 weeks (Wydoski and Whitney 2003; Johnson et al. 1997). In Washington, Chum reside in freshwater for up to a month and outmigrate to estuaries from late January through May, where they remain until they transition to areas of higher salinity (Wydoski and Whitney 2003; Johnson et al. 1997).

Distribution, Abundance, and Demographics in the Skagit River Basin

WDFW (2002) identified 69 Chum Salmon stocks in the Puget Sound region, three of which occur 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 from RM 34 to 93 in the Skagit River and in the Cascade River, Nookachamps, Gilligan, Illabot, and Bacon creeks.

All three Skagit River Chum populations are of native origin with wild production. The geometric mean escapement for return years 1994-2021 was 30,321 fish (Figure 4.2.3-10). The geometric mean escapement for return years 2016-2021 was 12,609 fish. A regional decline in Chum Salmon was found to be partially linked to marine productivity (Malick et al. 2017). Some Chum stocks have now rebounded, although not the Skagit River run (Ruff 2019). On March 10, 1998, NMFS determined that listing of the Puget Sound/Strait of Georgia Chum Salmon ESU was unwarranted based on trends in spawning escapement.



Source: WDFW 2022.

Figure 4.2.3-10. Skagit River Chum Salmon spawning escapement (1994-2021); 2021 estimates are preliminary.

<u>Sockeye Salmon</u>

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 depend on a period of juvenile rearing in a lake. However, some Sockeye (ocean-type) spawn in rivers and migrate directly to the ocean after only a few months. Spawning occurs from August-November in areas with small- to medium-sized gravel and limited 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, which includes fish produced on artificial spawning beaches that are transported as fry to Baker Lake and then released as smolts below lower Baker Dam. A small number of riverine Sockeye are found in the mainstem Skagit River, the Sauk River, and lower Bacon Creek.

<u>Steelhead</u>

General Life History and Habitat Requirements

O. mykiss can express an anadromous (steelhead) or resident (Rainbow Trout) life history, 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). Based on analysis of otolith strontium-calcium ratios, Bodensteiner (2020) found that 20 out of 60 steelhead captured in the Skagit River during 2018 had a non-anadromous maternal parent.

In the Skagit River basin, steelhead typically migrate to marine waters after spending two to three years in freshwater (NMFS 2012). They generally reside in the ocean for two or three years before returning to their natal streams to spawn as four-, five-, or six-year-olds. Unlike most Pacific salmon, steelhead are capable of spawning more than once. However, it is rare for steelhead to spawn more than twice and most that do so are females. Steelhead typically spawn between December and June (Bell 1990; Busby et al. 1996).

Steelhead can be divided into “stream-maturing” and “ocean-maturing” ecotypes. Stream-maturing steelhead enter freshwater in a sexually immature condition and require several months to a year to mature and spawn. These fish are often referred to as “summer-run” steelhead. Ocean maturing steelhead 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 (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 DO, and adequate water depth above the redd. After emergence, steelhead fry form small schools and inhabit stream margins. As they grow, they begin to disperse downstream. In their first year of life, most steelhead live in riffles, but some larger fish also inhabit pools or deep runs (Barnhart 1991). Instream cover such as large rocks, logs, root wads, and aquatic vegetation are important for juvenile steelhead. Rearing typically lasts two years, after which fish outmigrate, 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 by marine mammals and birds (Simenstad et al. 1982; Gonor et al. 1988). Steelhead smolts typically migrate rapidly from natal streams and rivers to the ocean, spending only a few days to a couple of weeks in Puget Sound. Despite their rapid migration into and through Puget Sound, steelhead mortality rates can be high at this time (Moore et al. 2010; Moore et al. 2015).

Steelhead oceanic migration patterns are largely unknown. Limited evidence from tagging and genetic studies suggests that Puget Sound Steelhead travel to the central North Pacific Ocean (Burgner et al. 1992; NMFS 2012).

Distribution, Abundance, and Demographics in the Skagit River Basin

Myers et al. (2015) grouped the Puget Sound Steelhead distinct population segment (DPS) into three MPGs containing 32 DIPs 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. The Skagit River contains four steelhead DIPs: (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. Lane and Lane (1977) report that Upper Skagit Indians fished for steelhead at, but not above, Newhalem.

The NWFSC 2015 status review of Puget Sound steelhead concluded that the risks faced by the DPS had not changed significantly since the 2007 ESA listing (Ford 2022). Negative trends in natural spawner abundance remained predominantly negative, and suitable habitat continued to be limited. Extinction risk for the DPS is still considered moderate (Ford 2022).

The long-term abundance of adult steelhead returning to many Puget Sound rivers has decreased significantly since the late 1970s. However, more recently there have been some improvements in abundance and productivity (Ford 2022). High ocean temperatures in 2014 and 2015 and high stream temperatures and low summer streamflows during 2015 decreased marine and freshwater survival. However, reduced harvest and declining hatchery production were determined to have modestly decreased risks to natural spawners.

Harvest of Puget Sound steelhead is limited to terminal tribal net and recreational fisheries. Harvest rates were curtailed in 2003, with "wild" harvest rates held below 10 percent (Ford 2022). Recreational fisheries are mark-selective for hatchery stocks, but some natural-origin fish succumb to hooking mortality and poaching.

Hatchery steelhead production for harvest consists mainly of Chambers Creek winter-run stock and Skamania Hatchery summer-run stock, both selected for run timing that precedes that of natural stocks to reduce interaction between hatchery and naturally spawned fish. To reduce the risk of introgression between native and hatchery-origin fish, Chambers Creek releases were discontinued in the Skagit River (Ford 2022). Although the risk posed by hatchery programs to naturally spawning populations has recently decreased, it is unclear how long it will take for the genetic legacy of introgression to subside.

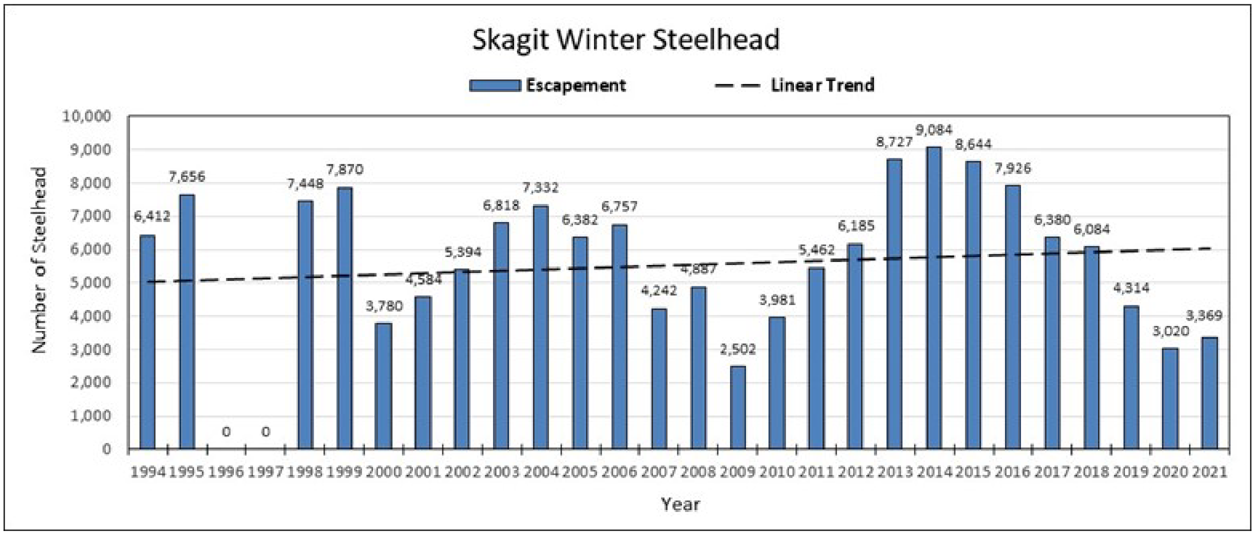
Steelhead emigrating from tributaries are exposed to a variety of potential predators (Pearson et al. 2015). Birds and marine mammals, harbor seals (*Phoca vitulina*) in particular, may have influenced the decline in Puget Sound steelhead population sizes (Pearson et al. 2015).

Skagit River Winter Steelhead

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, Newhalem, Goodell, and Jones creeks (WDFW 2002, 2019). WDFW (2019) 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 in the mainstem from its confluence with the Skagit River to RM 41, in portions of the South Fork Sauk, Suiattle, and White Chuck rivers, and in a number of tributaries such as White, Dan, Murphy, and Falls creeks. Spawning 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) and spawn from March-June, with peak spawning occurring in May.

Fry emergence peaks in early August (WDFW 2004), and outmigration occurs primarily from late April-early June (WDFW 2004, Kinsel et al. 2008).

Winter-run steelhead in the Skagit River basin increased in abundance from 2009 through 2014, after which declining abundance has been evident (Ford 2022) (Figure 4.2.3-11). The geometric mean escapement of Skagit River Winter Steelhead for return years 1994-2021 and 2016-2021 was 5,660 and 4,880 fish, respectively.



Source: WDFW 2022.

Figure 4.2.3-11. Skagit River Winter Steelhead spawning escapement (1994-2021); 2021 estimates are preliminary.

Skagit River Summer Steelhead

Recent surveys suggest that the summer-run of steelhead in the Skagit River is at a critically low level. Summer-run fish have been reported in 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-run fish are currently known to spawn is from RMs 8.0 to 11.6 of Finney Creek. Summer steelhead enter Finney Creek in October-November and spawn primarily from February- March (Sauk-Suiattle Indian Tribe et al. 2018). Fry emergence peaks in early August (WDFW 2004), and outmigration occurs primarily from early April through early June (Kinsel et al. 2008).

Resident Fish

As described in more detail above, geological analyses indicate that the Skagit River upstream of the Diablo Dam site was physically separated from the remainder of the river until the late Pleistocene. Prior to this, it is thought that the upper Skagit flowed into the Fraser River (Riedel et al. 2007). Genetic analyses support this hypothesis: 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 occur only 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, Small et al. 2020).

All three Project reservoirs support Rainbow Trout, Bull Trout, Dolly Varden, and Brook Trout. Redside Shiners are common in Ross Lake and present in Diablo and Gorge lakes. Cutthroat Trout are also present in Ross Lake (City Light 2012). Dolly Varden/Bull Trout and Dolly Varden/Brook Trout hybrids have been documented in the reservoirs and their tributaries in the U.S. and Canada (Small et al. 2016; McPhail and Taylor 1995).

Bull Trout, Dolly Varden, and Rainbow Trout are native upstream of Gorge Dam. Brook Trout are a non-native species first introduced into the Project vicinity in the early 1900s. Although Redside Shiners are native to the lower Skagit River basin, they are considered non-native in the Project reservoirs (Downen 2014). Redside Shiners were first introduced to Ross Lake around 2000 (Welch 2012). Likewise, Coastal Cutthroat Trout are native 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.

<u>Native Char (Bull Trout and Dolly Varden)</u>

General Life History and Habitat Requirements

The co-occurrence of Bull Trout and Dolly Varden in the upper Skagit River was first reported by McPhail and Taylor (1995). Although Bull Trout and Dolly Varden are present in all three Project reservoirs (Smith 2010; Small et al. 2016), because of their similar appearance, the majority of studies conducted upstream of Gorge Dam do not differentiate between them. As such, they are often referred to as “native char.”

Native char found upstream of Gorge Dam exhibit resident, adfluvial, and fluvial life histories (R2 Resource Consultants 2009; McPhail and Taylor 1995). Native char begin migrating to spawning areas in mid- to late September (City Light 2011). Pre-spawning adults stage at the mouths of spawning tributaries 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 conducted in Ross Lake suggests that spawning migrations occur at night (R2 Resource Consultants 2009). This work and earlier telemetry studies (Nelson et al. 2004) show that the majority of adfluvial native char spawn in Canada, although several U.S. tributaries are also used. Ongoing telemetry indicates that Bull Trout migrate to foraging areas in Ross Lake, including the mouths of Ruby, Lightning, and Big Beaver creeks where juvenile Rainbow Trout concentrate (R2 Resource Consultants 2009; Eckmann 2015; City Light 2011). Native char also prey on Redside Shiner in Ross Lake (Eckmann 2015).

Distribution, Abundance, and Demographics in the Skagit River Basin

Genetic analysis of native char suggests that Bull Trout, Dolly Varden, and hybrids of the two species occur in all three reservoirs, with Bull Trout most prevalent in Ross Lake and least prevalent in Gorge Lake (Anthony and Glesne 2014). Dolly Varden are more prevalent in Gorge and Diablo lakes (Smith 2010; Anthony and Glesne 2014; Small et al. 2016). McPhail and Taylor (1995) found a mixture of Dolly Varden, Bull Trout, and hybrids of the two species in the Skagit River basin in British Columbia and suggested that the creation of Ross Lake allowed previously segregated Bull Trout and Dolly Varden populations to mix. Dolly Varden are thought to have resided in tributaries above natural barriers, while Bull Trout occurred below the barriers and in the mainstem Skagit River. The inundation of natural barriers by Project reservoirs allowed Bull

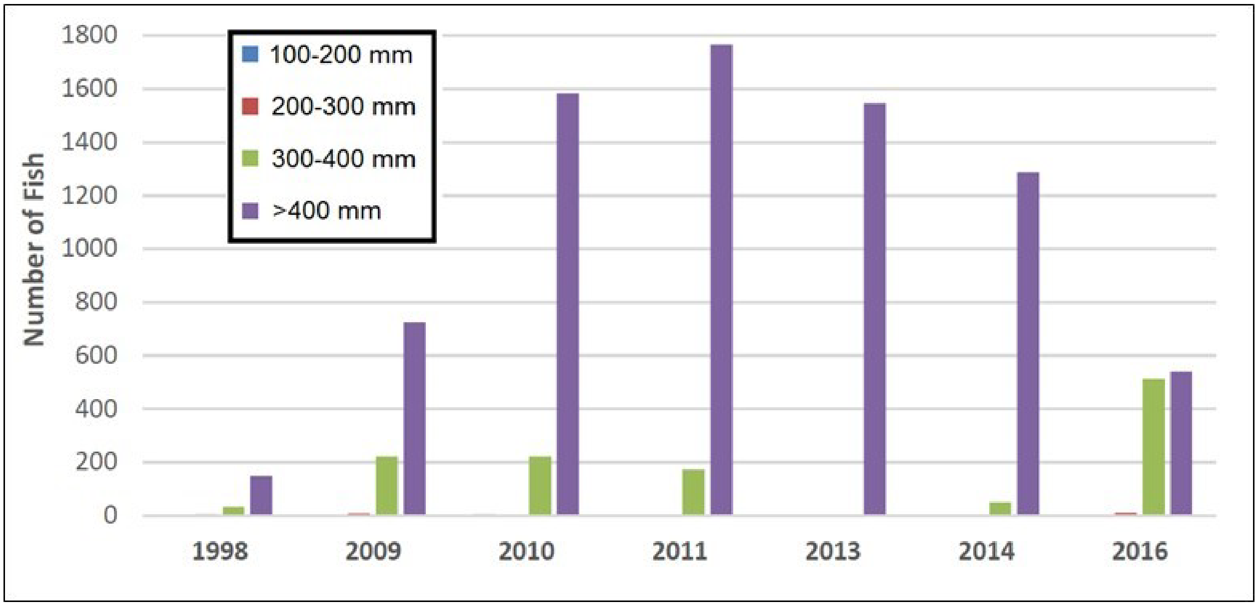
Trout to access spawning habitat previously occupied only by Dolly Varden, with the exception of Stetattle Creek, to which Bull Trout had full historical access.

As noted above, most large migratory native char in Ross Lake are thought to spawn and rear in streams 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 are reported to occur 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, U.S. Forest Service [USFS] 2002). Lightning, Ruby, Big Beaver, and Little Beaver creeks are likely the primary spawning streams outside Canada. Thunder Creek is the only tributary to Diablo Lake where native char spawning has been documented, although Colonial and Rhode creeks, which have limited habitat, might also be used (City Light 2012). As noted above, Stetattle Creek is the only native char spawning tributary to Gorge Lake (Anthony and Glesne 2014).

Native char/Brook Trout hybrids have apparently been mistaken for pure native char during many field studies (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. Genetic testing also indicates that native char over 300 mm in the upper Skagit River drainage are likely Bull Trout (Smith 2010; Small et al. 2016; McPhail and Taylor 1995; City Light 2011).

Based on snorkel counts conducted over a 22-mile index reach divided into 14-contiguous sections in the upper Skagit River (upstream of Ross Lake), the abundance of native char appears to have increased substantially from 1998-2011 but then decreased slightly from the 2011 peak (Figure 4.2.3-12) (Triton 2017). Nearly 100 percent of the char observed during these counts were over 300 mm long (Figure 4.2.3-12) and are assumed to be Bull Trout. Bull Trout are highly piscivorous, and it is thought that the introduction of Redside Shiner into Ross Lake in the early 2000s has contributed to an 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 allows the retention of Bull Trout may also have contributed to the increase in abundance. Despite the decline following the 2011 peak, native char counts have remained substantially above what they were prior to Redside Shiner introduction.

Although the index snorkel survey is conducted over a 22-mile reach and a one-week period to minimize double counting of fish, results should be viewed as a minimum number of fish and not an estimate of total abundance (Anaka et al. 2012; Triton 2017). Although 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). There are no population estimates for native char in the Gorge Lake and Diablo Lake drainages.



Source: Triton 2017.

Figure 4.2.3-12. Size class of native char counted in a 22-mile index reach of the upper Skagit River upstream of Ross Lake (1998-2016).

Rainbow Trout

General Life History and Habitat Requirements

Resident Rainbow Trout populations are found in fast flowing streams, rivers, and cool lakes. In the riverine environment, they prefer complex habitat, with submerged wood, boulders, undercut banks, and aquatic vegetation. Adults typically spawn during spring and early summer. Rainbow Trout feed primarily on drifting and benthic invertebrates, but larger individuals can be piscivorous. Individual fish establish territories, which they defend (Barnhart 1991).

Distribution, Abundance, and Demographics in the Skagit River Basin

Rainbow Trout are native to all three Project reservoirs and exhibit fluvial, adfluvial, and resident life histories upstream of Gorge Dam (Downen 2014; Anaka et al. 2012; Triton 2017). Resident fluvial Rainbow Trout are also present in the Skagit River and its tributaries below the Project (Pflug et al. 2013). Populations in Ross Lake are highly migratory (Anaka et al. 2012).

Rainbow Trout that inhabit the Project reservoirs rear for one to two years in larger streams or migrate from smaller streams to the reservoirs during their first summer (Downen 2014). Adults from Ross Lake migrate into the Skagit River upstream of the reservoir in late March and April to spawn (Anaka et al. 2012). A large proportion (up to 85 percent in 1986) of the run returns quickly to Ross Lake after spawning (Scott and Neuman 1988, as cited in Anaka et al. 2012). The remaining portion gradually migrates back to the reservoir (Anaka et al. 2012), and by late October few remain in the upper Skagit River. Water level, water temperature, and food availability influence the rate of return to the reservoir (Anaka et al. 2012). The most recent Rainbow Trout catch statistics for Ross, Diablo, and Gorge lakes are summarized in Table 4.2.3-8, and spawner abundance estimates in Roland and Dry creeks are shown in Table 4.2.3-9. Rainbow Trout likely spawn and rear at some level in all Ross Lake tributaries used by native char. Stetattle Creek is the only tributary to Gorge Lake, and Thunder and Colonial creeks are the only tributaries to Diablo Lake, known to support regular Rainbow Trout spawning (Downen 2014).

The 1991 Settlement Agreement provided for development of a native Rainbow Trout broodstock program in 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 in 2002 (Downen 2014). Annual releases of upper Skagit hatchery Rainbow Trout ranged from 1,000-286,000 fish into Diablo Lake and 2,040-4,000 fish into Gorge Lake (Downen 2014). This program is ongoing.

Table 4.2.3-8. Rainbow Trout gillnet sampling summary for Project reservoirs.

		Rainbow Trout Catch Statistics					
Lake	Year	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 4.2.3-9. 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.

As noted earlier, resident Rainbow Trout can produce anadromous offspring (Kendall et al. 2015). Because genetic introgression by hatchery fish can lead to the decline of wild steelhead populations

(Araki et al. 2008), there are concerns that fish released as part of the broodstock program could be displaced downstream and affect wild steelhead downstream of the Project.

To address this concern (and introgression by hatchery steelhead produced at Marblemount), genetic analyses were conducted of the three most common life-history forms of *O. mykiss* present in the Skagit River: hatchery and natural-origin steelhead and resident Rainbow Trout (Kassler and Warheit 2012 in Pflug et al. 2013). Basic genetic characteristics were evaluated along with ancestry, hybridization, and introgression. Juvenile and adult ancestry data were used to identify where natural-spawning hatchery steelhead were reproducing. Seven genetic groups were identified: (1) the upper Skagit (below Gorge) natural-origin steelhead and Baker River Rainbow Trout were in group 1; (2) Rainbow Trout from the Cascade River, Big Creek, Clear Creek, Finney Creek, and Blackwater River (Fraser River Tributary) were in groups 2, 3, 4, 5, and 7 respectively, and (3) the seven collections of resident Rainbow Trout from the upper Skagit River were in group 6. Analysis of the upper Skagit River Rainbow Trout collections revealed three genetic groups: (1) Diablo Lake and Stetattle Creek were in group 1; (2) Dry and Roland creeks were in group 2; and (3) Ross Lake 2010 was in group 3. Two other groups had split ancestry: Ross Lake 2006 was in groups 1 and 2, and Ross Lake 2009 was in groups 2 and 3.

Although genetic separation was identified among upper Skagit River resident Rainbow Trout collections, they were significantly different from natural-origin and hatchery-origin steelhead collections. All comparisons of resident Rainbow Trout to adult and juvenile steelhead collections from the same sub-watershed were significantly different. Based on this information, Downen (2014) supported managing Rainbow Trout in Ross, Diablo, and Gorge lakes as a single population.

<u>Ongoing Genetics Study of Resident Native Fish in Project Reservoirs</u>

City Light is conducting a two-year FA-06 Reservoir Native Fish Genetics Baseline Study (Reservoir Fish Genetics Study, City Light 2022a) to characterize the baseline population genetics of Bull Trout, Rainbow Trout, and Dolly Varden (target species) in Project reservoirs and provide data to inform the planning of long-term reservoir fish management. Results of the first year of study are summarized below. Results of the second year of study, also described below, will be reported in the Updated Study Report (USR) and Final License Application (FLA).

Rainbow Trout

For Rainbow Trout, analysis to date was conducted of 14 microsatellites in 1,900 individuals from 40 collections in the Project vicinity. These data were previously analyzed by Pflug et al. 2013. Genetic structure, i.e., the presence of a systematic difference in allele frequencies between subpopulations, was apparent (FST=0.09) and appeared to be partially associated with geography. Effects of hybridization with hatchery-origin Rainbow Trout and Cutthroat Trout on genetic structure were not assessed. However, the extent and potential population effects of hybridization are likely to be evaluated following license issuance.

Bull Trout

For Bull Trout, analysis to date was conducted of 16 microsatellites in 898 individuals from 21 collections in the Project vicinity. These data were previously collected and analyzed by Smith et al. (2010) and Small et al. (2013, 2016, 2020). Genetic structure was apparent (FST=0.19 across all collections; 0.03 within the Project Boundary). The largest genetic differences occurred between collections from upstream and downstream of the Project Boundary. Hybridization with other *Salvelinus* species was apparent but not directly assessed.

Dolly Varden

Analyses could not identify Dolly Varden with high certainty using the available data, i.e., few data are available, and existing information pertaining to the species is insufficiently documented for it to be distinguishable in the native char datasets.

Ongoing Genetics Research

Ongoing efforts in 2022 include collecting new salmonid tissue samples for genetic analysis of juvenile fish that occur near reservoir tributary spawning grounds. City Light is expanding sample collection and/or coordinating regarding existing samples and activities to conduct out-of-basin and above-and-below dam analyses. Newly developed genetic markers will be applied for each target species to evaluate within- and among-population genetic structure, genetic diversity, and hybridization. This approach will be used to estimate effective population size (N_e) for Bull Trout, Rainbow Trout, and, if possible, Dolly Varden.

Non-native Fish

<u>Cutthroat Trout</u>

General Life History and Habitat Requirements

Cutthroat Trout exhibit resident, fluvial, adfluvial, and anadromous life histories (Natural Resources Conservation Service 2007). They spawn in tributaries from winter through spring, and their life history and habitat requirements are similar to those of Rainbow Trout.

Distribution, Abundance, and Demographics in the Skagit River Basin

Although Coastal Cutthroat Trout are native in the lower Skagit River, they are not native upstream of Gorge Dam, but were stocked in the upper Skagit River drainage beginning in the early 1990s (Downen 2004). It is believed that Westslope and Yellowstone Cutthroat Trout were stocked in the upper Skagit River drainage and possibly other strains as well (Downen 2004). Cutthroat Trout upstream of Gorge Dam are self-sustaining, as no recent plantings have occurred.

The first recorded planting (47,000 fish) of Cutthroat Trout in the upper Skagit occurred in Big Beaver Creek in 1916, and since then at least 170,000 Cutthroat Trout have been stocked in the Ross Lake drainage (Johnston 1989). Stocked Cutthroat Trout became established in Thunder Creek, both above and below the current fish passage barrier (Downen 2014). Surveys conducted in Devil’s Creek upstream of barriers found no other species but Cutthroat Trout (USFWS 2004). Triton (2008) reported that spawning populations are present in Ruby, Big Beaver, Little Beaver, and Lightning creeks. Records of Cutthroat Trout in the Canadian Skagit River watershed are limited to incidental angler catches (British Columbia 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 multi-year Ross Lake gillnet surveys reported by

Anthony and Glesne (2014), Cutthroat Trout were only captured in 2008, i.e., six individuals, which represented 1.0 percent of the total catch.

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, small to medium rivers, and 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. Redside Shiner are consumed by fish and piscivorous waterfowl such as mergansers and loons (Scott and Crossman 1973).

Distribution, Abundance, and Demographics in the Skagit River Basin

Historically, Redside Shiner did not occur upstream of what is now the Gorge bypass reach. However, the species was introduced (likely as a baitfish) to Ross Lake around 2000 and was abundant by 2004. During summer, high densities of Redside Shiner occupy shallow areas in the reservoir (Welch 2012). As discussed in the Reservoir Bioenergetics section (below), the abundance of Redside Shiners in Ross Lake was assessed by a dedicated hydroacoustic survey, which estimated a minimum population size of 10 million individuals > 40 mm fork length during late summer/fall of 2021. This was considered a minimum estimate, because a potentially significant proportion of the fish might not have been included in the estimate due to an inability to distinguish their acoustic signals from the reservoir bottom signal or other boundary conditions (Beauchamp in development). In 2010, Redside Shiners were documented in Diablo Lake, and in 2019 they were observed in Gorge Lake.[48] Catch statistics for Redside Shiner in the Project reservoirs through 2011 are shown in Table 4.2.3-10.

Table 4.2.3-10. 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.

48 City Light's FA-08 Fish Entrainment Study (City Light 2022d) shows that entrainment risk for Redside Shiners is high at the Project reservoir intakes; based on this, it is likely that Redside Shiners were introduced to Diablo and Gorge lakes via this pathway.

As noted above, the introduction of Redside Shiners in Ross Lake coincided with a dramatic increase in adult Bull Trout abundance and a reduction in the number of juvenile (10-20 centimeter [cm]) Rainbow Trout. Also, Rainbow Trout historically showed no evidence of piscivory in Ross Lake, whereas large Bull Trout and Dolly Varden consumed juvenile salmonids. However, following the introduction and rapid population expansion of Redside Shiners in Ross Lake, all salmonid species have become piscivorous. Anaka et al. (2012) hypothesize that the introduction of Redside Shiners marked the beginning of a shift in the ecology of the reservoir. Resource managers are concerned that Redside Shiners could invade the Canadian Skagit River and compete with trout for limited resources. However, monitoring by the USGS and City Light identified no negative effects on salmonid stocks (Welch 2012). Regardless, the extremely large population size of Redside Shiners in Ross Lake makes control unachievable (Downen in prep., as cited in Anthony and Glesne 2014).

Brook Trout

Brook Trout, which are non-native to the western United States, were introduced into the upper Skagit River drainage in the early 1900s. Since then, they have become well established in the 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 tolerate warmer water (Gunkel et al. 2002) than native char and are known to often outcompete Bull Trout in small streams (Gunkel et al. 2002).

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 stocked in sub-alpine lakes in the early 1900s now occur in Hozomeen and Big Beaver creeks. According to USFWS (2004), Brook Trout is the dominant species in Hozomeen Creek and has 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 relatively warm embayment along the northern shore of Diablo Lake.

Although 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 4.2.3-11). As noted 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, but it is possible that Bull Trout/Brook Trout hybridization occurs.

Table 4.2.3-11. 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.

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 environmental DNA (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 (as already noted) Brook Trout and Redside Shiner,[49] which are found in all three reservoirs. New Zealand mudsnails (*P. antipodarum)* were found in Skagit County (Indian Slough, west of Burlington) (USGS 2019a) and in Whatcom County (Lake Padden south of Bellingham) (WDFW

[49] Redside Shiner are native to the lower Skagit River but were inadvertently introduced to Ross Lake and are considered an invasive species upstream of Gorge Dam.

2019) in 2018, but they have not been documented in the upper Skagit River drainage. There are two non-native 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 2019a), a tributary to the Skagit River, but has not been detected in the Project vicinity. The following species 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 2019b).

Aquatic Habitat

Ross Lake

Ross Lake is the largest of the three Project reservoirs and supports important resident, native game fish species including Bull Trout, Dolly Varden, and Rainbow Trout. Non-native Cutthroat Trout and Brook Trout are also present (see previous sections for discussion of fish populations). Physical characteristics of Ross Lake, including water surface elevations and volume, are described in Section 3.1 of this Exhibit E, and Ross Lake's water quality is discussed in Section 4.2.2 of this Exhibit E. Ross Lake is generally confined within a steep-sided basin, particularly from the dam to Lightning Creek, which enters from the east at approximately the mid-point of the reservoir. North of Lightning Creek, the reservoir bottom is flatter.

<u>Littoral Zone Habitat</u>

As part of Project relicensing, City Light conducted a GIS-Based Reservoir Littoral Zone Evaluation (City Light 2022b) to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and water surface elevation (WSE) for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes). The littoral zone is the shallow, near-shore region where enough sunlight reaches the lake bottom to support the growth of rooted aquatic plants (Zohary and Gasith 2014; Vander Zanden and Vadeboncoeur 2020). The extent of light penetration, i.e., the depth of the euphotic zone, which is proportional to water clarity, dictates the area of the littoral zone, which varies spatially and temporally (Zhang et al. 2006). Secchi disk data, which provide a measure of water transparency, for the Project reservoirs were used to estimate the extent of the euphotic zone.

Littoral zone habitat in Ross Lake is concentrated near tributary inputs and at the upstream end of the reservoir. The littoral zone, which is estimated to be between about 24 and 65 feet deep in Ross Lake, may be fully dewatered under normal permitted operations, as the elevation range of the varial zone spans 128 feet (Table 4.2.3-12).

Table 4.2.3-12. Range of water surface elevations in the Project reservoirs

Project Reservoir	Normal Maximum WSE (feet [ft])	Minimum WSE[1] (ft)	Varial Zone WSE Range (ft)
Ross Lake	1,608.76 NAVD 88 (1,602.50 CoSD)	1,480.76 NAVD 88 (1,474.50 CoSD)	128
Diablo Lake	1,211.36 NAVD 88 (1,205.00 CoSD)	1,204.36 NAVD 88 (1,198.00 CoSD)	7
Gorge Lake	881.51 NAVD 88 (875.00 CoSD)	831.51 NAVD 88[2] (825.00 CoSD)	50

Note: NAVD 88 = North American Vertical Datum of 1988.

1 Minimum (drawdown) WSE authorized by the current license, as identified in the Geographic Information System (GIS)-Based Reservoir Littoral Zone Evaluation (City Light 2022b).

2 The normal operating minimum WSE for Gorge Lake is 873.51 ft NAVD 88 (867 ft CoSD) (see Table 3.1-1), which was recently identified by City Light fisheries biologists to reduce fish stranding risk.

Based on minimum and maximum depths, the total area of the Ross Lake littoral zone at normal maximum WSE is about 1,586-3,875 acres. At 25 percent drawdown, 2,082 acres of littoral zone habitat are dewatered, resulting in a submerged littoral zone area of 0-1,793-acre (a 45.6-100 percent dewatering of the littoral zone) (Table 4.2.3-13). Overall, the Ross Lake littoral zone is more rapidly dewatered during the early phase of reservoir drawdown than during the later phases. The rate of littoral zone dewatering varies throughout the drawdown cycle.

Table 4.2.3-13. Cumulative acres and percent of the littoral zone that is dewatered in Ross Lake at various reservoir drawdown levels.

Water Surface Elevation (ft)	Percent Drawdown	Submerged Littoral Zone Area (acre)	Percent Littoral Zone Submerged	Percent Littoral Zone Dewatered	Submerged Portion of Littoral Zone as Percent of Reservoir Surface Area
1,608.76 NAVD 88 (1,602.50 CoSD)	Normal Maximum WSE	1,585.8 to 3,875.5	100	0	12.9 to 31.5
1,602.36 NAVD 88 (1,596.10 CoSD)	5% drawdown	1,240.8 to 3,530.4	78.2 to 91.1	8.9 to 21.8	10.4 to 29.7
1,595.96 NAVD 88 (1,589.70 CoSD)	10% drawdown	719.2 to 3,008.9	45.4 to 77.6	22.4 to 54.6	6.3 to 26.4
1,589.56 NAVD 88 (1,583.30 CoSD)	15% drawdown	335.7 to 2,625.4	21.1 to 67.7	32.3 to 78.9	3.1 to 23.8
1,583.16 NAVD 88 (1,576.90 CoSD)	20% drawdown	0 to 2,236.4	0 to 57.7	42.3 to 100	0 to 21.1
1,576.76 NAVD 88 (1,570.50 CoSD)	25% drawdown	0 to 1,793.1	0 to 46.2	45.6 to 100	0 to 17.6
1,544.76 NAVD 88 (1,538.50 CoSD)	50% drawdown	0 to 67.4	0 to 1.7	98.3 to 100	0 to 0.8
1,512.76 NAVD 88 (1,506.50 CoSD)	75% drawdown	0	0	100	0
1,480.76 NAVD 88 (1,474.50 CoSD)	Minimum WSE[1]	0	0	100	0

1 Minimum (drawdown) WSE authorized by the current license.

Fish Stranding and Trapping

The FA-03 Reservoir Fish Stranding and Trapping Risk Assessment (Stranding and Trapping Assessment, City Light 2022c) was conducted as part of Project relicensing. The study includes (1) a desktop GIS analysis of existing elevation and topobathymetric data to identify and map risk areas where stranding and trapping of native fish might occur; the desktop analysis accounted for fish life-history periodicities to identify periods of greatest susceptibility to stranding and trapping; (2) field surveys of fish stranding and trapping at select risk areas to evaluate the results of the desktop analysis; and (3) updating the desktop analysis as needed based on field results. Several additional modifications were made to the proposed study objectives per input from licensing participants (LPs), which are detailed in the Stranding and Trapping Assessment (City Light 2022c).

Eight areas around Ross Lake were identified as exhibiting topographic characteristics that could present a high risk of stranding and trapping at certain WSEs within the normal range of operations. Study methods were refined, including modifications to the spatial stratification of the varial zone and field survey techniques to prioritize the sampling of recently dewatered areas where the likelihood of observing stranded or trapped fish would be highest (Figure 4.2.3-13). Refinements ensured that field data focused on supporting the testing of GIS analyses to develop a robust estimate of the total risk around each reservoir.

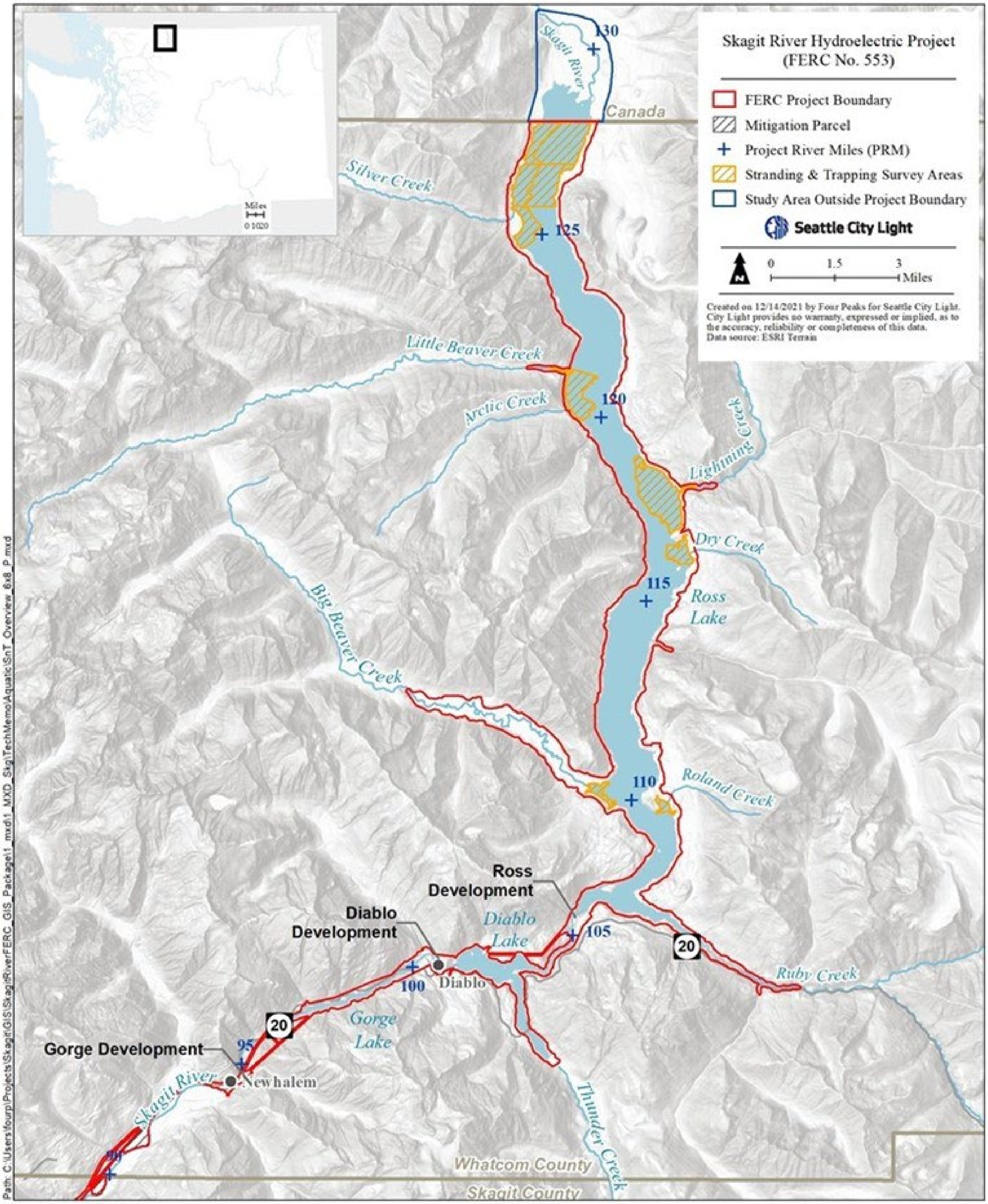


Figure 4.2.3-13. Total stranding and trapping study area and survey areas on Ross Lake.

Ross Lake WSE from 2011-2021 ranged between 1,487.46 and 1,608.76 feet North American Vertical Datum of 1988 [NAVD 88] (1,481.2 and 1,602.5 feet City of Seattle Datum [CoSD]). WSE peaks in July-August, immediately before drawdown begins. The most variability in WSE occurs during March-May. Based on frequency of occurrence and percent exceedance curves for the full dataset from 2011-2021, the most frequently occurring WSEs in the record are between 1,606.26 and 1,608.26 feet NAVD 88 (1,600 and 1,602 feet CoSD).

As part of the assessment, reconnaissance field surveys were completed in Ross Lake during the drawdown cycles of 2020-2021 and 2021-2022 (Table 4.2.3-14). During these surveys, field crews identified areas that appeared to present a risk of stranding or trapping. There was no evidence of stranding or trapping, i.e., no live fish, mortalities, or fish remains observed during the 2020-2021 surveys. However, a small number of stranded/trapped fish, nearly all Redside Shiner, were observed during the 2021-2022 surveys (Table 4.2.3-14).

Results from the stranding and trapping surveys are being compiled into a geodatabase to map their occurrence around Ross Lake and to visualize reservoir conditions (e.g., WSE and drawdown rate) during each instance of observed stranding or trapping. Data will be interpreted in the context of fish periodicities to identify locations, time periods, and reservoir drawdown rates that appear to present a fish stranding and trapping risk in Ross Lake.

Table 4.2.3-14. Observations of fish stranding and trapping during field surveys of Ross Lake, December 2020 – April 2022.

Date	Survey Area(s)	Species	Life Stage	Count	Status
12/17/2020	Ross, 1 mi S of Border E	--	--	0	--
12/18/2020	Ross, 1 mi S of Border W	--	--	0	--
	Mouth of Big Beaver Creek	--	--	0	--
3/24/2021	Lightning Creek	--	--	0	--
	Big Beaver Creek	--	--	0	--
	Lost Lake area	--	--	0	--
	Roland Creek	--	--	0	--
	Ruby Arm	--	--	0	--
4/20/2021	Little Beaver Creek	--	--	0	--
	Arctic Creek	--	--	0	--
	Lost Lake area	--	--	0	--
	Lightning Creek	--	--	0	--
10/5-6/2021	1 mi S of Border (E and W)	--	--	0	--
	2 mi S of Border (E and W)	--	--	0	--
	Silver Creek	--	--	0	--
	Little Beaver Creek	--	--	0	--
	Arctic Creek	--	--	0	--
	Lost Lake	--	--	0	--
	Lightning Creek	--	--	0	--
	Dry Creek	--	--	0	--
	Big Beaver Creek	--	--	0	--
	Roland Creek	--	--	0	--
	Ruby Arm	--	--	0	--

Date	Survey Area(s)	Species	Life Stage	Count	Status
10/26-27/2021	Big Beaver Creek	--	--	0	--
	1 mi S of Border W	Redside Shiner	Juvenile	2	Mortalities
	1 mi S of Border E	Brook Trout	Adult	1	Live
10/27/2021	Silver Creek	--	--	0	--
	Lost Lake	--	--	0	--
	Lightning Creek	--	--	0	--
	Roland Creek	--	--	0	--
	Dry Creek	Redside Shiner	Fry	5	Live
	Dry Creek	Unidentified salmonid	Fry	1	Live
4/7/2022	1 mi S of Border (E and W)	--	--	0	--
	2 mi S of Border (E and W)	--	--	0	--
	Little Beaver Creek	--	--	0	--
	Arctic Creek	--	--	0	--
	Lost Lake	--	--	0	--
	Lightning Creek	--	--	0	--
	Dry Creek	--	--	0	--
	Big Beaver Creek	--	--	0	--
	Roland Creek	--	--	0	--
	Ruby Arm	--	--	0	--
	Silver Creek	Redside Shiner	Fry	100	Live

Fish Entrainment and Impingement

In 2011, City Light submitted an application for a non-capacity amendment of the Project license (for construction of a second power tunnel between Gorge Dam and Gorge Powerhouse). As a component of its Biological Opinion, USFWS (2013) analyzed potential effects of entrainment on the Bull Trout population in Gorge, Diablo, and Ross lakes, which required City Light to report on its observations of acoustically tagged Bull Trout that were either entrained into the Project intakes or passed over the dams via spill. In its entrainment reports (City Light 2016, 2017, 2018, 2019, 2020a, 2021), City Light provided annual estimates of turbine and spillway entrainment at each Project development from 2015-2020 (Table 4.2.3-15).

Based on the results of these studies, it is apparent that Bull Trout entrainment via the intakes is rare at Ross Dam. Passage over the spillways at Ross Dam has never been empirically documented and is projected to be extremely rare given the limited number of spill events that occur at this facility (spill frequency is the primary metric used to provide a rough estimate of spillway entrainment). Entrainment rates for other species are unknown, although some Rainbow Trout entrainment and downstream passage has been documented at Ross Lake in the past (City Light 2011).

As part of Project relicensing, City Light conducted the FA-08 Fish Entrainment Study (City Light 2022d). The goals of this desktop analysis were to evaluate fish impingement and entrainment at Ross, Diablo, and Gorge dams and the potential effect of impingement and entrainment on the Skagit River fish community.

The first step of the desktop analysis was to incorporate the design and operational characteristics of each Project facility. Information on the fish community in the Skagit River and Project reservoirs was then compiled, i.e., species composition, abundance, and life-history characteristics. A qualitative risk matrix for each Project facility was developed for all target species and life stages evaluated using a traits-based assessment (Cada and Schweizer 2012) to assess entrainment and impingement risk; a separate evaluation for anadromous salmonids was conducted to account for potential implementation of fish passage at one or more of the dams in the future. For species with elevated risk of impingement or entrainment based on the qualitative risk assessment, entrainment rates, turbine blade strike, and survival were estimated based on the Electric Power Research Institute (EPRI 1997) entrainment database and Turbine Blade Strike Analysis (TBSA) Model (USFWS 2020). Spillway mortality was estimated from studies conducted at comparable facilities.

Table 4.2.3-15. Annually reported adult Bull Trout entrainment and estimated passage metrics at Ross Lake (2015-2020).

Year	Intake Entrainment (Observed via acoustic telemetry)		Spillway Mortality (Calculated with spill duration estimation method)
	Number of Active Tags	Number of Fish Entrained	
2015	50	0	5
2016	31	0	0
2017	37	0	0
2018	20	0	0
2019	20	0	0
2020	31	0	3
Total[1]	189	0	8

Source: City Light 2016, 2017, 2018, 2019, 2020a, 2021.
1 Authorized take for the Project is 435 Bull Trout from 2013-2025 (USFWS 2013).

Entrainment and impingement potential vary with time of year, Project operations, and fish species, life stage, body size, and swimming speed. Based on the qualitative risk assessment, few species or life stages have elevated (i.e., moderate or high) risk of entrainment or impingement at Project dams. Trout and char species spawn in tributaries, and rear in tributaries and shallower reservoir habitats, thereby avoiding the intakes, which are located at depth. Adult native char (Bull Trout and Dolly Varden) and Rainbow Trout may at times occur near the turbine intakes, but their swimming burst speeds are usually sufficient to overcome approach velocities and avoid entrainment or impingement at the intakes. Redside Shiners (an introduced species) likely experience the greatest risk of entrainment due to their small size and associated weaker swimming speeds and their tendency to migrate to deeper water in winter (Wydoski and Whitney 2003).

Application of the EPRI (1997) database indicates that the majority of fish entrained at the Project are less than 4 in long, and Redside Shiner, followed by Dolly Varden, have the greatest risk of being entrained. The EPRI (1997) database was unable to account for all site- or species-specific factors that could influence entrainment at the Project. Structural differences between Project facilities and those of the dams included in the EPRI database could result in entrainment risk being overestimated at the Project.

Redside Shiner was the only species with an elevated (i.e., moderate) risk of entrainment in Ross Lake. Adult Redside Shiner have a greater swimming burst speed than the estimated approach velocities at the Ross Dam intake (4.95 feet per second [ft/sec] swimming burst speed versus 1.11 or 3.88 ft/sec approach velocities). Early life stages are considered to be at low risk of entrainment because they spawn in the littoral zone, which is not within the vicinity of the intakes.

Some adult species, including Rainbow Trout, Cutthroat Trout, and Eastern Brook Trout, although present in Ross Lake, commonly remain in the upper water column well above the intake depth (< 52 ft deep compared to the intake depth of about 152 ft), and therefore are not susceptible to entrainment. Adult Bull Trout and Dolly Varden can be found in deeper areas (up to 196 ft), but based on swimming speed analysis, both species are able to navigate and escape approach velocities near the intake (swimming speeds > 3.88 ft/sec). Some adult Bull Trout in Ross Lake are larger than those used to estimate swimming burst speed in Katopodis and Gervais (2016) and are likely to have a greater ability to avoid or escape intake velocities than that identified in the analysis. In addition, multi-year acoustic telemetry studies of Bull Trout in Ross Lake indicate limited use of the intake zone, as evidenced by the data shown in Table 4.2.3-15.

Estimated entrainment rates for Dolly Varden and Redside Shiner in Ross Lake varied seasonally based on life stage, habitat selection, and changes in distribution that may encourage the species to move closer to or farther from Project intakes and spillways (Figure 4.2.3-14).

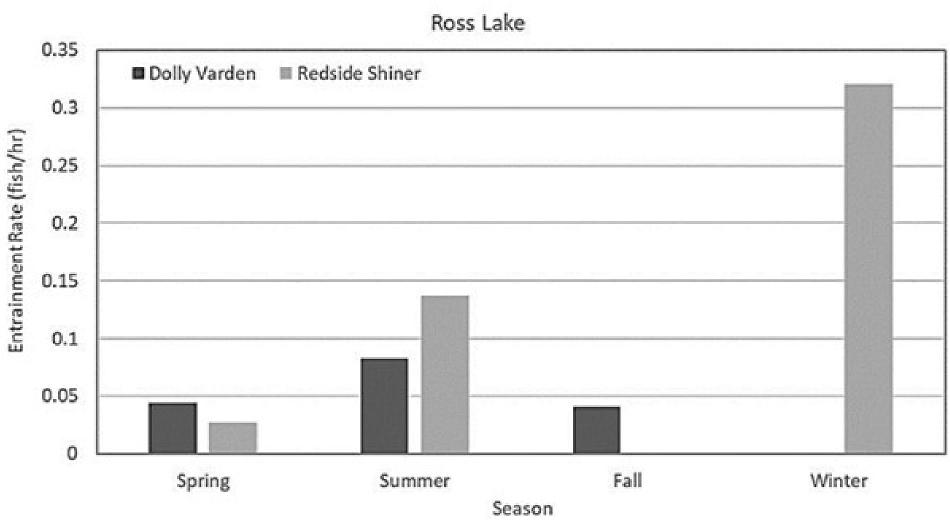


Figure 4.2.3-14. Average entrainment rate (fish/hr) of Dolly Varden and Redside Shiner, by season, in Ross Lake.

For the fish lengths evaluated, turbine blade strike probability ranged from 2.5-44.6 percent at Ross Dam. The majority (97.6 percent) of estimated entrainment consisted of small fish (< 4 in) with the lowest risk of turbine blade strike, ranging from 2.7-5.9 percent at Ross Dam. As noted above, larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, vertical distribution in relation to intake depth, and habitat selection.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency (i.e., 2.5 days per year, City Light [2020b]) and volume of spill at Ross Dam is low, thus reducing the significance of spill-related mortality. The combined survival, via all passage routes, of fish most frequently entrained (< 4 in) was estimated at ≥ 84 percent at Ross Dam.

Reservoir Bioenergetics

In 2018, prior to relicensing, City Light agreed to fund a food web assessment to evaluate demographic shifts and apparent recruitment limitations of Rainbow Trout in Ross Lake, thought to be related to the introduction of Redside Shiners. The USGS (Beauchamp in development) developed a proposed scope for a comprehensive study, i.e., Factors Limiting Native Salmonids above Skagit River Dams ("Food Web Study").

Provisional results of the Food Web Study (Beauchamp, in development[50]) provide a basic understanding of the structure and function of existing food webs in Project reservoirs and potential production bottlenecks for native salmonids related to the presence of non-native species, Redside Shiner in particular, and climate variability.

Reservoir food webs were examined by conducting seasonal, size- and depth-stratified sampling of fish and key zooplankton populations in representative regions of Ross and Diablo lakes. Trophic interactions were identified by a combined seasonal size-specific diet and stable isotope analyses and then quantified by applying bioenergetics models to each fish species using temporal diet, thermal experience, incremental growth, and energy densities of consumers and prey as inputs for model simulations. The bioenergetics simulations provide estimates of per capita daily consumption of each prey group by age/size class of the consumer and an estimate of the feeding rate as a percentage of the theoretical maximum feeding rate for a consumer exhibiting its observed growth, given its body mass and thermal experience.

Per capita daily consumption by each fish species and size/age class was scaled up to size-structured "unit population-level consumption" based on a size-structured population of 1,000 adfluvial Bull Trout (fork length > 200 mm) in Ross Lake. The Bull Trout were proportionally allocated among age classes based on the relative abundance of each age class observed in field samples, after correcting for size-selectivity of gill nets or by applying generic annual survival rates reported for other populations. The per capita monthly consumption for each age class was multiplied by the relative abundance of each age class to produce "unit population-level" monthly and annual consumption estimates for all observed prey categories. This process was repeated for all other fish species; the abundance of other salmonids observed in gill net samples, relative to Bull Trout (and their hybrids), was used to scale the consumption demand of each species, i.e., in relation to the 1,000 adfluvial Bull Trout from Ross Lake. For every 1,000 Bull Trout > 200 mm fork length, there were an estimated 2,138 Rainbow Trout, 260 Brook Trout, and 117 Dolly Varden. For every 1,000 Bull Trout, the unit population-level consumption demand by the other salmonids was generated based on these relative abundances.

50 Reporting on the Food Web Study is underway, and final results are forthcoming. The content presented herein represents provisional statements that have not yet undergone final vetting by the USGS. Any conclusions based on current content should be considered preliminary.

The consumption demand by Redside Shiners was estimated using a newly parameterized bioenergetics model (Johnson et al. in revision) and population-specific inputs for thermal experience, growth, and energy density, plus diet inputs inferred from size-specific, stable isotope analysis and prior data reported by Welch (2012). The abundance of Redside Shiners was assessed by a dedicated hydroacoustic survey, which estimated a minimum population size of 10 million individuals > 40 mm fork length during late summer/fall of 2021. This was considered a minimum estimate, because a potentially significant proportion of the fish might not have been included in the estimate due to an inability to distinguish their acoustic signals from the reservoir bottom signal or other boundary conditions.

The carrying capacity for salmonids rearing in the reservoirs is influenced by access to zooplankton (*Daphnia*) mediated by thermal stratification in the reservoirs, and competition with Redside Shiners for shared prey resources. The vast majority of Redside Shiners are < 100 mm fork length and feed primarily on zooplankton and secondarily on adult insects or benthic invertebrates. The seasonal diet composition of Redside Shiners strongly overlaps that of juvenile Rainbow Trout (fork length < 300 mm) in the reservoir, but the consumption demand of Redside Shiners is much higher than that of Rainbow Trout or other salmonids due to the disparity in abundance between Redside Shiners (> 10 million) and all adfluvial salmonids combined (≈ 10,000-20,000).

Beauchamp (in development) is estimating carrying capacity for juvenile resident salmonids under current conditions. Depending on decisions made regarding potential fish passage at one or more of the Project dams, a subsequent step in the food web analysis will be evaluation of the feasibility of introducing anadromous salmonids upstream of the Project dams, that is, an analysis of the accessibility and suitability of physical habitat in conjunction with an evaluation of fish growth potential in reservoir and tributary habitats. This analysis will account for the resource demands and growth performances of fish populations already occupying these habitats.

An important consideration associated with the potential introduction of anadromous fish is that anadromous salmonids would be subject to predation by resident piscivorous salmonids during reservoir rearing and outmigration. Historically, Rainbow Trout showed no evidence of piscivory in Ross Lake, whereas large Bull Trout and Dolly Varden consumed juvenile salmonids. However, following the introduction and rapid population expansion of Redside Shiners in Ross Lake, all salmonid species have become piscivorous. Stable isotope analysis indicates that adfluvial native char become significant fish predators soon after entering the reservoir, and Rainbow Trout become highly piscivorous at about 300 mm fork length. If anadromous salmonids were to be introduced, predation pressure would be directed toward juvenile anadromous fish in response to their abundance and availability, which could become quite high as predators respond to predictable prey pulses created by fry immigration and smolt emigration (see Furey et al. 2015, Lowery and Beauchamp 2015, Furey et al. 2016).

The Food Web Study is nearing completion, and preliminary results from the study may be available to be presented in the FLA. The results will eventually be integrated with those derived from other studies (e.g., FA-07 Reservoir Tributary Habitat Assessment) and modeling (e.g., the CE-QUAL-W2 nutrients and productivity model) efforts to develop a comprehensive characterization of the rearing capacity of the Project reservoirs and their tributaries, for both native resident and potentially introduced anadromous fish.

Lost Lake

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, and therefore isolated, when Ross Lake's WSE is below 1,505 feet, a condition that occurred only five times between 1989 and 2019. When isolated, Lost Lake is roughly circular, with a depth of approximately 90 feet and a 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 it during drawdown, primarily through exposure to elevated water temperatures and decreased DO concentrations.

After review of available information, Meridian Environmental (2019) made the following determinations regarding Lost Lake.

Three temperature profiles measured when Lost Lake was exposed in April 2018 show that warming occurred to about 5 m (16.4 ft), while the remainder of the water column (20-30 m, 66-98 ft) 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 significant fetch, and wind-induced mixing of the water column can occur at the upstream end of the reservoir. There is little effect of wind on Lost Lake, which more easily stratifies, thereby maintaining colder water at depth.

DO concentrations in Lost Lake were high (approximately 11 milligrams per liter [mg/L]) throughout the water column during the 2018 profile measurement period. In 2019, DO concentrations in Lost Lake (average 8.5 mg/L) were lower than in Ross Lake, despite lower temperatures in Lost Lake. This may also have been due to a lack of wind-induced mixing in Lost Lake.

Temperature and DO in Lost Lake are unlikely to adversely affect fish during the infrequent, short periods when it is isolated from Ross Lake (mid-March through April/early-May). Algae blooms were not apparent in either 2018 or 2019, indicating that nutrient regimes and biological activity are similar in Lost and Ross lakes.

Parent materials of soils around Lost Lake consist of volcanic ash over glacial drift or alluvium, and soil types are well-drained, with high or very high capacity to transmit water (U.S. Department of Agriculture [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 WSE 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). As noted above, however, the isolation of Lost Lake, which occurs when Ross Lake's WSE drops below 1,505 feet, is an uncommon event, which occurred only five times from 1989 through 2019. Native char, which spawn in fall, are and would be unaffected.

Ross Lake Tributaries

Tributaries entering Ross Lake provide spawning and rearing habitat for resident and adfluvial fish species: approximately 243 miles of stream in the U.S. are thought to be fish bearing, with 39 miles considered accessible to adfluvial fish (WDF 1975), and approximately 137 miles in Canada are considered to be fish bearing (Triton 2008). Triton (2008) reported that a bedrock-controlled falls on the Skagit River just upstream of Snass Creek (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).

Of the 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. Important salmonid spawning areas within the Ross Lake watershed include the Skagit River above Ross Lake (i.e., Canadian waters) and lower Lightning, Ruby, Canyon, Dry, Big Beaver, Silver, and Roland creeks (Federal Power Commission Bureau of Power 1974; Downen 2014; Anaka et al. 2012; Triton 2017). Rainbow trout spawning has also been observed within the upper drawdown zone of the reservoir (i.e., slightly below maximum WSE) within the creek channel confluences of Silver, Hozomeen, Pierce, Roland, and Lightning creeks (City Light 1989).

As part of relicensing the Project, City Light is conducting the FA-07 Reservoir Tributary Habitat Assessment (City Light 2022e) to evaluate the availability and production potential of habitat for Chinook, Coho, and Sockeye salmon and steelhead (target species) in reservoir tributaries. Study objectives include (1) applying the NetMap Intrinsic Potential (IP) model (e.g., Burnett et al. 2007) to characterize the extent of potential spawning and rearing habitat for the target species in tributaries based on geomorphic habitat suitability measures; (2) using physical habitat variables to estimate juvenile rearing habitat capacity, i.e., productivity potential, (e.g., Cooper et al. 2020) for the target species within reaches identified by IP modeling; and (3) evaluating the results of objective 2 in the context of the results of the Food Web Study (Beauchamp, in development). Field surveys and data analysis to address objectives 1 and 2 for tributaries within the U.S. were conducted from July-October 2022, and initial results are expected to be available in the USR and FLA.

IP modeling (Duda et al. in progress) was used to classify stream reaches as having no, low, medium, or high potential to support each target species.[51] A field inventory of anadromous fish passage barriers, combined with IP modeling results, was used to determine the extent of accessible, suitable habitat for the target species. Juvenile rearing capacity and potential smolt production of the tributary reaches containing accessible, suitable habitat was estimated using the Unit Characteristic Method (UCM) (Cramer and Ackerman 2009a; Cramer and Ackerman 2009b; Cooper et al. 2020). Field surveys of rearing habitat followed a modified USFS Stream Inventory Handbook Level II protocol (USFS 2016). Production potential for each target species was also based on the availability of suitable spawning habitat in the same reaches evaluated with the UCM.

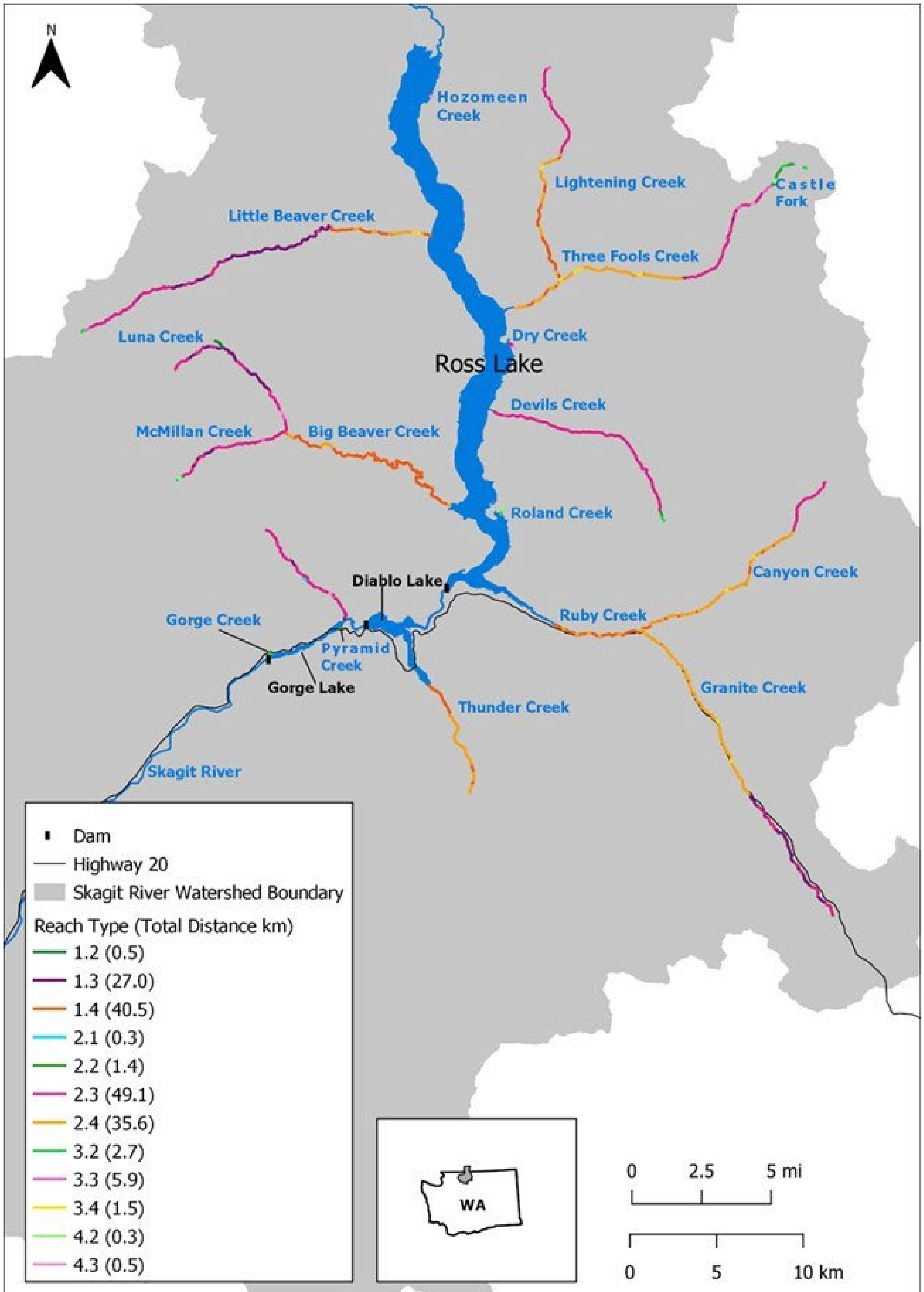
[51] USGS is developing a model to predict IP for Sockeye Salmon (Duda, in progress).

IP model distributions for steelhead (Burnett et al. 2007), Chinook Salmon (Connor et al. 2015), and Coho Salmon (Burnett et al. 2007) were merged to identify and map potential anadromous fish distribution. Habitat identified by IP modeling was classified into distinct reach types based on stream gradient and drainage area, following the methods of Cooper et al. (2020) (Table 4.2.3-16, Figure 4.2.3-15).

Table 4.2.3-16. Habitat surveys selected for each reach type. Reach types are defined by gradient and drainage area strata, as shown in Figure 4.2.3-15.

Reach Type Name	Gradient (%)	Drainage area (km^2)	Stream length (km) by reach type	Target sample length (km)	Number of survey reaches
1.2	0 - 2	2 - 10	0.50	0.25	1
1.3	0 - 2	10 - 100	27.00	13.50	30
1.4	0 - 2	>100	40.50	20.25	47
2.1	2 - 7	0 - 2	0.30	0.15	1
2.2	2 - 7	2 - 10	1.40	0.70	4
2.3	2 - 7	10 - 100	49.10	24.55	47
2.4	2 - 7	>100	35.6	17.8	49
3.2	7 - 12	2 - 10	2.7	1.35	7
3.3	7 - 12	10 - 100	5.9	2.95	13
3.4	7 - 12	>100	1.5	0.75	5
4.2	>12	2 - 10	0.3	0.15	2
4.3	>12	10 - 100	0.5	0.25	3

Reach types surveyed in the field correspond to combinations of gradient (0-2 percent, 2-7 percent, 7-12 percent, > 12 percent) and drainage area (0-2 kilometer squared [km^2] [0-0.8 mile squared [mi^2]]), 2-10 km^2 [0.8-3.9 mi^2], 10-100 km^2 [3.9-38.7 mi^2], > 100 km^2 [> 38.7 mi^2]) that are significant for salmonid use (Cooper et al. 2020). A 50 percent random sample of habitat identified by IP modeling, stratified by reach type, was selected to provide a robust sample. Total stream length of each reach type was calculated and used to allocate effort proportionally across reach types. All potential segments were randomly sequenced by reach type to create an initial sample representing 50 percent of the stream length within each reach type.



Drainage Area	0 - 2 km^2	2-10 km^2				10 - 100 km^2				> 100 km^2		
Slope	2-7%	0-2%	2-7%	7-12%	>12%	0-2%	2-7%	7-12%	>12%	0-2%	2-7%	7-12%
Reach Type	2.1	1.2	2.2	3.2	4.2	1.3	2.3	3.3	4.3	1.4	2.4	3.4
N (sample sites)	1	1	4	7	2	30	47	13	3	47	49	5

Figure 4.2.3-15 Map of the extent of modeled accessible anadromous fish habitat (based on Intrinsic Potential modeling) showing reach types and the number of subsamples that will be measured of each Reach Type.

Diablo Lake

WSEs in Diablo Lake fluctuate modestly on a diurnal cycle for power generation. Water residence time is low, and the glacial waters that feed the reservoir are nutrient-poor, resulting in oligotrophic conditions with low chlorophyll-*a* and limited zooplankton production. Thunder Creek contributes about 18 percent of the flow to Diablo Lake, carrying substantial glacial till that reduces visibility and diminishes light penetration into the reservoir. Discharge from Ross Lake strongly influences temperature profiles in Diablo Lake, which stratifies weakly, but does not develop as strong a thermocline in summer and fall as Ross Lake does (see Section 4.2.2.1 of this Exhibit E for a more in-depth discussion of water quality in Diablo Lake).

<u>Littoral Zone Habitat</u>

As noted above, City Light conducted a GIS-Based Reservoir Littoral Zone Evaluation (City Light 2022b) to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and WSE for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes).

Littoral zone habitat in Diablo Lake is concentrated near tributaries, particularly in the Thunder Arm. The depth of the littoral zone in Diablo Lake is estimated to be between about 14 and 39 feet, and the elevation range of the varial zone spans 7 feet (Table 4.2.3-12). Based on the dataset with the highest coverage (combined existing bathymetry and Thunder Arm Light Detection and Ranging [LiDAR]), the littoral zone area estimate could range from 342-396 acres. Due to the small operational range of WSE in Diablo Lake, the total acreage of the littoral zone that is dewatered over the range of drawdown is relatively small (Table 4.2.3-17). In Thunder Arm, the varial (littoral) zone area exposed at minimum WSE is 78.7 acres, or approximately 10.3 percent of the total Diablo Lake surface area at the normal maximum WSE. Incorporating the interpolated bathymetry data for the remaining portion of the lake, the estimated total area of the varial zone increases to 110.3 acres, or 14.4 percent of the reservoir's surface area at normal maximum WSE.

Table 4.2.3-17. Cumulative area dewatered at various reservoir drawdown levels for the full extent of Diablo Lake and Thunder Arm alone.[1]

Water Surface Elevation (ft)	Percent Drawdown	Cumulative Dewatered Area (acre): Thunder Arm	Cumulative Dewatered Area (acre): Thunder Arm + WA DNR LiDAR	Cumulative Dewatered Area (acre): Thunder Arm + Interpolated Data
1,211.36 NAVD 88 (1,205.00 CoSD)	Normal Maximum	0	0	0
1,209.61 NAVD 88 (1,203.25 CoSD)	25% drawdown	8.9	12.7	13.7
1,207.86 NAVD 88 (1,201.50 CoSD)	50% drawdown	27.8	36.2	41.0
1,206.11 NAVD 88 (1,199.75 CoSD)	75% drawdown	39.4[2]	n/a	57.2
1,204.36 NAVD 88 (1,198.00 CoSD)	Minimum WSE[3]	69.8[2]	n/a	98.1

1 The percent of the littoral zone dewatered at each reservoir level and the percent of littoral zone remaining in the reservoir were not calculated due to a lack of data with enough resolution to estimate subsets of the littoral zone accurately below the varial zone.
2 Thunder Arm values may underestimate the area dewatered at these elevations where they occurred in water too deep for the LiDAR to record accurately (removed from the DEM as part of LiDAR post-processing).
3 Minimum (drawdown) WSE authorized by the current license.

Fish Stranding and Trapping

As described above, the FA-03 Stranding and Trapping Assessment (City Light 2022c) was conducted as part of Project relicensing (for a description of the scope of the study, see the Ross Lake habitat section of this Exhibit E, above). A two-day opportunistic survey was conducted on Diablo Lake in September 2020 during a drawdown to the lowest limit allowed by the existing Project license, and quarterly surveys were performed in 2022 (Table 4.2.3-18).

The 2020 survey of Diablo Lake showed that conditions in the Thunder Arm presented a fish stranding and trapping risk when reservoir elevations were drawn down at a rate of ≈ 2.7 inches per hour from WSE 1,207.36 feet NAVD 88 (1,201 feet CoSD) to WSE 1,202.36 feet NAVD 88 (1,196 feet CoSD).

Table 4.2.3-18. Observations of fish stranding and trapping during field surveys of Diablo Lake.

Date	Survey Area(s)	Species	Life Stage	Count	Status
9/16/2020	Shoreline opposite Colonial Campground, upstream of SR-20.	Rainbow Trout	Fry	4	Live
9/17/2020	Thunder Arm mouth of Colonial Creek	Rainbow Trout	Fry	22	7 live, 15 dead
5/10/2022	Thunder Arm	--	--	0	--
	Colonial Creek	--	--	0	--
	Buster Brown Bay	--	--	0	--
	Dry Dock Bay	--	--	0	--

Date	Survey Area(s)	Species	Life Stage	Count	Status
6/30/2022	Thunder Arm	--	--	0	--
	Colonial Creek	--	--	0	--
	Buster Brown Bay	--	--	0	--
	Dry Dock Bay	--	--	0	--
8/29/2022	Thunder Arm	--	--	0	--
	Colonial Creek	--	--	0	--
	Buster Brown Bay	--	--	0	--
	Dry Dock Bay	--	--	0	--

As noted above, results from the stranding and trapping surveys are being compiled into a geodatabase to map their occurrence around Diablo Lake and to visualize reservoir conditions (e.g., WSE and drawdown rate) during each instance of observed stranding or trapping. Data will be interpreted in the context of fish periodicities to identify locations, time periods, and reservoir drawdown rates that appear to present a fish stranding and trapping risk within Diablo Lake.

Fish Entrainment

Between 2015 and 2020, City Light documented the entrainment of two tagged Bull Trout at the Diablo Dam intakes (Table 4.2.3-19). Both of these fish survived turbine passage as evidenced by their continued movements (detected via the acoustic tags) following each event. Both of these fish were relatively large, measuring > 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. Bull Trout spillway entrainment was estimated via the spill duration method, as required by USFWS's Biological Opinion (USFWS 2013). During the study period, one tagged Bull Trout passed over the Diablo Dam spillway and died.

Table 4.2.3-19. Annually reported adult Bull Trout entrainment and estimated passage metrics at Diablo Lake (2015-2020).

Year	Intake Entrainment (Observed via acoustic telemetry)		Spillway Mortality (Calculated with spill duration estimation method)
	Number of Active Tags	Number of Fish Entrained	
2015	11	0	4
2016	4	1[1]	6
2017[2]	4	0	52
2018[2]	11	1[1]	54
2019	11	0	17
2020	9	0	14
Total[3]	50	2	147

Source: City Light 2016, 2017, 2018, 2019, 2020a, 2021.
1 Bull Trout entrained into the Diablo intake survived downstream passage.
2 Extended maintenance outages at Diablo powerhouse in 2017 and 2018 (in comparison, average spill at Diablo Dam from 2013-2016 was only 37 days).
3 Authorized take for the Project is 435 Bull Trout from 2013-2025 (USFWS 2013).

As explained above, City Light conducted the FA-08 Fish Entrainment Study for the Project reservoirs as part of Project relicensing (City Light 2022d). See the Ross Lake Aquatic Habitat section, above, for a description of methods and overview of entrainment risk.

Adult native char (Bull Trout and Dolly Varden) at times occur in the dam forebays or near the intakes, but their swimming burst speeds are sufficient to overcome intake approach velocities, thereby allowing them to avoid entrainment or impingement. The risk of impingement or entrainment to resident target species in Diablo Lake is the same as that in Ross Lake. For those species present in the reservoir and in proximity to the intake, only juvenile Redside Shiner were found to be susceptible to entrainment (1.44 ft/sec swimming burst speed versus 3.88 ft/sec intake approach velocity) and were assigned a moderate risk rating.

Estimated entrainment rates for Dolly Varden and Redside Shiner in Diablo Lake varied seasonally based on life stage, habitat selection, and seasonal changes in proximity to the Project intakes and spillways (Figure 4.2.3-16).

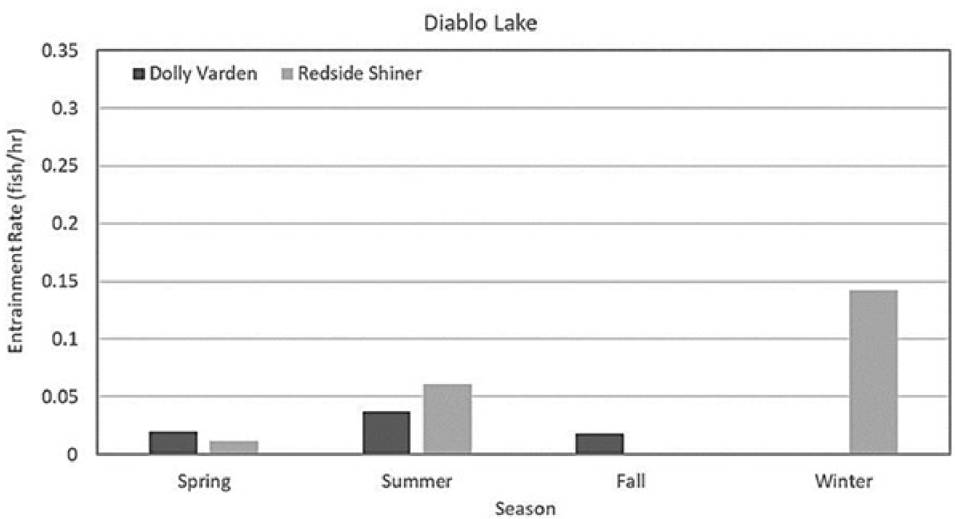


Figure 4.2.3-16. Average entrainment rate (fish/hr) of Dolly Varden and Redside Shiner, by season, in Diablo Lake.

For the fish lengths evaluated, turbine blade strike probability ranged from 2.7-40.3 percent at Diablo Dam. The majority (97.6 percent) of estimated entrainment consisted of small fish (< 4 in) with the lowest risk of turbine blade strike (2.7-5.3 percent at Diablo Dam). Larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, intake depth, and habitat selection.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency of spills at Diablo Dam is low (an average of 39 days annually in normal years [City Light 2022d]), which reduces the significance of spill-related mortality. The combined survival, via all passage routes, of fish most frequently entrained (< 4 in) was estimated to be > 87 percent at Diablo Dam.

Reservoir Bioenergetics

As described above, City Light contracted with USGS in 2018 to conduct a Food Web Study in Diablo Lake (see the Ross Lake section, above, for a description of the study's objectives). The Food Web Study is nearing completion, and results are expected to be presented in the FLA. The results will eventually be integrated with those derived from other studies (e.g., FA-07 Reservoir Tributary Habitat Assessment) and modeling (e.g., the CE-QUAL-W2 nutrients and productivity model) efforts to develop a comprehensive characterization of the rearing capacity of the Project reservoirs and their tributaries, for both native resident and potentially introduced anadromous fish.

Diablo Lake Connectivity

As part of Project relicensing, City Light conducted a Hydraulic Connectivity Assessment of the Reach between Diablo Dam and Diablo Powerhouse (City Light 2022f). The purpose of the analysis was to evaluate operating scenarios that could result in a loss of the reach's hydraulic connectivity, and associated potential effects on fish habitat and stranding and trapping in the reach between the toe of Diablo Dam and the Diablo Powerhouse (Diablo Reach).

The analysis consisted of four steps: (1) conducting a backwater analysis using WSE data (January 1, 1997-August 9, 2021) and Hydrologic Engineering Center River Analysis System (HEC-RAS) modeling to estimate the threshold WSE under which the Diablo Reach would begin to lose hydraulic connectivity with the rest of the reservoir; (2) using Diablo Powerhouse generation data to document the full range of generation (i.e., flow) conditions for use as inputs to the HEC-RAS model; (3) conducting HEC-RAS model runs using the aforementioned threshold WSE and a range of operational scenarios to identify powerhouse operations that might result in loss of hydraulic connectivity in the Diablo Reach; and (4) conducting a reoccurrence frequency analysis of Diablo Powerhouse operations to assess how often hydraulic connectivity in the Diablo Reach may have occurred historically.

Results of iterative HEC-RAS model simulations indicate that a WSE of 878.5 feet NAVD 88 (872.14 ft CoSD) was the threshold below which the Diablo Reach would experience loss of hydraulic connectivity. Four scenarios, based on operational data over the most recent 10-year period of record, were identified to represent the full range of potential Diablo Powerhouse operational conditions to be used as inputs to the HEC-RAS model:

- Zero flow released from Diablo Powerhouse.
- Average discharge from operation of the two small units (35 and 36) at Diablo Powerhouse (16 cubic feet per second [cfs]).
- Average discharge from operation of units 35 and 36 and one of the two large generators (31 or 32) at Diablo Powerhouse (1,867 cfs).
- Maximum discharge from the powerhouse based on the peak operation of all four generation units (3,716 cfs).

Modeling indicates that discharges from the units 35 and 36 alone are insufficient to maintain connectivity when the Diablo Powerhouse tailwater WSE reaches 878.5 feet NAVD 88 (872.14 ft

CoSD). However, operation of units 35 and 36 and one large unit (1,867 cfs) provides sufficient discharge to maintain hydraulic connectivity from the toe of Diablo Dam to Diablo Powerhouse.

A reoccurrence frequency analysis showed that during the 24-year period of record (1997-2021) the Diablo Powerhouse tailrace WSE fell below the threshold elevation 878.5 feet NAVD 88 (872.14 ft CoSD) on 271 days (≈ 3 percent of the days); over the past 10 years, the tailrace WSE fell below the threshold elevation on 34 days (≈ 1 percent of the days). On these days, releases < 1,867 cfs occurred on one day within the past 24 years and zero days during the most recent 10 years, i.e., results of the analysis show that the conditions that could bring about the loss of hydraulic connectivity in the Diablo Reach occurred on only 1 day in 24 years.

In reality, when Diablo Powerhouse discharges are extremely low or fully interrupted, i.e., during powerhouse outage, City Light is required to quickly restore flows to meet downstream minimum flow requirements, either by increasing Diablo Powerhouse generation or passing water via the Diablo Dam spillway. Because typical response times to an outage are two hours or less, low flows do not persist long enough to result in a loss of connectivity. Also, a loss of connectivity does not signify that the Diablo Reach is dewatered, i.e., water remains in the deep pools within the reach that would serve as fish holding habitat during the short period if connectivity were to be lost. When outages occur, flows are restored rapidly according to standard operating procedures, making the risk of stranding or trapping negligible. Moreover, the upper section of the Diablo Reach is a slot canyon, and aquatic habitat in this reach consists of deep pools with vertical rock walls. Shoreline slopes in this reach exceed the 4-6 percent range considered to pose a stranding risk to fish (Bauersfeld 1978; Beck Associates 1989; Bell et al. 2008).

<u>Diablo Lake Tributaries</u>

The largest tributary to Diablo Lake is Thunder Creek (17.8 miles long) (WDF 1975). Approximately 2.45 miles of Thunder Creek were made accessible to the upstream movement of fish when a historical passage barrier was inundated by Diablo Lake. Historically, Colonial, Pyramid, Rhode, and Sourdough creeks probably provided little, if any, accessible habitat for native fish. Today only Thunder and Colonial creeks are known to support regular spawning of Rainbow Trout and native char (Downen 2006). However, the spawning habitat that is available in tributaries is considered to be of high quality (WDFW 1998).

As noted above, City Light is conducting the FA-07 Reservoir Tributary Habitat Assessment (City Light 2022e) to evaluate the availability and production potential of habitat for Chinook, Coho, and Sockeye salmon and steelhead in reservoir tributaries (see the Ross Lake section of this Exhibit E, above, for an overview of study approach and tributaries being evaluated).

Gorge Lake

<u>Littoral Zone Habitat</u>

As noted above, City Light conducted a GIS-Based Reservoir Littoral Zone Evaluation (City Light 2022b) to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and WSE for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes).

The depth of the littoral zone in Gorge Lake is estimated to be between about 14 and 39 feet, and the elevation range of the varial zone spans 50 feet (Table 4.2.3-12). However, the reservoir is rarely drawn down to the minimum WSE. The total area of the littoral zone at the normal maximum WSE is approximately 103.3-179.3 acres (the total surface area of Gorge Lake at the normal maximum WSE is 235 acres). The most substantial dewatering of littoral zone habitat in Gorge Lake occurs during drawdowns between 75 and 100 percent of the normal maximum WSE (12.50 feet) (Table 4.2.3-20). Within this WSE range of 881.51 NAVD 88 (875.00 feet CoSD) to 869.01 NAVD 88 (862.50 feet CoSD), the littoral zone is dewatered by 47.7 to 82.7 percent.

Table 4.2.3-20 Cumulative acres and percent of the littoral zone that is dewatered in Gorge Lake at various reservoir drawdown levels.

Water Surface Elevation (feet) NAVD 88	Water Surface Elevation as Percent of Drawdown Range	Submerged Littoral Zone Area (acre)	Percent of Total Littoral Zone That is Submerged	Percent of Total Littoral Zone Dewatered
881.51 (875.00 CoSD)	Normal Maximum WSE	103.3 to 179.3	100	-
869.01 (862.50 CoSD)	25% drawdown	17.9 to 93.9	17.3 to 52.3	47.7 to 82.7
856.51 (850.00 CoSD)	50% drawdown	0 to 32.7	0 to 18.2	82.7 to 100%
844.01 (837.50 CoSD)	75% drawdown	0 to 5.8	0 to 3.2	96.8 to 100%
831.51 (825.00 CoSD)	Minimum WSE[1]	0	0	100%

1 Minimum (drawdown) WSE authorized by the current license.

Fish Stranding and Trapping

As described above, the FA-03 Stranding and Trapping Assessment (City Light 2022c) was conducted as part of Project relicensing (for a description of the scope of the study, see the Ross Lake habitat section, above). Stranding and trapping surveys were conducted on Gorge Lake in May, June, and August 2022. Live, stranded salmonid fry were observed in May 2022, and no stranded fish were observed during the June and August 2022 surveys (Table 4.2.3-21).

Table 4.2.3-21. Observations of fish stranding and trapping during field surveys of Gorge Lake.

Date	Survey Area	Species	Life Stage	Count	Status
5/10/2022	Reflector Bar	Rainbow Trout	Fry	2	Live
5/10/2022	Reflector Bar	Unidentified salmonids	Fry	5-10	Live
6/30/2022	Reflector Bar	--	--	0	--
8/29/2022	Reflector Bar	--	--	0	--

As noted above, results from the stranding and trapping surveys are being compiled into a geodatabase to map their occurrence around Gorge Lake and to visualize reservoir conditions (e.g., WSE and drawdown rate) during each instance of observed stranding or trapping. Data will be interpreted in the context of fish periodicity to identify locations, time periods, and reservoir drawdown rates that appear to present a fish stranding and trapping risk in Gorge Lake.

Fish Entrainment

Bull Trout entrainment via the intake routes has been shown to be relatively uncommon at Gorge Dam. Spillway passage is more common at Gorge Dam than it is at Ross Dam, although during a six-year study, only 1 of the 11 Bull Trout with active acoustic tags in Gorge Lake passed downstream over the spillway (in 2016). This fish was assumed to have died, as it was last documented in the forebay during a 26-day spill event and never detected again (Table 4.2.3-22). Bull Trout spillway entrainment was also estimated via the spill duration method for the annual entrainment estimation required by USFWS's Biological Opinion (USFWS 2013).

Table 4.2.3-22. Annually reported adult Bull Trout entrainment and estimated passage metrics at Gorge Lake (2015-2020).

Year	Intake Entrainment (Observed via acoustic telemetry)		Spillway Mortality (Calculated with spill duration estimation method)
	Number of Active Tags	Number of Fish Entrained	
2015	14	0	2
2016	11	0	6[1]
2017	10	0	4
2018	10	0	5
2019	10	0	0
2020	8	0	3
Total[2]	63	0	20

Source: City Light 2016, 2017, 2018, 2019, 2020a, 2021.
1 Includes one Bull Trout spill-related entrainment mortality observed via acoustic telemetry.
2 Authorized take for the Project is 435 Bull Trout from 2013-2025 (USFWS 2013).

As explained above, City Light conducted the FA-08 Fish Entrainment Study for the Project reservoirs as part of Project relicensing, (City Light 2022d). See the Ross Lake Aquatic Habitat section, above, for a description of methods and overview of entrainment risk.

The Gorge Dam intake is shallower (≈ 56.3 ft) and has a higher intake velocity than those at Diablo and Ross dams. As noted above, adult native char (Bull Trout and Dolly Varden) may occur in the dam forebays or near the intakes, but their swimming burst speeds are sufficient to overcome approach velocities, thereby allowing them to avoid entrainment or impingement. Although acoustic telemetry studies have at times documented Bull Trout in the Gorge Lake forebay, the majority of Bull Trout in Gorge Lake occur in the Diablo Dam tailrace, a primary foraging area, rather than the forebay (City Light 2018).

Adult Dolly Varden may be susceptible to entrainment at minimum WSE (5.54 ft/sec burst swimming speed versus 6.2 ft/sec intake approach velocity); the relatively shallow depth of the intake combined with low water levels during drawdown leads to an increase in intake velocities and, therefore, susceptibility to entrainment. Gorge Lake is drawn down to minimum WSE infrequently for unit maintenance or testing purposes (less than annually; the most recent drawdowns of this extent occurred in 2013 and 2019 [City Light 2022d]). An entrainment risk category of "moderate" was applied to this species and life-stage due to this elevated susceptibility.

Like Dolly Varden, adult Redside Shiner would be at risk of entrainment at the Gorge Dam intake during periods of minimum WSE (4.95 ft/sec swimming burst speed versus 6.2 ft/sec intake approach velocity). Because this species would only be susceptible at minimum WSE and only during certain portions of the year, it is considered to be at moderate risk of entrainment. Juvenile Redside Shiner would be susceptible to entrainment by intake approach velocities at normal or minimum WSE. However, this life-stage would only be at risk of entrainment during winter when the species may occur at depth and in closer proximity to the intake; therefore, it is also considered at moderate risk of entrainment.

Estimated entrainment rates for Dolly Varden and Redside Shiner in Gorge Lake varied seasonally based on life stage, habitat selection, and changes in distribution that may encourage the species to move closer to or farther away from Project intakes and spillways (Figure 4.2.3-17).

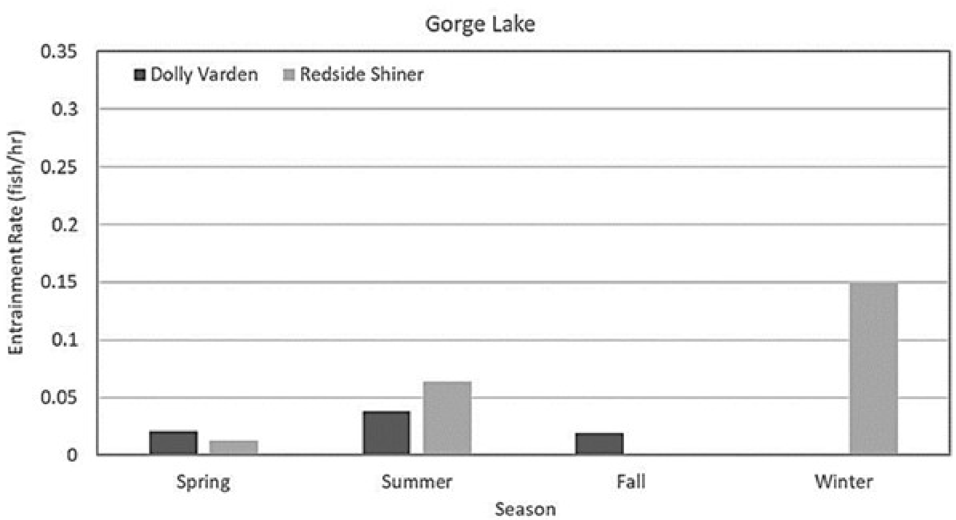


Figure 4.2.3-17. Average entrainment rate (fish/hr) of Dolly Varden and Redside Shiner, by season, in Gorge Lake.

For the fish lengths evaluated, turbine blade strike probability ranged from 2.9-51.1 percent for Gorge Dam. The majority (97.6 percent) of estimated entrainment consisted of small fish (< 4 in), with the lowest risk of turbine blade strike, 2.9-6.7 percent at Gorge Dam. Larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, intake depth, and habitat selection.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency and volume of spills at the Project is low, thus reducing the significance of spill-related mortality. Spill frequency for the period 2015-2020 is 37 days per year at Gorge Dam (City Light 2022d). The combined survival, via all passage routes, of fish most frequently entrained (< 4 in) was estimated at ≥ 94 percent at Gorge Dam.

Reservoir Bioenergetics

As described above in the Ross Lake section of this Exhibit E (see this section for a description of the study's objectives), City Light contracted with USGS in 2018 to conduct a Food Web Study. As originally formulated, the study scope was limited to Ross and Diablo lakes. At the request of LPs, City Light agreed to expand the scope of the study to include Gorge Lake.

The Food Web Study is nearing completion, and results are expected to be presented in the FLA. The results will eventually be integrated with those derived from other studies (e.g., FA-07 Reservoir Tributary Habitat Assessment) and modeling (e.g., the CE-QUAL-W2 nutrients and productivity model) efforts to develop a comprehensive characterization of the rearing capacity of the Project reservoirs and their tributaries, for both native resident and potentially introduced anadromous fish.

Gorge Lake Tributaries

Six tributaries, with approximately 54 miles of stream drainage, flow into Gorge Lake. Two of the tributaries, primarily Stetattle Creek but also Gorge Creek, have potential Bull Trout spawning habitat. As noted above, City Light is conducting the FA-07 Reservoir Tributary Habitat Assessment (City Light 2022e) to evaluate the availability and production potential of habitat for Chinook, Coho, and Sockeye salmon and steelhead in reservoir tributaries (see the Ross Lake section of this Exhibit E, above, for an overview of study approach and tributaries being evaluated).

Gorge Bypass Reach

The 2.5-mile-long reach of the Skagit River extending from Gorge Dam to Gorge Powerhouse (Gorge bypass reach) flows through a steep, confined canyon with predominately bedrock and large boulder substrate. There is no requirement under the current Project license for flow releases into this reach. Aquatic habitat in the Gorge bypass reach is limited by flow (approximately 1.5 to 2.0 cfs during the low-flow period),[52] which does not provide a fully wetted channel in many areas (Envirosphere 1988). Under existing conditions, flows of several hundred to over 20,000 cfs occur in the Gorge bypass reach during planned and unplanned spills at Gorge Dam (Figure 4.2.3-18). These spills are the result of load rejection, emergency shutdown, release of water during maintenance of Gorge Powerhouse, or under various flood risk management scenarios. During maintenance or emergency shutdown, water is routed through the Gorge bypass reach to maintain instream flow requirements in the Skagit River downstream of Newhalem. Between January 1, 1997 and December 31, 2021, there were 722 days (approximately 8 percent of the time) when Gorge Dam was spilling water into the bypass reach (Figure 4.2.3-18).

[52] Flows in the Gorge bypass reach are derived from seepage under Gorge Dam, groundwater accretion, and four ephemeral (non-fish-bearing) streams.

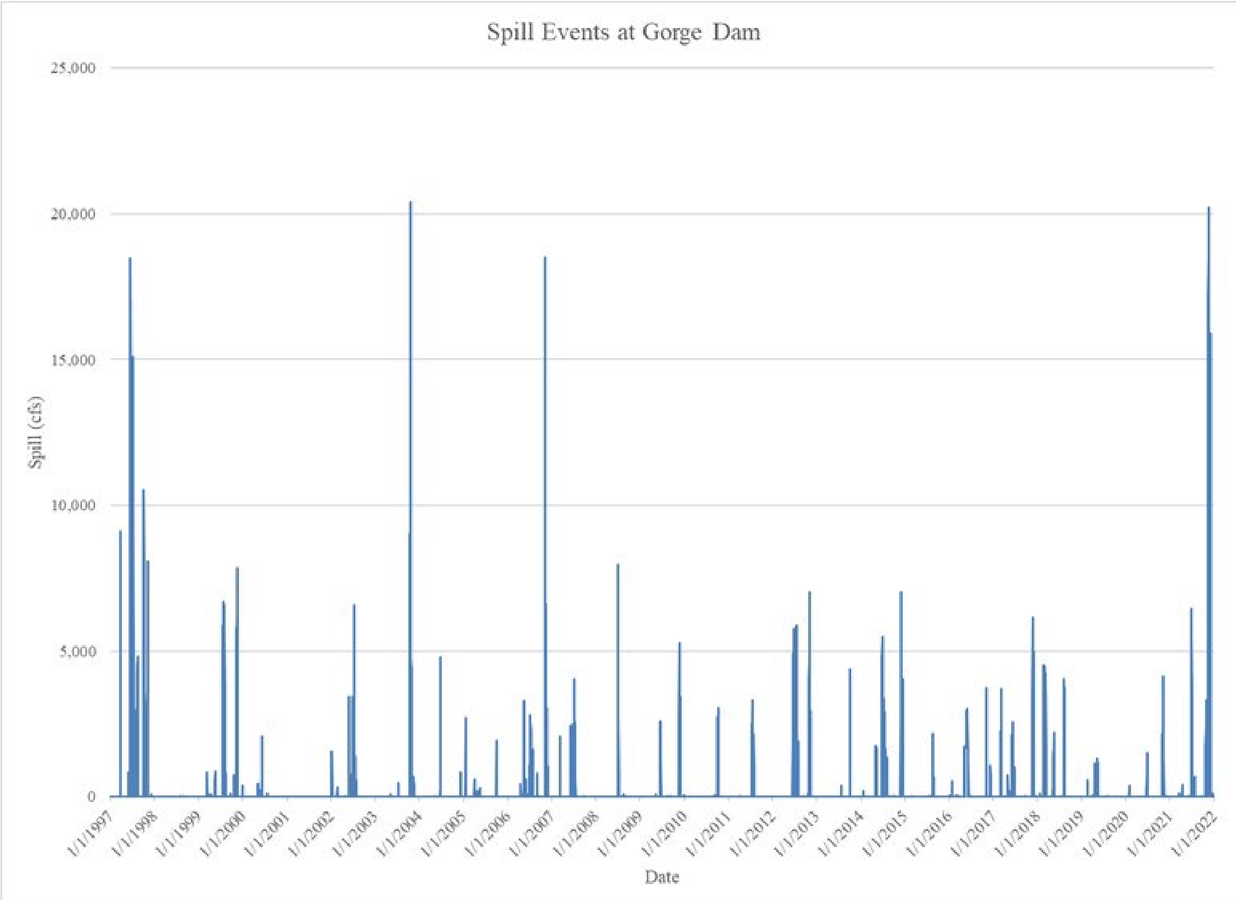


Figure 4.2.3-18. Documented spill events at Gorge Dam from January 1, 1997 – December 31, 2021.

As described in Envirosphere (1989), the stream channel in the Gorge bypass reach consists of high-gradient sections characterized by short boulder pools, cascades, and steep riffles. Substrates in these areas include bedrock, large granite blocks, boulders, and some cobbles. Above areas of channel confinement are aggraded sections, which have lower gradients and are made up of riffles, deep runs, and long pools. Substrates in these areas are small boulders and large cobbles in runs and riffles and sand and gravel in pools. The width of the active channel ranges from 60 feet in narrow canyon sections to 230 feet at wide pools and adjacent to active alluvial bars.

As noted above (i.e., in Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin), geologic, genetic, and ethnographic evidence indicates that anadromous salmonids did not pass upstream of Devil's Canyon, a feature now inundated by Gorge Lake. NMFS (2012) acknowledges this in the following statements, "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," and "the preponderance of evidence indicates limited historical anadromous fish use of the Skagit River watershed upstream from the present location of the Gorge Powerhouse." In addition, an assessment of historical WDFW (Envirosphere 1988) accounts states, "Some historical evidence suggests that small runs of steelhead trout migrated [only] as far as Stetattle Creek [a tributary to Gorge Lake.]..."

Recent surveys conducted by the Upper Skagit Indian Tribe and WDFW (Seamons et al. 2021; Upper Skagit Indian Tribe 2022a, 2022b, WDFW 2021) have shown that some anadromous fish are capable of passing the high-gradient reaches in the Gorge bypass reach under certain flow conditions, in particular what is referred to by the Upper Skagit Indian Tribe and WDFW as the 0.54-mile cascade (coordinates identified by WDFW for the cascade are 48.683099, -121.241766). Anadromous fish species observed above the 0.54-mile cascade include (1) juvenile Coho Salmon, confirmed by genetic analysis (Seamons et al. 2021); (2) Coho and Chinook salmon fry, unconfirmed by genetic analysis (Upper Skagit Indian Tribe 2022b); and (3) adult Coho Salmon (WDFW 2021) (see Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin for greater detail on the results of these surveys).

City Light is conducting the FA-05 Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development Study (Bypass Instream Flow Model Development Study, City Light 2022g) to construct and implement a flow-habitat evaluation tool (Bypass Habitat Model) for the Gorge bypass reach. The Bypass Habitat Model (City Light 2022g) extends longitudinally from the Gorge Dam plunge pool (PRM 97.15) to the USGS Skagit River at Newhalem gage (USGS gage 12178000) (PRM 94.25), a length of approximately 2.9 miles. Output from the Bypass Habitat Model can be combined with output from the Upper Skagit Habitat Model (FA-02 Instream Flow Model Development Study, City Light 2022h), which extends from the USGS Skagit River at Newhalem gage to the confluence with the Sauk River, to provide flow-habitat simulations for the 31-mile reach from Gorge Dam to the Sauk River.

As background the 31-mile study area was divided into 19 reaches: reaches 1-6 are within the domain of the Bypass Habitat Model and reaches 7-19 are within the domain of the Upper Skagit Habitat Model. Reach locations and lengths for the two models are summarized in Table 4.2.3-23. The habitat models provide a library of usable habitat area (UHA) curves, i.e., relationships between UHA and flow for each of the 37 fish species/life stage combinations identified by City Light in consultation with LPs (Table 4.2.3-24). UHA curves account for depth, velocity, substrate, and cover preferences of each species/life stage combination. These curves will be used in the evaluation of alternative flow management scenarios that will be presented in the USR and FLA.[53]

[53] Some discussion is provided here relating to the Upper Skagit Habitat Model, as it pertains to its linkage to the Bypass Habitat Model and the two models' overall joint functioning. However, most content related to the Upper Skagit Habitat Model can be found in the next section of this Exhibit E, i.e., Mainstem Skagit River from Gorge Powerhouse to the Sauk River Confluence.

Table 4.2.3-23. Reaches for the Bypass Habitat and Upper Skagit Habitat models.

Reach ID	Location	Length (mi)	Contributing Inflows
1	Gorge Dam to geomorphic reach break	0.5	
2	Geomorphic reach break to upstream of Afternoon Creek pool	0.6	
3	Upstream of Afternoon Creek pool to downstream end of pool	0.3	
4	Downstream end of Afternoon Creek pool to upstream limit of Gorge Powerhouse backwater	0.7	
5	Upstream limit of Gorge Powerhouse backwater to Gorge Powerhouse	0.4	
6	Gorge Powerhouse to USGS Skagit River at Newhalem gage	0.4	Ladder Creek
7	USGS Skagit @ Newhalem gage to upstream of Newhalem Creek	0.5	Skagit @ Newhalem
8	Newhalem Creek to upstream of Goodell Creek	0.5	Newhalem Creek
9	Goodell Creek to upstream of Thornton Creek	2.8	Goodell Creek
10	Thornton Creek to upstream of Damnation Creek	2.4	Thornton Creek
11	Damnation Creek to upstream of Alma Creek	1.4	Damnation Creek and additional drainage
12	Alma Creek to upstream of Bacon Creek	2.3	Alma and Copper Creeks
13	Bacon Creek to upstream of Diobsud Creek	2.2	Bacon Creek
14	Diobsud Creek to upstream of Cascade River Road Bridge	2.6	Diobsud and Taylor Creeks
15	Cascade River Road Bridge to upstream of Corkindale Creek	4.2	Cascade River
16	Corkindale Creek to upstream of Illabot Creek	2.6	Corkindale, O'Brien, Olson, and Rocky Creeks
17	Illabot Creek to upstream of Barr Creek	0.9	Illabot Creek
18	Barr Creek to downstream of SR 530 Bridge	3.1	Barr and Sutter Creeks
19	Downstream of SR 530 Bridge to Sauk River confluence (PRM 66.5)	1.2	Sauk R, Sauk Mtn drainage, and Barnaby Slough drainage

Table 4.2.3-24. Target species and life stages considered for the Upper Skagit (mainstem from Gorge Powerhouse to Sauk River) and the Bypass Instream Flow Models.[1]

Species	Scientific Name	Life Stage			
		Spawning	Adult	Juvenile	Fry
Steelhead	*Oncorhynchus mykiss*	X	X	X	
Chinook Salmon	*O. tshawytscha*	X		X	X
Pink Salmon	*O. gorbuscha*	X			
Chum Salmon	*O. keta*	X			X
Coho Salmon	*O. kisutch*	X		X	X
Sockeye Salmon	*O. nerka*	X			
Rainbow Trout	*O. mykiss*	X	X	X	X
Bull Trout/Dolly Varden	*Salvelinus confluentus/Salvelinus malma*	X		X	X
Sea-Run Bull Trout[1]	*S. confluentus*	X			
Cutthroat Trout	*O. clarkii*	X	X	X	X
Sea-Run Cutthroat Trout[1]	*O. clarkii*	X			
Mountain Whitefish	*Prosopium williamsoni*	X	X	X	X
Pacific Lamprey[1]	*Entosphenus tridentatus*	X			
Lamprey (generic)	*Lampetra* spp.			X	
Western Brook Lamprey[1]	*L. richardsoni*	X			
Western River Lamprey[1]	*L. ayresii*	X			
White Sturgeon[1]	*Acipenser transmontanus*	X			
Salish Sucker[1]	*Catostomus catostomus*	X		X	

1 Some species and/or life stages selected for habitat modeling consideration may not be present in the mainstem Skagit River, but in collaboration with LPs, have been included to evaluate the amount of potential habitat created under various flow regimes. The habitat model results for these species/life stages may or may not be considered in future instream flow management decisions.

City Light, in consultation with LPs, selected 42 combinations of flow, i.e., releases from Gorge Dam and discharges from Gorge Powerhouse, to define flow-habitat relationships for the Gorge bypass reach. The selected combinations of flow are shown in Table 4.2.3-25. Flow in reaches 1-4 represent releases from Gorge Dam only, because these reaches are not influenced by discharges from Gorge Powerhouse. Flow in reach 6 represents the combined release from Gorge Dam, discharge from Gorge Powerhouse, and a nominal allowance for inflow from Ladder Creek. Reach 5 is more complicated because depth and velocity are a function of both the inflow to that reach (i.e., the release from Gorge Dam) and the discharge from Gorge Powerhouse at the downstream end of the reach, thereby imposing a backwater effect on the lower end of reach 5.

Table 4.2.3-25. Combinations of Gorge Dam releases and Gorge Powerhouse discharges selected for habitat modeling.

Gorge Powerhouse Flows (cfs)	Gorge Dam Flows (cfs)									
	0	50	100	200	400	600	800	1,000	2,000	3,000
1,400	x	x	x	x	x	x	x	x	x	x
1,600	x									
1,700	x									
2,010	x									
2,500	x									
2,980	x	x	x	x	x	x	x	x		
3,740	x									
4,480	x									
5,057	x	x	x	x	x	x	x	x		
6,000	x									
6,954	x									
7,521	x	x	x	x	x	x	x	x		

A series of 2-D (reaches 1-4 and 6) or 3-D (reach 5, due to the backwater effects discussed above) plots characterizes the relationship between UHA and flow, or combination of flows, for a specific reach and species-life stage combination (222 plots). To facilitate comparison of results, the flow-habitat relationships for reaches 1-5 were grouped into the six categories: (1) salmonid spawning; (2) salmonid fry; (3) salmonid juveniles; (4) salmonid adults; (5) lamprey and Salish Sucker; and (6) White Sturgeon. Two types of example plots, for bypass reaches 4 and 5, are provided in Figure 4.2.3-19 and Figure 4.2.3-20, respectively. The full set of UHA plots will be provided in the FA-05 Bypass Instream Flow Model Development Study USR due to FERC in March 2023.

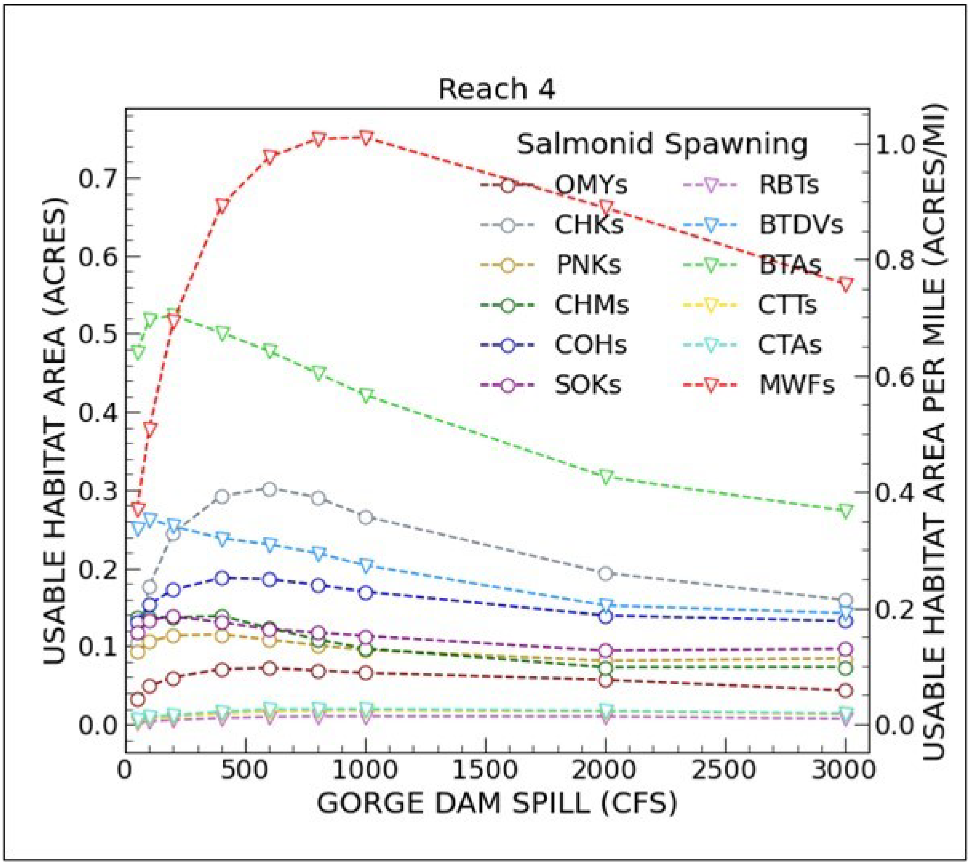


Figure 4.2.3-19. Sample UHA plot for salmonid spawning species/life stage in Bypass Habitat Model Reach 4. OMYs (steelhead), CHKs (Chinook Salmon), PNKs (Pink Salmon), CHMs (Chum Salmon), COHs (Coho Salmon), SOKs (Sockeye Salmon), RBTs (Rainbow Trout), BTDVs (Bull Trout/Dolly Varden), BTAs (Sea-Run Bull Trout), CTTs (Cutthroat Trout), CTAs (Sea-Run Cutthroat Trout), and MWFs (Mountain Whitefish).

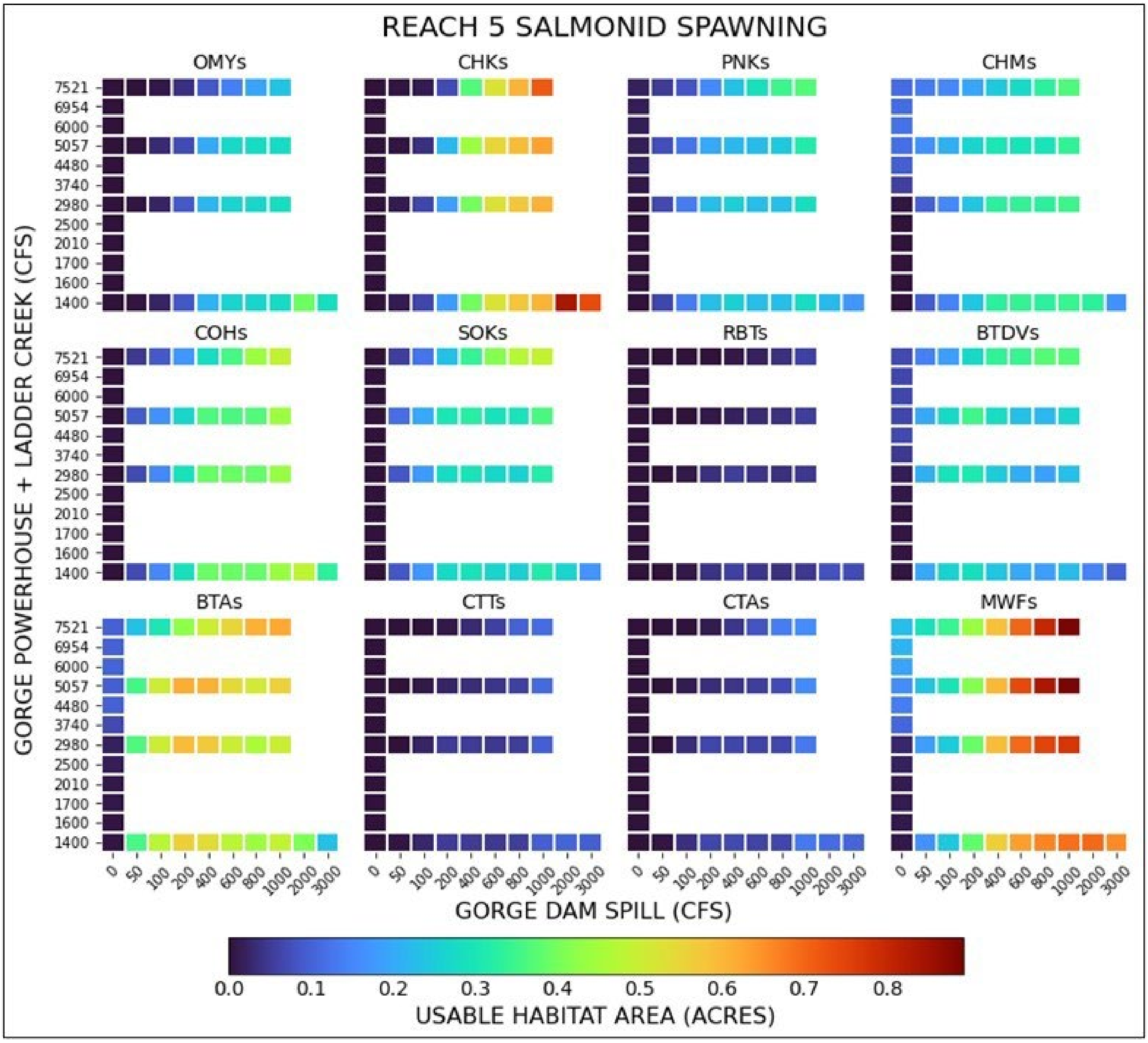


Figure 4.2.3-20. Sample UHA plot for salmonid spawning species/life stage in Bypass Habitat Model Reach 5. OMYs (steelhead), CHKs (Chinook Salmon), PNKs (Pink Salmon), CHMs (Chum Salmon), COHs (Coho Salmon), SOKs (Sockeye Salmon), RBTs (Rainbow Trout), BTDVs (Bull Trout/Dolly Varden), BTAs (Sea-Run Bull Trout), CTTs (Cutthroat Trout), CTAs (Sea-Run Cutthroat Trout), and MWFs (Mountain Whitefish).

A series of 17 steady-state runs were simulated with the calibrated Bypass Hydraulic Model to generate hydraulic data to support a fish passage evaluation at Existing Features 1 and 2[54] (Figure 4.2.3-21). Simulations were based on releases from Gorge Dam, identified in consultation with LPs and fish passage experts, ranging from 50 cfs to 4,800 cfs (Table 4.2.3-26), and a steady state discharge of 2,000 cfs from Gorge Powerhouse (although releases from Gorge Powerhouse have

[54] See the Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin section of this Exhibit E for a discussion of the understanding of historical fish passage and recent fish surveys in the bypass reach, which refer to the "0.54-mile cascade," which is the same as "Existing Feature 1."

no impact on hydraulic conditions at the Existing Features, which are upstream of the powerhouse). The model output will be used by the authors of the FA-04 Fish Passage Study (City Light 2022i) and will be presented in the Fish Passage Study USR.

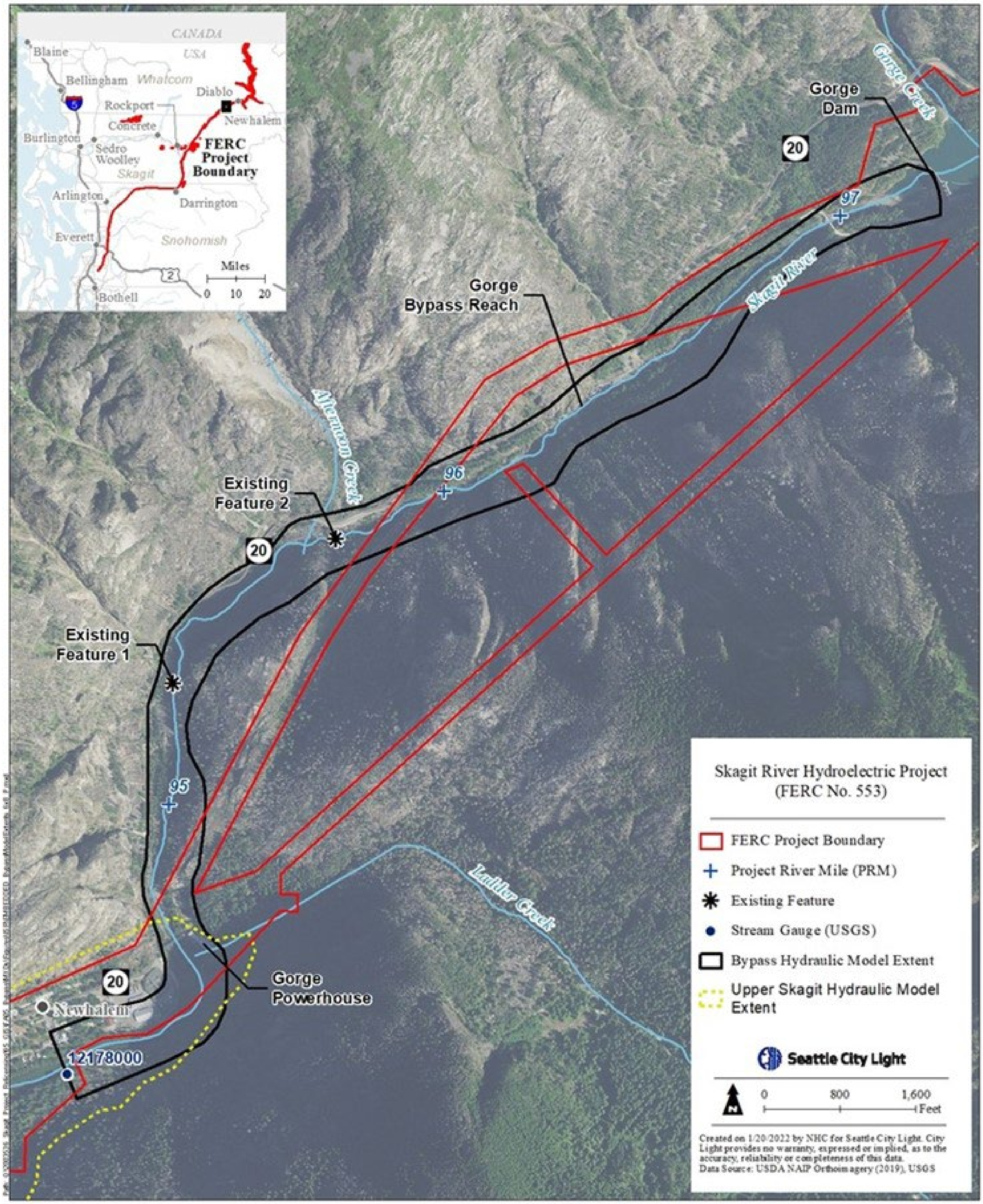


Figure 4.2.3-21. Bypass Habitat model study area, showing Existing Features 1 and 2.

Table 4.2.3-26. Flows simulated to generate hydraulic data in support of fish passage evaluation.

Run No.	Release from Gorge Dam (cfs)	Discharge from Gorge Powerhouse (cfs)
1	50	2,000
2	100	2,000
3	200	2,000
4	400	2,000
5	600	2,000
6	800	2,000
7	1,000	2,000
8	1,200	2,000
9	1,400	2,000
10	1,600	2,000
11	1,800	2,000
12	2,000	2,000
13	2,500	2,000
14	3,000	2,000
15	3,500	2,000
16	4,000	2,000
17	4,800	2,000

Mainstem Skagit River from Gorge Powerhouse to the Sauk River Confluence

The Skagit River below Gorge Powerhouse is at first fairly confined and then broadens gradually from the confluence of Alma Creek to the Sauk River confluence. Within the first mile downstream of Newhalem, the substrate is a mixture of gravel, cobbles, and boulders or bedrock, with few fine sediments present. Downstream of this reach, the river flows through a low-gradient (less than 0.2 percent) valley bounded by steep topography. Connor and Pflug (2004) and NMFS (2012) report that spawning gravel is abundant in this reach due to bedload contributions from tributaries and glacial gravel deposits along the riverbanks. Beamer et al. (2005a) concluded that the Skagit River below the Project is not sediment impaired, and spawning habitat is not a limiting factor for Chinook Salmon. Large wood jams are limited and highly mobile in this reach of river (Lowery 2019).

As part of relicensing, City Light is conducting the GE-04 Skagit River Geomorphology between Gorge Dam and the Sauk River Study (Geomorphology Study) (City Light 2022j) to characterize existing aquatic habitat between Gorge Dam and the Sauk River confluence and how Project-related changes in peak flows affect geomorphic processes. The primary study area is located upstream of the Sauk River (i.e., a 30-mile segment of the river and 56 side channels and off-channel habitat areas identified through a collaborative process with LPs), within which field data were collected in 2021 and 2022. This stretch of river was divided into geomorphic reaches based on landform mapping conducted by NPS (Riedel et al. 2020) (Figures 4.2.3-22-4.2.3-25) (Table 4.2.3-27). The secondary study area, within which sediment transport modeling is being conducted (sediment transport modeling is discussed below), extends from the Sauk River to approximately PRM 20.0.

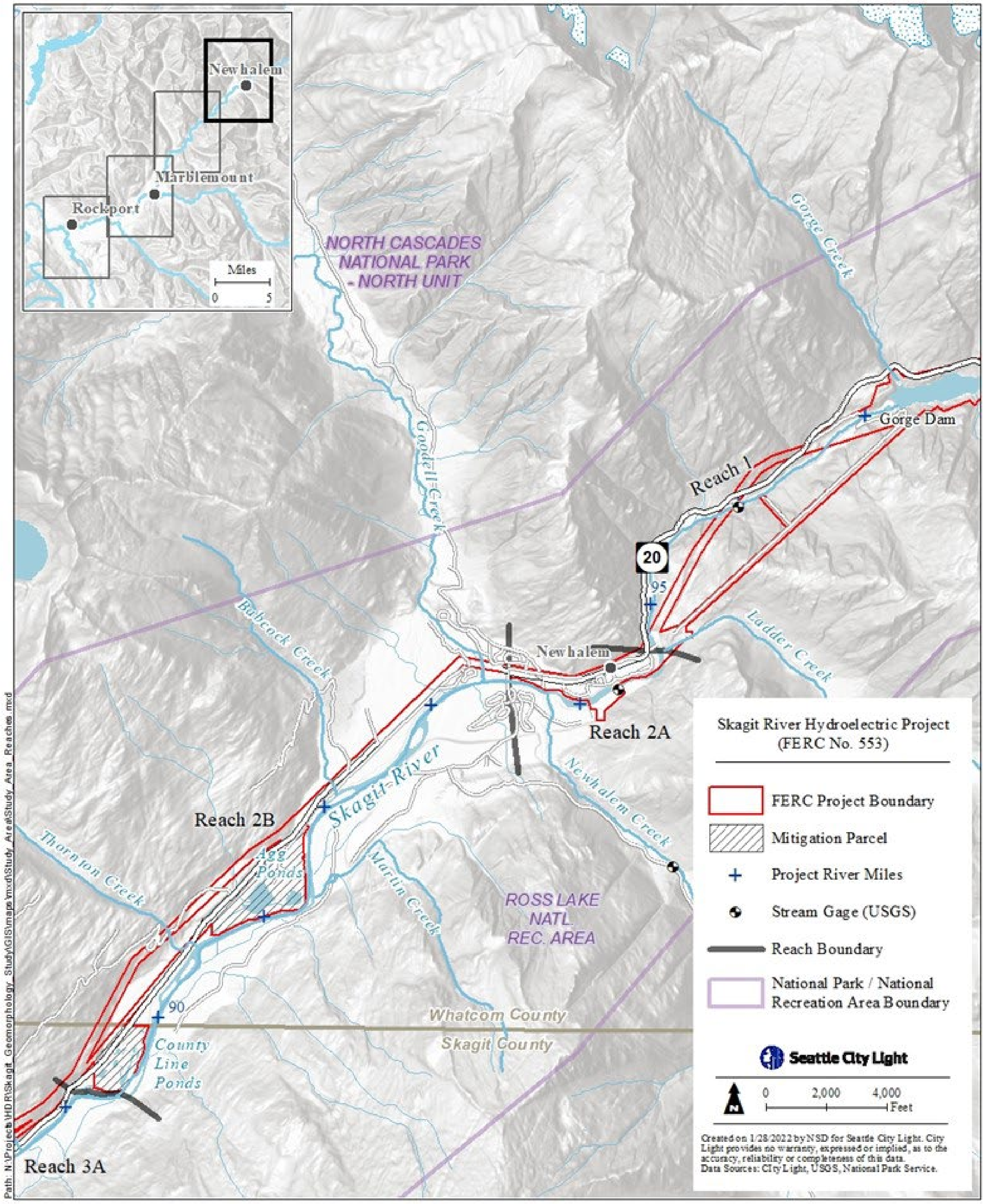


Figure 4.2.3-22. Northern portion of primary study area from Gorge Dam to the County Line including Reach 1, 2A, and 2B.

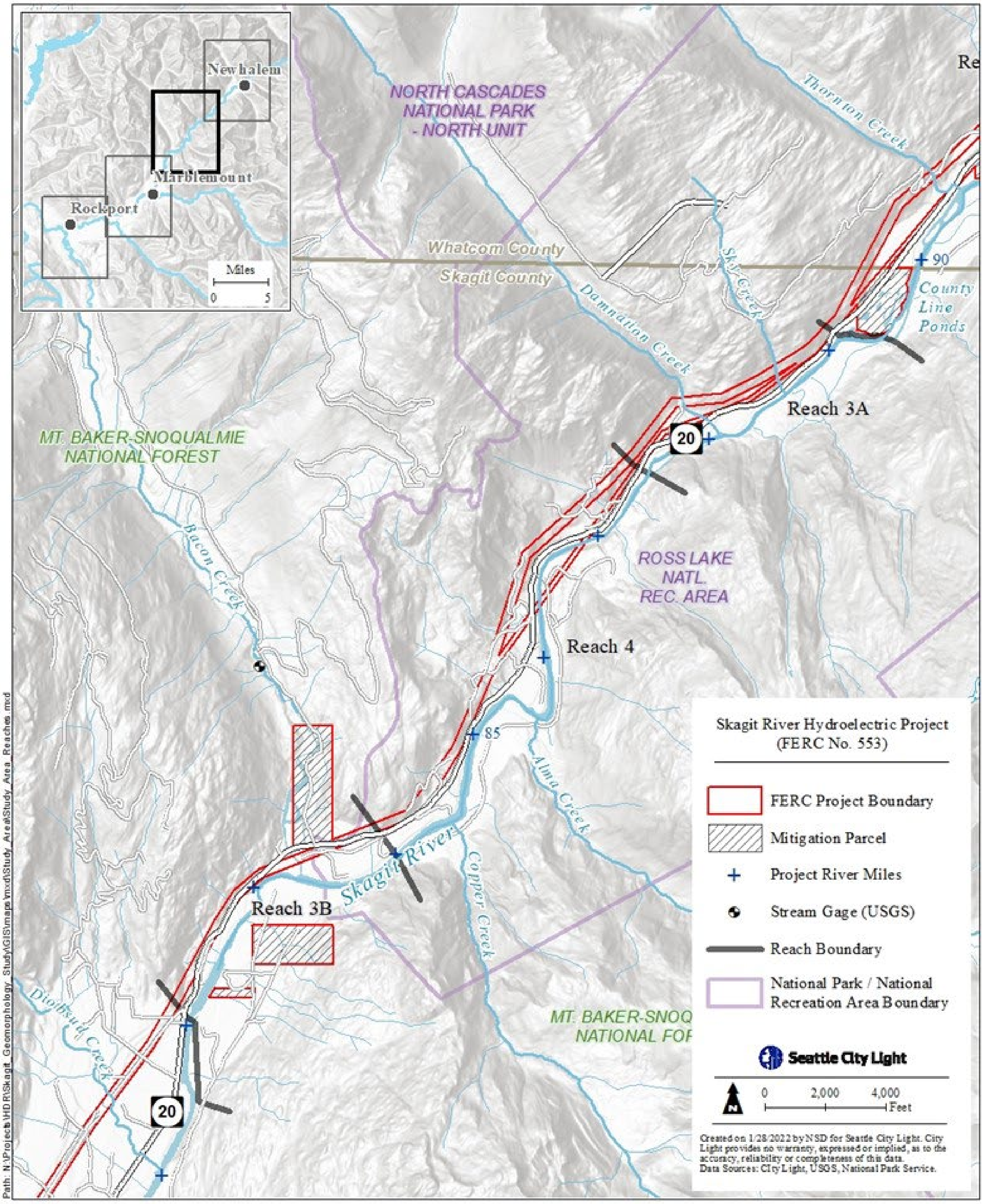


Figure 4.2-3-23. Primary study area reaches from County Line to the Straight Creek Fault Zone near Diobsud Creek including the Narrow Upper Skagit Reaches 3A/3B and the landslide zone (Reach 4).

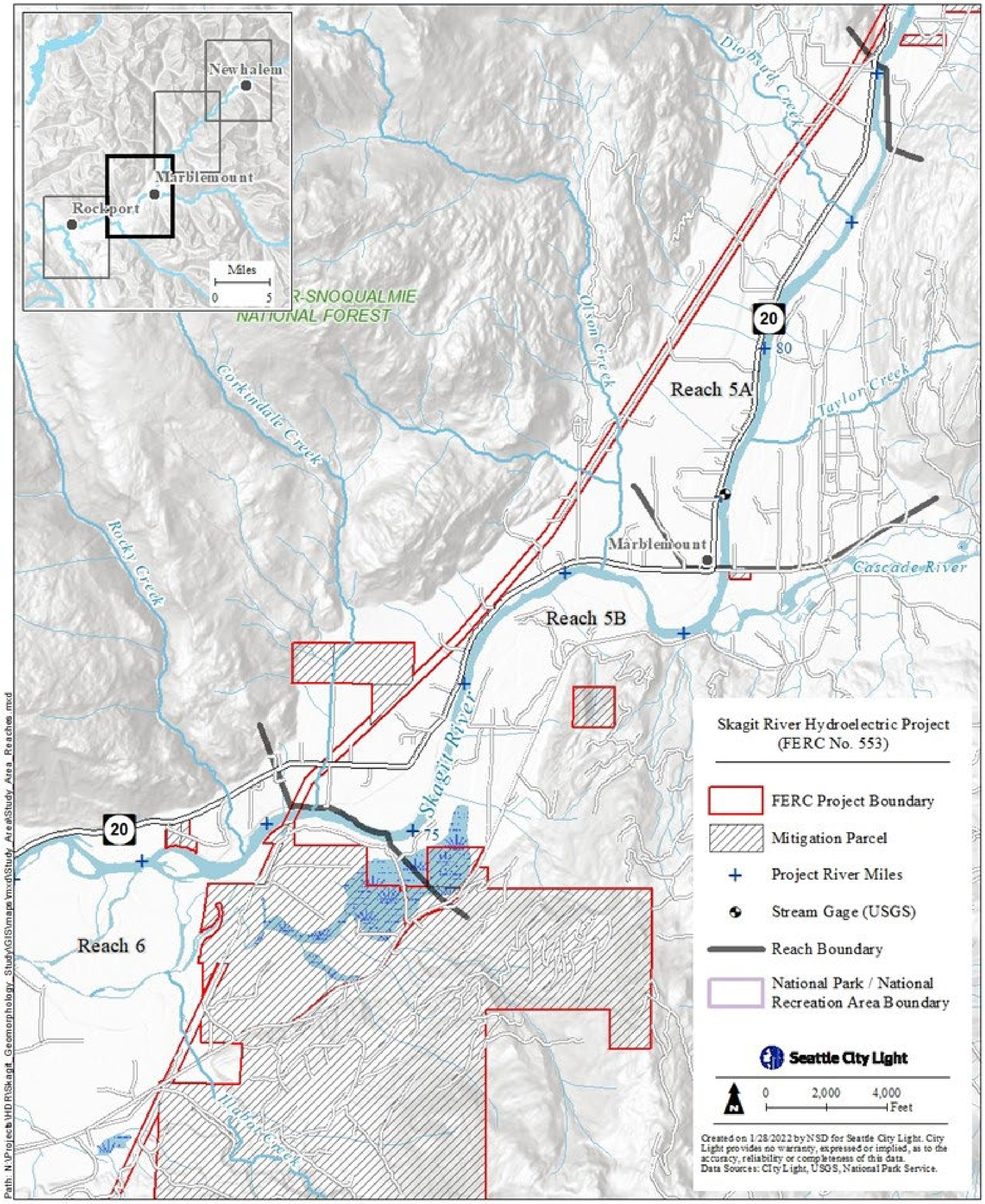


Figure 4.2.3-24. Primary study area reaches from the Straight Creek Fault Zone to the Cascade River (Reach 5A), Cascade River to Rocky Creek (Reach 5B), and the upper segments of Reach 6 near Illabot Creek.

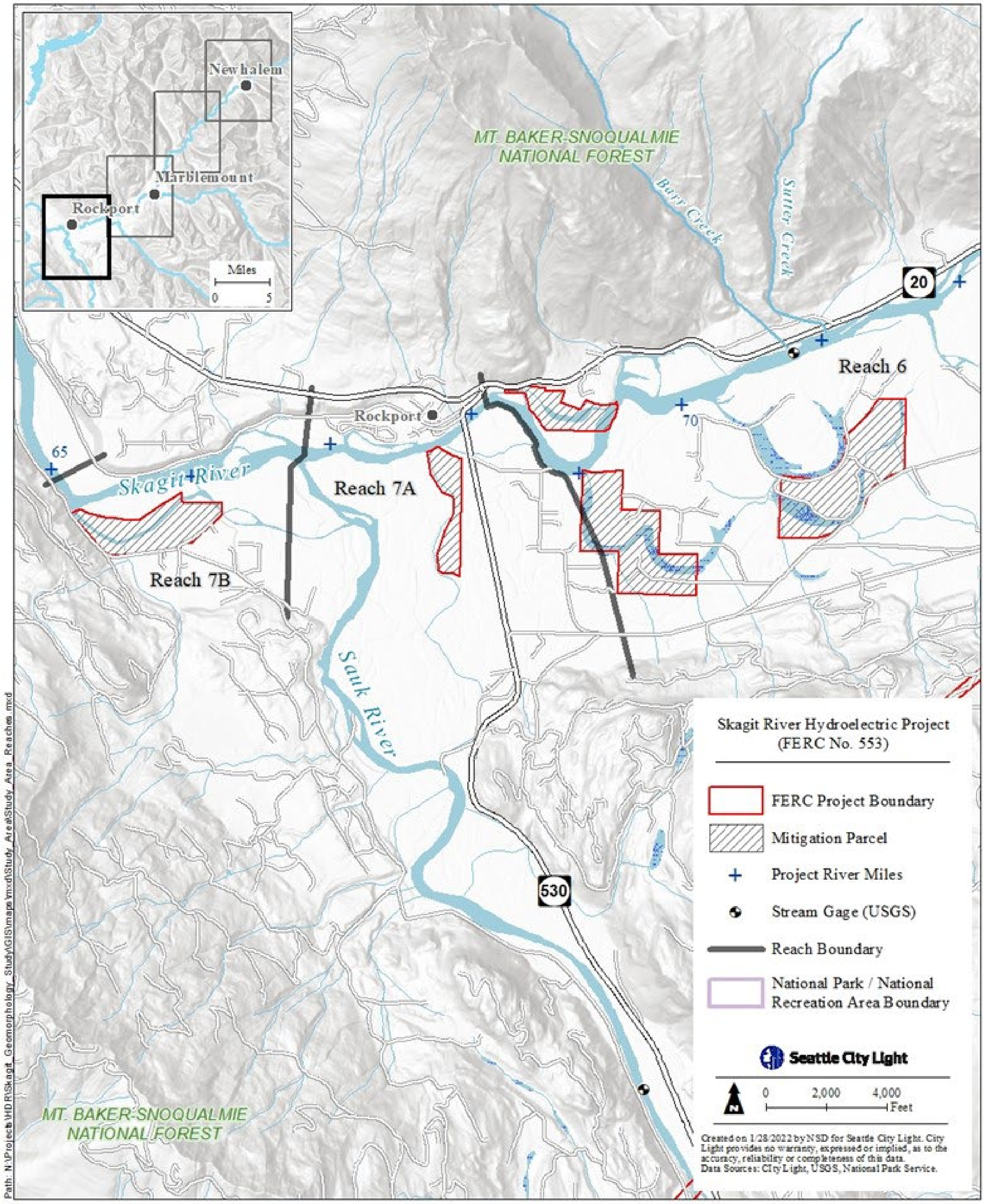


Figure 4.2.3-25. Downstream portion of the primary study area including the Barnaby Meanders (Reach 6) and Sauk River confluence (Reach 7).

Table 4.2.3-27. Reach designations (based on Riedel et al. 2020) used for the Skagit River Geomorphology Study.

Reach Number	Longitudinal Extent (PRM)
Reach 1	PRM 97.2-94.7
Reach 2A	PRM 94.7-93.6
Reach 2B	PRM 93.6-89.4
Reach 3A	PRM 89.4-87.5
Reach 4	PRM 87.5-84.0
Reach 3B	PRM 84.0-82.0
Reach 5A	PRM 82.0-8.1
Reach 5B	PRM 78.1-74.0
Reach 6	PRM 74.0-68.0
Reach 7A	PRM 68.0-66.8

Aquatic habitat in the study area was mapped and summarized based on existing aerial photographs and LiDAR data as well as field data collected during the GE-04 Geomorphology Study. The most common channel unit classification (i.e., habitat type) is glide habitat, and its proportion generally increases with distance downstream (Figure 4.2.3-26). This channel unit type represents the largest portion of habitat area for all the reaches except Reach 2A, which has many runs and rapids. Reaches 2B and 6 have the largest proportions of off-channel habitat and Reach 7A has the most side-channel habitat. The lower reaches (6 and 7A) have lower gradients and more flow, which results in less riffle and rapid habitat and more slow-water habitat. Reach 2B has the most diverse habitat and a high density of habitat units (15/mile). To some extent this reflects a large area of off-channel habitats that are relicts of human modifications, such as the aggregate ponds and Chum Salmon spawning channel. Reach 6 has extensive habitat and the highest density of habitat units and Reach 4 is also fairly diverse but much smaller than Reaches 2B and 6. Reach 7A is both the least diverse and has the lowest density of units. Pool habitat is most abundant in reaches 3A, 3B, and 4, and reaches 2B and 6 have the highest number of pools scaled by bankfull width.

Side-channel and off-channel habitats were evaluated for (1) connectivity with the Skagit River mainstem; (2) inlet and outlet conditions; (3) indicators of habitat quality, including large wood, fish cover, and spawning gravels (a detailed description of this evaluation is available in Appendix H of the GE-04 Geomorphology Study). Based on initial analysis of connectivity, 26 side channels are perennial, 15 seasonal, and four inactive. There are five perennial and two seasonal off-channel habitats. All four features containing both side-channel and off-channel habitat are perennial.

Side-channel and off-channel habitats are more common in the downstream reaches of the primary study area below the Cascade River, where the valley is wider and the floodplain is more dynamic. Most side-channel and off-channel habitat is found in Reach 6, followed by reaches 5B and 2B (Figure 4.2.3-26). Large wood, cover, and substrate data will be used to further evaluate and quantify habitat conditions for salmonid rearing and spawning. The hydraulic model developed as part of the Instream Flow Model Development Study (City Light 2022h) is being used to evaluate the connectivity and availability of side- and off-channel habitat at various flow recurrence intervals and conditions (e.g., depth and velocity). Results of instream flow modeling will be included in the USR and FLA.

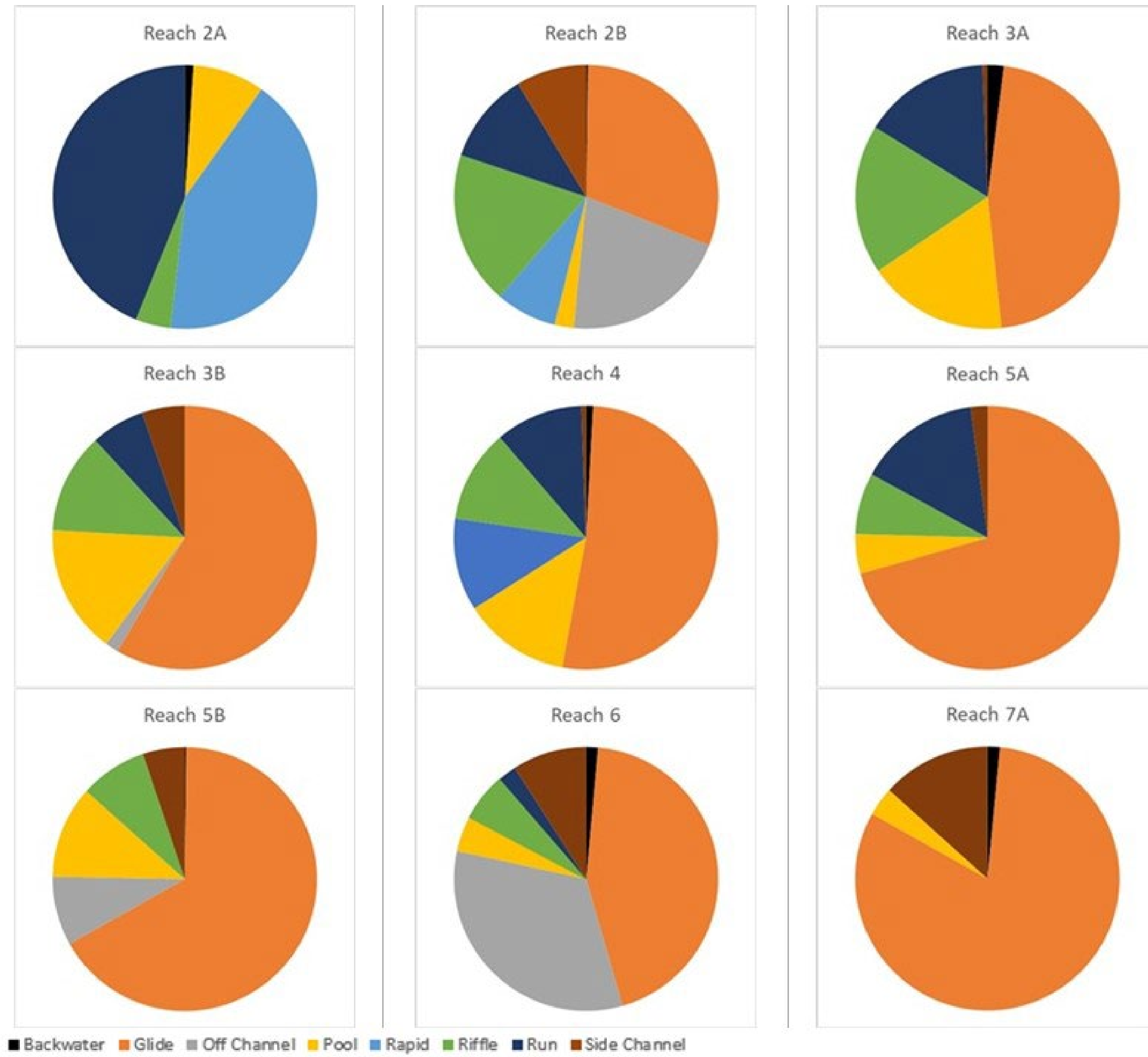


Figure 4.2.3-26. Distribution of the area of channel unit classes (habitat types) by study reach in the Skagit River between Gorge Powerhouse and the Sauk River (see Table 4.2.3-23 for a summary of reach lengths).

Historical maps and images of the Skagit River between Gorge Powerhouse and the Sauk River confluence and LiDAR data were used to identify reaches where dynamic channel processes have occurred and evaluate channel migration rates and changes in channel morphology (City Light 2022j). No lateral channel migration was recorded above Newhalem Creek or in the landslide zone (3.5-mile reach between Damnation and Bacon creeks, PRM 87.5-84.0). Only short segments of localized bank erosion (0.1 feet per year [ft/yr], on average) were apparent in the geologically confined segments upstream and downstream of the landslide zone. From the Straight Creek Fault

(PRM 82) to the Cascade River at Marblemount (PRM 78.2) there has been limited channel migration, with only localized areas of erosion and an average migration rate of 0.1 ft/yr. Two river segments, from Newhalem Creek down to the limit of alpine glaciation and downstream of the Cascade River to Rocky Creek, include areas where dynamic channel processes were observed in the historical record. However, rates of lateral channel migration have been low overall (0.4 ft/yr., on average). The reach from Rocky Creek to the Sauk River alluvial fan is geomorphically distinct from other reaches, with an average lateral migration rate of 4 ft/yr over the period 1944-2019.

As part of the GE-04 Geomorphology Study (City Light 2022j), an investigation was conducted to document local variability and longitudinal trends in sediment composition. Three principal methods were applied to provide a robust view of bed material through the study area: (1) Wolman (1954) pebble counts of the surficial material; (2) bulk samples of the material below the armor layer; and (3) facies mapping covering the active channel. Fifty-one pebble counts were conducted, and 43 bulk samples were collected, from representative bar head locations in each reach (Figure 4.2.3-27) or pockets of material believed to be typical bedload in steep reaches where the structural bed material is rarely mobilized.

Sediment at bar-head locations was composed mainly of cobble and gravel, with moderate spatial variability at the reach-scale. Surface pebble count results (Figure 4.2.3-28) indicate that D_{50}[55] and D_{84} values typically range from 64-91 mm and 91-128 mm, respectively. The grainsize distribution of the subsurface material (Figure 4.2.3-29) was dominated by gravel (D_{50} 20-50 mm). The D_{50} ratio of surface particles to that of subsurface material indicates that the study reach is about twice as coarse at the surface than it is at the subsurface. Interpretation and analysis of pebble count lithology data are ongoing. Evaluation of bed material mobility and further grainsize analysis in conjunction with development of the sediment transport models (see below) and the FA-02 Instream Flow Model Development Study (City Light 2022h) is underway and will be summarized in the USR.

55 D_{50}, equivalent to the median diameter of the particle size distribution, is the value of the particle diameter at 50 percent in the cumulative distribution.

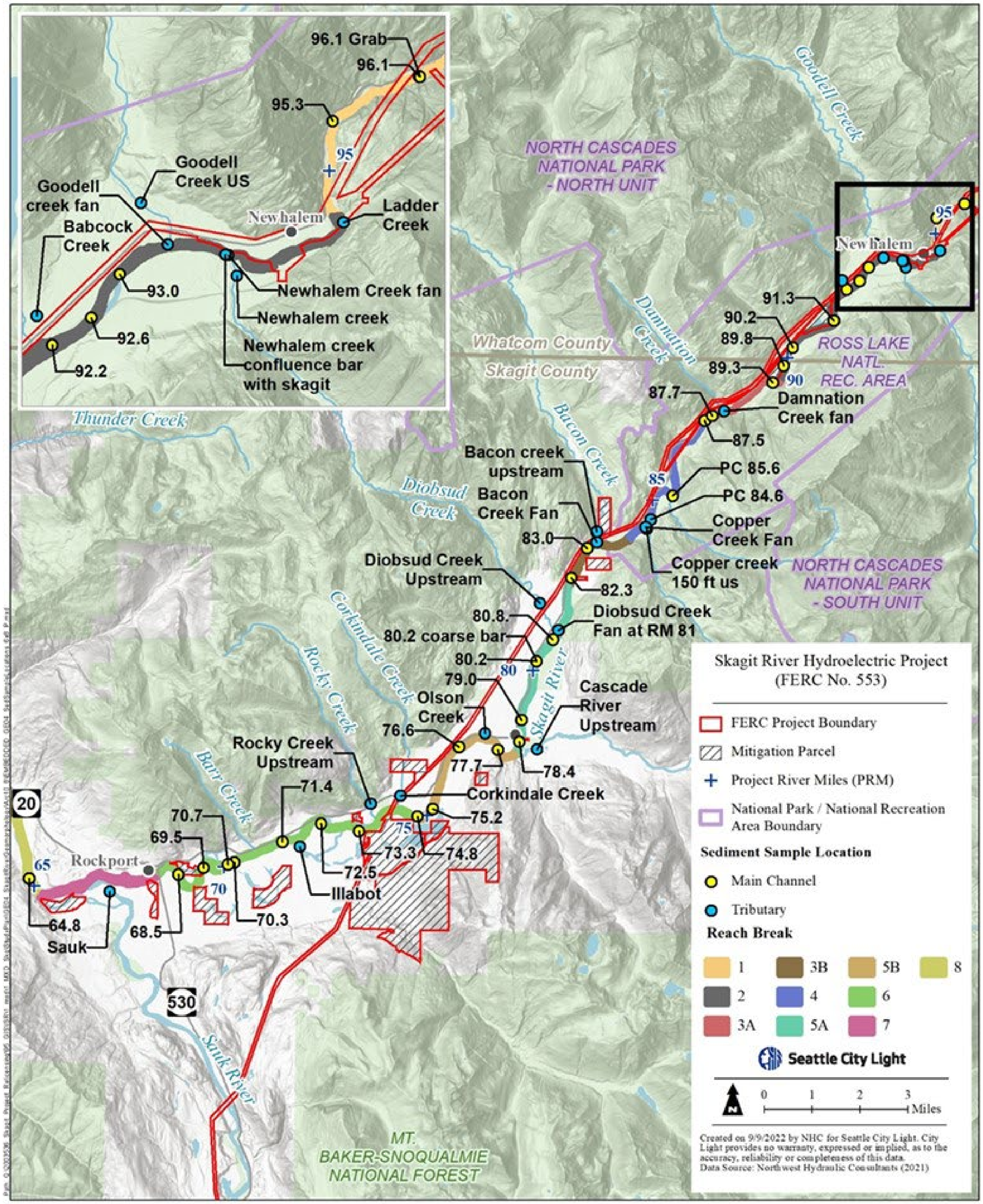


Figure 4.2.3-27. Overview of sediment sample locations for the GE-04 Geomorphology Study (City Light 2022j).

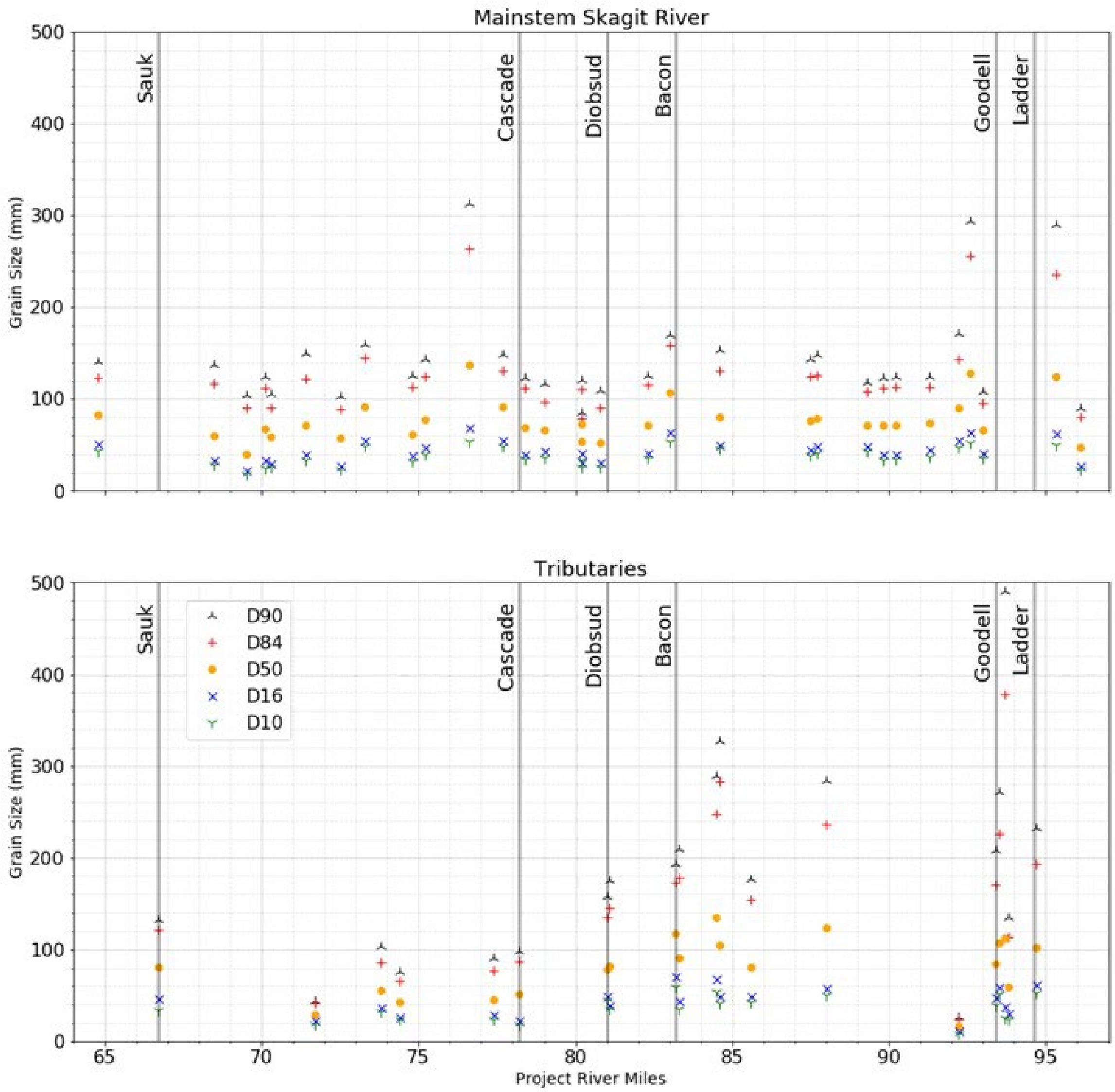


Figure 4.2.3-28. Summary grainsize statistics for all surface pebble count samples, GE-04 Geomorphology Study (City Light 2022j).

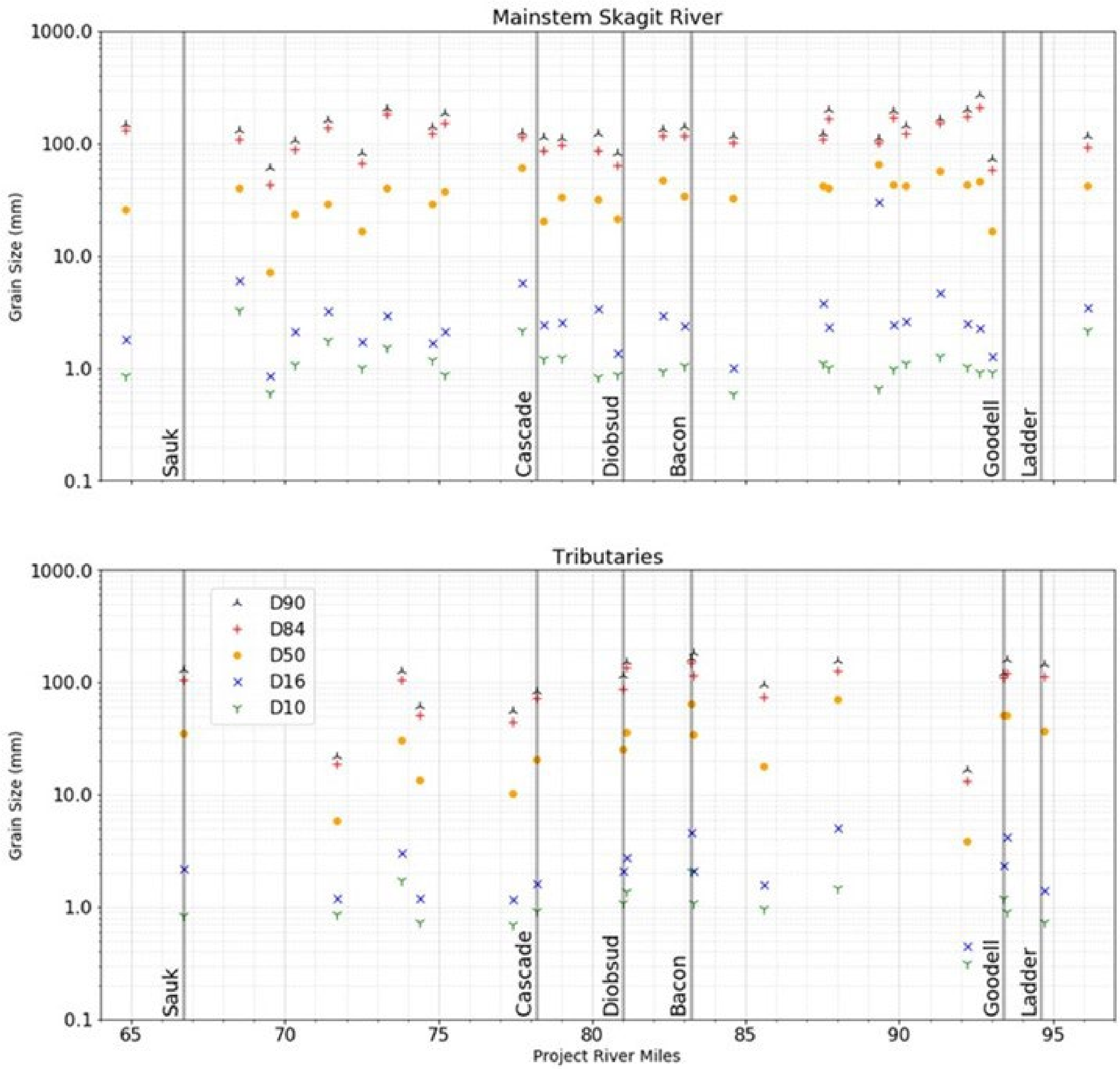


Figure 4.2.3-29. Summary grainsize statistics for all subsurface bulk sediment samples, GE-04 Geomorphology Study (City Light 2022j).

A sediment transport modeling scope has been developed in consultation with LPs (see below for a description of the scope and geographical range of the sediment transport modeling), and monitoring of sediment mobilization and transport (scour monitoring and tracer particles) is underway to provide calibration data for the model. Nineteen scour monitoring arrays, each consisting of eight or more scour monitors, have been installed in the Skagit River and lower reaches of select tributaries. Monitoring in summer 2021 indicates that there had been little bed mobility at spawning site scour monitoring stations installed in 2019 and 2020, with most locations showing no scour. The maximum observed scour depth was 6.8 inches. Preliminary interpretation of data from accelerometers suggests that most bed mobilization occurs during low flows but concurrent with the salmonid spawning season, indicating that observed scour was most likely the result of fish spawning activity.

Scour monitoring and particle tracing are being implemented to obtain information on bed mobilization during high flows. Tracer particles will provide information on the pattern of sediment particle displacement during floods and serve as a proxy for potential sediment movement. Tracer particles were deployed in early November 2021 at the confluence bars and delta fans of Ladder Creek, Newhalem Creek, Goodell Creek, and Bacon Creek and the riffle crest scour-monitor sites upstream at Bacon Creek and at PRM 89.8. At each site, approximately 100 particles were deployed, with sizes selected to match the distribution of the 45 mm and larger subsurface material present and provide duplicates (n=2 to 4) of larger size classes that would be represented by fewer particles.

The GE-04 Geomorphology Study (City Light 2022j) also included a large wood assessment. Results of the August 2021 field survey conducted in the primary study area are shown in Table 4.2.3-28. The majority of large wood (about two-thirds of the total count) was found downstream of the Cascade River confluence and upstream of Rockport (reaches 5B and 6). Most large wood occurred within log jams, and the majority of pieces in the mainstem were 25-49 ft long with a diameter of 1-1.9 ft (Table 4.2.3-29), and over half of the pieces had rootwads (Table 4.2.3-30). A significant portion of the large wood in the mainstem is on top of bars, outside the wetted channel during low flows.

Large wood was most abundant within side channels and at tributary confluences, with densities of 17.6 and 15.0 pieces per acre, respectively. In the mainstem, large wood had a density of 1.1 pieces per acre in the wetted channel and 13.0 pieces per acre on dry bars. At tributary confluences, large wood was most abundant near the Cascade River and Diobsud Creek, followed by Bacon, Goodell, Rocky, Damnation, and Illabot creeks. The remaining tributaries had little or no large wood at their mouths.

Table 4.2.3-28. Total number of pieces of large wood inventoried during field work in August 2021 by geomorphic reach and channel type in the Skagit River between Newhalem and the Sauk River confluence.

Geomorphic Reach	Mainstem			Tributary			Side Channel		
	Total Pieces	Total Length (mi)	Pieces Per Mile	Total Pieces	Total Length (mi)	Pieces Per Mile	Total Pieces	Total Length (mi)	Pieces Per Mile
2A	43	1.2	43	8	0.3	31	0	0.0	N/A
2B	237	4.1	89	9	0.3	32	117	3.1	37
3A	23	1.9	30	33	0.2	174	1	0.5	2
3B	195	3.5	67	8	0.3	25	8	0.8	10
4	48	2	29	5	0.2	26	4	0.1	28
5A	72	3.5	43	41	0.2	216	37	1.2	31
5B	178	3.7	224	43	0.2	226	606	3.9	157
6	1,156	6.7	285	52	0.9	60	700	22.8	31
7A	188	1.3	318	0	0.0	N/A	226	1.4	167
7B	20	0.3	67	0	0.0	N/A	0	0.0	N/A
	2,160			199			1,699		

Table 4.2.3-29. Diameter and length of measured pieces of large wood in the mainstem Skagit River between the Project and the Sauk River confluence.

Length (ft)	Diameter at Breast Height (ft)								Total	
	1-1.9		2-2.9		3-3.9		4 Plus			
25-49	293		35		12		2		**342**	**45%**
50-74	188		71		9		3		**271**	**36%**
75-99	26		65		15		4		**110**	**14%**
100 plus	8		11		7		11		**37**	**5%**
Total	**515**	**68%**	**182**	**24%**	**43**	**6%**	**20**	**3%**	**760**	

Table 4.2.3-30. Rootwads on individual pieces of large wood in the mainstem Skagit River between the Project and the Sauk River confluence.

Rootwad Presence	Diameter at Breast Height (ft)								Total	
	1.0-1.9		2.0-2.9		3.0-3.9		4.0-6.0			
Rootwad	229	44%	118	65%	37	86%	19	95%	**403**	**53%**
No Rootwad	286	56%	64	35%	6	14%	1	5%	**357**	**47%**
Total	**515**		**182**		**43**		**20**		**760**	

An evaluation of changes in large wood abundance was conducted using aerial imagery for the period 1979-2019 (City Light 2022j). Side channels could not be inventoried using aerial images due to canopy cover, except in the Cascade River distributary side channels. Log jam density gradually increased from 1.7 per mile to 3.5 per mile over the 40-year period, but the spatial distribution of large wood and log jams in the Skagit River mainstem upstream of the Sauk River has remained similar on a geomorphic reach scale since 1979. As expected, variation in the locations of log jams over time is more prevalent in reaches characterized by a greater degree of channel migration. Log jams located at the apexes of forested islands or bars are the most stable, followed by those at inlets to side channels, whereas jams at meanders and on the tops of bars are more readily displaced.

Between October 13 and December 15, 2021, radio and metal tags were affixed to 184 pieces of wood that were placed in the mainstem, tributaries, and side channels. Data from the large wood tracking will be used to assess transport distance, relationship between rootwads and log mobility, and log jam stability. Log tracking data will be analyzed in combination with hydraulic model output to identify thresholds of motion by logs of different sizes. Next steps related to large wood analysis include (1) evaluation of the hydrograph to assess the relationship between large wood dynamics and flow and (2) analysis of large wood tracking data in combination with the hydraulic model.

The GE-04 Geomorphology Study (City Light 2022j) includes sediment transport modeling from the Project downstream to where riverbed material shifts from gravel to sand (gravel-sand transition), which is located near Sedro-Woolley (PRM 21), about 11 miles upstream of the channel bifurcation at the head of the delta where the river enters the estuary and tidal processes begin to control channel dynamics.

The modeling program includes the nested development of four models (below) to represent key aspects of the Skagit River's channel processes (see Section 4.5 of the GE-04 Geomorphology Study report for a detailed description of the approach to sediment transport modeling). Sediment transport modeling is ongoing, and City Light anticipates providing preliminary results in the USR and/or FLA.

- The University of British Columbia Regime Model (UBCRM) (Eaton 2007; Millar et al. 2014) provides a means for assessing the channel's hydraulic geometry and propensity for side channel or multi-channel morphologic adjustments. The UBCRM will be applied to the reach of the Skagit River between Newhalem and the gravel-sand transition at PRM 21.
- A 1-dimensional (1-D) mobile bed USACE HEC-RAS model will be developed to quantify long-term channel bed and hydraulic profiles of the Skagit River from PRM 94 at Newhalem to PRM 67 near the confluence of the Sauk River.
- A suite of 2-D HEC-RAS models will be applied to the Skagit River between Newhalem and the Sauk River to quantify erosion and deposition processes related to key morphologic and habitat features identified in this reach.
- A MAST 1-D model of the Skagit River from below the Bacon Creek confluence (PRM 83) through the gravel-sand transition (about PRM 21) will be developed to quantify width adjustments of the Skagit River to existing and potential future operational flow release scenarios and to evaluate patterns of bed material mobility and channel-floodplain sediment exchange downstream of the Sauk River confluence.

As noted above in the Gorge Bypass Reach section, City Light has constructed two models to assess the relationship between flow and fish habitat in the Gorge bypass reach (Bypass Habitat Model, City Light 2022g) and the Skagit River from the Skagit River at Newhalem gage downstream to the Sauk River confluence (City Light 2022h). The lateral domain of the Upper Skagit Habitat Model includes the in-channel portion of the mainstem Skagit River corridor and side channels with direct hydraulic connections to the main channel and for which hydraulic conditions are driven by mainstem flows and water levels, such as the County Line Ponds and the Thornton side channel complex. The lateral extent of the mainstem corridor and side channels included in the Upper Skagit Habitat Model is defined by the area inundated by the five-percent exceedance flow, the maximum flow rate simulated for habitat modeling. The hydraulic model upon which the habitat model is based does not account for groundwater processes, so side channels that are primarily groundwater fed are excluded from the habitat model. However, City Light has installed 20 level loggers in side channels and off channel areas to measure stage fluctuation. City Light, in consultation with LPs, selected 12 sets of flows with exceedance probabilities ranging from greater than 99.9 to 5 percent (based on water years 1988-2020) to define flow-habitat relationships for each of the 13 reaches in the Upper Skagit Habitat Model (Table 4.2.3-31).

Table 4.2.3-31. Flows (cfs) used in defining flow-habitat relationships within the Upper Skagit Habitat Model.

Exceedance Probability	Reach 7	Reach 8	Reach 9	Reach 10	Reach 11	Reach 12	Reach 13	Reach 14	Reach 15	Reach 16	Reach 17	Reach 18	Reach 19	d/s Sauk River (d/s boundary)
>99.9	1,400	1,418	1,466	1,475	1,493	1,506	1,568	1,600	1,774	1,798	1,835	1,838	1,850	2,400
99.9	1,600	1,620	1,671	1,681	1,700	1,714	1,780	1,814	2,010	2,037	2,079	2,083	2,096	2,738
99.5	1,700	1,725	1,783	1,794	1,816	1,832	1,907	1,946	2,160	2,192	2,239	2,243	2,258	3,047
98	2,010	2,042	2,115	2,128	2,156	2,176	2,270	2,319	2,595	2,634	2,694	2,699	2,718	3,687
90	2,500	2,549	2,660	2,680	2,722	2,752	2,894	2,969	3,364	3,423	3,513	3,521	3,549	4,979
80	2,980	3,045	3,191	3,218	3,274	3,314	3,502	3,601	4,097	4,175	4,296	4,306	4,343	6,243
60	3,740	3,842	4,058	4,098	4,180	4,238	4,515	4,661	5,377	5,492	5,668	5,683	5,738	8,578
40	4,480	4,642	4,962	5,020	5,142	5,228	5,637	5,853	6,889	7,059	7,321	7,343	7,424	11,564
30	5,057	5,265	5,660	5,733	5,882	5,989	6,495	6,762	8,025	8,235	8,558	8,586	8,686	13,686
20	6,000	6,272	6,773	6,864	7,054	7,190	7,831	8,170	9,772	10,038	10,448	10,483	10,610	16,910
10	6,954	7,333	8,019	8,144	8,405	8,590	9,468	9,931	12,106	12,471	13,032	13,080	13,254	21,594
5	7,521	8,011	8,886	9,047	9,379	9,615	10,736	11,327	14,068	14,534	15,250	15,311	15,532	26,032

Note: see Table 4.2.3-23 for reach descriptions.

The model produced tabular results of UHA by flow for each reach and each species/life stage combination (Table 4.2.3-24), which were used to produce UHA curves. Each curve provides the relationship between total UHA and flow within a specific habitat model reach for a specific species/life stage combination. With 13 reaches in the Upper Skagit Habitat Model domain and 37 species/life stage combinations, a total of 481 individual curves were generated. To facilitate comparison of results, these curves were grouped into six categories for presentation purposes: (1) salmonid spawning; (2) salmonid fry; (3) salmonid juveniles; (4) salmonid adults; (5) lamprey and Salish Sucker; and (6) White Sturgeon. By grouping the UHA curves, the Upper Skagit Habitat Model results were distilled down to 78 UHA plots, an example of which is provided in Figure 4.2.3-30. The full set of UHA plots will be provided in the Upper Skagit Habitat Model USR (City Light 2022h).

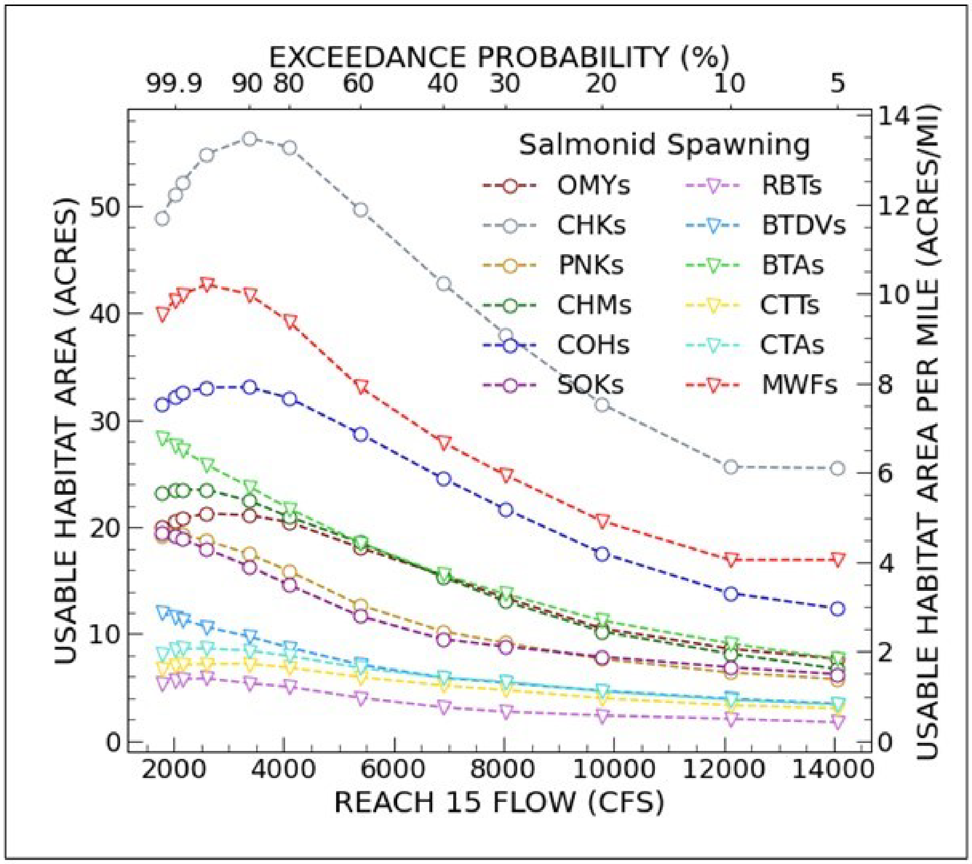


Figure 4.2.3-30. Sample UHA plot for salmonid spawning species/life stage in Upper Skagit Habitat Model Reach 15. OMYs (steelhead), CHKs (Chinook Salmon), PNKs (Pink Salmon), CHMs (Chum Salmon), COHs (Coho Salmon), SOKs (Sockeye Salmon), RBTs (Rainbow Trout), BTDVs (Bull Trout/Dolly Varden), BTAs (Sea-Run Bull Trout), CTTs (Cutthroat Trout), CTAs (Sea-Run Cutthroat Trout), and MWFs (Mountain Whitefish).

Skagit River Tributary Habitat Upstream of the Sauk River Confluence

Tributaries to the Skagit River between Gorge Powerhouse and the Sauk River provide 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, where the Project's transmission line crosses the streams near their mouths. Jordan and Boulder creeks, which are tributaries to the Cascade River, are considered to have poor salmonid rearing and incubation habitat due to high sediment loads, low levels of large wood, and poor riparian conditions resulting from past timber harvest (NMFS 2012). SRSC and WDFW (2005) came to a similar conclusion when evaluating tributaries upstream of the Sauk River confluence. They describe Corkindale, Diobsud, and Damnation creeks, in addition to Jordan and Boulder creeks, as sediment impaired.

The Channel Migration and Stream Crossings analysis component of the GE-02 Erosion and Geologic Hazards Study will provide an analysis of the interaction of streams with the transmission line right-of-way (ROW) and streamside facilities in Project-related townsites, including maintenance procedures near streams and bank protection. Most of this work, including assessments of channel migration zones and aquatic/riparian habitat, is in process or was not completed in time to be included in this Exhibit E. Results will be reported in the USR. The element of the study most relevant to fish and aquatic resources is the collection of information on stream/riparian/bank conditions at channel migration and transmission line maintenance locations.

As part of the GE-04 Geomorphology Study (City Light 2022j), City Light conducted field surveys in the lower 500 ft of tributaries (Table 4.2.3-32) to the Skagit Reach between Gorge Powerhouse and the Sauk River. Surveys conducted during low-flow conditions in August 2021 were designed to evaluate potential fish passage issues at tributary mouths. Stream width, depth, and gradient were measured at each tributary mouth and compared to minimum depths required for adult Chum Salmon passage. Chum Salmon have the least jumping ability and weakest burst swimming speed of the Pacific salmon and were used as the basis of the analysis to provide the most conservative results.

No depth-related fish passage issues were observed at tributary mouths; depths were adequate and aggradation at alluvial fans did not create conditions that would impede upstream migration. Three dry channel beds were observed, but these were not considered passage barriers because flow, and as a result entrance depth, fluctuate seasonally (WDFW 2019; Reiser, et al. 2006). Also, intermittent flows in tributaries are not linked to the Project's operation.

The mouths of Ladder and Sky creeks have natural waterfalls > 12 ft high. Three streams, i.e., Alma, Copper, and Damnation creeks, had average gradients > 5 percent. Of these, conditions at the mouth of Copper Creek appeared sufficient to preclude Chum Salmon from entering the tributary, although the gradient was not steep enough to deter other salmonid species, which can swim freely in grades lower than 7 percent, and are able to pass grades of up to 12 percent (WDFW 2019). Goodell Creek could not be surveyed due to deep, swift water and erosive banks; the mouth and area beneath the bridge were visually inspected, and it was determined that depth and channel gradient would not preclude fish passage.

Table 4.2.3-32. Tributaries in primary study area for the Skagit River Geomorphology between Gorge Dam and the Sauk River Study.

Tributary	Project River Mile (PRM)	Left Bank (LB) / Right Bank (RB) Looking Downstream
Ladder Creek	94.6	LB
Newhalem Creek	93.8	LB
Goodell Creek	93.3	RB
Babcock Creek	92.1	RB
Martin Creek	91.4	LB
Thornton Creek	90.5	RB
Sky Creek	88.6	RB
Damnation Creek	88.0	RB
Alma Creek	85.5	LB
Copper Creek	84.4	LB
Bacon Creek	83.2	RB
Diobsud Creek	81.0	RB
Taylor Creek	79.1	LB
Cascade River	78.2	LB
Olson Creek	77.2	RB
Corkindale Creek	74.3	RB
Rocky Creek	73.8	RB
Illabot Creek	73.0	LB
Sutter Creek	71.0	RB
Barr/Swift Creek	70.8	RB

Rare, Threatened, and Endangered (RTE) 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, along with their respective listing statuses and dates are shown in Table 4.2.3-33.

Table 4.2.3-33. Federal ESA status and WDFW status of RTE species addressed in this section of Exhibit E.

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 Bull Trout, Coastal-Puget Sound DPS	Threatened	64 FR 58910; Date: 11/1/1999	Candidate[1]
Puget Sound/Strait of Georgia Coho Salmon	Candidate	N/A	Species of Concern
Southern Resident Killer Whale	Endangered	70 FR 69903 Date 11/18/2005	N/A

1 Puget Sound Chinook Salmon and Bull Trout are listed by WDFW as Candidate species; individual stocks are not classified.

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 4.2.2-33). 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 de 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 within the Skagit River but only two in the Project vicinity: the Upper Cascade Spring Chinook and Upper Skagit Summer Chinook.

Chinook Population Status

Ford (2022) states that abundance across the Puget Sound Chinook Salmon ESU has generally increased since the NWFSC 2015 status review (NWFSC 2015), with only two of the 22 populations (Cascade River and North and South Fork Stillaguamish rivers) exhibiting a negative percent change in the five-year geometric mean for natural-origin spawner abundances. Fifteen-year trends computed for two time periods (1990-2005, 2004-2019) indicate that natural-origin spawner abundance had declined across most MPGs. The populations with the highest fractions of natural-origin spawners from 1980-2018 are the six Skagit River populations (Ford 2022).

Habitat protection and restoration in all watersheds have improved stream and estuary habitat, despite substantial increases over the last 20 years in the size of the human population in the Puget Sound region (Ford 2022). However, according to Ford (2022), the Salmon Science Advisory Group of the Puget Sound Partnership found that monitoring results reveal no strong link between restoration and large-scale fish response (Puget Sound Partnership 2021).

Puget Sound Chinook Salmon are harvested in ocean fisheries, Puget Sound fisheries, and terminal river fisheries. Because they migrate north, most ocean fishery impacts occur in Canada and Alaska. Some populations are also harvested at lower rates in the coastal fisheries off Washington and Oregon. For populations in the Whidbey Basin (Snohomish, Stillaguamish, and Skagit rivers), harvest in the northern fisheries accounts for a large portion of the exploitation rate (Ford 2022). Harvest rates for Chinook Salmon in Puget Sound generally declined in the 1990s but have been stable or increasing since then.

Chinook Limiting Factors

Limiting factors identified by SRSC and WDFW (2005) and NMFS (2016) for Skagit River Chinook Salmon populations are shown in Table 4.2.3-34.

Table 4.2.3-34. 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 PSTRT 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. Spatial structure is the geographic distribution of fish at all life stages. Diversity addresses the variability in genetic, physiological, morphological, life history, and behavioral attributes.

The Skagit River includes six of the 22 independent Chinook Salmon populations in the Puget Sound ESU, and consequently plays an important role in the species' recovery. The six Skagit River populations (also referred to as stocks) are (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. However, only Upper Skagit Summer Chinook and Upper Cascade Spring Chinook are present within the Project vicinity. Each of these populations is considered "demographically independent" based on 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).

Spatial, temporal, and genetic diversity is important for maintaining population viability because (1) it reduces the risk that stochastic events, such as droughts or floods, will adversely affect all components of a population; (2) it allows populations to use a wider range of habitat patches; and (3) 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 ages at outmigration and as returning adults, but also through the spatial variability of habitat used by both juveniles and spawners. All the populations have multiple life-history strategies during outmigration (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 use the delta region are more affected by the 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 has 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 higher marine survival rates during the 1970s and 1980s (Tables 4.2.3-35 and 4.2.3-36).

Table 4.2.3-35. 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 4.2.3-36. Recovery goals for Skagit River Chinook Salmon at high marine survival rates during the 1970s and 1980s.

	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

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). The DPS includes all naturally spawned populations 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.

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 NWFS (2015) status review of Puget Sound steelhead concluded that the risks faced by the DPS had not changed significantly since the 2007 ESA listing (Ford 2022). Negative trends in natural spawner abundance remained predominantly negative, and suitable habitat continued to be limited. Extinction risk for the DPS is still considered moderate (Ford 2022).

The long-term abundance of adult steelhead returning to many Puget Sound rivers has decreased significantly since the late 1970s. However, more recently there have been some improvements in abundance and productivity (Ford 2022). High ocean temperatures in 2014 and 2015 and high stream temperatures and low summer streamflows during 2015 decreased marine and freshwater survival. However, reduced harvest and declining hatchery production were determined to have modestly decreased risks to natural spawners.

Harvest of Puget Sound steelhead is limited to terminal tribal net and recreational fisheries. Harvest rates were curtailed in 2003, with “wild” harvest rates held below 10 percent (Ford 2022). Recreational fisheries are mark-selective for hatchery stocks, but some natural-origin fish succumb to hooking mortality and poaching.

Hatchery steelhead production for harvest consists mainly of Chambers Creek winter-run stock and Skamania Hatchery summer-run stock, both selected for run timing that precedes that of natural stocks to reduce interaction between hatchery and naturally spawned fish. To reduce the risk of introgression between native and hatchery-origin fish, Chambers Creek releases were discontinued in the Skagit River (Ford 2022). Although the risk posed by hatchery programs to naturally spawning populations has recently decreased, it is unclear how long it will take for the genetic legacy of introgression to subside.

Steelhead emigrating from tributaries are exposed to a variety of potential predators (Pearson et al. 2015). Birds and marine mammals, harbor seals (*Phoca vitulina*) in particular, may have influenced the decline in Puget Sound steelhead population sizes (Pearson et al. 2015).

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) (Table 4.2.3-37).

Table 4.2.3-37. 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

Potential Limiting Factor	Citation
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 stated in 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.

NMFS's abundance and productivity planning targets for Puget Sound Steelhead populations were based on an estimate of 70 percent of historical abundance, which is in turn 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 4.2.3-38, were initially generated from an IP model of steelhead habitat (Hard et al. 2015) and subsequently modified based on feedback from steelhead biologists in a series of meetings. Recovery goals based on productivity estimates are presented in Table 4.2.3-39. 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. Lower abundances consistent with recovery are paired with higher productivity values because lower abundance can be sufficient to meet recovery goals when productivity is consistently higher, and lower productivity can be sufficient to meet recovery goals when abundance thresholds are relatively high.

Table 4.2.3-38. 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 (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 4.2.3-39. 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.

Coastal-Puget Sound Bull Trout

The following sections are summarized from USFWS (2015a and 2015b) unless otherwise cited.

Description of Listed Unit

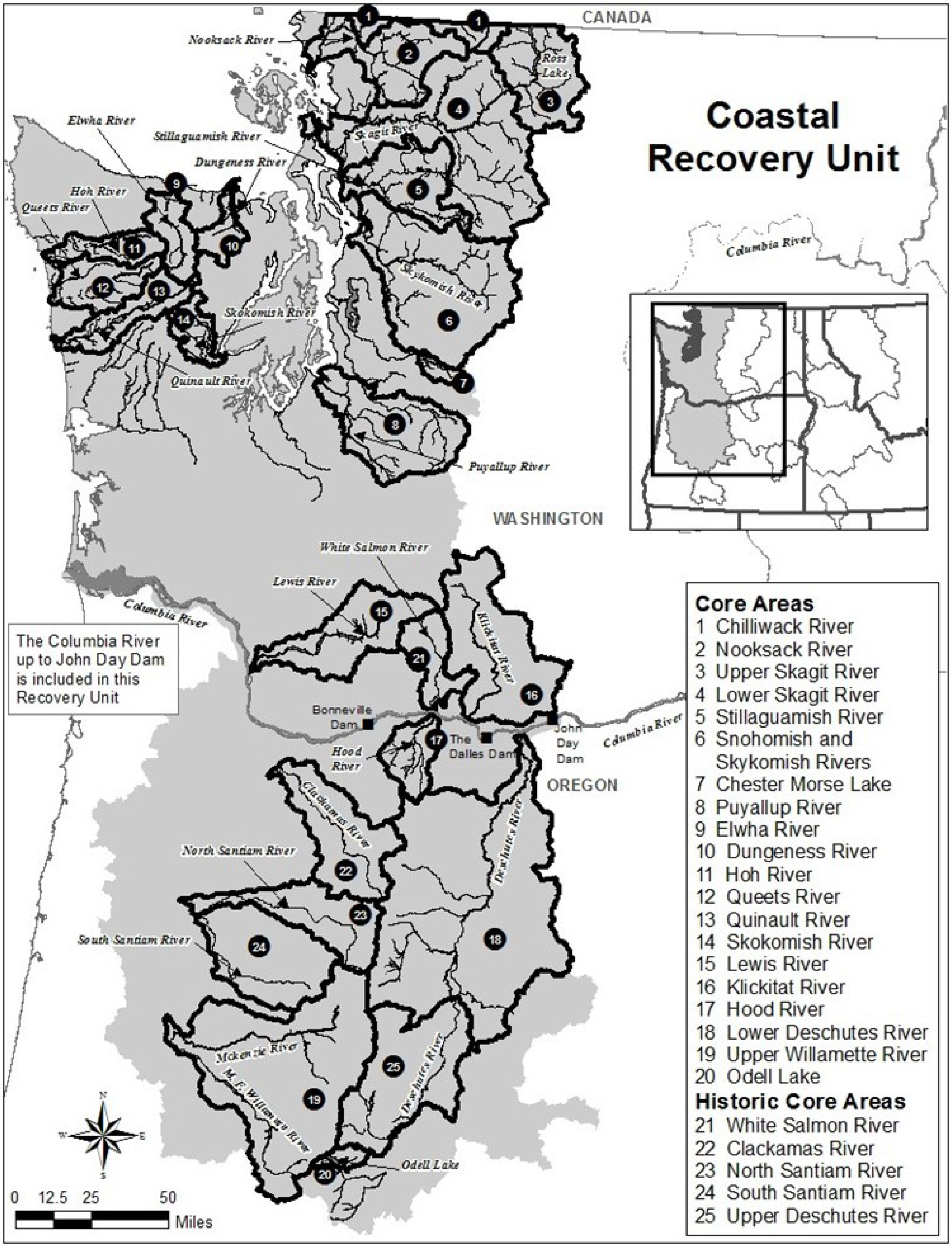
Prior to the November 1, 1999 listing of Bull Trout within the coterminous United States, initial analysis divided Bull Trout into five DPSs (Columbia River, Klamath River, Jarbidge River, Saint Mary-Belly River, and Coastal-Puget Sound). The 1999 listing merged the five separate DPSs into one DPS of 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, completed on April 8, 2008, 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 (the 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 4.2.3-31). Bull Trout in the Skagit River upstream of Gorge Dam (within the U.S.) 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 U.S. and the Skagit, East Fork Skagit, Klesilkwa, Skaist, and Sumallo rivers, and Nepopekum Creek in British Columbia. Bull Trout in the Skagit River downstream of the Project form the Lower Skagit River Core Area; defined lower-Core-Area populations upstream of the Sauk River confluence include Bacon, Goodell, Illabot, and Newhalem creeks, and the Cascade River and South Fork Cascade River.

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 four 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 the recovery unit.



Source: USFWS 2015b.

Figure 4.2.3-31. Coastal Recovery Unit (Core Areas) for Bull Trout.

Bull Trout Limiting Factors

Habitat limiting factors, i.e., "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 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 the 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.[56]

Federally Designated Critical Habitat

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.

<u>Puget Sound Chinook Salmon</u>

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 4.2.3-32). 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.

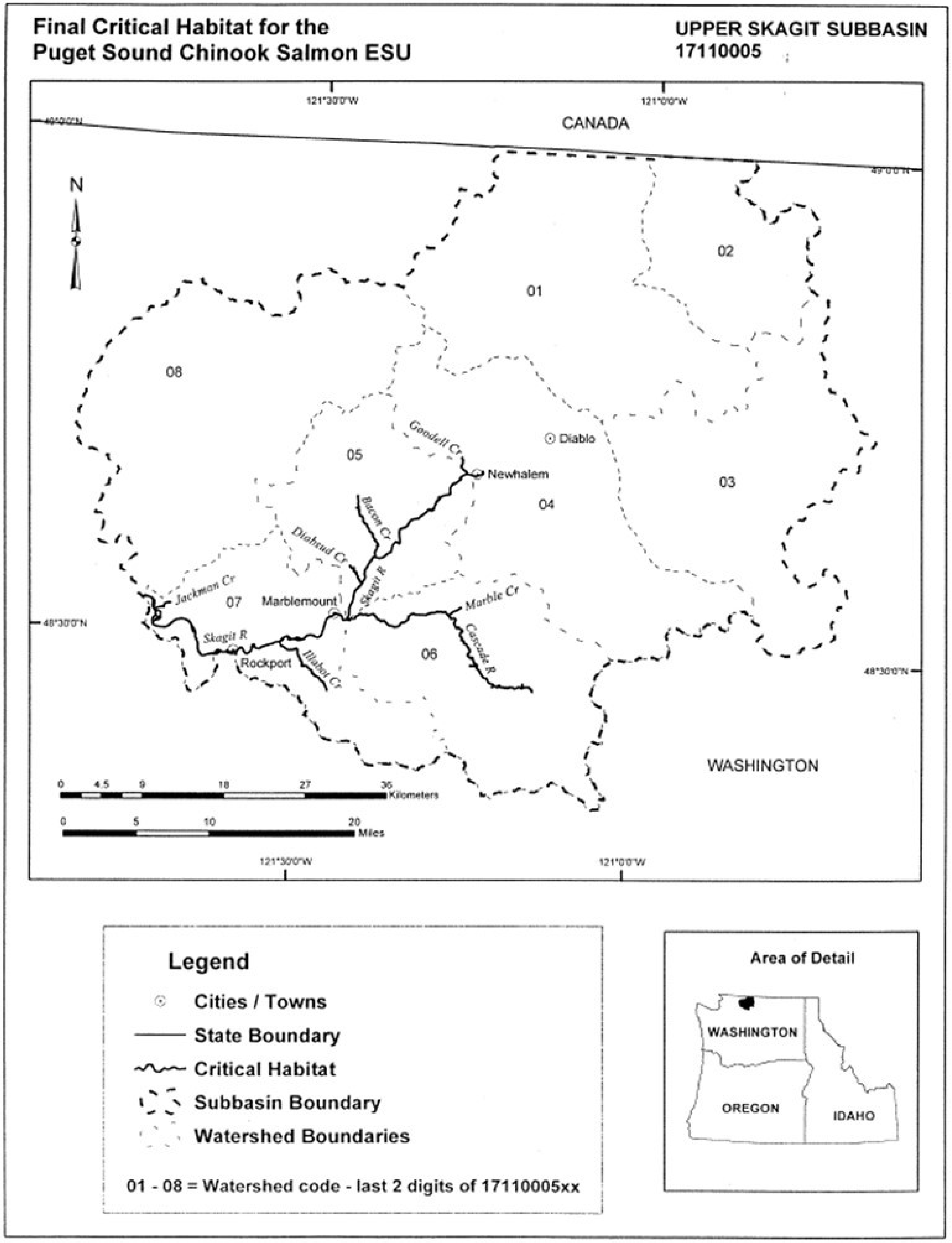
Salmon/steelhead PBF 2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging 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.

<u>Puget Sound Steelhead</u>

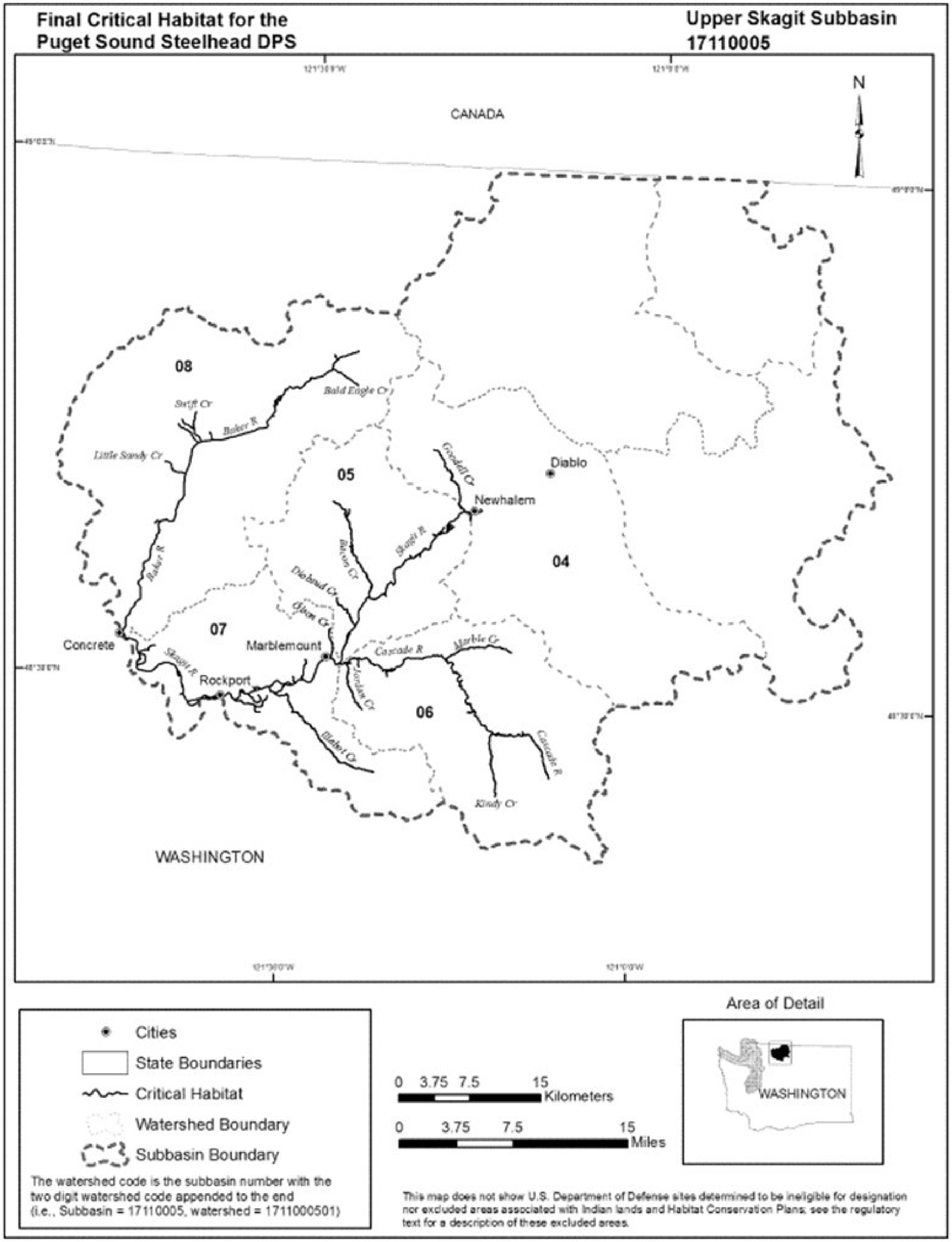
Critical habitat for the Puget Sound Steelhead DPS was designated by NMFS on February 24, 2016 (81 FR 52630). All of the mainstem Skagit River up to Gorge Powerhouse is designated as critical habitat, as well as portions of tributaries draining to the Skagit River, including the Baker River (Figure 4.2.3-33). PBFs for Puget Sound Steelhead critical habitat parameters are the same as those listed above for Chinook Salmon.

56 The Azurite Mine is located about 20 miles northwest of Mazama, Washington. Gold and silver were mined at the site in the 1930s. Ore was extracted and milled on site, and contaminated waste rock and mill tailings are eroding into nearby Mill Creek. Cleanup of the site by the USFS is ongoing to address the tailings and other hazards, and National Forest Land around the mine is currently closed to public access for safety while heavy equipment is mobilized. Work is expected to progress until 2022/2023 snows limit access.



Source: 70 FR 52630.

Figure 4.2.3-32. Critical habitat for the Puget Sound Chinook Salmon ESU: Upper Skagit Subbasin.



Source: 81 FR 52630.

Figure 4.2.3-33. 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 4.2.3-34 and 4.2.3-35).[57] 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 from 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.

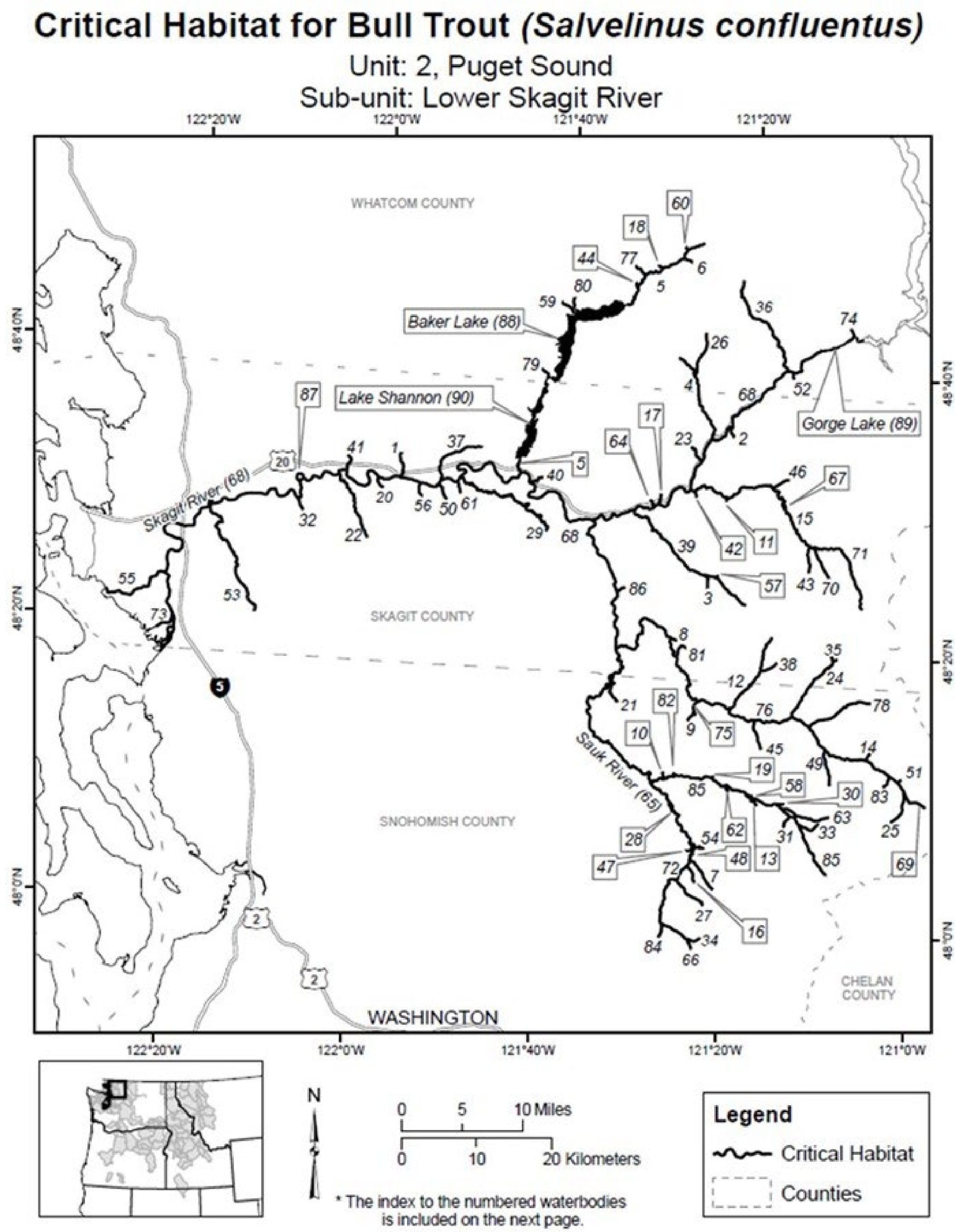
Bull Trout PBF 7. A natural hydrograph, including peak, high, low, and base flows, within historical and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

Bull Trout PBF 8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

---

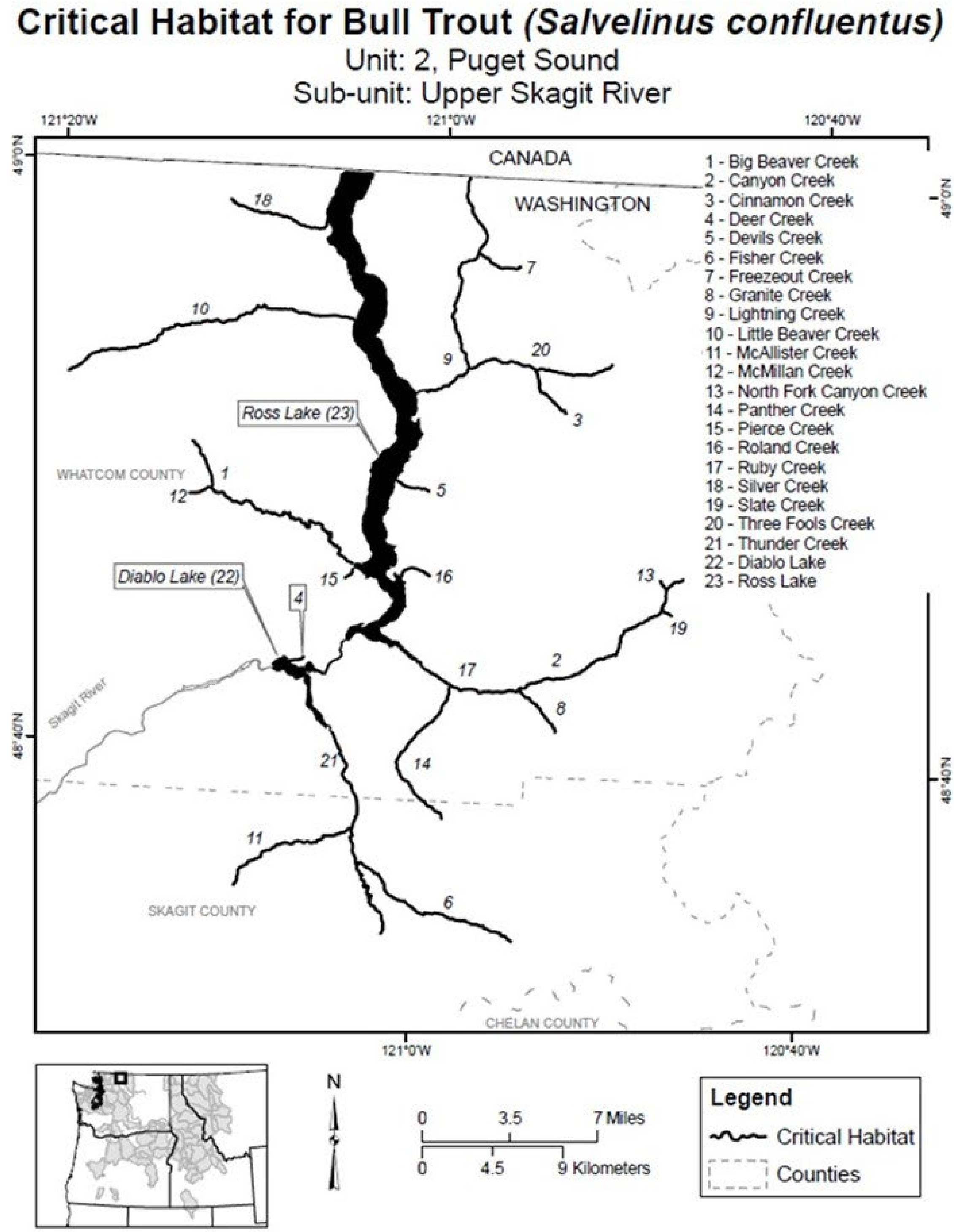
[57] The Coastal Recovery Unit Implementation Plan for Bull Trout (*Salvelinus confluentus*) (USFWS 2015b) states, "Recent genetic analysis places the isolated bull trout populations in Gorge and Diablo reservoirs in with the local populations of the Upper Skagit River core area (Smith 2010)" (page A-47).

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 4.2.3-34. Bull Trout critical habitat designated in the Lower Skagit River Sub-Unit (Note: Genetic analysis places the isolated bull trout populations in Gorge and Diablo reservoirs in with the local populations of the Upper Skagit River core area (Smith 2010).



Source: USFWS 2010.

Figure 4.2.3-35. Bull Trout critical habitat designated in the Upper Skagit River Sub-Unit (Note: Genetic analysis places the isolated bull trout populations in Gorge and Diablo reservoirs in with the local populations of the Upper Skagit River core area (Smith 2010).

Southern Resident Killer Whale

Description of Listed Unit

The Southern Resident killer whale (SRKW) DPS, composed of the “J,” “K,” and “L” pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). A 5-year review completed in 2021 concluded that the SRKW should remain listed as endangered (NMFS 2021). NMFS considers the SRKW to be among nine of the most at-risk species because of declining population trends and conflict with human activities. The population has relatively high mortality and low reproduction relative to other resident killer whale populations, which have been increasing in size since the 1970s (Carretta et al. 2021).

Life History and Ecology

Killer whales (also called Orcas) are apex predators and the most widely distributed marine mammal in the world (Leatherwood and Dahlheim 1978; Heyning and Dahlheim 1988). Killer whales in the Eastern North Pacific region, which includes the SRKW, are classified into resident, transient, and offshore ecotypes. Resident killer whales in the Eastern North Pacific are distinct from other killer whale ecotypes, forming large, stable pods that rely on fish as their primary prey (Dahlheim and Heyning 1999; Baird et al. 2000). The J, K, and L pods occupy the coastal waters of Washington, Oregon, and Vancouver Island and spend most of the year in inland waterways such as Puget Sound, the Strait of Juan de Fuca, and the Southern Georgia Strait (Bigg 1982; Ford et al. 2000; Krahn et al. 2002; Hauser et al. 2007; NMFS 2008; Carretta et al. 2021; Ford et al. 2017). These pods are considered a distinct stock under the Marine Mammal Protection Act (MMPA) and do not appear to breed with other killer whale populations (Hoelzel et al. 1998; Barrett-Lennard 2000).

Salmon are the primary prey of the SRKW, and the whales’ movements are linked to forage areas where migrating salmon occur. SRKW exhibit a strong preference for Chinook Salmon, especially from late spring through fall (Hanson et al. 2005; Ford and Ellis 2006), although they also prey on Chum, Coho, and Sockeye salmon, steelhead, and non-salmonid fishes. From May through September, individuals require as many as 143,000 Chinook and 53,000 other salmon to meet their energy requirements (NMFS 2007).

From late spring to early autumn, SRKW are found primarily in the Georgia Strait, the Strait of Juan de Fuca, and Puget Sound (Heimlich-Boran 1988; Osborne 1999; Hauser 2006 Bigg 1982; Ford et al. 2000; Krahn et al. 2002; Hauser et al. 2007). They also travel to the outer coasts of Washington and southern Vancouver Island during this time (Ford et al. 2000).

SRKW Population Status

Since the early 1970s, photo-identification has been used to conduct an annual summer census of killer whales in the Salish Sea (Bigg et al. 1990). The SRKW population size is currently near historically low levels, with 74 total whales: 24 in J pod, 17 in K pod, and 33 in L pod, including two calves born to J pod in September 2020 and one calf born to the L pod in February 2021 (Center for Whale Research 2021). Population growth has varied since ESA-listing in 2005, but the whales are currently experiencing a downward trend (NMFS 2021).

SRKW Limiting Factors

Potential threats to SRKW that may limit recovery include (1) insufficient prey availability; (2) contaminants; (3) effects of commercial and recreational vessels; (4) sound; (5) oil spills from pipelines, containers, oil tankers, and small chronic sources; (6) disease; (7) vulnerability due to small population sizes; and (8) live captures for aquaria (Ford and Ellis 1999; Ford et al. 2000; Baird 2001; Krahn et al. 2002, 2004; Wiles 2004).

SRKW Recovery Planning

To inform recovery, an active research program is underway to gather more information about the biology of the whales, their habitat and distribution, and how threats are affecting the whales. The NWFSC developed a research plan that informed the monitoring and research actions in the SRKW Recovery Plan. The NWFSC conducts research on the whales, partners with various academic and non-profit research groups, coordinates with Canadian researchers, and provides information to the public.

Critical Habitat

Critical habitat for the SRKW DPS, designated on November 29, 2006 (71 FR 69054), includes approximately 2,560 square miles of inland waters of Washington in three areas: (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca. On August 2, 2021, NMFS revised the critical habitat designation to encompass six new areas along the U.S. west coast, including 15,910 square miles of marine waters between the 6.1-m (20 ft) depth contour and the 200-m (656 ft) depth contour from the U.S. international border with Canada south to Point Sur, California (86 FR 41668).

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 PFMC 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 an 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).

4.2.3.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on fish and aquatic resources. These effects include impacts to aquatic habitat, fish stranding and trapping in reservoirs, fish entrainment and impingement, reservoir operations (e.g., water level, large woody material, sediment deposition), impacts to RTE fish species, transmission line ROW maintenance, recreation impacts on fisheries, and noise and lighting impacts on fisheries. The effects are organized below to address requests in FERC's Scoping Document 2 (SD2).

Four major fisheries issues were addressed during the previous relicensing: (1) Project influence on upstream migration of Pacific salmon and steelhead; (2) Gorge bypass reach dewatering; (3) salmonid redd dewatering and fry stranding in the Skagit River below the Project; and (4) loss of off-channel habitat. Agreed-upon measures in the current Project license were designed to mitigate these issues, and measures implemented by City Light have been effective for protecting and enhancing fish populations in Project reservoirs and the Skagit River downstream of the Project.

Measures include: (1) the instream flow plan (Flow Plan), which addresses spawning, incubation, rearing, and outmigration of salmonids; and (2) non-flow measures (Non-Flow Plan), which include the construction of off-channel habitats, Rainbow Trout stocking in Gorge and Diablo lakes, 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. Studies being conducted as part of the current relicensing represent a continuation of these preceding efforts, with current study designs and assessment of potential Project effects informed by what has been learned during compliance with the current FERC license and other basin-wide programs in which City Light participates.

Aquatic Habitat Connectivity

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on resident fish habitat and populations, including foraging, movements, population connectivity, and spawning in the Skagit River, project reservoirs, and tributaries (FERC SD2).

Reservoir Tributary Access

Project operations have no net effect on Rainbow Trout 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[58]). However, the increase in spawning habitat gained above historical natural barriers from access to Big Beaver and Lightning creeks at normal maximum water surface elevation (i.e., providing access to reaches historically inaccessible due to falls) offsets habitat losses due to 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 4.2.3-40.

[58] The lowest licensed water surface elevation for Ross Lake is 1,474.5 feet, 127 feet below normal maximum water surface elevation, 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.

Table 4.2.3-40. The effects of the seasonal drawdown on the availability of Rainbow Trout spawning habitat in 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 3.1.6, Existing Resource Measures, and Section 4.2.3.3, Proposed Resource Measures, of this Exhibit E, City Light mitigates for this effect by annually conducting surveys for and removing any transitory barriers to tributary spawning migration.

The results of these barrier surveys and barrier removal efforts in Ross Lake from 1997-2022 are summarized in Table 4.2.3-41. Barrier identification is coordinated annually with NPS and WDFW. When a barrier is identified, City Light takes photos before and after removal and reports this information to the Flow Plan Coordinating Committee (FCC) and Non-flow Coordinating Committee (NCC).

Table 4.2.3-41. The number of Ross Lake tributary barriers surveyed and removed by City Light, (1997-2019).[1]

Year	Arctic	Big Beaver	Devils	Dry	Lightning	Little 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
2020	0	0	0	0	0	0	0	0	0	0	0	0	0
2021	0	0	0	2	0	0	0	0	0	0	N/A	0	0
2022	0	0	0	0	N/A	0	0	N/A	0	N/A	N/A	0	0
Total Barriers	0	0	0	15	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.

Diablo Lake Hydraulic Connectivity

As discussed in Section 4.2.3.1 of this Exhibit E, a Hydraulic Connectivity Assessment of the Reach between Diablo Dam and Diablo Powerhouse (City Light 2022f) was conducted to evaluate operating scenarios that could result in a loss of hydraulic connectivity in the reach between the toe of Diablo Dam and the Diablo Powerhouse (Diablo Reach).

Results of iterative HEC-RAS model simulations indicate that a WSE of 878.5 feet was the threshold below which the Diablo Reach would experience loss of hydraulic connectivity. Modeling also indicates that discharges from the Diablo Powerhouse units 35 and 36 alone are insufficient to maintain connectivity when the Diablo Powerhouse tailwater WSE reaches 878.5 feet. However, operation of units 35 and 36 and one large unit (1,867 cfs) provides sufficient discharge to maintain hydraulic connectivity from the toe of Diablo Dam to Diablo Powerhouse.

A reoccurrence frequency analysis showed that during the 24-year period of record (1997-2021) the Diablo Powerhouse tailrace WSE fell below the threshold elevation of 878.5 feet on 271 days (≈ 3 percent of the days); over the past 10 years, the tailrace WSE fell below the threshold elevation on 34 days (≈ 1 percent of the days). On these days, releases < 1,867 cfs occurred on one day within the past 24 years and zero days during the most recent 10 years, i.e., results of the analysis show that the conditions that could bring about the loss of hydraulic connectivity in the Diablo Reach occurred on only 1 day in 24 years.

When Diablo Powerhouse discharges are extremely low or fully interrupted, i.e., during powerhouse outage, City Light is required to quickly restore discharges to meet downstream minimum flow requirements, either by increasing Diablo Powerhouse generation or passing water via the Diablo Dam spillway. Because typical response times to an outage are two hours or less, low flows do not persist long enough to result in a loss of connectivity of the Diablo Reach. Also, a loss of connectivity does not signify that the Diablo Reach is dewatered, i.e., water remains in the deep pools within the reach that would serve as fish holding habitat during the short period if connectivity were to be lost. When outages occur, flows are restored rapidly according to standard operating procedures, making the risk of stranding or trapping negligible. Moreover, the upper section of the Diablo Reach is a slot canyon, and aquatic habitat in this reach consists of deep pools with vertical rock walls. Shoreline slopes in this reach exceed the 4-6 percent range considered to pose a stranding risk to fish (Bauersfeld 1978; Beck Associates 1989; Bell et al. 2008).

Upstream Fish Migration in the Skagit River

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on resident fish habitat and populations, including foraging, movements, population connectivity, and spawning in the Skagit River, project reservoirs, and tributaries (FERC SD2).

Determination of benefits of providing fish passage at the project dams for resident and anadromous fish species (FERC SD2).

As described in Section 4.2.3.1 of this Exhibit E, geologic, genetic, and ethnographic evidence indicates that anadromous salmonids did not pass upstream of Devil's Canyon, a feature now inundated by Gorge Lake. NMFS (2012) acknowledges this in the following statements, "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," and "the preponderance of evidence indicates limited historical anadromous fish use of the Skagit River watershed upstream from the present location of the Gorge Powerhouse." In addition, an assessment of historical WDFW (Envirosphere 1988) accounts states, "Some historical evidence suggests that small runs of steelhead trout migrated [only] as far as Stetattle Creek [a tributary to Gorge Lake]..."

Although steelhead apparently did access Stetattle Creek (and possibly Chinook Salmon also), how many individuals, and under what conditions, remain uncertain. Recent surveys conducted by the Upper Skagit Indian Tribe and WDFW (Seamons et al. 2021; Upper Skagit Indian Tribe 2022a, 2022b, WDFW 2021) have shown that some anadromous fish are capable of passing the high-gradient reaches in the Gorge bypass reach, in particular what is referred to by the Upper Skagit Indian Tribe and WDFW as the 0.54-mile cascade (coordinates identified by WDFW for the cascade are 48.683099, -121.241766). Anadromous fish species observed above the 0.54-mile cascade include (1) juvenile Coho Salmon, confirmed by genetic analysis (Seamons et al. 2021); (2) Coho and Chinook salmon fry, not confirmed by genetic analysis (Upper Skagit Indian Tribe 2022b); and (3) adult Coho Salmon (WDFW 2021) (see Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin for greater detail on the results of these surveys).

The degree to which resident fish species passed upstream through what is now the Gorge bypass reach and the now inundated Devil's Canyon is also uncertain. However, genetics analyses (Smith 2019) indicate that Bull Trout populations in the Upper Skagit Core Area (which includes the Project reservoirs above Gorge Dam) are descendants of a founding population from the Fraser River. 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. These genetic differences coupled with the geologic history of the basin (see Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin in this Exhibit E) strongly suggest that salmonids in the upper Skagit River basin originated in the Fraser River.

Also, 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 regional headwater resident Rainbow Trout populations (Pflug et al. 2013). Prior to the construction of Ross Dam, gene flow between the upper and lower Skagit River was likely unidirectional (upstream to downstream) following the redirection of the Skagit River's flow to the south approximately 15,000 years ago (Downen 2014).

As part of relicensing, City Light is conducting, in collaboration with LPs, the FA-04 Fish Passage Study (City Light 2022i), which involves two elements: (1) a Fish Passage Assessment of Existing Features in the Gorge Bypass Reach, which is an assessment of upstream passage potential for a select group of target fish species under varying flow regimes at two existing channel features in the Gorge bypass reach and (2) a Fish Passage Facilities Alternatives Assessment, which is an evaluation of the feasibility of providing upstream and downstream passage for target fish species at the Project developments, including conceptual designs and preliminary cost estimates for selected alternatives. The Fish Passage Facilities Alternatives Assessment includes three stages: Stage 1, Design Criteria Document preparation; Stage 2, Concept Development Report; and Stage 3, Fish Passage Assessment.

As stated in Section 4.2.3.1 of this Exhibit E, a series of 17 steady-state runs were simulated with the calibrated Bypass Hydraulic Model (City Light 2022g) to generate hydraulic data to support the fish passage assessment of Existing Features 1[59] and 2 (Figure 4.2.3-21). Simulations were based on releases from Gorge Dam, identified in consultation with LPs and fish passage experts, ranging from 50 cfs to 4,800 cfs, and a steady state discharge of 2,000 cfs from Gorge Powerhouse (although releases from Gorge Powerhouse have no impact on hydraulic conditions at the Existing Features, which are upstream from the powerhouse). As noted in the preceding paragraph, the model output will be evaluated and applied by the authors of the FA-04 Fish Passage Study (City Light 2022i).

As part of the FA-04 Fish Passage Study, City Light is conducting the following tasks (from June 2021-February 2023):

- Five technical workshops to update LPs on study progress and solicit feedback on fish passage concepts to assess the feasibility of their construction and operation.
- Twenty-one biweekly collaborative Agency Working Sessions with fish passage experts and interested LPs to guide development of fish passage concepts.
- Draft and final versions of the Fish Passage Assessment of Existing Features in the Gorge Bypass Reach; this assessment includes evaluation of physical data and hydraulic modeling results from the FA-05 Bypass Instream Flow Model Development Study (City Light 2022g), i.e., characteristics of the Gorge bypass reach evaluated against known swimming and leaping abilities of the select target fish species, to estimate ranges of flow conditions that provide adequate fish passage through the Gorge bypass reach to Gorge Dam.

Results of the Fish Passage Study will be presented in the USR and FLA.

Tributary Connectivity in the Skagit River below the Project

The results of the GE-04 Geomorphology Study show that there are no depth-related fish passage issues at the mouths of tributaries entering the Skagit River between the Project and the Sauk River confluence (City Light 20222j). Depths were adequate and aggradation at alluvial fans did not create conditions that would impede upstream fish migration. Three dry channel beds were observed, but these were not considered passage barriers because flow, and as a result entrance depths, fluctuate seasonally (WDFW 2019; Reiser, et al. 2006), creating opportunities for fish to enter the streams. The intermittent flows in tributaries are not linked to the Project's operation. Three streams, i.e., Alma, Copper, and Damnation creeks, had average gradients > 5 percent. Of these, conditions at the mouth of Copper Creek were considered sufficient to preclude Chum Salmon from entering the tributary; of the anadromous salmonids in the river, Chum are the most

59 See the Geologic Conditions, Likely Origin of Salmonids, and Connectivity in the Upper Skagit River Basin section of this Exhibit E for a discussion of the understanding of historical fish passage and recent fish surveys in the bypass reach, which refers to the "0.54-mile cascade," which is the same as "Existing Feature 1."

susceptible to gradient barriers. The gradient was not steep enough to deter other salmonid species, which can swim freely in grades lower than 7 percent, and are able to pass grades of up to 12 percent (WDFW 2019). Goodell Creek could not be surveyed due to deep, swift waters and erosive banks. The mouth of Goodell Creek was visually inspected, and it was concluded that depth and channel gradient would not preclude fish passage.

Downstream Gene Dispersal

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on resident fish habitat and populations, including foraging, movements, population connectivity, and spawning in the Skagit River, project reservoirs, and tributaries (FERC SD2).

Concerns have been raised about the Project potentially contributing to inbreeding depression of Bull Trout in Diablo Lake or Gorge Lake. Although entrainment rates and associated mortality at the Project have been shown to be low (see below), some Bull Trout entrained at Ross and Diablo dams survive downstream passage, resulting in some level of downstream genetic connectivity. 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.

As described in Section 4.2.3.1 of this Exhibit E, City Light is conducting the two-year FA-06 Reservoir Fish Genetics Study (City Light 2022a) to characterize the baseline population genetics of Bull Trout, Rainbow Trout, and Dolly Varden in Project reservoirs and provide data to inform the planning of long-term reservoir fish management. Results of the first year of study, based on analysis of existing data, reveal evidence of genetic structure, i.e., the presence of a systematic difference in allele frequencies between subpopulations, for Rainbow Trout and Bull Trout, which appears to be partially associated with geography. For Bull Trout, the largest genetic differences occurred between samples collected from upstream and downstream of the Project Boundary. The data reveal Bull Trout hybridization with other *Salvelinus* species, but full assessment of the extent of interbreeding is a future objective. Analyses could not identify Dolly Varden with high certainty using the available data, i.e., few data are available, and existing information pertaining to the species is insufficiently documented for it to be distinguishable in the native char datasets.

During 2022, salmonid tissue samples are being collected from juvenile fish near reservoir tributary spawning grounds. Analysis of these and existing samples, along with existing information, will allow for an above-and-below dams comparison of fish genetics. Newly developed genetic markers will be applied to describe genetic diversity, hybridization, and some quantitative genetic traits, such as migration timing. The analysis will provide an estimate of effective population size (N_e) for Bull Trout, Rainbow Trout, and, if possible, Dolly Varden in Project reservoirs, and the study results will allow for an assessment of the viability of Bull Trout populations in the Project reservoirs and their tributaries and whether inbreeding depression or other indicators of genetic isolation are occurring. The approach is consistent with that used by WDFW and USFWS, which will provide a significant technological update to the current genetic database and allow for straightforward comparison of data among laboratories.

Aquatic Habitat in the Skagit River

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on resident fish habitat and populations, including foraging, movements, population connectivity, and spawning in the Skagit River, project reservoirs, and tributaries (FERC SD2).

Effects of existing and any potential changes to project facilities and operation, including flood control operations, on stream flows, aquatic habitat, sediment transport, off-channel habitats, flood plain connectivity, tributary accessibility, and other geomorphic processes of the Skagit River downstream of Gorge Dam (FERC SD2).

Adequacy of existing FSA Flow Plan at protecting resident and anadromous fish spawning, incubation, rearing, and outmigration life stages in the Skagit River (FERC SD2).

Adequacy of existing ramping rates to protect fisheries resources of the Skagit River (FERC SD2).

As discussed in Section 4.2.3.1 of this Exhibit E, the Project alters the magnitude, frequency, and duration of high-flow events in the Skagit River, which in turn influences channel dynamics in the reach below the Project. As part of the GE-04 Geomorphology Study (City Light 2022j), historical maps and images (1944-2019) were used to identify reaches where dynamic channel processes have occurred and evaluate channel migration rates and changes in channel morphology. No lateral channel migration was recorded above Newhalem Creek or in the landslide zone (3.5-miles between Damnation Creek and Bacon Creek, PRM 87.5-84.0). Only short segments of localized bank erosion (0.1 ft/yr, on average) were mapped in the geologically confined segments upstream and downstream of the landslide zone. From the Straight Creek Fault (PRM 82) to the Cascade River at Marblemount (PRM 78.2) there has been limited channel migration, with only localized areas of erosion and an average migration rate of 0.1 ft/yr. Two river segments, from Newhalem Creek down to the limit of alpine glaciation and downstream of the Cascade River to Rocky Creek, include areas where dynamic channel processes were observed in the historical record. However, rates of lateral channel migration remain low overall in these areas (0.4 ft/yr, on average). The reach from Rocky Creek to the Sauk River alluvial fan is geomorphically distinct from other reaches, with an average lateral migration rate of 4 ft/yr over the period 1944-2019.

Scour monitoring arrays installed along the Skagit River indicate that there was little bed mobility at spawning sites in 2019 and 2020, with most locations showing no scour. The maximum observed scour depth was 6.8 inches. Preliminary interpretation of data from accelerometers suggests that most bed mobilization occurred during low flows but concurrent with the salmonid spawning season, indicating that observed scour was most likely the result of spawning activity.

Large wood is an important component of riverine ecosystems because it influences fluvial hydraulics, thereby enhancing habitat complexity; provides instream cover for fish and substrate for aquatic invertebrates; contributes allocthonous nutrients as it decomposes; and traps sediments that aid in the establishment of riparian vegetation (Bjornn and Reiser 1991; Northcote and Atagi 1997). Large wood supply in the Skagit River has been reduced from historical levels due to timber harvest, agriculture, flood risk management, hydroelectric infrastructure, log jam removal, and rural and urban development, which limit the volume of large wood input and the size of logs (Natural Systems Design 2017; Beamer et al. 2005b; Collins 1998). The Skagit River receives wood inputs from the mainstem downstream of Newhalem, the entire Sauk-Suiattle watershed, the Cascade River, and numerous smaller tributaries.

City Light's evaluation (City Light 2022j) of changes in large wood abundance in the Skagit River mainstem from 1979-2019 shows that log jam density gradually increased from 1.7 jams per mile to 3.5 jams per mile over the 40-year period. However, the spatial distribution of large wood and log jams upstream of the Sauk River has remained similar on a geomorphic reach scale since 1979. Despite the Project's presence, large wood availability may have increased since the 1970s, potentially due to improvements in the management of federal and state lands.

Sediment transport modeling is being conducted from the Project downstream to the gravel-sand bed transition, located near Sedro-Woolley (PRM 21), about 11 miles upstream of where the river enters the estuary and tidal processes begin to control channel dynamics (City Light 2022j). The modeling program includes the nested development of four models to represent key aspects of the Skagit River's channel processes (see Section 4.5 of the GE-04 Geomorphology Study report for a detailed description of the approach to sediment transport modeling). Evaluation of bed material mobility and further sediment grainsize analysis will be completed in conjunction with development of the sediment transport model (see below) following completion of the FA-02 Instream Flow Model Development Study (City Light 2022h). Sediment transport modeling is ongoing, and results will be provided in the USR and FLA.

Adequacy of Existing FSA Flow Plan

City Light's three developments on the Skagit River are operated in unison to store water on a seasonal or daily basis and release it strategically to promote beneficial uses, such as flood risk management and downstream salmonid protection. As described below, flows in the Skagit River downstream of Gorge Powerhouse are stipulated by the current Project license, which fully incorporates the measures included in the Fisheries Settlement Agreement Flow Plan, as amended in 2011 (City Light 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

From 1991 through 2012, flows in the mainstem Skagit River downstream of Gorge Powerhouse were determined by the current 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, which consists of representatives from the Indian 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 [60] and the Revised FSA Flow Plan (City Light 2011) are described below by species and life stage.

Salmon Spawning and Redd Protection

The primary means of protecting spawning salmon and redds downstream of the Project are to: (1) limit maximum flows 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 watered until the fry emerge. The Revised FSA Flow Plan identifies anticipated spawning periods for each salmon species based on historic habitat use data:

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

During the spawning periods of each salmon species, daily average 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 assumed 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.

Salmon Fry Protection

The salmon fry protection period specified in the Revised FSA Flow Plan is January 1 through May 31 to protect emerging salmonid fry from being stranded on gravel bars (Pflug and Mobrand 1989). To minimize fry stranding, City Light (1) limits daily down-ramp amplitude; (2) maintains minimum flows during the salmon fry protection period that are adequate to cover gravel bars commonly inhabited by salmon fry; and (3) limits 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.

[60] 144 FERC ¶ 62,044.

- 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 as measured at the Newhalem gage.

Steelhead Spawning and Redd Protection

Measures to protect spawning steelhead and redds downstream of the Project include: (1) limiting maximum flows during spawning; (2) shaping daily flows for uniformity over the extended spawning period; and (3) maintaining minimum flows through the incubation period to keep redds watered 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 is from March 15 – June 15. This 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 determining steelhead spawning and incubation flows. Planned flows may not exceed 5,000 cfs in March and April and 4,000 cfs from May – June 15, unless forecasted inflow and storage are sufficient to provide incubation flows at least as high as spawning flows. Any planned spawning flows greater than the flow ranges identified above are not implemented without consulting the FCC. The actual spawning flow for each sub-period is defined as the average of the 10 highest daily spawning flows at the Newhalem gage during that sub-period.

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

- Incubation flows during the first 10 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 10 daily spawning flows that have occurred up to that day. Appropriate incubation flows for any given day are determined by the season spawning flows as specified in the Revised FSA.
- During August, the instantaneous daily minimum flow at the Newhalem gage is 2,000 cfs.

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 to cover gravel bars commonly inhabited by steelhead fry. Implementation details include the following:

- 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 natural flows at the 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 cfs in September and October. During August, down-ramp amplitude is further restricted to 500 cfs per day when flow insufficiency provisions are in effect as specified in Section 6.4 of the Revised FSA.

- Down-ramp Rate – When the Newhalem instantaneous natural 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, the down-ramp rate is up to 1,000 cfs per hour.
- Steelhead Fry Protection Flow – Minimum flows at the Newhalem gage must be the higher of flows specified in Table 4.2.3-42 or 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 4.2.3-42. Minimum flows for salmonid fry protection.

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.

2 Minimum flows in November-January are determined by incubation flow requirements.

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 through January 31 each year.

Other Flow Management Measures

Some impact to anadromous fish spawning, incubation, and rearing may occur despite the protection measures described above, particularly when uncontrollable flows occur. In addition to the downstream flow requirements, 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. 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 proposal 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.

Evaluation of Flow Plan Adequacy

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 have demonstrated that the aforementioned flow management measures have benefitted salmon 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 Gorge Powerhouse, suggesting that the effects of flow manipulation were most effective in the reach closest to the Project. Pink and Chum salmon commonly spawn along the shallow channel margins of the Skagit River (Stober et al. 1982), and 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 (see below) also appeared to increase the abundance of Pink and Chum salmon. Since the time of the Connor and Pflug (2004) study there has been a regional decline in Chum Salmon abundance, which was found to be partially linked to marine productivity (Malick et al. 2017). Some Chum stocks have now rebounded, although not the Skagit River run (Ruff 2019).

In contrast to Pink and Chum salmon, Chinook Salmon spawner abundance was only observed to increase within the upstream-most of the three study reaches.[61] Because Chinook Salmon generally spawn in relatively fast and deep water (Stober et al. 1982), it was concluded that Chinook Salmon have a substantially lower risk of redd dewatering than 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).

Steelhead spawner abundance between Gorge Powerhouse and the 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 steelhead fry and parr as key components of the fluvial Bull Trout diet. Model simulations run by Lowery and Beauchamp (2015) predicted that Bull Trout predation would 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 manifest in a low rate of steelhead adult returns to the reach between Gorge Powerhouse and the Sauk River. Juvenile Chinook Salmon were found to be relatively unimportant in the diets of fluvial Bull Trout, despite the year-round spatial overlap of Bull Trout and Chinook Salmon. Lowery and Beauchamp (2015) concluded that escapement rates to the Skagit River upstream of the Sauk River suggest that steelhead may be more vulnerable than Chinook Salmon to Bull Trout predation.

As stipulated by FERC's (2013) Order Amending License, the Project is subject to the reasonable and prudent measures and terms and conditions of the NMFS (2012) Biological Opinion, included as Appendix A to the Order. To ensure that incidental take levels are not exceeded, FERC directed City Light to prepare a Chinook Salmon and Steelhead Monitoring Plan in conjunction with NMFS

[61] 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).

and subject to FERC approval. The Monitoring Plan called for at least one Chinook Salmon and one steelhead fry stranding survey, with survey results reported as fry stranded per 100 ft of bar per Beck Associates (1989). The FCC 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 ft for salmon fry and 0.05/100 ft 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; this represents a stranding rate of 0.067/100 ft. In 2018, surveys were conducted in both the salmon and steelhead fry periods. City Light observed two stranded fry during the surveys: one Chum and one Chinook. The observed salmon stranding rate was 0.067/100 ft., and the steelhead rate was 0.00/100 ft. The results of the 2016, 2017, and 2018 surveys indicate a stranding rate for salmon fry that is substantially less than the 0.78/100 ft recorded by Beck Associates (1989).

As explained in greater detail in Section 4.2.3.1 of this Exhibit E, City Light has developed tools, i.e., the Bypass Habitat Model (City Light 2022g) and the Upper Skagit Habitat Model (City Light 2022h), to continue evaluating flow-habitat relationships for a range of fish species and life stages. The Bypass Habitat Model extends longitudinally from the Gorge Dam plunge pool (PRM 97.15) to the USGS Skagit River at Newhalem gage (USGS gage 12178000) (PRM 94.25). Output from the Bypass Habitat Model can be combined with output from the Upper Skagit Habitat Model (City Light 2022h), which extends from the USGS Skagit River at Newhalem gage to the confluence with the Sauk River, to provide instream flow-habitat simulations for the 31-mile reach from Gorge Dam to the Sauk River. The 31-mile study area is divided into 19 reaches; reaches 1-6 are within the domain of the Bypass Habitat Model and reaches 7-19 are within the domain of the Upper Skagit Habitat Model. The habitat models provide a library of UHA curves for each of the 37 fish species-life stage combinations identified by City Light in consultation with LPs. UHA curves account for the depth, velocity, substrate, and cover preferences of each species/life stage combination. Examples of model output are provided in Section 4.2.3.1 of this Exhibit E. These models will be used in the evaluation of alternative flow management scenarios that will be presented in the USR and FLA.

Topics related to modeling that are still being resolved are (1) integration of the instream flow and operations models; (2) use of the operations and instream flow models to project potential effects of climate change on future flow release schedules, via integration of the flow-habitat models with the University of Washington's Distributed Hydrology Soil Vegetation Model; and (3) construction of a 1-D hydraulic model for the river between the Sauk River confluence and the estuary.

Benefit of Providing Minimum Flows in Gorge Bypass Reach

Determination of benefits of providing minimum instream flows in the Gorge bypassed reach for resident and anadromous fish species (FERC SD2).

City Light is in the process of evaluating the potential for providing minimum flows in the Gorge bypass reach. Minimum flows would create fish habitat beyond what currently exists in the bypass reach under baseflow conditions and potentially increase low-flow connectivity in some habitats. Minimum flows would be insufficient to create the connectivity needed to allow anadromous fish to pass the existing channel features identified in the preceding section (i.e., for the FA-04 Fish

Passage Study, City Light 2022i). If minimum flows are provided, and as a result more fish begin to reside in the Gorge bypass reach, these fish would be exposed to occasional spill flows, which at times can be very high. Such flows in the narrow, high-gradient bypass reach would have the potential to displace fish downstream, possibly resulting in injury and mortality.

As explained in greater detail in Section 4.2.3.1 of this Exhibit E, City Light developed the Bypass Habitat Model (City Light 2022g), which extends longitudinally from the Gorge Dam plunge pool (PRM 97.15) to the USGS Skagit River at Newhalem gage (USGS gage 12178000) (PRM 94.25). Output from the Bypass Habitat Model, i.e., UHA curves for each of the 37 fish species-life stage combinations identified by City Light in consultation with LPs, will be used to analyze alternative flow management scenarios for the Gorge bypass reach, which will be presented in the FLA.

Skagit River Process Flows

Determination of benefits of providing dedicated flow releases to enhance aquatic habitat and ecologic processes in the Skagit River downstream of Gorge Dam (FERC SD2).

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on resident fish habitat and populations, including foraging, movements, population connectivity, and spawning in the Skagit River, project reservoirs, and tributaries (FERC SD2).

The creation, maintenance, and continued availability of side channel and off-channel habitat is a dynamic process that changes over time. It is largely controlled by episodic flow events, primarily major floods. In the mainstem Skagit River, the formation, availability, and quality of off-channel habitat is currently influenced by an altered flow regime resulting from Project operations, particularly operations associated with flood risk management, and watershed impacts due to a range of land management activities, such as timber harvest, which alter runoff patterns.

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 risk management. These operations have influenced channel-forming processes by reducing the magnitude, frequency, duration, and timing of 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. Reduced peak flows and vegetated riverbanks limit channel migration (Riedel 1990). Also, a recent inventory of hydro-modified banks (riverbanks stabilized by rip rap, which also retards channel migration) found that approximately 14.5 percent of the right bank of the Skagit River between Gorge Powerhouse and the Sauk River has been hydro-modified, with 1.5 percent of the left bank protected by rip rap (Hartson and Shannahan 2015).

Process flows are those that result in geomorphic changes to the river channel, including sediment transport and the creation, redistribution, modification, and maintenance of aquatic habitat. Scour monitoring and hydrophone and accelerometer data will be integrated with hydraulic and sediment transport modeling outputs to identify flows that initiate substrate movement. Hydraulic model results will also be used to identify potential flows that connect various side channel and off-channel habitats with the mainstem flow.

The Indicators of Hydraulic Alteration (IHA) will be used to estimate the timing and duration of high-flow events under unmanaged conditions, which will be used to inform the development of process flow scenarios. The evaluation of process flows, which began with review of existing information, was initiated in January 2022 during a series of iterative workshops involving City Light and LPs. This discussion began with acknowledgement of available guidance (Wald 2009), which suggests that natural conditions (2- and 10-year flows) should be used as the benchmark for setting channel forming and channel maintaining discharges. Preliminary evaluation of pre-regulated hydrology indicates that the natural 2-year recurrence flow at Newhalem is about 30,000 cfs, and the 10-year recurrence flow is about 50,000 ±10,000 cfs. Sediment transport modeling, described in Section 4.2.3.1 of this Exhibit E, is being applied to assess the channel's response to variability in flow and sediment input.

Work products to be provided in the USR include a detailed summary of geomorphic change over the term of the current Project license and further investigation into the correlation between peak flows and geomorphic disturbances, informed by the sediment transport modeling program. This effort will contribute to the analysis of side channel formation and maintenance processes and assessment of side channel connectivity to the mainstem at a variety of flows. The USR will also include a synthesis of the interactions among flow, sediment loading, large wood input, channel migration/side channel formation, floodplain connectivity, and aquatic habitat.

Stranding and Trapping in Project Reservoirs[62]

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir levels) on the potential for resident fish stranding and entrapment in project reservoirs (FERC SD2).

As discussed in Section 4.2.3.1 of this Exhibit E, results of the FA-03 Stranding and Trapping Assessment (City Light 2022c) indicate that the risk of fish stranding and trapping is low in the Project reservoirs.

Eight areas around Ross Lake were identified as exhibiting topographic characteristics that could present a high risk of stranding and trapping at certain WSE within the normal range of operations. Study methods were refined, including modifications to the spatial stratification of the varial zone and field survey techniques, to prioritize the sampling of recently dewatered areas where the likelihood of observing stranded or trapped fish would be highest. Refinements ensured that field data focused on supporting the testing of GIS analyses to develop a robust estimate of the total risk around each reservoir.

Three reconnaissance field surveys were completed on Ross Lake during 2020-2021, December 2020, March 2021, and April 2021, to assess various points in the drawdown cycle. During these surveys, field crews identified areas that appeared to present a risk of stranding or trapping. However, there was no evidence of stranding or trapping: no live fish, mortalities, or fish remains were found during any of the surveys. Three stranding and trapping field surveys were conducted on Ross Lake during October 5-6 and October 26-27, 2021 and on April 7, 2022. Results of these surveys are provided in Table 4.2.3-14. Stranded fish were observed during these surveys, but they

[62] Fish stranding and trapping in the Skagit River downstream of the Project is addressed in *Adequacy of Existing FSA Flow Plan* section, above.

were nearly all Redside Shiner. Only one potentially native trout fry (which could not be identified in the field) was observed during these surveys.

A two-day opportunistic reconnaissance survey was also conducted on Diablo Lake in September 2020 to coincide with an unplanned drawdown. The opportunistic survey of Diablo Lake showed that conditions in the Thunder Arm presented a fish stranding and trapping risk when reservoir elevations were drawn down over a two-day period (September 16-17, 2020) from WSE 1,207.36 feet NAVD 88 (1,201 feet CoSD) to WSE 1,202.36 feet NAVD 88 (1,196 feet CoSD). However, no fish stranding or trapping was observed during quarterly surveys performed in several areas on Diablo Lake in 2022 (Table 4.2.3-18).

Stranding and trapping surveys were conducted on Gorge Lake in May, June, and August 2022. During the first survey, up to 12 salmonid fry were observed to be stranded near Reflector Bar (Table 4.2.3-21). All of these fish were alive when they were encountered. Additional surveys performed in June and August 2022 resulted in no observations of fish stranding and trapping at Reflector Bar. City Light's current approach to addressing stranding and trapping in Gorge Lake is outlined in its monthly operations plan: if Gorge Lake WSE falls below 873.51 feet NAVD 88 (867 feet CoSD), City Light's Project Fish Biologists are contacted within 48 hours to conduct a stranding/entrapment assessment at known locations where stranding may occur. Water surface elevations below 873.51 feet NAVD 88 (867 feet CoSD) generally occur every few years and are related to Project maintenance.

Results from the reservoir stranding and trapping surveys are being compiled into a geodatabase to map their occurrence around the Project reservoirs and to visualize reservoir conditions (e.g., WSE and drawdown rate) during each instance of observed stranding or trapping. Data will be interpreted in the context of fish periodicities to identify locations, time periods, and reservoir drawdown rates that appear to present a fish stranding and trapping risk in the Project reservoirs. The FA-03 Stranding and Trapping Assessment (City Light 2022c) is ongoing, and updated results for all three reservoirs will be presented in the USR and FLA.

Lastly, as explained in the Diablo Lake Hydraulic Connectivity section above, stranding and trapping of fish in the reach between Diablo Dam and Diablo Powerhouse is not an issue due to the way in which the Project is operated and physical conditions within the reach (City Light 2022f).

Benthic Macroinvertebrates and Drift

Effects of existing and any potential changes in project facilities and operation (e.g., reservoir level fluctuations and drawdowns) on macroinvertebrate production in the project reservoirs (FERC SD2).

Project Reservoirs

As explained in Section 4.2.2.1 of this Exhibit E, City Light has expanded its BMI sampling program over what was outlined in the FERC-approved RSP. Sampling locations, methods, and frequencies are outlined in Table 4.2.2-11 in Section 4.2.2.1. Sampling underway or completed in the reservoirs and their tributaries includes (1) benthic grab samples using a Ponar dredge in reservoirs; (2) kick-net sampling of BMI in reservoir tributaries; (3) invertebrate drift sampling in reservoir tributaries; and (4) placement of rock baskets in Ross Lake to assess BMI colonization rates in the varial zone. Updated BMI and invertebrate drift sampling results for the Project reservoirs and their tributaries will be provided in the USR and FLA.

Ponar grab sampling will provide a pilot-scale understanding of the abundance and diversity of invertebrates in soft sediments in the lentic zones of all the reservoirs under baseline operations, and within the varial zone of Ross Lake, where the WSE fluctuation is much more extensive than it is in the downstream reservoirs.

Invertebrate drift and kick-net samples will be collected within each of the target tributaries of the reservoirs (see Table 4.2.2-11 in Section 4.2.2.1), just above the maximum reservoir WSE and in the stream channel within the varial zone just above the point where the tributary enters the reservoir. This will allow for a comparison of invertebrates in water flowing into and out of the varial zone to assess potential losses within the varial zone during low WSE conditions. Rock baskets were deployed in the lentic and varial zones of Ross Lake to evaluate BMI colonization rates, which can be used as an indicator of the degree to which operations associated with flood risk management influence benthic productivity in the reservoir.

In Ross Lake, WSE fluctuation is much more extensive than it is in the downstream reservoirs, largely due to storage and release patterns undertaken to minimize downstream flood risk. Rock baskets have been deployed in the lentic and varial zones of Ross Lake to evaluate BMI colonization rates following rewatering of the drawdown zone, which can be used as an indicator of the degree to which Project operations influence benthic productivity in the reservoir.

Rock baskets were positioned in the (1) upper varial zone (just below the maximum WSE); (2) lower varial zone (near the midpoint WSE in the drawdown zone); and (3) lentic zone (below the normal low WSE) (see Figure 4.2.2-52 in Section 4.2.2.1) at each of the following geomorphic regions of Ross Lake: Hozomeen, Desolation, Pumpkin, Ruby (see mapbook in Appendix E of this Exhibit E for locations). At each of the four sampling sites, 12 baskets were deployed in July 2022 (i.e., at full pool), four in each zone (Figure 4.2.2-53 in Section 4.2.2.1). At each sampling site, two baskets were removed from each of the three zones twice: two baskets were removed after four weeks and two baskets after 10 weeks (Figure 4.2.2-53 in Section 4.2.2.1). The samples removed after two weeks are intended to provide data on early colonization, and samples removed after 10 weeks provide information on colonization over a longer period.

As described in Section 4.2.3.1 of this Exhibit E, City Light conducted a GIS-Based Reservoir Littoral Zone Evaluation to estimate the areal extent of littoral zone habitat around Ross, Diablo, and Gorge lakes and to evaluate the relationship between the extent of the littoral zone and WSE for each reservoir (i.e., how the area of littoral zone changes as a function of the reservoirs' drawdown regimes) (City Light 2022b). The extent of light penetration, i.e., the depth of the euphotic zone, which is proportional to water clarity, dictates the area of the littoral zone, which varies spatially and temporally (Zhang et al. 2006).

Littoral zone habitat in Ross Lake is concentrated near tributary inputs and at the upstream end of the reservoir. The littoral zone, which is estimated to be between about 24 and 65 feet deep in Ross Lake, may be fully dewatered under normal permitted operations, as the elevation range of the varial zone spans 128 feet (Table 4.2.3-12).

Based on minimum and maximum depths, the total area of the Ross Lake littoral zone at normal maximum WSE is about 1,586-3,875 acres. At 25 percent drawdown, 2,082 acres of littoral zone habitat are dewatered, resulting in a submerged littoral zone area of 0-1,793-acre (a 45.6-100 percent dewatering of the littoral zone) (Table 4.2.3-13). Overall, the Ross Lake littoral zone is rapidly dewatered during the early phase of reservoir drawdown, and the rate of littoral zone dewatering varies throughout drawdown. The rate at which the rewatered varial zone returns to productivity is being assessed with the deployment of the BMI colonization rock baskets described above.

Skagit River below the Project

Effects of existing and any potential changes in project facilities and operation, including ramping rates, on benthic macroinvertebrates in the Skagit River downstream of Gorge Dam (FERC SD2).

As stated above, sampling locations, methods, and frequencies for the expanded BMI and invertebrate drift data collection program are outlined in Table 4.2.2-11 in Section 4.2.2.1. The number of samples collected longitudinally in the Skagit River was expanded from six locations to eight locations, resulting in not only a greater overall number of locations but also extending the study area farther downstream, to the SR 9 Bridge (PRM 23). Three of the longitudinal sampling sites include both mainstem and side channel sampling. The sampling site in the Sauk River at RM 5.4 continues to be sampled along with the longitudinal sampling in the Skagit River. The increased scope of longitudinal sampling will provide a more detailed characterization of river-wide patterns in macroinvertebrate densities and diversity, which can be used to assess potential Project impacts, including attenuation of impacts with increasing distance downstream of the Project.

The expanded scope also includes “intensive” BMI sampling at paired sites in the Skagit River (regulated) at PRM 75.6 and the Sauk River (unregulated), just upstream of the confluence with the Suiattle River. The paired sites were selected to be as similar as possible to each other in terms of elevation and channel characteristics. At each intensive sampling site, BMI samples are collected with a kicknet at intervals along a transect that runs from the shoreline, through a side channel, and into the mainstem toward the thalweg to the maximum wadable depth. Sampling at these intensive transect sites is being conducted every two weeks from July-October 2022 and every four weeks from November-December 2022 and from March-June 2023. Data from the two intensive sampling sites will be compared in an attempt to discern whether there are apparent effects of the Project on the invertebrate community at the Skagit River (regulated) site.

Thermographs have been deployed to continuously monitor temperature at each macroinvertebrate sampling site. At the sampling site in the Sauk River, nutrient data (grab samples) are being collected quarterly to allow for a comparison of conditions before and after the influx of marine-derived nutrients from spawned-out salmon and steelhead carcasses.

Fish Entrainment and Impingement

Effects of existing and any potential changes to powerhouse facilities and operations at the three developments on resident fish entrainment injury and mortality (FERC SD2).

As explained in Section 4.2.3.1 of this Exhibit E, City Light conducted the desktop FA-08 Fish Entrainment Study (City Light 2022d) to evaluate fish impingement and entrainment at Ross, Diablo, and Gorge dams and the potential effect of impingement and entrainment on the Skagit River fish community. Entrainment and impingement potential at the Project vary seasonally as the result of changes in reservoir operations and as a function of fish species, life stage, swimming speed, and body size. Based on City Light's (2022d) risk assessment, few fish species or life stages have an elevated (i.e., moderate or high) risk of entrainment or impingement at Project dams. Trout species spawn in tributaries and rear in tributaries and shallower areas of the reservoirs, thereby avoiding the intakes, which are located at depth. Adult native char (Bull Trout and Dolly Varden) and Rainbow Trout may at times occur near the turbine intakes, but their swimming burst speeds are usually sufficient to overcome intake approach velocities.

The risk assessment suggested that Redside Shiner and Dolly Varden were at greatest risk of entrainment, depending on the facility and species life stage. Although the EPRI (1997) database was unable to account for all site- or species-specific factors that could influence entrainment at the Project, it does indicate that the majority of fish entrained at the Project are less than 4 in long. Structural differences between Project facilities and those of the dams included in the EPRI database could result in entrainment risk being overestimated at the Project.

Redside Shiner was the only species with an elevated (i.e., moderate) risk of entrainment in Ross Lake. Adult Redside Shiner have a greater swimming burst speed than the estimated intake approach velocity at Ross Dam (4.95 ft/sec swimming burst speed versus 1.11 or 3.88 ft/sec approach velocities). Early life stages are considered to be at low risk of entrainment because the species spawns in the littoral zone, which is not within the vicinity of the intakes.

Some adult species, including Rainbow Trout, Cutthroat Trout, and Brook Trout, although present in Ross Lake, commonly remain in the upper water column well above the intake (less than 52 ft deep versus the intake depth of about 152 ft), and therefore are not susceptible to entrainment. Adult Bull Trout and Dolly Varden can be found in deeper areas (up to 196 ft), but based on swimming speed analysis, both species are able to navigate and escape approach velocities near the intake (swimming speeds > 3.88 ft/sec; however, many adult Bull Trout in Ross Lake are larger than those used to estimate swimming burst speed in Katopodis and Gervais [2016] and would therefore be even less susceptible to entrainment than what would be indicated by the authors). Additionally, multi-year acoustic telemetry studies of Bull Trout in Ross Lake indicate limited use of the intake zone (see below).

Estimated entrainment rates for Dolly Varden and Redside Shiner in Ross Lake are low and vary seasonally based on life stage, habitat selection, and changes in distribution that may encourage the species to move closer to or farther from Project intakes and spillways (Figure 4.2.3-36).

For the fish lengths evaluated, turbine blade strike probability ranged from 2.5-44.6 percent at Ross Dam. The majority (97.6 percent) of estimated entrainment consisted of small fish (< 4 in) with the lowest risk of turbine blade strike, ranging from 2.7-5.9 percent at Ross Dam. As noted above, larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, intake depth, and habitat selection.

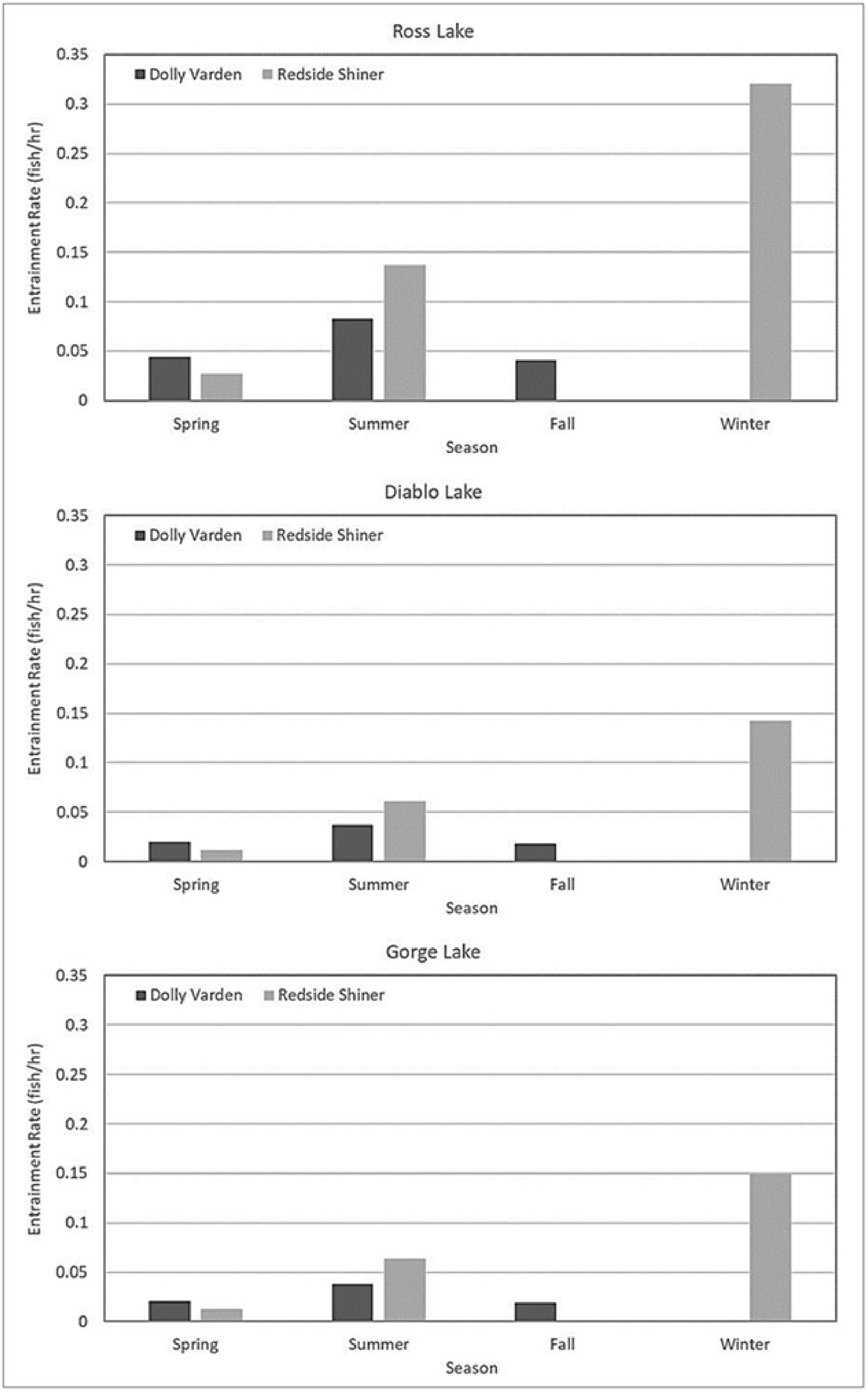


Figure 4.2.3-36. Average entrainment rate (fish/hr) by target species and season in Ross, Diablo, and Gorge lakes.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency and volume of spills at the Project is low, thus reducing the significance of spill-related mortality. Spill frequency at Ross Dam is 2.5 days per year (City Light 2020b). The combined survival, via all passage routes, of fish most frequently entrained (< 4 in) was estimated at ≥ 84 percent at Ross Dam.

The risk of impingement or entrainment to resident target species in Diablo Lake is the same as that in Ross Lake. For those species present in the reservoir and in proximity to the intake, only juvenile Redside Shiners were found to be susceptible to the minimum WSE intake approach velocity (1.44 ft/sec swimming burst speed versus 3.88 ft/sec intake approach velocity), and therefore the species was assigned a moderate risk assessment rating.

Estimated entrainment rates for Dolly Varden and Redside Shiner in Diablo Lake varied seasonally based on life stage, habitat selection, and changes in distribution that may encourage the species to move closer to or farther from Project intakes and spillways (Figure 4.2.3-36).

For the fish lengths evaluated, turbine blade strike probability ranged from 2.7-40.3 percent at Diablo Dam. The majority (97.6 percent) of estimated entrainment consisted of small fish (< 4 in) with the lowest risk of turbine blade strike, 2.7-5.3 percent at Diablo Dam. Larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, intake depth, and habitat selection.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency and volume of spills at the Project is low, thus reducing the significance of spill-related mortality. Spill frequency is 39 days per year at Diablo Dam (City Light 2022d), and the combined survival via all passage routes of fish most frequently entrained (< 4 in) was estimated at > 87 percent at Diablo Dam.

The Gorge Dam intake is shallower (≈ 56.3 ft) and has a higher intake velocity than those at Diablo and Ross dams. Adult Bull Trout and Rainbow Trout are likely able to escape intake approach velocities at Gorge Dam. Although acoustic telemetry studies have at times documented Bull Trout in the Gorge Lake forebay, the majority of Bull Trout in Gorge Lake occur in the Diablo Dam tailrace, a primary foraging area, rather than the forebay (City Light 2018). Adult Dolly Varden may be susceptible to entrainment at minimum WSE (5.54 ft/sec burst swimming speed versus 6.2 ft/sec intake approach velocity). Because Dolly Varden would only be susceptible to the approach velocity at minimum WSE, an entrainment risk category of "moderate" was applied to this species and life stage. However, a "moderate" risk rating is conservative considering how rarely Gorge Lake is drawn down (only twice between 2013-2022 [City Light 2020b]) and the infrequency with which Dolly Varden experience these conditions.

Adult Redside Shiner could be entrained at the Gorge Dam intake during periods of normal and minimum WSE (4.95 ft/sec swimming burst speed versus 6.2 ft/sec intake approach velocity). However, because this species only occurs at depth in winter, it is considered to be at moderate risk of entrainment.

Estimated entrainment rates for Dolly Varden and Redside Shiner in Gorge Lake are low and vary seasonally based on life stage, habitat selection, and changes in distribution that may encourage the species to move closer to or farther from Project intakes and spillways (Figure 4.2.3-36).

For the fish lengths evaluated, turbine blade strike probability ranged from 2.9-51.1 percent for Gorge Dam. The majority (97.6 percent) of estimated entrainment consists of small fish (< 4 in) with the lowest risk of turbine blade strike, 2.9-6.7 percent at Gorge Dam. As noted, larger fish (i.e., adult trout and some larger juveniles) are unlikely to be entrained based on swimming ability, life history characteristics, intake depth, and habitat selection.

Although the likelihood of mortality is estimated to be higher for individual fish passing over the spillways than for those passing through the turbines, the frequency and volume of spills at the Project is low, thus reducing the significance of spill-related mortality. Spill frequency for the period 2015-2020 is 37 days per year at Gorge Dam (City Light 2022d). The combined survival, via all passage routes, of fish most frequently entrained (< 4 in) was estimated at ≥ 94 percent at Gorge Dam.

Data collected as a requirement of the existing Biological Opinion for the Project (USFWS 2013) also indicate that entrainment of large fish is uncommon in Project reservoirs. In 2011, City Light submitted an application for a non-capacity amendment of the Project license (for construction of a second power tunnel between Gorge Dam and Gorge Powerhouse). As a component of its Biological Opinion, USFWS (2013) analyzed potential effects of entrainment on the Bull Trout populations in Gorge, Diablo, and Ross lakes, which required City Light to report on its observations of acoustically tagged Bull Trout that were either entrained into the Project intakes or passed the dams via spill. In its annual entrainment reports (City Light 2016, 2017, 2018, 2019, 2020a, 2021), City Light provided annual estimates of turbine and spillway entrainment at each Project development from 2015-2020 (Table 4.2.3-43).

Between 2015 and 2020, City Light documented two tagged Bull Trout being entrained at the Diablo Dam intakes (Table 4.2.3-43). Both of these fish survived turbine passage as evidenced by their continued movements (detected via the acoustic tags) following each event. Both of these fish were relatively large, measuring > 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 large Bull Trout can survive passage through the Diablo Powerhouse.

In 2016, 1 of the 11 Bull Trout 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 4.2.3-43).

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 spillway at Ross Dam is rare given the limited number of spill events that occur at this facility. 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 4.2.3-43). No tagged Bull Trout were documented passing over Diablo Dam spillway, although Bull Trout entrainment was estimated via the spill duration method at all three dams to provide the annual entrainment estimates required by USFWS's Biological Opinion (Table 4.2.3-43).

Table 4.2.3-43. Annually reported adult Bull Trout entrainment and estimated passage metrics at Project dams (2015-2020).

Year	Intake Entrainment (Observed via acoustic telemetry)		Spillway Mortality (Calculated with spill duration estimation method)
	Number of Active Tags	Number of Fish Entrained	
Ross Lake			
2015	50	0	5
2016	31	0	0
2017	37	0	0
2018	20	0	0
2019	20	0	0
2020	31	0	3
Total	189	0	8
Diablo Lake			
2015	11	0	4
2016	4	1[1]	6
2017[2]	4	0	52
2018[2]	11	1[1]	54
2019	11	0	17
2020	9	0	14
Total	50	2	147
Gorge Lake			
2015	14	0	2
2016	11	0	6[1]
2017	10	0	4
2018	10	0	5
2019	10	0	0
2020	8	0	3
Total	63	0	20
Grand Total[3]	**302**	**2**	**175**

Source: City Light 2016, 2017, 2018, 2019, 2020a, 2021.
1 Bull Trout entrained into the Diablo intake survived downstream passage.
2 Extended maintenance outages at Diablo powerhouse in 2017 and 2018 (in comparison, average spill at Diablo Dam from 2013-2016 was only 37 days).
3 Authorized take for the Project is 435 Bull Trout from 2013-2025 (USFWS 2013).

Large Wood Management

Effects of existing and any potential changes in project facilities and operation and large woody debris management within reservoirs on aquatic habitat in the reservoirs and Skagit River downstream of Gorge Dam (FERC SD2).

Although not a condition of the current Project license, City Light manages wood in each of the Project reservoirs. Wood that accumulates in the reservoirs requires removal to ensure the function of spillway gates to prevent overtopping or uncontrolled releases, reduce the risk of log damage to Project infrastructure, and limit interactions with boats. Until 2009, wood from Ross Lake was collected and burned along the Skagit River near the U.S.-Canada border. In 2013, City Light initiated a pilot program that included removing wood from Ross Lake and transporting it to the Skagit River below Gorge Dam. Wood extracted from the south end of Ross Lake and from Diablo Lake is transported to the Skagit River Aggregate Storage Facility (Aggregate Ponds) located downstream of the Project along the right bank of the river (≈ 2 mi southwest of Newhalem). Wood collection and transport data (2017-2021) are shown in Table 4.2.3-44. Gorge Dam is equipped with a chute that shunts woody material downstream, where it accumulates in the Gorge bypass reach until City Light spills water at Gorge Dam, at which point the wood is displaced downstream and contributes to recruitment in the lower river.

Wood removed from the reservoirs is prevented from providing shoreline structure within the reservoirs that could provide cover for fish and substrate for BMI (a food source for fish) production. Wood aggregates occasionally occlude tributary mouths in Ross Lake, thereby creating a potential obstacle to fish migration, and wood left in Ross Lake could exacerbate this effect. However, under current conditions, City Light remedies this potential effect by removing wood that could block fish access to tributaries that enter Ross Lake.

As described in Section 4.2.3.1 of this Exhibit E, City Light conducted an evaluation (City Light 2022j) of changes in large wood abundance in the Skagit River mainstem from 1979-2019, which shows that log jam density gradually increased from 1.7 jams per mile to 3.5 jams per mile over the 40-year period. However, the spatial distribution of large wood and log jams upstream of the Sauk River has remained similar on a geomorphic reach scale since 1979. Despite the Project's presence, large wood availability may have increased since the 1970s, potentially due to improvements in the management of federal and state lands.

Table 4.2.3-44. Wood extraction and transport data for Ross and Diablo Lakes, 2017-2021.

	2017	2018	2019	2020	2021
Ross Lake collection					
Collection dates	Jul-Aug 2017	Jul-Aug 2018	No wood collected due to low summer water level	Jul 1-Aug 31, 2020	Jul 21-Aug 10, 2021
Total quantity collected (CY)	1,000 CY	1,200-1,500 CY	N/A	2,500 CY	2,000 CY
Pieces used for log booms or bags	2 or 3	8 or 9	N/A	5	5
Ross Lake extraction					
Dates extracted	Nov-Dec 2017	Nov-Dec 2018	N/A	Nov 2020	Nov 2021
Dates transported to Aggregate Ponds	Jun 2019	Jun 2019[1]	N/A	Nov 10-Dec 14, 2020	Dec 2021
Total quantity for extraction	500 CY	500 CY	N/A	750 CY	500 CY
Percent high-quality large wood[2,3]	0	0	-	30	10
Percent low-quality large wood[3]	5	5	-	10	30
Percent medium woody debris[3]	10	10	-	10	30
Percent small woody debris[3]	85	85	-	50	30
Total # intact rootwads[3]	5	1	-	50	1
Total loads to Aggregate Ponds	40 loads (≈ 350 CY) (≈ 150 CY deteriorated over 2 years)	40 loads (≈ 350 CY) (≈ 150 CY deteriorated over 2 years)	N/A	56 loads (≈ 600 CY[4])	40 loads (≈ 500 CY)
Diablo Lake collection					
Collection dates	None collected in 2017	Sep 2018	None collected in 2019	Jun 2020	None collected in 2021
Bags collected	N/A	N/A	N/A	1 bag	N/A
Total quantity collected (CY)	N/A	70 CY	N/A	200 CY	N/A

	2017	2018	2019	2020	2021
LWD for log booms or bags	N/A	No	N/A	No	N/A
Diablo Lake extraction					
Dates extracted	N/A	Sep 2018	N/A	Jun 2020	None extracted from Diablo Lake
Dates transported to Aggregate Ponds	N/A	Sep 2018	N/A	Jun 1-4, 2020	N/A
Total quantity for extraction	N/A	70 CY	N/A	200 CY	N/A
Percent high-quality large wood	-	2	-	60	0
Percent low-quality large wood	-	12	-	10	0
Percent medium woody debris	-	12	-	20	0
Percent small woody debris	-	75	-	10	0
Total number of intact rootwads	-	0	-	10	0
Total quantity to Aggregate Ponds	N/A	70 CY	N/A	200 CY	N/A
Total quantity of wood from Ross and Diablo lakes placed in the Skagit River at the Aggregate Ponds					
	350 CY	420 CY	N/A	800 CY	500 CY

Source: modified from HDR (2022).

Note: CY = cubic yards; LWD = large woody debris; N/A = not applicable.

1 Wood transported was from earlier year extraction activities.

2 Extracted high quality wood over 12 feet long is cut to fit in dump trucks for transport to Aggregate Ponds.

3 Note that these percentages reflect all collected wood on Ross Lake, not just wood that was extracted. The year 2021 is an exception to this, as 2021 data reflect only the wood extracted from Ross Lake.

4 Although 750 CY were transported to Green Point for extraction, only 600 CY were extracted as 3 logs were used at the Diablo Fuel Dock Mitigation Site.

Sediment Deposition in Project Reservoirs

Effects of existing and any potential changes in project facilities and operation on sediment deposition in project reservoirs and any potential measures to address sedimentation (e.g., dredging) on resident fish species (FERC SD2).

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).[63] While these sediments likely provide productive habitats for fish, BMI, 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.

The interception of coarse sediment by the reservoirs does not appear to be resulting in significant adverse effects on salmonid spawning habitat in the Skagit River between Gorge Powerhouse and the Sauk River, as high-quality spawning gravel is abundant in the river below the Project. Annual spawner and redd surveys show that appropriate-sized substrate is widely available to salmonids (Conner and Pflug 2004), and 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. 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 reach to provide spawning habitat immediately downstream of the Gorge Powerhouse. Landslides and past and current timber harvest in sub-watersheds downstream of Gorge Powerhouse have been documented to increase coarse sediment loads to tributaries entering the Skagit River (Paulson 1997), and existing flow management, which decreases the frequency and magnitude of peak flows, likely retards coarse sediment transport relative to what it would have been under natural conditions (see Skagit River Process Flows, above) (Conner and Pflug 2004; NMFS 2012).

RTE Fish Species

Effects of existing and any potential changes to Project facilities or operations on Chinook Salmon, steelhead, Bull Trout, which are federally listed as threatened, Dolly Varden is proposed for listing (FERC SD2).

Effects of existing and any potential changes to Project facilities and operations on designated critical habitat for Bull Trout, Chinook Salmon, and steelhead (FERC SD2).

Potential Project effects on RTE species are addressed, by topic, in the preceding sections, i.e., Chinook Salmon, steelhead, and Bull Trout (and their designated critical habitat) are primary foci of the analyses that have been and are being conducted by City Light.

[63] Based on results of the GE-04 Geomorphology Study (City Light 2022j), sediment trapping efficiency calculations indicate that 93 percent of the silt and clay particles entering Ross Lake are trapped in that reservoir, whereas greater proportional outflows and smaller impoundment volumes result in lower sediment trapping efficiencies in Diablo and Gorge lakes. About 58 percent of the silt and clay entering Diablo Lake is trapped there, and an insignificant amount of silt and clay is trapped in Gorge Lake.

Effects of Transmission Line Maintenance

Effects of transmission line maintenance activities on fisheries and aquatic habitat in rivers, streams, and floodplains within the transmission line corridor (FERC SD2).

Activities associated with the Project's transmission line can affect aquatic habitats where the transmission line crosses streams. Vehicle access to improved and unimproved roads and trails associated with transmission line ROW has the potential to affect aquatic resources. Use of Project roads can increase soil erosion and, in turn, sediment input to streams. As part of the GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-of-Way Study (Erosion and Geologic Hazards Study) (City Light 2022k), estimated sediment delivery rates were computed for routes associated with the transmission line that are hydrologically connected to waterbodies. Table 4.2.1-14 in Section 4.2.1 of this Exhibit E shows sediment delivery rates for routes associated with eight ROWs associated with the transmission line.

Culverts that are occluded, undersized, hanging, or with excessive slopes can impede the upstream and/or downstream movements of aquatic biota at Project-road crossings and can restrict the downstream movement of coarse sediment and small wood, thereby affecting aquatic habitat quality downstream of the crossing. Armored banks adjacent to culverts can diminish riparian vegetation and habitat complexity at the stream's edge, thereby affecting habitat quality for fish and other aquatic biota. Stream fords, although uncommon on Project related roads, have the potential to increase fine sediment loads and contaminants in tributaries, resulting in effects on aquatic biota, or temporarily displace fish or other aquatic organisms when vehicles cross streams.

The clearing of riparian vegetation associated with transmission line maintenance can influence stream shade and large wood recruitment to streams. Reductions in stream shade can lead to increased water temperatures, and reductions in large wood input to waterways can affect physical habitat and productivity.

Effects of Recreation on Fisheries

Effects of Project recreation use on fisheries resources (e.g., disturbance of spawning redds in streams near Project recreation facilities) (FERC SD2).

There are no demonstrated adverse effects of the Project or Project-related activities on fish populations within or downstream of the Project Boundary, and there are no anticipated actions that would change this situation.

Effects of Noise and Lighting on Fisheries

Effects of Project noise and lighting on fish habitat and resident and anadromous fish populations (FERC SD2).

There are no demonstrated adverse effects of either Project-related light or noise on fish and aquatic resources. Sources of light and noise are minor and localized, and aquatic organisms, fish in particular, have access to large expanses of reservoir habitat. City Light's Lighting Plan and facility upgrades are likely to improve conditions relative to the baseline. If City Light undertakes in-water construction activities, it would implement agency-recommended best management practices to minimize or avoid any short-term impacts due to temporary construction noise or lighting.

4.2.3.3 Existing Resource Measures Proposed to Continue in the New License

Under its current Project license, City Light implements, in cooperation with federal and state agencies, Indian Tribes, and non-governmental organizations, a number of protection, mitigation, and enhancement (PME) measures focused on fish and aquatic resources. These efforts include both flow-related and non-flow related measures, which are briefly described below. City Light proposes to continue implementing many of these measures under the new Project license, along with additional PME measures, which will be further identified in the FLA.

FSA Flow Plan

The current Project license was amended in 2013 to incorporate a Revised FSA Flow Plan (City Light 2011) that includes measures City Light had been implementing voluntarily since 1995 to further reduce Project effects on steelhead and salmon. To enhance salmon and steelhead resources and minimize Project effects downstream of the Project, the FLA will include updates to the flow provisions within the current FSA Flow Plan (City Light 2011). The current FSA Flow Plan's flow measures and ramping rate restrictions are briefly described below.

Salmon Spawning and Redd Protection

To protect spawning salmon and redds downstream of the Project, City Light proposes 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 watered until fry emergence.

Salmon Fry Protection

To minimize and mitigate for potential Project effects on fry stranding, City Light proposes to (1) limit daily down-ramp amplitude; (2) maintain minimum flows throughout the salmon fry protection period that are adequate to cover gravel bar areas commonly inhabited by salmon fry; and (3) limit down-ramping to nighttime hours except during periods of high flow.

Steelhead Spawning and Redd Protection

City Light proposes to implement measures to protect spawning steelhead and redds downstream of the Project, including (1) limiting maximum flow levels during spawning; (2) shaping daily flows for uniformity over the extended spawning period; and (3) maintaining minimum flows through the incubation period that are sufficient to keep redds covered until fry emergence. 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 (1) limiting daily down-ramp amplitudes and rates and (2) maintaining minimum flows to cover gravel bar areas commonly inhabited by steelhead fry. City Light proposes to continue implementing these measures.

Steelhead and Chinook Salmon Yearling Protection

City Light proposes to continue limiting down-ramp rates to protect steelhead and Chinook Salmon yearlings.

City Light anticipates the updated flow plan will consider additional flood risk management measures, recreation and an adaptive management program to periodically evaluate flows using structured decision-making. Additional details will be provided in the FLA.

Early Action Measure: Short-Term Anadromous Fish Flow Plan

To continue to enhance salmon and steelhead resources and minimize Project effects downstream of the Project, City Light proposes to develop a short-term flow plan in consultation with the FCC to implement specific flow operations that may be needed to protect salmon and steelhead during the interim period prior to the issuance of the new license. City Light anticipates integrating effective measures into the Anadromous Fish Flow Plan in the new license.

Rainbow Trout Broodstock Program (Diablo Lake and Gorge Lake Stocking)

City Light currently funds the native Rainbow Trout broodstock program, involving collection of fish from Ross Lake to produce hatchery fish to supplement the Gorge Lake and Diablo Lake Rainbow Trout fisheries. Starting in 2010, an updated production target was agreed upon by City Light, NPS, and WDFW: (1) annually produce 265,000 Rainbow Trout fry (1,200/pound [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 in Gorge (20,000) and Diablo (75,000) lakes, and (3) maintain the broodstock necessary to support the program.

To continue to enhance recreational fishing opportunities at Diablo Lake and Gorge Lake, City Light proposes to continue funding the native Rainbow Trout broodstock program, which involves collection of fish from Ross Lake to produce hatchery fish to supplement the Gorge Lake and Diablo Lake Rainbow Trout fisheries. Additional details will be provided in the FLA.

Reservoir Tributary Barrier Removal Program

City Light currently removes potential upstream fish migration barriers at the mouths of Ross Lake tributaries. 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 minimum and maximum reservoir elevations. Barrier identification is coordinated annually with NPS and WDFW. When a barrier is identified, City Light takes photos before and after its removal and reports this information to the FCC/NCC.

To continue to protect fisheries resources within Ross Lake, City Light proposes to continue removing potential upstream fish migration barriers at the mouths of Ross Lake tributaries. Additional details will be provided in the FLA.

Reservoir Fish Stranding and Trapping Program

Although not a requirement of the current Project license, City Light conducts stranding and trapping surveys in Gorge Lake if the reservoir's WSE is drawn down below 873.51 feet NAVD 88 (867 feet CoSD). City Light proposes to continue implementing this measure under the new Project license.

To minimize risks of stranding and trapping of fish in Project reservoirs, City Light proposes to develop a Reservoir Fish Stranding and Trapping Program to prevent and minimize the potential for negative impacts of Project operational and maintenance activities on fisheries resources due to stranding and trapping in Ross, Diablo, and Gorge lakes. The program's objectives are to minimize stranding and trapping risk in Project reservoirs by monitoring problem water surface elevations associated with seasonally-identified stranding or trapping risk while minimizing impacts on Project operations. The objectives will be achieved through identified surveillance triggers and monitoring information that will support the development of future adaptive management actions to reduce risk (e.g., implementation of habitat modification measures). Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

4.2.3.4 New Resource Measures

Fish Passage at Gorge Dam

NMFS, USFWS, the Treaty Tribes and others are evaluating as part of the ongoing relicensing whether fish passage should be included within the new license. This evaluation may include consideration of whether fish passage may meaningfully assist in bringing Skagit basin fish populations to healthy, harvestable, and sustainable levels in the Skagit River watershed without negatively impacting native Skagit basin fish populations and the Skagit River watershed ecosystem.

City Light anticipates implementing a Gorge Dam Fish Passage Program if a decision is made to proceed with fish passage at Gorge Dam. This program will be developed in consultation with NMFS, USFWS, Treaty Tribes and other LPs and will include a plan for safe, timely, and effective upstream and downstream fish passage at Gorge Dam. Upon FERC approval, City Light will implement this program.

City Light anticipates further dialogue with the LPs regarding fish passage at the Project, and such dialogue will be informed by the results of the FA-04 Fish Passage Technical Study, the FA-06 Reservoir Native Fish Genetics Baseline Study, the FA-07 Reservoir Tributary Habitat Assessment, relevant Agency guidance (e.g., Anderson et al. 2014, McClure et al. 2018), and other information as deemed appropriate. Additional details are being developed and will be provided in the FLA.

Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan

To enhance aquatic habitat downstream of the Project, City Light proposes to develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan that will include measures to address Limiting Factors and to enhance and improve the availability of mainstem, off-channel and side-channel habitats throughout the Skagit River downstream of the Gorge Powerhouse. The plan may include but not be limited to: (1) release of process flows; (2) restoration of existing off-channel habitat; (3) wood augmentation; (4) sediment augmentation; and (5) monitoring. If Project modifications have potential to create environmental impacts or adversely affect historic properties, environmental and the National Historic Preservation Act Section 106 review and consultation would be completed as required. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Aquatic Invasive Species Management Plan

To prevent the introduction of invasive species into the Project reservoirs and to detect aquatic invasive species presence (should one or more AIS be inadvertently introduced into the area within the Project Boundary), City Light proposes to develop an AIS Management Plan that will include measures aimed at reducing the impact of any AIS that may be introduced. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

4.2.3.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to fish and aquatic resources have been identified at this time.

4.2.4 Botanical Resources

4.2.4.1 Affected Environment

This section describes botanical resources in and near the Project Boundary. Botanical resources include: (1) plant communities (vegetation cover types); (2) wetlands, which were assessed for functions and values; (3) Endangered Species Act (ESA)-listed and other rare, threatened, and endangered (RTE) plant species; (4) plant species considered important because of their commercial, recreational, or cultural value to Indian Tribes and Canadian First Nations; and (5) non-native, invasive plants or "noxious weeds."

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, City Light has engaged with Indian Tribes and Canadian First Nations regarding botanical resources to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While botanical resources are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in botanical resources as, or related to, tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Information provided in this section was summarized from databases, reports, and maps, as well as supporting literature. Additionally, in support of relicensing the Project, Seattle City Light (City Light) conducted the following studies: (1) TR-01 Vegetation Mapping Study; (2) TR-02 Wetland Assessment; (3) TR-03 Rare, Threatened and Endangered Plants Study (RTE Plants Study); and (4) TR-04 Invasive Plants Study. The scope, objectives, study areas, methods, and results of all four studies are detailed in the Revised Study Plan (RSP) filed with the Federal Energy Regulatory Commission (FERC or Commission) on April 7, 2021 and approved by FERC in its Study Plan Determination Letter dated July 16, 2021, and the draft reports for each study (City Light 2022a, City Light 2022b, City Light 2022c, City Light 2022d). The results of these studies are summarized in this section.

Relicensing study areas were based on the objectives for each study. All four botanical resources study areas include the land within the Project Boundary. Additionally, sections of the Skagit River outside of the Project Boundary were included for some studies: the TR-01 Vegetation Mapping Study and TR-02 Wetland Assessment study areas include the channel migration zone (CMZ) from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers; and the TR-04 Invasive Plants Study includes the banks of the Skagit River from Gorge Dam to the confluence with the Sauk River. The Vegetation Mapping Study also includes a 0.5-mile buffer around the Project Boundary. Some non-public roads and trails outside the Project Boundary that City Light uses to access the transmission line right-of-way (ROW) and other City Light facilities that support Project operations that are inside or outside of the Project Boundary are also included.

To organize results of the relicensing studies, study areas for three of the four botanical studies (TR-01 Vegetation Mapping Study, TR-02 Wetland Assessment, and TR-04 Invasive Plants Study; the TR-03 RTE Plants Study has minimal results) are divided into segments based solely on geography. Specific descriptions of segments for each study (study areas for each study differ slightly) are detailed in draft study reports (TR-01 Vegetation Mapping Study Draft Report [City Light 2022a], TR-02 Wetland Assessment Draft Report [City Light 2022b], TR-04 Invasive Plants Study Interim Report [City Light 2022c]). The study area segments and sub-segments are as follows:

- Segment 1: Ross Lake National Recreation Area (RLNRA)
    - Sub-segment 1A: Ross Lake (excluding Big Beaver Valley) starts at the U.S.-Canada border and extends to Ross Dam, excluding area within the FERC Project Boundary in Big Beaver Valley.
    - Sub-segment 1B: Big Beaver Valley
    - Sub-segment 1C: Diablo Lake, including the approximately 3.6 miles of transmission line ROW from the Ross Powerhouse to the Diablo Powerhouse
    - Sub-segment 1D: Gorge Lake including the approximately 3.5 miles of transmission line ROW from the Diablo Powerhouse to the southern end of Gorge Lake
    - Sub-segment 1E: Gorge Lake to Bacon Creek, which includes the corridor between Gorge Lake and Bacon Creek that includes approximately 8.5 miles of transmission line ROW and the Skagit River
- Transmission Line ROW Segments
    - Segment 2: Bacon Creek to Sauk River Crossing
    - Segment 3: Sauk River Crossing to Oso
    - Segment 4: Oso to State Route (SR) 528
    - Segment 5: SR 528 to Bothell Substation
- Segment 6: Fish and Wildlife Mitigation Lands
- Segment 7: Skagit River - Gorge Powerhouse to Sauk River (included in TR-04 Invasive Plants Study only)

Vegetation Mapping

In 2020 and 2021, City Light conducted the TR-01 Vegetation Mapping Study to describe and map vegetation by using existing data, remote sensing methods, and models to identify and map vegetation composition and overstory structure within the study area. Vegetation was mapped to the "Group" level using the U. S. National Vegetation Classification (USNVC) Standard.[64] The Group level is defined as a combination of relatively narrow sets of diagnostic plant species (including dominants and co-dominants) with broadly similar composition and diagnostic growth forms reflecting biogeographic differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes. For highly modified areas such as the transmission line ROW, a custom set of cover types was used during mapping based on field observations and aerial photograph interpretation. The study area for the TR-01 Vegetation Mapping Study is approximately 145,400 acres and consists of land within the Project Boundary, as well as the area within 0.5 miles of the Project Boundary, and the channel migration zone from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers (Figures 4.2.4-1 through 4.2.4-3).

[64] For more information on the USNVC Standard and categories see: https://usnvc.org/about/plant-communities-and-vegetation-classification/natural-vegetation-classification/

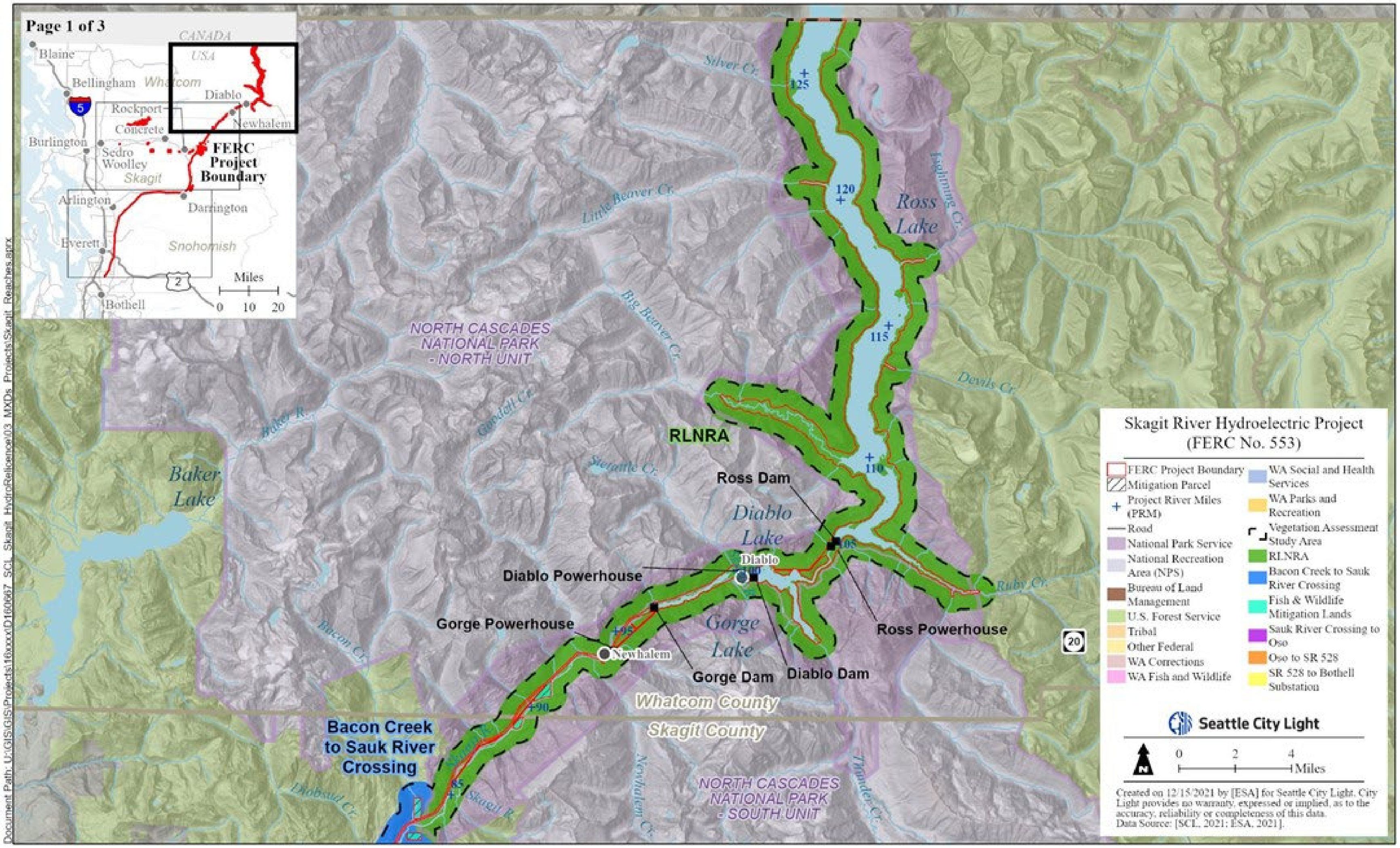


Figure 4.2.4-1. Study area segments for the Vegetation Mapping Study (north).

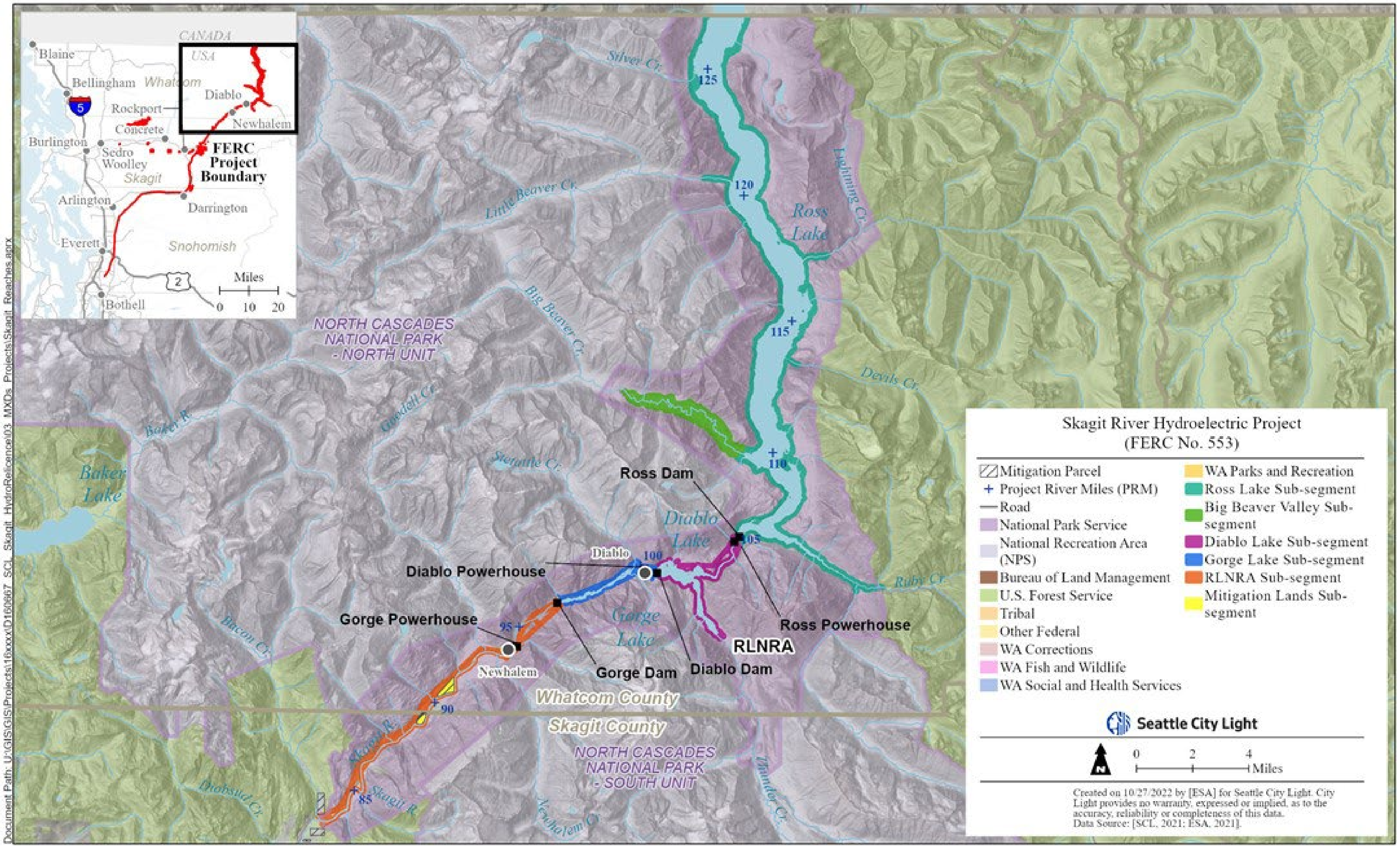


Figure 4.2.4-1a. Study area sub-segments for the RLNRA segment.

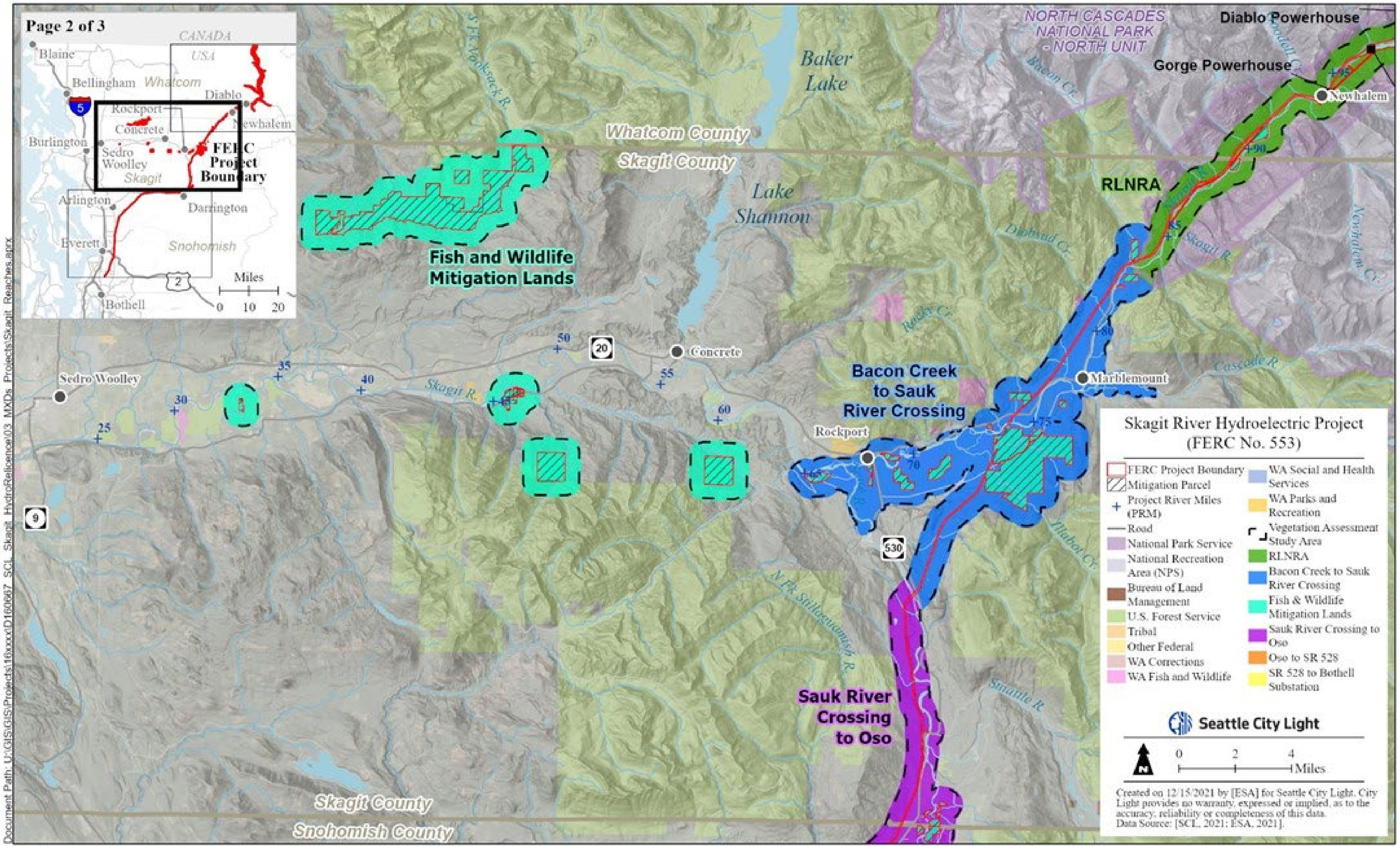


Figure 4.2.4-2. Study area segments for the Vegetation Mapping Study (central). Note: expanded canopy metrics modeling area is included.

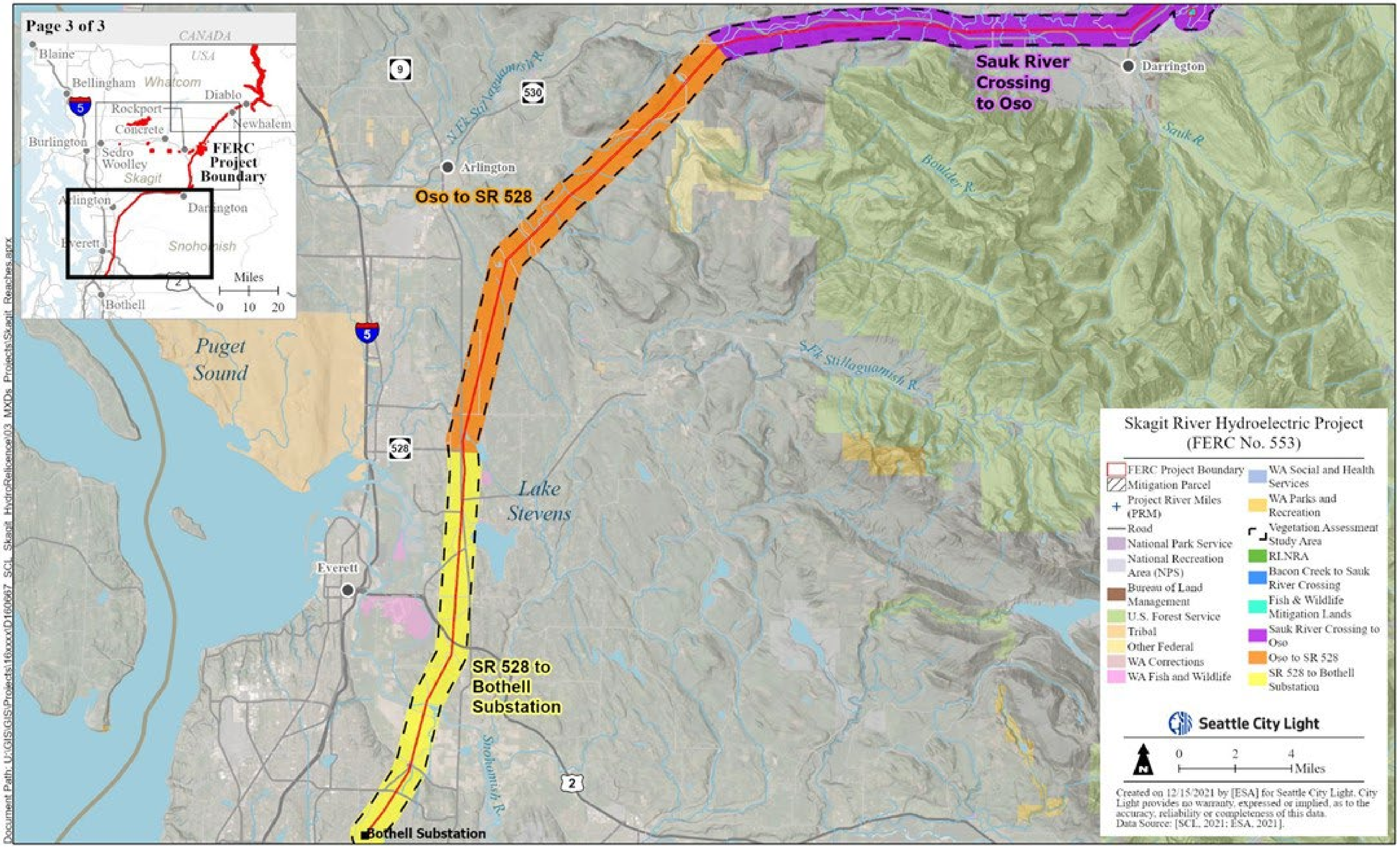


Figure 4.2.4-3. Study area segments for the Vegetation Mapping Study (south).

Most of the Project Boundary lies within the Western Hemlock Zone and Pacific Silver Fir Zone of the Northern Cascades Physiographic Province, except for the south end of the transmission line ROW, which is within 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; National Park Service [NPS] 2019). 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. Parts of the transmission line ROW traverse industrial forest lands, agricultural areas, and residential properties.

A total of 35 unique vegetation cover types were mapped in the study area (Table 4.2.4-1). The Upland Forest Group Types North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240; 54,007 total acres) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237; 22,990 total acres) were the most abundant cover types within the study area. The vegetation maps for the Project are included as Attachment B of the TR-01 Vegetation Mapping Study Draft Report (City Light 2022a). Tree heights are summarized into 5 canopy height ranges based on the mean canopy height of the mapped vegetation polygons: < 25.0 feet, 25.1-40.0 feet, 40.1-60.0 feet, 60.1-90.1 feet, and > 90 feet.

Table 4.2.4-1. Mapped cover type descriptions.

Group Type	Description
USNVC Upland Forest and Shrubland Groups	
G210 – Central Rocky Mountain Douglas-fir – Pine Forest	Montane coniferous forests found in the interior Pacific Northwest; most occurrences of this group are dominated by a mix of Douglas-fir, lodgepole pine, and ponderosa pine, but ponderosa pine can be absent. Other typically seral species have increased on many sites once dominated by Douglas-fir and ponderosa pine. Generally, floristic affinities are with areas of maritime-influenced climate of the interior Pacific Northwest.
G219 – Rocky Mountain Subalpine Dry-Mesic Spruce – Fir Forest & Woodland	This group consists of matrix forests of the drier sites within the subalpine zone of the Cascades and Rocky Mountains with Engelmann spruce (*Picea engelmannii)* and subalpine fir (*Abies lasiocarpa)* dominating either mixed or alone. These forests often represent the highest elevation forests in an area, and the relatively xeric understory species are diagnostic.
G237 – North Pacific Red Alder –- Bigleaf Maple – Douglas-fir Rainforest Group	Lowland hardwood or mixed-hardwood-conifer forest group dominated by red alder (*Alnus rubra*) or bigleaf maple (*Acer macrophyllum*). Common companion species observed through the study area include conifers such as Douglas-fir, western redcedar, and/or western hemlock and hardwood species including cascara (*Frangula purshiana*) and bitter cherry (*Prunus emarginata*).
G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group	Mesic to dry lowland forests dominated by Douglas-fir. Other coniferous species may be present, primarily western redcedar and/or western hemlock. Deciduous species such as red alder and/or bigleaf maple are frequently observed in the subcanopy, but never dominant species.

Group Type	Description
G241 – North-Central Pacific Maritime Silver Fir – Western Hemlock Rainforest	Lower and montane regions of the central Pacific Northwest rainforest region, primarily west of the Cascade Crest. Western hemlock and/or Pacific silver fir (*Abies amabilis)* dominate the canopy of late seral stands, and Alaskan yellow-cedar (*Callitropsis nootkatensis)* can be codominant, especially at higher elevations or moister sites. Western redcedar is also common. In drier settings, Douglas-fir is usually also common.
G305 – Central Rocky Mountain – North Pacific High Montane Mesic Shrubland	This shrubland group is found within the zone of continuous forest in the upper montane and subalpine zones and is composed of a diverse mix of deciduous shrubs. Vegetation is mostly deciduous broadleaf shrubs, sometimes mixed with shrub-statured trees or sparse evergreen needleleaf trees and quaking aspen (*Populus tremuloides)*. Stands are typically initiated by fires.
G318 – North Vancouverian Montane Bedrock, Cliff & Talus Vegetation	This group consists of sparsely vegetated rock outcrops and cliff faces where fractures in the rock surface and colluvial slopes may be occupied by small patches of dense vegetation, typically scattered trees and/or shrubs. Scattered shrubs may be present. Soil development is limited as is herbaceous cover.
G488 – Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie	The vegetation is grassland with some dwarf-shrubs that can occur as small patches but are usually in a matrix with the herbaceous vegetation. Bunchgrasses often dominate. Dwarf-shrub species are imbedded in the herbaceous cover.
G648 – Southern Vancouverian Lowland Ruderal Grassland & Shrubland	This group is dominated by non-native invasive shrubs, such as Scot's broom (*Cytisus scoparius*)*,* Himalayan blackberry (*Rubus bifrons*), and common gorse (*Ulex europaeus*), as well as non-native grasses. It is abundant in waste areas and disturbed land throughout Pacific coastal areas either as abandoned pastures, roadside margins, or other weedy places, below approximately 1,500 m (5,000 feet) in elevation.
G849 – North-Central Pacific Mountain Hemlock – Silver Fir Woodland	This forested group occurs throughout the mountains of the North Pacific and is dominated mostly by mountain hemlock (*Tsuga mertensiana*), but other species can be codominant, including Pacific silver fir, subalpine fir, yellow cypress, and/or western hemlock.
Riparian & Wetland USNVC Group Types	
G322 – Vancouverian Wet Shrubland	This wetland group is dominated by shrub species that are adapted to seasonally wet to saturated soils. Common dominant species observed throughout the study area were willows (*Salix* spp.), hardhack (*Spirea douglasii*), and salmonberry (*Rubus spectabilis*).
G517 – Vancouverian Freshwater Wet Meadow & Marsh Group	Freshwater herbaceous and shrubby wetlands dominated by a wide variety of graminoids and forbs, usually along freshwater ponds or wet meadows. Dominated by native sedges and rushes such as slough sedge (*Carex obnupta*) and soft rush (*Juncus effusus*). Shrubs are primarily willows.
G520 – Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow, and Dwarf-shrubland	High-elevation upper subalpine to alpine (1,500-3,600 meters [m]) communities dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. Occur as large meadows in subalpine valleys, as narrow strips bordering ponds, lakes, and streams, and along toe-slope seeps. They are dominated by graminoids or forbs.
G521 – Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Wet meadows found in low and high montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1,000-3,600 m). They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toe-slope seeps

Group Type	Description
G524 – Western North American Ruderal Wet Shrubland, Meadow, and Marsh	Disturbed wet meadows found in lowland, montane, and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (sea level to 3,600 m) throughout the western U.S. Vegetation is dominated by non-native grasses including reed canarygrass *(Phalaris arundinacea*), and various weedy forbs. Native species may be present but are low in abundance.
G527 – Western Montane-Subalpine Riparian & Seep Shrubland	Montane to subalpine riparian shrublands ranging from short to tall (0.5-15 m) that occur in steep and narrow to wide, low-gradient valley bottoms and floodplains as well as steep, moist avalanche chutes, often associated with beaver activity. Various shrub species may be dominant.
G851 – North Pacific Lowland Riparian Forest & Woodland Group	Low-elevation linear forests found in riparian areas and alluvial floodplains dominated by red alder, black cottonwood (*Populus balsamifera*), and bigleaf maple. Some conifers are also observed, primarily western redcedar. It occurs at elevations ranging from 300 to 2,300 m (1,000-7,500 feet).
G853 – North Pacific Maritime Hardwood-Conifer Swamp	Forested wetlands occurring in poorly drained areas dominated by tree species that grow on saturated or seasonally flooded soils. Cover can be conifer- or hardwood-dominated stands. Dominant species observed in the study area included western redcedar and red alder.
USNVC Cultural Groups	
CGR022 – Cultivated Pasture & Hay Grass Cultural	Arable land specifically modified to grow pasture and hay.
CGR033 – Cool-Season Lawn	Lawn and recreation grasslands dominated by cool-season grasses.
CGR038 – Tree Garden Cultural	Horticultural garden vegetation dominated by trees.
USNVC Modified Cover Types	
CGR – MOD – Cultivated Row Crops	Arable land specifically modified to grow crops for harvesting. Includes all agricultural areas outside of those used for pasture/hay.
Transmission Line ROW Cover Types	
Regenerating Conifer/Native Shrub (conifer dominant)	Mix of coniferous tree species and native shrub species where conifers make up > 50 percent cover.
Invasive Shrub	Invasive shrubs make up > 50 percent cover.
Invasive Shrub/Native Shrub/Forb (invasive shrub cover dominant)	Mix of invasive shrubs, native shrubs, and forbs combine to make up 60 percent of cover.
Mixed Grass/Forb/Invasive Shrub	Mix of grasses, native forbs, and invasive shrubs combine to make up 60 percent of cover.
Mixed Native Shrub/Tree/Forb (co-dominants)	Mix of native shrub, native coniferous and/or deciduous trees, and native forbs combine to make up 60 percent of cover.
Mixed Native Shrub-Regenerating Tree/Invasive Shrub (native shrub cover dominant)	Mix of native shrubs, trees, and invasive shrubs. Native shrubs and trees combine to make up 60 percent of cover.
Native Deciduous Shrub/Regenerating Tree	Mix of native deciduous shrubs and trees combine to make up 60 percent of cover.
Native Shrub/Regenerating Conifer (native shrub dominant)	Mix of native shrub and conifers combine to make up 60 percent of cover.
Other Vegetated Cover Types	
Grass-dominated	Natural or regrown areas of grass, lawn, or pasture.
Recently Burned	Forested areas recently burned by wildfire.

Group Type	Description
Non-Vegetated Cover Types (Categories Defined by Washington Department of Fish and Wildlife [WDFW])	
Developed (built roads/structures)	Impervious surfaces and compacted dirt and/or gravel.
Gravel (water)	Unvegetated gravel bars below the ordinary high water mark of river and stream channels.
Open & Flowing Water	Includes open water such as ponds and lakes as well as flowing water in streams channels.

Table 4.2.4-2. Summary of botanical environment by Study Area Segment.

Study Area Segment or Sub-Segment	Summary of Botanical Environment	Common Species within Transmission Line ROW
1: RLNRA	Douglas-fir is the dominant species, with western redcedar and/or western hemlock around reservoirs; dominant vegetation transitions to red alder and bigleaf maple between Gorge Lake to Bacon Creek. Subcanopy trees are predominantly red alder and/or bigleaf maple.	Douglas-fir, red alder, bigleaf maple, vine maple, thimbleberry, salal, bracken fern, and sword fern.
2: Bacon Creek to Sauk R. Crossing	At lower elevations along mainstem Skagit River, the dominant species is red alder, bigleaf maple, and Douglas-fir. At higher elevations within the CMZ and in the outer edges of the valley the dominant species transitions to Douglas-fir, western redcedar, and western hemlock. Subcanopy trees are predominantly red alder and/or bigleaf maple.	Red alder, salal, and bracken fern; Scot's broom and Himalayan blackberry
3: Sauk R. Crossing to Oso	On forested slopes west of the Sauk River and south of the North Fork Stillaguamish River, the dominant species is Douglas-fir. At lower elevations along the Sauk and NF Stillaguamish rivers, dominant species are red alder and bigleaf maple. Subcanopy trees are predominantly red alder and bigleaf maple.	Scot's broom, native salal, and bracken fern; in areas with farmland: reed canarygrass and Himalayan blackberry
4: Oso to SR 528	North of the SF Stillaguamish River, Douglas-fir is dominant; lower elevation areas associated with riparian and wetland areas are dominated by red alder and bigleaf maple. South of the SF Stillaguamish River, rural and residential land use dominates with farmland, roads, and cleared land separating red alder and bigleaf maple forests.	Majority of segment is mixed grasses and native shrubs with some invasive shrub cover, primarily Himalayan blackberry; salal, bracken fern, and bigleaf maple are co-dominants in areas.
5: SR 528 to Bothell Substation	Highly developed and primarily residential. Large parcels of farmland in Snohomish River valley, south of river includes dense residential developments.	Mostly invasive species, primarily Himalayan blackberry.
6: Fish and Wildlife Mitigation Lands	Mitigation lands on forested slopes are dominated by Douglas-fir with bigleaf maple and red alder in the subcanopy. Mitigation lands located along rivers are dominated by red alder and bigleaf maple.	n/a

The discussion below describes the mapped vegetation types within each of the six study segments. Each study area segment discussion includes a description of the segment, including any sub-segments or mitigation lands, a description of the most common vegetation cover types, and a general discussion of cover and tree height.

Segment 1: RLNRA

The RLNRA study area segment (Segment 1) occurs within the upper Skagit River basin and includes all lands of the Project Boundary that lie within the RLNRA, including the transmission line ROW near the confluence of Bacon Creek and the Skagit River, excluding fish and wildlife mitigation lands (i.e., the Newhalem Ponds and County Line Ponds parcels).

Segment 1 includes approximately 38,583 acres of mapped vegetation cover types in the study area (6,214 acres within the Project Boundary) and runs about 44 river miles from the Canadian border to Bacon Creek. Within this segment, there are 295 acres of developed and 12,654 acres of open water mapped cover types. Land ownership in this segment includes National Park Service, Seattle City Light, and U.S. Forest Service (USFS). Within the RLNRA segment there are three reservoirs (Ross, Diablo, and Gorge lakes), 15.6 miles of transmission line ROW, Project facilities (including dams, powerhouses, penstocks, surge tanks, boathouses/docks/landings), and the Diablo and Newhalem townsites. Approximately 4,671 acres of the RLNRA segment study area have recently burned from wildfires from 2003 to 2021. More details on the specifics for each sub-segment can be found in the TR-01 Vegetation Mapping Study Draft Report (City Light 2022a).

A diverse mixture of vegetation types was mapped within the RLNRA segment, including six Upland Forest and Woodland Types, two Upland Shrub-dominated Types, six Wetland and Riparian Types, and an additional three Other Types. The most dominant vegetation type was the North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) with 22,490 acres mapped in the RLNRA segment (58.3 percent) and 3,438 within the Project Boundary. Other common types were North Pacific Red Alder –- Bigleaf Maple – Douglas-fir Rainforest Group (G237) with 5,485 acres (14.2 percent) mapped in the RLNRA segment, including 827 acres in the Project Boundary; and Central Rocky Mountain Douglas-fir – Pine Forest (G210) with 4,553 acres (11.8 percent) mapped in the study area, including 489 acres in the Project Boundary. Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie (G488) was the most common Shrubland Type in this study area segment, with 1,154 acres (3.0 percent) in the study area (122 acres in the Project Boundary), while the most common Wetland Type is North Pacific Lowland Riparian Forest & Woodland Group (G851) with 1,020 acres (2.6 percent) in the study area (406 acres in the Project Boundary). There were also 1,057 acres (2.7 percent) mapped of North Vancouverian Montane Bedrock, Cliff & Talus Vegetation (G318), including 206 acres in the Project Boundary.

The summary table (Table 4.2.4-3) shows each of the different vegetation types by sub-segment but does not include vegetation within the transmission line ROW, which cannot be mapped according to Group and was instead mapped by structural categories. Brief descriptions of the vegetation in each subsection are provided below.

Table 4.2.4-3. Acreage of mapped vegetation cover types within the RLNRA study area segment.[1,2]

Sub-segment	Acreage of Mapped Cover Types[4]																	
	G210	**G219**	**G237**	**G240**	**G241**	**G305**	**G318**	**G322**	**G488**	**G517**	**G520**	**G521**	**G527**	**G849**	**G851**	**CGR033**	**CGR038**	**Grand Total**
1A: Ross Lake (excl. Big Beaver Valley)	3,065 (356)	3 (0)	2,273 (535)	16,187 (2,488)	401 (0)	3 (0)	653 (138)	210 (13)	904 (86)	53 (49)	2 (0)	2 (1)	62 (3)	843 (117)	71 (41)	0 (0)	0 (0)	**24,732 (3,827)**
1B: Big Beaver Valley[3]	9 (9)	0 (0)	10 (10)	589 (589)	1 (1)	0 (0)	8 (8)	189 (189)	3 (3)	89 (89)	0 (0)	0 (0)	2 (2)	83 (83)	218 (218)	0 (0)	0 (0)	**1,201 (1,201)**
1C: Diablo Lake	810 (65)	0 (0)	348 (15)	2,486 (215)	54 (2)	0 (0)	115 (27)	18 (2)	156 (18)	12 (9)	0 (0)	0 (0)	20 (0)	221 (51)	99 (69)	5 (5)	0 (0)	**4,344 (478)**
1D: Gorge Lake	532 (48)	0 (0)	146 (45)	1,181 (104)	30 (7)	0 (0)	144 (19)	27 (0)	73 (13)	2 (2)	0 (0)	0 (0)	8 (1)	163 (29)	42 (27)	21 (21)	0 (0)	**2,369 (316)**
1E: Gorge Lake to Bacon Creek	137 (11)	0 (0)	2,708 (222)	2,047 (42)	115 (0)	0 (0)	137 (14)	10 (0)	18 (2)	5 (2)	0 (0)	0 (0)	2 (0)	149 (16)	590 (51)	17 (30)	2 (2)	**5,937 (392)**
Total	**4,553 (489)**	**3 (0)**	**5,485 (827)**	**22,490 (3,438)**	**601 (10)**	**3 (0)**	**1,057 (206)**	**454 (204)**	**1,154 (122)**	**161 (151)**	**2 (0)**	**2 (1)**	**94 (6)**	**1,459 (296)**	**1,020 (406)**	**56 (56)**	**2 (2)**	**38,583 (6,214)**

1 Primary values reported in this table do not include acreages within the transmission line.
2 Values in parentheses are acres within the FERC Project Boundary.
3 Acreages for the 1B Big Beaver Valley sub-segment only include the area within the FERC Project Boundary. The study area outside of the FERC Project Boundary surrounding Big Beaver Valley is captured in the 1A Ross Lake sub-segment acreages.
4 Table 4.2.4-1 contains an explanation of cover type codes.

Sub-segment 1A: Ross Lake (excluding Big Beaver Valley)

The Ross Lake sub-segment (1A) includes 24,732 acres of mapped vegetation cover types surrounding Ross Lake and represents approximately 64 percent of the RLNRA segment. Within this sub-segment, three areas have recently burned from wildfires including the 2015 Thursday Creek Fire (408 acres), the 2015 Cat Island Fire (113 acres), and the 2003 Big Beaver Fire (790 acres); 35 total acres were burned within the Project Boundary in sub-segment 1A. There are 59 acres of mapped developed cover type, and 11,493 acres of mapped open water.

The North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) dominates the uplands around Ross Lake and represents 65.4 percent of the vegetation in the sub-segment. The second most common vegetation type, Central Rocky Mountain Douglas-fir – Pine Forest (G210), occurs on both sides of the lake with the largest patches at higher elevations. Pockets of North Pacific Red Alder –- Bigleaf Maple – Douglas-fir Rainforest Group (G237), in the segment (9.2 percent), are largely concentrated on the east side of the lake, except for an area near several unnamed drainages to the west, south of Skymo Creek. Central Rocky Mountain Douglas-fir – Pine Forest (G210) occurs on both sides of the lake but the largest patches are at higher elevations. Similarly, Southern Vancouverian Shrub & Herbaceous Bald, Bluff, & Prairie (G488), the most common shrub-dominated group in RLNRA, occurs mostly at higher elevations in steep gradient areas

Less common are wetland or riparian cover types around Ross Lake. These include North Pacific Lowland Riparian Forest (G851) and Vancouverian Freshwater Wet Meadow and Marsh (G517). Both these cover types contain lacustrine fringe wetlands, a type of wetland that occurs adjacent to lakes where the water elevation of the lake determines the water table of the wetland and is therefore strongly influenced by water-level fluctuations (Environmental Protection Agency [EPA] 2002). Vancouverian Wet Shrubland (G322) represents the largest area of wetland or riparian habitat around Ross Lake and also occurs in narrow bands along tributaries.

In general, the Ross Lake area exhibits mixtures of trees between 40 to 60 feet and 60 to 90 feet in height. The largest concentration of trees taller than 90 feet is located on the east side of Ross Lake between May Creek and Hidden Hand Creek and is associated with the G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group cover type. Additional concentrations of tall trees are within the Ruby Arm corridor and at the northern extent of the study area along both the west and east sides of the lake near the Canadian border; all areas are dominated by G240 – North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group cover.

Sub-segment 1B: Big Beaver Valley

The Big Beaver Valley sub-segment 1B represents approximately 3 percent of the RLNRA segment. Acreages for the 1B Big Beaver Valley sub-segment only include the area within the FERC Project Boundary. The study area outside of the FERC Project Boundary surrounding Big Beaver Valley is captured in the 1A Ross Lake sub-segment acreage. Sub-segment 1B is on the west side of Ross Lake and includes the area surrounding Big Beaver Creek from its confluence with Ross Lake to about 8 miles upstream. Sub-segment 1B is entirely on lands administered by NPS. Big Beaver Creek is a large tributary to Ross Lake and flows through a relatively wide floodplain with numerous beaver dam complexes. Big Beaver Creek and associated ponds make up approximately 90 acres of mapped open water in this sub-segment. The Big Beaver Fire recently burned 80 acres within the FERC Project Boundary of sub-segment 1B.

Vegetation in most of the Big Beaver Valley sub-segment (41.3 percent) consists of a combination of several wetland and riparian cover types. These include Vancouverian Freshwater Wet Meadow and Marsh (G517), which primarily coincides with open water or emergent wetlands; Vancouverian Wet Shrubland (G322), which generally covers shrub-dominated wetlands located along the outer boundaries of emergent wetlands in the valley, as well as the riparian areas of several contributing streams to Big Beaver Creek; and North Pacific Lowland Riparian Forest and Woodland Group (G851), which encompasses most forested riparian areas along the creek. Upland areas are mostly North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240); this type represents 20.0 percent of the Big Beaver Valley segment.

Trees taller than 90 feet within the Big Beaver Valley are associated with North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover and are concentrated along the edges of the valley as well as along the narrow channel near the confluence of Big Beaver Creek with Ross Lake. In some areas, these tall trees continue up to higher elevations, but generally, at higher elevations within this sub-segment, G240 cover consists of trees at heights of 40 to 60 feet and 60 to 90 feet. Trees at these higher elevations are mapped as G210 and are generally 25 to 40 feet. Trees near the burned area are less than or equal to 25 feet because they are currently in an early stage of re-growth.

Sub-segment 1C: Diablo Lake

The Diablo Lake sub-segment (1C) encompasses the area surrounding Diablo Lake, which is approximately 11 percent of the RLNRA segment. Sub-segment 1C extends from Ross Dam to Diablo Dam and includes lands administered by NPS and owned by City Light. There are approximately 3.6 miles of transmission line ROW in this sub-segment from the Ross Powerhouse to the Diablo Powerhouse; there are 778 acres of mapped open water and 40 acres of developed cover type, including SR 20 and the Environmental Learning Center (ELC).

Similar to the 1A Ross Lake sub-segment, vegetation surrounding Diablo Lake is dominated by North Pacific Maritime Douglas-fir – Western Hemlock Forest (57.2 percent, G240). However, Central Rocky Mountain Douglas-fir – Pine Forest (18.6 percent, G210) is more prevalent in this area than around Ross Lake and is primarily located along Thunder Knob, north of the lake near the transmission line ROW, and at higher elevations near Diablo townsite. North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest G237 is generally concentrated along forested areas north of the lake. North Pacific Lowland Riparian Forest and Woodland Group (G851) occurs along several drainages; the largest patch is at the outlet of Thunder Creek

Approximately 76 acres of vegetation occur within the transmission line ROW of this sub-segment. The northern portions of the transmission line ROW have a mix of native shrubs, trees, and forbs, where vegetation types are co-dominant. Common species include Douglas-fir, vine maple (*Acer circinatum*), and salal (*Gaultheria shallon*). The remainder of vegetation within the transmission line ROW in this sub-segment is a mixture of conifers and native shrubs with Douglas-fir dominating.

Trees taller than 90 feet dominate the area north of the lake. Trees taller than 90 feet also occur near the outlet of Thunder Creek and along much of the area upslope of SR 20. Smaller trees (less than 60 feet in height) that occur within this study area sub-segment correlate with areas mapped as Central Rocky Mountain Douglas-fir – Pine Forest. Most of the vegetation (74 percent) within the transmission line ROW of is 25 feet tall or less and the remaining 26 percent of this sub-segment is no taller than 90 feet.

Sub-segment 1D: Gorge Lake

The Gorge Lake sub-segment (1D) includes 2,369 acres of mapped vegetation cover types surrounding Gorge Lake, which is approximately 6 percent of the RLNRA segment. Sub-segment 1D extends from Diablo Dam to Gorge Dam and includes lands administered by NPS and owned by City Light. There are approximately 3.5 miles of transmission line ROW in this sub-segment from the Diablo Powerhouse and Diablo townsites to the southern end of Gorge Lake; 242 acres of mapped open water; and 62 acres of mapped developed cover type, including SR 20 and the Diablo townsite. The southern extent of study area in this sub-segment (5 acres) was burned in the 2015 Goodell Fire.

The area surrounding Gorge Lake contains a mixture North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) and Central Rocky Mountain Douglas-fir – Pine Forest (G210) cover types, but includes an extensive area recently burned from the 2015 Goodell Fire. North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) is present in smaller patches primarily located on the north side of the lake, upstream of Gorge Dam. Approximately one-third of the area within the Project Boundary in this section consists of G240 (104 acres).

Trees taller than 90 feet are relatively scarce and largely confined G240 in the vicinity of Stetattle Creek to the north and Pyramid Creek to the south. Areas of G237 cover, upstream of Gorge Dam, exhibit trees taller than 90 feet mixed with trees of 40 to 60 feet in height, exhibiting the characteristics of an older forest with more canopy complexity. Vancouverian Wet Shrubland (G322) is mapped within the riparian areas of several tributaries, on the north and south sides of the lake. As within the Diablo Lake sub-segment, areas mapped as G210 are generally a mixture of trees with heights of less than 25 feet and 25 to 40 feet.

Approximately 202 acres of vegetation occur within the transmission line ROW of this study area sub-segment. The majority of vegetation within the transmission line ROW of this study area sub-segment is a mix of deciduous trees and shrubs, except for a portion of the northern transmission line ROW north of Gorge Creek that is a mix of conifers and native shrubs where conifers are dominant. Dominant species include bigleaf maple (*Acer macrophyllum*), Douglas-fir, and vine maple. Almost half of the vegetation within the transmission line ROW of this sub-segment (95 acres, 47 percent) is less than or equal to 25 feet tall.

Sub-segment 1E: Gorge Lake to Bacon Creek

The Gorge Lake to Bacon Creek sub-segment (1E) includes 5,937 acres of mapped vegetation cover types surrounding the Skagit River, which is approximately 15 percent of the RLNRA segment. Sub-segment 1E extends from Gorge Dam to the confluence of Bacon Creek and the Skagit River and includes the Skagit River and the Gorge bypass reach. There are approximately 8.5 miles of transmission line ROW in this sub-segment, which includes lands administered by

NPS, City Light, and a small portion owned by USFS at Bacon Creek. Mapped developed areas (134 acres) include portions of SR 20, the Newhalem townsite, and other City Light lands. A significant portion of this sub-segment (114 acres) was burned in the 2015 Goodell Fire.

The northern extent of this study area sub-segment is largely unvegetated due to the Goodell Fire and is characterized by a steep topography with exposed bedrock, pockets of early successional species, and remnant patches of forest. Vegetated areas in the vicinity of this recently burned area are primarily Vancouverian Wet Shrubland (G322) cover types located along several tributaries to the mainstem Skagit River. Additionally, small remnant pockets of forest cover are also present. Along the north side of the river, North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) is the dominant cover type south to Bacon Creek, outside of a stretch of G240 cover located between Thornton Creek and just south of Damnation Creek. On the south side of the Skagit River, vegetation is generally a mix of G237 and G240, with a narrow band of North Pacific Lowland Riparian Forest and Woodland Group (G851) representing the riparian area adjacent to the river.

Outside of the area affected by the Goodell Fire and the transmission line ROW, trees taller than 90 feet are prevalent throughout most of the area. The area overall had a high rumple index as shown in Appendix C of the TR-01 Vegetation Mapping Study Draft Report (City Light 2022a). A rumple index is a measurement of vertical and horizontal complexity within a forest canopy; the higher the rumple index, the more complex the canopy. This area also includes the riparian areas of the Skagit River. The tall trees are frequently mixed with trees 60 to 90 feet in height and are associated with both G237 and G240 cover types. A few small patches of trees 40 to 60 feet in height are present across from the Newhalem Ponds parcel near Babcock Creek, which are mapped as G237.

Approximately 840 acres (14.1 percent) of this study area sub-segment are within the transmission line ROW. Vegetation is a mix of native deciduous and coniferous trees and shrubs, with some areas also containing native forbs. Conifers are primarily Douglas-fir, and deciduous cover is primarily red alder (*Alnus rubra*). Shrubs include thimbleberry (*Rubus parviflorus*) and salal. Forbs are primarily bracken fern (*Pteridium aquilinum*) with some sword fern (*Polystichum munitum*) interspersed. Riparian vegetation within the transmission line ROW is limited to a narrow band on the south side of the Skagit River near Project River Mile (PRM) 87, which then transitions to a mix of upland native shrubs, trees, and forbs. The majority of the vegetation within the transmission line ROW (440 acres, 52 percent) is less than or equal to 25 feet tall. Trees between 90 feet and 150 feet in height occur in steeper areas of the transmission line.

Transmission Line ROW Segments (2-5)

Segments 2 through 5 include the study area along the transmission line ROW outside the RLNRA. These segments extend from the Bacon Creek confluence with the Skagit River to the Bothell Substation and include approximately 72 miles of transmission line ROW and portions of the Skagit River and the CMZ from Bacon Creek to the Sauk River confluence. The study area was divided into these segments based solely on geography for reporting purposes. A discussion of vegetation cover types mapped within segments 2 through 5 is provided below and summarized (Table 4.2.4-4). The numbers below do not include the managed vegetation categories within the transmission line ROW.

Table 4.2.4-4. Acreage of mapped vegetation cover types outside of the RLNRA study area segment.[1, 2]

Study Area Segment	G210	G237	G240	G241	G318	G322	G488	G517	G524	G648	G849	G851	G853	CGR 022	CGR MOD	Grand Total
2: Bacon Creek to Sauk River Crossing	55 (43)	6,092 (1,186)	9,670 (2,605)	69 (0)	12 (4)	833 (175)	6 (5)	5 (4)	342 (21)	1 (0)	8 (7)	1,724 (269)	321 (25)	423 (169)	25 (1)	**19,586 (4,514)**
3: Sauk River Crossing to Oso	0 (0)	4,665 (253)	7,219 (48)	0 (0)	0 (0)	891 (75)	0 (0)	0 (0)	145 (10)	1,288 (7)	0 (0)	1,607 (77)	206 (0)	673 (47)	16 (0)	**16,710 (517)**
4: Oso to SR 528	0 (0)	3,168 (22)	3,227 (13)	0 (0)	0 (0)	828 (67)	0 (0)	0 (0)	44 (9)	1,242 (2)	0 (0)	1,327 (4)	187 (0)	333 (29)	22 (0)	**10,334 (146)**
5: SR 528 to Bothell Substation	0 (0)	707 (1)	1,227 (1)	0 (0)	0 (0)	195 (15)	0 (0)	0 (0)	22 (1)	1,607 (4)	0 (0)	982 (3)	3 (0)	354 (21)	898 (36)	**5,995 (82)**
Total	**55 (43)**	**14,632 (1,462)**	**21,343 (2,667)**	**69 (0)**	**12 (4)**	**2,747 (332)**	**6 (5)**	**5 (4)**	**509 (41)**	**4,138 (13)**	**8 (7)**	**5,640 (353)**	**717 (25)**	**1,783 (266)**	**961 (37)**	**52,625 (5,259)**

1 Values in parentheses are acres within the FERC Project Boundary.
2 Table 4.2.4-1 contains an explanation of cover type codes.

Segment 2: Bacon Creek to Sauk River Crossing

The Bacon Creek to Sauk River Crossing Segment (2) includes approximately 19,586 acres of mapped vegetation cover types and extends along the Skagit River from the confluence of Bacon Creek (PRM ~83.2) to the confluence with the Sauk River (PRM ~66.7). This segment occurs primarily within the upper Skagit River basin and includes 14.3 miles of transmission line ROW from Bacon Creek to the Sauk River transmission line ROW crossing. This segment also includes the majority of the CMZ outside of the RLNRA, as well as the Taylor, Illabot, and Powerline spawning channels.[65] The southern approximately 2.5 miles of this study area segment occurs within the Sauk River basin. Land ownership in study area segment 2 includes City Light, USFS, WDFW, Washington Department of Natural Resources (DNR), Washington State Department of Transportation (WSDOT), Washington State Parks and Recreation, Skagit County, Upper Skagit Indian Tribe, Sauk-Suiattle Indian Tribe, municipalities, and privately owned lands.

This segment exhibits a wide variety of cover types due to various biogeographic conditions and land uses. Generally, forested areas at lower elevation within the CMZ, including those along the mainstem Skagit River, are predominately mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover type. These areas also include the largest concentrations of trees taller than 90 feet. Within the CMZ and lower valleys, there are several slough and wetland complexes that exhibit a combination of wetland and upland cover, primarily Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest and Woodland Group (G851), respectively. On the outer edges of the valley and at higher elevations of the CMZ, the predominant forest cover transitions to North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover type, and tree height is variable and largely a product of previous timber harvesting activities. Additionally, several narrow bands of G322 shrubland are present within the channels of the Skagit and Sauk rivers. Farmland and pastures are present in this segment, as well as the Town of Rockport. Additional land clearing adjacent to farmland or development are characterized as Southern Vancouverian Lowland Ruderal Grassland and Shrubland cover (G648), where non-native species are dominant. Adjacent to the ROW, areas of recent timber harvest are apparent outside of the CMZ. Additionally, a large wet shrub and forested area is mapped with a mix of G322 and North Pacific Maritime Hardwood – Conifer Swamp (G853). Most of the area within the Project Boundary in this section consists of a mixture of G240 (2,605 acres) and G237 (1,186 acres).

Similar to sub-segment 1E, the area has a high rumple index, or canopy height complexity. Extensive areas of trees taller than 90 feet associated with G237 cover are present in large tracts within this segment. Larger concentrations of these tall trees include riparian areas near the Skagit and Sauk River confluence, as well as most of the CMZ on the south side of the mainstem Skagit River. Coverage of these large trees is mostly continuous within this segment, excluding interruptions by several farm parcels and SR 530.

The transmission line ROW in this segment is adjacent to several developed areas such as farmland, rural residences, and access roads. Invasive shrubs, Scot’s broom and Himalayan blackberry, were observed throughout most of the transmission line ROW north of the Skagit River crossing, along with red alder, salal, and bracken fern. South of the Skagit River crossing, these

[65] The Taylor, Illabot, and Powerline spawning channels were developed under the current license but are not considered to be part of the fish and wildlife mitigation parcels.

three native species were predominant. The majority of the vegetation within the transmission line ROW (394 acres, 78 percent) is less than or equal to 25 feet tall. The remaining 22 percent that ranges from 40 feet and up are mostly located in riparian areas on the eastern bank of the Sauk River, as well as the forested hillside upslope of the area.

Segment 3: Sauk River Crossing to Oso

The Sauk River Crossing to Oso Segment (3) includes approximately 16,710 acres of mapped vegetation cover types and extends along 25.6 miles of transmission line ROW from the Sauk River transmission line crossing to the community of Oso. The eastern part of this segment is located in the Sauk River basin from the Sauk River crossing to near Darrington. The western portion of this segment, from Darrington to Oso, is located in the Stillaguamish River basin. Land ownership in study area segment 3 includes City Light, USFS, WDFW, Washington DNR, WSDOT, Washington State Parks and Recreation, Skagit County, Snohomish County, Sauk-Suiattle Indian Tribe, Stillaguamish Tribe of Indians, municipalities, and privately owned lands.

From the Sauk River crossing south to Darrington, the study area contains forested slopes rising west of the transmission line ROW and the Sauk River and associated river valley east of the transmission line ROW. North Pacific Maritime Douglas-fir – Western Hemlock Rainforest Group (G240) cover dominates the area west of the transmission line ROW. Some areas at lower elevations contain a mix of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Rainforest Group (G237) and North Pacific Lowland Riparian Forest & Woodland Group (G851) cover.

From Darrington west to the community of Oso, the study area segment is located in the low elevation river valley of the North Fork Stillaguamish River. This area is dominated by G237 cover north of the transmission line ROW, and a mixture of G237 and G240 cover where the land slopes up to higher elevations.

The majority of this portion of the study area segment is adjacent to the Sauk River and dominated by G237 and Vancouverian Wet Shrubland (G322) cover types. Surface water drainages that run down the slope from the west also contain a mixture of G237 and G851 cover. Several shrub-dominated riparian wetlands also occur within the channel of the Sauk River and are also mapped as G322 cover.

From Darrington west to the community of Oso, riparian areas represent a mix of G322 and G851 cover. These wetland and riparian cover types are along the mainstem of the North Fork Stillaguamish River, as well as several tributaries flowing from the south including Squire, Ashton, Furland, and Moose creeks and the Boulder River. Nearly half of the area within the Project Boundary in this section consists of G237 (253 acres).

Within the northern portion of this study area segment, riparian areas along the Sauk River primarily contain trees taller than 90 feet mixed with shorter trees with heights of 40 to 90 feet. Along the North Fork Stillaguamish River, riparian areas are dominated by G237 cover with a mix of trees with heights between 40 to 60 feet and trees taller than 90 feet.

This study area segment is approximately 950 acres, all of which occur within the transmission line ROW portion of the Project Boundary. Approximately 25 percent (236 acres) of this segment is mapped as invasive shrubs, primarily Scot's broom (*Cytisus scoparius*). From south of the Sauk

River to where the transmission line ROW heads west near Darrington, the transmission line ROW is within industrial timber lands and is dominated by invasive shrubs, primarily Scot's broom. Flume Creek and Rinker Creek both cross the transmission line ROW in this portion of the study area, with riparian areas mapped as G851 and G322, respectively. West of Darrington, this study area segment is largely adjacent to developed areas, such as SR 530 and rural residences, where cover includes invasive shrubs, primarily Scot's broom. Farther west, where the transmission line ROW enters industrial timber lands again, the transmission line ROW is dominated by a mix of native salal and bracken fern. In the western extent of this study area segment, where the transmission line ROW runs adjacent to SR 530, cover is largely farmland and areas dominated by reed canarygrass and Himalayan blackberry, primarily in riparian areas near Montague Creek. Several streams cross the transmission line ROW between Darrington and Oso. French Creek has a narrow riparian area mapped as G322. The majority of other streams within this portion of the transmission line ROW have riparian areas dominated by native and non-native shrubs. The majority of the vegetation within the transmission line ROW (864 acres, 92 percent) is less than or equal to 25 feet tall. No trees taller than 90 feet occur within the transmission line ROW in this study area segment.

<u>Segment 4: Oso to SR 528</u>

The Oso to SR 528 Segment (4) includes approximately 10,334 acres of mapped vegetation cover types and extends along the 17.5 miles of transmission line ROW from the community of Oso to SR 528 just east of Marysville, WA. The northern portion of this segment is located within the Stillaguamish River basin, and the southern portion is located within the Snohomish River basin. Land ownership in study area segment 4 includes City Light, WDFW, Washington DNR, WSDOT, Snohomish County, Non-Tribal USA Trust Land, municipalities, and privately owned lands.

Most of this segment, north of the South Fork Stillaguamish River, is mapped as North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover and largely represents timber harvest areas. Most of this area appears to have been recently harvested, as evidenced by the uniform cover of trees less than 25 feet in height.

Lower elevations within this segment are mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover and are frequently adjacent to riparian and wetland areas along Jim Creek, mapped as North Pacific Lowland Riparian Forest and Woodland Group (G851) and Vancouverian Wet Shrubland (G322), respectively. Some trees taller than 90 feet are apparent within the riparian areas of Jim Creek and associated tributaries; these are a mix of G240 and G237 cover. G851 and G322 riparian and wetland cover types, respectively, are mapped near Lake Riley in the northern portion of this segment. Several farmland parcels are also present just north of the South Fork Stillaguamish River.

South of the South Fork Stillaguamish River, this segment is dominated by rural residential land use. The dominant forest cover is G237 and is frequently interrupted by farmland, roads, and cleared land containing residences and Southern Vancouverian Lowland Ruderal Grassland and Shrubland (G648). A large wetland area mapped as G322 is located near Olsen Lake, just south of Jim Creek. This cover type, along with G851, is also located on several wetland and stream complexes within this segment, including Star Creek and Quilceda Creek. Some narrow bands of trees taller than 90 feet are mapped in the riparian areas along Star Creek and Quilceda Creek and in some areas south of the river that have not been impacted by development. However, most of this area is dominated by trees 25 to 60 feet in height, primarily located adjacent to cleared parcels containing residences. The most common cover type occurring within the Project Boundary in this section consists of G322 (67 acres); with the next most common cover types consisting of CGR022 (29 acres), and G237 (22 acres).

The majority of the vegetation within the transmission line ROW (582 acres, 96 percent) is less than or equal to 25 feet tall. No trees taller than 90 feet occur within the transmission line ROW in this study are segment.

Segment 5: SR 528 to Bothell Substation

The SR 528 to Bothell Substation Segment (5) includes approximately 5,995 acres of mapped vegetation cover types and extends along the 14.4 miles of transmission line ROW from SR 528 to the Bothell substation. Segment 5 is located primarily within the Snohomish River basin and the lower approximately 1.5 miles of this segment is located in the Lake Washington basin. Land ownership in study area segment 4 includes City Light, WSDOT, Snohomish County, municipalities, and privately owned lands.

This segment is in a highly developed and primarily residential environment. Vegetation throughout this segment is largely disturbed and limited to residential lawns and street trees. In the northern portion of this segment, some intact North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) forest cover occurs in natural areas near Martha Lake, Lake Cassidy, and Lake Stevens. These include smaller areas of Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest and Woodland Group (G851) along wetland and riparian corridors that flow into these lakes to the east, and Ebey Slough to the west. Some tracts of intact North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover are also located adjacent to rural residential areas. Large parcels of farmland occur within this segment and are primarily concentrated within the river valley of the Snohomish River. South of the farmland, dense residential developments with little forest cover sit on a plateau. A steep forested corridor mapped as G240 and G851 cover connects the plateau with the Snohomish River Valley. Forested corridors on the plateau near the residences are primarily narrow bands of G240 cover and are frequently interrupted by streets and other developments.

Within this segment, trees taller than 90 feet are limited to the natural areas near Martha Lake and Lake Cassidy, which are mapped as G237 and G851 cover. Other forested areas near rural residences or narrow riparian corridors are associated with G240, generally at heights of 60 to 90 feet with a few interspersed patches of trees taller than 90 feet. Trees in the denser neighborhoods within this segment are primarily landscaping and street trees with heights of less than 25 feet. Most of the land within the Project Boundary in this section consists of CGR Mod (36 acres) and CGR022 (21 acres).

The majority of this segment (101 acres, 25 percent) is mapped as invasive shrub cover. The transmission line ROW in the northern portion of this segment is predominantly adjacent to rural residences and is dominated by grass lawns and invasive shrubs, primarily Himalayan blackberry. In the southern portion of this segment, where denser residential development exists, the upland vegetation is generally dominated by Himalayan blackberry brambles.

Segment 6: Fish and Wildlife Mitigation Lands

The Fish and Wildlife Mitigation Lands Segment (6) includes all fish and wildlife mitigation lands within the study area and includes 23,875 acres of mapped vegetation cover types. They are separated below by location within the RLNRA and the watershed in which they occur in (i.e., the South Fork Nooksack, Sauk, and Skagit River basins). All mitigation lands are on City Light-owned lands. A discussion of vegetation mapped within the fish and wildlife mitigation lands is provided below.

RLNRA

Parcels 6A, 6B: County Line Ponds and Newhalem Ponds

The County Line Ponds parcel is predominantly North Pacific Lowland Riparian Forest and Woodland Group (G851) along the river and between the various ponds, with North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover located farther inland and adjacent to the access road.

The Newhalem Ponds parcel is dominated by North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover with a narrow band of North Pacific Lowland Riparian Forest and Woodland Group (G851) in riparian areas adjacent to the Skagit River (Table 4.2.4-5).

Trees 60 to 90 feet make up the majority of both the County Line Ponds and Newhalem Ponds parcels and largely occur along the perimeter of the ponds. Trees taller than 90 feet occur away from the ponds and along the access roads.

Table 4.2.4-5. Acreage of mapped cover types[1] on fish and wildlife mitigation lands within the RLNRA and Project Boundary[2]

Parcel No. & Name	G237	G240	G517	G851	Total
6A: County Line Ponds	25	1	0	20	**46**
6B: Newhalem Ponds	70	2	1	9	**82**
Total	**95**	**3**	**1**	**29**	**128**

1 Riparian and wetland USNVC Group Types.
2 Table 4.2.4-1 contains an explanation of cover type codes.

South Fork Nooksack Basin

Parcels 6C, 6D, 6E: Bear Lake, Nooksack, Nooksack West

Riparian areas along the South Fork Nooksack River are predominantly mapped as North Pacific Lowland Riparian Forest and Woodland Group (G851) and North Pacific Maritime Hardwood – Conifer Swamp (G853), with some upland areas with North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover in the lower parts of the river valley (Table 4.2.4-6). Generally, trees 60 to 90 feet in height are in riparian areas where G237 is dominant. In the narrow steep areas of the river valley, however, trees taller than 90 feet and mapped as North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) are immediately adjacent to the river channel. Upslope of the river valley, the vegetation cover is predominantly G240 within the mitigation parcels, as well as the surrounding 0.5-mile, where trees taller than 90 feet are dominant in areas upslope to the north of the river and on steep ridges upslope to the south. Vancouverian Wet Shrubland (G322) and G851 cover are mapped along Howard Creek, which drains into the South Fork Nooksack River from the north. Outside of the riparian areas, trees less than 25 feet in height are on the outer edges of most of the study area and appear to be the result of timber harvesting operations. The Bear Lake parcel and surrounding area are also predominantly G240 cover, excluding the shrub-dominated wetland adjacent to the lake and some narrow fringe wetland areas along a drainage to the South Fork Nooksack River to the south, both mapped as G322. Trees less than 25 feet in height are also dominant within upland areas of the Bear Lake parcel.

Table 4.2.4-6. Acreage of mapped cover types[1] on fish and wildlife mitigation lands within the South Fork Nooksack River basin and the Project Boundary.

Parcel No. & Name	G237	G240	G322	G524	G648	G851	G853	Total
6C: Bear Lake	0	133	4	0	10	0	0	**147**
6D: Nooksack	448	2,622	58	1	27	417	176	**3,749**
6E: Nooksack West	61	215	2	0	0	72	28	**378**
Total	**509**	**2,950**	**64**	**1**	**37**	**489**	**204**	**4,274**

1 Riparian and wetland USNVC Group Types.
2 Table 4.2.4-1 contains an explanation of cover type codes.

Sauk River Basin

Parcels 6F, 6G, 6H, 6I, 6J: Dan Creek, Everett Creek, North Everett Creek, North Sauk, Sauk Island

Canopy cover in all of the mitigation parcels within the Sauk River basin are generally dominated by the North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237), with smaller areas of Vancouverian Wet Shrubland (G322) and North Pacific Lowland Riparian Forest and Woodland Group (G851) interspersed throughout, excluding the Sauk Island parcels where G851 is the dominant cover type (Table 4.2.4-7). The G322 and G851 cover types are mapped adjacent to the mainstem Sauk River, as well as off-channel habitat within the Dan Creek and North Everett Creek parcels. Land use within 0.5 miles to the east of these parcels is primarily rural residences and farmland within the CMZ of the Sauk River. These surrounding areas are a mixture of North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240), G322, Southern Vancouverian Lowland Ruderal Grassland and Shrubland (G648), and cleared field used for farming, including some areas mapped as Western North American Ruderal Wet Shrubland, Meadow (G524).

The tallest trees in this study area segment are generally 60 to 90 feet in height and are primarily located along the side channels that are within and in the vicinity of the Dan Creek and North Everett Creek parcels. These trees are associated with the G237 cover type. Some of these taller trees are also along the riparian corridor of Gravel Creek, which flows into the Sauk River from the east. These trees are a mix of G237 and G851 cover. In general, most of the trees immediately adjacent to the Sauk River in this segment are mapped as both wetland (G322) and upland (G237) cover, and are less than 25 feet in height.

Table 4.2.4-7. Acreage of mapped cover types on fish and wildlife mitigation lands within the Sauk River basin and Project Boundary.[1,2,3]

Parcel No. & Name	G237	G240	G322	G648	G851	CGR022	Total
6F: Dan Creek	32	0	0	0	10	0	**42**
6G: Everett Creek	34	0	0	0	4	0	**38**
6H: North Everett Creek	108	1	16	5	31	4	**165**
6I: North Sauk	21	5	4	1	3	0	**34**
6J: Sauk Island	6	0	0	0	9	0	**15**
Total	**201**	**6**	**20**	**6**	**57**	**4**	**294**

1 Riparian and wetland USNVC Group Types.
2 This table only represents acreage within the Project Boundary. Acreage mapped outside the Project Boundary is captured in the Sauk River Crossing to Oso study area segment in Table 4.2.4-3.
3 Table 4.2.4-1 contains an explanation of cover type codes.

Skagit River Basin

A summary of the acreages and cover types mapped within the fish and wildlife mitigation lands in the Skagit River basin is presented in Table 4.2.4-8. A description of the vegetation composition and structure follows and is organized from north to south, then west to east within the study area.

Table 4.2.4-8. Acreage of mapped vegetated cover types[1] on Fish and Wildlife Mitigation lands within the Skagit River basin and Project Boundary[2, 4]

Parcel No. & Name	G210	G237	G240	G322	G524	G648	G851	G853	CGR022	Total
6K: B&W Road 1[3]	2	36	38	0	0	0	0	0	0	**76**
6L: B&W Road 2[3]	0	5	4	0	0	0	1	0	0	**10**
6M: Bacon Creek[3]	3	61	8	0	0	0	12	0	0	**84**
6N: Barnaby Slough	0	102	54	28	0	0	14	0	0	**198**
6O: Bogert and Tam	0	10	0	0	0	1	5	0	0	**16**
6P: Corkindale Creek	0	34	4	1	8	4	2	0	89	**142**
6Q: Day Creek Slough	0	2	0	1	1	1	0	0	31	**36**
6R: False Lucas Slough	0	131	1	55	0	0	16	0	0	**203**
6S: Finney Creek	0	75	508	7	0	0	45	0	0	**635**
6T: Illabot North	0	390	206	51	0	2	39	12	0	**700**
6U: Illabot South	0	209	2,188	7	0	6	98	5	0	**2,513**
6V: Johnson Slough	0	14	0	8	2	4	26	0	0	**54**
6W: McLeod Slough	0	51	1	4	1	1	15	0	49	**122**
6X: Napoleon Slough	0	40	7	0	0	0	12	0	0	**59**
6Y: O'Brien Slough	0	32	0	5	0	0	9	1	0	**47**
6Z: Pressentin	0	3	632	0	0	0	1	0	0	**636**
6AA: Savage Slough	0	55	12	45	17	31	41	0	0	**201**
6AB: South Marble 40	0	1	40	0	0	1	0	0	0	**42**
Total	**5**	**2,068**	**7,215**	**439**	**100**	**186**	**586**	**28**	**516**	**11,143**

1 Riparian and wetland USNVC Group Types.
2 This table only represents acreage within the Project Boundary unless otherwise noted. Acreage mapped outside the Project Boundary for most of these parcels is captured in the Bacon Creek to Sauk River Crossing study area segment in Table 4.2.4-4.
3 The B&W Road 1 & 2 and Bacon Creek parcels were mapped as part of the NPS vegetation mapping effort.
4 Table 4.2.4-1 contains an explanation of cover type codes.

Parcels 6K, 6L: B&W Road 1 and 2

Both the B&W Road 1 and 2 parcels, between PRM 82 and 83, are predominantly a mix of North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover types. Small pockets of North Pacific Lowland Riparian Forest and Woodland Group (G851) are mapped along several small streams within B&W Road 1 and along the mainstem of the Skagit River in B&W Road 2. Cover types are similar outside of the parcels, except at higher elevations to the east, where cover type is generally a mix of G240 and Rocky Mountain Subalpine Dry-Mesic Spruce – Fir Forest and Woodland (G219).

Outside of a narrow patch of trees taller than 90 feet within the riparian area of the B&W Road 2 parcel, trees are 60 to 90 feet throughout the parcels. B&W Road 1 also includes a large portion of trees less than or equal to 25 feet in height, as it was previously harvested for timber. Some taller trees (25 to 60 feet) are mixed in with the shorter trees on the outer edges of these parcels. Trees taller than 90 feet occur along the riparian area of the Skagit River between the two parcels, as well as north of B&W Road 1. These are generally associated with the G237 cover type. Additionally, trees taller than 90 feet are mapped as occurring at high elevation to the south and southwest of the parcels, predominantly mapped as G240.

Parcel 6M: Bacon Creek

The Bacon Creek parcel is located north of the Skagit River between PRM 83 and 84. A narrow riparian corridor mapped as North Pacific Lowland Riparian Forest and Woodland Group (G851) occurs in patches along both the east and west sides of Bacon Creek. Outside of the riparian corridor, the Bacon Creek parcel and surrounding areas are predominantly North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover to the west of the creek, and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) to the east. Trees taller than 90 feet are mapped throughout and are frequently mixed with trees 60 to 90 feet in height, except for the trees immediately adjacent to Bacon Creek, which are generally less than 25 feet tall. There is also an approximately 5-acre patch of smaller trees in a former gravel pit in the southeastern corner of this parcel.

Parcels 6N, 6R: Barnaby Slough and False Lucas Slough

The Barnaby Slough and False Lucas Slough parcels are located west of Illabot and O'Brien Sloughs between PRM 70 and 72, part of the complex slough system on the north side of Rockport-Cascade Road described above. Upland areas within both parcels are dominated by North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover that continues north to the Skagit River. Forested areas to the south of these sloughs are dominated by North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover. Trees are largely 60 to 90 feet in height, with trees taller than 90 feet mixed in at areas along the river.

Parcel 6O: Bogert and Tam

The Bogert and Tam parcel is located just upstream of PRM 73, mapped predominantly as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) forest with North Pacific Lowland Riparian Forest and Woodland Group (G851) cover in areas adjacent to the Skagit River. This mix of G237 and G851 continues along the Skagit River to the east. Trees within the parcel and surrounding area are generally 60 to 90 feet in height. Some small clusters of trees taller than 90 feet occur adjacent to a side channel under G851 riparian forest cover. Larger tracts of trees taller than 90 feet occur across SR 20 and are associated with G240 cover.

Parcel 6P: Corkindale Creek

The Corkindale Creek parcel, near PRM 76, has been used for agriculture for many decades and is still leased for grazing and haying. Thus, this parcel is dominated by farmland and Western North American Ruderal Wet Shrubland, Meadow (G524) cover, outside of a narrow strip of riparian forest mapped as North Pacific Lowland Riparian Forest and Woodland Group (G851) along the creek itself. In the northwest portion of the parcel, outside of the agricultural fields, forested areas at low elevation are mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) and transition to North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) at higher elevations. Within the parcel, the majority of trees are 60 to 90 feet, and are located along the northern edge of the parcel and along the creek.

Parcel 6Q: Day Creek Slough

The Day Creek Slough parcel, located between PRM 33 and 35, is largely former farmland. Day Creek Slough flows through the northeast portion of the parcel and is mapped as a combination of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) and Vancouverian Wet Shrubland (G322) cover types. Outside the parcel, the slough is shrub-dominated and only represents the G322 cover type. Riparian areas north of the parcel are a mix of G237 and North Pacific Lowland Riparian Forest and Woodland Group (G851) with some shrub-dominated areas with G322 cover within the Skagit River. Adjacent to this parcel, the Skagit River exhibits high channel complexity with several large, vegetated islands with a mix of G851, G237, and G322 cover. Trees taller than 90 feet are dominant here, primarily in areas of G237 and G851 cover.

Parcel 6S: Finney Creek

The Finney Creek parcel and surrounding area are predominantly North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover outside of the Finney Creek channel, which lies in a river valley to the northwest and downslope from most of the channel. Vegetation at higher elevations of the river valley is mapped as North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237), which transitions to North Pacific Lowland Riparian Forest and Woodland Group (G851) at lower elevations closer to the river. The largest trees are associated with the G240 cover type and are located along a slope in the west portion of the parcel. The remainder of the study area, including the river valley, is dominated by trees 60 to 90 feet in height.

Parcels 6T, 6U, 6Y: Illabot North, Illabot South, and O'Brien Slough

In general, these parcels are predominantly North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover in higher elevations located on the southeast side of Rockport-Cascade Road, and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) forest cover in the lower elevations located northwest of Rockport-Cascade Road. Illabot Creek and O'Brien Creek flow into the study area from the southwest. Illabot Creek has a mix of G240, G237, and North Pacific Lowland Riparian Forest and Woodland Group (G851) cover through most of the area, and dense concentration of trees taller than 90 feet are mapped across all cover types. Riparian areas of O'Brien Creek also exhibit these cover types; however, they are limited to narrow bands due to the steep gradient. Trees taller than 90 feet are present within the O'Brien Creek corridor in a narrow band, due to its steep gradient and narrow riparian area.

Both streams cross Rockport-Cascade Road into a complex slough system on the south side of the Skagit River between PRM 73 and 76, where the dominant cover is G237. However, the sloughs themselves are generally large wetland complexes with a mix of Vancouverian Wet Shrubland (G322), North Pacific Maritime Hardwood – Conifer Swamp (G853), and G851, and provide a forested connection to the Skagit River. Trees 60 to 90 feet in height are dominant within upland areas near O'Brien Slough, and some trees taller than 90 feet occur in riparian areas of the Skagit River, as well as near the transmission line ROW crossing.

Parcel 6V: Johnson Slough

Located on the north side of the Skagit River near PRM 69, the Johnson Slough parcel is mapped as a mix of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) and North Pacific Lowland Riparian Forest and Woodland Group (G851) cover types. Trees taller than 90 feet are associated with these cover types and are located throughout the parcel.

Parcel 6W: McLeod Slough

The McLeod Slough parcel, located west of the Skagit-Sauk confluence near PRM 66, contains a large grass field that has been used as a hayfield for many years. Forested areas to the north and west of the field are largely North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover types with North Pacific Lowland Riparian Forest and Woodland Group (G851) along two small channels that are connected to the Skagit River via McLeod Slough. Trees taller than 90 feet are dominant throughout the forest areas and continue to the Skagit River.

Parcel 6X: Napoleon Slough

Located immediately west of SR 530 near PRM 68, the Napoleon Slough parcel is predominantly North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) cover, with narrow bands of North Pacific Lowland Riparian Forest and Woodland Group (G851) cover along the riparian areas of the stream and slough channels. Trees associated with G237 are 60 to 90 feet or taller than 90 feet, while trees 40 to 60 feet in height are located along the stream and slough channels mapped as G851.

Parcel 6Z: Pressentin

Pressentin Creek flows southwest to northeast through the parcel through a steep canyon dominated by North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240). In areas of lower gradients, the forest cover transitions to a combination of G240 and Vancouverian Wet Shrubland (G322). The parcel is largely dominated by trees 60 to 90 feet tall and trees taller than 90 feet, including areas within the Pressentin Creek river valley, and excluding areas that have previously been used for timber harvest.

Parcel 6AA: Savage Slough

The Savage Slough parcel is located between PRM 46 and 47 of the Skagit River and includes land on both the north and south sides of the South Skagit Highway. On the south side of the highway, forest cover at higher elevations and lower elevations is primarily North Pacific Maritime

Douglas-fir – Western Hemlock Forest (G240) and North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237), respectively. The river valley of Mill Creek, which flows north to south into the parcel and eventually into the Skagit River, has large patches of North Pacific Lowland Riparian Forest and Woodland Group (G851) forest cover and Vancouverian Wet Shrubland (G322) shrub-dominated cover. North of the South Skagit Highway, forest cover is generally G237. Within this portion of the channel, several shrub-dominated side channels exist that likely connect to the mainstem Skagit River during times of high flow. In general, these channels are primarily G322 cover with a G851 forest cover on their outer edges. There are a few areas within the Mill Creek channel where trees taller than 90 feet are dominant. However, most of the forested areas within this study area segment are a mix of the various tree heights. Areas where these forests contain trees taller than 90 feet are apparent on the northwest, north, and northeast edges of the parcel, adjacent to the Skagit River.

Parcel 6AB: South Marble 40

The South Marble 40 parcel located south of PRM 77, as well as the surrounding area, is predominantly North Pacific Maritime Douglas-fir – Western Hemlock Forest (G240) cover with average tree height being less than or equal to 25 feet due to prior timber harvesting. There is some cover of North Pacific Red Alder – Bigleaf Maple – Douglas-fir Forest (G237) along steep drainages to the south and north, with a cluster of trees taller than 90 feet along the steep slope to the north. Trees are generally 40 to 60 feet in height on the G240 slope to the east and outside of the parcel. A large shrub-dominated wetland is present to the west of the parcel along Rockport-Cascade Road and mapped as Vancouverian Wet Shrubland (G322). Immediately adjacent, narrow patches of North Pacific Lowland Riparian Forest and Woodland Group (G851) are along the road with trees that are taller than 90 feet.

Wetland Assessment

The TR-02 Wetland Assessment was conducted in 2020 and 2021 to provide a detailed and accurate overview of wetlands within the study area. The field methods summarized are detailed in the TR-02 Wetland Assessment Draft Report (City Light 2022b) provide an assessment of wetland boundaries and ecological function for wetlands where there is the greatest potential for Project effects. City Light identified portions of the study area that may be potentially affected by Project operations and maintenance (O&M) and Project-related recreational activities (e.g., reservoir fluctuation zone and adjacent to Project facilities, buildings, and infrastructure) that overlapped areas likely to be wetlands to determine the focus of the field assessment and analytical portion of the study.[66]

The study area for the TR-02 Wetland Assessment is approximately 42,980 acres and consists of the area within the Project Boundary and the channel migration zone (CMZ, mapped by NPS), specifically from Gorge Powerhouse to the confluence of the Sauk and Skagit rivers. The study area was divided into six similar geographic sub-segments as described above for the vegetation mapping. The Wetland Assessment study area is shown in Figures 4.2.4-4 through 4.2.4-6; study area subsegments divisions are depicted in Figure 4.2.4.1a. A mapbook (Attachment A of the TR-

[66] These areas were digitized on aerial imagery and compiled in a mapbook. This mapbook was shared with LPs for comment in May 2021. No comments were received.

02 Wetland Assessment Draft Report; City Light 2022b) was produced to display wetlands in the study area according to Cowardin vegetation class and rating category.[67]

Each potentially affected wetland was rated according to the Wetland Rating System for Western Washington (Hruby 2014). Per the rating system guidance, the entire wetland unit was rated and not just the portion of the wetland that was observed in the field or that was within the study area. Each wetland was categorized as follows:

- **Category I**[68] (total score 23 – 27 points) are those wetlands that represent a unique or rare wetland type, or are more sensitive to disturbance than most wetlands, or are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime, or provide a high level of function. These wetlands are rare and require a high level of protection.
- **Category II** (total score 20 – 22 points) are those wetlands that are difficult, although not impossible, to replace and that provide high levels of some functions. These occur more commonly than Category I wetlands, although still need a high level of protection.
- **Category III** (total score 16 – 19 points) are considered to be wetlands with a moderate level of function, can often be adequately replaced with a well-planned mitigation project, generally have been disturbed in some ways, and are often less diverse or more isolated from other natural resources than Category II wetlands.
- **Category IV** (total score is less than 16 points) are often heavily disturbed and are wetlands that should be able to be replaced and, in some cases, be able to be improved.

67 The mapbook also shows wetlands that were modeled outside of the study area. The additional 0.5 mile area outside of the study area is referred to as the wetland modeling area as shown in the mapbook in Attachment A. Wetlands mapped within the wetland modeling area were not verified and are not included in any of the results or analysis presented in this report as they are not within the Project Boundary or the CMZ (i.e., the study area). However, these mapped wetlands are included here as they inform the results of the TR-01 Vegetation Mapping Study.

68 No Category I wetlands were mapped within the study area.

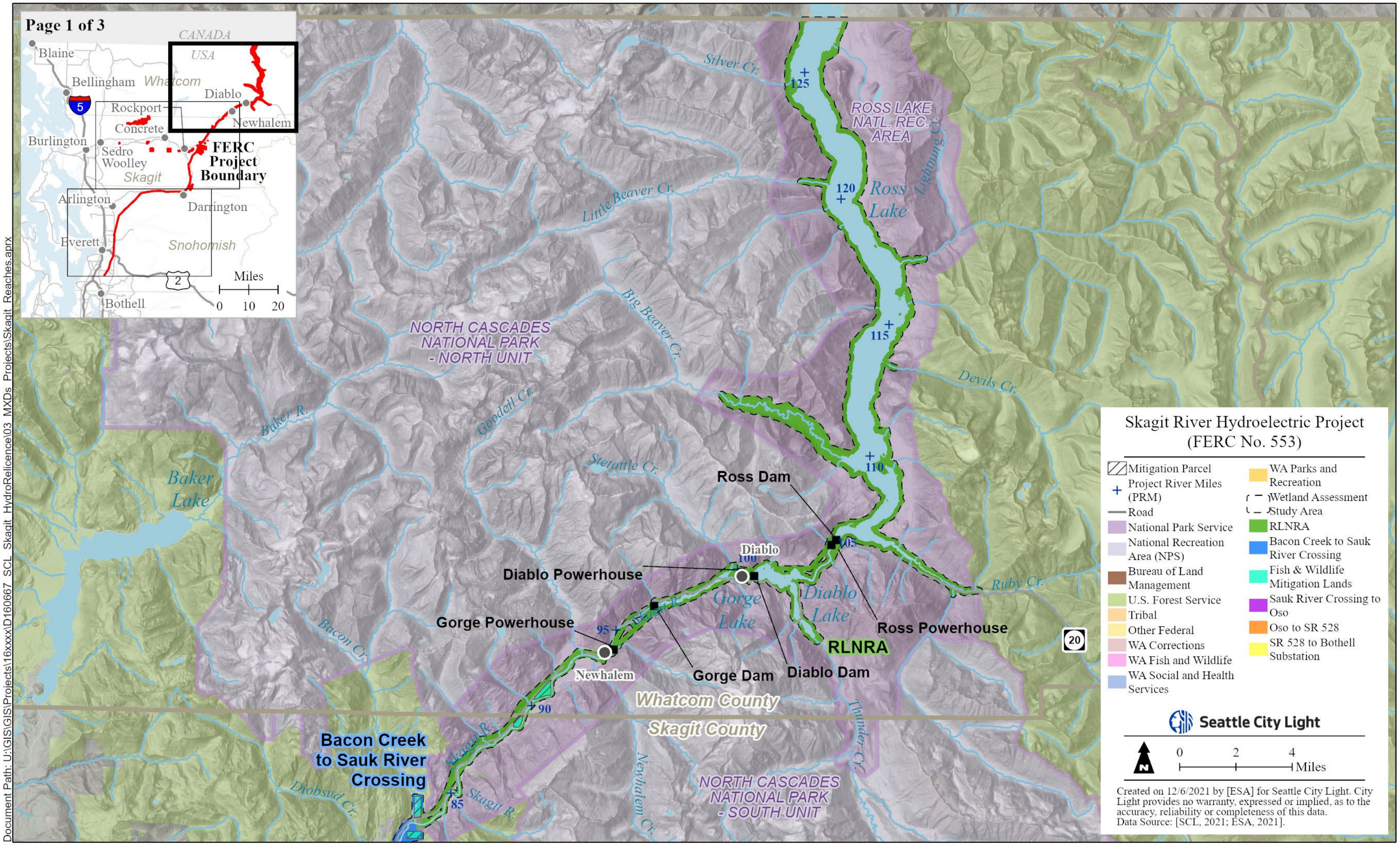


Figure 4.2.4-4. Study area segments for the Wetland Assessment (north).

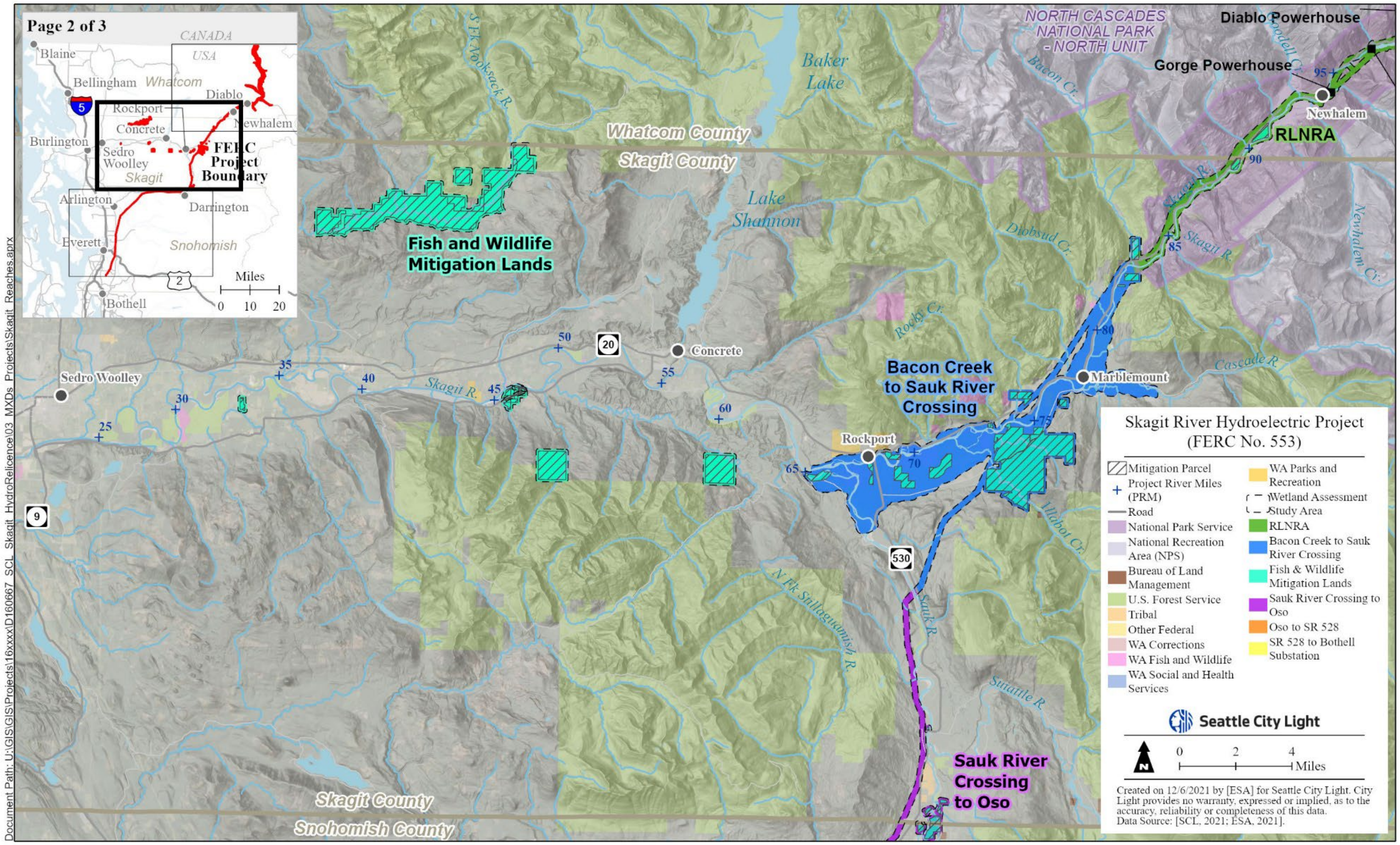


Figure 4.2.4-5. Study area segments for the Wetland Assessment (central).

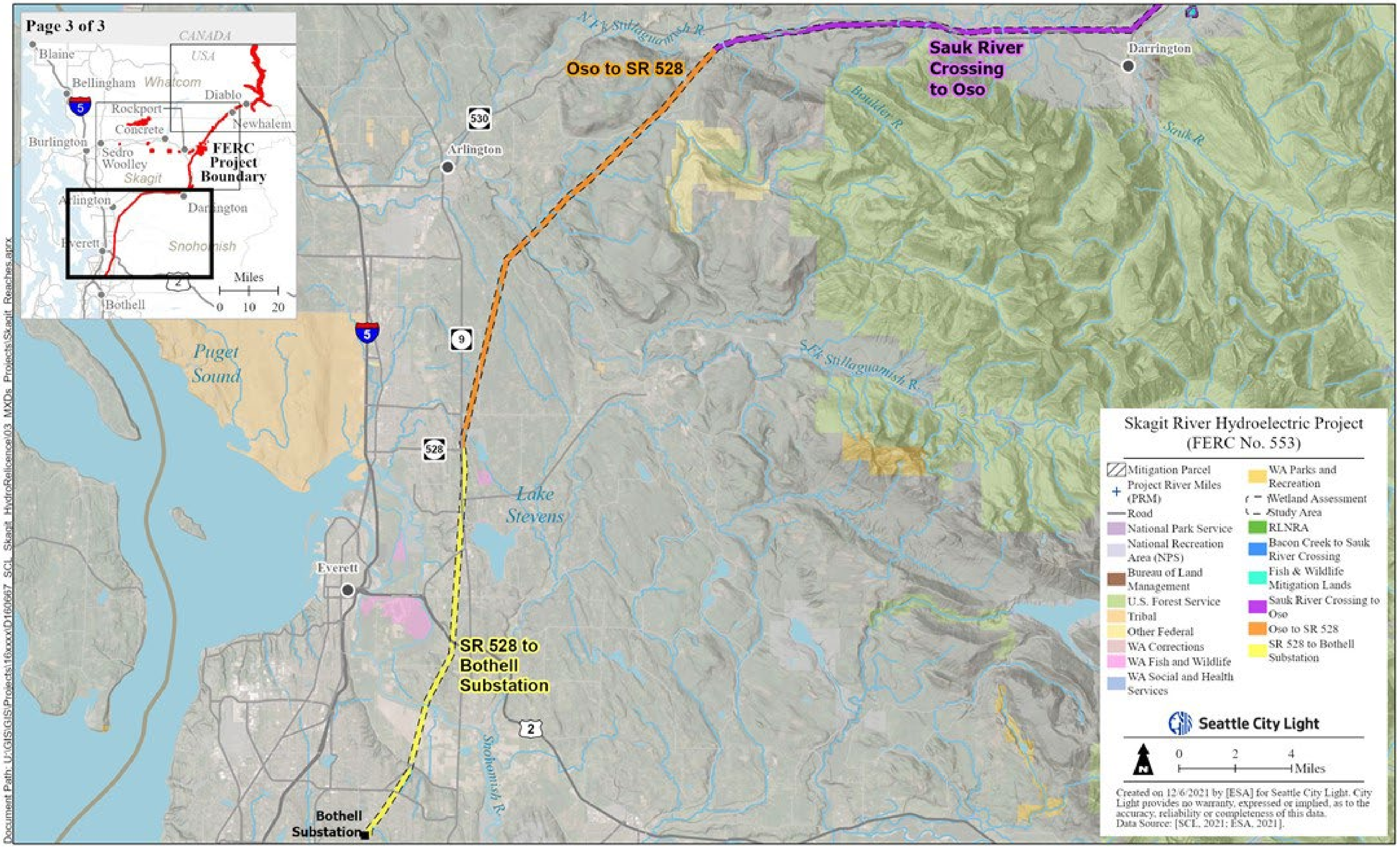


Figure 4.2.4-6. Study area segments for the Wetland Assessment (south).

The TR-02 Wetland Assessment study area encompasses approximately 2,540 acres of wetlands. Of this total, 1,775 acres (70 percent) are within the FERC Project Boundary, and the remaining 765 acres (30 percent) are outside of the FERC Project Boundary, primarily in the Skagit River CMZ portion of the study area. The results below summarize the Wetland Assessment results for each study area segment or sub-segment (Table 4.2.4-9) based on their Cowardin vegetation class, as well as the results of their functional assessment using the Wetland Rating System for Western Washington (Hruby 2014).

Table 4.2.4-9. Wetland acreage by Cowardin vegetation class.[1]

Study Area Segment or Sub-Segment		PFO	PFO/ PSS	PFO/ PEM	PFO/ PSS/ PEM	PSS	PSS/ PEM	PEM	PUB	Total
1: RLNRA	1A: Ross Lake (exclusive of Big Beaver Valley)	8 [7]	0	37 [4]	0	0	0	168 [7]	0	**213 [18]**
	1B: Big Beaver Valley	0	0	0	674 [1]	0	0	0	0	**674 [1]**
	1C: Diablo Lake	16 [2]	44 [4]	0	0	1 [1]	0	0	0	**61 [7]**
	1D: Gorge Lake	0	2 [2]	0	0	0	0	0	0	**2 [2]**
	1E: Gorge Lake to Bacon Creek[2]	3 [6]	4 [4]	0	0	0	0	0	0	**7 [10]**
2: Bacon Creek to Sauk R. Crossing[2]		205 [74]	13 [4]	13 [1]	192 [11]	8 [6]	36 [12]	316 [51]	0	**783 [159]**
3: Sauk R. Crossing to Oso[2]		3 [3]	22 [4]	6 [3]	1 [1]	10 [6]	3 [2]	2 [1]	0	**47 [20]**
4: Oso to SR 528		2 [3]	15 [6]	5 [1]	13 [1]	5 [2]	22 [8]	6 [3]	0	**68 [24]**
5: SR 528 to Bothell Substation		0	1 [1]	0	3 [3]	4 [3]	7 [7]	0	0	**15 [14]**
6: Fish and Wildlife Mitigation Lands		414 [119]	7 [12]	41 [6]	165 [8]	4 [3]	0	34 [17]	5 [1]	**670 [166]**
Total		**651 [214]**	**108 [37]**	**102 [15]**	**1,048 [25]**	**32 [21]**	**68 [29]**	**526 [79]**	**5 [1]**	**2,540 [421]**

PFO = palustrine forested, PSS = palustrine shrub-scrub, PEM = Palustrine emergent, PUB = palustrine unconsolidated bed.

1 Numbers in brackets are counts of individual wetlands.

2 These calculations do not include lands within the fish and wildlife mitigation parcels located in these segments. All fish and wildlife mitigation lands are included in the Fish and Wildlife Mitigation Lands study area segment of this table.

All the field assessed wetlands were classified as palustrine wetlands based on the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Palustrine wetlands include all nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses, or lichens. Major vegetation classes of the Palustrine system include forested (PFO), scrub-shrub (PSS), and emergent (PEM). Wetlands that are largely open water were categorized as Palustrine unconsolidated bottom (PUB), which are wetlands that have a vegetated cover of less than 30 percent. Different hydrogeomorphic (HGM) types within palustrine systems in the study area include depressional, slope, riverine flow-through, and lake fringe. In addition to the Cowardin vegetation class, the geospatial dataset includes the HGM class for each wetland within the area of potential disturbance.

Segment 1: RLNRA

A total of 957 acres (38 percent) of all mapped wetlands occur within the various sub-segments of the RLNRA. Of the total acres of wetlands mapped within the RLNRA, 950 acres (99 percent) occur within the Project Boundary. The remaining 7 acres are located within several riparian areas of the Skagit River between Newhalem and Bacon Creek. Of the total 957 acres of wetlands mapped in the RLNRA, 276 acres (29 percent) are associated with the three Project reservoirs while 674 acres (70 percent) of mapped wetlands are part of the Big Beaver Valley wetland complex within the High Ross portion of the FERC Project Boundary. No wetlands are mapped along the approximately 7-mile-long section of transmission line ROW in the RLNRA from Ross Powerhouse to the southern end of Gorge Lake.

The Washington DNR maps Wetlands of High Conservation Value (WHCV) as part of the Washington Natural Heritage Program (WNHP) throughout Big Beaver Valley (Sub-segment 1B). The WNHP has identified these wetlands as either high quality, undisturbed wetlands or wetlands that support rare or sensitive plant populations (Washington DNR 2021a). When applying the Washington State Rating System functional assessment, the Big Beaver Valley wetland complex receives a high habitat function due to its diversity of plants and plant structure, its diversity in hydroperiods and interspersion of habitats, and its ability to support a wide range of wildlife species due to the presence of habitat features such as streams, ponds, large downed wood, and snags. Additional information can be found in A Floristic Survey of Big Beaver Valley (Vanbianchi and Wagstaff 1987). The Ross Lake – Big Beaver Creek confluence was visited and several patches of reed canarygrass were observed, which are discussed below. The TR-04 Invasive Plants Study summarizes these observations, as well as NPS reed canarygrass inventory and treatment information for the Big Beaver Valley wetlands (City Light 2022c).

City Light mapped a total of 267 acres of wetlands around the three reservoirs in Segment 1 (Table 4.2.4-10), with approximately 206 acres (77 percent) along Sub-segment 1A: Ross Lake (see Attachment A of the TR-02 Wetland Assessment Draft Report, pages 1 through 8), 59 acres (22 percent) around Sub-segment 1C: Diablo Lake (see Attachment A of the Wetland Assessment Draft Report, pages 8 and 9), and 2 acres (less than 1 percent) along Sub-segment 1D: Gorge Lake (see Attachment A of the Wetland Assessment Draft Report, pages 8, 10, and 11). Most of these wetlands are lake fringe wetlands, with the reservoirs being the primary source of hydrology. However, small streams and drainages upslope, as well as groundwater, also likely feed the PFO and PSS wetlands. As mentioned above, the hydrology of Ross Lake does not affect wetlands in Big Beaver Valley, and these wetlands are not considered to be in an area of potential disturbance. Therefore, wetlands in Big Beaver Valley were modelled but not visited in the field and are not part of this assessment. Sixteen of the 21 identified wetlands, including 10 around Ross Lake (1A), five on Diablo Lake (1C), and one on Gorge Lake (1D) were visited. For the five wetlands not visited, functions were assessed using remote sensing data.

Table 4.2.4-10. Wetland acreage by Cowardin vegetation class within an elevation of 10 feet over the normal maximum water surface at reservoirs in RLNRA.[1,2]

Sub-segment, Reservoir	PFO	PFO/PSS	PFO/PEM	PSS	PEM	Total
1A: Ross Lake	2 [2]	0	35 [3]	0	169 [7]	**206 [12]**
1C: Diablo Lake	16 [2]	42 [4]	0	1 [1]	0	**59 [7]**
1D: Gorge Lake	0	2 [2]	0	0	0	**2 [2]**
Total	**18 [4]**	**44 [6]**	**35 [3]**	**1 [1]**	**169 [7]**	**267 [21]**

1 Numbers in brackets are counts of individual wetlands.
2 Sub-segments 1B: Big Beaver Valley and 1E: Gorge Lake to Bacon Creek are not included here as they do not contain reservoirs.

Approximately 85 percent of wetland acres mapped along the three Project reservoirs in Segment 1 were rated as Category III wetlands (Table 4.2.4-11). Wetlands along the reservoirs typically had a moderate level of water quality function. Although emergent vegetation that can effectively filter pollutants and sediments dominate these wetlands, due to their location in the RLNRA, there are few sources of pollution within the watershed. These wetlands also exhibit a moderate level of hydrologic function. Most wetlands along the reservoir shorelines lack shrubs or trees to reduce or prevent shoreline erosion from wave action, likely due to inundation by the reservoir during most of the growing season, which prevents the establishment of woody plants. Finally, these wetlands have a moderate to high level of habitat function. Although the plant species richness and structural diversity was determined to be moderate to low in most wetlands, many wetlands contain downed wood, are close to mature forests, and have not been subject to fragmentation and habitat loss from development, all of which increase their level of habitat function.

Table 4.2.4-11. Wetland acreage by rating category within reservoir fluctuation zone in RLNRA.[1,2]

Sub-segment, Reservoir	II	III	IV	Total
1A: Ross Lake	36 [2]	170 [10]	0	**206 [12]**
1C: Diablo Lake	0	56 [6]	3 [1]	**59 [7]**
1D: Gorge Lake	0	2 [2]	0	**2 [2]**
Total	**36 [2]**	**228 [18]**	**3 [1]**	**267 [21]**

1 Numbers in brackets are counts of individual wetlands.
2 Sub-segments 1B: Big Beaver Valley and 1E: Gorge Lake to Bacon Creek are not included here as they do not contain reservoirs.

Sub-segment 1A: Ross Lake (excluding Big Beaver Valley)

Wetlands mapped around Ross Lake (1A) range from approximately 2,000 square feet to approximately 96 acres in size. All 12 wetlands rated along Ross Lake (1A) are lake fringe wetlands. The smallest wetlands are in a series of wetlands along Ruby Creek, upstream of Ruby Arm. The largest mapped wetland is a large PEM wetland, on the east side of the lake near the Canadian border (#3860; see Attachment A of the TR-02 Wetland Assessment Study Draft Report, page 1). This wetland is also the wetland mapped at the lowest elevation along Ross Lake. Wetlands near Ross Lake occur at elevations between 1,597 feet and 1,621 feet City of Seattle Datum (CoSD), compared to a normal maximum water surface elevation of 1,602.5 feet CoSD.

Patches of reed canarygrass and submerged aquatic plants (e.g., *Potamogeton* spp.) occur at elevations lower than mapped wetlands in the Ross Lake drawdown zone. Individual wetlands along Ross Lake are described in more detail in the TR-08 Special-Status Amphibians Study Report (City Light 2022d). No wetlands are mapped along the approximately 7-mile-long section of transmission line ROW from Ross Powerhouse to the southern end of Gorge Lake.

Most of the wetlands along Ross Lake are lake fringe wetlands and have a PEM cover class that is submerged at normal maximum water surface elevation. Based on a review of aerial photography, wetland areas extend along the shore of Ross Lake into British Columbia. Reed canarygrass dominates 82 percent of the wetlands along Ross Lake. Wetlands at or above normal maximum water surface elevation are less diverse and contain primarily reed canarygrass and stunted soft rush (*Juncus effusus*). Reed canarygrass is a resilient and aggressive grass that, with sufficient nutrients, sunlight, and moisture, can limit native emergent species in wetlands. However, within the drawdown zone, it appears that reed canarygrass is not outcompeting existing vegetation as there is ample bare soil for other species to establish. There are likely multiple sources of reed canarygrass propagules (i.e., seed, culm, and root fragments) because these can be spread by water, wind, and animals. A large reed canarygrass-dominated wetland on the Canadian side of Ross Lake likely contributes to reed canarygrass dispersal via water. Although reed canarygrass is difficult to eradicate, shade from trees and shrubs can inhibit reed canarygrass growth; however, because areas in the drawdown zone are inundated almost the entire growing season, woody species generally do not occur. The TR-04 Invasive Plants Study includes additional information on reed canarygrass along Ross Lake (City Light 2022c). Wetlands below normal maximum water surface elevation have more species richness and include species such as jointleaf rush (*J. articulatus*), slough sedge, and lesser spearwort (*Ranunculus flammula*).

Thirty-six acres of wetlands around Ross Lake (1A) were rated as Category II wetlands. These wetlands, including one near the mouth of Big Beaver Creek, rated higher due to more diversity in their hydrologic regimes and vegetation structure. A large Category II wetland located just north of Dry Creek was observed to have special habitat features, such as downed wood and large snags. Both of these wetlands have more diverse native vegetation species composition and structure, partially due to NPS efforts to reduce reed canarygrass coverage through the installation of native sedges (Tressler 2021).

<u>Sub-segment 1C: Diablo Lake</u>

Wetlands on Diablo Lake (1C) range from 0.4 acre to approximately 37 acres in area. All wetlands are located within Thunder Arm (see Attachment A of the TR-02 Wetland Assessment Draft Report, page 8). Five of the seven wetlands rated along Diablo Lake (1C) are near the outlet of Thunder Creek and are riverine wetlands. The remaining two wetlands along Diablo Lake are depressional wetlands. Approximately 71 percent of the wetlands around Diablo Lake contain a mixture of PFO and PSS habitat and are primarily located within Thunder Arm at the outlet of Thunder Creek. Red alder and western red cedar dominate the forested cover, and red osier dogwood (*Cornus stolonifera*), willow species, and salmonberry dominate the shrub cover.

<u>Sub-segment 1D: Gorge Lake</u>

Gorge Lake (1D) includes two primary wetland habitats. Both wetlands along Gorge Lake (1D) are riverine wetlands. A nearly 2-acre forested wetland (#3630; see Attachment A of the TR-02

Wetland Assessment Draft Report, page 10) occurs on the south side of the river, downstream of the Diablo Powerhouse. Access to this wetland was not possible during field assessments; however, based on aerial imagery, the forested cover is deciduous and likely includes red alder and black cottonwood. Another small wetland (#3992, 0.1 acres; see Attachment A of the Wetland Assessment Draft Report, page 10) occupies a low-lying terrace on the south side of the Diablo townsite.

Skagit River CMZ

The wetlands in the Skagit River CMZ include a mixture of PFO habitats and PEM wetlands in farm fields within the CMZ, as well as the PFO/PSS/PEM slough complexes within the Skagit – Sauk River confluence. This does not include the wetlands in the fish and wildlife mitigation lands located in this study area segment (discussed separately in Fish and Wildlife Mitigation Lands segment 6).

The Skagit River 100-year floodplain was used to determine which wetlands have the highest probability of connectivity to the Skagit River,[69] and are possibly hydrologically influenced by Project operations. Therefore, a functional assessment of all wetlands that intersect the Skagit River 100-year floodplain was conducted. However, due to the inaccessibility of this area, only five of these wetlands were visited and most of the functional assessments were conducted as a desktop exercise using remote sensing data.

A total of 754 acres of wetlands were mapped within the Skagit CMZ (excluding wetland acreage within the transmission line ROW or fish and wildlife mitigation lands). Dominant cover types include PEM (303 acres or 40 percent), PFO (203 acres or 27 percent), and a combination PFO/PSS/PEM (180 acres or 24 percent). The remaining 68 acres, or 9 percent, represent a variety of PFO, PSS, and PEM cover (Table 4.2.4-12).

Table 4.2.4-12. Wetland acreage by Cowardin vegetation class within the Skagit River CMZ.[1]

Segment	PFO	PFO/ PSS	PFO/ PEM	PFO/PSS/ PEM	PSS	PSS/ PEM	PEM	Total
Segment 2: Skagit River CMZ	203 [73]	12 [3]	13 [1]	180 [10]	7 [5]	36 [12]	303 [41]	**754 [145]**

1 Numbers in brackets are counts of individual wetlands.

Large PFO/PSS/PEM wetland habitats are primarily located next to (but not within) the Barnaby Slough, False Lucas Slough, and Illabot North fish and wildlife mitigation lands and nearby WDFW, The Nature Conservancy (TNC), and Skagit Land Trust lands, and likely have a hydrological connection to most of the wetlands mapped on those parcels. Most of the PEM wetlands are portions of large agriculture fields south of Rockport and west of Marblemount. Large, forested wetlands are located to the east of the Skagit River near Marblemount, as well as

69 The hydraulic model being developed in support of the FA-02 Instream Flow Model Development Study will provide additional information related to flow connectivity in the Upper Skagit River downstream to PRM 64.95; the hydraulic model will allow for analysis of the main stem connection to side channels with significant fisheries habitat value at various flow levels; the model also includes, in lesser detail, the overbank floodplain out to the valley side walls (City Light 2022d).

along the north side of the river east of Rockport. Narrow forested wetlands are also common along the riparian areas of the Sauk River, as well as several smaller tributaries to the Skagit River.

The Taylor spawning channel is also within the CMZ of the Skagit River on USFS-administered land and is characterized by PFO/PSS/PEM cover. City Light constructed this channel in 1998, creating 5,694 square feet (0.13 acres) of new off-channel aquatic habitat. Forested wetland fringes both sides of the spawning channel and is characterized by primarily red alder cover. Shrub and emergent classes are located on the banks, and shallow portions of the channel are dominated by salmonberry and slough sedge.

Approximately 560 acres (81 individual wetlands) of the 754 acres of wetland mapped in the CMZ in the Bacon Creek to Sauk River Crossing segment are located within the Skagit River 100-year floodplain. Fifty-one of these wetlands are riverine wetlands, and 30 are depressional wetlands. In total, 202 acres (36 percent) of the wetlands are Category II wetlands, 188 acres (34 percent) are Category III wetlands, and the remaining 170 acres (30 percent) are Category IV wetlands (Table 4.2.4-13).

Table 4.2.4-13. Wetland acreage by rating category within the Skagit River 100-year floodplain within the CMZ.[1]

Segment	II	III	IV	Total
Segment 2: Skagit River 100-year floodplain	202 [8]	188 [63]	170 [10]	**560 [81]**

1 Numbers in brackets are counts of individual wetlands.

The majority of Category II wetlands are located along the slough next to the Barnaby and False Lucas Slough mitigation land parcels. These wetlands exhibit a moderate water quality function and high hydrologic and habitat functions.

The Category III wetlands within the floodplain are forested wetlands along the Sauk River and several tributaries to the Sauk and Skagit rivers. Similar to other wetlands in the vicinity, these wetlands have a moderate water quality function as they have the ability to filter pollutants, but large pollutant sources are not present in the landscape. They also tend to have a moderate hydrologic function because they are narrow and only hold or slow minimal flows. These wetlands have a moderate to high habitat function because they connect to large areas of undisturbed habitat; however, they are likely only inundated during times of high flow, so the availability of sufficient aquatic habitat can be seasonal.

The Category IV wetlands are located entirely within the farm and hay fields in the floodplain. These wetlands exhibit low to moderate water quality, hydrologic, and habitat functions. Vegetation in these wetlands can filter pollutants from surrounding areas, and depressions can serve as water storage during flood flows; however, many of these wetlands appear to be connected to agricultural ditches, so the residence time of water in them is low. They provide some habitat, but the vegetation lacks diversity and is frequently disturbed during farming operations. They do, however, provide connectivity to larger undisturbed habitats that are likely used as stop-over habitat for waterfowl.

Wetlands Within the Transmission Line ROW

This section describes the results of the TR-02 Wetland Assessment for areas within the Project transmission ROW by study area segment. This discussion includes only wetlands within the transmission line ROW portion of the Project Boundary, excluding any fish and wildlife mitigation lands that geographically fall within the transmission line ROW study area segments. No wetlands are mapped along transmission line ROW within the RLNRA; therefore, these areas are not discussed below. A Cowardin class was assigned for all mapped wetlands within the transmission line ROW and outside of the fish and wildlife mitigation lands. However, the functional assessment focused on the wetlands where City Light conducts more frequent vegetation management. City Light-managed portions of the transmission line ROW include privately and publicly owned parcels. Vegetated portions of the ROW that are not managed by City Light account for approximately 15 percent of the total length of the ROW. A large portion of these wetlands are depressional HGM type systems supported by groundwater and precipitation.

Most of the wetland habitats within the ROW are a mix of two or more Cowardin vegetation classes. This is largely a result of wetlands within the transmission line ROW extending outside of the transmission line beyond the extent of City Light vegetation management. Vegetation management conducted by City Light has included periodic mowing and/or the cutting of trees and large shrubs to maintain compliance with overhead transmission line clearance standards. For this reason, emergent or scrub-shrub habitats dominate the wetlands within the transmission line ROW, but there is a transition to more structurally complex and diverse forested wetlands outside of the managed ROW. Per the rating system guidance, the entire wetland unit is rated and not just the portion of the wetland within the study area, which results in multiple Cowardin classes for most of these wetlands. Douglas spirea (*Spiraea douglasii*) dominates most of the wetlands within the transmission line ROW, occasionally interspersed with taller shrubs such as red osier dogwood and willows. Slough sedge, skunk cabbage (*Lysichiton americanus*), common cattail (*Typha latifolia*), and reed canarygrass are common emergent species. Most of the 21 acres classified as PEM are in agricultural fields north of the Skagit – Sauk River confluence. Most of the PFO wetlands are in areas with minimal vegetation management where the transmission lines cross river valleys, ravines, or other topographical areas with sufficient conductor clearance such that only tall trees need to be removed occasionally. Table 4.2.4-14 describes the wetland acreages by segment.

Table 4.2.4-14. Wetland acreage by Cowardin vegetation class within the transmission line ROW portion of the Project Boundary outside the RLNRA.[1,2]

Segment	PFO	PFO/ PSS	PFO/ PEM	PFO/ PSS/ PEM	PSS	PSS/ PEM	PEM	Total
Segment 2: Bacon Creek to Sauk R. Crossing[3]	2 [2]	1 [1]	0	12 [1]	1 [1]	< 1 [1][4]	13 [13]	**29 [19]**
Segment 3: Sauk R. Crossing to Oso	1 [2]	22 [4]	6 [3]	1 [1]	10 [6]	3 [2]	2 [1]	**45 [19]**
Segment 4: Oso to SR 528	2 [3]	15 [6]	5 [1]	13 [1]	5 [2]	22 [8]	6 [3]	**68 [24]**
Segment 5: SR 528 to Bothell Substation	0	1 [1]	0	3 [3]	4 [3]	7 [7]	0	**15 [14]**
Total	**5 [7]**	**39 [12]**	**11 [4]**	**29 [6]**	**20 [12]**	**32 [18]**	**21 [17]**	**157 [76]**

1 No wetlands are associated with the transmission line ROW identified within the RLNRA (Segment 1).
2 Numbers in brackets are counts of individual wetlands.
3 Only includes acreage of Powerline and Illabot spawning channels that occur within the transmission line ROW. Additional acreage of these channels that occurs outside of the transmission line ROW is included in Table 4.2.4-19 as they are part of the Illabot North wildlife mitigation land parcel.
4 The portion of the Powerline spawning channel within the transmission line ROW account for less than 1 acre of PSS/PEM within this study area segment.

Of the 75 wetlands mapped along the transmission line ROW, 67 (89 percent) are on parcels where City Light conducts vegetation management. Of these 67 wetlands, 32 were visited. Sixty-two of these wetlands were rated as depressional, and the remaining five wetlands were rated as riverine wetlands. Eighty-one acres, or 55 percent of the wetlands that occur in City Light-managed portions of the transmission line ROW, were Category III wetlands. An additional 49 acres (34 percent) were Category II wetlands; and the remaining 16 acres (11 percent) were Category IV wetlands (Table 4.2.4-15). Most of the Category II wetlands within the Project Boundary are associated with large, diverse wetland complexes that extend outside of the Project Boundary. Functions of wetlands were only assessed on accessible parcels where City Light conducts vegetation management.

Table 4.2.4-15. Wetland acreage by rating category within the transmission line ROW portion of the Project Boundary.[1]

Segment	II	III	IV	Total
Segment 2: Bacon Creek to Sauk R. Crossing	12 [1]	4 [3]	7 [9]	**23 [13]**
Segment 3: Sauk R. Crossing to Oso	4 [2]	32 [10]	8 [5]	**44 [17]**
Segment 4: Oso to SR 528	32 [7]	34 [15]	1 [1]	**67 [23]**
Segment 5: SR 528 to Bothell Substation	4 [3]	11 [10]	0	**15 [13]**
Total	**52 [13]**	**81 [38]**	**16 [15]**	**149 [6]**

1 Numbers in brackets are counts of individual wetlands.

Segment 2: Bacon Creek to Sauk River Crossing

Eighteen percent of wetlands occur within Segment 2, and most of these wetlands cover less than an acre of the land within the transmission line ROW. Wetland #1564 is a large wetland complex with a total of 233 acres in area and that has 12 acres within the transmission line ROW. More information on Wetland #1564 is provided in the functional assessment discussion below.

The Powerline (#2297) and Illabot (#3998) spawning channels are located along the transmission line ROW within Segment 2 and are mapped as PSS/PEM and PFO/PSS, respectively. City Light constructed the Powerline spawning channel in 2003, creating 27,448 square feet (0.6 acres) of off-channel aquatic habitat. Invasive species, including reed canarygrass, policemen's helmet (*Impatiens glandulifera*) and Himalayan blackberry, dominate this spawning channel. City Light constructed the Illabot spawning channel in two phases and created 23,207 square feet (0.5 acres) of aquatic habitat in 1995 and an additional 40,978 square feet (0.9 acres) of habitat in 2002. This channel is less disturbed—red alder dominates the forested class and willows dominate the shrub class. However, reed canarygrass and Himalayan blackberry are still present along the banks of the channel.

The largest wetland complex within the transmission line ROW in Segment 2 Bacon Creek to Sauk River Crossing segment includes a Category II wetland that may be hydrologically connected to a wetland identified as a WHCV by the WNHP. WNHP identifies the upper approximately 55 acres of this wetland complex (which is located outside of the Project Boundary) as a WHCV. WHCVs are generally Category I wetlands that are known or suspected to contain a rare species or that represent a rare/high quality habitat or riparian community and are important for maintaining plant diversity (Washington DNR 2021a). According to the WNHP website, the WHCV wetland has a cover type containing USNVC North Pacific Transitional Poor Fen and North Pacific Conifer Basin Swamp Subgroups. Although there is potential for a hydrological connection from the WHCV to the transmission line wetland (#1564), the WHCV is located upslope of and outside of the Project Boundary. Therefore, the portion of the wetland complex within the Project Boundary was rated separately and categorized as a Category II wetland based on functions and lack of special habitat characteristics. Only the portion of this wetland complex within the Project Boundary was visited. No rare or high-quality plant associations or rare plant species were observed within the Project Boundary portion of this wetland complex. Twelve acres of this 233-acre wetland complex are within the Project Boundary.

The Powerline and Illabot spawning channels were rated as Category III wetlands within the Bacon Creek to Sauk River Crossing segment. These wetlands scored low to moderate for water quality and hydrologic functions because they can receive and detain hyporheic flows and groundwater. Other than some dust from access roads, these wetlands do not receive pollutants found in stormwater runoff. However, these wetlands were rated as high for habitat function because they are structurally diverse, have a variety of hydroperiods, contain habitat features that provide refuge and riparian shading, and are largely connected to other undisturbed habitats.

Segment 3: Sauk River Crossing to Oso

Approximately 29 percent of the wetlands along the transmission line ROW occur within Segment 3. Wetlands within this segment cover on average 2 acres or less of the land within the transmission line ROW. The largest wetland is a depressional PFO/PSS wetland located northeast of Darrington.

Fourteen acres of this 39-acre wetland occur within the transmission line ROW. Wetlands were mapped adjacent to the transmission line ROW associated with Montague Creek; recent beaver activity and human actions may be contributing to additional wetland development on the floodplain of the creek.

Segment 4: Oso to SR 528

Much of the wetland area within the transmission line ROW portion of the Project Boundary (43 percent) occurs within Segment 4. The wetlands in this segment vary in size, with most covering 2 acres or less of the land within the transmission line ROW.[70] The largest wetland is part of a 186-acre PFO/PSS/PEM depressional wetland associated with Olsen Lake and several streams northeast of Marysville. Thirteen acres of this wetland occur within the transmission line ROW.

Most of the Category III wetlands are in Segments 3 and 4 (Sauk River Crossing to Oso and Oso to SR 528). These wetlands typically scored moderate to high for water quality depending on their location. For instance, a wetland next to SR 530 would receive a higher water quality and hydrologic score because it can detain and filter road runoff. Wetlands within the Stillaguamish River basin also received a higher water quality score as there is an Ecology-approved Water Quality Improvement project for that basin. Conversely, wetlands in the adjacent Snohomish River basin, where there is not an approved Water Quality Improvement project, scored lower. Location also affects the habitat score. Wetlands near SR 530 or a study road have lower scores because roads fragment habitat and often break connectivity between areas of undisturbed or less-disturbed habitats. Wetlands entirely within the managed transmission line ROW likely scored low due to a lack of plant diversity and structural complexity that results from periodic clearing and maintenance while wetlands that extend beyond the managed transmission line ROW are likely to be more diverse and scored higher.

Thirteen of the 32 acres of Category II wetlands within Segment 4 are associated with Olsen Lake and several other large wetlands within the lower South Fork Stillaguamish River basin. These wetlands often scored high for water quality and hydrologic functions due to their large size compared to the contributing basin and because they are near developed areas, reflecting their potential to filter pollutants in surface runoff, or because they are near an impaired stream listed as polluted by Ecology. Habitat function is also relatively high due to multiple hydroperiods and diverse vegetation structure.

Segment 5: SR 528 to Bothell Substation

The remaining 10 percent of wetlands within the transmission line ROW occur within Segment 5. Wetland #3954 is the largest individual wetland within the transmission line ROW in this segment; 3 acres of this 4-acre wetland are within the Project Boundary. Although larger wetlands occur along the segment, most of the wetland area is outside of the Project Boundary. The largest wetland in this segment is in agricultural fields in the Snohomish River Valley.

Due to the vegetation management within the transmission line ROW, vegetation throughout the ROW is relatively disturbed, and the structure is less complex. Trees are generally absent from the portions of wetlands directly within the ROW, and tall shrubs are infrequent and provide little

[70] These values are an estimate of the average area of each wetland within the Project Boundary and do not include wetland areas that may extend outside of the Project Boundary.

cover. The majority of wetlands are characterized by a monoculture of spirea, which provides minimal habitat diversity. Additionally, the access road network throughout the transmission line ROW can alter the natural hydrology of these areas as water flows adjacent to the roadbed and into culverts. Access roads are effective impervious surface areas and contribute to erosion and delivery of suspended sediments in stormwater runoff to some wetlands. Some erosion is caused by unauthorized off-road vehicle use. Roads can also fragment and disconnect these wetlands from their protective buffers and nearby habitats.

Segment 6: Fish and Wildlife Mitigation Lands

The fish and wildlife mitigation lands encompass approximately 26 percent of all mapped wetlands in the study area. The majority of these are the PFO habitats within the Nooksack River basin parcels, and the PFO/PSS/PEM wetland complexes at the Skagit – Sauk River confluence within the McLeod, Napoleon, False Lucas, Barnaby, O'Brien, and Illabot sloughs mitigation lands. All wetlands within the fish and wildlife mitigation lands, as well as the transmission line, are within the Project Boundary.

<u>RLNRA</u>

Parcels 6A, 6B: County Line Ponds and Newhalem Ponds

City Light constructed the spawning channels within these lands to improve salmonid habitat as part of the Fisheries Settlement Agreement under the current FERC license. City Light completed construction of the spawning channels at Newhalem Ponds and County Line Ponds in 1991, providing 81,000 square feet (1.9 acres) and 22,000 square feet (0.5 acre) of new or restored off-channel aquatic habitat, respectively. City Light expanded the County Line Ponds in 1996, providing an additional 730 square feet (0.2 acres) of habitat. Wetlands within these lands are primarily located around the edges of ponds that were created during past gravel extraction activities. The Newhalem Ponds parcel is still used as a storage facility for the Project, as well as a site for depositing large woody debris into the Skagit River. A total of 9 acres of wetlands were mapped within these two parcels, as described below. In addition to determining vegetative cover, a functional assessment was conducted on these wetlands due to Project activities at the Newhalem Ponds and beaver dam management at the County Line Ponds.

Approximately 6 acres of wetlands were mapped within the County Line Ponds, and 3 acres of wetlands at the Newhalem Ponds (Table 4.2.4-16). The banks of the Newhalem Ponds are fairly steep, and wetlands are located as a narrow fringe along the pond shore or on small jetties extending toward the center. The shallow and low gradient banks along the County Line Ponds support wetlands along most of the ponds' shoreline. All wetlands had a forested component, with red alder dominant along the banks of the ponds. Douglas spirea and red osier dogwood dominated the shrub layer, while slough sedge dominated the emergent layer. Several areas of reed canarygrass were observed along the shores of the ponds, more prominently at the County Line Ponds parcel.

Table 4.2.4-16. Wetland acreage by Cowardin vegetation class at County Line Ponds and Newhalem Ponds.[1]

Parcel No. & Name	PFO	PFO/PSS	PFO/PEM	Total
6A: County Line Ponds	1 [1]	5 [1]	0	**6 [2]**
6B: Newhalem Ponds	0	1 [2]	2 [4]	**3 [6]**
Total	**1 [1]**	**6 [3]**	**1 [4]**	**9 [8]**

1 Numbers in brackets are counts of individual wetlands.

All wetlands on the County Line Ponds (6A) and Newhalem Ponds (6B) parcels were visited, and all rated as Category III wetlands. These wetlands have moderate water quality and hydrologic functions because they can hold water to trap sediment and detain water during high flows. However, wetlands at the Newhalem Ponds scored slightly higher due to the Project activities in the immediate vicinity, which can potentially contribute to pollutants (e.g., suspended sediment) in stormwater runoff. Wetlands at both parcels provide a high habitat function based on their structural diversity and multiple hydroperiods. Special habitat features observed during the site visit included downed wood and standing snags. These wetlands also provide a connection to other habitats, particularly the Skagit River.

As described above, City Light uses the Newhalem Ponds parcel as a storage facility for the Project. Large wood, gravel, metal culverts, and heavy machinery are all stored at this site. Additionally, the machinery used to transport these materials to and from the site has compacted soils, which can lead to sedimentation and an excess of stormwater runoff to nearby wetlands. City Light is in the process of restoring forested habitats and reducing the footprint of the storage facility. Large woody debris piles have been created and plantings completed in an approximately 0.7-acre area adjacent to the east pond. Large amounts of concrete and asphalt debris from historical activities have been removed and disturbed areas were planted on November 10, 2021. Removal of 1,000 feet of the boat launch road was completed in 2021. In addition, other road abandonment and restoration actions and control of invasive plants are being implemented as part of City Light's Aggregate Storage Facility Implementation Plan.

The County Line Ponds wetlands are not in the vicinity of any Project activity. However, there have been several accounts of beaver activity within the constructed spawning channels.

<u>South Fork Nooksack Basin</u>

Parcels 6C, 6D, 6E: Bear Lake, Nooksack, Nooksack West

A total of 317 acres of wetlands were mapped within mitigation lands in the South Fork Nooksack River basin (Table 4.2.4-17). Only wetlands along the study roads that could be safely accessed were visited. Most of the wetlands mapped here are along the South Fork Nooksack River, away from study roads or other potential effects. Therefore, a remote sensing analysis was primarily used to map wetlands. As a result, wetland area might be overestimated, particularly in riparian areas. Most of the modeled wetlands within these parcels are palustrine forested wetlands that are hydrologically connected to the river. In total, the Nooksack parcel contains 295 acres (93 percent), and the Nooksack West parcel contains 14 acres (4 percent). Most are narrow, forested bands along the banks of the South Fork Nooksack River. Aerial photos indicate that black cottonwood and red alder likely dominate these deciduous forests. Additional forested wetlands occur along several of the stream channels that flow into the South Fork Nooksack River from the south and east. The remaining 8 acres (3 percent) within the Bear Lake parcel were mapped, primarily in and around the lake. A small lake fringe emergent wetland was mapped on the northeast edge of Bear Lake that is likely inundated during higher lake levels.

Table 4.2.4-17. Wetland acreage by Cowardin vegetation class on fish and wildlife mitigation lands within the South Fork Nooksack River basin.[1]

Parcel No. & Name	PFO	PFO/ PSS	PFO/ PEM	PFO/ PSS/ PEM	PSS	PSS/ PEM	PEM	PUB	Total
6C: Bear Lake	0	0	0	0	0	0	3 [1]	5 [1]	**8 [2]**
6D: Nooksack	285 [60]	0	7 [1]	0	0	0	3 [1]	0	**295 [62]**
6E: Nooksack West	14 [9]	0	0	0	0	0	0	0	**14 [9]**
Total	**299 [69]**	**0**	**7 [1]**	**0**	**0**	**0**	**6 [2]**	**5 [1]**	**317 [73]**

1 Numbers in brackets are counts of individual wetlands.

Sauk River Basin

Parcels 6F, 6G, 6H, 6I, 6J: Dan Creek, Everett Creek, North Everett Creek, North Sauk, Sauk Island

A total of 14 acres of wetlands were mapped within the fish and wildlife mitigation lands within the Sauk River basin (Table 4.2.4-18). The North Everett Creek parcel includes 12 acres (86 percent), and the North Sauk parcel includes 2 acres (14 percent). The Everett Creek, Sauk Island, and Dan Creek parcels include no mapped wetlands. Most of the wetlands are palustrine deciduous forested wetlands along North Everett Creek. Similar to other sloughs in the vicinity, red alder, black cottonwood, and western red cedar (*Thuja plicata*) dominate these wetlands. Narrow shrub-dominated sloughs, predominantly covered by willow species, connect the larger forested wetlands. These sloughs are depressional-outflow HGM types that are likely supported hydrologically by the Sauk River and North Everett Creek during high flows and groundwater during the drier seasons.

Table 4.2.4-18. Wetland acreage by Cowardin vegetation class on fish and wildlife mitigation lands within the Sauk River basin.[1]

Parcel No. & Name	PFO	PFO/ PSS	PFO/ PEM	PFO/ PSS/ PEM	PSS	PSS/ PEM	PEM	Total
6F: Dan Creek	0	0	0	0	0	0	0	**0**
6G: Everett Creek	0	0	0	0	0	0	0	**0**
6H: North Everett Creek	9 [3]	0	0	0	3 [1]	0	0	**12 [4]**
6I: North Sauk	2 [2]	0	0	0	0	0	0	**2 [2]**
6J: Sauk Island	0	0	0	0	0	0	0	**0**
Total	**11 [5]**	**0**	**0**	**0**	**3 [1]**	**0**	**0**	**14 [6]**

1 Numbers in brackets are counts of individual wetlands.

Skagit River Basin

A total of 329 acres of wetlands were mapped within the fish and wildlife mitigation lands within the Skagit River basin (Table 4.2.4-19).

Table 4.2.4-19. Wetland acreage by Cowardin vegetation class on fish and wildlife mitigation lands within the Skagit River basin.[1,2]

Parcel No. & Name	PFO	PFO/ PSS	PFO/ PEM	PFO/ PSS/ PEM	PSS	PSS/ PEM	PEM	Total
6K and 6L: B&W Road 1 & 2	5 [3]	0	0	0	0	0	0	**5 [3]**
6M: Bacon Creek	3 [7]	0	0	0	0	0	0	**3 [7]**
6N: Barnaby Slough	0	0	0	35 [1]	0	0	0	**35 [1]**
6O: Bogert and Tam	0	0	0	0	0	0	0	**0**
6P: Corkindale Creek	0	0	0	0	0	0	6 [7]	**6 [7]**
6Q: Day Creek Slough	0	0	0	0	0	0	2 [1]	**2 [1]**
6R: False Lucas Slough	0	0	0	50 [2]	0	0	0	**50 [2]**
6S: Finney Creek	9 [9]	0	0	0	0	0	0	**9 [9]**
6T: Illabot North	6 [1]	1 [4]	0	73 [2]	0	0	0	**80 [7]**
6U: Illabot South	47 [13]	0	0	0	0	0	0	**47 [13]**
6V: Johnson Slough	0	0	0	7 [1]	1 [1]	0	0	**8 [2]**
6W: McLeod Slough	12 [2]	0	0	0	0	0	0	**12 [2]**
6X: Napoleon Slough	1 [2]	0	0	0	0	0	0	**1 [2]**
6Y: O’Brien Slough	11 [1]	0	0	0	0	0	0	**11 [1]**
6AA: Savage Slough	9 [2]	0	31 [1]	0	0	0	20 [3]	**60 [6]**
Total	**103 [40]**	**1 [4]**	**31 [1]**	**165 [6]**	**1 [1]**	**0**	**28 [11]**	**329 [63]**

1 Numbers in brackets are counts of individual wetlands.
2 Parcels 6Z Pressentin and 6AB South Marble 40 are not included in this table because they did not contain any wetlands.

In total, 80 acres (24 percent) of wetlands are part of the Illabot North mitigation parcel. These wetlands consist of large and diverse sloughs next to the southeast side of the transmission line ROW. Black cottonwood and red alder dominate these deciduous forested wetlands. The sloughs have defined channels with scrub-shrub cover in areas that are seasonally inundated and emergent vegetation in areas that are inundated most of the year. These sloughs could not be accessed, and, therefore, the dominant shrub and herbaceous species in the understory were unassessed. These sloughs are depressional-outflow HGM types that are likely supported hydrologically by both surface and groundwater.

60 acres (18 percent) of wetlands within the Skagit River basin are part of the Savage Slough parcel located along the south side of the Skagit River, between the towns of Lyman and Hamilton. Most of the wetlands on these parcels are PFO/PEM along a side channel providing off-channel habitat for salmon. Additional wetlands are located within a large field covered by grass. City Light has recently installed mitigation plantings here to promote structural diversity.

The False Lucas Slough parcel includes approximately 50 acres (15 percent) of wetlands within these mitigation lands, the Illabot South parcel includes 47 acres (14 percent), and the Barnaby Slough parcel includes 35 acres (11 percent). A diverse PFO/PSS/PEM type covers the False Lucas Slough and Barnaby Slough parcels. The outer edges of the wetland area of these two sloughs were visited. Red alder dominated the forested cover class. Twinberry (*Lonicera involucrata*), salmonberry, and willow were the predominant shrub species observed. Lady-fern (*Athyrium filix-femina*), soft rush, slough sedge, skunk cabbage, and common cattail were the dominant emergent species. The Illabot South parcel exhibited a similar native plant composition; however, much of the shrub and emergent vegetation was under a closed forest canopy dominated by red alder. Dense reed canarygrass covered large areas in both Barnaby and False Lucas sloughs, and bittersweet nightshade (*Solanum dulcamara*) was also observed in portions of False Lucas Slough.

The remaining 57 acres (17 percent) of mapped wetland within mitigation lands in the Skagit River basin are located in the following parcels: McLeod Slough (12 acres; 4 percent); O'Brien Slough (11 acres; 3 percent); Finney Creek (9 acres; 3 percent); Johnson Slough (8 acres; 2 percent); Corkindale Creek (6 acres; 2 percent); B&W Road 1 and 2 (5 acres; 2 percent); Bacon Creek (3 acres; 1 percent); Day Creek Slough (2 acres; 1 percent); and Napoleon Slough (1 acre; less than 1 percent). No wetlands were mapped within the Bogert and Tam parcel.

Approximately 197 acres of wetlands within the fish and wildlife mitigation lands are within the 100-year floodplain of the Skagit River. A functional assessment of these wetlands, which may be hydrologically influenced by the river by either overbank or hyporheic flows, was conducted. Of the 20 wetlands, 13 are depressional wetlands and 7 are riverine wetlands. Only wetlands on the Barnaby Slough, False Lucas Slough, Illabot North, McLeod Slough, and O'Brien Slough parcels were visited, and most were Category II wetlands. One acre of wetland is mapped within the Napoleon Slough parcel and was a Category III wetland (Table 4.2.4-20).

Table 4.2.4-20. Wetland acreage by rating category of fish and wildlife mitigation lands within the Skagit River 100-year floodplain.[1]

Parcel No. & Name	II	III	Total
6N: Barnaby Slough	35 [1]	0	**35 [1]**
6R: False Lucas Slough	50 [2]	0	**50 [2]**
6T: Illabot North	79 [3]	1 [5]	**80 [8]**
6V: Johnson Slough	0	8 [3]	**8 [3]**
6W: McLeod Slough	0	12 [2]	**12 [2]**
6X: Napoleon Slough	0	1 [3]	**1 [3]**
6Y: O'Brien Slough	11 [1]	0	**11 [1]**
Total	**175 [7]**	**22 [13]**	**197 [20]**

1 Numbers in parenthesis are counts of individual wetlands.

Wetlands on the Illabot North and False Lucas Slough parcels comprise most of the Category II wetlands, containing 79 acres (45 percent) and 50 acres (29 percent), respectively. The remaining Category II wetlands occur on the Barnaby Slough (35 acres; 20 percent) and O'Brien Slough (11 acres, 6 percent) parcels. These wetlands have a moderate water quality function because they are large, vegetated depressions with the ability to trap and filter pollutants, but much of their contributing basin is undeveloped and pollution sources are low. These large vegetated depressions can detain large amounts of water during floods and high flow. These wetlands also provide a high habitat function as they have multiple hydroperiods and relatively diverse vegetation structure, which increases habitat suitability for a larger array of wildlife. Several of the sloughs within the floodplain also provide off-channel habitat for salmonid species, including federally listed Chinook Salmon.

The 12 acres of wetlands on the McLeod Slough parcel make up most of the acreage of Category III wetlands. They have moderate water quality and hydrologic functions because they are near sources of pollution and excess runoff, such as the Concrete – Sauk Valley Road and agricultural operations. These wetlands provide high habitat function due to their diversity in vegetative structure, multiple hydroperiods, and connectivity to other habitats, including the Skagit River. The same is true for the 8 acres of Category III wetland on the Johnson Slough parcel. The one acre of Category III wetland on the Napoleon Slough parcel is located along a tributary that flows north into the Skagit River and is part of a larger wetland that continues outside of the parcel to the east. The one acre of Category III wetland on the Illabot North parcel includes the portions of the Illabot and Powerline spawning channels that are outside of the transmission line ROW. Similar to other wetlands in the watershed, these wetlands have depressions that detain floodwaters and trap pollutants, but pollutant input is relatively limited. They have a high habitat function, as they have a diverse vegetative structure and are near priority habitats (such as riparian vegetation) and habitat features (such as snags and logs).

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 Indian Tribes or Canadian First Nations consider as culturally important. A list of these species was created based on feedback from the Stillaguamish Tribe of Indians, the Sauk-Suiattle Indian Tribe, the Swinomish Indian Tribal Community, the Upper Skagit Indian Tribe, and the Nlaka'pamux Nation Tribal Council. Survey crews recorded 1,311 individual occurrences of 118 culturally important plant species.

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 also occur. Additionally, trees are important in recreational areas to provide shade, and shrubs and grasses prevent erosion and increase the aesthetic values of these sites.

Rare, Threatened, and Endangered Plant Species

For this Project, RTE plant species are defined as vascular plant species that are on one or more of the following lists: (1) ESA Federally Listed or Proposed; (2) ESA Federal Candidates; (3) ESA Federal Species of Concern; (4) State Listed Species; and/or (5) USFS Sensitive Species.

City Light developed a list of vascular plant species of interest that could potentially occur based on known RTE plant species occurrences and potential suitable habitats present within the study area, an NPS survey report (Bivin and Rochefort 2010), and consultation with the NPS botanist (Bivin 2019a, personal communication) as part of the Pre-Application Document (PAD) (City

Light 2020a) for the Project. Additionally, City Light queried the U.S. Fish and Wildlife Service's (USFWS) online Information for Planning and Consultation (IPaC) to determine whether any federally endangered, federally threatened, and proposed endangered, threatened, and candidate plant species should be considered as part of any future effects analysis of the Proposed Action. In response to a request from USFS, two lichen species, blue vinyl (*Leptogium cyanescens*) and cartilage lichen (*Ramalina thausta*), were added to the target list of RTE plant species for surveys on USFS land. There were 25 RTE species in total identified that had potential to occur in the Project vicinity (Table 4.2.4-21).

No ESA-listed or -proposed plant species has ever been observed or mapped within the Project Boundary, including the fish and wildlife mitigation lands. The only botanical resource identified by the IPaC report was whitebark pine (*Pinus albicaulis*), which 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 (Hoffman et al. 2015) and, therefore, is not present within the Project Boundary or foreseeably affected by the Project.

The study area for the TR-03 RTE Plants Study consists of the land within the Project Boundary that is subject to Project-related O&M and/or Project-related recreation. The study area is shown in Figures 4.2.4-7 through 4.2.4-9. Potentially suitable habitats that coincided with Project-related O&M and/or Project-related activities were surveyed. Survey methods and specific areas that were targeted during the surveys are further detailed in the RSP and TR-03 RTE Plants Study Interim Report (City Light 2022d). RTE plant surveys were concurrent with field surveys conducted for the TR-04 Invasive Plants Study (City Light 2022c).

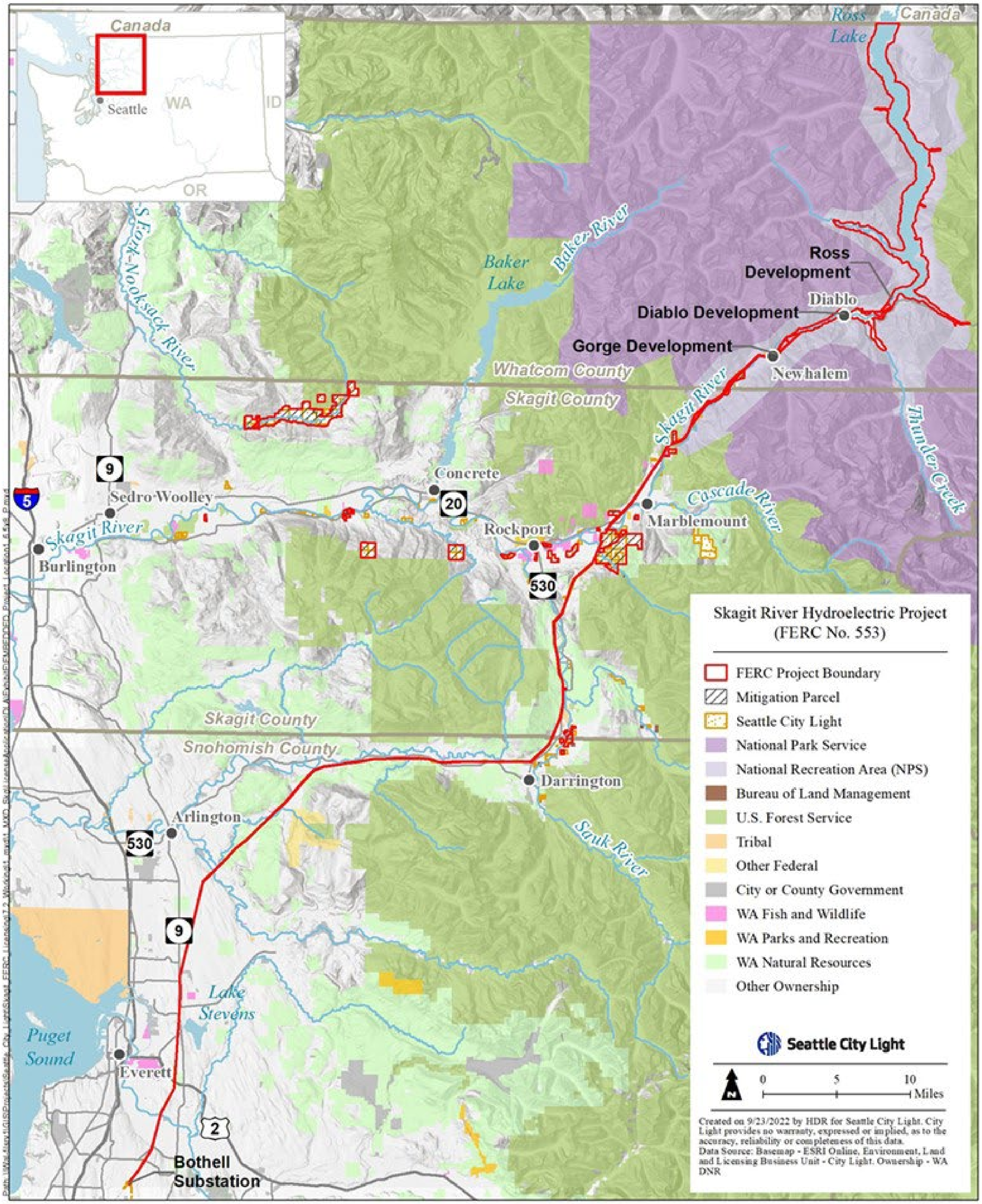


Figure 4.2.4-7. Study area overview.

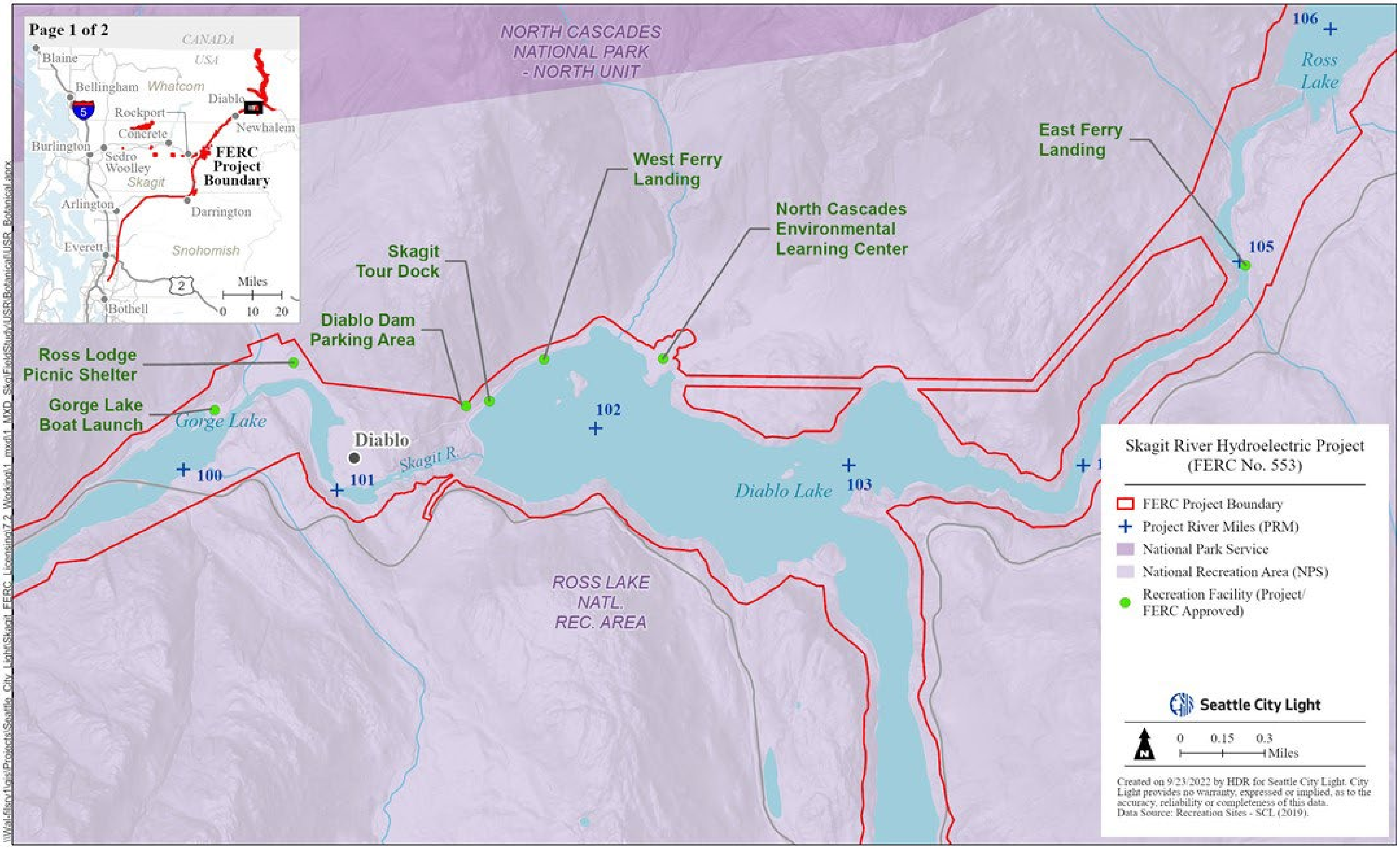


Figure 4.2.4-8. Study area associated with recreation facilities at and around Diablo and Gorge lakes.

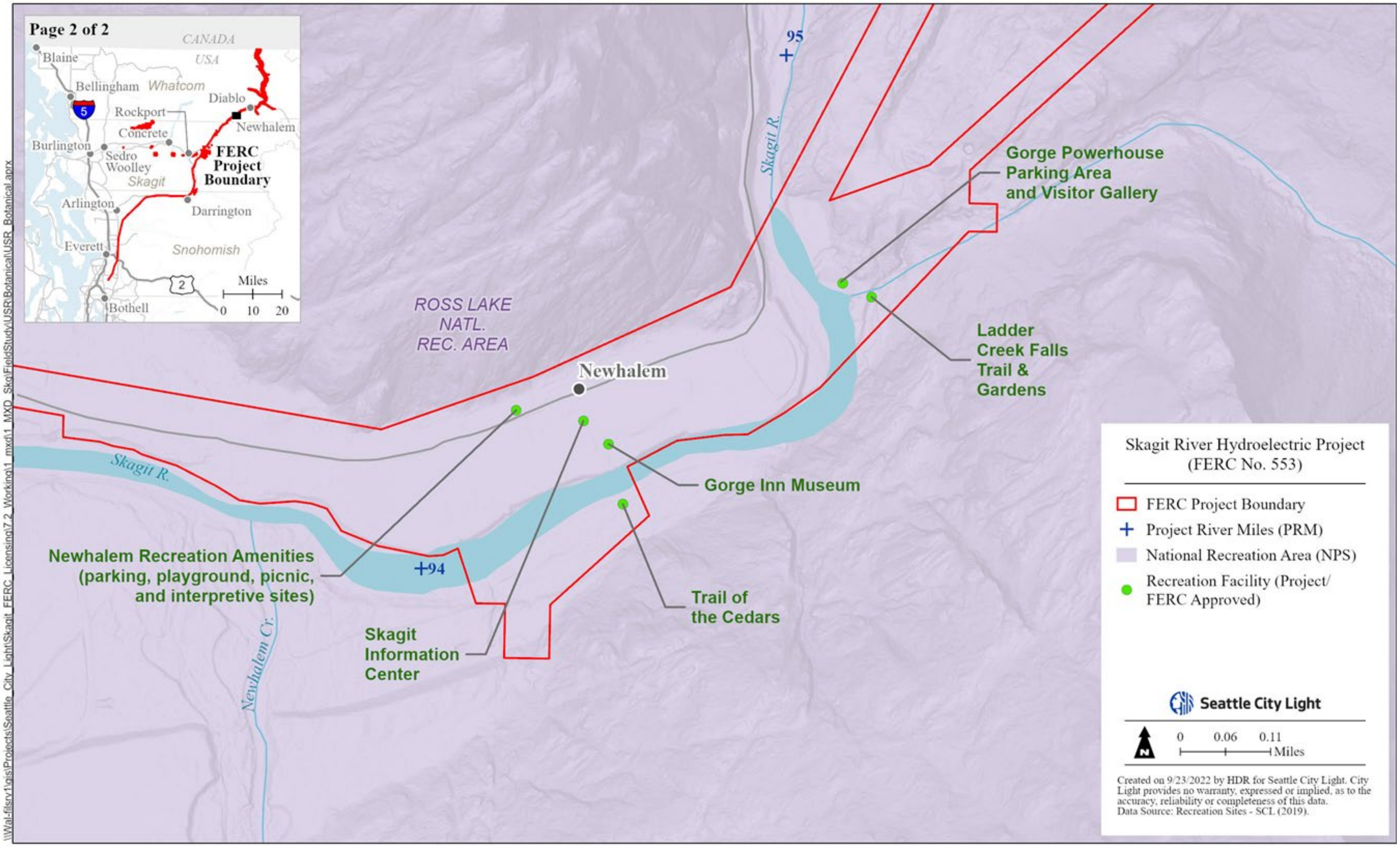


Figure 4.2.4-9. Study area associated with recreation facilities at and around Newhalem.

Field surveys were conducted between June and September 2021. Additional surveys occurred between June and September 2022 at specific areas not visited during the 2021 field season and at other specific areas where 2021 surveys had occurred outside of the peak flowering times.

Through the assessment of potentially suitable habitats, City Light determined that 23 vascular plant species and two lichen species have potential to occur in the study area (Table 4.2.4-21). Suitable habitats for the RTE plant species were observed throughout the study area and include wetlands, riparian areas, seeps, upland forest, upland meadows, and rocky outcrops (see Attachment C of the TR-03 RTE Plants Study Draft Report [City Light 2022d]). However, none of the plant species on the target species list were found during the surveys (nor observed incidentally during other fieldwork). One state-listed plant species, boreal jewelweed (*Impatiens noli-tangere*), was observed during a September 1, 2022 survey. This species was not on the target RTE plant list[71] for the Project but was observed as field crews were searching for all RTE plant species, including other target species in that genus.

Boreal jewelweed is a native, hairless, branching, succulent annual herbaceous plant in the balsam family (*Balsaminacea*). It has a global rank of 5 (G5-Secure), meaning it is at a very low risk of extirpation due to a very extensive range, abundant occurrences, and little to no concern from decline or threats. It is state-listed as Sensitive, meaning it is vulnerable or declining and could become Threatened or Endangered in Washington. Threats include habitat loss from timber harvest, recreation, grazing, or competition from introduced plants. It is considered to be widely distributed across the state but with relatively few populations (less than 20). It has been documented in Whatcom and Skagit counties.

One population of boreal jewelweed was found in the study area (location information for this observation is considered confidential and is not included in this report). Subpopulations range from 50 plants to 100 plants. Associated dominant plant species observed included: stinging nettle (*Urtica dioica)*, bracken fern, common sword fern, three-leaf foamflower (*Tiarella trifoliata var. unifoliate*), and lady-fern (*Athyrium filix-femina*) in the herbaceous layer; salmonberry, and red elderberry (*Sambucus racemose*) in the shrub layer; and bigleaf maple, western red cedar, western hemlock in the tree layer. Associated weeds and non-native plants included: herb-Robert (*Geranium robertianum*), greater burdock (*Arctium lappa*), creeping buttercup (*Ranunculus repens*), and common hemp nettle (*Galeopsis tetrahit*).

71 Was not included as a species of interest by City Light or LPs during the development of the target RTE plant species list.

Table 4.2.4-21. Target list of RTE plant species with potential to occur in the study area.

Species Name[1]	Common Name[1]	Flowering Times	Last Documented	State Status (Rank) 2021[2]	Habitat Requirements[3]	Elevation Range (feet)	Wetlands, Streams/ Riparian	Wet to Moist Meadow	Upland Meadow	Upland Forest	Rocky Outcrop
Botrychium hesperium	**western moonwort**	May to August	-	S (S2)	Moist open areas in meadows and forests.[4]	2,493-6,300	-	X	-	X	-
Botrychium paradoxum	**two-spiked moonwort**	June to August	Suspected	T (S2)	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.	2,460-6,560	X	X	X	X	X
Botrychium pedunculosum	**stalked moonwort**	June to August	2010	T (S2)	Moist or dry meadows, springs, stream terraces, coniferous forests, and forest edges.	1,640-4,350	-	X	X	X	-
Carex buxbaumii	**Buxbaum's sedge**	June to August	-	-	Bogs, marshes, wet meadows.	0-2,000[5]	X	X	-	-	-
Carex capillaris	hair sedge	June to August	2010	S (S1)	Streambanks, wet meadows, bogs, and marshy lake lakeshores.	2,790-6,496	X	X	-	-	-
Carex comosa	**bristly sedge**	May to July	-	-	Marshes, lake edges, wet meadows.	30-2,525	X	X	-	-	-
Carex flava	**yellow sedge**	June to August	-	-	Wet meadows, forested wetlands, bogs, shores of streams, and lakes.	1,150-4,265	X	X	-	X	-
Carex macrochaeta	**Alaska long-awn sedge**	June to August	2010	S (S1)	Moist open spaces, including seeps and wet meadows, and around streams, lakes, and waterfalls.	1,195-3,200	X	X	-	-	-
Carex pluriflora	**black bog sedge**	June to July	1988	S (S2)	Wetlands, boggy lake margins, prairies, streambanks, and coastal inland areas.	165-3,165	X	X	-	-	-
Carex rostrata	northern beaked sedge	June to August	2010	S (S2)	Fens, bogs, quaking or floating peat, lake and stream shores, wet meadows; often in shallow water or on floating mats.	3,200-5,120	X	X	-	-	-
Cicuta bulbifera	**bulblet-bearing water-hemlock**	August to September	-	S (S2S3)	Edges of marshes, lakes, bogs, meadows, shallow standing or slow-moving water.[4]	230-3,710	X	X	-	-	-
Coptis asplenifolia	fern-leaf goldthread	April to May	-	S (S2)	Moist, cool, old forests with a well-developed litter layer.	95-3,051	-	-	-	X	-
Dendrolycopodium (Lycopodium) dendroideum	**prickly tree clubmoss/tree ground-pine**	All growing season	-	S (S2)	Rocky outcrops, talus fields, moss, and significant debris layers.[4]	785-3,610	-	-	X	-	X
Eriophorum viridicarinatum	**tassel cottongrass**	June to July	2010	S (S2)	Obligate wetland species of cold, usually calcareous swamps, bogs, fens, ponds, and wet meadows.	1,970-6,560	X	X	-	-	-
Githopsis specularioides	common bluecup	mid-April to mid-June	1970	S (S2S3)	Dry, open places at lower elevations, such as thin soils over bedrock outcrops, grassy balds, talus slopes, and gravelly prairies.	195-2,495	-	-	X	-	-
Hypericum majus	**greater Canadian St. John's-wort**	July to September	-	S (S2)	Along ponds and lakeshores, riparian areas.[4]	195-2,330	X	-	-	-	X
Impatiens aurella	**varied jewelweed**	July to September	-	-	Moist shaded areas at low elevations.	0-4,000[5]	X	X	X	X	-
Leptogium cyanescens	blue vinyl	Growing Season	-	E (S1)	Bark, rotten logs, rocks; moist forests, usually near creeks. Coast to mid-elevations.	0-1,540	X	-	-	X	-
Lycopodiella inundata	**bog clubmoss**	All growing season	2010	S (S2)	Sphagnum bogs, wet sandy places, and wetlands adjacent to lakes, marshes, and swampy grounds.	10-1,885	X	-	-	-	-
Montia diffusa	branching montia	April to July	Suspected	S (S1S2)	Moist forests and open fir woodlands in the lowland and lower montane zones; occasionally in xeric soils or disturbed sites.	1,181-2,890	-	-	X	X	-

Species Name[1]	Common Name[1]	Flowering Times	Last Documented	State Status (Rank) 2021[2]	Habitat Requirements[3]	Elevation Range (feet)	Wetlands, Streams/ Riparian	Wet to Moist Meadow	Upland Meadow	Upland Forest	Rocky Outcrop
Oxytropis campestris var. *gracilis*	slender crazyweed	May to June	Suspected	S (S2)	Montane sites on glacial outwash terraces in sandy loam soil, scree, and alpine tundra.	1,870-7,545	-	-	-	-	X
Platanthera chorisiana	choriso bog orchid	July to August	1991	S (S2)	Wettest regions of sphagnum bogs, streams, seeps, wet meadows, gravel outwashes, and moist areas with fine soils; often just above the water table.	2,540-4,265	X	X	-	-	-
Ramalina thrausta	cartilage lichen	All growing Season	-	T (S2)	Low elevation moist coniferous forests.	50-2,790	-	-	-	X	
Silene seelyi	Seely's silene	late May to August	2000	S (S3)	Shaded crevices in ultramafic, granitic, or basaltic cliffs and rocky outcrops, and occasionally among boulders in talus; restricted to sites with poor nutrient and water availability.	1,115-6,560	-	-	-	-	X
Spiranthes porrifolia	**western ladies'-tresses**	July to August	-	S (S2)	Meadows, seeps, streams.[4]	40-6,810	X	X	-	-	-

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 (2019a, 2019b).

2 State Status: E=Endangered; S=Sensitive; T=Threatened; State Rank: S1=Critically Imperiled; S2=Imperiled; S3=Vulnerable. For more detail on state status codes, see Washington DNR (2021b).

3 Source: Camp and Gamon (2011) unless otherwise noted.

4 Source: Hitchcock (1971).

5 Source: Wildflower Search (2021).

Invasive Species

For the purpose of the Project, an invasive plant species was defined as a species in one or more of the following categories: 1) all species listed as Class A or Class B weeds by the County Noxious Weed Boards of Skagit, Whatcom, and Snohomish counties, 2) species identified by NPS as ornamental species that have escaped from historical cultivation in Newhalem, also known as "First Priority Species" (NPS 2011) and listed in the PAD (City Light 2020a),[72] 3) species identified as target species during the 2019 Study Plan Development Process (i.e., reed canarygrass, Japanese knotweed [*Fallopia japonica*], traveler's-joy [*Clematis vitalba*], petty spurge [*Euphorbia peplus*], and sycamore maple [*Acer pseudoplatanus]*), and 4) other non-native species recommended by City Light and/or LPs[73]. The classifications for noxious weeds are defined in Washington State Noxious Weed Control Board [WSNWCB] 2021, Revised Code of Washington 17.10.010, and detailed in the TR-04 Invasive Plants Study Interim Report (City Light 2022c).

The final target list of invasive plant species identified prior to fieldwork includes 141 species in the following categories (the complete list is available as Attachment B of the TR-04 Invasive Plants Study Interim Report [City Light 2022c]):

- 36 species listed as Class A noxious weeds.
- 67 species listed as Class B noxious weeds.
- 13 species listed as Class C noxious weeds.
- 21 species listed as First Priority Species by NPS.
- 2 species that were identified during study planning and not listed as noxious weeds or First Priority Species (i.e., traveler's-joy and petty spurge).
- 2 species added by City Light that are not listed as noxious weeds or First Priority Species (i.e., bishop's goutweed [*Aegopodium podagraria*] and cheatgrass [*Bromus tectorum*]).

To organize the results of the study, the study area was divided into segments similar to those described above for other botanical surveys (with an additional seventh segment called Skagit River [approximately PRM 66.5 to PRM 97.2]) and shown in Figures 4.2.4-10 through 4.2.4-12. Focused surveys were conducted on the land within the Project Boundary where potential Project-related disturbances or pathways for invasive plant species establishment or spread could occur.

City Light conducted surveys for the TR-04 Invasive Plants Study in 2021 and 2022 within the Project Boundary and the banks of the Skagit River from Gorge Dam downstream to the confluence with the Sauk River. Surveys were conducted along the three reservoirs, all accessible

---

[72] The PAD and RSP refer to "First Priority Species" as "Highest Priority Species" as NPS documents appear to use both terms (as well as "Top Priority Species"). The term First Priority Species is used here based on terminology in the Invasive Non-Native Plant Management Environmental Assessment (NPS 2011), which was prepared to address the control and prevention of new infestations of invasive, non-native plants within North Cascades National Park Complex.

[73] This included several Class C noxious weeds that City Light biologists observed on the fish and wildlife mitigation lands and the transmission line ROW. Class C weeds are 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.

portions of the transmission line ROW, along the study routes in 19 fish and wildlife mitigation lands, and along all accessible portions of the 30.7 miles of the Skagit River from Gorge Dam to the confluence with the Sauk River (approximately PRM 66.5 to PRM 97.2).

Surveys were conducted following the qualitative "exploratory" method outlined and described by Rew and Pokorny (2006) and the Intuitive Controlled Survey method used by the Bureau of Land Management (BLM) (BLM 2017; Whiteaker et al. 1998). Some incidental observations of invasive plant species along the transmission line ROW were recorded during field efforts for the TR-02 Wetland Assessment between July and September 2020. Along the transmission line ROW, point data are not depicted for the most common species (e.g., reed canarygrass and Scot's broom), and only large populations of these species are displayed. Ubiquitous species such as St. John's-wort and oxeye daisy (*Leucanthemum vulgare*) are also not mapped.

Focused surveys for invasive species occurred between June and September 2021. The entire study area was surveyed during the 2021 field season except for the following:

- The study routes in the O'Brien Slough and Finney Creek fish and wildlife mitigation properties;
- Approximately 30.7 miles of the right bank of the Skagit River from the Gorge Dam to the confluence with the Sauk River (approximately PRM 66.5 to PRM 97.2); and
- Approximately 22.2 miles of the left bank of the Skagit River (approximately PRM 90 to PRM 97.2; PRM 73 to PRM 88).

Biologists completed surveys of these areas between June 23 and August 5, 2022 in coordination with field surveys for the TR-03 RTE Plants Study.[74] Results of the 2021 and 2022 surveys are discussed below and will also be presented in the Updated Study Report (USR) to be filed in 2023.

Summary of Occurrences

Over 6,100 occurrences of a total of 46 target invasive plant species (of the 141 total targeted species) were observed during field surveys (Table 4.2.4-22 and Appendix C of the TR-04 Invasive Plants Study Interim Report; maps of these occurrences). The TR-04 Invasive Plants Study Interim Report (City Light 2022c) and accompanying geodatabase, available upon request, includes a more detailed account of invasive species found during surveys with associated descriptive information on co-occurring species, the area and density of populations, possible dispersal vectors and sources of disturbance, and existing management efforts, as applicable.

The most widespread species included herb-Robert and reed canarygrass, which were found at all but a few sites. No herb-Robert was documented at sub-segments Ross Lake to Gorge Lake, Corkindale Creek, and Illabot Spawning Channel; and no reed canarygrass was documented at sub-segments B&W Roads 1 and 2, Bogert and Tam, and North Everett Creek. Herb-Robert is listed as a Class B noxious weed by WSNWCB and Whatcom County, and reed canarygrass is listed as a Class C noxious weed. Two Class A noxious weed species were found: egg leaf spurge (*Euphorbia oblongata*) and Italian thistle (*Carduus pycnocephalus*), each limited to small

74 The need for field surveys in 2022 was shared with LPs during the October 7, 2021 TWG, formally known as the Terrestrial Resources and Reservoir Erosion Work Group (TRREWG), meeting.

occurrences at a single site (Diablo townsite for egg leaf spurge and Illabot South for Italian thistle). The sections below provide a brief description of observations, by study area segment or specific study area location.

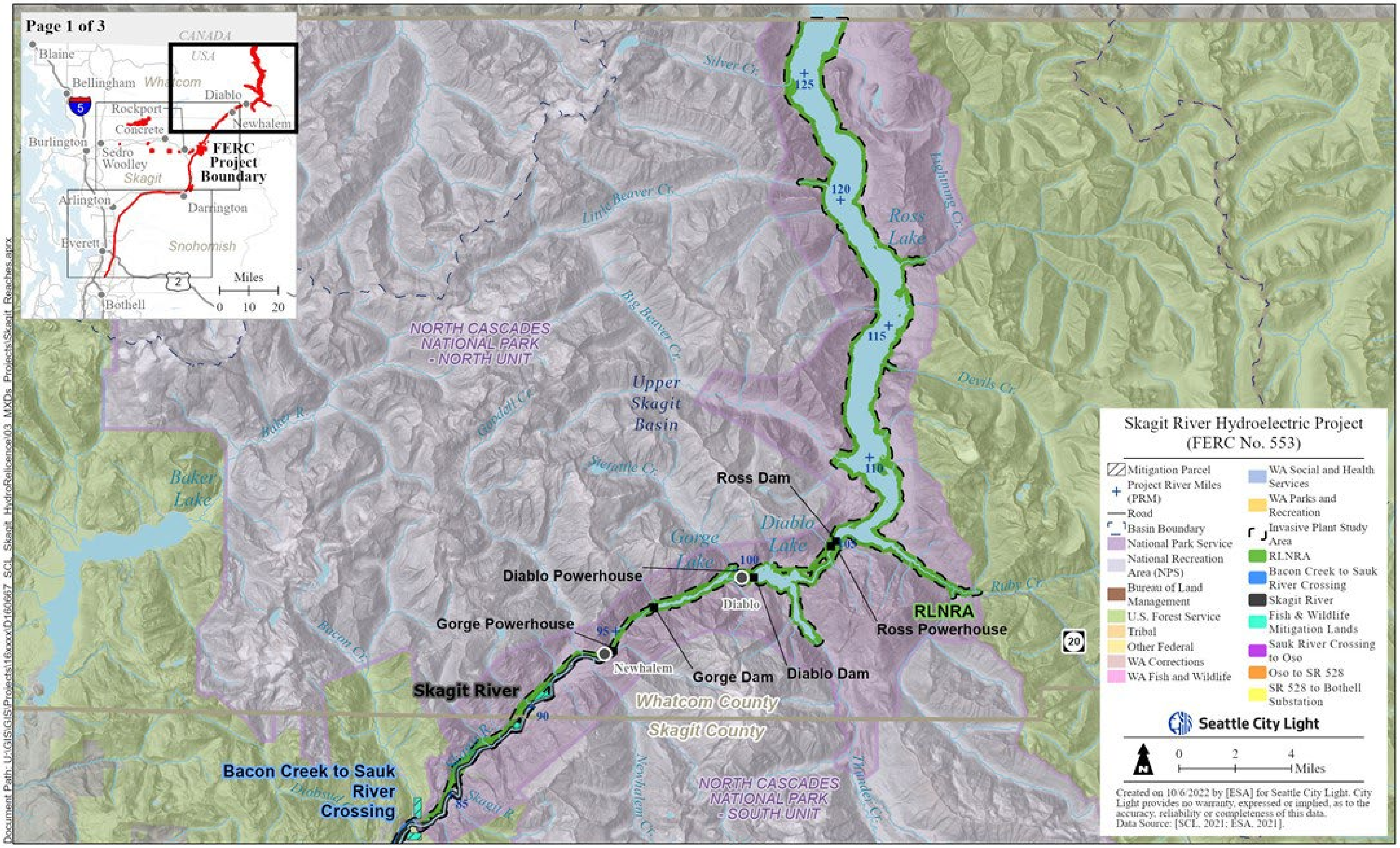


Figure 4.2.4-10. Study area segments for the Invasive Plants Study (north).

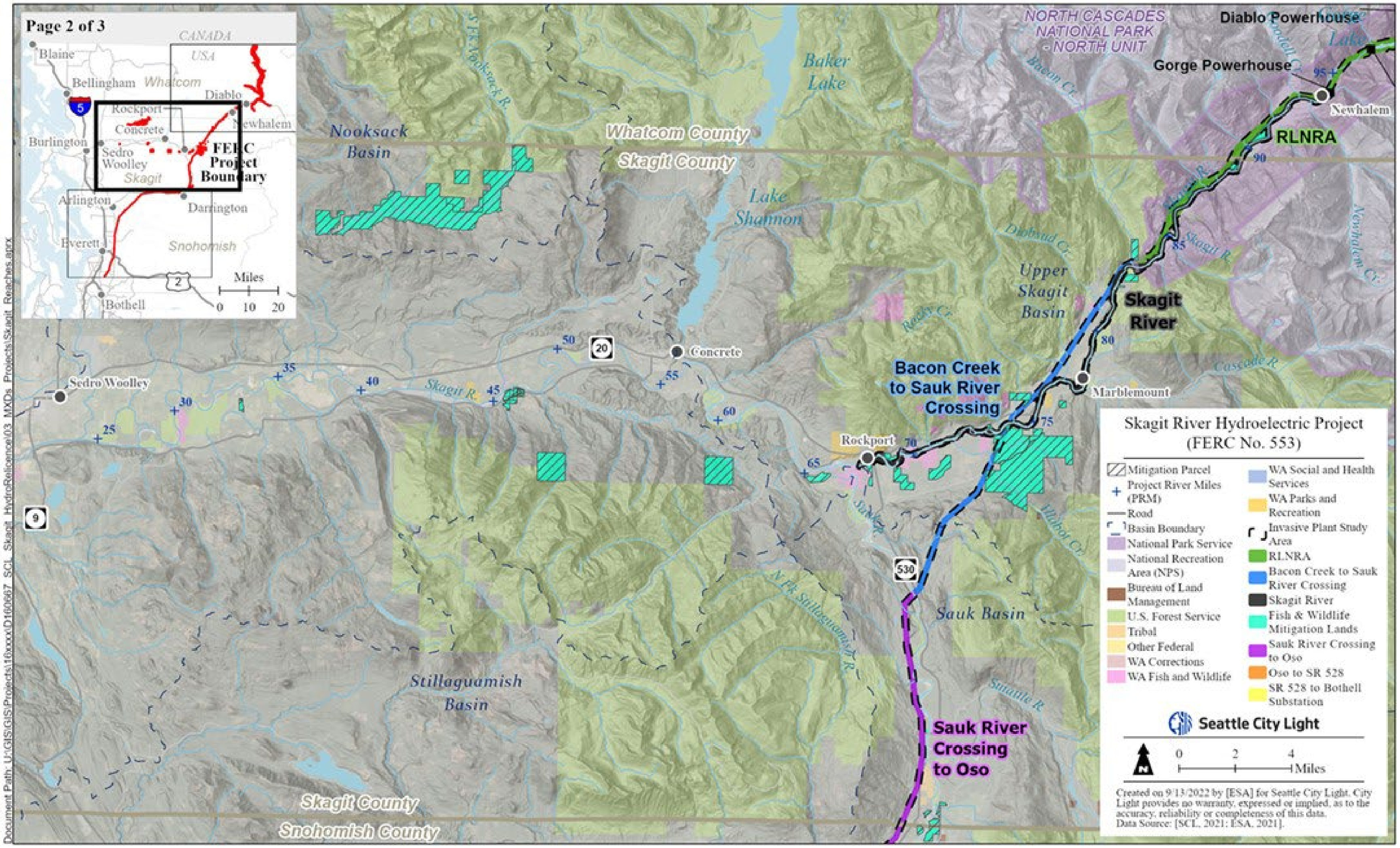


Figure 4.2.4-11. Study area segments for the Invasive Plants Study (central).

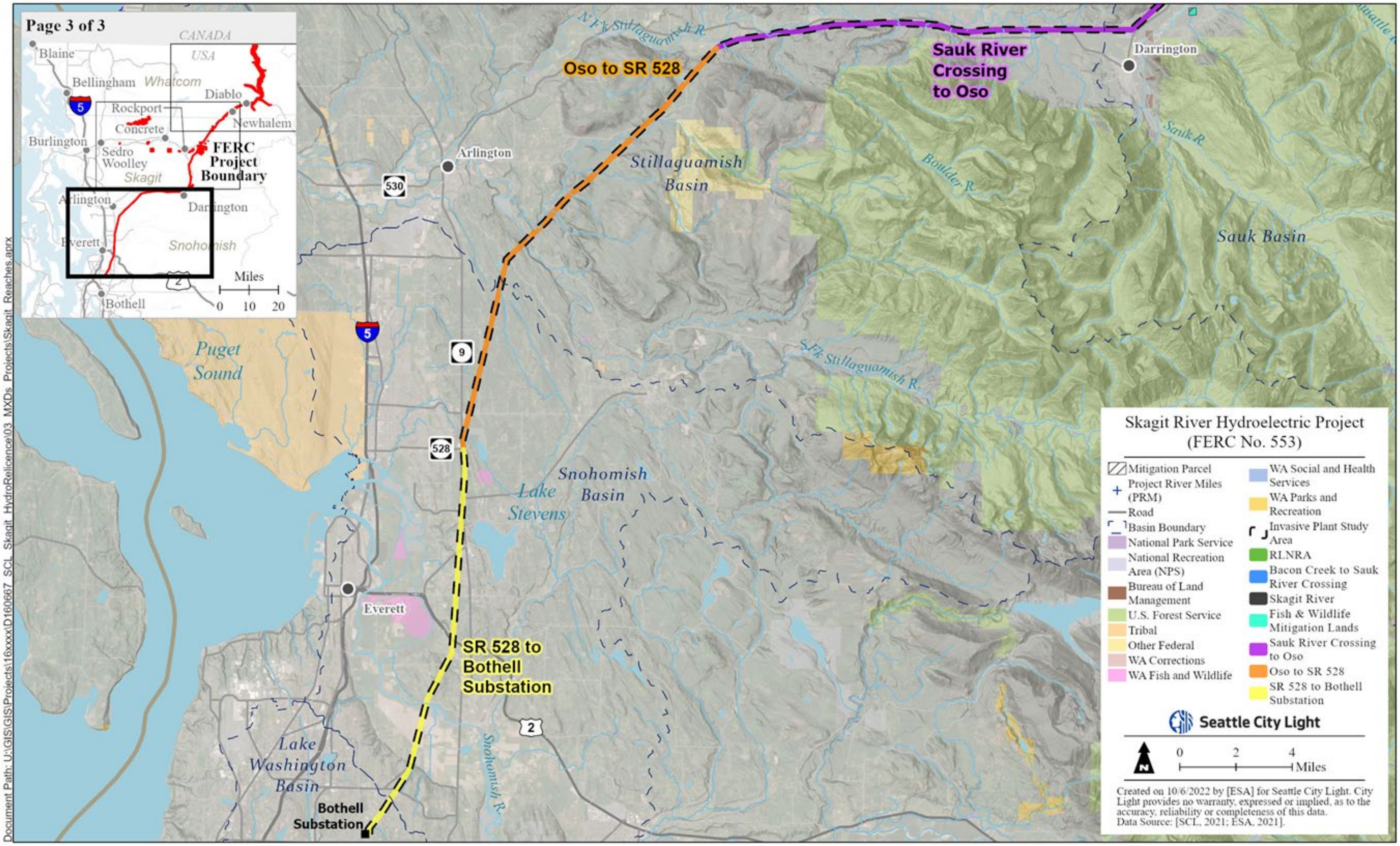


Figure 4.2.4-12. Study area segments for the Invasive Plants Study (south).

Table 4.2.4-22. Observed invasive plant species by location.

Scientific Name	Common Name	Segment 1: RLNRA[1]							Segments 2-5				Segment 6: Fish and Wildlife Mitigation Lands and Other Locations																	Skagit River Banks Gorge Dam to the Sauk
		1A; Ross Lake	1C: Diablo Lake	1D: Gorge Lake	Newhalem Townsite	Diablo Townsite	Ross Lake to Gorge Lake	1E: Gorge Lake to Bacon Creek	2: Bacon Creek to Sauk River Crossing	3: Sauk River Crossing to Oso	4: Oso to SR 528	5: SR 528 to Bothell Substation	6K, 6L: B&W Roads 1 and 2	6M: Bacon Creek	6O: Bogert & Tam	6N: Barnaby Slough	6P: Corkindale Creek	6A: County Line Ponds	6R: False Lucas Slough	6T: Illabot North	6U: Illabot South	Illabot Spawning Channel	6W: McLeod Slough	6B: Newhalem Ponds	6D: Nooksack	6H: North Everett Creek	Powerline Spawning Channel	6AA: Savage Slough	Taylor Spawning Channel	
Acer platanoides[*]	Norway maple	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Acer pseudoplatanus[N]	Sycamore maple	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Aegopodium podagraria[2N]	Bishop's goutweed	-	-	-	X	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arctium lappa[N]	Greater burdock	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-	-	-	-	-	X
Bromus tectorum[2N]	Cheatgrass	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buddleja davidii[B]	Butterfly-bush	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X
Carduus pycnocephalus[A]	Italian thistle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-
Campanula rapunculoides[N]	Creeping bellflower	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centaurea diffusa[B]	Diffuse knapweed	X	-	-	X	X	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centaurea ×gerstlaueri[B]	Meadow knapweed	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centaurea stoebe[B]	Spotted knapweed	X	X	-	-	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cirsium arvense[C]	Canadian thistle	X	X	-	X	X	-	X	X	X	X	X	-	-	-	-	X	-	-	X	-	-	X	-	X	-	-	-	-	X
Cirsium vulgare[2C]	Bull thistle	-	-	-	X	X	-	-	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X
Clematis vitalba[C]	Traveler's-joy	-	-	-	X	X	-	X	X	-	-	-	-	-	X	-	-	X	-	X	-	-	-	-	-	-	X	-	X	X
Convolvulus arvensis[C]	Field bindweed	-	-	-	X	X	-	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Conium maculatum[B]	Poison hemlock	-	-	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crataegus monogyna[C]	English hawthorn	-	X	-	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Cytisus scoparius[B]	Scot's broom	-	X	-	X	X	-	X	X	X	X	X	-	-	X	-	-	X	-	X	X	X	-	X	-	-	-	-	X	X
Daphne laureola[B]	Spurge-laurel	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Echium vulgare[B]	Common viper's bugloss	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euphorbia oblongata[A]	Egg leaf spurge	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fallopia japonica[B]	Japanese knotweed	-	-	-	-	-	-	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Geranium robertianum[B]	Herb-Robert	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	-	X	X	X	X	-	X	X	X	X	X	X	X	X
Hedera helix[C]	English ivy	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hieracium aurantiacum[B]	Orange hawkweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Hieracium pilosella[B]	Mouse-eared hawkweed	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hieracium piloselloides[B]	Tall hawkweed	X	-	X	X	X	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Hypericum perforatum[2C]	St. John's-wort	X	X	X	X	X	X	X	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-	X	X	-	-	-	-	X
Ilex aquifolium[N]	English holly	-	-	-	X	X	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X
Jacobaea vulgaris[2B]	Tansy ragwort	X	-	-	X	X	-	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Juglans nigra[N]	Black walnut	-	-	-	X	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Leucanthemum vulgare[2C]	Oxeye daisy	X	X	X	X	X	X	X	X	X	X	X	-	X	X	-	-	X	-	X	X	-	-	X	X	-	X	-	X	X
Linaria dalmatica[B]	Dalmatian toadflax	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Scientific Name	Common Name	Segment 1: RLNRA[1]							Segments 2-5				Segment 6: Fish and Wildlife Mitigation Lands and Other Locations																	Skagit River Banks Gorge Dam to the Sauk
		1A; Ross Lake	1C: Diablo Lake	1D: Gorge Lake	Newhalem Townsite	Diablo Townsite	Ross Lake to Gorge Lake	1E: Gorge Lake to Bacon Creek	2: Bacon Creek to Sauk River Crossing	3: Sauk River Crossing to Oso	4: Oso to SR 528	5: SR 528 to Bothell Substation	6K, 6L: B&W Roads 1 and 2	6M: Bacon Creek	6O: Bogert & Tam	6N: Barnaby Slough	6P: Corkindale Creek	6A: County Line Ponds	6R: False Lucas Slough	6T: Illabot North	6U: Illabot South	Illabot Spawning Channel	6W: McLeod Slough	6B: Newhalem Ponds	6D: Nooksack	6H: North Everett Creek	Powerline Spawning Channel	6AA: Savage Slough	Taylor Spawning Channel	
Linaria purpurea[*]	Purple toadflax	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Lunaria annua[C]	Honesty	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phalaris arundinacea[C]	Reed canarygrass	X	X	X	X	X	X	X	X	X	X	X	-	X	-	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X
Potentilla recta[B]	Sulphur cinquefoil	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Prunus cerasifera[*]	Cherry plum	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus lauroceraasus[N]	Cherry-laurel	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robinia hispida[N]	Bristly locust	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubus bifrons[C]	Himalayan blackberry	-	-	-	X	X	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X
Sorbus aucuparia[N]	European mountain-ash	-	-	-	X	X	-	X	X	X	X	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Tanacetum vulgare[C]	Common tansy	X	X	X	X	X	X	X	X	X	X	X	-	X	X	-	X	X	-	X	X	-	-	X	X	-	X	-	X	X
Verbascum thapsus[N]	Flannel mullein	X	X	X	X	X	X	X	X	X	X	X	-	-	X	-	-	X	-	X	X	-	-	X	X	-	-	-	-	X
Vinca minor[N]	Lesser periwinkle	-	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

X = Presence of species in specified survey area.
1 Sub-segment 1B: Big Beaver Valley was not included in the invasive species survey area.
2 These species were not on the original target invasive plant list; however, they were included in mapping and reporting at the request of City Light.
* = NPS First Priority Species.
N = Non-native, not listed on Washington State Noxious Weed List.
A = Class A Noxious Weeds: Non-native species with a limited distribution in the state. Eradication is required by state law.
B = Class B Noxious 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.
C = Class C Noxious 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.

<u>Segment 1: RLNRA</u>

Thirty-seven different target invasive plant species were observed within the RLNRA. Common invasive plant species, such as Canadian thistle (*Cirsium arvense*), herb-Robert, and flannel mullein, are widespread and occur in several of the RLNRA sub-segments. The townsites of Newhalem and Diablo contain the highest number of target invasive plant species, including many species previously used for ornamental landscaping, such as honesty (*Lunaria annua*), cherry-laurel (*Prunus laurocerasus*), and creeping bellflower (*Campanula rapunculoides*). Generally, these ornamental invasive species are sparse, occurring as individuals or small populations, and are confined to the townsites.

The transmission line ROW from Ross Lake to the southern end of Gorge Lake had seven target invasive plant species observed during surveys. Cover of invasive plant species in this area ranged from 0 to 5 percent, and species such as common tansy and St. John's-wort were ubiquitous.

Study routes within the RLNRA include maintenance roads, access roads to Project facilities and Project-related recreation sites, and SR 20. Invasive plant species such as oxeye daisy and St. John's-wort are ubiquitous along these roads. Common tansy was the most frequently observed target invasive plant species along all study routes. This species often formed dense patches within road prisms and showed signs of multigenerational colonies with senesced seed heads and juveniles emerging close by.

Populations of both diffuse and spotted knapweeds occurred along SR 20, mostly consisting of scattered mature and juvenile individuals interspersed with other non-native species such as oxeye daisy, herb-Robert, and common tansy; dense colonies were not observed. Dense mats of herb-Robert occur frequently along SR 20, particularly in moist ditches, seeps, or areas shaded by shrubs. The Ross Haul Road was the only road where this species was unobserved.

Tall hawkweed occurred as scattered individuals or smaller clumps (fewer than 10 individuals) along most study routes in the RLNRA, often interspersed with introduced grasses and common tansy. Larger populations occur on the north side of Diablo Dam Road where cover sometimes exceeds 40 to 50 percent along the roadside and extends onto the rocky outcrops above. This species is present along approximately 0.2 miles of the 0.5-mile road from Diablo Dam to the North Cascades ELC.

Two populations of bristly locust **(***Robinia hispida***)**, a NPS First Priority Species, were found along the spur road from Diablo Dam to the top of the Incline Lift. The population to the west was approximately 0.4 acres with 40 percent cover. The population to the east, and closest to the dam, was approximately 0.3 acres with 80 percent cover. Most seedlings were not yet mature at the time of the survey. However, a few fallen inflorescences, but no seed pods, were found. Flannel mullein, common tansy, English hawthorn (*Crataegus monogyna*), and Scot's broom seedlings were also present in this area.

Sub-segment 1A: Ross Lake (excluding Big Beaver Valley)

Fourteen target invasive plant species were observed along the shoreline of Ross Lake. Ross Lake has a normal maximum water surface elevation of 1,608.76 feet North American Vertical Datum of 1988 (NAVD 88) (1,602.5 feet CoSD). During the surveys, water surface elevations ranged from 1,574.16 to 1,586.36 feet NAVD 88 (1,567.9 to 1,580.1 feet CoSD). Ten invasive plant species observed around Ross Lake, including reed canarygrass, were in the drawdown zone, primarily along the northeast shore close to the international border. This is consistent with the Invasive Plant Species Inventory for the Skagit Valley Provincial Park conducted north of the Canadian border in 2006.

According to the 2006 survey, the Ross Lake Campground (approximately 0.1 mile north of the Canadian border) was noted as one of three areas of Skagit Provincial Park that require the highest degree of treatment and monitoring (McIntosh 2006).[75] Species observed near the Ross Lake Campground include, but are not limited to, greater burdock (*Arctium lappa*), Canadian thistle, and flannel mullein.

Class B species found on Ross Lake include small populations of diffuse knapweed (*Centaurea diffusa*) and spotted knapweed (*C. stoebe*) near the NPS Hozomeen Ranger Station, along trails at the NPS Winnebago Flats Campground, and south of the public boat launch near the NPS Hozomeen Campground. Overall, knapweed populations are sparse with few individuals (i.e., less than 10) and are within areas with loose, gravelly soils frequented by recreation. One population of mouse-ear hawkweed (*Hieracium pilosella*) was found at the north end of Ross Lake near the Canadian border; it is the first infestation of the species observed at Ross Lake. This population is along a swath of dry gravelly soils and appears to extend north across the border. Mouse-ear hawkweed forms a dense carpet of rosettes. This species infests areas of bare to loose, gravelly soils (Thurston County Noxious Weed Control Board [TCNWCB] 2017), similar to the substrate along the shores of Ross Lake. City Light alerted NPS and British Columbia Parks (BC Parks), who confirmed the infestation on the Canadian side of the border. BC Parks is part of the Inter-Ministry Invasive Species Working Group (IMISWG), which considers mouse-ear hawkweed an Early Detection Rapid Response species, or a species that should be eradicated before it becomes established and dispersed (IMISWG 2014). BC Parks treated the population along the border in fall 2021 and summer 2022, however, post-survey observations incidences in the Hozomeen area has been documented. BC Parks, NPS and City Light are coordinating on weed survey management of these incidences.

Reed canarygrass, listed as Class C noxious weed by WSNWCB and Whatcom County is the most abundant and widespread invasive plant species observed within the Ross Lake study area sub-segment.[76] Reed canarygrass occurred in 250 scattered clumps and in long, linear populations along the shoreline of Ross Lake ranging from 140 feet to 2.2 miles in length, with the longest stretch just south of Skymo Creek. Where the shoreline is steep, reed canarygrass occurred in scattered clumps along the normal maximum water surface elevation line in a 2- to 10-foot-wide band; cover of reed canarygrass populations in this area is low, and plants frequently appeared stressed. Lower gradient portions of the shoreline had more extensive coverage.

The total linear extent of reed canarygrass around Ross Lake is estimated to be 34 miles, or 50 percent, of the approximately 68-mile shoreline. Populations were comparable on both the eastern

---

75 The other two areas of the Skagit Provincial Park determined to require the highest degree of treatment and monitoring include the trail to Chittenden Meadow and the disturbed areas in Chittenden Meadow (McIntosh 2006), both located at the head of Ross Lake and accessible by the Ross Lake Campground.

76 According to recent studies, reed canarygrass may be a hybrid of native and non-native genetics strands (Kavova et al. 2018; Jakubowski et al. 2012).

and western shorelines. This is a much larger extent when compared to the NPS (2017a) reed canarygrass survey, which mapped the species occurring along approximately 8.3 miles of shoreline, primarily on the western shoreline. Other infestations are in wetlands and flat open areas around Ross Lake. This includes the large wetlands at the north end of Ross Lake, particularly on the eastern shore between the U.S.-Canada border and the public boat launch near the NPS Hozomeen Campground. Reed canarygrass cover is approximately 75 to 100 percent in these wetlands and often co-dominant with native sedge species, such as slough sedge and Kellogg's sedge (*C. kelloggi*). Based on a review of aerial imagery, this infestation continues to the north, across the border. While conducting surveys in this northern portion of the lake during lower lake levels in June 2021, biologists observed that live grass occurred down to about 16 feet below the normal maximum water surface elevation, despite being inundated during a large part of the growing season. These populations are well established, in contrast to the distribution of the grass along the shore of Ross Lake in other areas. A similar infestation occurs in a wetland on the western shore near the NPS Silver Creek Campground. In the areas of the forests immediately next to the wetlands that biologists could access, no reed canarygrass was observed. This suggests that the species is not actively establishing outside of the drawdown zone of the reservoir. This is likely due to suppression by shade from trees and shrubs, which has an adverse effect on reed canarygrass rhizome survival (Waggy 2010). Other shaded areas within the lower gradient areas of the drawdown zone also had sparse reed canarygrass cover, including the areas where large wood is naturally deposited.

Sub-segment 1B: Big Beaver Valley

Big Beaver Valley was not included in the invasive species survey area because City Light has not received any evidence to suggest that Project operations spread invasive species to wetlands upstream of the Project. The Project has no effect on the hydrology of these wetlands, which are located between about 0.8 and 2 miles from Ross Lake and above the normal maximum water surface elevation. However, reed canarygrass is known to occur in Big Beaver Valley and management of this species is of concern to City Light and NPS. The information below is a summary of various recent surveys conducted by NPS and a site visit conducted by NPS and City Light on August 20, 2020.

In 2017, the NPS North Coast-Cascades Network Exotic Plant Management Team (EPMT) surveyed locations and recorded population densities of reed canarygrass along Big Beaver Creek from its outlet on Ross Lake to its confluence with McMillan Creek (NPS 2017b). Some areas on the north side of the creek had concentrations of reed canarygrass. EPMT noted that there were likely more infestations in other areas, but large portions of the valley are inaccessible. The EPMT began control measures in 2017.

In 2019, the EPMT returned to Big Beaver Valley and treated two additional infestations of reed canarygrass. Approximately 0.7 acres of the estimated 3.5-acre infestation was treated at the site known as Hoe-dee-doe. Additionally, the entire 1.5-acre infestation at the site, known as Purgatory, was also treated (NPS 2019).

During the August 20, 2020 site visit, City Light and NPS observed reed canarygrass in some wetland areas, but overall, the wetlands supported a diversity of native species. Most of the reed canarygrass patches were small (approximately 6 x 6 feet) and mixed with horsetail (*Equisetum* spp.). Larger patches were estimated to be up to 3 acres. Reed canarygrass was less prevalent and less well-established in wetlands that had a dense shrub stratum compared to wetlands that lacked a dense shrub layer. Herbaceous-dominated wetlands, determined to be disconnected from Ross Lake, had more patches than shrub-covered wetlands. NPS estimates that reed canarygrass cover was less than 1 percent of the wetland area in the valley (City Light 2020b). Based on the results of the TR-02 Wetland Assessment, the estimated infestations at the Hoe-dee-doe and Purgatory sites cover approximately 0.7 percent of the 674-acre wetland.[77] NPS has since conducted additional treatments of reed canarygrass. City Light will continue to coordinate with NPS and update information as it becomes available.

Sub-segment 1C: Diablo Lake

Twelve target invasive plant species were observed along Diablo Lake, but all occurrences were individuals or in small patches (fewer than 10 individuals). Diablo Lake has a normal maximum water surface elevation of 1,211.36 feet NAVD 88 (1,205 feet CoSD). During the survey period, water surface elevations ranged from 1,205.76 to 1,206.96 feet NAVD 88 (1,199.4 to 1,200.6 feet CoSD). Species included common tansy, which occurred along the rocky shoreline, spotted knapweed near Colonial Creek in the vicinity of the NPS Thunder Knob Trail, Scot's broom, on Deer Island, and herb-Robert on the lakeshore along Thunder Arm near the NPS Colonial Creek recreational facilities and the boat ramp for the NPS Hidden Cove campsite.

Overall cover of reed canarygrass along the shoreline of Diablo Lake is sparse. Two populations of this species occur on the eastern shoreline of Thunder Arm. Both populations consisted of small numbers (fewer than 10) of small plants, occurring in sparse patches in the rocky soils. No plants were observed flowering.

There is a dense cover of invasive plants at Diablo Lake near the Skagit Tour Dock. Diffuse knapweed is present in areas surrounding the dock, parking lot, and road. It grows in patches with other weedy species, such as oxeye daisy, and bristly locust (*Robinia hispida*) and is scattered along rocky substrate.

The trails and roads within the North Cascades ELC facility have scattered, small and sparse populations of common invasive plant species such as St. John's-wort, oxeye daisy, and flannel mullein. Surveys were conducted on June 3 and June 16, 2021. Individuals of two invasive tree species were observed here and included one juvenile European mountain ash and one mature sycamore maple. Common tansy is widespread along the main road and in the parking lot. One small population (fewer than 10 individuals) of tall hawkweed was observed along the main road immediately next to the parking lot to the north, and a small population (fewer than 10 individuals) of spotted knapweed was observed on the beach, bordering the parking lot to the south. A population of approximately 50 to 100 stems of mature and flowering Canadian thistle was also observed along the main road west of the parking lot.

Sub-segment 1D: Gorge Lake

Eleven target invasive plant species were observed, all in small populations of fewer than 50 individuals each. Gorge Lake has a normal maximum water surface elevation of 881.51 feet

[77] The NPS 2019 inventory did not cover the entire wetland area. NPS recently conducted a complete inventory of reed canarygrass within Big Beaver Valley. Once City Light receives the data this estimate will be updated and included in the USR.

NAVD 88 (875 feet CoSD). During the survey period, water surface elevations ranged from 876.91 to 878.01 feet NAVD 88 (870.4 to approximately 871.5 feet CoSD). The portion of Gorge Lake that abuts SR 20 has more target invasive plant species occurrences than elsewhere. The southern shoreline of Gorge Lake is dominated by native forest species, such as western red cedar, and has noticeably fewer occurrences of target invasive plant species.

Survey findings included one population of common viper's bugloss (*Echium vulgare*), a Class B noxious weed, on the north shore of Gorge Lake. This population extended vertically up the rocky cliffs of the reservoir and included one large group of approximately 30 stems and 2 small occurrences nearby that were likely part of the same population. This infestation appears to be newly established, as no stems from previous seasons were observed. This species was growing in the thin, rocky soils with other target invasive plant species, primarily flannel mullein, and native grasses (*Agrostis* spp.). There were additional occurrences of small numbers of flannel mullein along the shores of Gorge Lake, primarily along the northern shore. Individuals occurred in a scattered formation, usually 2 to 10 feet apart. Plants included mature and reproductive individuals that were well established, particularly in rocky areas with thin, gravelly soils.

Herb-Robert was the most common invasive plant species within the fluctuation zone of Gorge Lake. This species was observed growing in mats, which were frequently spreading outside of the study area and into the forest. The two largest populations were along the north shore: one upstream of the SR 20 crossing (0.9 acres with 20 percent cover) and one near the Gorge Boat Launch (1.1 acres with 30 percent cover). Most of the plants were mature and/or reproductive. Higher concentrations of this species also occur on the southern shoreline.

Two NPS First Priority Species were also found. One population of lesser periwinkle *(Vinca minor)*, approximately 350 square feet in size with 60 percent cover, occurred along the southern shoreline of Gorge Lake. This species was growing in a dense patch that was partially submerged during the site visit. Greater burdock occurred in six locations, each of fewer than 10 stems, along the northern shoreline of Gorge Lake, where weeds are more common. The observed individuals were mature.

Newhalem recreation facilities are largely landscaped and lack populations of widespread weeds. Areas such as the interpretive display, playground, Gorge Powerhouse Visitor Gallery, Skagit Information Center, and Gorge Inn Museum are actively managed and planted with non-native ornamental plant species. There are scattered seedlings of sycamore maple. Parking areas have higher occurrences of widespread weeds such as common tansy, reed canarygrass, Himalayan blackberry, and greater burdock. Additionally, a population (0.2 acres with 5 percent cover) of NPS First Priority purple toadflax (*Linaria purpurea*), one of two known occurrences on the Project, occurs near the entrance of Ladder Creek Gardens and is expanding downslope to the riverbanks, growing with flannel mullein and horseweed (*Conyza canadensis*). Herb-Robert is found along most of the Trail of the Cedars alignment, but plants are sparse. Three populations of traveler's-joy, one juvenile English hawthorn, and one mature European mountain ash also occur here. The Gorge Boat Launch has large populations of herb-Robert and common tansy. A large population of spotted knapweed (0.3 acres with 15 percent cover) is also present at the Gorge Boat Launch.

Diablo Townsite

In addition to 33 target invasive plant species, populations of escaped ornamental species were observed at the Diablo townsite. The unoccupied area of Diablo—referred to as Reflector Bar—has the most target invasive plant species, particularly in the riparian area of Gorge Lake. Widespread species include common tansy, flannel mullein, Himalayan blackberry, herb-Robert, Scot's broom, St. John's-wort, and oxeye daisy. These species overlap with less common ornamental species, such as golden chain-tree (*Laburnum anagyroidis*), European beech (*Fagus sylvatica*), dame's rocket (*Hesperis matronalis*), and target listed bishop's goutweed. The ornamentals were likely intentionally planted and have the potential to spread to other less-disturbed areas. In the occupied areas of Diablo—referred to as Hollywood—invasive cover was sparse overall. However, the recreational areas near the Ross Lodge Picnic Shelter have some occurrences of greater burdock, bull thistle (*Cirsium vulgare*), and the ubiquitous species oxeye daisy and St. John's-wort. Invasive plant species are also common in the riparian areas of the Diablo townsite, which is likely the result of dumping yard waste over the bank.

Two occurrences of Class A rated egg-leaf spurge were observed at the Diablo townsite. The first population is in a remnant landscape bed east of the substation in Reflector Bar. This population occurs with petty spurge and cypress spurge (*E. cyparissias*), as well as ornamental fir trees (*Abies* spp.). The population does not appear to be spreading outside of the concrete landscaped area. Within the landscaped area, however, spreading rhizomes were observed. Approximately 900 feet south of this area, 10 to 15 additional individuals were observed in a small clump near the Gorge Lake shoreline. They were growing within the root zone of a birch tree (*Betula* sp.) on gravelly substrate with English plantain (*Plantago lanceolata*). None of these individuals were in flower and all were juvenile.

Newhalem Townsite

A total of 33 target invasive plant species were observed in the Newhalem townsite. Several intentionally planted species grow interspersed with more common target invasive plants such as Himalayan blackberry, herb-Robert, bishop's goutweed, and reed canarygrass. Overall, the Newhalem townsite area had a high occurrence of sycamore maple and other unlisted, non-native, ornamentally planted trees, most of which are well established and reproductive. Sycamore maples are planted along roads, and seedlings have spread along the riparian areas of the Skagit River behind houses. Other listed invasive tree species within the Town of Newhalem include NPS First Priority Norway maple, black walnut (*Juglans nigra*), European mountain ash (*Sorbus aucuparia*), and bristly locust. Based on a separate, landscape tree inventory conducted in 2021, other unlisted, non-native, ornamental trees that appear to be spreading include red oak (*Quercus rubra*), English oak (*Quercus robur*), and sweet cherry (*Prunus avium*).

Along recreational trails (e.g., the Trail of the Cedars), herb-Robert is abundant in shaded forested areas and into adjacent forest outside of the survey area. Bristly locust occurs near the warehouse north of SR 20.

Scot's broom occurs at high frequency in the townsite. Overall, populations consist of both individual seedlings and woody, mature shrubs. Approximately 2 acres of plants were observed on cliff faces north of the Newhalem townsite (referred to as the Newhalem Slope). This population is scattered as individuals with cheatgrass—likely an effect of the Goodell Creek Fire of 2015.

Cover is sparse and estimated at 5 percent. As with other invasive plant species observed in the study area, most larger populations are confined to roadsides and disturbed areas.

Three individuals of traveler's-joy grow along the Trail of the Cedars. Two other occurrences are located near the parking lot and trail up to the transmission line near Ladder Creek Gardens. These populations are mixed with other weeds such as common tansy, flannel mullein, and Himalayan blackberry.

Sub-segment 1E: Gorge Lake to Bacon Creek

All surveys in this sub-segment occurred along the transmission line ROW. In areas where biologists could access the transmission line ROW, one sycamore maple and a few individual common tansy and herb-Robert occurred along the rocky slopes. Moving west along the transmission line ROW, no target invasive plant species were observed. Invasive cover was most dense near the transmission line towers and maintenance roads and included scattered occurrences of Scot's broom, tall hawkweed (*Hieracium piloselloides*), Canadian thistle, and one sighting of traveler's-joy. In total, 21 target invasive plant species were observed in this portion of the study area.

Herb-Robert occurs along the section of the transmission line ROW nearest to SR 20 and is concentrated along maintenance roads that are shaded by big leaf maple *(Acer macrophyllum)* and native shrubs. Seven large populations occur within this study area segment and ranged from 0.1 acres to 4.3 acres with an average cover of 18 percent, the largest (4.3 acres with 20 percent cover) occurring where the transmission line crosses SR 20 near PRM 86.5.

One large population (1.6 acres with 10 percent cover) of Himalayan blackberry occurred in the storage area across SR 20 from Newhalem. Other larger infestations occur north of Bacon Creek and ranged from 0.5 to 3.0 acres in size. Populations along the riparian areas of Bacon Creek have 80 percent cover. A few individual vines and scattered patches occur through the remainder of this segment along the roadside within the transmission line ROW. These populations range from large monocultures with 100 percent cover to less dense brambles interspersed with common tansy and flannel mullein with a lower cover of up to 50 percent.

Segment 2: Bacon Creek to Sauk River Crossing

Nineteen target invasive plant species were observed in Segment 2 with concentrations along the main access road that traverses the center of much of the transmission line ROW. The primary ubiquitous invasive plant species included St. John's-wort, common tansy, and flannel mullein. Most of the populations had less than 25 percent cover.

From Bacon Creek south to Diobsud Creek, common tansy was the dominant invasive plant species observed, and populations were scattered with low stem counts. Other populations of target invasive plant species occurred as individuals or small patches and included Scot's broom, Himalayan blackberry, and flannel mullein. One large population of traveler's-joy occurred approximately 0.75 miles south of Bacon Creek.

South of Diobsud Creek to the crossing of the Skagit River, the transmission line ROW intersects several rural residential and agricultural lands, and invasive cover was higher in this section, including dense patches of Himalayan blackberry and reed canarygrass near the access road.

Approximately 5.5 acres of reed canarygrass (with an average cover of 19 percent) was mapped between Diobsud Creek and the Skagit River crossing. Additionally, approximately 58 acres of Himalayan blackberry (with an average cover of 45 percent) was mapped, including an 11.2-acre area (with 100 percent cover) next to the Corkindale Creek fish and wildlife mitigation land property. Small Scot's broom populations (fewer than 10 individuals) were frequently interspersed away from the roadway. City Light recently treated Scot's broom from near Bacon Creek to Dexter Lane. There remains a somewhat large population from Dexter Lane to Diobsud Creek.

Following an on-site listening session with the Sauk-Suiattle Indian Tribe in 2020, City Light set up a pilot program to control Scot's broom, with one of two sites located near Diobsud Creek Road. The other site is near Spearhead Lake, west of the Sauk River. The objective of this program is to analyze and evaluate effectiveness of different control methods, and to determine if they promote more diverse habitat within the transmission line ROW. The three control treatment methods include: (1) cut only; (2) cut and treat with herbicide; and (3) cut and cover. The "cut and cover" method involves cutting select vegetation that is then covered to shade out new growth. City light intended to use wood chips to cover the cut area. Instead, the cut-up Scot's broom was chipped, and used to cover the cut stems due to wood chip delivery issues.

South of the Skagit River to the Sauk River crossing, the first 1.3 miles of transmission line ROW is within the Illabot North fish and wildlife mitigation property. Invasive plant species near the Skagit River, including the Powerline spawning channel, are primarily Himalayan blackberry and reed canarygrass. One mature population of traveler's-joy occurs near the Powerline spawning channel. Additionally, reed canarygrass is the dominant species along the O'Brien Creek channel. In recent years, City Light has implemented invasive plant species management in this area along Illabot Creek Lane. Management efforts are focused on Himalayan blackberry, Scot's broom, and traveler's-joy. Additional past control efforts have included the removal of one small patch of Japanese knotweed. Control efforts are still ongoing.

South of the Rockport-Cascade Road, common tansy consistently grows next to the road, and small populations of Canadian thistle are present. South to the Sauk River crossing, several larger populations of Scot's broom (between approximately 200 square feet and approximately 0.2 acres in size) begin to appear, with an estimated cover of this species at 5 to 25 percent.

Segment 3: Sauk River Crossing to Oso

Nineteen target invasive plant species were observed in Segment 3, which is all in the transmission line ROW. Vegetation communities shift distinctly west of the Sauk River. Areas along the transmission line access road frequently exceeded 60 percent cover of invasive plants which decreased further south. Scot's broom is the dominant target invasive plant species from the Sauk River south to Darrington. Throughout the northernmost 4 miles of this segment, approximately 53 acres of Scot's broom occurs with an average cover of 44 percent. Occurrences of Scot's broom are intermittent and co-dominant with Himalayan blackberry, reed canarygrass, and common tansy. These species primarily occur along roadsides and transmission line towers and are not spreading into nearby forested areas. In 2020, City Light also implemented a pilot site in this portion of the transmission line ROW to test Scot's broom treatment methods, similar to the program near the Diobsud Creek Road described above.

West from Darrington to the community of Oso, the transmission line travels through the low elevation river valley of the North Fork Stillaguamish River and borders developed areas such as SR 530 and rural residences. Larger populations of Scot's broom are frequent. A total of approximately 91 acres of Scot's broom, with an average cover of 41 percent, was mapped from Darrington to Oso. Other dominant invasive plant species include Himalayan blackberry and reed canarygrass. Several individual or small populations of butterfly bush (*Buddleja davidii*) and Canadian thistle were also observed. Ubiquitous species, such as St. John's-wort and common tansy, cover less than 25 percent. City Light has also initiated invasive plant species management within this study area segment, including a project focusing on the management of Scot's broom near French Creek, as part of a tower replacement project.

<u>Segment 4: Oso to SR 528</u>

Eighteen target invasive plant species were observed in Segment 4. From Oso south to the South Fork Stillaguamish River, the ROW is predominantly located in timber and rural residential lands. Vegetation is disturbed, and large populations of Himalayan blackberry and reed canarygrass occur. North of the South Fork Stillaguamish River, approximately 43 acres of Himalayan blackberry and 57 acres of reed canarygrass were mapped, with an average cover of 50 and 43 percent, respectively. Several smaller populations (fewer than 10 individuals) of Scot's broom and Canadian thistle were also observed throughout.

South of the South Fork Stillaguamish River, Himalayan blackberry and reed canarygrass continue to be the dominant invasive plant species, frequently forming monocultures interspersed with neighboring pasture and rural residential lands. Larger infestations of Himalayan blackberry are scattered throughout this study area segment. South of the South Fork Stillaguamish River, approximately 30 acres of Himalayan blackberry and 35 acres of reed canarygrass were mapped, with an average cover of 35 percent and 40 percent, respectively. Fifteen individual European mountain ash, three English hawthorn, and two English holly trees (*Ilex aquifolium*) were also observed near the rural residences. Other dominant invasive species, primarily Scot's broom and Canadian thistle, were also observed throughout as individuals or in small populations. Common tansy occurs throughout this study area segment at less than 5 percent cover.

<u>Segment 5: SR 528 to Bothell Substation</u>

This segment is highly developed and characterized by residential land use. Twenty-one target invasive plant species were observed. Common tansy and oxeye daisy are ubiquitous and occur at approximately 5 and 25 percent cover, respectively. The dominant invasive plant species were generally the same species that occur to the north (Oso to SR 528). However, invasive plant species occurred much more frequently. Large brambles of Himalayan blackberry occur throughout. North of the Snohomish River crossing, approximately 89 acres of Himalayan blackberry and 23 acres of reed canarygrass were mapped, with an average cover of 55 percent and 42 percent, respectively. South of the Snohomish River crossing, approximately 34 acres of Himalayan blackberry and 5 acres of reed canarygrass were mapped, with an average cover of 50 percent and 41 percent, respectively. Three Japanese knotweed populations were also observed within this study area segment. Two populations contained fewer than 10 stems. The third population was relatively large and was approximately 0.2 acres with 90 percent cover. One occurrence of cherry plum, an NPS First Priority species, was documented in sub-segment SR 528 to Bothell Substation.

<u>Segment 6: Fish and Wildlife Mitigation Lands</u>

As detailed in Section 4.2 of the TR-04 Invasive Plants Study Interim Report (City Light 2022c), City Light prioritized survey locations based on portions of the study area that were identified where potential Project-related disturbances or pathways for invasive plant species establishment or spread could occur. These areas were prioritized for field investigation and analysis. Not all mitigation lands were surveyed.

Surveys of prioritized areas included areas within 50 feet of either side of study routes within the fish and wildlife mitigation lands. Similar to the transmission line ROW, common and ubiquitous invasive plant species are seen frequently, although they occur in smaller populations.

RLNRA

Parcels 6A, 6B: County Line Ponds and Newhalem Ponds

Reed canarygrass is the dominant target invasive plant species at the County Line Ponds property and was often observed in association with salmonberry and thimbleberry shrubs. Several clumps along the banks were documented along the western ponds, and larger populations occur at the ponds closer to the Skagit River. Four occurrences of greater burdock were observed on the westernmost pond, along with one population of traveler's-joy. This small population was approximately 150 square feet with an estimated 50 to 75 percent cover. Additionally, one mature individual English holly was observed at the pond to the north.

Parcel 6B: Newhalem Ponds

Greater burdock and herb-Robert were both common along the road prism leading through the property. The perimeter of the storage area is dominated by Himalayan blackberry, herb-Robert, and common tansy, which also occur in the adjacent forested areas. One patch (less than 50 square feet) of Japanese knotweed is also in this area, located on a gravel mound with Scot's broom, greater burdock, herb-Robert, common tansy, and oxeye daisy. Most target invasive plant species are confined to the gravel road and the maintenance area with the exception of reed canarygrass, which was observed around the perimeter of the western pond and the island within it. Additionally, a small population (fewer than 20 individuals) of NPS First Priority purple toadflax was mapped on the western edge of the larger pond near the transmission line ROW. In recent years, City Light has implemented invasive plant species management projects on this property. The site is currently being managed and monitored for several target invasive plant species, including Himalayan blackberry, Scot's broom, lesser periwinkle, and English ivy (*Hedera helix*).

South Fork Nooksack Basin

Parcels 6D, 6E: Nooksack, Nooksack West

Ten target invasive plant species were observed along survey routes and 50 feet to either side. Herb-Robert is the dominant target invasive plant species within these properties, occurring along the length of the road. Reed canarygrass is interspersed throughout, along with several occurrences of Canadian thistle. Three small populations of butterfly bush, each containing fewer than 10 stems, were observed along the roadside. Each year since the 14-acre elk forage area was created in 2016, the Upper Skagit Indian Tribe (under direction of City Light) has conducted manual hand-pulling of small clusters of Canadian thistle plants along the field perimeter. In 2021 and 2022, City Light had a licensed applicator treat small patches of thistle with an approved herbicide; in 2022 City Light manually removed a 5-ft diameter patch of reed canarygrass.

Sauk River Basin

Parcel 6H: North Everett Creek

This property is primarily undisturbed and dominated by western red alder with a salmonberry-dominant understory. The only target invasive plant species observed within this property was one small population (approximately 10 stems) of herb-Robert. In the past, the Sauk-Suiattle Indian Tribe and the Skagit Fisheries Enhancement Group (SFEG) have treated small knotweed patches in the riparian forest understory near the side channel of the Sauk River. Very little knotweed occurs on this property due to these efforts.

Skagit River Basin

Parcels 6K, 6L: B&W Roads 1 and 2

Herb-Robert was observed along the entire road as scattered plants. No other target invasive plant species were observed.

Parcel 6M: Bacon Creek

Herb-Robert and Himalayan blackberry are the dominant invasive plant species, located along the access road that was primarily covered by native salmonberry. A few intermittent patches of common tansy occur in the northern portion of the surveyed road. Oxeye daisy, St. John's-wort, and reed canarygrass were the only other target invasive plant species observed.

Parcel 6N: Barnaby Slough

Three target invasive species were found along the access road and trail. Herb-Robert occurs as single plants or small patches along the roadside. Himalayan blackberry grows along the recreational path that leads to the slough. Reed canarygrass grows along the path next to the slough. The western portion of the slough was not accessible due to construction along the trail.

Parcel 6O: Bogert and Tam

Eight target invasive plant species were observed. Dominant invasive plant species include Himalayan blackberry and herb-Robert. Himalayan blackberry grows in large brambles along the access road, as well as the western edge of the property, in dense monocultures with 20 to 80 percent cover. Herb-Robert is abundant throughout. English ivy growing up the trunk of a western redcedar tree and three juvenile black walnut trees also occur on site.

Parcel 6P: Corkindale Creek

Four target invasive species were found during a survey of the entire property. Himalayan blackberry is the dominant invasive plant species on this property, forming dense brambles that cover both banks of Corkindale Creek as well as the perimeter of the property. Approximately 34.7 acres of Himalayan blackberry was mapped on the property, mostly along the perimeter of the recently purchased pasture and hayfield. Interspersed throughout these thickets and the grassy open area is reed canarygrass and well-established clumps of common tansy. Canadian thistle was also observed as single plants or sparse clumps near Corkindale Creek, with larger patches interspersed throughout the field. No other target invasive plant species were observed, although there is a non-native rose species that appears to be spreading in the pastures.

Parcel 6R: False Lucas Slough

Four target invasive species were found along the access road. Invasive cover is sparse, with the majority being in a reed canarygrass-dominated wetland at the western end of the access road. A single greater burdock was also observed here. Small patches of Himalayan blackberry and herb-Robert are also scattered along the trail and road.

Parcel 6S: Finney Creek

The study area for this parcel included portions of a former logging road, approximately 0.25-miles long. This parcel is relatively undisturbed and exhibits a native shrub understory dominated by salmonberry, red elderberry, and vine maple, beneath a primarily coniferous overstory dominated by Douglas-fir, western hemlock, and western redcedar. Except for a few sporadic populations of common St. John's-wort and oxeye daisy growing along the road, no target invasive plants were observed.

Parcel 6T: Illabot North

A total of 11 target invasive plant species were observed. A dense cover of herb-Robert occurs along the access road to the south as well as along the former recreational trail to the north. Reed canarygrass is dominant along the Illabot Spawning Channel, with very little observed outside of inundated areas. Other species include Himalayan blackberry, Canadian thistle, and Scot's broom.

Parcel 6U: Illabot South

A total of nine target invasive plant species were observed. One individual Class A rated Italian thistle (*Carduus pycnocephalus*) was found along the access road for the Illabot South property. Other common target invasive plant species observed along the road include reed canarygrass, herb-Robert, and Himalayan blackberry.

Parcel 6W: McLeod Slough

A total of five target invasive plant species were observed in a survey of the perimeter of the elk foraging area within the McLeod Slough property. Target invasive plant species occur around most of the perimeter of the meadow and are primarily Himalayan blackberry brambles (approximately 1.5 acres with 100 percent cover) interspersed with reed canarygrass (approximately 1 acre with 80 percent cover) and small patches of Canadian thistle. Reed canarygrass is also the dominant species in the 1.4-acre wetland near the western edge of the property. A small patch of common tansy, approximately 100 feet in length, is present along the southern edge of the property; as well as a 0.2-acre population of herb-Robert (with 20 percent cover). Approximately five years ago, the Sauk-Suiattle Indian Tribe treated a small patch of knotweed near a wetland in the interior of the property, and the species has not been observed there since.

Parcel 6Y: O'Brien Slough

The study area for this parcel included portions of an access road adjacent to the slough, approximately 130 feet long, used by former restoration crews. This parcel is relatively undisturbed and forested with a mix of black cottonwood, red alder, western redcedar, and western hemlock. Reed canarygrass was the dominant target invasive plant species observed; it had dense cover (75 to 95 percent) along the banks of the slough. The only other target invasive plant species was a patch of Himalayan blackberry near the east side of the slough.

Parcel AA: Savage Slough

Three target invasive species were found in a previously disturbed portion of this property, immediately adjacent to South Skagit Highway. The densest cover of target invasive plant species within the Savage Slough property occurs south of the South Skagit Highway, where Himalayan blackberry forms large monocultures; reed canarygrass is also dense next to the open water. Approximately 8.3 acres of reed canarygrass (with an average cover of 90 percent) and approximately 4.7 acres of Himalayan blackberry (with an average of 73 percent cover) were mapped on the property. Bands of herb-Robert were growing along South Skagit Highway, as well as the access road to the south (approximately 850 and 650 feet in length, respectively).

Since 2011, a permittee has annually cut hay on approximately 10 acres where riparian reforestation has not taken place to aid in controlling weeds, and the Skagit River System Cooperative (SRSC) has been managing noxious weeds on 90 acres of this property. In 2020, SRSC treated tansy ragwort (*Jacobaea vulgaris*), Canadian thistle, and orange hawkweed (*Hieracium aurantiacum*) across 17.3 acres of the property; Himalayan blackberry and evergreen blackberry (*Rubus laciniatus*) over 13.6 acres of the property; and knotweed over 0.7 acres of the property. SRSC has mapped invasive plant species on the property since 2011 and has concluded that total invasive plant species coverage has decreased from 4.2 acres to 1.0 acres, but Scot's broom has increased by 0.2 acres. Additionally, orange hawkweed and policeman's helmet (*Impatiens glandulifera*), both observed in 2014, were not observed during the 2020 surveys (SRSC 2020).

<u>Segment 7: Skagit River</u>

In 2021, the field crew surveyed the left bank of two sections of the riparian areas of the Skagit River: PRM 88 to 90 and PRM 66 to 73. The entire right bank from Gorge Dam to the confluence with the Sauk River (approximately PRM 66.5 to PRM 97.2), and the remaining portions of the left bank (approximately PRM 90 to PRM 97.2; PRM 73 to PRM 87.5) were surveyed between July 26 and August 5, 2022. Areas upstream of approximately PRM 86 could not be accessed by boat due to rapids and downed wood. Crews surveyed these areas on foot to the extent possible.

Within the RLNRA, observed target invasive plant species were primarily individuals, and no large contiguous populations of target invasive plant species were observed. The right bank of the river near Newhalem had a high diversity of invasive plant species, with 12 target invasive plant species observed. These include less commonly observed target invasive plant species such as sycamore maple, creeping bellflower, and black walnut in addition to more common species such as herb-Robert and common tansy. These species were also observed along the right bank near the Gorge Powerhouse, growing with native plants including snowberry (*Symphoricarpos albus*), bigleaf maple, vine maple, salmonberry, and thimbleberry. Additional target invasive plant species observed here included European mountain ash and greater burdock. Invasive tree species were also observed along the left bank of the Skagit River near the Newhalem Campground where three sycamore maple and 17 European mountain ash were observed. Outside of Newhalem and the Gorge Powerhouse, invasive plant populations along the Skagit River within the RLNRA were sporadic and primarily consisted of narrow bands of reed canarygrass and common tansy. Several small populations of traveler's-joy were also observed on both the left and right banks of the Skagit River within the RLNRA.

Outside of the RLNRA, invasive plant populations were dominated by reed canarygrass, Himalayan blackberry, and traveler's-joy. These populations had moderate to high cover (25 to 100 percent) and were larger than those observed within the RLNRA. Invasive plant species populations were generally continuous between the confluence with the Sauk River and approximately PRM 81 where much of the adjacent land is residential, recreational, or agricultural. Dense thickets of Himalayan blackberry were observed along portions of the bank that were both developed and forested, primarily between the confluence with the Sauk River and approximately PRM 67.8. These Himalayan blackberry populations were frequently growing with co-dominants reed canarygrass and traveler's-joy. Some of the larger thickets, particularly on some river islands within this reach, extended out of the study area and into forests dominated by black cottonwood and red alder.

Traveler's-joy was frequently observed both in and outside the RLNRA, with populations recorded throughout the length of the study area. This species was observed forming groundcover on sand and gravel bars and climbing as high as 75 feet in some trees along the left bank. Scot's broom and common tansy also occur intermittently throughout this study area segment and have denser cover within the islands and gravels bars of the river. Traveler's-joy was common in the lower reaches of the RLNRA near Bacon Creek, with eight distinct populations observed between approximately PRM 82.9 and 83.8.

Butterfly bush frequently occurs in the riparian areas of the Skagit River as well as on gravel bars. Forty-four occurrences of this species were observed, primarily as individual plants. Ubiquitous species such as common tansy, oxeye daisy, and St. John's-wort are frequently co-dominants within these populations. Most individuals observed were mature and flowering. This species was unobserved upstream of approximately PRM 74.2.

Approximately 38 sycamore maple seedlings and mature trees were observed on the banks of the Skagit River, frequently on gravel bars. Because these trees are difficult to discern within native vegetation, higher intensity surveys were required to identify younger individuals and seedlings. This species was unobserved between approximately PRM 93 and 89.1. The farthest downstream this species was observed was at approximately PRM 87.5 on a gravel bar with other target invasive plant species such as Scot's broom, English hawthorn, traveler's-joy, and European mountain ash.

Only three occurrences of Japanese knotweed were observed along the riparian areas of the Skagit River. Two patches were immediately upstream of PRM 68, and one was along the left bank near the confluence with the Sauk River. When compared to data from surveys conducted by the Sauk-Suiattle Indian Tribe and SFEG in 2017, which show continuous knotweed infestations along the left and right banks of the Skagit River, overall occurrences of the species were significantly lower, indicating that Skagit Cooperative Weed Management Area and SFEG control measures have been successful.

Vegetation Management

There are several vegetatio*n management practices implemented by City Light including legal obligations and rights to manage vegetation. Vegetation is managed along the transmission line ROW, within the townsites of Newhalem and Diablo, within the RLNRA, and within fish and wildlife mitigation lands. The following sections discuss the vegetation management practices in those areas.*

Transmission Line ROW Vegetation Management

City Light has rights to manage vegetation throughout the transmission line ROW to protect infrastructure, maintain safe Project operations, and provide access to towers and facilities to respond to emergencies. According to Washington state law, City Light is unable 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).

Vegetation management is performed year-round on the transmission line ROW. Vegetation management practices generally follow guidelines in 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 North American Electric Reliability Corporation 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, topped, or girdled as they grow taller and begin to pose a threat to Project operations. In this area, City Light vegetation management primarily involves girdling conifer trees that need to be managed. Deciduous trees are either removed or topped when a visual screen or shade needs to be maintained. In highly visible areas, vegetation management debris and slash is fly chipped and left in place while in less visible areas, trees will either be left to die and fall in place or slash will be lopped and scattered to promote wood/soil contact and thereby reduce potential wildfire fuels. In addition to vegetation within 25 feet of the corridor, crews 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. Herbicide is very limited, applied in riparian areas, and only aquatic formulations are used. City Light also manages vegetation, including invasive species, in the Newhalem and Diablo townsites.

South of the Sauk River, vegetation management 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 on a multi-year rotation. Crews start at one end of the segment and move to the other end performing whatever treatments are needed including mowing, applying herbicides, and removing trees (Bayard 2019). Crews follow the Transmission ROW Vegetation Management Plan to the extent possible; however, in general, more trees are removed and more areas are mowed in the southern extent of the transmission line ROW than in the north.

Vegetation Management near Newhalem and Diablo Townsites

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, watering, 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 in Diablo and Newhalem, including the accessible portions of the transmission line corridor and the Skagit River riparian zone. Management has included mechanical and herbicide treatments and replanting.

Invasive Species Management within the RLNRA

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 City Light, USFS, NPS, and the Sauk-Suiattle Indian Tribe. Eradication efforts take place in the Skagit and Sauk watersheds both within and outside of the RLNRA and have included sites in the Newhalem area and on City Light mitigation lands near the Sauk River. 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).

Vegetation Management on Fish and Wildlife Mitigation Lands

City Light has signed a Memorandum of Agreement 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 into the Skagit Wildlife Mitigation Lands Management Plan (City Light 2006) in accordance with City of Seattle policies and implemented cooperatively with the Wildlife Management Review Committee (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).

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 (life estate condition from acquisition).
- 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 Slough 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, and St. John's-wort in 2018-2019 (Tressler 2019).
- Removal of road prism from O'Brien Slough.
- Creation of 14-acre elk forage fields on South Fork Nooksack property through tree removal, seeding and annual mowing and weed control.
- Access control measures at Dan Creek to prevent timber theft.
- Knotweed control along Sauk and Skagit rivers.
- Removal of the caretaker house and decommissioning of unneeded pipe at Barnaby Slough.
- Illabot Creek Restoration – connection to former channel and revegetation of restoration spoil material placed on transmission line on Illabot South property.

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. 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.

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 major 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. Additional wildfires have occurred near the Project Boundary including as recent as 2022.

Three years prior to the Goodell Creek fire, City Light in collaboration with NPS 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 Townsite 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. Additionally, City Light and NPS have collaborated with the ELC campus on a wildfire fuels reduction project.

4.2.4.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on vegetation, wetlands/riparian areas, special-status plants and invasive species. These effects include reservoir operations (e.g., water level, large woody material, sediment deposition), Project O&M, transmission line ROW vegetation maintenance, fish and wildlife mitigation land management, and downstream effects of flow alteration. The effects are organized below to address requests in FERC's Scoping Document 2 (SD2).

Effects of Reservoir Operations

Effects of continued or modified project operations, including reservoir fluctuations, on littoral, wetland, emergent, and riparian habitats and associated wildlife, including wetland-dependent birds and amphibians (FERC SD2).

Reservoir water level management affects vegetation at shoreline erosion sites and distribution of plant species in littoral and shoreline habitats. Along Gorge and Diablo lakes, the combination of generally steep shoreline topography, naturally exposed bedrock. and relatively stable water levels throughout the year limits the establishment of emergent wetland vegetation along most of the shoreline. Limited shoreline and littoral zone vegetation do occur in areas of the upper portion of Gorge Lake and in the Thunder Arm of Diablo Lake. 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), contribute to continuing erosion and suppression of re-establishing vegetation. The characteristics of the erosion that have been documented within the three reservoirs are described further in Section 4.2.1 of this Exhibit E.

Changes in reservoir water surface elevations expose shoreline substrates and can alter erosion of soils and sedimentation patterns along the shorelines. Sediment deposition documented at larger tributary mouths, such as Thunder Creek and Big Beaver Creek, can influence species composition and invasive plant species can establish in the disturbed and exposed soils. Steep shoreline topography and long periods of inundation during the growing season can also interfere with or limit the establishment of native riparian vegetation.

Another localized effect is the collection and storage of large woody material near the U.S.-Canada border and in other inlets of Ross Lake, especially Dry Creek and Roland Creek inlets. Woody material is gathered and stored in log pens at multiple locations to prevent boating hazards that would otherwise occur. The large volume of wood covers an approximately 1,500-foot-long section of the Ross Lake shoreline and may restrict native vegetation establishment and affect vegetation species composition in wood storage areas.

Effects of Project O&M Activities on Vegetation Communities and RTE Plants

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on terrestrial wildlife, habitats and habitat connectivity, wildlife migration and movement, and vegetation communities, including sensitive plants and nesting northern goshawk (FERC SD2).

Project O&M activities (road repairs and maintenance, vegetation management, and utility line and structure maintenance) can affect upland and riparian plant community structure from trimming or removal of trees within the transmission line ROW. Vegetation management within the transmission line ROW and along roads could affect the known occurrence of the RTE plant species boreal jewelweed.

Project O&M and recreation activities can bring in material or equipment from outside the Project Boundary or cause ground disturbance that can contribute to the introduction and spread of invasive plants, as well as invasive plant propagules that are moved from inside the Project Boundary to other areas in the RLNRA. The use and maintenance of Project access roads provide a corridor to spread invasive plant species in the RLNRA, along the transmission line ROW, and within some of the fish and wildlife mitigation lands. Vehicles, equipment, and crews traveling on Project roads can inadvertently transmit propagules of local or distant populations.

City Light maintains landscaping around infrastructure, townsites, and some recreation facilities. These sites are often planted with non-native, ornamental species. Some of these introduced species can begin to reproduce and spread, often after a "lag" or establishment period ranging from one year to several decades. A number of the invasive species documented in the Project vicinity, including but not limited to, sycamore maple, bristly locust, walnuts, lesser periwinkle, annual honesty, Bishop's goutweed, and creeping bellflower, were likely introduced as ornamental species.

Effects of Project O&M Activities on Establishment and Spread of Invasive Species

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on the establishment, spread, and control of invasive plants (FERC SD2).

Invasive plants have the potential to impact RTE and other native plant populations and sensitive habitats within the Project Boundary including fish and wildlife mitigation lands. This is because invasive species limit diversity, 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. There are multiple pathways and vectors influencing the establishment and spread of invasive species in the study area; pathways are the means that species are introduced to new environments, and vectors are the transfer mechanisms. These are both natural, such as seed dispersal via wind or animals, and human-induced, such as spread by humans as they move through areas on foot, by boat, or via other vehicles. The pathways and associated vectors for invasive plant species observed in the study area include: fluctuating water surface elevations in reservoirs, boat and trailer use in rivers and reservoirs, recreational visitors and activities, vehicles and equipment used for Project O&M on roads and within the transmission line ROW, ornamental species introductions in landscaping, and contamination of hay and feed from agricultural uses of lands within the transmission line ROW and on mitigation lands (where haying occurs under conditions of the original purchase agreement or under permit conditions as a management tool to reduce weed cover until new management objectives are set). Detailed descriptions of each of these pathways and vectors are included in the TR-04 Invasive Plants Study.

Invasive plant species can establish in the disturbed and exposed substrates created by changing reservoir water surface elevations. Project reservoir water level management may also affect the distribution of existing invasive species populations, particularly reed canarygrass that grow along shorelines, primarily Ross Lake. 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.

Project O&M and recreational visitors can be pathways for transmitting invasive plant species (aquatic or terrestrial) by attaching to clothing, boots, waders, boats and trailers, vehicles, or equipment. Project-related or recreational vehicle use can also lead to soil disturbance and/or compaction and can disturb native vegetation, creating areas where invasive plant species can take root and thrive. Vegetation management that removes native overstory vegetation can create openings for invasive species that thrive in disturbed areas. Introduced non-native, ornamental species planted as part of City Light landscaping can begin to reproduce and spread, often after a "lag" or establishment period ranging from one year to several decades. In addition, imported garden soil and mulch can harbor weedy species.

Effects of Vegetation Management

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on terrestrial wildlife, habitats and habitat connectivity, wildlife migration and movement, and vegetation communities, including sensitive plants and nesting northern goshawk (FERC SD2).

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on the establishment, spread, and control of invasive plants (FERC SD2).

City Light manages much of the transmission corridor using selective tree removals; however, some areas are periodically cut with heavy equipment mounted field deck or reticulated-arm flail brush cutters. Other areas 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, simplify vegetation structure, and affect RTE plant species that occur in the transmission line ROW. Invasive species are known to be present along the transmission line.

City Light maintains vegetation in the transmission line ROW and around Project infrastructure and townsites through cutting and mowing. Removing native overstory vegetation removes shade, which can create openings for species that thrive in exposed, open, and disturbed areas (Dudney et al. 2021). The use of heavy equipment in these areas can also compact or disturb soils, further limiting native plant species growth and promoting invasive plant establishment. In addition, machinery can actively spread seeds and vegetative fragments that can result in new populations of the invasive species.

Results of the field surveys indicate that Project-related activities, including O&M, present minimal threat to RTE plant species or habitats where they are present because only one RTE plant species was observed in a very limited area within the study area. Surveys were focused on areas where potentially suitable habitats coincide with or intersect areas that could be affected by Project-related activities, but most of the habitats appear to lack the conditions, features, and characteristics that the target RTE plant species require, the exception being the boreal jewelweed found along a maintenance access road within the study area. Future road maintenance in the vicinity of the occurrence could have a direct impact on this species. In addition to the weed infestations currently present near the observed RTE plants, maintenance vehicles, equipment, and crews travelling on the road can inadvertently transmit seeds of local or distant populations of invasive species that can compete with RTE plants and degrade their habitat.

Vegetation management associated with the Project's transmission line can affect riparian habitats where the transmission line crosses streams. Vehicle access to improved and unimproved roads and trails associated with vegetation management within the transmission ROW has the potential to affect riparian vegetation and associated habitat.

Effects of Recreation Use

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on terrestrial wildlife, habitats and habitat connectivity, wildlife migration and movement, and vegetation communities, including sensitive plants and nesting northern goshawk (FERC SD2).

Recreation use along the Project reservoirs, such as boat mooring along the shore and foot traffic outside of designated campsites, day use areas, and trails, has the potential to affect vegetation in general and possibly RTE plants, too.

Boating, whether Project-related, associated with NPS or U.S. Border Patrol administrative activity, or recreation, can be a pathway for transmitting invasive aquatic plant species in the reservoirs, Skagit River, or any other recreational waterbody within the study area. Common ways invasive species travel by boat include, but are not limited to, attaching to mud on propellers, contaminating bilge water, and attaching to boat trailers.

Additionally, recreational visitors to the RLNRA can bring invasive plant species from local or distant populations via their vehicles, boats, clothing, shoes, or pets. This can also occur in portions of the transmission line ROW that are used for walking (e.g., near the Bothell Substation). Furthermore, areas used for recreation (e.g., roads, trails, boat launches, parking areas) often have disturbed or compacted soils where some invasive plant species can out compete native species.

Results of the field surveys indicate that Project-related recreation presents minimal threat to RTE plant species or habitats where they are present because only one RTE plant species were observed in the study area along the transmission line ROW. Project-related recreation is unexpected to impact boreal jewelweed since it was only documented in the transmission line ROW where there are no public recreation access sites.

Effects of Downstream Flow Alteration

Effects of existing and any modified flow regulation on the pattern, establishment, and recruitment of riparian vegetation along the Skagit River (FERC SD2).

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 from Gorge powerhouse to the Sauk 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 due to a combination of factors may have impacted riparian habitat dynamics in some areas.

Effects of Wildfire Management

Effects on the natural fire regime of the North Cascades National Park complex due to project-related fire management practices (e.g., fuels reduction treatments and suppression of naturally ignited fires) in forests surrounding project facilities, in order to protect lives and property (FERC SD2).

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., Fire Wise Program), affects the type, density, and distribution of plants within and near the fire suppression zone.

4.2.4.3 Existing Resource Measures

While Section 4.2.3 of the existing settlement agreement on Recreation and Aesthetics provides specific vegetation management prescriptions, designed to obscure or enhance views of transmission infrastructure, there were no specific articles or protection, mitigation, and enhancement (PME) measures in the current Project license that specifically addressed botanical resources.[78] However, over the years, City Light has collaborated with agencies, Indian Tribes, and non-governmental organizations to identify and implement measures to protect and benefit botanical resources in the Project vicinity. These include the following:

- 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. In addition, City Light actively coordinates with and supports NPS and BC Parks' efforts to manage weeds in the RLNRA and Skagit Valley Provincial Park.
- Concerted efforts of weed control and riparian habitat restoration on the Project have been ongoing since 2009. City Light, in partnership with NPS, Upper Skagit Indian Tribe, SRSC,

[78] The Recreation Plan (Article 412) and Project Visual Quality Plan (Article 413) both include tasks related to botanical resources.

SFEG, and the Washington Conservation Corps (part of Ecology), creates annual strategies for habitat restoration and invasive plant management throughout the Project vicinity.

- Land acquisition and management – Through approval of the Land Acquisition Group and WMRC established by the license and Wildlife Settlement Agreement, City Light purchased parcels for the fish and wildlife mitigation lands to mitigate for the Project inundation of terrestrial, wetland, and riparian wildlife habitat. Currently, City Light owns a total of approximately 10,804 acres of fish and wildlife mitigation lands. 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, abandonment of unnecessary forest roads, and removal of rip-rap from riverbanks. The removal of roads and the control of vehicular access to these sites reduces 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 3.1.6.5 of this Exhibit E for details of funding over the term of the current FERC license).

4.2.4.4 Proposed Resource Measures

City Light anticipates continuing its management of the mitigation lands to be directed by an updated Wildlife Mitigation Lands Management Plan as well as continued collaboration and management of invasive species. The new license will also include potential modifications to current operations and additional proposed PME measures to be informed by on-going studies and discussions with LPs prior to its Final License Application (FLA) submittal in April 2023. Anticipated measures related to botanical resources to be proposed in the FLA in more detail include:

Vegetation Management Plan

To manage vegetation within the Project Boundary, City Light proposes to develop a Vegetation Management Plan. This plan will address townsites and transmission line corridors.[79] This plan will also include measures to address special-status plant protection and protection of streams, wetlands, riparian areas, and other priority habitats. This plan would include best management practices (BMPs) consistent with implementation of the Historic Properties Management Plan (HPMP) to avoid, minimize, or mitigate adverse effects to historic properties as required by the National Historic Preservation Act (NHPA). Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Invasive Plants Management Plan

To manage the establishment and spread of invasive, non-native plant species within the Project Boundary, City Light proposes to develop an Invasive Plants Management Plan which will address townsites, transmission line corridors, and fish and wildlife mitigation lands and include measures to address: (1) the introduction and spread of invasive plant species in the Project Boundary; (2) early detection and rapid response measures; (3) effective control measures; (4) monitoring and reporting; and (5) outreach, education and coordination measures. This plan would include BMPs

[79] The Mitigation Lands Management Plan will incorporate applicable measures from the Vegetation Management Plan.

consistent with implementation of the HPMP to avoid, minimize, or mitigate adverse effects to historic properties as required by the NHPA. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Wildfire Management Plan

To provide wildfire management for lands within the Project Boundary and to support regional wildfire management efforts, City Light proposes to develop a Wildfire Management Plan, in collaboration with the NPS, that addresses fire prevention and response as well as fuel management topics. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Ross Lake Wetland Habitat Enhancement Measures

City Light will implement management actions to protect or enhance wetland habitats along the Ross Lake shoreline that are consistent with woody debris management in the reservoir. City Light will consider NPS riparian restoration activities conducted along several hundred feet of Ross Lake shoreline in Dry Creek bay which 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. Additional details will be provided in the FLA.

4.2.4.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to botanical resources have been identified at this time.

4.2.5 Wildlife Resources

This section describes the general habitat features associated with the Project vicinity and the wildlife known or with the potential to occur there. In this section, "Project vicinity" is defined as the Project structures and reservoirs, transmission line right-of-way (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 3.1-14 in Section 3.0 of this Exhibit E for locations of the fish and wildlife mitigation lands. This section is organized by the following topics: (1) wildlife distribution; (2) special-status wildlife species (i.e., Endangered Species Act [ESA] federally listed, candidate, or proposed species; U.S. Forest Service [USFS] sensitive species; protected under the federal Bald and Golden Eagle Protection Act; or Washington State listed); (3) other wildlife species of cultural, recreational, or economic importance.

Information about potential wildlife use of the Project vicinity is based on literature on species/habitat associations; observations by Seattle City Light (City Light) biologists; and surveys conducted by National Park Service (NPS) biologists in the North Cascades National Park Complex and Washington Department of Fish and Wildlife (WDFW), Tribal, and British Columbia Ministries of Parks biologists elsewhere in the Project vicinity.

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 Ross Lake National Recreation Area (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 vicinity.

To supplement existing, relevant, and reasonably available information from City Light's Pre-Application Document (PAD), City Light also conducted the following studies that address wildlife resources: (1) TR-05 Marbled Murrelet Study; (2) TR-06 Golden Eagle Habitat Analysis; (3) TR-07 Northern Goshawk Habitat Analysis; (4) TR-08 Special-Status Amphibian Study; (5) TR-09 Beaver Habitat Assessment; and (6) TR-10 Northern Spotted Owl (NSO) Habitat Analysis. The results of these studies are summarized in this section.

4.2.5.1 Affected Environment

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, City Light has engaged with Indian Tribes and Canadian First Nations regarding wildlife resources to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While geology and soils are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in wildlife resources as, or related to, tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Wildlife Distribution

The Project Boundary spans parts of two Level III Ecoregions, which are analogous to physiographic provinces (Wiken et al. 2011). The Project reservoirs, a small portion of the transmission line corridor, and most of the fish and wildlife mitigation lands lie within lower elevations of the North Cascades Ecoregion, which encompasses the Cascade Mountains and foothills in Washington. The North Cascades Ecoregion (or Western Slopes and Crest, Washington Cascades physiographic province) includes faunal elements characteristic of western Washington (i.e., slopes west of the Cascade Crest) and eastern Washington (east of the Cascade Crest). The area around Ross Lake, although west of the Crest, is transitional; it is situated in the lower elevations of the Ross Lake drainage and between moist coastal and dry interior forests and in the rain shadow of mountains to the west including Mount Baker, Mount Shuksan, and the Picket Range (Finney and Gouvenain 1989). The Picket Range serves as an additional ecological barrier in the RLNRA causing an influential rain shadow around Ross Lake with dry slopes and balds (Nielsen et al. 2021). Species associated with alpine and subalpine habitats of the North Cascades Ecoregion are largely absent from the Project Boundary (the maximum elevation of the Project Boundary around the Project reservoirs ranges from 2,000 to 2,432 feet elevation, and only a few of the fish and wildlife mitigation lands are at higher elevations of 3,632 to 4,040 feet elevation) but may occur seasonally or during dispersal periods. The North Cascades Ecoregion contains large areas of unbroken forest and roadless tracts. Most of the transmission line corridor and the remaining fish and wildlife mitigation lands lie within the Strait of Georgia/Puget Lowland Ecoregion (Puget Trough physiographic province), which generally includes areas of low topographic relief and foothills up to about 1,000 feet in elevation surrounding Puget Sound. Habitats along the transmission line corridor likely support a less diverse assemblage of native wildlife species than is present in less disturbed habitats found on the wildlife mitigation lands.

Mammals

There have been no comprehensive surveys of mammals specific to the Project. However, information sources include observations recorded by North Cascades National Park Complex or various NPS studies (summarized for some taxa by Hoffman et al. 2015), iNaturalist, City Light biologists and other staff, or noted during relicensing studies. Mammal distribution and abundance are dependent on many factors including forest seral stage, aspect, level of habitat disturbance, and elevation (Weber et al. 2009). Most of the more than 70 species of mammals documented in the North Cascades National Park are known to occur or could potentially occur within the Project Boundary around the Project reservoirs, except species only associated with high elevations or locations east of the Cascade crest. Mammals that are state or federally listed as threatened, endangered, sensitive, or accorded other special status and are documented or likely to occur in the Project vicinity are discussed at length in sections below individually and organized by status. Commonly observed or notable species that occur in the Project Boundary around the Project reservoirs include black-tailed deer (*Odocoileus hemionus*), marten (*Martes americana*), black bear (*Ursus americanus*), river otter (*Lontra canadensis*), several bat species, American pika (*Ochotona princeps*), Keen's mouse (*Peromyscus keeni*), deer mouse (*Peromyscus maniculatus*), Townsend's chipmunk (*Tamias townsendii*), and Douglas squirrel (*Tamiasciurus douglasii*). Mountain goats (*Oreamnos americanus*) are sometimes observed on the steep slopes around Diablo Lake. Columbian ground squirrel (*Urocitellus columbianus*) has a limited distribution in the Project Boundary, occurring only at sites on the east side of Ross Lake. Tracks observed in the drawdown zone at the north end of Ross Lake in 2022 include black-tailed deer, river otter, and a smaller mustelid (possibly mink [*Mustela vison*]).

Pikas make use of talus patches along the Project reservoirs, adjacent roads near 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 was 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 unsuitable for pika survival at low elevations in the North Cascades National Park Complex (Bruggeman 2010).

A sizable bat maternity colony, mostly Yuma myotis (*Myotis yumanensis*), occurs at a Hozomeen warehouse (Christophersen and Kuntz 2003) and have been 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, the buildings were made inaccessible after the bats left in the fall. City Light installed bat houses in Newhalem in 2010, Diablo in 2017, and a bat condo at Hozomeen in 2017, which are used by *Myotis* spp. A silver-haired bat (*Lasionycteris noctivagans*) 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, *Pseudogymnascus destructans*, and the results were negative. NPS has conducted additional swab testing in recent years and no positive results have been reported. Various bat species have been detected on the Barnaby Slough wildlife mitigation land including California myotis (*M. californicus*), silver-haired bat, 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. These species are discussed at greater length below.

Birds

The distribution of birds is related to many factors including elevation and habitat conditions. At least 88 species occur as breeding birds in the North Cascades National Park, more than half of which are migratory species (Audubon Society 2022). Some of these breeding species are restricted to high elevations, but most others could potentially occur in the Project vicinity. Hoffman et al. (2015) summarizes information on bird species occurrence from various sources, including intensive long-term monitoring at transect sites in the North Cascades National Park Complex, North American Breeding Bird Survey (BBS) accounts (part of the North Cascades BBS route is along State Route (SR) 20 and was surveyed each year from 1988 through 2006), Christmas Bird Counts, and surveys of various special-status species. Although much of the information is not indicated by location, species are categorized as increasing, decreasing, stable, or uncertain because information is insufficient. eBird has more than 20 registered birding "Hotspots" associated with the Project vicinity, including sites on Ross Lake, Diablo Lake, Gorge Lake, associated campgrounds and trails, the Diablo and Newhalem townsites, and some of the fish and wildlife mitigation lands. The bird observation lists from these locations are useful for general patterns of seasonal presence and for detections of rare or uncommon bird species.

More than half of the species breeding in the North Cascades are migratory and winter in the southern United States, Mexico, Central America, and South America. Major species groups include hummingbirds, flycatchers, vireos, swallows, thrushes, warblers, tanagers, and grosbeaks. Bird species expected to occur within with the transmission line ROW include those associated with the predominant habitats within and surrounding the ROW, including upland shrub habitats, shrub-dominated wetlands, forests, riparian corridors, agricultural, and developed lands. Category IV wetlands located along the transmission line ROW within farm and hay fields, although lacking vegetative diversity and frequently disturbed, provide connectivity to larger undisturbed habitats that are used as stop-over habitat by waterfowl.

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's 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 mergansers (*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 (*Rubus spectabilis*) and red-flowering currant (*Ribes sanguineum*) in natural habitats and ornamental 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 providing opportunities for viewing a variety of waterfowl, bald eagles, and passerines during the breeding season. Breeding birds at the County Line Ponds reportedly include Hammond's (*Empidonax hammondii*) and Pacific-slope flycatchers (*Empidonax difficilis*), red-eyed vireo (*Vireo olivaceus*), Swainson's thrush (*Catharus ustulatus*), and yellow-rumped (*Setophaga coronata*), Townsend's (*Setophaga townsendi*), and black-throated gray warblers (*Setophaga nigrescens*), along with American redstart (*Setophaga ruticilla*), the only known breeding site in Western Washington. Species that utilize the Newhalem Ponds are also diverse, including belted kingfisher (*Megaceryle alcyon*), spotted sandpiper (*Actitis macularius*), American dipper (*Cinclus mexicanus*), and numerous species of waterfowl. Waterfowl observed at Barnaby Slough include 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).

Christophersen and Ransom (2022) summarize the results of surveys of osprey (*Pandion haliaetus*) in the Cascades National Park Service Complex during 24 of the 41 years between 1979 to 2020; peregrine falcon (*Falco peregrinus*) from 2006 to at least 2020 (except for 2008 and 2013); and bald eagle (*Haliaeetus leucocephalus*) from 2015 to 2020. Surveys by NPS biologists for osprey breeding territories have been performed mostly at Ross Lake, where the species occurs at low density, with evidence of a stable population since the 1990s. The number of active nests in any one year has ranged from 1 to 13. City Light biologists have also observed ospreys nesting along the Skagit River downstream of the Project, and on multiple Project transmission towers. Peregrine falcon eyries are associated with steep, rocky cliffs near Ross Lake (3 sites), Diablo Lake (1 site), Gorge Lake (1 site) and near Newhalem (1 site), although not all these sites are occupied each year. Overall, the population has increased from the historical low. Inconsistencies in survey effort and difficult access to some sites complicates interpretation of survey results (Christopherson and Ransom 2022). As of 2022, there is one actively occupied bald eagle nest on Ross Lake located north of Little Beaver Creek. Additional information regarding peregrine falcon and bald eagle is presented in the special-status species accounts below.

Special-status birds that are documented or likely to occur in the Project vicinity are discussed at length in the sections below, including information developed by City Light's TR-05 Marbled Murrelet Study, TR-06 Golden Eagle Habitat Analysis, TR-07 Northern Goshawk Habitat Analysis, and TR-10 NSO Habitat Analysis studies.

Reptiles

Few reptile species occur in the Ecoregions of the Project but all are considered common (Brown et al. 1995, Washington Natural Heritage Program [WNHP] et al. 2009). None of the reptiles that occur are state or federally listed special-status species. The northern alligator lizard (*Elgaria coerulea*), the only lizard known to occur in the Project vicinity, is commonly associated with forest openings, talus, and other rocky areas in both Ecoregions, and is therefore likely to occur within the Project transmission line ROW. These lizards are frequently observed by City Light staff in the rocky habitats around Gorge Powerhouse and in the powerhouse itself and were noted during relicensing field work around Ross Lake, adjacent wetlands, and among stumps and woody debris in the drawdown zone. Three species of gartersnake (*Thamnophis spp.*) occur and are found in both Ecoregions. However, common gartersnake (*Thamnophis sirtalis*) is by far the most frequently found and is especially conspicuous near aquatic habitats with amphibians. Northwestern gartersnake (*T. ordinoides*) has the most restricted distribution, mostly west of the Cascade crest, and is most often encountered in seasonally moist environments. The western terrestrial gartersnake (*T. elegans*), of which the wandering gartersnake (*T. e. vagrans*) is the representative species in the region, also occurs in the Puget Lowland but may be largely absent in the North Cascades. The three species of gartersnake in the region exhibit a wide range of scale and color patterns which can confound positive identification from photographs or reported incidental observations. The only other snake which occurs in the area is the rubber boa (*Charina bottae*), found throughout the region in both Ecoregions but infrequently encountered because of semifossorial habits and nocturnal activity. There are no turtle species native to the Project vicinity, although introduced species are possible, especially in the Puget Lowlands. These possible introduced species include painted turtle (*Chrysemys picta*), a species native to eastern Washington and occurring widely in the U.S., snapping turtle (*Chelydra serpentina*), and slider (*Trachemys scripta*). However, none of these species have been reported or documented by City Light staff.

Amphibians

Amphibians known or likely to occur within the Project Boundary include seven lentic or pond-breeding species, two species almost entirely associated with lotic (stream) habitats, and two species that are terrestrial in all life stages—western red-backed salamander (*Plethodon vehiculum*) and ensatina (*Ensatina eschscholtzii*) (McAllister 1995, WNHP et al. 2009) (Table 4.2.5-1). These two terrestrial salamanders are generally associated with low to mid-elevations and seasonally moist sites, with few known occurrences in the North Cascades Ecoregion beyond the westernmost slopes. Although possibly an artifact of limited sampling, studies in the North Cascades National Park Complex recorded only ensatina, and this species only within Big Beaver Valley west of Ross Lake (Hoffman et al. 2015). The range of Columbia spotted frog (*Rana luteiventris*) in the North Cascades Ecoregion lies mostly east of the Project, but includes occurrences in the Big Beaver Valley west of Ross Lake. (It is discussed below as a special-status species.) Columbia spotted frog does not occur in the Puget Lowlands. The introduced and invasive American bullfrog (*Lithobates catesbeianus*) has reportedly not been documented in the North Cascades National Park Complex (Holmes and Glesne 1997). However, the species is well established in the Puget Lowland Ecoregion, especially in permanent ponds and lakes, and has risk to occur in some of the lower elevation fish and wildlife mitigation lands along the Skagit River or along the transmission line, although no detections have been recorded to date. The nearest known occurrences of American bullfrog in the Skagit River Valley are in the area between Lyman and Sedro-Woolley, including observations by City Light biologists at the Anderson Creek salmon habitat restoration site south of Ross Island Slough and other sightings posted on iNaturalist (Tressler 2022a, personal communication). The pond-breeding Oregon spotted frog (*Rana pretiosa*), federally listed as threatened, is discussed as a special-status species below. However, Oregon spotted frog is undocumented within the Project Boundary and unlikely to occur. Habitat evaluations and the results of surveys performed by City Light in the TR-08 Special-Status Amphibian Study are also detailed below.

Suitable habitats for additional pond-breeding amphibians occur at wetland sites along the transmission line and parts of Ross Lake. The fish and wildlife mitigation lands also contain substantial amphibian habitat at Barnaby Slough, Harrison Slough, False Lucas Slough, Savage

Slough, and other parcels, as well as at the County Line Ponds and Newhalem Ponds. Pacific chorus frog (*Hyliola* [*Pseudacris*] *regilla*) was the species most frequently detected by the TR-08 Special-Status Amphibian Study, occurring at all sites where at least one species was found, followed by northwestern salamander (*Ambystoma gracile*), including occurrences of both species at sites along the transmission line, on mitigation lands, and sites on Ross Lake. Northern red-legged frog (*Rana aurora*) was documented at fewer sites along the transmission line and occurs on mitigation lands but was not found at Ross Lake sites. The latter result is consistent with results of earlier studies in the North Cascades National Park Complex, which included pond inventory surveys in Big Beaver Valley and other sites, detecting this species only at lower elevation in the Skagit watershed. Egg mass surveys by City Light in 2011-2012 found northern red-legged frog particularly abundant on the mitigation lands in upper Harrison Slough associated with beaver-modified habitats. Northern red-legged frog is likely absent from some sites along the transmission line because of high levels of development, loss of forested habitat in the surrounding area, and fragmentation by roads—factors unrelated to the Project.

City Light's TR-08 Special-Status Amphibian Study also documented the pond-breeding long-toed salamander (*Ambystoma macrodactylum*), western toad (*Anaxyrus boreas*), and Columbia spotted frog (*Rana luteiventris*) at Ross Lake. The latter two species are discussed in detail below as special-status species. Surveys of pools in the drawdown zone within one mile of the U.S.-Canada border found northwestern salamander egg masses at some of the sites. Although the pools were later inundated by Ross Lake, with cooler, deep water, and are accessible by fish, northwestern salamander is adapted for permanent ponds and lakes where these conditions sometimes occur. A pool high in the drawdown zone north of Roland Point was also used by northwestern salamander, along with long-toed salamander, western toad, and Pacific chorus frog. This site holds stable water and develops suitably warm conditions for breeding in late spring. The long-toed salamander, western toad, and Pacific chorus frog likely metamorphose before or soon after the pool is flooded by the lake. Other sites at or near the upper limits of the lake's water surface elevation are used by breeding western toads and Pacific chorus frogs, including the west and east side of the north end of the lake, and shallow, sloping edges of inlets near Dry Creek and Roland Point. One site, a borrow pit pool on the northeast side of the lake, just south of the U.S.-Canada border and near the upper limit of the lake's water surface elevation, was the only location where Columbia spotted frog egg masses occurred.

The stream obligate species, coastal tailed frog (*Ascaphus truei*) has been found in several tributaries to Ross Lake and within the lower reach of Sourdough Creek, which flows into Diablo Lake (Rawhouser et al. 2009). Coastal tailed frogs from Goodell and Newhalem Creeks, tributaries that flow into Gorge Lake, exhibited a slight, but detectable, level of genetic differentiation compared to populations on streams that flow into Ross and Diablo lakes, which were genetically indistinguishable (Grummer and Leache 2016). The authors suggested that the difference might be explained by reduced population connectivity resulting from Gorge Dam, the oldest of the three Project dams, whereas the other sample sites, particularly in the area between Ross Dam and Gorge Dam, were indicative of high connectivity, and no current population effects were evident. The other stream species, coastal giant salamander (*Dicamptodon tenebrosus*), was not found on tributaries of Ross Lake but occurs on other tributaries downstream.

Batrachochytrium dendrobatidis (Bd), a pathogenic fungus associated with the disease chytridiomycosis in amphibians, was undetected in samples of coastal tailed frog larvae, long-toed salamanders, 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 2017).

Table 4.2.5-1. Summary information regarding amphibians verified or likely to occur within the Project Boundary.

Species	Habitat Associations	Verified Within Project Boundary?
Coastal giant salamander *Dicamptodon tenebrosus*	Larvae and gilled adults are aquatic in streams. Larvae that metamorphose require multiple years and become terrestrial after metamorphosis, living in forests and usually associated with large woody debris.	No, but could occur in some streams crossed by the transmission line. Apparently not widely distributed in the RLNRA.
Northwestern salamander *Ambystoma gracile*	Larvae and gilled adults occur in permanent or semi-permanent ponds, marshes and other wetlands, lakes, and slow flowing streams. Larvae usually require two years to reach metamorphosis and then reside in forest habitats.	Yes, in both Ecoregions of the Project, including sites at Ross Lake, along the transmission line, and on mitigation lands.
Long-toed salamander *Ambystoma macrodactylum*	Adaptable and able to breed successfully in aquatic habitats that dry by early summer as well as permanent ponds, lakes, and slow streams. Terrestrial after metamorphosis in forests and other areas.	Yes, at Ross Lake sites and likely to occur at sites along the transmission line and on mitigation lands.
Rough-skinned newt *Taricha granulosa*	Breeds in slow moving streams, ponds, and lakes. Larvae often require two years to reach metamorphosis. Transformed juveniles and adults are terrestrial in forests and often diurnally active.	Not known to occur at Ross Lake but found in Big Beaver Valley and on mitigation lands.
Western red-backed salamander *Plethodon vehiculum*	Completely terrestrial species (no free-living larval form) often associated with large woody debris, rocks, and other cover objects. Few records in the North Cascades	No, but likely to occur in forested segments along transmission line and on mitigation lands.
Ensatina *Ensatina eschscholtzii*	Completely terrestrial species often associated with large woody debris, including bark slabs, and other cover objects. Few records in the North Cascades.	Yes, found in Big Beaver Valley and Newhalem Ponds, and likely occurs in forested segments along transmission line and on mitigation lands.
Coastal tailed frog *Ascaphus truei*	Obligate stream species requiring perennial, clear, cool-water sites with rocky substrates where larvae develop slowly. Adults also aquatic or living on stream edges and foraging at night.	Yes, found in tributaries of Ross Lake and Diablo Lake. Likely to occur at other sites, including perennial tributaries of Gorge Lake and some of the streams crossed by the transmission line (e.g., Hilt Creek).
Western toad *Anaxyrus boreas*	Breeds in shallow water in marshes, margins of small lakes, and ponds; may travel long distances from breeding sites and use a variety of terrestrial habitats.	Yes, at Ross Lake sites, Big Beaver Valley, County Line and Newhalem Ponds, and at least one site on mitigation lands. Possible at a few wetlands associated with the transmission line ROW.
Pacific chorus frog *Hyliola regilla*	Breeds in marshes, ponds, pools, stream backwaters, and shallow lake edges; can be found far from breeding sites.	Yes, verified at all sites where at least one aquatic amphibian species occurs.
Northern red-legged frog *Rana aurora*	Breeds in marshes, ponds, bogs, and slow flowing streams, usually at lower elevations; often occurs in moist woodlands adjacent to streams.	Yes, at sites along transmission line and on mitigation lands. No verified occurrences at Ross Lake or Big Beaver Valley.

Species	Habitat Associations	Verified Within Project Boundary?
Columbia spotted frog *Rana luteiventris*	Highly aquatic, associated with permanent aquatic areas (small lakes, ponds, marshes, streams, ands springs) and seasonal use of sites that dry. Breeds in shallow, seasonally flooded, emergent wetlands.	Yes, at extreme north end of Ross Lake near the U.S.-Canada border and in Big Beaver Valley.
American bullfrog *Lithobates catesbeianus*	Highly aquatic introduced species, associated with permanently flooded ponds, lakes, reservoirs, deep marshes, and sluggish streams, particularly with at least some warm water areas and emergent or submerged vegetation.	No, but known to occur in the lower Skagit River Valley downstream of Lyman and at sites in Lake Stevens and Arlington.

Sources of information: Jones et al. (2005), WHNP et al. (2009), Hoffman et al. (2015), City Light (2022d).

Special-Status Wildlife Species

The sections below describe species that are known or have the potential to occur within the Project Boundary and that are regarded as special-status species formally listed by the U.S. Fish and Wildlife Service (USFWS), USFS, or WDFW, including species listed as endangered, threatened, or sensitive.[80] In addition to the categories listed 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 extensive and less focused than the categories below, it is not included. Some of the special-status species discussed below are listed in multiple categories, as summarized in Table 4.2.5-2.

Endangered Species Act (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.

Washington State Listed Species – Species that are protected by the State of Washington (Washington Administrative Code [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). State endangered species included grizzly bear, gray wolf, northern spotted owl, yellow-billed cuckoo, Oregon spotted frog, fisher, and the Cascade red fox. State threatened species included Canada lynx and marbled murrelet. Common loon is a state sensitive species and Townsend's big-eared bat, northern goshawk, western toad, and Columbia spotted frog are state candidates.

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. Sensitive species discussed below include little brown bat, common loon, harlequin duck and northern goshawk.

[80] These are wildlife species described as "rare, threatened, and endangered species" in the PAD. The term "special-status" is used here instead because "rare" is not a listing category used for wildlife species by any of the involved agencies.

Table 4.2.5-2. Special-status species with the potential to occur in the Project vicinity.

Common Name (*Scientific Name*)	Status
Grizzly bear (*Ursus arctos horribilis*)	FT SE
Gray wolf (*Canis lupus*)	FE SE
Canada lynx (*Lynx canadensis*)	FT ST
Marbled murrelet (*Brachyrampus marmoratus*)	FT ST
Northern spotted owl (*Strix occidentalis caurina*)	FT SE
Yellow-billed cuckoo, western U.S. DPS (*Coccyzus americanus*)	FT SE
Oregon spotted frog (*Rana pretiosa*)	FT SE
Cascade red fox (*Vulpes vulpes cascadensis*)	SE
Monarch butterfly (*Danaus plexippus*)	FC
Wolverine (*Gulo gulo*)	FC
Fisher (*Pekania pennanti*)	SE
Townsend's big-eared bat (*Corynorhinus townsendii*)	SC
Little brown bat (*Myotis lucifugus*)	USFS SS
Common loon (*Gavia immer*)	WDFW SS USFS SS
Harlequin duck (*Histrionicus histrionicus*)	USFS Sensitive Species
Northern goshawk (*Accipiter gentilis*)	SC USFS SS
Western toad (*Anaxyrus boreas*)	SC
Columbia spotted frog (*Rana luteiventris*)	SC

FE = Federally Endangered
FT = Federally Threatened
FC = Federal Candidate
SE = State Endangered
ST = State Threatened
SC = State Candidate
SS = Sensitive Species

ESA Federally Listed or Proposed Species

City Light developed the list of ESA-listed species known or with the potential to occur within the Project Boundary by querying the USFWS' online Information for Planning and Consultation (IPaC) to generate an unofficial list of federally endangered (FE), threatened (FT), and proposed endangered or threatened, and official candidate species that should be considered as part of any future effects analysis of the Proposed Action.[81] In addition, City Light accessed existing species records through the WDFW Priority Habitats and Species (PHS) online-based system[82]. The database searches were performed with a two-mile buffer surrounding the Project Boundary, an area much larger than that potentially affected by the Project, intended to provide a comprehensive initial list. City Light reviewed other pertinent literature and readily available information that might not be reflected by these federal and state sources for additional species that may occur in the Project vicinity.

City Light researched the known distribution, habitat associations, and requirements of these species to determine which species warranted further analysis. Species known to be endemic to restricted geographic areas and habitat types not found within the Project Boundary or nearby area were excluded from further analysis.

There were eight ESA-listed species identified as known or with the potential to occur in the Project vicinity. One of the ESA-listed species identified by IPaC, the streaked horned lark (*Eremophila alpestrris strigata*), was excluded from further consideration because the Project is outside the current known range, which is limited to the south of Puget Lowlands and areas further south, and suitable habitat also does not occur. The remaining list includes seven species. Table 4.2.5-3 summarizes the status, habitat associations, and any known occurrences in the Project Boundary or nearest known occurrences of these federally listed threatened or endangered wildlife species that may occur or be affected by the Project.

Table 4.2.5-3. ESA-listed species with the potential to occur in the Project vicinity.

Common Name (*Scientific Name*)	Status	Habitat Associations	Known Occurrences in the Project Vicinity
Grizzly bear *Ursus arctos horribilis*	FT SE	Diverse habitats include valley bottoms, high meadows, forests, woodlands, and prairies. Individuals range over large areas seasonally. May be functionally extirpated in the North Cascades.	No recent records. Few known to occur in the North Cascades in adjacent British Columbia, Canada.
Gray wolf *Canis lupus*	FE SE	Diverse habitats include forests and grasslands, provided that adequate populations of primary prey species (large ungulates) occur.	Recent detections in the Hozomeen area but currently no known resident packs in the Project vicinity ("Diobsud Creek" occurrence currently a lone wolf).
Canada lynx *Lynx canadensis*	FT ST	Subalpine and boreal forests; in Washington mostly in Okanogan region at sites above 3,600 feet elevation. Reliant on snowshoe hare as prey.	Few, but recent individual observations in and near the Project.

81 Species for which the USFWS has been petitioned to list and that are under petition review or under 12-month status review after a substantial finding, but that have not been listed or proposed for listing, are not discussed in this section.

82 WDFW Priority Habitats and Species mapping. [Online] URL: https://geodataservices.wdfw.wa.gov/hp/phs/.

Common Name (*Scientific Name*)	Status	Habitat Associations	Known Occurrences in the Project Vicinity
Marbled murrelet *Brachyrampus marmoratus*	FT ST	Seabird that forages in nearshore marine habitats and nests on large, mossy, horizontal tree branches in mature and late successional forests, including verified sites as much as 52 miles from the ocean.	No verified breeding but radar detections (no visual confirmation) in flight downstream of Gorge Lake. One recent observation on Ross Lake.
Northern spotted owl *Strix occidentalis caurina*	FT SE	Nests primarily in old-growth forests; second-growth forests used for dispersal. Increased occurrence of barred owls in areas that once supported spotted owls.	Few, but no recent detections. No confirmed breeding pairs.
Yellow-billed cuckoo, western U.S. DPS *Coccyzus americanus*	FT SE	Mostly associated with large, intact areas of riparian forest. Functionally extirpated as a breeding species in Washington, with no breeding records since 1940.	No records.
Oregon spotted frog (*Rana pretiosa*)	FT SE	Highly aquatic, requiring permanent aquatic habitat but also uses connected seasonal wetlands. Breeds in shallow parts of emergent wetlands. In western Whatcom County occurs in upper Samish River, lower South Fork Nooksack, and Sumas River drainages.	No records but possible DNA detection north of the Project in Canada outside of known range.

Sources of information: Hallock 2013; Hoffman et al. 2015; USFWS 2017, 2022; Wiles and Kalasz 2017; WDFW 2022a; City Light 2022a, 2022b, and 2022c.

Grizzly Bear

The grizzly bear (*Ursus arctos horribilis*) was federally listed as threatened in the lower 48 States on July 28, 1975. Critical habitat was designated in 1976. A Recovery Plan was issued in 1982 and revised on September 10, 1993 (USFWS 1993). Supplements to the Recovery Plan that address specific recovery zones were subsequently issued, including the Supplement for the North Cascades Ecosystem, approved on June 23, 1997. The North Cascades Ecosystem includes northwest and north-central Washington and extends into British Columbia, Canada. Within this Ecosystem the designated recovery zone is comprised of the North Cascades National Park Complex (North Cascades National Park, RLNRA, and Lake Chelan National Recreation Area (NRA), parts of the Mount Baker-Snoqualmie and Okanogan-Wenatchee National Forests, as well as state, Tribal, and private lands. The most recent Species Status Assessment was issued on January 21, 2022 (USFWS 2022) and is the primary source of information for this species account.

Before the arrival of Europeans, grizzly bears occupied much of the western United States, central Mexico, western Canada, and most of Alaska. By the 1930s, the species was eliminated from all but two percent of its historical range in the lower 48 States as a result of extermination programs, habitat loss, and continuing excessive human-caused mortality (USFWS 1993).

Grizzly bears are considered generalists in habitat use and diet but are associated with large areas of diverse habitat to accommodate their seasonal dietary needs and large body size. Habitat suitability is related to distance from roads and, more generally, isolation from human developments and activities, where human-bear interactions are less likely to occur. Male grizzly bears have a known dispersal distance of 42-109 miles compared to a maximum distance of 56 miles for females. Because females do not begin breeding until four years old or older, have small litters, and have long periods between breeding, population growth, even under good conditions, is a slow process (USFWS 2022).

An assessment by Almack et al. (1993) concluded that adequate habitat was available in the North Cascades to support grizzly bears, with an estimated carrying capacity of 200 to 400 individuals, subsequently revised by Lyons et al. (2016) to approximately 280 individuals. Three years of DNA hair-snare sampling in a portion of the North Cascades Ecosystem resulted in only one detection, which occurred about 15 miles north of the U.S.-Canada border in 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 it is now considered "uncertain." The most recent confirmed observation within the U.S. portion of the North Cascades Ecosystem was in 1996, south of Glacier Peak (Interagency Grizzly Bear Committee North Cascades Ecosystem Subcommittee personal communication 2016, cited in U.S. Department of the Interior [USDOI] 2017). Only one or two grizzly bears have been documented in the British Columbia portion of the North Cascades Ecosystem in the past two decades. These detections were from wildlife camera stations, including a station in Manning Provincial Park in the upper Skagit River watershed 20 miles north of the border with an associated hair snare, which documented a male grizzly bear in 2010 and 2012 (USDOI 2017), and a second series of photographs in 2015 10 miles north of the border, which could have been the same bear photographed in 2010 and 2012.

Grizzly bear experts do not believe that there is currently a functional population in the North Cascades Ecosystem. A population is defined by USFWS as "two or more reproductive females or one female reproducing during two separate years." USFWS (2022) categorizes the current condition for the North Cascades Ecosystem as "functionally extirpated," with no predicted change in status in the next 30-45 years unless additional conservation measures, including translocation, are undertaken. Natural recolonization of the North Cascades Ecosystem is considered unlikely due to isolation south and north of the U.S.-Canada border from potential source populations which are also small. Although the Ecosystem is within long range dispersal distance for male grizzly bears, the distance is excessive for female grizzly bears, making dispersal into the region unlikely.

In 2017, a Draft Environmental Impact Statement identified four options or "Alternatives" to recover the grizzly bear population in the Ecosystem (USDOI 2017). Alternative A (No Action) would be a continuation of current measures, which are unexpected to improve the current status of the population and would not avoid the permanent loss of grizzly bears in the Ecosystem. The other three Action Alternatives (B, C, and D) relied on translocation of bears captured from other populations in Canada, but differed in the number and schedule of releases, and the role that monitoring and adaptive management would play. Under the Expedited Restoration option (Alternative D), the recovery goal for the North Cascades Ecosystem (a population of 200 grizzly bears) could be achieved in 25 years. However, plans for grizzly bear restoration in the North Cascades Ecosystem were terminated in July 2020, and, currently, no further actions have been proposed.

No incidental observations of grizzly bears or signs of grizzly bears were noted during any of City Light's relicensing studies.

Gray Wolf

The gray wolf (*Canis lupus*) has been federally listed as an endangered species since the 1970s and is also classified as endangered by WDFW. USFWS has not published a recovery plan or designated critical habitat for the gray wolf. On May 5, 2011, the federal government by legislation ended federal protection for wolves in the eastern third of Washington State, which is within the boundaries of the Northern Rocky Mountains distinct population segment (DPS). WDFW issued the Wolf Conservation and Management Plan for Washington (Wiles et al. 2011) in December 2011. Effective January 4, 2021, USFWS delisted the gray wolf throughout the lower 48 States and relinquished management authority in Washington to WDFW outside of tribal lands (84 Federal Register [FR] 9648). However, on February 10, 2022, a U.S. District court vacated the delisting rule, effective immediately, and restored endangered species protections. The court determined that the USFWS had been arbitrary and capricious in its action by not performing necessary analyses to justify delisting. The court noted that USFWS failed to provide genetic evidence that West Coast wolves were indistinct from Northern Rocky Mountains wolves and had not performed an adequate threats assessment. The ruling is currently under appeal.

The gray wolf is an apex predator, affecting not only its prey populations but populations of subordinate predators and their prey. Wolves are highly adaptable and thrive in diverse habitats including temperate forests, tundra, taiga, and grasslands, primarily associated with the occurrence of adequate prey populations (mostly large ungulates) and where wolf-livestock conflicts are low or manageable. In Washington, wolves were functionally extirpated by the 1930s after a long period of intensive hunting, trapping, and poisoning, including government-funded bounty programs aimed at eradication (Wiles et al. 2011). In the absence of persecution, wolves were capable of recolonizing suitable areas through long distance dispersal. Statewide, since data were first collected in 2008, the wolf population has increased each year, especially in the northeastern part of the Eastern Washington Recovery Zone and more recently in the southwest part of the zone (WDFW 2022a). Persistent, resident wolf packs, including successful breeding pairs, have been documented in the Northern Cascades Recovery Zone in Okanogan, Chelan, and Kittitas counties. As of winter 2021, the most recent count, there were 206 known wolves in Washington, with 33 packs, and at least 19 successfully breeding pairs, 4 of which resided in the eastern part of the Northern Cascades. Two other packs in the same region did not include breeding pairs. There are currently no known packs west of the Cascade Crest.

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 found in the Hozomeen area in the spring of 2012. These wolves were suspected to be part of a pack that likely denned in British Columbia. Wolf tracks have been observed by NPS and City Light biologists in the drawdown zone of Ross Lake as recently as April 28, 2022 (incidental observation during TR-08 Special-Status Amphibian Study), and an NPS trail camera has documented a lone wolf near Hozomeen in May 2022.

A wolf that was captured in Skagit County and fitted with a radio-collar in 2017 was found to be traveling with another wolf in late 2018 and the two were designated as the "Diobsud Creek" pack by WDFW. This pack, which was using the western part of the national park complex and industrial timberland east of Lake Shannon and north of SR 20, was the first confirmed wolf pack west of the Cascade Crest (WDFW et al. 2019). The Diobsud Creek pack activity area included portions of the transmission line corridor and fish and wildlife mitigation lands in the vicinity of the Sauk and Skagit River confluence. In the 2020 annual wolf population survey, only a lone wolf was documented in the activity area of the Diobsud Creek pack, which no longer constitutes a pack (WDFW 2022b).

Canada Lynx

The Canada lynx (*Lynx canadensis*) was federally listed as threatened on March 24, 2000 and has been state listed as threatened in Washington since 1993. Primary threats to the species include habitat loss and overutilization (trapping) (65 FR 16051). On November 9, 2006, USFWS designated critical habitat for lynx, including the North Cascades (Unit 4) east of the Cascade crest mostly within Chelan County (also includes a small part of Okanogan County) above 4,000 feet elevation (71 FR 53355). Washington State Department of Natural Resources (DNR) lands managed in accordance with the Lynx Habitat Management Plan (Washington DNR 2006) are excluded from the designated critical habitat. The Canada lynx is closely associated with boreal forests because of 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 generally above 3,600 feet, including subalpine and high-elevation mixed conifer zones in the east Cascades. According to the most recent Species Status Assessment (USFWS 2017), the only confirmed resident breeding population in the state is in the Okanogan region, although lynx are being reintroduced into the Kettle Range in northeastern Washington. Key characteristics of occupied habitat in the Okanogan region as summarized by USFWS (2017) are forests dominated by Engelmann spruce (*Picea engelmannii*), subalpine fir, or lodgepole pine; and slopes less than 30 degrees. Conversely, forest openings and recently burned areas are avoided, as are elevations below 3,000 feet and steep slopes. Suitable habitats do not occur in the Project vicinity. In 2008, the Canada lynx population in Washington was estimated at 87 individuals, with the highest concentration in the Okanogan-Wenatchee National Forest. 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, at least temporarily, because of multiple large wildfires (Lewis 2016). Longer term projections suggest habitat conditions for Canada lynx are likely to decline because of climate change (USFWS 2017).

Observations of lynx have been noted on Washington State Department of Transportation (WSDOT) trail cameras near SR 20 east of the Ruby Arm during SR 20 winter closure in 2021/2022 (Kalisz 2022). Remote wildlife camera stations detected Canada 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, a lynx was observed and photographed traversing the frozen edge of Diablo Lake near SR 20, and another observation by City Light personnel occurred near the Newhalem Ponds Storage Area on City Light land just downstream of Newhalem. Canada lynx scat has also been identified and tested for DNA in the northern Cascades region including several sites east and southeast of Ross Lake by the Cascades Carnivore Project conducted in 2018 and 2019 (Akins et al., 2022). Because the highest elevation areas around the Project facilities are well below the elevations of occupied Canada lynx habitat, any observations of Canada lynx likely represent animals in dispersal.

No incidental observations of Canada lynx or signs of Canada lynx were noted during City Light's relicensing studies.

Marbled Murrelet

The marbled murrelet (*Brachyramphus marmoratus*) is a unique seabird because adults will fly considerable distances inland from the ocean during the breeding season to nest in old growth and mature coniferous forests. In Washington, marbled murrelets usually nest in older forests dominated by conifer trees that have large branches with substantial accumulations of moss, epiphytes, and/or other debris that form platforms on which a single egg is laid (Hamer and Nelson 1995). Marbled murrelets exhibit strong site fidelity to nesting areas and appear to nest in alternate years, on average (Desimone 2016).

The species was listed as threatened under the ESA in 1992 in Washington, Oregon, and California, primarily due to loss of old growth forest nesting habitat from commercial timber harvesting and mortality associated with net fisheries and oil spills. USFWS designated critical habitat for the marbled murrelet in 1996 (61 FR 26255) and finalized the recovery plan in 1997 (USFWS 1997). The Project Boundary does not contain any designated critical habitat for marbled murrelet. However, critical habitat is located within portions of the study area (within 0.5 miles of the Project Boundary, Figure 4.2.5-1; City Light 2022a) adjacent to the following fish and wildlife mitigation lands: northern edge of Nooksack, southern boundary of Pressentin, southwest corner of Finney Creek, and the southern tip of Illabot South. Critical habitat is mapped near the Town of Marblemount, approximately 1 mile south of the Bacon Creek confluence within the Skagit River (Project transmission lines cross near this confluence) and the Illabot Creek fish and wildlife mitigation land (USFWS 2019). In the Sauk River Basin, critical habitat is mapped 2 miles east of the transmission line ROW, where it runs along the Sauk River (between Rockport and Darrington). Critical habitat is mapped in the Stillaguamish River Basin approximately 2 miles west of the transmission line ROW (north of Darrington) and approximately 0.9 miles north of the transmission line ROW (between Darrington and Arlington). Multiple active and historical marbled murrelet nest sites have been documented in close proximity to the Project transmission line ROW between Marblemount and Darrington, between Darrington and Arlington, and also near City Light fish and wildlife mitigation lands southwest of Rockport, Washington (WDFW 2021a). A historical occupied murrelet site on Clear Creek, 1 mile south of Darrington in the Sauk watershed, is within 4 miles of the Project transmission line ROW (Reed 2021).

The distance marbled murrelets breed inland is variable and influenced by several factors, including 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 flying up to 70 miles inland (Huff et al. 2006). Nesting in Washington occurs over an extended period from late April through late August (McShane et al. 2004). In 2008, radar surveys recorded detections of possible marbled murrelets flying along the Skagit River near the mouths of Bacon and Thornton creeks (Hamer Environmental 2010). Thornton Creek is approximately 2 miles from the Gorge Powerhouse. Eleven of the possible murrelet 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 audio-visual (AV) surveys in 2009 detected murrelets 1.5 miles up the Thornton Creek drainage but failed to detect any on the Bacon Creek drainage (Hamer Environmental 2010).

Marbled Murrelet Study

To support relicensing of the Project, City Light completed a study to map potentially suitable marbled murrelet nesting habitat within the study area, document flight activity, and to assess the likelihood of marbled murrelet nesting (TR-05 Marbled Murrelet Study Draft Report; City Light 2022a). Although a previous survey documented murrelet flights at several sites between Newhalem and Marblemount, no surveys had been conducted within the Project Boundary to determine if the species occurs this far inland from their marine habitat. The observation of a pair of murrelets in 2017 on Ross Lake near Roland Point, 2.9 miles northeast of the Ross Dam, suggests that murrelets may use that area, at least on occasion. The study area included the Project Boundary with an additional 0.5-mile buffer (Figure 4.2.5-1).

In Washington State, marbled murrelet nesting habitat is generally defined as coniferous forest containing suitable nesting platforms within 70 miles of marine waters (Desimone 2016). The USFWS defines a suitable nesting platform as a relatively horizontal surface at least 10 centimeters (cm; 4 inches) in diameter and located a minimum of 10 meters (m) (33 feet [ft]) high in the live crown of a coniferous tree (USFWS 2012). Any forested area with one observed nest platform is capable of supporting a murrelet nest (USFWS 2012). Potentially suitable nesting habitat was assessed through the identification of nest platforms, cover, and tree size. A Potentially Suitable Marbled Murrelet Nesting Habitat Model (Murrelet Habitat Model) was developed for this study, which was informed by a review of NPS' mapping of vegetation associations within the North Cascades National Park, the results of the TR-01 Vegetation Mapping Study, and a literature review conducted during development of the Revised Study Plan (RSP) (City Light 2021, 2022b). The goal of the Murrelet Habitat Model was to identify all forested areas in the Project study area that are potentially suitable nesting habitat for marbled murrelet, not to define where marbled murrelet nesting occurs. To briefly assess habitat connectivity to lands outside of the study area, the Washington DNR stand age data layer was reviewed for presence of older forest stands adjacent to study area lands with modeled suitable nesting habitat. Areas where forest stands were 60 years and older were generally described in relation to modeled habitat in the study area. Presence of conifers (the only suitable tree for marbled murrelet nesting) and canopy height were used as variable inputs within the Murrelet Habitat Model. Stand height was shown to positively correlate with number of suitable nesting platforms (Hamer and Nelson 1995; Hamer and Meekins 1998; McShane et al. 2004).

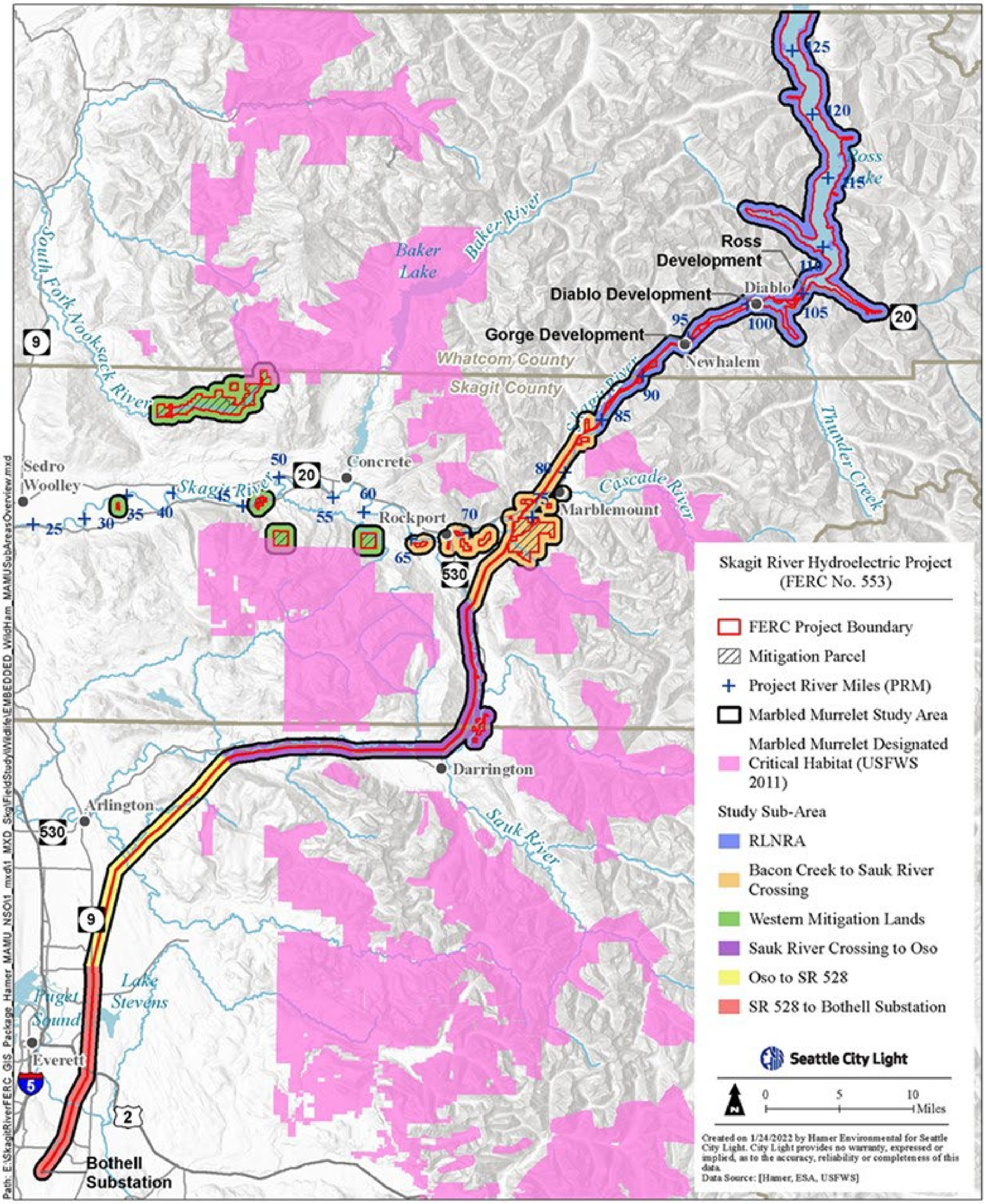


Figure 4.2.5-1. Study area segments for marbled murrelet nesting habitat analysis.

The study conducted limited field habitat assessments to: (1) verify the results of the Murrelet Habitat Model and (2) verify the accuracy of the mapping of suitable marbled murrelet nesting habitat in areas surveyed by radar. The field habitat assessment was conducted concurrently with the radar surveys and prior to the Murrelet Habitat Model analysis. Habitat plots were located in forest stands near Newhalem and near or within the Project Boundary of Gorge, Diablo, and Ross lakes. In each of the ten stands, a 25-m (82-ft) radius habitat plot was assessed to collect information on potential nest platform abundance. In each plot, information was collected about average percent moss cover on tree limbs (5 percent increments), average moss depth on tree limbs (none, marginal, thick), presence of dwarf mistletoe, tree species, tree diameters, potential nest platforms, number of tree canopy layers (1-5), and flight access of murrelets. The parameters of the Murrelet Habitat Model were intentionally conservative to avoid excluding any suitable habitat, deeming forest stands containing conifer trees 60 years and older, and 85 feet or taller as potentially suitable nesting habitat.

Radar and AV surveys were completed from May through July 2021 to document marbled murrelet flight activity near Project facilities and at sites where current and future maintenance, construction, or recreation activities may result in noise disturbance. Radar survey locations were chosen using four criteria: (1) within the Project Boundary where operations and maintenance (O&M) activities may have the highest likelihood of impacting nesting marbled murrelets, if present; (2) presence of suitable marbled murrelet nesting habitat; (3) presence of a major river valley or reservoir that could be used as potential flight corridors; and (4) suitability to detect birds using ornithological radar.

Potentially suitable nesting habitat for marbled murrelets was mapped throughout the study area, and the acreages for each segment are summarized below (Tables 4.2.5-4 through 4.2.5-6). The RLNRA contains the largest segment of the study area with 22,710 hectares (ha) (56,118 acres) comprising 39 percent of the study area. The largest amount of potentially suitable murrelet nesting habitat also is in the RLNRA, 10,753 ha (26,570 acres), comprising 47 percent of the RLNRA segment. Bacon Creek to Sauk River Crossing contains the second largest amount of potentially suitable habitat, which comprises 21 percent of the total area. The southernmost segment of the study area, SR 528 to Bothell Substation, contains both the smallest total area of all study area segments and the smallest amount of potentially suitable murrelet nesting habitat, comprising only 13 percent of the segment. An analysis of the Washington DNR stand age data layer in the study area, with forest stands younger than 60 years removed, resulted in a mean stand age of 273 ± 125 years (range of 60 to 506 years) for the entire study area.

The Murrelet Habitat Model found the greatest proportion of potentially suitable nesting habitat in the northeastern portions of the study area, particularly within the Ross Lake and Diablo Lake sub-segments of the RLNRA study area segment at the far inland extent of the known range for the marbled murrelet. The lowest quantity of potentially suitable nesting habitat was found in the southwestern portions of the study area, along the transmission line ROW segments from Oso to the Bothell Substation and had a patchy distribution.

Table 4.2.5-4. Potentially suitable marbled murrelet nesting habitat area in the study area by segment.

Study Area Segment[1]	Potentially Suitable Habitat			Total Study Area Segment (ha [acres])
	Area (ha [acres])	Percent of Segment	Area Within Project Boundary[2] (ha [acres])	
RLNRA	10,753 (26,570)	47%	1,628 (4,023)	22,710 (56,118)
Bacon Creek to Sauk River Crossing	2,107 (5,206)	21%	318 (785)	9,923 (24,520)
Fish and Wildlife Mitigation Lands	1,944 (4,803)	24%	583 (1,441)	8,100 (20,016)
Sauk River Crossing to Oso	1,293 (3,196)	16%	35 (85)	7,943 (19,628)
Oso to SR 528	234 (579)	5%	< 1 (1)	4,732 (11,694)
SR 528 to Bothell Substation	54 (133)	1%	-	4,092 (10,112)
Total	**16,385 (40,487)**	**28%**	**2,564 (6,335)**	**57,500 (142,088)**

1 The TR-01 Vegetation Mapping Study conducted field verification plots that were reviewed by the study team for use in the verification of the Murrelet Habitat Model. The dbh measures at those plots were of co-dominant trees and were binned and not collected for residual older trees likeliest to contain suitable nesting platforms. As explained above, the study team could not use the Vegetation Mapping Study as anticipated, and, for that reason, the team conducted field verification plots as part of this study consistent with Section 2.6.2 of the RSP. See Figure 4.2.5-1 for map of study area segments.

2 Area within Project Boundary includes fish and wildlife mitigation lands.

Findings of the limited field habitat assessment survey plots and qualitative assessment of potential murrelet nesting habitat in the study area were largely consistent with the results of the Murrelet Habitat Model. On Ross Lake and Diablo Lake, habitat plot results confirmed the presence of suitable nesting platforms in older conifer trees, and the qualitative assessment confirmed the presence of nesting habitat that was consistent with that of the potentially suitable habitat identified by the Murrelet Habitat Model. Similarly, in areas where suitable habitat was largely absent from the limited field verification (e.g., from Newhalem to Gorge Lake), the Murrelet Habitat Model found little potentially suitable habitat.

Trees in the Pacific Northwest, however, do not typically attain platforms suitable for nesting until they are 200 to 250 years old (61 FR 26256), and Hamer and Nelson (1995) found a mean age of 522 years (range of 180-1,824 years) for 16 nest trees in the Pacific Northwest. However, younger forest stands, particularly those with mistletoe infections or damage, can sometimes provide suitable structures for nesting, as found in Oregon with two nest trees in 60- to 70-year stands of mistletoe-infected conifers (Nelson 1997). A mean forest stand age within the study area of 273 years (range of 60 to 506 years) indicates that many of the areas mapped as potentially suitable are old enough to have developed platforms suitable for marbled murrelet nesting. However, the most important factor for determining marbled murrelet nesting habitat is the presence of suitable nesting platforms, which cannot be assessed to confirm nesting habitat suitability without ground-based field verifications conducted by a trained biologist. Since the Murrelet Habitat Model is conservative, it is likely that some of the mapped habitat quality is only marginally suitable, and the field habitat assessments completed during this study were too limited to assess quality of potentially suitable nest habitat for the study area.

Table 4.2.5-5. Potentially suitable marbled murrelet nesting habitat in fish and wildlife mitigation land properties (not including study area buffer).

Mitigation Land Parcel Name	Potentially Suitable Habitat		Study Area Segment Where Located[1]
	Area (ha [acres])	Percent of Mitigation Land	
Newhalem Ponds	18 (44)	40%	RLNRA
County Line Ponds	4 (11)	20%	RLNRA
Bacon Creek	12 (30)	25%	Bacon Creek to Sauk River Crossing
B & W Road 1	5 (13)	17%	Bacon Creek to Sauk River Crossing
B & W Road 2	1 (2)	14%	Bacon Creek to Sauk River Crossing
Corkindale Creek	3 (8)	5%	Bacon Creek to Sauk River Crossing
South Marble 40	6 (15)	37%	Bacon Creek to Sauk River Crossing
Bogert and Tam	0 (0)	0%	Bacon Creek to Sauk River Crossing
O'Brien Slough	0 (1)	2%	Bacon Creek to Sauk River Crossing
Illabot North	20 (48)	7%	Bacon Creek to Sauk River Crossing
Illabot South	185 (456)	18%	Bacon Creek to Sauk River Crossing
Barnaby Slough	16 (39)	17%	Bacon Creek to Sauk River Crossing
False Lucas Slough	38 (94)	46%	Bacon Creek to Sauk River Crossing
Johnson Slough	3 (7)	96%	Bacon Creek to Sauk River Crossing
Napoleon Slough	10 (25)	41%	Bacon Creek to Sauk River Crossing
McLeod	13 (33)	26%	Bacon Creek to Sauk River Crossing
Nooksack	221 (546)	14%	Fish and Wildlife Mitigation Lands
Bear Lake	5 (11)	7%	Fish and Wildlife Mitigation Lands
Nooksack West	26 (65)	17%	Fish and Wildlife Mitigation Lands
Savage Slough	2 (5)	2%	Fish and Wildlife Mitigation Lands
Day Creek Slough	0 (0)	0%	Fish and Wildlife Mitigation Lands
Pressentin	205 (506)	79%	Fish and Wildlife Mitigation Lands
Finney Creek	125 (310)	48%	Fish and Wildlife Mitigation Lands
North Sauk	4 (9)	20%	Sauk River Crossing to Oso
Sauk Island	1 (2)	10%	Sauk River Crossing to Oso
North Everett Creek	20 (49)	28%	Sauk River Crossing to Oso
Everett Creek	4 (10)	25%	Sauk River Crossing to Oso
Dan Creek	3 (8)	19%	Sauk River Crossing to Oso
Total	**950 (2,347)**	**22%**	

1 See Figure 4.2.5-1 for map of study area segments.

Table 4.2.5-6. Potentially suitable marbled murrelet nesting habitat area in the RLNRA by sub-segment.

RLNRA Sub-Segment Name[1]	Potentially Suitable Habitat			Total Land Area (ha [acres])
	Area[2] (ha [acres])	Percent of Sub-Segment	Area Within Project Boundary[3] (ha [acres])	
Ross Lake (exclusive of Big Beaver Valley)	6,710 (16,581)	49%	1,173 (2,899)	13,696 (33,844)
Big Beaver Valley	970 (2,396)	49%	249 (614)	1,969 (4,866)
Diablo Lake	1,286 (3,177)	59%	96 (238)	2,161 (5,341)
Gorge Lake	581 (1,436)	45%	60 (148)	1,306 (3,226)
Gorge Lake to Bacon Creek	1,206 (2,980)	34%	50 (123)	3,578 (8,841)
Total	**10,753 (26,570)**	**47%**	**1,628 (4,022)**	**22,710 (56,118)**

1 See Figure 4.2.5-1 for a map of the study area segments.
2 Area within the study area.
3 Area within Project Boundary includes fish and wildlife mitigation lands.

The Fish and Wildlife Mitigation Lands segment of the study area contains a total area of 8,100 ha (20,016 acres), with 24 percent of the total segment area that meets the criteria for potentially suitable murrelet nesting habitat. The Pressentin and Finney Creek mitigation lands, exclusive of the 0.5-mile study buffer, both contain high quantities of potentially suitable murrelet nesting habitat (Table 4.2.5-4). The Pressentin mitigation land contains 79 percent, or 205 ha (506 acres), of potentially suitable murrelet nesting habitat. Finney Creek mitigation land contains 48 percent or 125 ha (310 acres) of potentially suitable murrelet nesting habitat. Lands within 0.5 miles of the transmission line ROW from Sauk River Crossing to the Bothell Substation adjacent to the study area were minimally assessed but did not contain significant areas of older forest.

The ornithological radar and AV portion of the study was located well-outside (far inland) of areas considered to be high-use or highly suitable for marbled murrelet nesting and occurrence (USFWS 1997). The westernmost radar site, Newhalem, located 57.9 miles east of Padilla Bay Estuary, is beyond the 50-mile zone generally considered to be the farthest distance from saltwater for nesting marbled murrelets in Washington (USFWS 1997). In the Northern Washington Cascades, 90 percent of all observations have been made within 37 miles of the coast (57 FR 15328). Prior to this study, marbled murrelets have only been documented within the Project reservoirs once on Ross Lake by NPS in 2017. However, a 2008-2009 radar and AV study conducted by Hamer Environmental (2010) detected murrelet-type targets on Thornton Creek, 2 miles from the Gorge Dam Powerhouse, and at the mouth of Bacon Creek within the Project transmission line ROW. The current relicensing study focused coverage on areas closest to Project activities and did not address areas of potentially suitable murrelet habitat further west within the Stillaguamish and Sauk watersheds where sections of the Project transmission line ROW and most fish and wildlife mitigation lands occur.

No murrelets were detected by the AV surveyor during the course of 45 simultaneous surveys conducted at radar sites throughout the 2021 breeding season (City Light 2022a). This is not unusual considering the smaller area of coverage an AV surveyor can survey (200 m [656 ft] visual distance) compared to that of the radar (up to 0.9 miles) and that the dark periods (105 to 46 minutes before sunrise) during the pre-sunrise portion of each survey session further limit visibility by the AV surveyor, despite use of night vision equipment. A total of 119 targets were documented by surveillance radar with flight speeds ≥ 64.0 kilometers per hour (kph) (40 miles per hour [mph]) minimum threshold speed for marbled murrelet. Of these 119 targets, 53 percent were marbled murrelet-type targets, 38 percent were other species targets, 8 percent were band-tailed pigeon targets, and 1 percent were osprey targets. Over the 45 survey days, and one weather-out survey day (June 13, 2021, at Diablo Lake Sand Spit), a total of 63 murrelet-type targets were recorded on the surveillance radar. Notably, no murrelet-type targets detected by radar exhibited circling flight paths, which are usually documented during the breeding season near marbled murrelet nesting locations and are considered evidence of nesting activity. Most targets (92 percent) exhibited straight flight paths and were also documented over water (not land), indicating these birds were using the waterways for transiting the area. The findings of this study indicate with high confidence that a very small number of marbled murrelets are likely using the upper Skagit River, Diablo Lake, and Ross Lake waterways as travel corridors to transit through the Project Boundary. In comparison to radar studies conducted in other near-coast regions of the Pacific Northwest (Burger 2002; Cooper et al. 2006; Hamer Environmental 2010), these detection rates for marbled murrelets can be considered very low.

Northern Spotted Owl

The NSO (*Strix occidentalis caurina*) is federally listed as threatened under the ESA and listed as endangered in Washington State. NSOs in the Western Cascades primarily utilize late successional mature and old-growth forests or forests with old growth characteristics, such as large diameter coniferous trees, snags, downed wood, and a closed canopy with multiple canopy layers (Davis et al. 2016; Buchanan 2016). Preferred nesting and roosting habitat include multi-story forest containing a diversity of tree species, moderate to dense canopy cover (> 60 percent) dominated by large trees with a high incidence of cavities or broken tops, sufficient open space below the canopy for flight, and an accumulation of woody debris on the ground (USFWS 2011). NSO usually nest in tree and snag cavities or in broken tops of large trees. They less frequently nest in mistletoe clumps and abandoned raptor and raven nests (Zeiner et al. 1990). Foraging habitat for NSO is similar to nesting and roosting habitat, though it can encompass a more diverse range of forest types, such as younger forests with some component of residual large diameter conifer trees and snags (Forsman et al. 2015; North et al. 1999; Sovern et al. 2015). NSO are territorial; however, home ranges of adjacent pairs can overlap. The size of the home range varies with geography and differences in local prey species. Along the Cascade Range, the estimated average home range size is 2,955 acres with flying squirrels as the predominant prey item (Hamer et al. 2001; USFWS 2011). A minimum habitat patch size required for NSO nesting, roosting, or foraging habitat has not been established or documented.

Critical habitat for NSO was designated in 1992 and has been revised numerous times, most recently in 2021 (86 FR 62606).[83] This updated critical habitat all falls within National Forest

[83] Endangered and threatened wildlife and plants; designation of revised critical habitat for the northern spotted owl. Federal Register Volume 86, Number 215: 62606-62666.

boundaries and does not extend into the National Park or RLNRA. Congressionally reserved natural areas, including National Parks, Wilderness Areas, and National Scenic Areas, were excluded by USFWS from the designated critical habitat. The designated critical habitat overlaps the Project Boundary in only one location—the southernmost tip of Ross Lake's Ruby Arm, and it ends at the boundary of the RLNRA.

NSO detection data within and immediately surrounding the Project vicinity is limited (Hoffman et al. 2015). Survey efforts began in the early 1980s and have sporadically continued since that time (Siegel et al. 2012). A baseline NSO inventory was conducted by the North Cascades National Park Complex in the mid-1990s, with 11 NSO activity centers detected, including six pairs (Kuntz and Christopherson 1996). Additional surveys were conducted by the Institute of Bird Populations between 2007 and 2010 (Siegel et al. 2012). These included follow-up surveys at the NSO activity centers identified during the baseline inventory and additional surveys in the vicinity of reservoirs. The study indicated locations of five historical spotted owl activity centers, all one mile or farther from Project reservoirs:

- Deer Lick > 2.5 miles from Ross Lake;
- Big Beaver Boundary > 6 miles from Ross Lake;
- Pyramid Lake 1 mile from Diablo Lake/Colonial Creek Campground;
- Newhalem Creek > 2 miles from Newhalem; and
- Little Devil/Stout Creek > 3 miles from Newhalem.

Surveys at each of these locations in 2009 and 2010 by Siegel et al. (2012) yielded an NSO response only at Newhalem Creek in 2009 (but not in 2010); much of the Newhalem Creek drainage was subsequently burned in the 2015 Goodell Fire.

An NSO habitat suitability model was originally created by the Northwest Forest Plan's (NWFP) Effectiveness Monitoring Program in 2005 using data from NSO territories throughout the Pacific Northwest for the purposes of assessing trends of NSO populations and their habitat (Davis and Lint 2005). The first iterations of the NWFP Model produced vegetation maps as described in the RSP. An analysis of the original NWFP Model was conducted for North Cascades National Park, comparing model results to known NSO nest sites in the Park (Wilkerson and Siegel 2007). The analysis concluded that the NWFP Model performed relatively well for the Park and could be used as a reliable tool for land management decisions within the Park.

The NWFP Model has since been updated based on the latest science and species location data, refining the variables used for analysis to include: (1) diameter diversity index; (2) canopy cover of all conifers; (3) stand height; (4) mean conifer diameter; (5) density of large conifers; (6) stand age; and (7) forest species composition (Davis et al. 2016).While the updated NWFP Model has been used to map suitable NSO habitat in its range and at regional scales, it has not been accurately applied at the local scale in the Skagit River watershed due to the lack of locally available NSO habitat and detection data. The NWFP Model attempts to predict potential nesting and roosting habitat, and, while it does include "highly suitable," "suitable," and a third category of "marginal" habitat, it does not include foraging habitat in its predictions. Therefore, a more detailed and refined map of suitable NSO habitat was necessary.

Northern Spotted Owl Habitat Analysis

In support of relicensing the Project, City Light completed a study designed to map potentially suitable NSO nesting, roosting, and foraging (NRF) habitat within and near (i.e., within 0.5 miles) the Project Boundary (TR-10 NSO Habitat Analysis Draft Report; City Light 2022b).

The Project study area segments are shown in Figure 4.2.5-2. The study area includes the Project Boundary with a 0.5-mile buffer.

Methods used to develop a map of potentially suitable NSO NRF habitat include the following steps: (1) review relevant scientific literature and models of suitable NSO NRF habitat to inform model criteria and approach; (2) identify and map habitat components for the study area using a Geographic Information System (GIS); and (3) develop a system of criteria to identify potentially suitable and potentially highly suitable NSO NRF habitat, referred to as the NSO NRF Habitat Suitability Model.

The NSO NRF Habitat Suitability Model for this study was designed to create a conservative and localized model that predicts potentially suitable and highly suitable NRF habitat, using some of the variables utilized by the NWFP Model (Davis et al. 2016). Like the NWFP Model (Davis et al. 2016), this NSO NRF Habitat Suitability Model used data on canopy cover, tree height, density of large conifers, and stand age. However, values for these components were set lower than the NWFP model, based on synthesized findings in other scientific literature, in order to better capture younger forest as potential foraging habitat. Like the NWFP Model, the NSO NRF Habitat Suitability Model described potential habitat as “suitable” or “highly suitable.” Refer to the TR-10 NSO Habitat Analysis Draft Report (City Light 2022b) for additional details on the methods used to conduct this study.

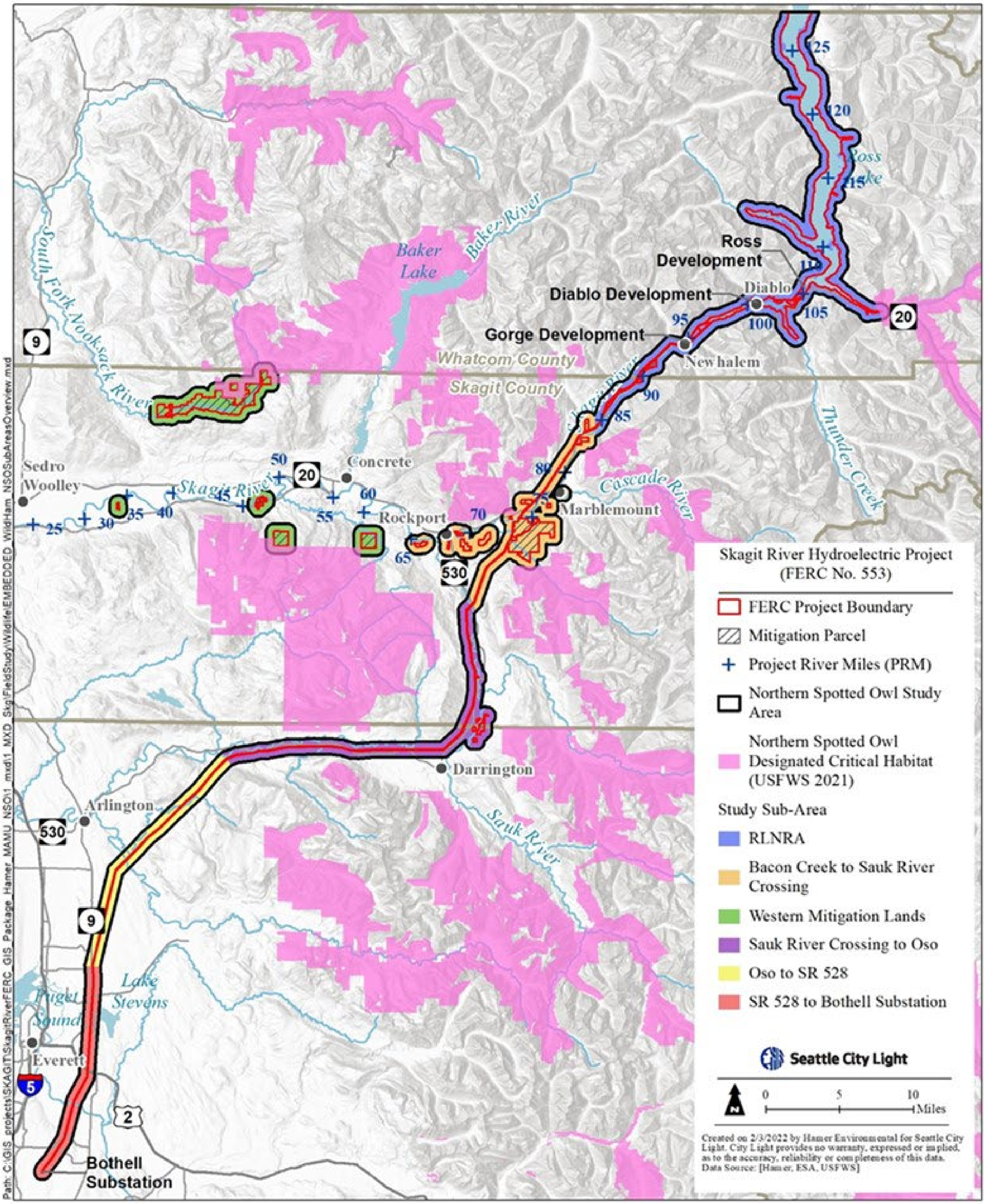


Figure 4.2.5-2. Study area segments for Northern Spotted Owl nesting, roosting, and foraging habitat analysis.

The results of the modeling effort suggest that the amount of potential suitable NSO NRF habitat in the Project vicinity is relatively low. The model outputs indicate that within the 142,088.8-acre study area, 9.6 percent is potentially suitable habitat for NSOs, and only 4.7 percent is potentially highly suitable habitat (Tables 4.2.5-7 and 4.2.5-8). As would be expected, the RLNRA (which is the largest segment of the study area) also has the greatest amount of suitable NSO habitat, with 71.8 percent of the modeled suitable NSO habitat and 80.2 percent of the modeled highly suitable habitat being found in the RLNRA. While the Ross Lake sub-segment has the greatest acreage of modeled suitable habitat in the study area, it represents only 17.5 percent of the area of this segment. Conversely, nearly 30 percent of the Diablo Lake sub-segment contains modeled suitable NSO habitat. While the model outputs indicate areas of potentially suitable and potentially highly suitable NSO NRF habitat, they do not predict or determine NSO presence or habitat use.

Table 4.2.5-7. Modeled suitable NSO NRF habitat area in the study area by segment.

Study Area Segment[1]	Modeled Suitable Habitat		
	Area in Study Area (acres)	Percent of Segment	Area Within Project Boundary[2] (acres)
RLNRA	9,797.2	17.5%	1619.9
Bacon Creek to Sauk River Crossing	1,237.6	5.0%	41.5
Fish and Wildlife Mitigation Lands	1,152.3	5.8%	278.2
Sauk River Crossing to Oso	1,325.2	6.8%	2.7
Oso to SR 528	120.6	1.0%	0.2
SR 528 to Bothell Substation	2.0	0%	0
Total	**13,634.9**	**9.6%**	**1942.5**

1 See Figure 4.2.5-2 for a map of the study area segments.
2 Area within Project Boundary includes fish and wildlife mitigation lands.

Table 4.2.5-8. Modeled highly suitable NSO NRF habitat area in the study area by segment.

Study Area Segment[1]	Modeled Highly Suitable Habitat		
	Area in Study Area (acres)	Percent of Segment	Area Within Project Boundary[2] (acres)
RLNRA	5,405.7	9.6%	961.3
Bacon Creek to Sauk River Crossing	547.9	2.2%	11.9
Fish and Wildlife Mitigation Lands	412.7	2.1%	84.0
Sauk River Crossing to Oso	350.1	1.8%	0.2
Oso to SR 528	20.3	0.2%	0
SR 528 to Bothell Substation	0.1	0%	0
Total	**6,736.8**	**4.7%**	**1057.4**

1 See Figure 4.2.5-2 for a map of the study area segments.
2 Area within Project Boundary includes fish and wildlife mitigation lands.

Upon completion of the two binary site suitability analyses, the model outputs of “suitable” and “highly suitable” NSO NRF habitat were qualitatively compared to the NWFP Habitat Model GIS layer (uses same data as Davis et al. 2011 and 2015), showing "unsuitable," "marginal," "suitable," and "highly suitable" habitat. During this visual comparison, the two models showed similar patterns across the study area. The NSO NRF Habitat Suitability Model output layers overlap with the suitable and highly suitable habitat from the NWFP Model layer as well as some of the marginal category. This indicates that the NSO NRF Habitat Suitability Model was effective at identifying potential nesting and roosting habitat and some of the lower quality habitat possibly used for foraging. Although there were some instances of the NSO NRF Habitat Suitability Model capturing areas labeled as "unsuitable" by the NWFP, this was infrequent and appears to be a result of the difference in data used and the coarse resolution of the NWFP Model output.

While NSO designated critical habitat only overlaps with the Project Boundary in a single small area on Ross Lake's Ruby Arm, it overlaps with the buffer portion of the NSO study area in that location and in a few other places (as seen in Figure 4.2.5-2). A substantial patch of critical habitat can be found in the buffer around the Bear Lake and Nooksack mitigation lands; however, none falls within the Project Boundary, and the habitat is limited to the National Forest Boundary. Critical habitat can similarly be found in the buffer south of the Pressentin and Finney Creek mitigation lands. Very small patches of critical habitat can be found in the buffer area southeast of the B&W Road 1 and 2 mitigation lands, near Marblemount southwest of the Corkindale Creek mitigation land, and near the southernmost tip of the Illabot South mitigation land. Based on review of the critical habitat GIS data and methodology, it appears these areas of overlap are minimal due to the fact that critical habitat was not designated within the National Park or Recreation Area boundaries.

All documented NSO activity centers are 1 mile or more away from Project reservoirs, and, therefore, outside the entire NSO study area, which prevents comparison of observational data to the outputs of the NSO NRF Habitat Suitability Model. As the NSO NRF Habitat Suitability Model variables and thresholds were designed to create a conservative model, and resulting outputs were found to be in good agreement with existing data and models, field verification via habitat assessment plots as described in the RSP was deemed unnecessary at this time.

No incidental observations of NSO or signs of NSO were noted by City Light during relicensing studies.

<u>Yellow-billed Cuckoo</u>

The yellow-billed cuckoo (*Coccyzus americanus)* is one of 13 species in the genus *Coccyzus.* Although subspecies of yellow-billed cuckoos were previously recognized through the 1970s (American Ornithologists' Union [AOU] 1957, Oberholser and Kincaid 1974), yellow-billed cuckoos breeding in western North America are currently treated as the "western DPS of yellow-billed cuckoo" (USFWS 2014). Birds within the DPS are also sometimes referred to as "western yellow-billed cuckoos."

The western DPS of yellow-billed cuckoo was federally listed as threatened in November 2014 (79 FR 59991). The species also receives protection under the federal Migratory Bird Treaty Act. In Washington, yellow-billed cuckoos are classified as "other protected wildlife" under state law (WAC 220-200-100) and became a state candidate species in 1991. The species was placed on

WDFW's 2005 and 2015 lists of Species of Greatest Conservation Need (WDFW 2015b), but this designation carries no legal status.

In May 2021, USFWS designated 298,845 acres of critical habitat for the western DPS of the yellow-billed cuckoo in Arizona, California, Colorado, Idaho, New Mexico, Texas, and Utah. The USFWS did not include critical habitat units within Washington because the species has been extirpated as a breeder in the state since at least the 1940's and recent observations of the species have not coincided, for the most part, with suitable breeding habitat and appear to represent birds in dispersal, but not breeding in Washington (USFWS 2021).

The population, which is migratory and overwinters in South America, formerly nested across much of the western United States, southern British Columbia, and northwestern Mexico. In the western United States, nesting is strongly associated with large, wide patches of low to mid-elevation riparian habitat dominated by cottonwoods, willows, and a mix of other species. Historically, Washington birds also nested in brushy habitats and fir forests. Most western yellow-billed cuckoos arrive at their breeding range from early to mid-June and depart in late August to mid-September. Although cuckoo species often practice brood parasitism (i.e., laying eggs in the nests of other bird species which then incubate the eggs and raise the young), yellow-billed cuckoos typically rear their own broods and rarely parasitize the nests of other birds. One brood is produced in most years, but two or three broods may be reared in years with abundant prey resources. Their diet consists mostly of large insects, such as caterpillars (Wiles and Kalasz 2017).

The population size and breeding range of western yellow-billed cuckoos have greatly declined during the past century, with only 680 to 1,025 breeding pairs estimated to remain. Historical records suggest that the species once nested in at least six areas of western Washington, none of which are within the Project vicinity: (1) the vicinity of Bellingham and Marietta in Whatcom County; (2) the Mount Vernon area in Skagit County; (3) the area around Lake Washington and Seattle in King County; (4) the Tacoma area in Pierce County; (5) the vicinity of Grays Harbor in Grays Harbor County; and (6) the lower Columbia River in the vicinity of Vancouver and Ridgefield in Clark County. With the exception of the lower Columbia River, abundance in each of these areas was probably small. Breeding in the state was last fully confirmed in 1923, but likely continued until at least the early 1940's (Wiles and Kalasz 2017).

There have been only 20 sightings of yellow-billed cuckoos documented in Washington since the 1950's, with 19 occurring from 1974 to 2016 at an average rate of one sighting every 2.3 years. Sixteen of the 20 records occurred in eastern Washington. Nearly all of the birds recorded since the 1950s were very likely non-breeding vagrants or migrants, indicating that cuckoos are now functionally extirpated in Washington (Wiles and Kalasz 2017).

No incidental observations of yellow-billed cuckoo or signs of yellow-billed cuckoo were noted during City Light's relicensing studies.

Oregon Spotted Frog

The Oregon spotted frog 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 federally listed as threatened on August 29, 2014 (79 FR 51658) in response to declines throughout its range and has been listed as endangered in Washington by WDFW since 1997. As summarized by Hallock (2013), known extant populations of Oregon spotted frog in Washington are limited to six sub-basins compared to 15 sub-basins with verified historical records. All the known occurrences, extant or extirpated, are from the Puget Trough or southern Cascades. There are no known occurrences within the Project Boundary.

Known extant populations of Oregon spotted frog occur in the Sumas River and lower South Fork Nooksack sub-basins in western Whatcom County; upper Samish River in western Whatcom County and adjacent Skagit County; upper Black River in Thurston County; and lower Trout Lake Creek and Outlet Creek Conboy Lake and Camas Prairie in Klickitat County. USFWS designated critical habitat in each of these occupied drainages in 2016 (81 FR 29335). Historical occurrences nearest to the Project, which are considered extirpated, were near the confluence of the Skykomish and Snoqualmie rivers three miles south of Monroe in Snohomish County (based on a 1939 museum collection record) and two miles northwest of Concrete within the lower Skagit River sub-basin about five river miles (RMs) downstream of the Sauk River confluence (1930 museum collection record) (McAllister et al. 1993, Hallock 2013). These extirpated occurrences were at least 7.5 and 11 miles, respectively, from the nearest point on the Project transmission line ROW. Surveys in 2011 and 2012 at sites near Concrete and other locations near the Skagit River, including wetlands on City Light fish and wildlife mitigation lands between Marblemount and Concrete, did not find evidence of Oregon spotted frog (McAllister et al. 1993; Bohannon et al. 2016).

The Oregon spotted frog has not been documented in the North Cascades National Park Complex, an area outside of the expected range of the species (Hallock 2013). However, Ovaska et al. (2019) found genetic evidence of Oregon spotted frog from environmental DNA (eDNA) sampling and skin swabs of one captured frog at a site less than 2 miles north of Ross Lake and 2.75 miles north of the U.S.-Canada border. Skin swabs of three other frogs at the same site were identified as the related Columbia spotted frog, the species expected to occur. Because Oregon spotted frog and Columbia spotted frog are not known to occur together at any other location, these findings will require further study. In this regard, at the request of City Light, the Skagit Environmental Endowment Commission (SEEC) is currently funding surveys to collect more data from the site, including photographs and morphometric measures of frogs and DNA analyses. The study is supporting surveys of the north end of Ross Lake in Canada, where there are reported observations of presumed Columbia spotted frog.

Oregon spotted frogs are highly aquatic, rarely found more than a few leaps from water, and adults are not known to move long distances over land. Populations are largely limited to large wetland complexes (> 10 acres) that include areas of permanent water, vegetated shallows, and aquatic connections. Oregon spotted frog has been described as a warmwater marsh specialist, associated with sites where water is warm (i.e., 20 to 35 degrees Celsius [˚C]) during the late spring and summer season, when the frogs are active (Pearl and Hayes 2005).

The final critical habitat rule for Oregon spotted frog (81 FR 29335) identified three physical or biological features (PBF) essential to the conservation of the species that may require special management considerations or protection. Formerly called “primary constituent elements” or “PCEs”, these PBFs include:

- Permanent or seasonal water bodies holding water continuously for a minimum of four months, which corresponds to the time of year required for eggs and larvae (generally, as early as February and as late as September) with:
  - Shallow water up to 12 inches deep (or up to 12 inches over vegetation in deeper water),
  - Gradual topographic gradient, and
  - If seasonal, hydrologic connection to deeper, more permanent water;
- Aquatic movement corridors up to 3.1 miles from breeding habitats and free of impassable impediments; and
- Habitat characteristics that provide refuge from predators.

Other considerations include vegetation conditions in potential oviposition habitats, which may limit or preclude egg-laying if the previous year's emergent growth remains tall and dense, or, where bent-over, completely covers the water. Most Oregon spotted frog populations in lowland western Washington occur at sites with a recent history of livestock grazing, hay production, or mowing, which reduce reed canarygrass. However, at a few sites with no apparent management of reed canarygrass, oviposition habitat is associated with submerged, flattened grass floating near the surface in unusually deep water. Seasonal habitats of Oregon spotted frog occasionally include forested wetlands within larger wetland complexes (Hallock 2013).

Special-Status Amphibian Study

In support of relicensing the Project, City Light conducted the TR-08 Special-Status Amphibian Study in 2021-2022, which evaluated the potential for Oregon spotted frog and other special-status species to occur where there was no prior survey information (TR-08 Special-Status Amphibian Study Interim Report; City Light 2022c). Wetlands were first evaluated based on site and watershed characteristics. Field visits to collect habitat information were performed at selected accessible sites, along with amphibian surveys designed to detect Oregon spotted frog if present. The study included all wetlands within the Project Boundary along the Project transmission line, around the three reservoirs, and in the Skagit River floodplain between Diablo Powerhouse and the confluence of the Sauk River (Figure 4.2.5-3). The latter area included the County Line Ponds and Newhalem Ponds, which are flooded borrow pit ponds on City Light land, and wetlands in the area between the confluences of the Sauk River and Illabot Creek. Although there are no documented or suggested potential Project effects on amphibians in this area, study sites were nonetheless designated at selected locations to characterize the potential for special-status amphibians to occur. The study did not include wetlands within Big Beaver Creek Valley, an area within the Project Boundary, due to the High Ross Treaty. Current Project operations have no effect on the hydrology of these wetlands, which are located between 0.85 to 2 miles from Ross Lake and 10 to 15 feet above the normal maximum water surface elevation of the lake. No Project effects on amphibian populations have been documented in the wetlands of Big Beaver Creek Valley. Columbia spotted frog is the only documented ranid species in Big Beaver Valley. Except as noted above, the study area also did not include the fish and wildlife mitigation lands because no Project effects occur in these areas.

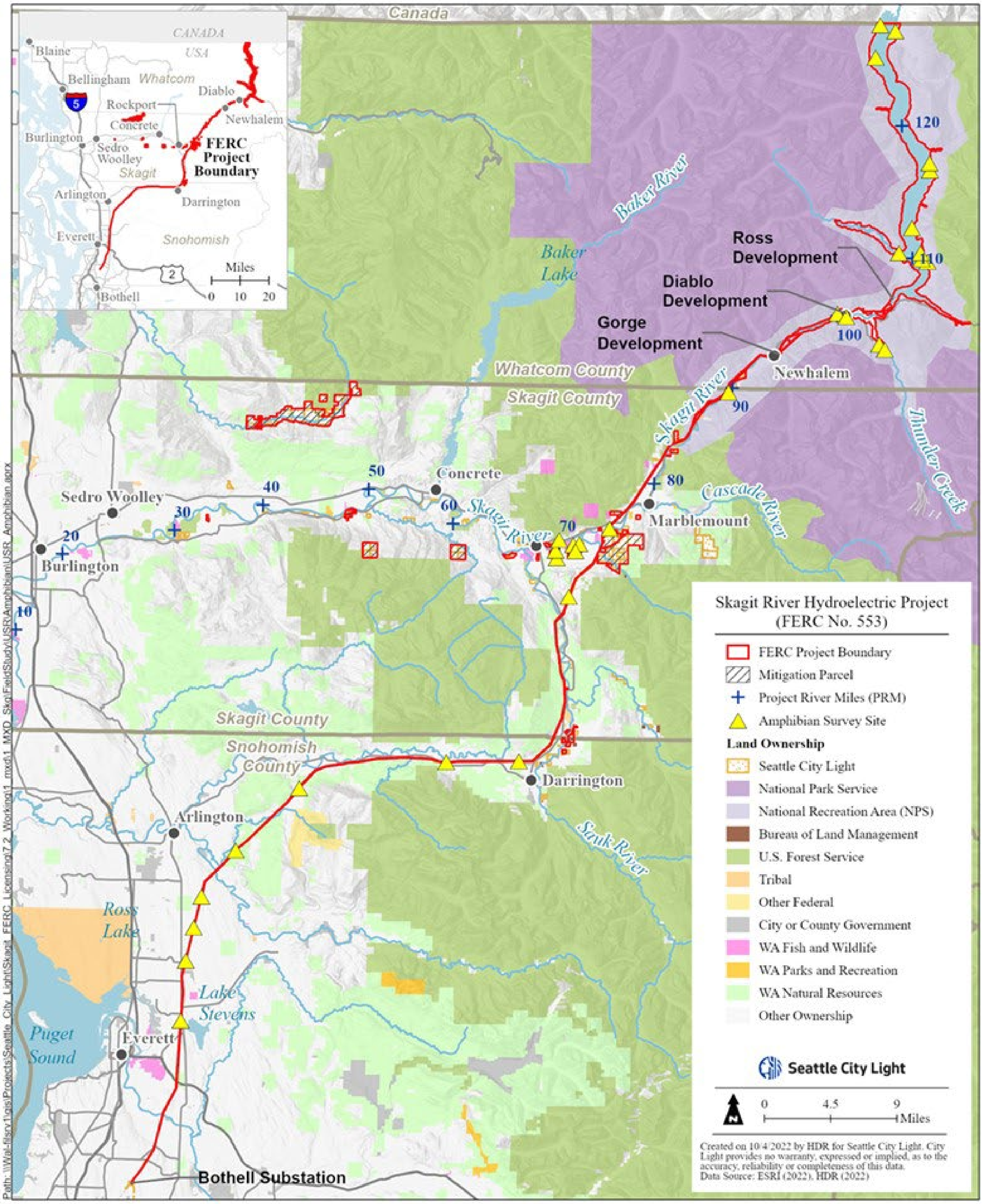


Figure 4.2.5-3. Special-Status Amphibian study area and study sites.

The study found no evidence to suggest that Oregon spotted frog occurs within or proximate to the Project transmission line ROW or in floodplain wetlands between Diablo Powerhouse and the confluence of the Sauk River. Wetlands along the transmission line do not share the landscape and historical characteristics of known occupied watersheds in western Washington that allow for extensive and persistent emergent wetlands. Overall, the most common vegetation type on wetlands within the ROW is a dense cover of Douglas spiraea, which does not represent suitable oviposition habitat for Oregon spotted frog. Many of these shrub areas may only be non-forested because of ROW vegetation maintenance or have developed wetland characteristics since the line was constructed, including areas where the access roads have impeded drainage or where roadbed construction required excavation. Egg mass surveys of selected sites found other common amphibian species, but not Oregon spotted frog.

Key features of Oregon spotted frog habitat were generally scarce or absent at sites in the Skagit River floodplain between Diablo Powerhouse and the Sauk River confluence, particularly the presence of shallow, emergent edges with low-growing or submerged vegetation and the potential to develop warm water conditions. The County Line and Newhalem Ponds are mostly steep-sided permanent ponds of relatively recent origin (i.e., created by excavation for aggregate material used in the construction of the Project dams) and are not potential habitat for Oregon spotted frog. Northern red-legged frog was the only ranid species found during surveys at sites in the Skagit River floodplain, consistent with the findings of surveys performed by City Light at some of the same sites in 2012.

No wetlands potentially suitable for Oregon spotted frog occur at Gorge Lake or Diablo Lake where the only significant wetlands are forested or shrub dominated. Suitable conditions do not occur at lake-fringe wetlands at the margin of Ross Lake that are isolated from other wetlands and dry during the winter drawdown. Several borrow pit pools and other depressional features in the drawdown zone near the north end of the lake hold water during the spring amphibian breeding period, but most of the pools were devoid of vegetation when investigated during this period in 2022 and only egg masses of northwestern salamander and long-toed salamander were detected at some of these sites.

Spotted frogs tentatively identified as Columbia spotted frog were found at two locations, each just south of the U.S.-Canada border. Although the frogs were readily identifiable as belonging to the spotted frog species complex based on morphology and color patterns, they differed in some key characteristics, especially orientation and color of the eyes. Unlike Oregon spotted frogs, which are characterized by sharply upturned and bright yellow or chartreuse (yellow-green) colored eyes (Hallock 2013), these frogs had dark and slightly to moderately upturned eyes (i.e., oriented upward at less than 45 degrees). Skin cells from swabs of frogs of the same population on the west side of Ross Lake, but just north of the U.S.-Canada border, have been collected by the Canadian crew performing the SEEC-funded amphibian study and are currently being analyzed for DNA at the University of Victoria to verify identification. The study will also include additional amphibian surveys of potential breeding habitat and DNA sampling of spotted frogs in 2023 at the north end of Ross Lake in Canada and north of Ross Lake to resolve identification issues. If partial or complete results are available, they will be included in the Final License Application (FLA).

The site on the northwest side of Ross Lake less than 0.25 miles from the border was associated with a small perennial stream, which represents seasonal, non-breeding habitat, primarily for juveniles. Habitat suitable for breeding was not found. The other location on the northeast side of the lake about 200 feet from the U.S.-Canada border is a small borrow pit pool where 3 or 4 developing egg masses were found on May 3, 2022. These survey findings are discussed further below in the section that addresses Columbia spotted frog.

Federal Candidate Species

There were two candidate species for the ESA identified as occurring or having the potential to occur in the Project Vicinity, as discussed in this section.

Monarch Butterfly

The IPaC review identified monarch butterfly (*Danaus plexippus*) as a federal candidate species with the potential to occur in the Project vicinity. Monarch butterfly was most recently assigned a listing priority of "8" (moderate to low priority) in a ranking system that ranges from 1 (highest) to 12 (lowest) (87 FR 26152). The monarch butterfly is also identified as a WDFW Species of Greatest Conservation Need (SGCN). Threats to the species include loss and degradation of habitat (conversion of grasslands to agriculture, widespread use of herbicides, logging/thinning at overwintering sites in Mexico, incompatible management or senescence of overwintering sites in California, urban development, and drought), repeated exposure to insecticides, and excessively high temperatures related to climate change (USFWS 2020).

The North American migratory populations are divided into the eastern and western populations by the Rocky Mountains (USFWS 2020). Both populations have experienced long-term declines at overwintering sites. Monarch butterfly does not occur as a breeding species in western Washington, where milkweeds (*Asclepias* spp.), the essential food of monarch caterpillars, are absent except in cultivation (WDFW 2020). Milkweed occurs in Washington east of the Cascades in the Columbia River Basin, although in patchy distribution. Adult monarch butterflies could rarely occur in the Project vicinity during migration or as vagrants.

No incidental observations of monarch butterflies or signs of monarch butterflies, nor any milkweed, were noted during City Light's relicensing studies.

Wolverine

The wolverine (*Gulo gulo* or *G. g. luscus*) is a federal candidate species. In 2020, the USFWS withdrew a proposed rule to list the DPS of the North American wolverine occurring in the contiguous United States as a threatened species (85 FR 64618). USFWS concluded that the species was not now or projected to be threatened in the near future. In addition, listing was not warranted because wolverines in the contiguous United States are not genetically isolated from wolverines in Canada, which indicates they are part of the same population. However, a federal District Court ruled on May 26, 2022 that the species should be restored to the candidate species list while USFWS reconsiders its 2020 decision.

Wolverine is also a candidate species for listing by the WDFW in Washington and a USFS sensitive species. Naturally uncommon (i.e., occurring at low densities), because of a need for large, exclusive territories, the wolverine is one of the least understood mammals in North America. Wolverines are wide-ranging, with documented long-distance dispersals across habitats far from the high mountains near the timberline where known populations reside in Washington, Idaho, Montana, and Wyoming (USFWS 2018). These southern occurrences represent less than 4 percent of greater North American metapopulation which extends to the far north of Canada and Alaska. Adults vary in size from approximately 15 to 60 pounds, with males typically substantially larger than females (USFWS 2018). Female wolverines typically utilize subnivean dens in late winter to give birth and wean and may be particularly sensitive to human disturbance during this period (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), although individual wolverines have been found as far south as California, and 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 Interstate 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). Activity areas of radio-tracked wolverines reported by Aubry et al. (2016) were mostly east of the Project but included one individual that ventured to the east shore of Ross Lake. During 2012 surveys, a successful reproductive den site was found in the Park and a second den just northeast of the Park (Aubry et al. 2012). The NPS is known to have also documented a wolverine west of the Park near Sauk Mountain later in summer 2012 and detected a wolverine on a game camera in the general vicinity of Ruby Creek in the winter of 2021/2022 (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. 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.

No incidental observations of wolverines or signs of wolverines were noted by City Light during relicensing studies.

State Listed and USFS Special-Status Species

This section describes the eleven special-status species listed by the WDFW as state endangered, threatened, candidate, or sensitive, or by USFS as sensitive species that were identified as known or with the potential to occur in the Project vicinity.

<u>Fisher</u>

The fisher (*Pekania pennanti*) has been listed by WDFW as state endangered since 1998 and is a WDFW SGCN. The native population in Washington was extirpated by the mid-1990s as a result of unregulated over-trapping, habitat loss, and fragmentation of remaining habitat. The existing population is comprised of fishers translocated from British Columbia, Canada in 2008-2010 on the Olympic Peninsula and from Alberta in 2015-2021 in the Cascades, and the descendants of these animals. Fishers of the Southern Sierra Nevada DPS were federally listed as endangered on May 15, 2020 but fishers of the Northern California/Southern Oregon DPS and the introduced population in Washington are not federally listed.

The fisher is a house cat-sized carnivore that preys primarily on squirrels, mice, snowshoe hares, porcupines, and birds. 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 20 to the Big Beaver Valley in the Park. NPS continues to participate in monitoring efforts. A wild female fisher with young was documented by a trail camera in western Chelan County in April 2021 (NPS 2021a). A fisher carcass was documented by WSDOT in 2017 just east of the Project on SR 20 (Kalisz 2020). Reintroduced fisher have been seen on mitigation lands and along the Skagit River between Rockport and Newhalem (Tressler 2022b, personal communication).

Cascade Red Fox

The Cascade red fox (*Vulpes vulpes cascadensis*) was listed by WDFW as a state endangered species in 2022. This sub-species inhabits alpine and subalpine montane ecosystems of the Cascade Range with a preference for drier subalpine meadows, parklands, and open forests east of the Cascade Crest. The Cascade red fox is distinct from the introduced red fox in the lowlands of western Washington.

The range of the Cascade red fox has contracted from its historical extent, which included British Columbia, and is now believed to be largely limited to the southern Cascades south of Interstate 90. Based on substantial survey efforts across its historical range since 2008, including baited and unbaited wildlife camera stations, hair-snare, and scat surveys the Cascade red fox has been found only in Washington and within less than 50 percent of its historical range, with only one detection from any of these efforts in the North Cascades ecoregion (i.e., DNA evidence from the Stevens Pass area south of Highway 2 in 2018). Most of the few detections in the North Cascades since 2000 have been in Kittitas and Okanogan counties, and it is unlikely that a resident population exists north of Interstate 90 (Lewis et al. 2021). There are no known occurrences in the Project vicinity. The current population is apparently very small and includes isolated occurrences. As such, the Cascade red fox's long-term viability in Washington is uncertain (Lewis et al. 2021).

Townsend's Big-Eared Bat

Townsend's big-eared bat (*Corynorhinus townsendii*) is a WDFW candidate species of conservation concern because of apparent natural low density, few known roosts, and sensitivity to disturbance. Low detections may also be associated with a low intensity echolocation call that may not register on echolocation recording devices and behaviors that make capture with mist nets difficult (Hayes and Wiles 2013). These bats roost in caves, lava tubes, mines, under bridges, buildings, and basal hollows within large trees, and use different structures seasonally. Maternity roosts are typically colonial but other types of roosts, including hibernacula, are often used by a solitary or small number of bats. Temperature and spatial conditions suitable for maternity roosts are more specialized than for other types of roosts. 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). The species occurs across a wide range of elevations and is found associated with conifer and conifer-hardwood forests, riparian habitat, shrub-steppe, and fields; individuals may often travel long distances between roosts and foraging sites (Hayes and Wiles 2013).

Townsend's big-eared bat is known to occur regionally but was not detected by acoustic surveys or captured during a wide-ranging effort in the North Cascades National Park Complex in 1998-2001, an effort which included sites on or surrounding the three reservoirs, as well as the County Line Ponds (Christophersen and Kuntz 2003). The same report indicated the separate observation of a solitary Townsend's big-eared bat in an old cabin within the "western bounds of the RLNRA" (exact location not indicated, but presumably not within the Project Boundary).

<u>Little Brown Bat</u>

Little brown bat (*Myotis lucifugus*) is a USFS sensitive species. Although historically common across most of North America, recent declines associated with white-nose syndrome have occurred, particularly in the Northeast, where the numbers of little brown bats at colonial winter hibernacula have reportedly been reduced by more than 90 percent since the disease appeared in 2006. Although white-nose syndrome is now known to occur at sites in Washington (first detected in 2016) and continues to spread, population declines have not yet been documented, possibly because the species vulnerable to the disease in Washington, including at least four *Myotis* species, do not typically hibernate here in large colonies.

Little brown bats are habitat generalists but are most common in conifer and hardwood forests. Within forest habitats, riparian edges and open water are preferred foraging areas. Day roosts used by this species include buildings and other structures, caves, mines, rock crevices, tree cavities, and beneath tree bark. Night roosting also occurs, particularly on cool nights. Information is limited regarding little brown bat hibernacula in the Pacific Northwest, but caves, abandoned mines, and lava tubes are known to be used, typically by solitary or small numbers of individuals. Maternity roosts are generally associated with sites that provide stable high temperatures, such as attics. Colonies vary in size from a dozen individuals to more than 1,000 and may be shared with other *Myotis* species (Hayes and Wiles 2013).

Information on occurrence in the Project includes results of surveys conducted by NPS in 1998-2001 within the North Cascade National Park Complex (Christophersen and Kuntz 2003). The study found that echolocation calls associated with little brown bat and Yuma bat represented one-third of all recorded calls (the two species could not be differentiated by their calls), with other data indicating little brown bat occurred at all sampled elevations and may be the most common species at high elevation sites. *Myotis* species maternity colonies have been found in older buildings in the Newhalem and Diablo townsites and other City Light and NPS facilities. The maternity colony of mostly *M. yumanensis* at Hozomeen may also include other *Myotis* species, including the little brown bat. Limited acoustic bat surveys on the fish and wildlife mitigation lands documented several bat species, including little brown bat and/or Yuma bat, foraging in the forested wetlands on the City Light Barnaby Slough property during April to July (City Light 2013). Bats identified as *Myotis* species utilize bat boxes in the townsites and the "bat-condo" at Hozomeen. Although little brown bat cannot be reliably detected without special means, including physical examination, it is reasonable to assume that this species occurs widely in the Project vicinity.

Common Loon

Common loon (*Gavia immer*) is listed by both the WDFW and USFS as a sensitive species. 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 active nests were documented in Washington. 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).

Common loons are regularly observed on Ross Lake by City Light and others (e.g., Ransom 2019) in small numbers (i.e., 1-3 birds) in spring, summer, and fall, and occasionally on Diablo Lake (McShane 2019, personal communication). 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, as they typically nest within five feet of water (Richardson et al. 2000). Loons have been documented breeding at sites on Hozomeen Lake (Christophersen 2016), which is approximately 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). 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. In 1971 a dead adult loon was found entangled in fishing line at Hozomeen Lake. Limited data on loon use of the North Cascade National Park Complex preclude inferences on population size and distribution (Hoffman et al. 2015).

Common loons were heard calling from Ross Lake near the Hozomeen Campground on the morning of July 9, 2021 during an overnight site visit associated with the TR-08 Special-Status Amphibian Study.

Harlequin Duck

Harlequin duck (*Histrionicus histrionicus*) is designated by the USFS as a sensitive species. Harlequin ducks nest near shallow, fast-flowing water in forested areas 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. Although 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. 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. Most recently, a 27-year period study between 1990-2017 conducted surveys on major streams within North Cascades National Park and collected incidental observations from 1968-2021 (Rine et al. 2002). There were 623 harlequin duck observations, representing 372 individuals, most of which (330 individuals) were from the Stehekin River. Among the surveyed streams that are tributaries to the Project, pairs and/or broods have been detected at Little Beaver, Big Beaver, and Newhalem Creeks. The study concluded that the Stehekin drainage likely supports the greatest densities of harlequin duck populations in North Cascades National Park due to its large watershed area and varied aquatic habitats. While the transmission line ROW crosses streams that may have suitable habitat, there are no high-concentration areas of harlequin ducks in the vicinity of the Project transmission line ROW. 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 fewer than 10 observations of harlequin duck posted on eBird in the park (Hoffman et al. 2015).

No incidental observations of harlequin ducks or signs of harlequin ducks were noted during City Light's relicensing studies.

Peregrine Falcon

The peregrine falcon exhibited well-documented population declines across North America and much of its global range following the widespread use of dichloro-diphenyl-trichloroethane (DDT) shortly after the Second World War. The peregrine falcon was listed nationally as an endangered species by USFWS in 1970 and by the Washington Fish and Wildlife Commission in 1980 when only five pairs were found to be nesting statewide. With the restriction placed on the use of DDT, the peregrine population has recovered and was removed from the federal endangered species list in 1999. In 2002, the species was reclassified as a state sensitive species as more than 70 territories were found occupied.

In 2004, the USFWS and WDFW began allowing small numbers of peregrine falcon nestlings to be taken for falconry, and in 2010 the regulations were modified to include trapping of first-year Washington falcons. WDFW last completed comprehensive surveys of peregrine falcon territories in 2009. In that year, WDFW identified 108 occupied territories, an increase from 91 occupied territories in 2006, and a continued linear increase in the number of occupied territories since 1990. In 2012 as a response to state down-listing of the peregrine, the Washington Forest Practices Board approved the removal of peregrine falcon critical habitat from Forest Practice Rules (WAC 222-16-080) (Vekasy and Hayes 2016).

The species no longer meets the definition of a state sensitive species under Washington law, which is described as "vulnerable or declining and … likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats" (WAC 232-12-297). Subsequently, the peregrine falcon was delisted at the state level in Washington. The species remains classified as "protected wildlife" under state law (WAC 232-12-011) and will continue to be protected under the federal Migratory Bird Treaty Act (Vekasy and Hayes 2016).

Peregrine falcons have increased since the 1980s in the North Cascades National Park Complex, when no detections were recorded in suitable areas, but remain rare. Currently there are seven documented nesting territories in the park complex, including six in the RLNRA and one at Lake Chelan (Christophersen and Ransom 2022). Observations of individual adult peregrine falcons have also been recorded at three other locations along Ross Lake. The NPS, along with WDFW and City Light biologists, has conducted annual surveys of peregrine falcon nesting territories in the North Cascades National Park Service Complex in 13 of 15 years between 2006 and 2020, which include three sites on Ross Lake (two on the west shore and one on the east shore), one near Diablo Dam, one at Gorge Lake, and one at Newhalem (Christophersen and Ransom 2022). All the nest sites, or eyries, are on ledges shielded by a slight overhang and are associated with vertical cliffs. The Gorge Lake eyrie is located across the Skagit River from the Gorge Powerhouse on a cliff 550 feet from, and within line-of-sight of, the portal area. Although nest occupancy has varied over the years, each of the nesting territories has successfully fledged young in multiple years in which surveys were performed (ranging from 2 to 6 years). The results of surveys indicate the number of occupied nests has generally declined, with one or two occupied nests per year in most years from 2014 to 2020. However, Christophersen and Ransom (2022) caution against drawing broad conclusions from the data because of annual differences in survey effort, which may have allocated insufficient time to remote sites, and variability in observer experience. Recent wildfires may have affected habitat conditions at some of the sites.

No incidental observations of peregrine falcons or signs of peregrine falcons were noted during City Light's relicensing studies.

<u>Northern Goshawk</u>

The northern goshawk (*Accipiter gentilis*) is designated as a candidate species for listing by the WDFW and as a sensitive species by the USFS. The species occurs in a wide variety of boreal and montane forests in North America and Eurasia (WDFW 2021b). Goshawks inhabit all forested regions of Washington and prefer to nest in coniferous stands, although they are also known to nest in red alder (*Alnus rubra*) (WDFW 2010) and aspen (*Populus* spp.) groves (WDFW 2021b). The breeding season, including post-fledgling activity, in Washington generally ranges from March through September.

WDFW estimates there were 338 goshawk breeding territories statewide in 2003, but the current number of territories is unknown (WDFW 2021b). These woodland raptors are opportunistic foragers that prey on a variety of small- to medium-sized mammals and birds, including Douglas squirrel (*Tamiasciurus douglasii*), snowshoe hare (*Lepus americanus*), and grouse (*Dendragapus obscurus* and *Bonasa umbellus*) (Watson et al. 1998). Their diet also includes passerine birds, woodpeckers, and chipmunks (WDFW 2021b).

Goshawk productivity and survival are highly dependent upon the availability of suitable prey and nesting habitat. There is evidence to suggest that timber harvest can fragment nesting habitat or otherwise adversely affect nest site selection and nesting rates (WDFW 2021b). Goshawks are also known to be sensitive to human activities, including those that generate loud noises, especially during the breeding season (McClaren et al. 2015). Pedestrian activities as well as the use of heavy equipment near active nests may cause nest abandonment and failure (Squires and Kennedy 2006). Other evidence suggests that goshawks can adapt to regular vehicular noise, such as truck traffic on logging roads near nest sites. Nesting goshawks exposed to regular logging truck activity in Arizona did not exhibit discernible responses to the noise, and all three nesting pairs successfully fledged young (Grubb et al. 2013). McGrath et al. (2003) found that goshawk nests in central Washington and northeastern Oregon occurred closer to forest roads compared with random sites, indicating some tolerance of human presence (e.g., periodic car and truck traffic). Irregular and loud noises (pile-driving/blasting) and pedestrian intrusion close to nests are anticipated to be more disruptive than regular activities that are farther away or less severe (McClaren et al. 2015).

PHS data only identified one potential goshawk nest within the study area. The potential breeding area was observed in June 1987 at Roland Point on Ross Lake. Several goshawk sightings have been reported, including a juvenile goshawk that collided with a window at the Diablo Powerhouse in 2014. Following this incident, City Light conducted acoustic broadcast goshawk surveys in 2015 along the lower portions of the Stetattle Creek Trail and Sourdough Trail for evidence of nesting goshawks, following methods based on a Washington DNR protocol and approved by NPS staff, but no goshawks were detected. Goshawks were detected 12 times during Landbird Inventory and Monitoring surveys conducted by the NPS in the North Cascades National Park Complex from 2008-2018 (Ray et al. 2018; NPS 2020a), and twice during northern spotted owl surveys in 1995 (NPS 2020a). The NPS wildlife observation records documented a total of 32 goshawk observations during 1995-2018 (NPS 2020b).

There were several recent goshawk sightings in the Project vicinity or adjacent areas noted in the eBird database, largely observed near the Skagit River and its tributaries. For example, there have been six observations at Corkindale Creek, four observations in Concrete, and numerous sightings around Diablo Lake and Ross Lake (eBird 2021).

Northern Goshawk Habitat Analysis

In support of relicensing activities, City light conducted a habitat analysis study for northern goshawk in the study area (within 0.5 miles of the Project Boundary) (TR-07 Northern Goshawk Habitat Analysis Draft Report; City Light 2022d). The objective of the study was to develop a map of suitable goshawk nesting habitat within the study area. The results of this study are intended to assess potential Project-related impacts to any identified goshawk breeding areas. City Light will use the information from this study to implement best management practices (BMPs) to minimize potential adverse impacts to nesting northern goshawk. The study area for this analysis is shown in Figures 4.2.5-4 through 4.2.5-6.

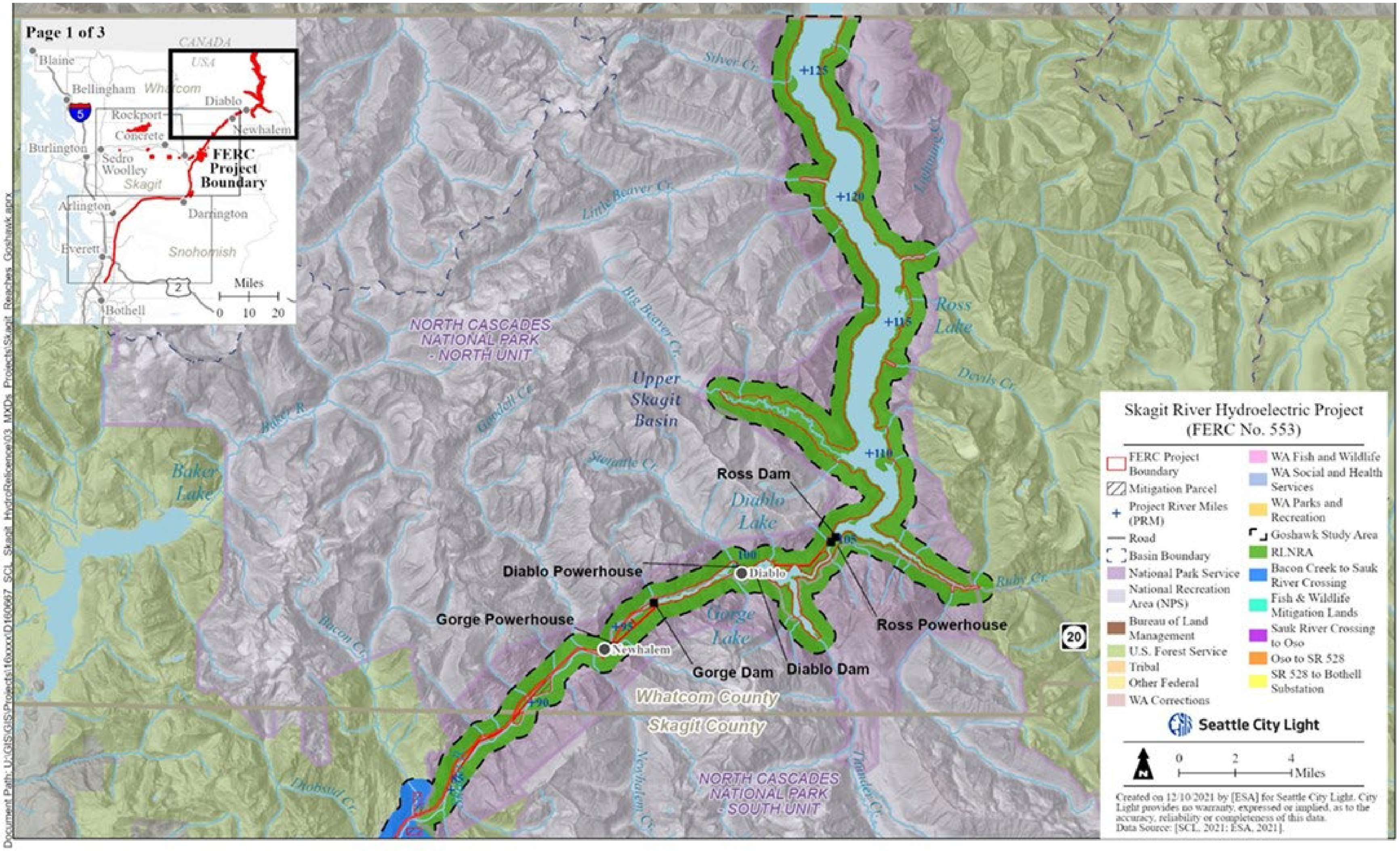


Figure 4.2.5-4. Study area segments for the Northern Goshawk Habitat Analysis (north).

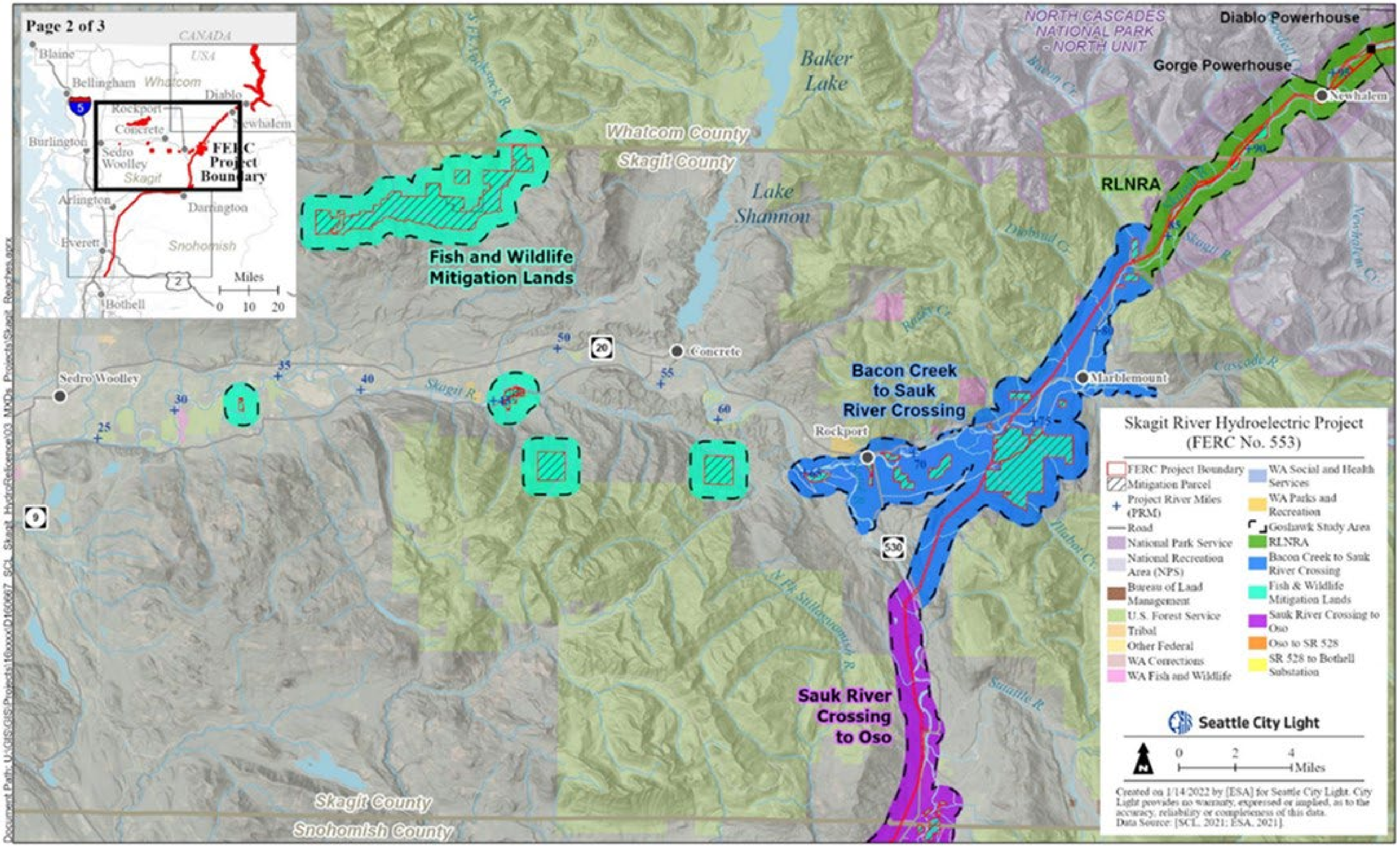


Figure 4.2.5-5. Study area segments for the Northern Goshawk Habitat Analysis (central).

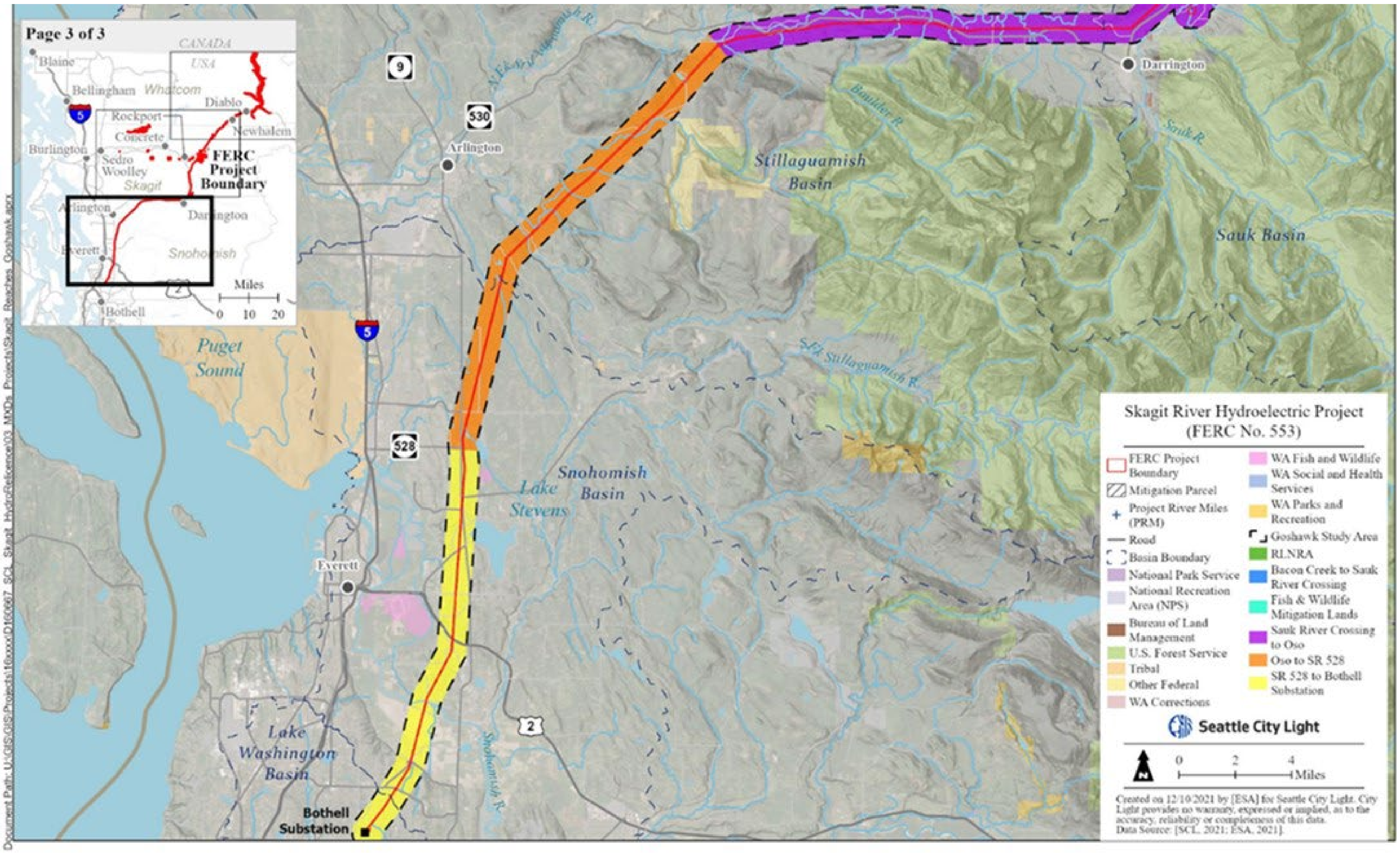


Figure 4.2.5-6. **Study area segments for the Northern Goshawk Habitat Analysis (south).**

Methods used to develop a map of potentially suitable goshawk nesting habitat involved the following steps: (1) using existing information from relevant scientific literature and consultation with species experts and agency staff to identify goshawk nesting habitat suitability criteria and (2) using GIS to combine the mapped habitat parameter layers to identify potentially suitable goshawk nesting habitat elements in a tiered manner.

Given the habitat requirements for goshawk nest stands within a surrounding post-fledgling family area (PFA), a tiered approach was used to create the habitat suitability map (i.e., each tier is inclusive of all tiers preceding it); the first two tiers describe potentially suitable PFA, and the last two tiers define potentially suitable nesting habitat (within the PFA). The first tier consists of forested areas with a mean height greater than 20 feet. The second tier includes Tier 1 areas that encompass 69 or more continuous acres. The third tier includes Tier 1 and Tier 2 areas with tree heights of 75 feet or higher. The fourth tier includes areas that meet all requirements of the previous three tiers and were at least 38 acres in area. A threshold of 75 feet was chosen because it is the minimum nest tree height recorded in WDFW PHS goshawk breeding records from 1987 to 2010 (WDFW 2010). The maximum nest tree height recorded is 150 feet, with 113 feet as the average nest tree height. To capture the range of forest types and tree heights that may be selected, a tall tree (> 113 feet) overlay is added to Tier 4 to show both location and density of the taller trees throughout the study area, representing potential highly suitable habitat.

Potentially suitable goshawk nesting habitat is shown in Attachment A of the TR-07 Northern Goshawk Habitat Analysis Draft Report (City Light 2022d) and summarized in the table below. The results of this study are organized by study area segment. As shown in the maps, Tier 4 (which is inclusive of Tiers 1-3 criteria) represents potentially suitable goshawk nesting habitat. Areas within Tier 4 polygons with taller trees are shown as black pixels. The Nesting Habitat Suitability Model indicates that 20,889 acres, or approximately 15 percent of the entire study area, is potentially suitable nesting habitat (Table 4.2.5-9).

Table 4.2.5-9. Potentially suitable goshawk nesting habitat (Tier 4) acreage in the study area by segment.

Segment	Acreage of Potentially Suitable Habitat (% of segment)			Acreage of Total Study Area Segment
	Project Boundary	0.5-mile Buffer	Project Boundary + Buffer	
RLNRA	1,504 (3%)	9,411 (16%)	10,915 (19%)	56,598
Bacon Creek to Sauk River Crossing	5 (0.02%)	4,907 (19.08%)	4,912 (20%)	24,099
Sauk River Crossing to Oso	950 (5%)	754 (4%)	1,704 (9%)	19,659
Oso to SR 528	0	0	0	11,810
SR 528 to Bothell Substation	0	0	0	9,953
Fish and Wildlife Mitigation Lands	47 (0.23%)	3,311 (16.77%)	3,358 (17%)	20,101
Total	2,506 (2%)	18,383 (13%)	20,889 (15%)	142,220

The Nesting Habitat Suitability Model identifies the largest patches of potentially suitable goshawk nesting habitat as mapped on the east side of Ross Lake from Project River Mile (PRM)

108 to 113 and along the Skagit River from PRM 83 to 90. Approximately 37 percent of the entire study area is mapped only as Tier 2, indicating that adequate PFA is present but suitable nest stands are absent. Areas that only qualify as Tier 1 and Tier 3 cover only 3 and 2 percent of the entire study area, respectively; 43 percent of the study area does not meet any of the nesting criteria, indicating that the land cover is either water, developed, agricultural, pastureland, or young or newly planted forest. The tall tree overlay on Tier 4 allows identification of potentially older, multi-storied conifer forests and thus potentially more suitable for goshawk nesting habitat.

The Nesting Habitat Suitability Model does not account for human disturbance, nor does it incorporate buffers into the identification of potentially suitable nesting areas, but Tier 2 (forested areas 69 acres or larger) excludes highly fragmented sites that are likely to have more frequent human activity, such as agricultural parcels, tree plantations, and rural residences. Other ecological factors that contribute to successful goshawk nesting habitat, such as adequate prey base and low fragmentation/low edge effect of suitable nesting habitat areas (e.g., shape of Tier 4 habitat patches), are unaddressed by the Nesting Habitat Suitability Model and may influence whether a seemingly suitable nest site is occupied or not.

No incidental observations of northern goshawk or signs of northern goshawk were noted during City Light's relicensing studies.

Western Toad

Western toad is a WDFW candidate species and a SGCN on the basis of regional declines in lowlands of the Puget Trough and lower Columbia River Gorge. Western toad may no longer occur in parts of its former range in the urbanized areas of the Puget Lowlands (WNHP et al. 2009). The Committee on the Status of Endangered Wildlife in Canada [COSEWIC] (2002) reported a similar pattern of decline and disappearance in southwestern British Columbia documented by numerous sources, sometimes with no clear explanation. Populations may be particularly affected by fragmentation of habitat and mortality crossing roads.

Western toad breeding habitats are diverse, including seasonal to permanent ponds, small to large lakes, low gradient streams, side channels and backwaters of large rivers, ditches, and various anthropogenic habitats such as tire ruts and stock ponds (COSEWIC 2002, Jones et al. 2005, Muths and Nanjappa 2005). Although able to use aquatic sites that do not hold water persistently because of rapid embryonic and larval development, populations usually occur where there are permanent ponds or lakes. Common features are still- or very slowly flowing water, shallow edges, prolonged sun exposure, and water levels that do not rapidly fluctuate. On lakes and ponds surrounded by forests, north and east shores are typically favored because of longer sun exposure. Breeding habitats may contain submerged aquatic vegetation or lack vegetation entirely (Hawkes and Tuttle 2013). Barren sites far from hiding cover (e.g., dense vegetation, small mammal burrows, or rock slides) may be unsuitable (Rombough 2012). Western toads often breed communally, with egg strings deposited in a concentrated area, and may use the same sites in successive years (Muths and Najappa 2005) but may also quickly exploit newly constructed ponds (Pearl and Bowerman 2006). Eggs are laid at sites when water temperatures are sufficiently warm, generally later than sympatric ranid frogs (Rombough 2012). Seasonal timing is affected by latitude, elevation, and local conditions. For example, at lowland stream-associated sites, breeding may be delayed until after springtime flows subside, but occur soon after spring thaw at some high elevation sites. Tadpoles exhibit distinctive schooling behavior, and, after metamorphosis, the transformed toads often aggregate on the shores of the natal site before emigrating en masse (Muths and Nanjappa 2005). Western toads are largely terrestrial after metamorphosis.

Various sources, including PHS on the Web, iNaturalist, and other verified observations, provide evidence of western toad occurrences within or near the Project Boundary, although these tend to be terrestrial occurrences that do not directly indicate the location of breeding sites. Western toad is known to occur in Big Beaver Valley west of the study area (Holmes and Glesne 1997). Information regarding breeding sites around Ross Lake and the County Line and Newhalem Ponds are summarized below in discussion of City Light's surveys in 2021-2022 (City Light 2022e). Museum and sight records summarized by McAllister (1995), Nussbaum et al. (1983), and WNHP et al. (2009) show no records along the Project transmission line. PHS on the Web includes observations of western toad young-of-year in the Bear Creek watershed about one mile from the transmission line.

Special-Status Amphibian Study

City Light's TR-08 Special-Status Amphibian Study (City Light 2022e) documented western toad breeding at Ross Lake, the County Line Ponds, and the large Newhalem Pond. Supplemental surveys in 2022 also documented breeding locations in the inlet north of Dry Creek and at a pool on the isthmus between Roland Point and Jerusalem Island ("Jerusalem Island pool" hereafter). Other breeding sites at Ross Lake indicated by earlier observations by City Light or reasonably inferred by the presence of yearling toads include the north end of Ross Lake on both the west and east sides, although likely north of the border on the west side. In addition, NPS credibly reported finding western toad breeding activity in the inlet by Roland Point in 2021, although NPS has not provided other details, and City Light's survey in 2022 was unsuccessful in finding the breeding location. The results at Ross Lake suggest that toads at most of these locations breed when the lake is still filling, but is approaching peak normal water surface elevation, approximately in late June or early July. The sites are associated with low gradient shorelines, where breeding activity may be triggered by warming water and availability of shallow water in traditional breeding areas. An exception to this pattern occurs at Jerusalem Island pool, which holds water perched above the lake water surface elevation during the drawdown and develops suitably warm water for western toad breeding much earlier (e.g., recently hatched tadpoles were found on May 4, 2022), suggesting that eggs were laid in late April, compared to July 1, 2022 at the inlet north of Dry Creek). The same pool also supports long-toed salamander, northwestern salamander, and Pacific chorus frog—the only site where all four species occurred. Western toads were not found in borrow pit pools at the north end of Ross Lake.

Western toad breeding at the County Line Ponds and large Newhalem Pond occurred in the last week of April in 2022 (eggs were first observed on April 27). The egg deposition sites were the same locations where western toad tadpoles were found in June 2021. Although western toad was not detected within the transmission line ROW during the study, the species could also occur at certain sites associated with large wetlands not near busy roads and which contain permanent ponds.

<u>Columbia Spotted Frog</u>

The Columbia spotted frog is a WDFW candidate species and regarded as a SGCN on the basis of regional declines within areas of shrub-steppe habitat, especially in the Columbia Basin, although the species reportedly remains common in many places elsewhere in Washington State (WDFW 2015b). This aquatic species occurs over a vast geographic area from the Alaskan panhandle to the Great Basin and as far east as Montana, and in diverse biomes, including arid scrub and montane forests, associated with permanent ponds, lakes, or sluggish streams. Columbia spotted frogs in Washington are assigned to the "Northern" clade, the most widespread genetically differentiated group of the species (Funk et al. 2008). In Washington, almost all known populations are east of the Cascade Crest or just west of the Crest as occurs near Hart's Pass and Rainy Pass. The only known exception to this pattern is within the Big Beaver Valley west of Ross Lake, more than 16 miles west of the Crest, in an area of extensive beaver-dammed wetlands. Ranid frogs (i.e., frogs of the family Ranidae) found there in 1997 and 1998 reportedly could not be reliably field-identified because they shared characteristics with northern red-legged frog and Cascades frog (*R. cascadae*) (Holmes and Glesne 1997), although the account did not include descriptions of these confusing characteristics and supporting photographs are unavailable (Rawhouser 2021, personal communication). Collected specimens were later determined by genetic analyses to be Columbia spotted frog (Holmes and Glesne 2000).

On May 5, 2012 City Light biologists incidentally observed and photographed two egg masses that were identifiable as ranid in wetlands associated with the north end of Ross Lake in British Columbia. The egg masses were in a low-gradient drainage channel within an extensive grass-, or sedge-dominated wetland. Based on the known range of the species and the elevation of the site, these were probably Columbia spotted frog egg masses; although certain identification cannot be established without more information. A recent iNaturalist observation from Skagit Provincial Park at the north end of Ross Lake is reported as Columbia spotted frog, with photographs that are consistent with species of the spotted frog complex. Columbia spotted frog is also reliably documented in Manning Provincial Park in Canada in the Skagit basin north of Ross Lake and east of the Skagit basin (Ovaska et al. 2019). There are no other records or reported sightings of Columbia spotted frog elsewhere within or near the Project Boundary.

Columbia spotted frogs typically deposit egg masses in vegetated, shallow water locations, including the margins of permanent water bodies and separate seasonal sites, and after hatching larvae require aquatic habitats that persist until at least mid- to late summer to complete metamorphosis. All life stages of this species are typically aquatic, but eggs and larvae are the most sensitive to site drying and changes in water level. Adult and juvenile Columbia spotted frogs are usually found in or near water, except possibly during dispersal.

Habitat suitability for Columbia spotted frog is not precisely described in the literature, in part because this species is so wide-ranging. However, throughout its range, Columbia spotted frog typically breeds on the margins of permanent water bodies or seasonal sites where egg masses are placed in vegetated, shallow water locations, and after hatching larvae require aquatic habitats that persist until at least mid- to late summer to complete metamorphosis. Movements between essential habitats of Columbia spotted frog populations often follow stream and wetland corridors (Reaser and Pilliod 2005). However, Pilliod et al. (2001) documented individual radio-tagged Columbia spotted frogs at a high montane site (7,620–8,640 feet elevation) in Idaho making direct overland movements of over 540 feet through dry habitats, although some of these frogs stopped at seeps, springs, and isolated pools along the way when these were available (Pilliod et al. 2001). Habitats of Columbia spotted frog may include forested wetlands, but typically only as a component of a larger wetland habitat complex with emergent class wetlands (Reaser and Pilliod 2005).

Special-Status Amphibian Study

City Light's TR-08 Special-Status Amphibian Study (City Light 2022c) documented spotted frogs, tentatively identified as Columbia spotted frog, in 2022 in two locations near the U.S.-Canada border at the north end of Ross Lake. Along with known occurrences in Big Beaver Valley west of Ross Lake, these are the only locations in the Project Boundary that are potentially suitable for Columbia spotted frog. Columbia spotted frog was not found at any other sites on the margin of Ross Lake and no other suitable sites were identified on Ross Lake or elsewhere in areas that may be affected by Project operations. The location on the northwest side of Ross Lake, which was surveyed on April 28, 2022 (day and night survey) and June 24, 2022 (day survey), is approximately 0.25 miles from the U.S.-Canada border and is associated with a low gradient section and the mouth of a small perennial tributary—the only potential habitat at the site during the drawdown period. When surveyed on April 28, the water surface elevation of Ross Lake was approximately 1,530.76 feet North American Vertical Datum of 1988 [NAVD 88]) (1,524.5 feet City of Seattle Datum [CoSD]), and the shoreline of the lake was more than 3 miles south of the U.S.-Canada border. On June 24, the lake water surface elevation was approximately 1,598.76 feet NAVD88 (1,592.5 feet CoSD), and the shoreline was now within about 370 feet of the location of the earlier sightings, and the rising waters then extended north into Canada. On this date, frogs were found in the stream, which was connected by surface flow to the lake, and on the edge of the lake, and many more were observed (estimated at least 30) compared to the April survey when 6 or 7 were found. The area around the mouth of the stream on the forest edge is densely vegetated with reed canarygrass, small-fruited bulrush, and other graminoids, with a few scattered alder saplings. Channels of the Skagit River east of the site during the drawdown do not represent potential habitat because of flowing water and absence of any perennial vegetation. A borrow pit approximately 0.25 miles south of the site is also unsuitable habitat. During day and night surveys of this borrow pit, which was devoid of perennial vegetation, no frogs of any stage were detected, although egg masses of northwestern salamander were found.

Except for one adult male frog, all spotted frogs observed at the west-side site during surveys were juveniles, including yearlings. Unlike potential breeding habitat, water at the site during the breeding season was cold (5˚C), pools were shallow, and the stream flows as seepage lower on the slope. No egg masses or tadpoles were found. At some time after the breeding season as water levels rise, the site becomes connected to Ross Lake by shallow surface flow and presumably connects to spotted frog habitats north of the border. Based on these observations, the site appears to be seasonal, non-breeding habitat, where juveniles overwinter during the drawdown period and additional frogs move into the site subsequently from habitats north of the border. Amphibian surveys at the north end of Ross Lake in Canada to be performed by the SEEC-funded amphibian study in 2023 should provide more information on spotted frog habitat use north of the border, including locations, elevations, and habitat characteristics of breeding sites. If partial or complete results are available, they will be included in the FLA.

The other site where spotted frogs were observed, located about 200 feet south of the U.S.-Canada border on the northeast side of Ross Lake, is a small borrow pit pool surrounded by dense reed canarygrass. The elevation of the site is approximately 1,604.26 feet NAVD88 (1,598 feet CoSD), which is near the maximum normal water surface elevation of Ross Lake (1,608.76 feet NAVD88 [1,602.5 feet CoSD]). The site was day and night surveyed on May 3, 2022 and June 7, 2022. Spotted frog egg masses were found on May 3 in a small cluster (2 or 3 egg masses) and an adjacent single "satellite" egg mass. The egg masses were on a substrate of grass thatch in shallow water next to the deeper pool. Some of the embryos were at hatching stage, suggesting that breeding occurred around mid-April. A small number of juvenile spotted frogs were also found (one on May 3 and five on June 7), along with one adult male during each survey. No other comparable sites occur at Ross Lake south of the U.S.-Canada border or north of the border on the east side of Ross Lake.

Federally Protected Birds

The bald eagle and gold eagle remain protected under the federal Bald and Golden Eagle Protection Act and are discussed below.

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 compared to 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 support of relicensing in the 1980s. The Illabot wildlife mitigation lands encompass part of the communal roost area. Adult bald eagles have been observed foraging for fish in Ross Lake and fledged juvenile bald eagles are occasionally observed foraging in the Ross drawdown during winter. Groups of wintering eagles also regularly hunt for salmon at the Newhalem and County Line Ponds.

Two eagle nests adjacent to the Ross Lake shoreline within the Project Boundary have been active at times between 2015 and 2020, one north of Little Beaver Creek and one at Dry Creek, with a total of five fledged young, all in 2016 or 2017 (Christopherson and Ransom 2022). The nest tree north of Little Beaver Creek was damaged in a windstorm in 2017, and the nest site was subsequently abandoned. An eagle was observed sitting on the nest on April 29, 2022, during City Light's relicensing studies. In 2022, a new nest was observed by NPS and City Light biologists north of the mouth of Little Beaver Creek that appeared to be active in 2022 but productivity is unknown. A historically occupied nest near Roland Inlet blew down and no other nests were seen in the area in 2022. According to WDFW PHS data, ten historical bald eagle nest sites occur within 0.5 miles 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 fish and 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. A nest on WDFW land near the Barnaby Slough mitigation property was observed by City Light biologists in 2021 but activity and productivity are unknown.

Incidental observations of bald eagles and nests were noted on Ross Lake near Little Beaver Creek on April 29, 2022 during TR-08 Special-Status Amphibian Study fieldwork and other City Light relicensing studies.

Golden Eagle

Golden eagles (*Aquila chrysaetos*) are protected under the federal Bald and Golden Eagle Protection Act. In Washington, golden eagles nest throughout much of the state but are most common east of the Cascade Range in the north-central highlands at the transition between montane and shrub-steppe landscapes. Golden eagles are considered uncommon to rare west of the Cascade crest (Larrison and Sonnenberg 1968). In 2017, only 46 territories had been identified by WDFW in western Washington (Hansen 2017). Much of the landscape in western Washington is dominated by closed-canopy coniferous forest, which is unsuitable habitat for this species (Singh et al. 2016). In western Washington, golden eagles nest in Douglas fir or other relatively large trees in noncontiguous forest (Bruce et al. 1982), as well as on cliffs and rock outcrops. Nest trees are typically in small patches of forest at or near (i.e., within 1,500 feet) the edge of more open habitat; large contiguous forest tracts are not used. Clear-cuts and open forest stands offer prime habitat for mountain beaver and other small mammal prey. These areas are strongly associated with the golden eagle nest sites known in western Washington (Hansen 2017; Bruce et al. 1982).

Few systematic avian monitoring studies have been conducted in the Project vicinity. Six of the established once-annual survey routes that are part of the North American Breeding Bird Surveys (BBS; U.S. Geological Survey [USGS] 2018) overlap with portions of the study area. The Newhalem BBS survey route is located almost entirely within the Project transmission line ROW and a 1-mile buffer. Golden eagles have never been recorded along this BBS route in 52 years of surveys. The NPS has also conducted annual landbird monitoring within the North Cascades National Park Complex, which partially overlaps the study area, since 2007 (except 2017; NPS 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2019, 2020a, 2021b). The surveys that occur in June and July of each year have not recorded golden eagles, although in some years golden eagles have been observed outside of the field season (i.e., during training or incidentally).

Incidental observations of golden eagles have been recorded by the NPS (2021c) and eBird (2021), and incidental observations of nest sites are available from WDFW (2021 c, d). There have been only 130 incidental observations of golden eagles within the North Cascades National Park Complex since 1970, only three of which were within the study area. Only two nest sites have ever been confirmed within ten miles of the Project transmission line (one 4.5 miles southeast and the other about 10 miles northwest).

The NPS incidental observation data suggests that most golden eagle sightings in the area occur during fall migration. Observations (n = 130) of golden eagles are highest in September, more than three-times higher than any other month. This is consistent with other evidence that golden eagles are more commonly observed as they pass through the North Cascades National Park Complex in late summer/early fall during fall migration (Hawk Migration Association of North America 2021). Abundance appears to gradually increase throughout the summer until peaking in September and then declines steeply and remains low throughout the winter and spring. These data suggest the northern Cascades are primarily a fall migratory route for golden eagles as opposed to a breeding area (NPS 2021c).

The available data suggest that golden eagle abundance in the North Cascades was greatest during and immediately following the peak in timber harvest but has subsequently declined during the last two decades as clear-cuts have regrown. Today, timber harvest predominately occurs on state and private lands (Washington DNR 2018), and evidence of recent clear-cuts is more common at lower elevations.

Golden Eagle Habitat Analysis

In support of relicensing activities, City Light conducted a TR-06 Golden Eagle Habitat Analysis (City Light 2022e) with a goal of mapping habitat for golden eagle nesting, foraging, and movement corridors in the study area (i.e., geospatial habitat assessment and golden eagle use assessment) and to conduct a geospatial risk assessment (GRA) to identify risk associated with potential collision with Project transmission lines. This information can then be used to assess the potential effects of continued Project O&M with respect to collision risk of golden eagles with transmission lines and to inform BMPs and elements of City Light's Avian Protection Plan. There have been no recorded collisions of golden eagle with Project transmission lines.

The study area was limited to the transmission line ROW and a 1-mile buffer on either side of the ROW (Figure 4.2.5-7).

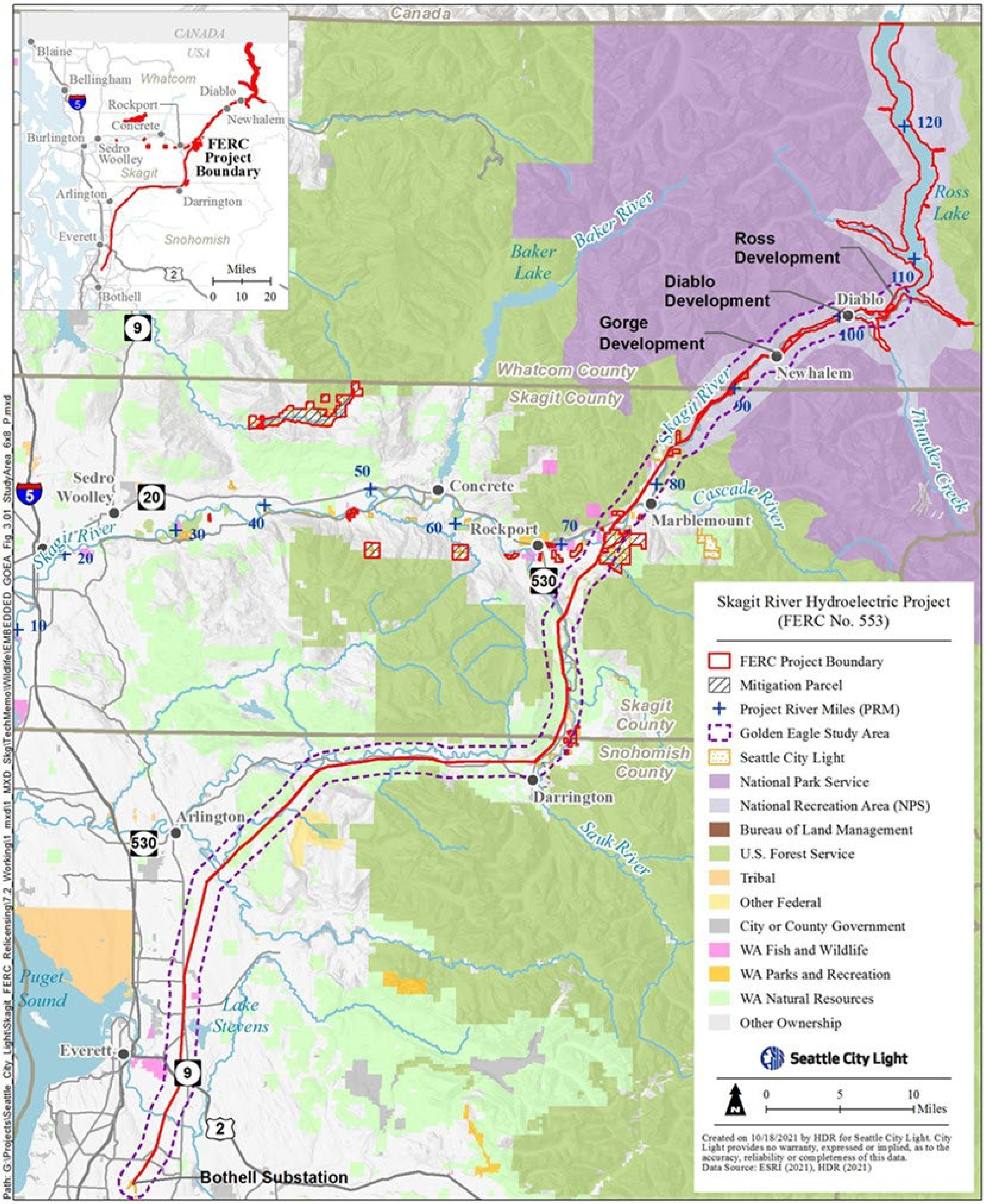


Figure 4.2.5-7. Golden Eagle Habitat Assessment study area.

Existing information on golden eagle nesting and foraging habitats in the region and golden eagle observations were compiled and reviewed. Existing information that was reviewed included observational data sets, existing habitat models, physical and ecological datasets, and landscape characteristics. Using the data sets, a habitat suitability model (HSM) was developed to map nesting and foraging habitat in the study area. Additionally, a GRA was developed to identify areas of relatively high risk of golden eagle collision with transmission lines.

The nesting habitat model output showed most of the study area as low-quality nesting habitat. High-quality nesting habitat is primarily located in very small patches near Diablo and Gorge lakes and on Sourdough Mountain. Moderate-quality nesting habitat is also found in this same area and occurs in larger patches as far south as Wheeler Ridge, located just east of Arlington.

The foraging habitat model shows that most of the study area is unsuitable for foraging. Relatively large patches of high-quality foraging habitat are located within the boundaries of the Goodell Creek Fire near Newhalem, within clear-cuts near Rockport and Marblemount, and sporadically throughout the study area. Moderate-and high-quality foraging habitat was mapped within the transmission line ROW, where vegetation management results in a linear swath of open and non-forested land cover. A large and contiguous area of moderate-and high-quality foraging habitat was mapped within agricultural lands near the City of Snohomish, along the Snohomish River. Because most of the study area consists of forested land cover, less than 20 percent is modelled as suitable for foraging by golden eagles.

Based on the review of existing golden eagle observational data, systematic monitoring, and available literature, golden eagle abundance in and near the study area is extremely low. Golden eagles are uncommon during fall migration and rare during spring, winter, and summer in the study area. Notwithstanding, there are several eBird (2021) observations of golden eagles in the study area during winter and spring, likely moving along major drainages towards estuaries where they occur in relatively large numbers during winter. Overall, observational data and habitat modeling suggest golden eagles, when they occur in the study area, they should most likely be observed between Newhalem and Ross Dam. In this area, the rugged, mountainous topography is most like that preferred by golden eagles. Nesting habitat, although limited, is present on cliffs and barren alpine slopes as well as trees that border forest openings. Recent burns provide temporarily suitable foraging habitat in addition to the alpine slopes outside of the study area. Although nesting and foraging habitat is present in patches throughout the study area, its abundance wanes as one heads south, largely due to moderating topographic relief. Based on the model, the transmission line ROW provides moderate- and high-quality foraging habitat. However, it is unlikely that golden eagles would venture further south than Marblemount to access this foraging habitat due to a lack of other important habitat parameters both in and adjacent to the study area. As a result of the above, relative collision risk would be greatest between Newhalem and Ross Dam as well as other points at which topography, habitat, and the position of the transmission line combine to be considered relatively elevated risk.

Golden eagle risk of collision with Project transmission lines can be confidently described as very low because: (1) golden eagle abundance is very low; (2) high-quality nesting habitat is limited in and near the study area; (3) foraging habitat is limited relative to other portions of golden eagle range; (4) collisions are rare during migration (greatest during foraging and territorial defense), which is when golden eagles are most commonly in the study area; and (5) golden eagles, like all raptors, rarely collide with transmission lines due to their visual acuity and maneuverability.

No incidental observations of golden eagles or signs of golden eagles were noted during City Light's relicensing studies.

Other Wildlife Species of Cultural, Recreational, or Economic Importance

Ungulates

The four ungulates that occur in the Project vicinity (black-tailed deer, elk, moose, and mountain goat) are particularly important species for local Indian Tribes and recreational hunters and for general wildlife viewing.

<u>Black-tailed Deer</u>

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. Severe winter conditions during the 2016-2017 season likely affected over-winter survival of fawns to a greater degree than the previous five years (Mule Deer Working Group 2017).

Black-tailed deer are regularly observed throughout much of 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 (Chapman and Feldhamer 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).

<u>Elk</u>

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 is about 1,046 animals. Observations from biologists and anecdotal information suggest that an additional 200 to 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 at the McLeod Slough, Savage Slough, and Johnson Slough properties, and are occasionally seen on Illabot and Barnaby Slough. 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 and WSDOT has installed warning signs between Sedro-Woolley and the Concrete area to reduce elk-vehicle collisions. A study of 2012-2019 data for elk-vehicle collisions along SR 20 notes that 92 percent of elk-vehicle collisions documented west of Washington Pass occur within a 23-mile reach between mileposts 66 and 89 (Sevigny et al. 2021). 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 are the main predators of elk in the Project vicinity.

The current North Cascades Elk Herd Management Plan (WDFW 2018) has a population objective for the North Cascades elk herd of 1,700 to 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 square miles (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.

<u>Moose</u>

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 rarely reported in the Project vicinity but includes sightings at Granite Creek and the Diablo and Gorge lakes areas (P. MacKay 2010, personal communication).

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).

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 Washington (including the North Cascades National Park) indicates that seasonal home ranges here highly variable; males had a maximum home range of 14.3 sq. mi. and females up to 6.4 sq. mi (Jenkins et al. 2011). 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 steep slopes on the north side of SR 20 in Newhalem and in the canyon along the Gorge bypass reach 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 from Jack Mountain. In summer, they disperse to higher elevations and remote areas of the park.

Cougar

Cougars are considered relatively common large predators in the North Cascades, although rarely observed. Cougar movements are highly tied to their primary prey item, black-tailed deer/mule deer (Chapman and Feldhamer 1982). In Washington, elk may also be an important part of the cougar diet. In an area in central Washington where deer and elk were both abundant, male cougars preyed on elk more frequently than deer, and more than one-third of kills by female cougars were elk (White 2009). 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 2015a).

The RLNRA is within GMU 426, whereas 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 2015a). Data are not provided by GMU. Cougar density and distribution within the RLNRA are unknown, 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 North Cascades Institute (NCI) staff also occasionally observe cougar within the Project Boundary, including in and near the townsites and generation facilities.

Black Bear

The black bear is the most commonly observed large carnivore in the Project Boundary. Black bears 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 2015a). 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 2015a). 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 forest carnivore study in the North Cascades National Park Complex using remote wildlife cameras indicates 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 Interstate 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 Environmental Learning Center (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. All occupied houses in the towns and other buildings have bear-resistant trash cans.

Beaver

The American beaver is a keystone species, exerting a disproportionately large effect on its environment in its role as an "ecosystem engineer." The presence of beavers in watersheds affects not only the types and numbers of many terrestrial and aquatic plant and animal species, but also maintains the dynamic nature of channel form and watershed hydrology. Beaver dams provide many ecosystem services, including raising the groundwater levels and increasing riparian habitat, instream habitat, and retention of organic matter (Johnston and Naiman 1987; Naiman et al. 1988), and improving water quality (Pollock et al. 2018).

Comprehensive data on beaver distribution and abundance within the Project Boundary are lacking. However, sources of information include incidental observations of various signs of beaver occurrence. In addition, habitat suitability for beavers can be modeled by the hydrogeomorphic, or underlying intrinsic physical conditions of streams, suitable for beavers to occur. According to MacFarlane et al. (2014), there are five primary habitat conditions necessary for beaver dam occurrence: (1) a perennial water source; (2) availability of forage and dam building materials (woody deciduous vegetation); (3) ability to build a dam at baseflow; (4) likelihood of dams to withstand a typical flood; and (5) likelihood that the stream gradient would not limit or eliminate dam building by beavers. A beaver intrinsic potential (BIP) model predicts where beavers can likely exist within a watershed given the ability of beavers to modify variable habitat characteristics, such as vegetation density and type.

Downstream of Gorge Powerhouse, there are several constructed Chum Salmon spawning channels where beavers have been attempting to construct dams. The spawning channels have been constructed in areas where spring-fed, hyporheic flows, and groundwater sources provide perennial flow. Potential low water in the Skagit mainstem could reduce or temporarily cut off connectivity to these channels but would not be effective in dissuading beavers from inhabiting them. 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 changes in the state law (Revised Code of Washington [RCW] 77.32.585) now allow 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.

Beaver Habitat Assessment

In support of relicensing the Project, City Light conducted the TR-09 Beaver Habitat Assessment to characterize habitat conditions for beaver within the Project vicinity, summarize information on beaver occurrence, and provide information that can be used to address the ongoing issues from beaver dams and modification of habitat at the Project's Chum Salmon spawning channels (TR-09 Beaver Habitat Assessment Interim Report; City Light 2022f). Additional information about the beaver observations from 2022 relicensing study fieldwork, including in the Stillaguamish watershed, will be provided in the Updated Study Report (USR) and FLA.

The study area for the TR-09 Beaver Habitat Assessment covered the entire Project Boundary, including the transmission line ROW and fish and wildlife mitigation lands plus a two-mile buffer. This study also summarized the beaver habitat in the general vicinity of the spawning channels funded by City Light as well as past beaver and beaver dam management activities. These channels include the Newhalem and County Line Ponds, Park Slough, and the Taylor, Powerline Pond, and Illabot spawning channels Figure 4.2.5-8).

Beaver habitat potential was assessed in the study area. The study indicated suitable habitat is largely absent on Ross Lake and its tributaries, with the notable exception of Big Beaver Creek where beaver dam complexes occur beginning approximately 0.75 miles upstream from Ross Lake. The margins of Diablo Lake and Gorge Lake offer limited suitable habitat along the shoreline and side channel, including the area near the Diablo townsite, but the surrounding steep hillslopes have high gradient, narrow drainages unsuitable for beaver. Tributaries upstream of Marblemount were generally too steep and had ravine-like characteristics unsuitable for beaver habitat. The area with highest quality beaver habitat in the Skagit watershed is between Marblemount and the Sauk River confluence. The mainstem Skagit River and channel migration zone (CMZ) do not provide high quality habitat for beavers. Beavers can live in banks of large rivers provided they have good access to forage. Beavers in large rivers can also occur as transients, such as dispersing juveniles in search of available suitable tributary habitat. The more channelized portions of the Skagit River have few connections to low gradient side channels and, therefore, offer less habitat for beavers. The establishment of beavers can help maintain water levels in side channels and tributaries by slowing flows and retaining groundwater, and creating habitat for many aquatic species, including juvenile salmon. However, these same habitat features created by beaver activity can be detrimental to suitable salmon spawning habitat in these low gradient tributaries.

Within the Project Boundary itself, there was a total of 143.2 miles of mapped stream segments by the BIP model. Of these, 8 percent were mapped as having high, 5 percent moderate, 18 percent low, and the remaining 69 percent no intrinsic potential (Table 4.2.5-10). The percent of mapped stream length that was ranked moderate or high in the BIP model was the primary determinant of the study area segment ranking. Vegetation cover mapping was limited to the TR-01 Vegetation Mapping Study area and does not completely cover the extent of the TR-09 Beaver Habitat Assessment study area but offers a general assessment within the area covered (City Light 2022f). The dominant land use is an important consideration but is generalized at this scale and would need to be evaluated more closely and specifically at potential individual sites if and when future beaver relocation or restoration is considered.

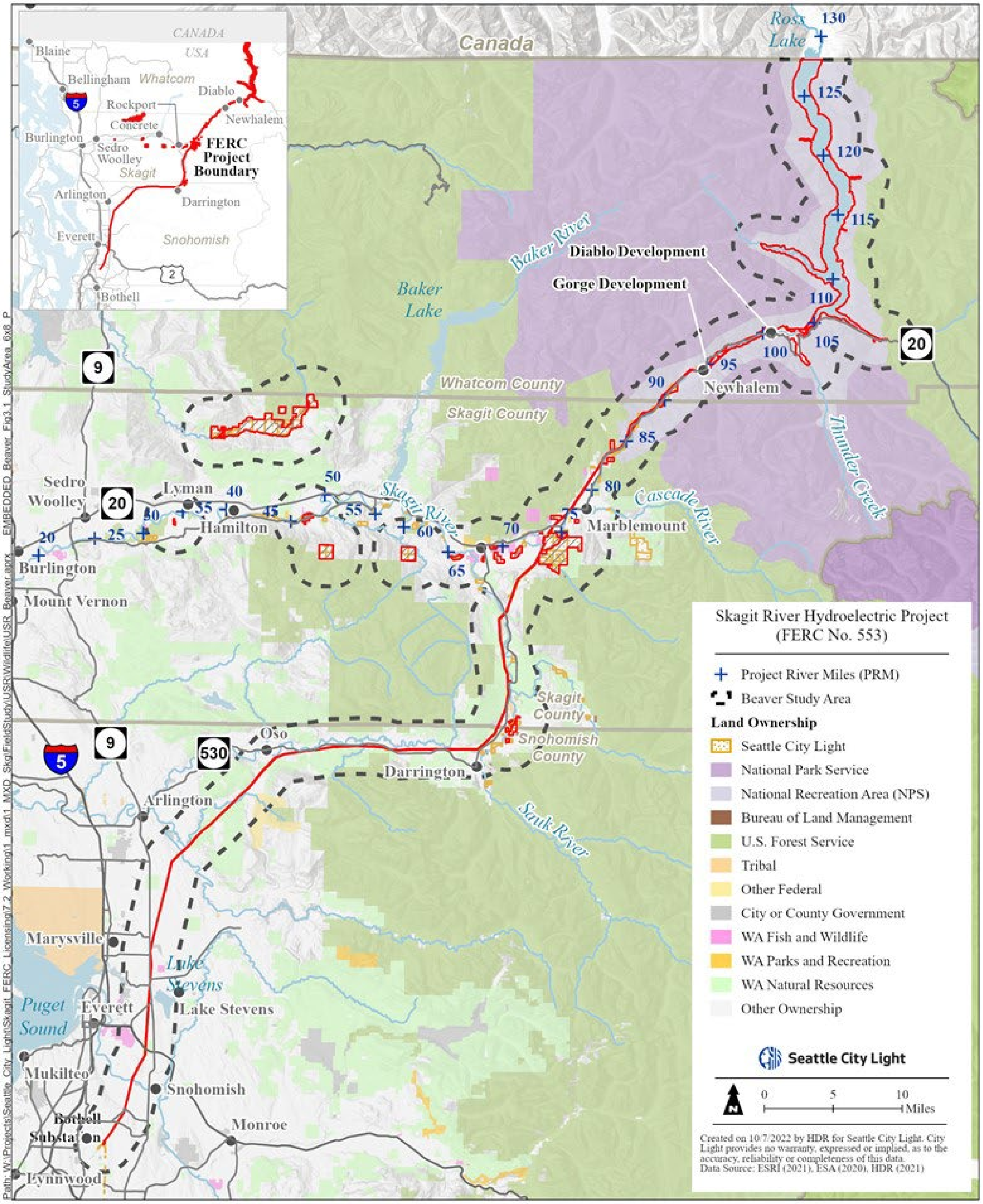


Figure 4.2.5-8. Beaver Habitat Assessment study area.

Table 4.2.5-10. Summary of the percentage of BIP[1] and vegetation scores for study area segments.

Study Area Segment	Percent Stream Length Classified as Moderate or High BIP	Vegetation Cover	Relative Potential for Beaver
Ross Lake	1	Low	Low
Diablo to County Line	3	Low	Low
Skagit Mainstem	4	Moderate	Low
Skagit Confluence	12	High	High
Skagit Downstream	3	Low	Low
Nooksack Wildlife Mitigation Lands	1	Low	Low
Savage Slough and Pressentin Mitigation Lands	5	Low	Low
Day Creek Slough Mitigation Lands	35	Moderate	High
Sauk River	14	High	High
South Fork Stillaguamish	19	Moderate	High
North Fork Stillaguamish	12	Moderate	Moderate

1 BIP scores are percentage of length of stream of each category within total mapped stream length in each study area segment.

The distribution of observed beaver locations was concentrated between the Sauk River confluence and County Line Ponds. Upstream of this area beaver and beaver sign sightings tended to be along the Skagit River itself or within small side channels and tributaries along the valley bottom, including the constructed spawning channels. Along the transmission line ROW, there were only 6 observations: 3 in the South Fork Stillaguamish drainage and 3 at the south end by Lake Stevens.

The County Line, Illabot, Taylor and Newhalem Ponds spawning channels all had significant beaver activity, requiring dam and woody debris removal, compared to relatively infrequent activity at the Powerline channel. For example, a total of 51 dams and/or woody debris jams were removed over 15 years at County Line Ponds, and removals occurred in 12 of 15 years. County Line and Newhalem Ponds also experienced an increase in beaver activity in recent years; Newhalem Ponds fluctuated between some years with dams observed, and others with none. The low level of activity at the Powerline channel (15 dams and/or woody debris material removed) is likely due to the tendency for beavers to target the location near the confluence with the Skagit River where flowing water is present at the location of the fish ladder, and because beaver exclusion structures have been put in place.

At culverts and the Powerline fish ladder, installation of beaver exclusion fencing (6-inch wide and 8-inch-tall openings) with complete coverage of the bottom and top of the exclusion cage was an effective means of preventing beaver damming within the exclusion while providing safe and effective adult Chum and Coho passage. As demonstrated in a past study at Illabot spawning channel, the placement of a fish ladder and pond leveler structure did not appear to alter beaver behavior as it inadvertently became a targeted area for dam construction (Hall and Shannahan

2009). Therefore, installation of a fish ladder and beaver exclusion structure may only be appropriate where beaver typically construct a single dam within a channel. Ideally, a beaver control device would reduce the construction of additional dams within the Powerline channel upstream of the control site by maintaining water levels similar to those desired by beaver. The incorporation of a fish ladder that is passable to all life stages of salmonids but not accessible to beaver (similar to that constructed at the Powerline channel) would provide access upstream for spawning adults as well as juvenile access to valuable pool rearing habitat.

4.2.5.2 Environmental Analysis

This section addresses known, suggested, or plausible potential effects[84] of the Project on wildlife resources, including effects associated with Project O&M and recreation. This section analyzes the potential effects primarily as identified in FERC's Scoping Document 2 (SD2) on: (1) ESA-listed species; (2) federal candidate species; (3) other special-status wildlife; (4) reservoir water level fluctuations; (5) wildlife migration and movements; (6) invasive plants on habitat value; and (7) transmission line bird collision or electrocution hazard. A final issue identified in SD2, the adequacy of existing management plans for the fish and wildlife mitigation lands, is addressed under Proposed Resource Measures.

The analyses below focus on routine operations and activities associated with Project O&M and recreation. Currently, the proposed action includes no significant alterations to Project facilities or other Project operations. Non-routine Project O&M activities that may occur during the new license period will be evaluated for permitting needs, including any additional effects on ESA-listed and other special-status wildlife species.

The existing resource measures such as management of mitigation lands, education funds, and wildlife research grants may provide positive benefits to wildlife species, including the ESA-listed, federal candidates, and other special-status species discussed below.

Finally, it should be noted that as protection, mitigation, and enhancements (PMEs) are further developed, anticipated impacts (if any) to each species from implementation of such PMEs will be discussed in the FLA as appropriate.

Effects on ESA-Listed Species

Effects of existing and any potential changes to project facilities or operations on grizzly bear, Canada lynx, northern spotted owl, marbled murrelet, streaked horned lark, yellow-billed cuckoo, and Oregon spotted frog, which are federally listed as threatened; (FERC SD2).

Effects of existing and any potential changes to project facilities and operations on designated critical habitat for marbled murrelet, and northern spotted owl (FERC SD2).

Grizzly Bear

The grizzly bear is considered functionally extirpated in the North Cascades Ecoregion, a vast region in which a very small number of grizzly bears may persist, and the species' status is

[84] City Light anticipates providing a draft Biological Assessment with the FLA. Effects statements and findings for wildlife species, including ESA-listed species, are preliminary and subject to further informal consultation with federal resource agencies.

unexpected to improve without artificially increasing the number of bears through reintroduction, an action not currently proposed or under consideration. Because there have been so few recent documented occurrences of the species anywhere in the Ecoregion, and these mostly north of the international border, an analysis of potential Project effects is largely speculative. Notwithstanding, under current and foreseeable conditions, the occurrence of individual grizzly bears within the Project vicinity is likely to be an exceedingly rare and perhaps transitory event.

Grizzly bears use various habitats seasonally, including forests and meadows from low to high elevations and individual bears range over very large areas. Potentially, grizzly bears could occur in the region surrounding the Project within the RLNRA. The operation of the Project (i.e., operations of the reservoirs, management of large woody material, and other maintenance activities) will not affect grizzly bear. Project related recreation, including boating, camping, fishing, and other activities, will not have an effect on grizzly bear. Furthermore, existing measures to minimize conflicts with black bear (e.g., bear-proofing food and garbage at campsites, and providing recreationists with information on safe practices around bears) would also minimize any potential conflicts with grizzly bears.

Gray Wolf

Lone gray wolves or small packs have been detected at times in the Project Boundary or close vicinity in at least two areas, at the north end of Ross Lake near the U.S.-Canada border and in the general area between Marblemount and Diobsud Creek. There are currently no known resident breeding pairs or resident packs, but these could occur in time. Wolves are capable of traveling long distances, especially during dispersal from natal areas when wolves are in search of mates. Dispersal occurs both within and between populations, crossing international and state borders, and across areas with different land uses and habitats. Models of wolf habitat suitability summarized by Wiles et al. (2011) vary in their conclusions regarding the extent of potential wolf habitat in the North Cascades; one of these models suggests that the North Cascades may represent "sink" habitat, related to the low availability of elk compared to areas in eastern Washington where wolf populations are growing more rapidly, and may be unable to support a population without periodic inflow from other areas that are a source of dispersing individuals. Nonetheless, wolves in the North Cascades are regarded as important to the overall recovery of the species. Authorized, legal killing to resolve wolf-livestock conflicts and illegal killing are impediments to wolf recovery in Washington, although not known to be a factor in the North Cascades at this time.

The operation of the Project will not affect gray wolf. The only livestock grazing that occurs on mitigation land is on a portion of the recently acquired Corkindale Creek property, where haying and grazing are used to help control weeds until a new Wildlife Mitigation Lands Management Plan is developed. While a radio-collared wolf was reported on at least one occasion near the property, no wolf-livestock conflicts have occurred on City Light property and therefore there have been no wolf-livestock conflicts associated with the Project.

Canada Lynx

According to the most recent Species Status Assessment (USFWS 2017), the only confirmed resident breeding population of Canada lynx in Washington is in the Okanogan region in an area of subalpine forests where elevations exceed 3,600 feet, comparable to the boreal forests where most Canada lynx in North America occur. As noted above, species closely associated with subalpine habitats are largely absent from the Project vicinity, where the Project Boundary does not exceed 2,000 - 2,432 feet elevation, except on a few of the fish and wildlife mitigation lands that reach 3,632 to 4,040 feet elevation. The Project does not contain suitable habitat to support Canada lynx. There is no designated critical habitat for the Canada lynx within the Project vicinity.

The only known occurrences of Canada lynx are occasional reports of individual lynx, most likely animals in dispersal or searching for prey when snowshoe hare populations in occupied habitats undergo cyclic declines. Continued operation of the Project will not affect Canada lynx.

Northern Spotted Owl

Based on information on past detections and survey results as recently as 2010 and patterns of distribution of suitable habitat, NSO may occur in the Project vicinity, but in few locations. The results of the TR-10 NSO Habitat Analysis study suggest that the amount of potential suitable NRF habitat in the Project vicinity is concentrated in the RLNRA, primarily around Ross Lake and Diablo Lake, where a total of about 1,620 acres were modeled as "suitable," of which 961 acres are "highly suitable." Although modeled suitable habitat may not be occupied, it represents potential habitat, whereas unsuitable habitat is unlikely to support NSO. The most recent surveys of five known NSO activity centers near the Project (all one mile or more away from Project reservoirs, none from within the Project Boundary), detected NSO at only one of the sites.

Regardless of occurrence, continued operation of the Project may affect, but not likely to adversely affect NSO. Forested habitats modeled as suitable for NSO are unaffected by vegetation management, operation of the Project reservoirs, or Project-related road use. Limited Project-related helicopter use, if near to occupied habitat, could be a source of temporary noise disturbance to NSO. However, City Light's existing and ongoing helicopter noise protection measures are designed to avoid disturbance in sensitive areas.

Transmission line collisions or electrocution have a limited potential to affect avian species in the Project Boundary; however, most of the potentially suitable NSO NRF habitat is concentrated in areas where there are no Project transmission lines. NSO outside of suitable habitat areas (e.g., owls that are dispersing) could encounter Project transmission lines, although transmission line collisions or electrocution have not been identified as a threat to NSO (USFWS 2004, 85 FR 81144). The Project also does not affect designated critical habitat for NSO, which does not occur within the Project Boundary.

Marbled Murrelet

Multiple active and historical marbled murrelet nest sites have been documented near the Project transmission line ROW between Marblemount and Darrington, between Darrington and Arlington, and near City Light fish and wildlife mitigation lands southwest of Rockport, although there are no known occurrences within the Project vicinity (WDFW 2021a). The Project Boundary does not contain any designated critical habitat for marbled murrelet. There have been no verifications of nesting on the Project, but marbled murrelet-type targets have been detected by radar downstream of Gorge Lake. There was also one observation in 2017 of a pair of marbled murrelets on Ross Lake near Roland Point, 4.7 km (2.9 miles) northeast of Ross Dam. The TR-05 Marbled Murrelet Study indicates with high confidence that a very small number of marbled murrelets are likely using the upper Skagit River, Diablo Lake, and Ross Lake waterways as travel corridors to transit through the Project, but it is unlikely that murrelets are nesting in the Project vicinity. This conclusion is supported by the types of flight paths detected by radar, which did not include any circling flight paths by murrelet-type targets, which are good indicators of nearby nesting activity.

The Murrelet Habitat Model found the greatest proportion of potentially suitable nesting habitat around Ross Lake and Diablo Lake, which are at the far inland extent of the known range for the marbled murrelet. Potentially suitable nesting habitat is most scarce and patchily distributed in areas along the transmission line ROW segments from Oso to the Bothell Substation.

Minimal effects to marbled murrelet are expected as a result of continued Project operations as currently licensed. Electrocution and transmission line collisions have the potential to affect avian species in the Project Boundary, which is minimized through City Light's avian protection measures. Limited Project-related helicopter use in the Project vicinity may also cause temporary disturbance to marbled murrelet, although this is minimized through City Light's helicopter noise protection measures.

Regardless of occurrence, continued Project operations as currently licensed is unlikely to adversely affect marbled murrelet. Forested habitats modeled as suitable for marbled murrelet are unaffected by vegetation management, operation of the Project reservoirs, or Project related road use. Limited Project-related helicopter use, if near to occupied habitat, could be a source of temporary noise disturbance to nesting marbled murrelet. However, City Light's existing and ongoing helicopter noise protection measures are designed to avoid and minimize disturbance in sensitive areas.

Streaked Horned Lark

The streaked horned lark was identified in FERC's SD2 for environmental analysis. However, the Project is outside the current known range of the species, which extends south from the south part of Puget Sound, and suitable habitat does not occur. The streaked horned lark is a rare subspecies found only in parts of western Washington and Oregon primarily in remnant prairie habitats, and similar habitats such as airport grassland, dredge spoils in the lower Columbia River, marine beaches, and similar sparsely vegetated areas in the south Puget Lowlands. The streaked horned lark is currently known to breed at up to 17 locations in Washington; eight in the southern Puget Sound region; six sites on the outer coast; and four on islands and shore sites along the Columbia River (Stinson 2016). There are no reports of the streaked horned lark in the Project vicinity, and this species is unlikely to occur. Therefore, continued operation of the Project will not affect streaked horned lark.

Yellow-Billed Cuckoo

The yellow-billed cuckoo has been functionally extirpated in Washington since at least the 1940's, and there is no recent evidence of the species continuing to breed in the State (USFWS 2021). The few sightings recorded in Washington since the 1950s (most of which were in eastern Washington) were all likely non-breeding vagrants or migrants. Breeding habitat is generally associated with large tracts of riparian, deciduous forest. Riparian deciduous or mixed conifer-deciduous forests occur on some of the Project fish and wildlife mitigation lands (e.g., parcels in the Skagit River floodplain) and may develop more suitable habitat characteristics as these forests mature, but there is no evidence to suggest that yellow-billed cuckoo is likely to recover as a breeding species in western Washington. Therefore, continued operation of the Project will not affect yellow-billed cuckoo.

Oregon Spotted Frog

There are no known occurrences of the Oregon spotted frog within the Project Boundary, and none of the watersheds or sub-basins associated with the Project are currently regarded as occupied by the species. Historical occurrences nearest to the Project, which are considered extirpated, were near the confluence of the Skykomish and Snoqualmie rivers three miles south of Monroe in Snohomish County (based on a 1939 museum collection record) and two miles northwest of Concrete within the lower Skagit River sub-basin about five RMs downstream of the Sauk River confluence (1930 museum collection record) (McAllister et al. 1993; Hallock 2013). Oregon spotted frog occurrences in the South Fork Nooksack River watershed are restricted to low elevation, low gradient tributaries of the lower South Fork Nooksack, and there is no suitable habitat on the fish and wildlife mitigation lands around the upper South Fork Nooksack River. City Light's TR-08 Special-Status Amphibian Study identified no areas of suitable habitat along the Project transmission line ROW. Wetlands associated with the Project reservoirs are also not generally suitable and are outside of the known range of the species. Spotted frogs found in Big Beaver Valley west of Ross Lake have been identified by genetic analyses as Columbia spotted frog. The spotted frogs found at the north end of Ross Lake, for which genetic analyses have not been completed, are also likely Columbia spotted frog. Therefore, continued operation of the Project will not affect Oregon spotted frog.

Effects on Federal Candidate Species

Wolverine

Available information suggests that occurrences of wolverine in the Project vicinity are likely to be rare and, perhaps, transitory events. Wolverines are wide-ranging animals mostly using habitats at higher elevations than prevail within the Project, but are known to sometimes travel through lower elevation areas. Project operations as currently licensed are expected to have no foreseeable effect on these occasional occurrences. Project-related recreation, including boating, camping, fishing, and other activities, are also unlikely to affect individual wolverines, which generally avoid areas of human activity and tend to reside in alpine areas above Project elevations during the summer recreation season. Therefore, continued operation of the Project will not affect wolverine.

Monarch Butterfly

The breeding range of monarch butterfly does not include any areas in western Washington, although individual monarch butterflies could occur rarely in the Project vicinity during migration or as vagrants. The Project vicinity does not support the food plant required by monarch butterfly (i.e., milkweed species) and most of the factors which continue to cause declines in monarch butterfly populations are inapplicable. Although vegetation management could rarely affect individual monarch butterflies, overall Project activities are not expected to have a measurable effect on the species or its habitat. Therefore, continued operation of the Project will not affect monarch butterfly.

Effects on Other Special-Status Wildlife Species

Fisher

The fisher occurs as a reintroduced species in Washington and the population, which continues to be supplemented by translocated animals, is expected to increase. The Project vicinity overlaps the Northwestern Reintroduction Area of the North Cascades Recovery Area for fisher, which extends from SR 20 to the Big Beaver Valley. As such, fishers may occur in the Project vicinity now or in the near future. Overall, existing Project O&M and recreation activities have a limited potential to affect fisher, particularly in forested habitats around the Project reservoirs, where hunting is limited and trapping is prohibited and where vegetation management is limited to the immediate vicinity of formal recreation sites, including trails, campgrounds, and boat launches. Project O&M also has little or no effect on fisher prey species. Therefore, continued operation of the Project will not affect fisher.

Townsend's Big-eared Bat and Little Brown Bat

Townsend's big-eared bat is an uncommon but poorly documented species. There are no known occurrences at Project facilities or elsewhere within the Project Boundary. Potential roost sites for this species include rocky outcrops and crevices, trees, and buildings or other structures associated with Project facilities, townsites, and recreation areas. Little brown bat is currently regarded as a common species in Washington and is likely distributed throughout the Project vicinity, where day roosts may occur in buildings and other structures, caves, mines, rock crevices, tree cavities, and beneath tree bark, and maternity roosts are often associated with building attics.

Although these two species differ in roosting behavior and likelihood of occurrence, considerations of potential effects are similar. Existing Project O&M and recreation activities could affect individual roosting Townsend's big-eared bats or little brown bats, which are more likely to be undetected than colonial maternity roosts. Townsend's big-eared bat is particularly sensitive to various disturbances and can be directly or indirectly affected by human activities at roost sites. Sources of disturbance to either species could include periodic vegetation management and hazard tree removal. However, vegetation management occurs within specific existing footprints at town sites, dams, powerhouses, transmission and distribution ROWs, materials storage areas, and along access routes. Since vegetation management has been ongoing through the life of the Project, the vegetation in managed areas is already expected to be disturbed and not preferred habitat for bats. Therefore, impacting maternity roosts through vegetation removal or management would be very unlikely.

Ongoing maintenance is generally minor and would not be anticipated to impact maternity roosts that were already present in a structure where human activity is common. Bat removal from the attics of residential houses occasionally occurs within townsites in the Project Boundary and leads to temporary disturbances of individuals in solitary roosts. Past removals have involved species of *Myotis*. Yuma myotis was most common in Newhalem house attics as observed by City Light biologists. BMPs are implemented for bat removal so exclusion occurs when bats are absent during fall-winter.

Year-round recreation effects on bats roosting in trees or rock crevices are also limited to the disturbance of occasional individuals within a small buffer around recreational facilities. Similarly, possible effects to bat foraging habitats within the Project vicinity are limited to areas of vegetation management. Like all other potential Project O&M effects, night-time lighting would be confined to Project facilities, townsites, and recreation areas. These areas have been developed for many years and bats are likely habituated to this night-time lighting. There are no proposed changes to facilities or Project O&M that would cause a change in lighting.

Therefore, Project activities may affect individual bats but are not likely to adversely affect Townsend's big-eared bat or little brown bat or the habitat of either species.

Common Loon

Existing Project O&M and recreation activities have a limited potential to affect common loons that use Ross Lake as non-breeding habitat (i.e., foraging or resting), which likely includes loons that nest at Hozomeen Lake east of the Project. Common loons are most sensitive to human disturbance where they breed. Non-breeding occurrences may be temporarily disturbed by passing boats or other associated recreation activities. However, irregular use of Ross Lake or the other two Project reservoirs by common loons during migration or in the post-breeding period does not suggest that any measures to restrict recreation activities are warranted. Overall, recreation on the Project likely represents an intermittent and relatively minor source of disturbance to common loons that does not have a significant effect.

Harlequin Duck

Available information indicates that harlequin duck may occur along some rocky, fast-flowing tributaries of the Project reservoirs, where suitable breeding habitat occurs, but that the Project reservoirs themselves do not support this species. Electrocution and transmission line collisions have the potential to affect avian species in the Project Boundary, which is minimized through City Light's avian protection measures, however, there is only one record of a harlequin duck collision mortality with transmission lines in the literature (Robertson and Goudie 1999), and there are no high-concentration areas of harlequin ducks in the vicinity of the Project transmission line ROW. Additionally, City Light attempts to maintain a riparian buffer around larger streams by limiting vegetation management within the buffer, although depending on topography and underlying ownership individual trees may be removed or trimmed occasionally as necessary. This limits the impacts of vegetation management on potential harlequin duck habitat in areas where the buffer is maintained. Project recreation is centered on the Project reservoirs where harlequin duck is not expected to occur. Existing trails and campgrounds in the Project vicinity that are near fast flowing streams represent limited areas where vegetation management and concentrated recreation activities have occurred for many years. Therefore, no effects to harlequin duck are expected as a result of continued Project operations as currently licensed. Therefore, continued operation of the Project will not affect harlequin duck.

Peregrine Falcon

There are seven known peregrine falcon nesting territories within or near the Project Boundary from Ross Lake to Newhalem, although all the nest sites may not be currently occupied. The eyries are in locations generally remote from sources of disturbance (i.e., on steep, inaccessible cliffs), except possibly by noise or close approach by aircraft. None are affected by vegetation management.

Limited Project-related helicopter use, if near to occupied habitat, could be a source of temporary noise disturbance to nesting peregrine falcon. However, City Light's existing and ongoing helicopter noise protection measures are designed to avoid disturbance in known sensitive areas and flight paths avoid falcon nests. Therefore, continued operation of the Project is unlikely to adversely affect peregrine falcon.

Northern Goshawk

Available information suggests there may be northern goshawk nesting in the Project vicinity, although there are no documented occurrences and nests may be in areas not subject to Project O&M (for example, in forested areas around the Project reservoirs where there is no vegetation management).

Existing Project O&M and recreation activities have a limited potential to affect northern goshawk. Goshawks, especially during the breeding season, may be disturbed by loud, abrupt noises, close approach, or other intrusive activities near nest sites. This suggests that goshawks nesting activity could be disrupted near existing project facilities, roads, and recreation areas where vegetation management or hazard tree removal is required. However, there are no known northern goshawk nests in these areas nor an expectation that northern goshawks would nest in vegetation management areas that are regularly disturbed. A juvenile northern goshawk collided with a window at the Diablo Powerhouse and died in 2014. Electrocution, transmission line strikes, and building collisions have the potential to affect avian species in the Project Boundary, including northern goshawk, which is minimized through City Light's avian protection measures.

Limited Project-related helicopter use, if near to occupied habitat, could be a source of temporary noise disturbance to nesting goshawks. However, City Light's existing and ongoing helicopter noise protection measures are designed to avoid disturbance in known sensitive areas. Therefore, continued operation of the Project may affect, but is unlikely to adversely affect northern goshawk.

Bald Eagle

Bald eagles have been documented nesting in locations around Ross Lake, using the Skagit River downstream of the Project in winter, and using areas near Illabot Creek and Bacon Creek in winter as communal roosts. Three bald eagle nests (two active) occur within the Project Boundary on Ross Lake: north of Little Beaver Creek, at Dry Creek, and at Roland Point. Two other bald eagle nest sites occur near fish and wildlife mitigation lands along the Sauk River. Bald eagles aggregate in winter communal roosts, which partially overlap the Illabot fish and wildlife mitigation lands.

Existing Project O&M and recreation activities have a limited potential to affect bald eagle. Limited Project-related helicopter and boat use as well as foot traffic, if near to occupied habitat, could be a source of temporary noise disturbance to nesting bald eagles. Project O&M at some storage areas may generate short-term disturbance to wintering eagles. City Light's existing and ongoing helicopter noise protection measures, and access limitations in bald eagle nest protection zones and are designed to minimize disturbance in sensitive areas during nesting periods.

Transmission line collisions or electrocution have a limited potential to affect avian species in the Project Boundary. City Light has installed markers in 2001 and 2021 on the Project transmission line in several locations to reduce risk of avian collisions by waterfowl or bald eagles. 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. After conducting monitoring studies, 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.

Golden Eagle

Available information suggests that golden eagles may occur in very low numbers in the Project vicinity during fall migration and even less frequently nest in the North Cascades. Apparently suitable golden eagle nesting habitat in the Project vicinity is mostly limited to the area between Newhalem and Ross Dam, associated with rugged, mountainous topography with cliffs, barren slopes, and forest openings.

Existing Project O&M and recreation activities have a limited potential to affect golden eagle. Migrating golden eagles could be at risk flying though unfamiliar areas with intersecting powerlines. However, there is no evidence that the Project transmission lines pose a collision hazard for golden eagles, and there have been no documented golden eagle collisions or evidence of possible collision mortality.

Golden eagles are unlikely to nest near existing project facilities, roads, and recreation areas where vegetation management or hazard tree removal may occur. Limited Project-related helicopter use, if near to occupied habitat, could be a source of temporary noise disturbance to nesting golden eagles. However, City Light's existing and ongoing helicopter noise protection measures are designed to minimize disturbance in sensitive areas.

Western Toad

Western toad occurs at multiple locations at Ross Lake and at the County Line Ponds and Newhalem Ponds. Habitats at the two latter City Light-owned properties include permanent ponds that are a byproduct of extraction of aggregate used for Project construction. No Project activities currently occur at the County Line Ponds. Parts of the Newhalem Ponds parcel continue to be used for material storage and a spawning channel developed as a fish mitigation measure that requires periodic maintenance. There are no other Project activities at Newhalem Ponds that could affect western toad.

At Ross Lake, western toad breeding sites have been identified by City Light at the Dry Creek inlet and Jerusalem Island pool; and other evidence indicates breeding somewhere at the Roland Point inlet and at one or more locations at the north end of Ross Lake. Except at the Jerusalem Island pool, where there were developing eggs and hatchlings on May 4, 2022, breeding occurred or is presumed to occur in late June or in July under typical current operations, when reservoir water levels are approaching the normal maximum water surface elevation. Because toads usually breed in relatively shallow water, which may provide optimal water temperatures for developing eggs, the timing of breeding relative to water surface elevation and the stage of reservoir filling could affect subsequent embryonic development or hatching time. However, published reports of western toad breeding at other reservoirs that operate similarly (Hawkes and Tuttle 2013; Schuett-Hames and Blessing-Earle 2021), suggest that western toad successfully exploits breeding sites over a range of elevations. This is also illustrated by western toad breeding at the Jerusalem Island pool, where suitable conditions for breeding develop much earlier. The latter pool is not connected to Ross Lake until water surface elevation is about 1,600 feet (NAVD88), by which time western toad eggs have long since hatched. The western toad breeding location at the Dry Creek inlet in 2022 was at approximately 1,606 feet (NAVD88) elevation, and water depths where toads were active on July 1 ranged from 0.5 to 2.5 feet.

Western toads at Ross Lake may also be affected by the storage and management of large woody material. Woody material is gathered and stored in log pens at multiple locations to prevent boating hazards that would otherwise occur. Although night observations at the north end of Ross Lake indicate that adult western toads use habitats with large amounts of floating woody material upon which they perch and likely forage at night, the wood may limit suitable oviposition sites or have other undesirable effects. In addition, large amounts of stored wood likely restrict the establishment of native wetland vegetation in storage areas. City Light is currently reviewing options to protect or enhance potential western toad breeding habitat that are consistent with necessary large woody material management.

Columbia Spotted Frog

Frogs tentatively identified as Columbia spotted frog occur at the north end of Ross Lake, the only area on Ross Lake identified as potentially suitable for this species. Seasonal, non-breeding habitat occurs on the northwest side of Ross Lake and is presumably associated with breeding habitats somewhere north of the international border. SEEC-sponsored amphibian surveys north of the border in 2023 are expected to provide more information regarding these breeding habitats, allowing for analyses of potential effects of Project operations. Columbia spotted frog egg masses were found by City Light surveys at a flooded borrow pit just south of the border on the northeast side of Ross Lake, the only location with suitable habitat. This limited occurrence is consistent with published reports of Columbia spotted frog breeding in permanent ponds near the normal maximum water surface elevation at other reservoirs (Hawkes and Tuttle 2013; Swan et al. 2015). Pools lower in the drawdown zone that are inundated by May or early June are unsuitable habitat for Columbia spotted frog and are likely avoided. Similarly, suitable lake fringe habitats do not occur when this species breeds.

The information developed by City Light's TR-08 Special-Status Amphibian Study suggests that Project operations governing water levels at Ross Lake are and have been compatible with occurrence of a population of Columbia spotted frog. Suitable breeding conditions at the breeding pool on the northeast side of Ross Lake develop during the seasonal drawdown, and eggs hatch well before the pool is affected by the rising reservoir water level.

Columbia spotted frogs at Ross Lake could be affected by storage and management of large woody material. Although accumulated driftwood was present at the site on the northwest side of Ross Lake, the area where the frogs occurred was not within one of the log pens where woody material is stored. However, the large storage pen north of the border could more directly affect Columbia spotted frog, particularly if there is a breeding site nearby. As indicated above, the SEEC-sponsored amphibian study should help address Project effects issues north of the border. Similarly, development of any coordinated management plans for reed canarygrass in the area surrounding the breeding pool on the northeast side of Ross Lake must consider possible effects on Columbia spotted frog.

Effects of Reservoir Fluctuations

Effects of continued or modified project operations, including reservoir fluctuations, on littoral, wetland, emergent, and riparian habitats and associated wildlife, including wetland-dependent birds and amphibians (FERC SD2).

Reservoir fluctuations have a limited potential to affect waterfowl that use Project reservoirs or wetlands associated with reservoirs as foraging habitat. Canada geese, common mergansers, and common loons are frequently observed foraging on Ross Lake. Common merganser, Canada goose, and mallard broods have been seen on all three reservoirs. While common loons have been observed on Ross Lake (and occasionally on Diablo Lake), the species does not breed along the reservoir. The large reservoir fluctuation levels likely discourage nesting by loons, which typically nest within five feet of water (Richardson et al. 2000).

Reservoir water level fluctuations may affect pond-breeding amphibians associated with lake fringe emergent wetlands and pools in the drawdown zone at Ross Lake. Water level changes at Ross Lake are mostly associated with the seasonal drawdown during which the lowest water level is, on average, more than 65 feet lower than normal maximum pool elevation. Drawdown normally begins sometime after Labor Day. Typically, the lowest water levels occur in late March or early April, preceding the spring runoff. Because the shoreline of Ross Lake is mostly steep and near-shore areas are deep, wetlands that could be suitable for amphibian breeding are limited to the few areas with gently sloping shorelines and areas with natural or anthropogenic topographic depressions. Pools are associated with borrow pits created when old logging roads were constructed or where these roads impede drainage. Most of these pools are located too deep in the drawdown zone for perennial vegetation, although annuals or other ruderal species may occur.

Five species of amphibians utilize Ross Lake habitats for breeding. (Potential habitats for amphibians at Diablo Lake and Gorge Lake are much more limited and likely support fewer species, which have not been reported to occur.) Amphibian breeding is constrained by multiple factors including the onset of warming in spring sufficient to trigger the start of breeding, the duration of conditions subsequently suitable for larvae, and the flexibility in life history characteristics of each species (Table 4.2.5-11). Eggs deposited in shallow margins may also be exposed to increasingly deep and colder water as the reservoir fills, which may slow development. Larvae of some species may also be at risk when separate pools in the drawdown zone are inundated by rising reservoir water levels. In addition to temperature changes and increased turbulence, inundation allows access by predatory fish.

Table 4.2.5-11. Characteristics of pond-breeding amphibians that may affect habitat use at Ross Lake.

Characteristics	Long-toed salamander	Northwestern salamander	Pacific chorus frog	Western toad[1]	Columbia spotted frog[1]
Early breeding only	Early April[2]	Mid-April	-	-	Mid-April
Early or late breeding	-	-	April to July	April to July	-
Minimum larval period to metamorphosis	~50 days	At least one full season, and usually not until second year	45 days	45 days	70 days or more
Other characteristics	Not aquatic after metamorphosis	Adults may be terrestrial or remain aquatic	Not aquatic after metamorphosis	Not aquatic after metamorphosis	Aquatic after metamorphosis

Sources of information: Pilliod and Fronzuto 2005, Rorabaugh and Lannoo 2005, Shaffer 2005, Rombough 2012.

1 See species accounts for western toad and Columbia spotted frog in Section 4.2.5.1, State Listed and USFS Special-Status Species sections.

2 Estimated.

Generally, those species that breed early, grow and develop quickly, and can metamorphose at a small size may successfully exploit at least some habitats in the drawdown zone. As such, sites with conditions that promote rapid growth and development (e.g., pools with warmer water) are more likely to be used. Long-toed salamander is the earliest breeding species in the area and best exemplifies this strategy. Another favorable attribute is the ability to breed later in the season and thereby use habitats that do not develop until June or July. Western toad and Pacific chorus frog may breed in spring soon after post-winter emergence or breed much later. Both species are also capable of rapid larval development and metamorphosis at a very small size. Northwestern salamander is an early breeding species but grows and develops slowly. However, northwestern salamanders are successful in permanent ponds and lakes where larvae regularly overwinter before metamorphosing. In addition, northwestern salamanders may mature in a gilled form (i.e., paedogenesis), remaining aquatic, even in habitats with fish. Columbia spotted frog is not as flexible as the other species but could exploit sites that are situated near the upper limit of reservoir water surface elevation. These are habitats with perennial vegetation that can provide suitable egg deposition habitat and hiding cover; and allow tadpoles adequate time to reach large size before sites are connected by rising water to the reservoir, if this occurs. However, few habitats of this kind occur at Ross Lake. Pools lower in the drawdown zone that are inundated by May or early June are not suitable habitat for Columbia spotted frog and are likely avoided.

Swan et al. (2015) and Hawkes and Tuttle (2013) found that Columbia spotted frogs only bred in vegetated pools within about 6 feet of normal maximum water surface elevation at two large reservoirs with seasonal drawdowns. This is similar to observed use at Ross Lake, where the only confirmed breeding site south of the international border is less than 5 feet below normal maximum water surface elevation. In contrast, western toads have been reported to use a much wider range of elevations and sometimes used pools devoid of vegetation (Hawkes and Tuttle 2013). Schuett-Hames and Blessing-Earle (2021) observed western toad breeding at different locations as shallow water oviposition sites were each successively flooded by rising reservoir water; the result was a prolonged breeding period with eggs at the earliest breeding sites exposed to increasingly deep, colder water as they developed and hatched. However, the authors concluded that use of diverse breeding habitats by western toad is an adaptive response to unpredictable conditions that may favor early season, mid-season, or late season breeding in different years. At Ross Lake under current operations, western toads at most sites breed late in the drawdown period as water levels are approaching the normal maximum water surface elevation in late June or in July but breed earlier at one site (Jerusalem Island pool) where suitable conditions for breeding develop much earlier. This flexibility in breeding behavior suggests that western toads could likely adapt to operational changes affecting the schedule under which Ross Lake refills.

Effects on Wildlife Migration and Movements

Effects of existing and any potential changes to project facilities, operations, maintenance, and project-related recreation activities, on terrestrial wildlife, habitats and habitat connectivity, wildlife migration and movement, and vegetation communities, including sensitive plants and nesting northern goshawk (FERC SD2).

There is no evidence that the Project isolates wildlife populations or hinders movement, to any significant degree, of wildlife populations. There have been some recent research projects on forest carnivores relevant to this connectivity. Aubry et al. (2012) documented extensive wolverine movement east and north of Ross Lake and into British Columbia where core populations occur. Long et al. (2013) found north and south black bear genetic population segments with a steep gradient near Highway 2, but no evidence of structuring within the vicinity of the Project. They also found no evidence of genetic structuring for marten populations (but sample sizes were small). Previous concurrence letters from USFWS determined that continued routine operation of the Project was "likely to affect, not likely to adversely affect" the grizzly bear and gray wolf (letter from D. Frederick, State Supervisor, USFWS, Olympia, WA, to J. Clement, Acting Director, FERC, Washington D.C., August 10, 1994).

City Light is not responsible for potential impacts of SR 20 on wildlife movement in the region as it is not a Project facility. Additionally, SR 20 is not comparable to Interstate 90, which research has identified as a barrier to wildlife movement. SR 20 is a much narrower road with far less traffic and is closed for five months out of the year. Therefore, continued Project operations as currently licensed are expected to have no foreseeable effect on wildlife migration and movements in the Project vicinity.

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, areas of reservoir operations, and the Project transmission line ROW, are areas where invasive vegetation frequently thrives. Non-native, invasive plants, especially Himalayan blackberry and Scot's broom, occur along some sections of the transmission line, sometimes in abundance, where vegetation management is required in the ROW, and in isolated patches on fish and wildlife mitigation lands. Reed canarygrass is also a dominant species in many of the emergent wetlands in the ROW and has become established in lake-fringe wetlands on Ross Lake and is affecting plant species composition and wildlife habitat structure in some wetlands used by amphibians. The effects of reed canarygrass on amphibians are complex and likely varies by species, with some studies showing no effect on patterns of amphibian use, secondary productivity, or growth and development of larvae. Conversely, reed canarygrass can reduce aquatic habitat in some settings and when unmanaged (i.e., not periodically mowed, cut for hay, or grazed) may reduce or eliminate suitable sites for spotted frog species oviposition in shallow, emergent habitat, particularly where conditions allow thatch to accumulate or where thatch is not compressed by snow cover. On the other hand, reed canarygrass may grow in locations where few other perennial plants can survive long periods of inundation, providing vegetation cover that may not otherwise occur, erosion control, and bank stability.

Effects of Transmission Line Bird Collision and Electrocution Hazard

Effects of electrocution and collision hazards of existing and any new project transmission lines on eagles, waterfowl, and other birds (FERC SD2).

According to the USFWS and conservation organizations, millions of birds die annually in the United States from collisions into manmade structures, including wind turbines, powerlines, and buildings (Loss et al. 2014). 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. Avian collisions with powerlines have been a growing concern as the number of powerlines continues to increase (Bernardino et al. 2018). However, different types of birds have varying susceptibility to collisions. Factors that contribute to collision risk include maneuverability due to wing morphology and physiology, flight speed, and flight behavior, such as flying in flocks or nocturnal migrations (Rayner 1988; Bevanger 1998; Bernardino et al. 2018). Based on these factors, waterfowl, shorebirds, and cranes would be expected to have a much higher risk of collision with powerlines, and this has been documented by several studies (Janss 2000; Rioux et al. 2013; Rubolini et al. 2005, Bevanger 1998). Almost all avian collisions reported along the Project transmission line have been waterfowl (City Light 2014).

City Light has developed and adheres to a utility-wide Avian Protection Plan that is approved by the USFWS[85] and obtains annual permits from USFWS and WDFW to manage bird issues that may arise. The plan is described below under Existing Resource Measures.

Eagles and other raptor species have a much lower risk of collision with powerlines, particularly transmission lines (Luzenski et al. 2016) that have larger diameter conductors than distribution lines, than other bird groups due to their strong eyesight and agility in flight (Mojica et al. 2020; Slater et al. 2020, Janss 2000). Compared to electric distribution systems, transmission lines pose a relatively low risk of electrocution to avian species, especially eagles and other birds with wide wingspans, because of the greater distance between energized lines or between each energized line and any grounded part. Collisions with powerlines by eagles is considered rare but may be more of a concern when powerlines intersect travel corridors between nests, roosts, and foraging areas (Bevanger and Brøseth 2004; Stehn and Wassenich 2008; Avian Power Line Interaction Committee [APLIC] 2012; Watts et al. 2015; Eccleston and Harness 2018; Mojica et al. 2020). During migration, raptors tend to fly during clear weather (Ligouri 2005) and appear to have success avoiding transmission lines that cross even major migration corridors (Luzenski et al. 2016). Golden eagle collisions with powerlines have been documented in the literature, but the number of incidents is low. For example, of 17 golden eagle fatalities along distribution lines in Colorado, only three were suspected collisions (Harness et al. 2003). Similarly, of 14 golden eagle

85 http://www.seattle.gov/light/enviro/avian/

fatalities in Mongolia, only one was determined to be caused by collision (Amartuvshin and Gombobaatar 2012). No electrocutions have been documented at any of the lower voltage distribution lines that carry power to Project facilities within the Project Boundary; if a distribution line was discovered to be a problem in the future, the structure would be addressed with retrofits per the APP.

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.

One bald eagle collision with the Project transmission line has been recorded since 1973 (City Light 2014). In response to observed bald eagle avoidance maneuvers associated with the Project transmission line near the Corkindale crossing of the Skagit River and the Illabot Creek bald eagle wintering area, an intensive monitoring study was implemented between 1996 and 2000; no avian collisions were observed (Springwood 2001).

There is no evidence that the Project transmission lines pose a collision hazard for golden eagles, and there have been no documented golden eagle collisions or evidence of possible collision mortality. Golden eagle risk of collision with Project transmission lines can be confidently described as very low because: (1) golden eagle abundance is very low; (2) high-quality nesting habitat is limited in and near the study area; (3) foraging habitat is limited relative to other portions of golden eagle range; (4) collisions are rare during migration (greatest during foraging and territorial defense), which is when golden eagles are most commonly in the study area; and (5) golden eagles, like all raptors, rarely collide with transmission lines due to their visual acuity and maneuverability (TR-06 Golden Eagle Habitat Analysis; City Light 2022e).

Marking transmission lines has been shown to significantly reduce avian collisions (Manville 2005, Jenkins et al. 2010, Barrientos et al. 2011, Bernardino et al. 2021). Marking of transmission lines is most often done to prevent collisions by waterfowl and other avian species at greater risk of collision than raptors. In fact, raptors typically do not benefit as much from marking transmission lines (as described above). Marking may include PVC spirals; polypropylene or reflective flappers that swing or are fixed; near-ultraviolet light; aerial marker spheres; or aviation balls (Sporer et al. 2013, Dwyer et al. 2019, Ferrer et al. 2020). APLIC (2012) provides recommendations for spacing and other design specifications.

City Light installed markers in 2001 and 2021 on the Project transmission line in several locations to reduce risk of avian collisions by waterfowl or bald eagles, and which may incidentally reduce the already low risk of golden eagle collision (see Attachment D of the TR-06 Golden Eagle Habitat Analysis Draft Report; City Light 2022e). These include three areas:

(1) Bird flight diverters (BFD) on the optical ground wire from the Corkindale crossing of the Skagit River (PRM 74.2) to near Illabot Creek where wintering bald eagles forage and communally roost (installed in 2001) as well as Skagit River crossing near Bacon Creek (PRM 83.3) and at "Pinkies" (PRM 86.3);

(2) Aviation markers over the Sauk River; and

(3) BFDs over the Snohomish River and adjacent agricultural areas where trumpeter swans sometimes occur during winter and collisions have been recorded on rare incidences (installed in 2021).

Several other areas were evaluated for marking in 2001, but a study documented many safe bald eagle flights across the lines, and City Light consulted state and federal biologists and eagle researchers, who agreed additional line markers would do little to provide protection (Springwood 2001). City Light shared this information with FERC, and FERC issued an order concluding City Light was not required to install BFD to prevent bald eagle collisions (FERC 2001).

Although there are only a few anecdotal reports, bird collisions with building windows at the Project are likely to occasionally 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, personal communication). The only known raptor collision mortality associated with a Project facility was a juvenile goshawk at the Diablo Powerhouse in 2014.

4.2.5.3 Existing Resource Measures

Adequacy of Existing Management Plans

Under the current Project license, City Light has developed and implemented wildlife-focused protection and enhancement measures in cooperation with NPS and other licensing participants. These efforts are briefly described below. Additional details regarding the effectiveness of these efforts are further described in Appendix D of this Exhibit E.

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 in compliance with Article 410. 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 10,804 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, initially in 1991 in consultation with WSA parties, which was then updated in 2006 (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 maximizing habitat acquisition and preservation with less emphasis on active habitat management. 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 allocated to USFS for bald eagle monitoring along the Skagit River.

City Light also provides annual funding of $20,000 (1990$) to NCI to specifically 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 70 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 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[86] and obtains annual permits from USFWS and WDFW to manage bird electrocution, collision, and nests that pose operation or safety hazards. Known avian mortalities and nest removals are annually reported to USFWS and WDFW. At locations where bird mortality has been documented due to electrocution or collision, City Light has installed 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 (e.g., peregrine falcon, and bald eagle) 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).

4.2.5.4 Proposed Resource Measures

Wildlife Protection and Enhancement Plan

To protect wildlife species within the Project Boundary, City Light proposes to develop a Wildlife Protection and Enhancement Plan, which will include measures for (1) O&M actions and BMPs; (2) habitat management and enhancements; and (3) monitoring and reporting. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Avian Species Protection Plan

To protect avian species within the Project Boundary, City Light proposes to develop an Avian Species Protection Plan, which will include measures to protect avian species, including: (1) maintenance of bird flight diverters; (2) coordination with NPS on helicopter noise protection measures; and (3) BMP measures to avoid or minimize the disturbance of avian species. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Wildlife Mitigation Lands Management Plan

To continue its ongoing stewardship of wildlife mitigation lands, City Light proposes to include a Wildlife Mitigation Lands Management Plan that is currently being developed in collaboration with Treaty Tribes and other LPs. This management plan will include measures for management of the wildlife mitigation lands and management of invasive species on these lands. This plan would also include BMPs consistent with implementation of the Historic Properties Management Plan to avoid, minimize, or mitigate adverse effects to historic properties as required by the National Historic Preservation Act. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

[86] http://www.seattle.gov/light/enviro/avian/

Off-license Measure: Wildlife Monitoring and Education Funds

To enhance wildlife management and education, City Light will provide a fund with monetary contributions on an annual basis 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 will maintain an existing City Light building in Newhalem to serve as a wildlife research laboratory. The fund may be used in support of efforts to protect and monitor bald eagles in the Skagit River basin and for educational activities during winter bald eagle viewing events sponsored by USFS and Washington State Parks. Additional details will be provided in the FLA.

Off-license Measure: Wildlife Research Grants

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), City Light will continue to provide wildlife research grants to qualifying applicants on an annual basis. Additional details will be provided in the FLA.

4.2.5.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to wildlife resources have been identified at this time.

4.2.6 Recreation and Land Use

To supplement existing, relevant, and reasonably available information from Seattle City Light's (City Light) Pre-Application Document (PAD) and to determine the potential effects of the Project on recreation resources, City Light is conducting three recreation-related studies – RA-01 Recreation Use and Facility Assessment (Recreation Assessment); RA-02 Gorge Bypass Reach Safety and Whitewater Boating Study (Bypass Safety and Whitewater Boating Study); and RA-05 Lower Skagit River Recreation Flow (Recreation Flow Study). These studies are ongoing. Information available from the completed portions of these studies, as of writing of this Draft License Application (DLA), has been included herein. The status of these studies is described below.

- RA-01 Recreation Assessment. The primary goals of the Federal Energy Regulatory Commission (FERC)-approved study were to determine within the study area: (1) the condition, accessibility, and use impacts of recreation facilities; (2) the preferences, attitudes, and characteristics of recreation users; (3) current recreation use and activities; and (4) future demand for recreation facilities and opportunities. City Light summarized the data collection and key results as part of the Initial Study Report (ISR), which included the condition, accessibility, and use impacts of recreation facilities within the study area. The remaining study goals and tasks are ongoing, including data collection through October 2022 and subsequent data analysis, and will be included in the Final License Application (FLA). Information available from the Recreation Assessment as of writing of this DLA has been included in this section.
- RA-02 Bypass Safety and Whitewater Boating Study. The primary goals of the FERC-approved study were to evaluate the suitability of the Skagit River in the Gorge bypass reach for whitewater boating under current conditions, inform future operational scenarios that include the range of instream flow measures that may be included in a future license, and assess

potential constraints such as Project operations and safety concerns. This study will include identifying any river access needs and potential effects of access on other Project resources. This study had the following objectives:

- Describe the whitewater boating opportunity in the Gorge bypass reach including the whitewater difficulty, character of rapids, number of portages, suitability for expert paddlers, and uniqueness of opportunity;
- Determine the range of flows that would provide whitewater boating opportunities in the Gorge bypass reach;
- Quantify the frequency, timing, duration, magnitude, and rate of change of spill events from Gorge Dam annually within the whitewater boating flow range;
- Assess the feasibility of expert whitewater boating, including public safety, effects on generation, and cost of providing whitewater boating in the bypass reach;
- If boating is determined feasible, compare the results of this assessment with an estimate of potential whitewater boating use; and
- If boating is determined feasible, identify existing and potential river access needs and routes, challenges with utilizing those routes, including potential effects to natural, cultural, and other Project resources from increased public access.

City Light summarized the data collection and key results as part of the ISR, which included a desktop analysis and field reconnaissance. The remaining study goals and tasks are ongoing, including additional data collection in 2023 (i.e., Level 3 multiple flow assessment), and will be included in the FLA. Information available from the Bypass Safety and Whitewater Boating Study as of writing of this DLA has been included in this section.

- RA-05 Recreation Flow Study. The primary goal of the FERC-approved study was to document the recreation flow needs in the Skagit River from Goodell Creek Boat Launch to the Howard Miller Steelhead Park with the following objectives:
    - Describe the recreational boating opportunity in the Skagit River from Goodell Creek Boat Launch to the Howard Miller Steelhead Park near Rockport, including delineating the respective recreation segments, access locations, whitewater difficulty, character of rapids, number of portages, watercraft types, and uniqueness of opportunity;
    - Determine the range of boatable flows by watercraft for each river segment; and
    - Quantify the frequency, timing, duration, magnitude, and rate of change of flows downstream of the Gorge Powerhouse within the boating flow range.

  City Light summarized the data collected and key results related to the initial objective as part of the ISR. The remaining study objectives and tasks are ongoing, including data collection through October 2022, and will be included in the FLA. Information available from the RA-05 Recreation Flow Study as of writing of the DLA has been included in this section.

4.2.6.1 Affected Environment

This section describes existing recreational resources and is divided into the following four areas: (1) recreational setting; (2) recreational resources within the FERC Project Boundary; (3)

recreational use; (4) recreational river opportunities on the Project-affected river reaches; and (5) land use and management.

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. City Light acknowledges the potential impacts that recreational and land use activities may have on tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Recreational Setting

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 away, and portions of the parks and the one highway, State Route (SR) 20, in the vicinity are closed each year, usually from November until April. Nonetheless, the Project reservoirs and vicinity provide many recreational opportunities and receive significant visitation, especially in the summer.

The Project is unique in that the generation facilities are almost entirely within a national recreation area, the Ross Lake National Recreation Area (RLNRA). RLNRA is managed by the National Park Service (NPS) and was established in 1968 by 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 RLNRA attracts nearly 1 million visitors annually and when combined with the rest of the North Cascades National Park Complex, it provides both front country, backcountry, and wilderness recreation opportunities and settings. Per the RLNRA General Management Plan, the NPS manages RLNRA using five management zones, including the Frontcountry Zone (5 percent of RLNRA), Backcountry Zone (18.5 percent of RLNRA), Wilderness Zone (73 percent of RLNRA), Skagit River Zone (3 percent of RLNRA), and Hydroelectric Zone (0.5 percent of RLNRA) (NPS 2012). The Skagit River Project lies in the Hydroelectric Zone (i.e., Project dams, powerhouses, switchyards and townsites), Frontcountry Zone (i.e., Diablo and Gorge lakes and northern/southern portions of Ross Lake), and Backcountry Zone (middle portion of Ross Lake).

Additionally, the Project is bordered on the east and west by National Forest (Okanogan-Wenatchee National Forest to the south and east; Mount Baker-Snoqualmie National Forest to the west) and is upstream of the Skagit River Wild and Scenic River System. The Project Boundary also encompasses two company towns, Newhalem and Diablo, and an environmental education center (Environmental Learning Center [ELC]).

This section summarizes relevant information, much of it developed by NPS as the entity responsible for recreation management in the RLNRA and surrounding park; and is supplemented with information from City Light's recreation-related studies (i.e., RA-01 Recreation Assessment, RA-02 Bypass Safety and Whitewater Boating Study, and RA-05 Recreation Flow Study). Regionally, the U.S. Forest Service (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.

Recreational Resources Within the FERC Project Boundary

City Light operates and maintains several Project recreation and interpretive facilities at the Project (Figure 3.1-11). Project recreation facilities are FERC-approved facilities that are required by the Project license. In addition, there are numerous non-Project recreation facilities within and adjacent to the Project Boundary. Most of the non-Project recreation facilities are owned and managed (i.e., operated and maintained) by the NPS as part of the RLNRA, plus there are several facilities owned and managed by the USFS and other entities (Figure 3.1-11). These facilities are detailed in Table 4.2.6-1 and described below by reservoir/area and separated by Project versus non-Project recreation facilities. Notably, under the Settlement Agreement associated with the current license, City Light provides NPS and USFS with annual funding for general operations and maintenance (O&M), capital facility funding, and interpretation and signage at non-Project recreation facilities within the RLNRA and Project vicinity.

The following section includes recreation facility information from the RA-01 Recreation Assessment, including accessibility (i.e., Americans with Disabilities Act [ADA] and Architectural Barriers Act [ABA] compliance) and use impacts for the applicable facilities in this section. The use impact assessment was rated based on the amount and dispersion of use impact evidence at recreation sites (e.g., presence of litter, dumping, tree cutting, inadequate vegetation clearances around fire pits/rings, visible off-highway vehicle use/tracks, trampled vegetation, erosion, human waste, toilet paper). In addition, City Light also collected condition information for the Project recreation facilities, which is included in this section as well.

Table 4.2.6-1. Summary of study area recreation facilities including ownership, management, and Recreation Assessment study elements.

Resource Area	Recreation Facility	Project / Non-Project Facility	Land Management/ Ownership	Facility Management	Study Elements						
					Inventory	Condition	Accessibility	Use Impact	Trail Accessibility	Visitor Survey	Observation Survey
Ross Lake	Winnebago Flats Campground	Non-Project	Federal (NPS)	NPS			X	X		X	
	Winnebago Flats Boat Launch	Non-Project	Federal (NPS)	NPS			X	X		X	X
	Hozomeen Campground	Non-Project	Federal (NPS)	NPS			X	X		X	
	Hozomeen Boat Launch	Non-Project	Federal (NPS)	NPS			X	X		X	X
	Hozomeen Lake Trailhead	Non-Project	Federal (NPS)	NPS			X	X			
	Ross Lake Boat-in Camps	Non-Project	Federal (NPS)	NPS			X	X			
	Ross Lake Resort	Non-Project	Federal (NPS)	Private							
	Ross Dam Trail/Trailhead	Non-Project	Federal (NPS)	NPS			X	X	X	X	X
	East Bank Trail/Trailhead	Non-Project	Federal (NPS)	NPS				X		X	X
	Happy Panther Trail	Non-Project	Federal (NPS)	NPS					X		
	Canyon Creek Trailhead	Non-Project	Federal (USFS)	USFS				X			
Diablo Lake	Environmental Learning Center	Project	Federal (NPS)	City Light	X[1]			X[1]			X[1]
	Skagit Tour Dock	Project	Federal (NPS)	City Light	X	X	X	X		X	X
	Diablo Dam Parking Area	Project	Federal (NPS)	City Light	X	X	X	X		X	X
	West Ferry Landing	Project	Federal (NPS)	City Light	X	X	X	X		X	X
	East Ferry Landing	Project	Federal (NPS)	City Light	X	X	X	X			
	Colonial Creek Campground	Non-Project	Federal (NPS)	NPS			X	X		X	
	Colonial Creek Boat Launch/Fishing Pier	Non-Project	Federal (NPS)	NPS			X	X		X	X
	Diablo Overlook	Non-Project	Federal (NPS)	NPS			X	X		X	
	Diablo Lake Boat-in Camps	Non-Project	Federal (NPS)	NPS			X	X			
	Diablo Lake Trail/Trailhead	Non-Project	Federal (NPS)	NPS			X	X	X	X	
	Thunder Creek Trail/Trailhead	Non-Project	Federal (NPS)	NPS			X	X	X		X
	Thunder Knob Trail/Trailhead	Non-Project	Federal (NPS)	NPS			X	X	X		X

Resource Area	Recreation Facility	Project / Non-Project Facility	Land Management/ Ownership	Facility Management	Study Elements						
					Inventory	Condition	Accessibility	Use Impact	Trail Accessibility	Visitor Survey	Observation Survey
Gorge Lake	Gorge Lake Boat Launch	Project	City Light	City Light	X	X	X	X		X	X
	Ross Lodge Picnic Shelter	Project	City Light	City Light	X	X	X	X			X
	Gorge Lake Campground	Non-Project	Federal (NPS)	NPS			X	X		X	
	Gorge Creek Overlook	Non-Project	Federal (NPS)	NPS			X	X	X	X	X
	Diablo Dam Trail/Trailhead	Non-Project	Federal (NPS)	NPS			X	X	X		X
	Sourdough Mountain Trailhead	Non-Project	Federal (NPS)	NPS				X			X
	Stetattle Creek Trailhead	Non-Project	City Light	NPS				X			X
Newhalem	Gorge Inn Museum	Project	City Light	City Light	X						
	Gorge Powerhouse Visitor Gallery	Project	City Light	City Light	X						
	Ladder Creek Falls Trail and Gardens	Project	Federal (NPS)	City Light	X	X					
	Trail of the Cedars	Project[2]	Federal (NPS)	NPS/City Light	X	X			X		
	Skagit Information Center	Project	City Light	City Light	X						
	Newhalem Visitor Facilities (parking, picnic, interpretation, and playground)	Project	City Light	City Light	X	X	X	X		X[3]	X[3]
Skagit River	Newhalem Creek Campground	Non-Project	Federal (NPS)	NPS						X	
	Goodell Creek Campground	Non-Project	Federal (NPS)	NPS			X	X		X	
	Goodell Creek Boat Launch	Non-Project	Federal (NPS)	NPS			X	X		X	X
	Damnation Creek Boat-in Picnic Site	Non-Project	Federal (NPS)	NPS			X	X			
	Copper Creek Boat Access Site	Non-Project	City Light	NPS			X	X			
	Marblemount Boat Launch	Non-Project	Federal (NFS)	USFS			X	X		X	X
	Marble Creek Campground	Non-Project	Federal (NFS)	USFS						X	

1 Study elements were conducted at the parking area adjacent to the formal Environmental Learning Center facility that is operated by North Cascades Institute.
2 Trail of the Cedars is a provision of the Newhalem Creek Project license. However, City Light proposes to make this a Skagit Hydroelectric Project facility as City Light filed an application to surrender and decommission the Newhalem Creek Project.
3 Visitor and observation surveys at the Newhalem recreation amenities were conducted at the parking areas and picnic sites.

Ross Lake

Project Recreation Facilities

There are no Project recreation facilities on Ross Lake. However, under the terms of the Settlement Agreement of the current license, City Light annually provides funding to the NPS for O&M, capital facility implementation, and interpretation and signing for non-Project recreation facilities and services within the RLNRA, including on Ross Lake.

Non-Project Recreation Facilities

Winnebago Flats Campground (NPS)

Winnebago Flats Campground consists of campsites, two vault-restroom buildings, and an information kiosk. The facility is owned and managed by NPS.

Overall, the campground does not meet current accessibility standards with only the restroom buildings meeting the standards (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Winnebago Flats Boat Launch (NPS)

The Winnebago Flats Boat Launch consists of a concrete launch ramp, floating courtesy dock, gravel parking area, and information kiosk. The facility is owned and managed by NPS.

Overall, the boat launch does not meet current accessibility standards with few/limited accessible components (i.e., the floating courtesy dock). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Winnebago Flats Boat Launch ramp is usable down to an elevation of 1,600.26 feet (ft) North American Vertical Datum of 1988 (NAVD 88)(1,594 ft City of Seattle datum [CoSD])(NPS 2022a). Under the terms of the Settlement Agreement of the current license, City Light fills Ross Lake as early and as full as possible after April 15 each year, achieving a normal maximum water surface elevation of 1,608.76 ft NAVD 88 (1,602.5 ft CoSD) by July 31, subject to hydrologic conditions, adequate runoff, anadromous fisheries protection flows, flood protection, minimized spill, and power generation needs. Further, City Light holds Ross Lake as close to normal maximum water surface elevation as possible through Labor Day weekend, subject to the same constraints. For the period of record from 1983 to 2021, the boat ramp was usable 27 percent of the year and 92 percent of the peak season (July and August), on average. During the peak season for the same period of record, the boat ramp was not usable, on average, for 2.5 days in July and 2.4 days in August.

Hozomeen Campground (NPS)

The Hozomeen Campground consists of 75 campsites, vault restroom buildings, and an information kiosk. The facility is owned and managed by NPS.

Overall, the campground does not meet current accessibility standards with only the restroom buildings meeting current standards (City Light 2022a). Signs of recreation use impacts were minimal with moderate to large areas of bare ground at campsites as the predominant sign of use impact, which is expected at a developed campground facility (City Light 2022a).

Hozomeen Boat Launch (NPS)

The Hozomeen Boat Launch consists of a concrete launch ramp, floating courtesy dock, gravel parking area, restroom building, and information kiosk. The facility is owned and managed by NPS.

Overall, the boat launch does not meet current accessibility standards with few/limited accessible components (i.e., dock and restroom building) (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

The Hozomeen Boat Launch ramp is usable down to an elevation of 1,589.26 ft NAVD 88 (1,583.0 ft CoSD)(NPS 2022a). For the period of record from 1983 to 2021, the boat ramp is usable 47 percent of the year and 97 percent of the peak season (July and August), on average. During the peak season during the same period of record, the boat ramp is not usable, on average, less than one day each in July and August. As noted above, under the terms of the Settlement Agreement of the current license, City Light fills Ross Lake as early and as full as possible after April 15 each year, achieving a normal maximum water surface elevation of 1,608.76 ft NAVD 88 (1,602.5 ft CoSD) by July 31, subject to hydrologic conditions, adequate runoff, anadromous fisheries protection flows, flood protection, minimized spill, and power generation needs. Further, City Light holds Ross Lake as close to normal maximum water surface elevation as possible through Labor Day weekend, subject to the same constraints.

Hozomeen Lake Trailhead (NPS)

The Hozomeen Lake Trailhead is in the Hozomeen Campground and provides trail access to the East Bank Trail and Hozomeen Lake Trail. The facility provides a small, unmarked gravel parking area and a single-panel information kiosk. The facility is owned and managed by NPS.

Overall, the trailhead does not meet current accessibility standards and no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trailhead does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Ross Lake Boat-in Camps (NPS)

There are 19 boat-in camps on Ross Lake, all owned and managed by NPS as part of the RLNRA. Amenities available at the boat-in camps include picnic tables, fire-rings, vault toilets, and bear-resistant food lockers. Additionally, twelve of the boat-in camps have floating docks (Table 4.2.6-2). The camps without docks include Roland Point, Ten Mile Island, Dry Creek, Ponderosa, Lodgepole, Lightning Creek Stock Camp, and Boundary Bay.

Overall, the boat-in camps do not meet current accessibility standards with only the boat docks meeting current accessibility standards (City Light 2022a). Notably, the camping amenities (i.e., tables, fire rings, food lockers, tent pads, docks, and restroom buildings), site terrain/conditions, and subsequent accessibility constraints were similar across all boat-in camps (City Light 2022a).

Signs of recreation use impacts at the boat-in camps were minimal with occasional signs of trash or tree/branch cutting; moderate areas of bare ground at camps, which is typical at developed camps; and foot traffic between satellite areas within the camps and to shoreline areas was largely limited to well-worn or delineated paths/routes (City Light 2022a).

Table 4.2.6-2 summarizes the minimum usable lake levels and the usable periods of the boat docks associated with the boat-in camps on Ross Lake. Again, under the terms of the Settlement Agreement of the current license, City Light fills Ross Lake as early and as full as possible after April 15 each year, achieving a normal maximum water surface elevation of 1,608.76 ft NAVD 88 (1,602.5 ft CoSD) by July 31, subject to hydrologic conditions, adequate runoff, anadromous fisheries protection flows, flood protection, minimized spill, and power generation needs. Further, City Light holds Ross Lake as close to normal maximum water surface elevation as possible through Labor Day weekend, subject to the same constraints.

Table 4.2.6-2. Minimum usable lake level elevations and usable periods for Ross Lake boat-in campsite docks.

Ross Lake Boat-in Camp Boat Dock	Minimum Usable Lake Level elevation NAVD 88 (feet)[1]	Usable Periods (1983-2021)		Peak Season – Average Days Below Minimum Usable Level (1983-2021)	
		Year	Peak Season (July-August)	July	August
Silver Creek	1,605.26 (1,599 CoSD)	17%	80%	6.3	6.1
Lightning Creek	1,604.26 (1,598 CoSD)	20%	85%	4.7	4.4
Green Point					
McMillan	1,602.26 (1,596 CoSD)	24%	90%	3.0	2.6
May Creek					
Spencer’s					
Cougar Island	1,600.26 (1,594 CoSD)	27%	92%	2.5	2.4
Devil's Junction					
Rainbow Point	1,596.26 (1,590 CoSD)	35%	95%	1.4	1.7
Cat Island	1,592.26 (1,586 CoSD)	42%	97%	1.0	0.9
Little Beaver	1,588.26 (1,582 CoSD)	48%	97%	0.9	0.8

1 Source: NPS 2022a.

Ross Lake Resort (Private)

Ross Lake Resort is privately owned and managed and operates under a concession contract from NPS and 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. Ross Lake Resort is open June through 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 on the east end of Diablo Lake 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.

The Ross Lake Resort manages a visitor dock on the east side of Ross Lake just upstream of Ross Dam. 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. The dock does not meet current accessibility standards (City Light 2022a).

Ross Dam Trailhead (NPS)

The Ross Dam Trailhead consists of a paved/gravel parking area, restroom building, information kiosk, and trash facilities. The trailhead provides access to the Ross Dam Trail, a 1-mile-long trail that leads to the Ross Dam area. The facility is owned and managed by NPS.

Overall, the trailhead does not meet current accessibility standards with few/limited accessible components (i.e., vault restroom building) and no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trailhead does not have a trail condition sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

East Bank Trailhead (NPS)

The East Bank Trailhead is located off SR 20 along the Ruby Creek arm of Ross Lake. The facility consists of a gravel parking area, restroom building, information kiosk, trash facilities, and equestrian hitch rail. The facility is owned and managed by NPS.

Overall, the trailhead does not meet current accessibility standards with few/limited accessible components (i.e., elements of the vault restroom building and information kiosk); no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trailhead does not have a trail condition sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Recreational Trails (NPS)

Numerous hiking trails originate on or near the Ross Lake shoreline (Table 4.2.6-3). 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, 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 several 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 east shore to Ross Dam, where it proceeds up the west shore of Ross Lake to Big Beaver Creek. The recreational trails in the Ross Lake vicinity are summarized in Table 4.2.6-3, including whether the trail is within the FERC boundary. All these trails are managed by NPS including the portion of the PNT within the Project boundary.

Table 4.2.6-3. Recreational trails in the Ross Lake vicinity.

Trail	In FERC Boundary	Start	End	Length (miles one-way)	Accessible	Difficulty
Hozomeen Lake Trail	No	Hozomeen Campground	Hozomeen Lake	3.6	No	Moderate
Little Beaver Trail	Partially	Ross Lake at Little Beaver Creek	Whatcom Pass	17.5	No	Strenuous
Desolation Peak Trail	Partially	Ross Lake at Desolation Trailhead	Desolation Peak Fire Lookout	4.8	No	Strenuous
Big Beaver Trail	Partially	Ross Lake at Big Beaver Creek	Beaver Pass	13.7	No	Strenuous
Devil's Dome Loop Trail	Partially	Ross Lake at Devil's Ridge Trailhead	Big Beaver	40.4 (loop)	No	Strenuous
Panther Creek	No	East Bank Trailhead	Fourth of July Pass	6.5	No	Strenuous
East Bank Trail	Partially	SR 20 milepost (MP) 138	Hozomeen	31	No	Moderate
Happy Panther Trail	Partially	Ross Haul Road near Ross Dam	East Bank Trailhead	6.2	No	Moderate
Happy Creek Trail	No	SR 20 between milepost (MP) 134 and 135	Loop trail	0.5 (loop)	Yes	Easy
Ross Dam Trail	Partially	SR 20 between MP 134 and 135	Ross Dam	1.0	No	Moderate
Pacific Northwest Scenic Trail	Partially	Ross Lake near Devil's Creek	Big Beaver Creek	13.8 (inside the Project Boundary)	No	Moderate

Source: NPS 2022b; PNTA 2019; Washington Trails Association 2022.

Of these trails in the Ross Lake area, City Light qualitatively evaluated the accessibility of two trails in the Ross Lake area in 2021 (Ross Dam Trail and Happy Panther Trail), each of which is summarized below.

The 1-mile-long Ross Dam Trail has a substantial change in elevation (approximately 700 vertical ft) from the trailhead along SR 20 to its terminus at Ross Dam. The primary constraint to accessibility is the steep descent overall, which is markedly outside the running slope standards for trail accessibility. Additional constraints include generally rocky and inconsistent tread and surfacing, significant tread obstacles (4 to 8 inches high) including rocks and roots, and numerous areas with excessive cross slopes (5 to 10 percent). Overall, the steep vertical descent and the other constraints noted above are pervasive (City Light 2022a).

The 6.2-mile-long Happy Panther Trail connects the East Bank Trailhead to the upstream side of Ross Dam and meanders through the forest between Ross Lake and SR 20. Overall, the trail width is narrow ranging primarily between 18 and 24 inches wide with short segments as narrow as 12 inches wide. City Light observed substantial accessibility constraints at the start of the trail near

Ross Dam, including steep running slopes, cross slope, tread obstacles (e.g., rocks, roots), and loose and rocky trail surface. Beyond the initial 300 to 500 ft, City Light observed constraints intermittently with steep running slopes between 50 and 250 ft in length, numerous drainage crossings with loose rocks/boulders resulting in uneven tread width, and trail segments with uneven and loose boulder/large gravel trail surface. The trail does not have trail conditions signs that describe the level of difficulty and trail conditions/accessibility constraints at either end of the trail (City Light 2022a).

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. All recreation facilities along the Diablo Lake shoreline are within the Project Boundary and the RLNRA, unless otherwise stated. Recreation opportunities include water sports, camping, hiking, angling, environmental education, and boat tours. Recreation facilities and services at Diablo Lake include the ELC, boat tours and ferry service, docks and ferry landings, a boat launch, campgrounds, boat-in camps, and trails.

<u>Project Recreation Facilities</u>

North Cascades Environmental Learning Center (City Light)

The ELC, which opened in 2005, is a Project recreation facility owned by City Light. City Light leases the ELC to the North Cascades Institute (NCI), a non-profit organization focused on environmental education. The purpose of the ELC is to educate “the public about the North Cascades bioregion and its natural and human history and resources consistent with applicable law.” (City Light 1991). It achieves this purpose by providing in-depth environmental education, including information about hydropower and climate change. Environmental education programming is targeted to youth, but also to adults and families. NCI hosts tours, conferences, trainings, retreats, and other special events, all of which contain an environmental education component, 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 offered to schools.

The ELC is located on the north shore of Diablo Lake on federal land administered by NPS. 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 shoreline in front of the ELC, provides boat access to Diablo Lake for visitors participating in programs at the ELC. The ELC was awarded Silver Certification under the Leadership in Energy and Environmental Design Green Building Rating System in 2009.

The ELC represents City Light’s most significant investment in recreational facilities and services under the current license. City Light funded site acquisition and preparation, facility design and planning, and facility construction and furnishings, as well as provided funding for ELC program start-up and staffing costs, including a lump sum endowment. City Light continues to provide the

ELC with electricity service at no cost as well as annual funding for maintenance of the facility, wildlife education, and vehicles.

ELC Parking Area (NPS)

The ELC parking area is located at the end of Diablo Dam Road at the entrance to the ELC campus, but outside the controlled access of the main ELC campus. This parking area provides public access to Diablo Lake (outside the ELC campus) and to the adjacent Diablo Lake Trail. The ELC parking area facility consists of two unmarked gravel parking areas with two accessible parking spaces. The ELC parking area also includes trash facilities (i.e., dumpsters) and an information board. The facility is owned and managed by NPS.

Overall, the facility is in good condition and does not meet current accessibility standards with only a few elements meeting the standards (i.e., trash facilities) (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Skagit Tour Dock (City Light)

The Skagit Tour Dock is on the north shore at the west end of Diablo Lake, near Diablo Dam. The dock is accessible by road from Diablo Dam Road. It is used for Skagit Tours which are offered by City Light during the summer months. The facility consists of three paved/striped parking spaces and unmarked roadside gravel parking, a 24 ft by 48 ft staging area shelter with eight benches and two information boards, and a recently replaced 24 ft by 48 ft boat dock with a 40 ft gangway with handrail. The facility is owned and managed by City Light.

Overall, the tour dock is in fair-to-good condition with an aging parking area surface. The facility does not meet current accessibility standards with a few elements meeting the standards (i.e., boat dock, staging area) (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Diablo Dam Parking Area (City Light)

The Diablo Dam Parking Area is located on the north side of Diablo Dam. The facility consists of a flush restroom building, a paved parking area (three striped spaces), and informal roadside parking area (2-3 vehicles). Visitors may park here to view or walk across the dam. The facility is owned and managed by City Light.

Overall, the parking area and restroom are in good condition. The facility does not meet current accessibility standards. No noticeable recreation use impacts were observed at the facility (City Light 2022a).

West Ferry Landing (City Light)

The West Ferry Landing is on the north shore at the west end of Diablo Lake, along Diablo Dam Road. It is used exclusively for embarking and disembarking the Diablo Ferry, a service managed by City Light, 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. City Light provides the ferry service between the West and East Ferry Landings. The facility consists of 32 paved/striped parking spaces, a 24 ft by 48 ft boat dock with a 40 ft gangway with handrail although the access route includes concrete steps, two parking signs, and an information board. The facility is owned and managed by City Light.

Overall, the ferry landing is in good condition and does not meet current accessibility standards with portions of the dock platform meeting current standards (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

East Ferry Landing (City Light)

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, only accessible by boat or trail. 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. 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. Both the ferry landing and the canoe/kayak dock are owned and managed by City Light.

The ferry landing consists of a 32 ft by 60 ft boat dock with a 30 ft gangway with handrail and an information board. At lower water levels, the slope of the gangway may exceed the requisite slopes and affect the accessibility of the boat dock.

Overall, the ferry landing is in good condition and does not meet current accessibility standards with portions of the boat dock platform and the new accessible kayak dock elements meeting the standards (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Non-Project Recreation Facilities

Colonial Creek Campground (NPS)

Colonial Creek Campground provides the only campground on Diablo Lake accessible by road. 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 owned and managed by NPS.

Colonial Creek Campground has two loops, including approximately 135 campsites. Sites are available for advance reservation on www.reservation.com. The south loop, on the south side of SR 20, has a total of 93 designated sites, three of which are designated accessible and five are designated group sites (NPS 2019a). One site in the south loop is a campsite held for bicyclists on a first-come, first-served basis. The north loop, on the north side of SR 20, has 42 designated sites, one of which is accessible, and 10 are walk-in sites. The campground is not suitable for recreational vehicles (RV) larger than 25 ft in the north loop and 36 ft in the south loop.

Amenities available at the campground include potable water, an information kiosk, RV dumping station, flush restroom buildings, garbage and recycling services, and a fish cleaning station. The campground also includes an amphitheater for ranger programs.

Overall, the campground does not meet current accessibility standards, including within the campsites, access routes to the campsites, parking areas, water faucets, and restrooms (City Light

2022a). Signs of recreation use impacts were moderate, with large areas of bare ground at campsites and satellite areas beyond the campsite living spaces – both indicative of heavy campground use (City Light 2022a).

Colonial Creek Boat Launch and Fishing Pier (NPS)

The Colonial Creek Boat Launch provides the only public launch site for trailered boats on Diablo Lake. The boat launch consists of 67 paved and striped parking spaces with two accessible parking spaces with accompanying signage/markings, and a fishing pier. Overall, the boat launch and fishing pier do not meet current accessibility standards with only a few elements meeting the standards (i.e., courtesy dock, picnic site) (City Light 2022a). No noticeable recreation use impacts were observed at the boat launch and fishing pier as the site is a hardened, highly developed facility (City Light 2022a). The facility is owned and managed by NPS.

The NPS does not have information on the elevation of the bottom end of the constructed boat ramp or the minimum usable elevation of the Colonial Creek Boat Launch ramp. As a result, the percentage of time the boat ramp is usable over the period of record or during peak season (July and August) is not precisely known. However, as detailed in Section 4.2.1.2 of this Exhibit E, during most fall/winter seasons sediment coming down Rhode Creek is deposited at the boat launch ramp. These annual events typically deposit 50 to 100 cubic yards (cu yd) of sediment, which alters the minimum usable elevation of the boat ramp.

Diablo Overlook (NPS)

The Diablo Overlook near MP 132 along SR 20 provides a paved/striped parking area with accessible parking signage/markings, vault restrooms, picnic tables, interpretive displays dispersed throughout the overlook including a relief map, and expansive views of Diablo Lake and the surrounding mountain peaks. The facility is owned and managed by NPS.

Overall, the overlook does not meet current accessibility standards with only a few elements meeting the standards (i.e., parking area, restrooms), and no noticeable recreation use impacts were observed at the facility as the site is a hardened, highly developed facility (City Light 2022a).

Diablo Lake Boat-in Camps (NPS)

There are three boat-in camps on Diablo Lake—all owned and managed by NPS. Amenities available at the boat-in camps include picnic tables, fire-rings, vault toilets, bear-resistant food lockers, and floating docks. Overall, the facilities do not meet current accessibility standards with only the docks meeting the standards (City Light 2022a). At lower water levels, the slope to access the docks may exceed the requisite slopes and affect the accessibility. Signs of recreation use impacts were moderate for each of the three camps, with several signs/evidence of use impact, but not extensive or widespread impacts (e.g., signs of trash and tree cutting, user-created trails leading to shoreline areas or satellite areas) (City Light 2022a). The other predominant sign of use impact was the moderate areas of bare ground at campsites common in developed campsites (City Light 2022a).

Recreational Trails (NPS)

There are three recreational trails in the Diablo Lake area, including the Diablo Lake Trail, Thunder Knob Trail, and Thunder Creek Trail (Table 4.2.6-4). Each of these trails is described below, including a summary of the trailhead facilities and results of the qualitative trail accessibility evaluation conducted by City Light in 2021. The trails are managed by NPS.

Table 4.2.6-4. Recreational trails at Diablo Lake.

Trail	In FERC Boundary	Start	End	Length (miles one-way)	Accessible	Difficulty
Diablo Lake Trail	Partially	Environmental Learning Center Parking Area	Ross Powerhouse	3.8	No	Moderate
Thunder Creek Trail	Partially	Colonial Creek Campground (south loop)	Park Creek Pass via Fourth of July Pass	19.6	No	Strenuous
Thunder Knob Trail	Partially	Colonial Creek Campground (north loop)	Thunder Knob	1.8	No	Moderately easy

Diablo Lake Trail (NPS)

The 3.8-mile-long Diablo Lake Trail begins near the ELC and extends to the upper end of Diablo Lake near Ross Powerhouse. 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 Powerhouse. It travels in and out of the Project Boundary. The trailhead for this trail is the ELC parking area discussed above. The trail is managed by NPS.

Overall, the Diablo Lake Trail ascends approximately 1,400 ft in the first 2.5 miles to a ridge that overlooks Diablo Lake before descending steeply in the final mile to the bridge over Diablo Lake that connects to Ross Powerhouse and the Haul Road to Ross Lake/Dam. Overall, the steep running slope on the trail is the primary accessibility constraint, which is pervasive and substantial. Beyond the steep running slope, much of the start of the trail from the ELC parking area is on a varied, inconsistent trail surface with frequent sections with significant tread obstacles (3-12 inches high), including loose rocks and gravel, large, embedded rocks, and roots, most of which span the majority of (if not the entirety of) the tread width. Several narrow wooden bridge crossings are also found on the initial ascent to the ridgetop.

The tread width varies along the entirety of the trail from 18 inches in some locations to 24 to 36 inches for much of the trail. The descent from the ridgetop to the bridge over Diablo Lake has some of the steepest running slopes between 10 and 20 percent with the steepest sections in the final 0.5-mile segment. This portion of the trail also has numerous natural stepped trail surface sections and several major creek/drainage crossings consisting of large, loose rocks and boulders. Only the short, approximately 0.25-mile-long segment along the ridge/outcrop (where excellent vistas exist) is in moderate terrain with lesser slopes, more consistent trail surfacing, and fewer tread obstacles.

Overall, the accessibility constraints on this trail are substantial and pervasive throughout the trail, primarily on the segments leading to/from the ELC and the bridge over Diablo Lake. The trailhead does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Thunder Creek Trail (NPS)

The 19.6-mile-long Thunder Creek Trail starts in the south loop of Colonial Creek Campground and 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 trailhead consists of a paved parking area (18 single spaces with one accessible space) and a single-panel information kiosk. A restroom associated with the campground is located adjacent to the trailhead. The trail is managed by NPS.

Overall, the trailhead facility meets current accessibility standards (i.e., parking area and information kiosk) (City Light 2022a). No noticeable recreation use impacts were observed at the facility. The trailhead does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

In 2021, City Light evaluated the initial 1.6 miles of the trail from Colonial Creek Campground to the junction with the Fourth of July Trail. Overall, the trail ascends approximately 125 ft over the course of the 1.6-mile-segment evaluated, with mostly rolling terrain with moderate grades/slopes (i.e., 3 to 8 percent), and several short, steep sections with excessive slopes (i.e., 10 to 15 percent). The first half of the evaluated trail section has modest tread widths between 36 and 48 inches, which narrows (24 to 36 inches) along much of the second half of the trail, with increasing instances of encroaching vegetation and obstacles resulting in narrow tread widths. The most common accessibility constraints are significant tread obstacles (4 to 8 inches high) including rocks and roots, and areas of excessive cross slope (5 to 10 percent). There are also several locations where the tread width is reduced by downslope erosion. Overall, despite the rolling terrain and nominal overall rise of the 1.6-mile-long trail segment, the constraints noted above are pervasive (City Light 2022a).

Thunder Knob Trail (NPS)

The out-and-back, 1.8-mile-long Thunder Knob Trail starts in the north loop of Colonial Creek Campground and ascends approximately 425 vertical ft to the terminus of the trail at the overlook of Diablo Lake. The trailhead consists of a dirt-surfaced lot and single-panel information kiosk on the shoulder of SR 20 at the entrance to the north loop of Colonial Creek Campground. Trail users walk along the Colonial Creek Campground circulation roads to access the start of the trail approximately 0.5-miles from the trailhead parking along SR 20. The trail is managed by NPS.

Overall, the trailhead does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trailhead does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

The initial 0.1-miles of Thunder Knob Trail is often re-routed (including in 2022) due to flooding and debris from Colonial Creek, and overall has extensive accessibility constraints. These include narrow tread width ranging from 24 to 36 inches wide; inconsistent/uneven surfacing with mostly loose, rocky, and uneven tread with small stretches of sandy/small gravel surfacing; extensive tread obstacles (i.e., large rocks); and a very narrow, bridge crossing. Beyond this point, the trail widens (36 to 60 inches wide) with more consistent slopes and surfacing, much of which falls within or approaches accessibility standards, but with numerous, intermittent segments (25 to 150 ft in length) with large tread obstacles and steep running slopes (City Light 2022a).

Gorge Lake

The 4.5-mile-long Gorge Lake is largely undeveloped due to the steep topography of the shoreline and resulting access constraints. SR 20 parallels the entire lake on the north side and crosses it at the upper end near the Town of Diablo. There are four developed recreation facilities associated with Gorge Lake – a boat launch, picnic shelter, campground, and overlook.

Project Recreation Facilities

Gorge Lake Boat Launch (City Light)

The Gorge Lake Boat Launch is located adjacent to Gorge Lake Campground. The facility consists of a single-lane concrete boat launch ramp, floating courtesy dock, gravel parking area, and an information kiosk. The boat ramp and dock are on City Light land and used by City Light when boat access to Gorge Lake is needed. The facility is owned and managed by City Light.

Overall, the boat launch is in good condition and does not meet current accessibility standards, with only the dock platform meeting the standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

The Gorge Lake Boat Launch ramp is usable by trailered boats down to an elevation of 878 ft NAVD 88 (871.5 ft CoSD) (City Light 2022a). For the period of record from 1983 to 2021, the boat ramp was usable 66 percent of the year and 65 percent of the peak season (July and August), on average. During the peak season over the same period of record, the boat ramp was not usable 8.1 days in July and 11.5 days in August, on average. Notably, the Gorge Lake Boat Launch is located in a cove on the north side of Gorge Lake where gravel is deposited at the outlet to the boat launch cove, which impedes many large boats from using the launch, particularly when Gorge Lake levels are low (City Light 2022a). Notably, below 878 ft NAVD 88 (approximately 871.5 ft CoSD), the launch ramp remains usable by non-motorized watercraft and other watercraft not requiring a trailer.

Ross Lodge Picnic Shelter (City Light)

The Ross Lodge Picnic Shelter is in the Hollywood section of the Diablo townsite adjacent to Ross Lodge. The picnic shelter consists of roadside parking and a picnic shelter with picnic tables. The facility is owned and managed by City Light.

Overall, the picnic shelter is in good condition and does not meet current accessibility standards with only a few accessible elements (i.e., shelter floor and access route) (City Light 2022a). No noticeable recreation use impacts were observed at the facility (City Light 2022a).

Non-Project Recreation Facilities

Gorge Lake Campground (NPS)

The Gorge Lake Campground is located near the Town of Diablo, just downstream of the mouth of Stetattle Creek. The campground consists of eight campsites, and a two-unit vault restroom.

Each campsite has a picnic table, fire ring, bear-resistant food lockers, and vehicle parking spur. Water is not provided at this facility. The facility is owned and managed by NPS.

Overall, campground does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Gorge Creek Overlook (NPS)

The Gorge Creek Overlook is located along SR 20 at the confluence of Gorge Creek into Gorge Lake. The overlook consists of two paved parking areas on either side of Gorge Creek, a vault restroom building, and an interpretive trail. The parking areas are connected via a bridge on SR 20 with protected pedestrian walkways, which allows visitors to view Gorge Creek Falls from either parking area. The facility is owned and managed by NPS.

Overall, the overlook does not meet current accessibility standards with only a few accessible elements (i.e., restroom building and the interpretive trail) (City Light 2022a). No noticeable recreation use impacts were observed at the facility as the site is a highly developed and hardened site with sanitation facilities (City Light 2022a).

In 2021, City Light conducted a qualitative trail accessibility evaluation at the Gorge Creek Trail. The 0.6-mile interpretive trail is divided into two distinct segments. The first segment is a paved asphalt trail designed to meet accessibility standards, including accessible access to the interpretive displays along the route. While the trail is designed to accessibility standards, there are several locations where trail conditions have changed since its initial construction that have resulted in short segments that do not meet the standards. These include two areas where tree root upheaval has created inconsistent surfacing with cross slopes beyond the 5 percent standard. In addition, one of these areas also has some drainage issues where trailside debris (i.e., loose rocks and dirt) has encroached on the tread width creating an uneven and loose trail surface. The second segment is a narrower, gravel surface trail that loops back to the main parking/restroom area. This segment does not meet accessibility standards due to steep running slopes, areas of loose gravel surfacing, a narrow tread width lacking resting intervals/passing spaces, and occasional tread obstacles (roots). (City Light 2022a)

Overall, the trail provides an accessible interpretive trail opportunity for the initial segment of the trail with two inaccessible areas due to changing site conditions (City Light 2022a). The facility also provides an unpaved, inaccessible trail segment on the second half of the loop, but with trail conditions signs allowing visitors to determine if the trail is navigable based on the difficulty rating and noted conditions.

Recreational Trails

There are three non-Project recreational trails in the Gorge Lake area, including the Diablo Dam Trail, Sourdough Mountain Trail, and Stetattle Creek Trail (Table 4.2.6-5). Each of these trails and associated trailhead facilities are described below.

Table 4.2.6-5. Non-Project Recreational trails at Gorge Lake.

Trail	In FERC Boundary	Start	End	Length (miles one-way)	Accessible	Difficulty
Diablo Dam Trail	Yes	Reflector Bar (Diablo townsite)	Road between Diablo Dam and Incline Lift	0.5	No	Moderate
Sourdough Mountain Trail	Partially	Hollywood (Diablo townsite)	Sourdough Mountain Lookout	5.2	No	Strenuous
Stetattle Creek Trail	Partially	Hollywood (Diablo townsite)	(No defined terminus)	3.0	No	Moderate

Diablo Dam Trail (NPS)

The 0.5-mile Diablo Dam Trail originates in the Reflector Bar section of the Diablo townsite and was originally constructed to provide a means of reaching Diablo Dam if other access (i.e., road and helicopter) was unavailable. Currently, this trail appears to receive very little use and in recent years has been used mostly by NCI staff who lived in Diablo and worked at the ELC, or by City Light staff. The trail does not have a formal trailhead and informal parking occurs along the road shoulder. The trail is managed by NPS.

Overall, the informal trailhead parking area does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Diablo Dam Trail ascends steeply approximately 350 vertical ft from the informal parking area to the terminus of the trail at the paved road leading to Diablo Dam. The primary accessibility constraints are the steep running slope of the trail that is continuous for the majority of the trail and the varied, inconsistent trail surface that is predominantly loose rock with significant tread obstacles (3 to 18 inches high). In addition, the trail tread width is narrow (12 to 24 inches) with prevalent excessive cross slopes combined with eroding tread width on the downhill side of the trail. Overall, the accessibility constraints on this trail are substantial and pervasive throughout the trail. The trail does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Sourdough Mountain Trailhead (NPS/City Light)

The Sourdough Mountain Trailhead is located on City Light property in the Hollywood section of the Diablo townsite. The trail leads steeply away from the Project/Gorge Lake area to the Sourdough Mountain lookout and into North Cascades National Park. The trailhead consists of paved roadside parking, a single-panel information kiosk, and a trail marker. The trail is managed by NPS though the parking area is along an access road maintained by City Light.

Overall, the trailhead does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trail does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Stetattle Creek Trailhead (NPS/City Light)

The Stetattle Creek Trailhead is located on City Light property in the Hollywood section of the Diablo townsite at the mouth of Stetattle Creek. The trail leads away from the Project/Gorge Lake area along Stetattle Creek and north into North Cascades National Park. The trailhead consists of an unmarked gravel roadside parking area and a trail marker. The trail is managed by NPS though the parking area is along an access road maintained by City Light.

Overall, the trailhead facility does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a). The trail does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles.

Newhalem

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 the RLNRA. The Newhalem townsite is owned by City Light where a number of visitor amenities are provided, including restrooms, an information center, parking, picnic tables, playground equipment, trails, and interpretive signs.

<u>Project Recreation Facilities</u>

Gorge Inn Museum (City Light)

The Gorge Inn Museum is in the front of the Gorge Inn on the south end of Main Street in Newhalem. The Gorge Inn, constructed in 1920, is the oldest building remaining at the Project and served as the cookhouse for City Light crews and visitors until sometime in the 1970s when it was closed due to the need for major repairs, at which time food services were moved to Diablo. It was completely renovated in 2010 and again serves as a dining hall for City Light staff and visitors. The facility is owned and managed by City Light.

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 the role of J.D. Ross, the long-time superintendent and “Father of City Light” who conceived of and drove the construction of the Project. 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 has also recently offered the Dam Good Chicken Dinner to the public two nights per week.

Gorge Powerhouse Visitor Gallery (City Light)

The visitor gallery was added to Gorge Powerhouse in 1949 when that structure was expanded. The gallery 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, including how hydroelectricity is generated, the history of the Project, Project operations, and environmental programs included in the current Project license. The visitor gallery is open to the public daily from May through October. The facility is owned and managed by City Light.

Recreational Trails

There are two Project recreational trails in the Newhalem townsite, including the Ladder Creek Falls Trail and Garden and Trail of the Cedars (Table 4.2.6-6). Each of these trails and associated trailhead facilities are described below.

Table 4.2.6-6. Recreational trails in Newhalem.

Trail	In FERC Boundary	Start	End	Length (miles one-way)	Accessible	Difficulty
Ladder Creek Falls Trail	Yes	Gorge Powerhouse Footbridge	Ladder Creek Falls	0.3	No	Easy
Trail of the Cedars	Yes	Newhalem Suspension Bridge	-	0.4	No	Easy

Ladder Creek Falls Trail and Garden (City Light/NPS)

Ladder Creek Falls Trail and Garden is located on federal land administered by NPS within the Project Boundary. The Ladder Creek Falls Trail is a 0.3-mile loop trail that leads to Ladder Creek Falls, a dramatic series of waterfalls in a slot canyon, and winds along the creek and through a garden developed on the adjacent hillside. The trail includes four interpretive panels, three wooden benches, and colored lighting that illuminates the falls and surrounding features at night. The facility is open year-round and managed by City Light.

The trail and garden 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. In 2009, City Light refurbished the trail and lights and added several interpretive panels. Currently, colored light-emitting diode lights illuminate the falls from dusk to 11 pm each night.

The trail does not have a designated trailhead; instead, visitors start in the Gorge Powerhouse parking area and follow a directional sign. The facilities are in good condition, the trail does not meet accessibility standards, and does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles (City Light 2022a).

Trail of the Cedars (City Light/NPS)

This 0.4-mile-long interpretive trail is located within the Project Boundary on NPS land and provides pedestrian access from Newhalem to the Newhalem Creek Powerhouse, and links with a NPS trail that leads to Newhalem Campground downstream of Newhalem. 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. 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. The facility does not have a designated trailhead; instead, visitors utilize the general parking areas in Newhalem (see below). Although management responsibilities are not defined in the current license, they are generally shared between City Light and NPS. Both City Light and NPS have undertaken management tasks on this trail under the current license. Trail of the Cedars is a provision of the Newhalem Creek Project license; however, City Light proposes to make this a Skagit Hydroelectric Project facility as City Light filed an application to surrender and decommission the Newhalem Creek Project.

The trail is a compacted, gravel surface trail ranging from 3 to 6 ft in width. A total of 28 interpretive displays are dispersed along the trail. The displays generally consist of synthetic panels with metal frames on metal posts unless affixed to a structure. The displays are either situated along the edge of the trail or at the Newhalem Creek Powerhouse building. The Newhalem Creek Powerhouse building serves as an interpretive feature at the midpoint of the trail with windows allowing visitors to observe various powerhouse facilities. All the interpretive displays are in good condition though the information on some of the trail interpretive displays is outdated.

Regarding the qualitative trail accessibility evaluation, the trail has few constraints, and the majority of the trail meets accessibility standards, including surfacing (compacted/firm and stable), clear tread width (mostly 48 to 60 inches wide with short segments 36 inches wide), cross slopes (5 percent or less), and running slopes (largely between 0 and 5 percent with short segments between 8 and 12 percent). However, several locations along the trail had notable constraints, including several steep running slope segments exceeding the 12 percent threshold, a short segment where the cross slope exceeded the 5 percent threshold, and one location where a tree uprooted, and the root-ball impeded the clear tread width. The running slope segments of note included a 60 ft-long segment at the start of the trail between 19 and 22 percent slope, a 30 ft-long segment in the first third of the trail with 12 to 14 percent slope, and a 125 ft-long segment in the middle of the trail with 12 to 14 percent slope. Overall, the trail is close to meeting the standards outside of a few notable constraints. The trail does not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles (City Light 2022a).

Skagit Information Center (City Light)

The Skagit Information Center is just off SR 20 on Main Street in Newhalem. 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. In recent years, the center has been staffed by employees from City Light, NPS, and NCI from Memorial Day weekend into September. At the facility, visitors may obtain a free pamphlet with a self-guided walking tour of Newhalem if they wish to explore the historical features of the townsite at their own pace. The facility is owned and managed by City Light.

Other Newhalem Recreation/Visitor Facilities

Several other recreational and visitor service facilities are in Newhalem. These include general parking areas, picnic tables, interpretive displays, playground equipment, public restrooms, and a general store. All of these facilities are owned and managed by City Light. Each of these facilities is described below.

Parking Areas (City Light)

The Newhalem townsite has three designated parking areas dispersed throughout the townsite, including on Main Street, along SR 20, and at the Gorge Powerhouse/Ladder Creek Falls Trail and Garden.

The Main Street parking area is located on Main Street in Newhalem. The facility provides a paved parking area with 24 striped parking spaces including three accessible spaces. This parking area provides access to numerous Newhalem recreation facilities and buildings including the Skagit Information Center, Gorge Inn Museum, Skagit General Store, and the picnic, playground, and interpretive displays. Overall, the parking area is in good condition, and does not meet current accessibility standards. No noticeable recreation use impacts were observed at the facility(City Light 2022a).

The SR 20 gravel parking area is located on the north side of SR 20 in Newhalem. The facility provides a gravel parking area for 30 single vehicles (2 accessible spaces) as well as an area for overflow RV and trailer parking since these types of vehicles are not permitted on Main Street in Newhalem. The facility also has trash/dumpster facilities and two dual, 30-amp and 70-amp, electric vehicle charging stations. Overall, the parking area facilities are in good condition, do not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

The Gorge Powerhouse parking area is located at the east end of Newhalem along the Skagit River. The parking area consists of a gravel parking area and interpretive displays. The parking area also serves as the trailhead parking for the adjacent Ladder Creek Falls Trail and Garden. Overall, the parking area is in good condition, does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Picnic Sites (City Light)

There are 17 picnic sites dispersed throughout the Newhalem townsite along Main Street, along SR 20, and near the start of the Trail of the Cedars. Each picnic site consists of a picnic table, and some are connected to the SR 20 gravel parking area via an access route that meets accessibility standards. Overall, the picnic sites are in good condition, do not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Interpretive Displays (City Light)

There are seven interpretive displays dispersed throughout Newhalem, primarily along either side of Main Street. The interpretive displays are named The Iron Horse of the Skagit; Automobiles Come to the Skagit; The Meaning of Place; Newhalem Company Town; Spinning Waterwheel; Temple of Power; and Chinook Redd. Overall, the interpretive displays are in good condition, do not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Playground Equipment (City Light)

A playground structure is located off Main Street, which provides multiple play structures and equipment. Overall, the playground equipment is in good condition, does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Skagit General Store (City Light)

The Skagit General Store, located on Main Street, is open to the public. The store originally served the needs of employees working on the Project and their families. 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.

<u>Non-Project Recreation Facilities</u>

There are no non-Project recreation facilities in Newhalem.

Skagit River

<u>Project Recreation Facilities</u>

There are no Project recreation facilities along the Skagit River downstream of Newhalem.

<u>Non-Project Recreation Facilities</u>

Newhalem Creek Campground (NPS)

The Newhalem Creek Campground is on the south side of the Skagit River. Entrance to the campground is via a single-lane bridge near MP 120 on SR 20. The campground has 107 individual sites (2 accessible sites; 13 walk-in sites) and two group sites. The facility is owned and managed by NPS. Facilities include water, picnic tables, fire rings, bear-resistant food storage containers, flush toilets, picnic shelters, recycling receptacles, garbage service, and an RV dump station. Campers can access the nearby NPS North Cascades Visitor Center and the Newhalem townsite via short hiking and interpretive trails originating in the campground. The Newhalem Creek Campground can accommodate large RVs. Sites may 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. The campground is open from approximately Memorial Day weekend through September but closed during the off-peak season.

North Cascades National Park Visitor Center (NPS)

The North Cascades National Park Visitor Center is located adjacent to the Newhalem Creek Campground and provides interpretive trails around the facility. Inside there is a theater featuring a large format slide program and video presentation, multimedia exhibits on the park's natural and cultural history, relief map of the region, NPS staffed information desk, a gift shop, and flush restrooms. The visitor center is open to the public daily from May through September. The facility is owned and managed by NPS. (NPS 2022c).

Goodell Creek Campground (NPS)

The 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 consists of 21 sites (19 standard sites and 2 group sites), a picnic shelter, potable water, vault restroom buildings, trash facilities, and an information kiosk. Each campsite includes a picnic table, fire ring, bear-resistant food lockers, and vehicle parking spur. Goodell Creek Campground is suitable for tents and small RVs. Sites may be reserved during the summer season; the campground remains open during the off-peak season as well, when sites are available on a first-come, first-served basis. The facility is owned and managed by NPS.

City Light conducted accessibility and use impact assessments at this facility. Overall, the campground does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility beyond large areas of bare ground which is typical of developed campsites (City Light 2022a).

Goodell Creek Boat Launch (NPS)

The Goodell Creek Boat Launch is on the Skagit River adjacent to the Goodell Creek Campground. The site provides opportunities for cartop launching of non-motorized boats into the Skagit River. This site is frequently used by private and commercial whitewater boaters. The boat launch consists of a dirt and gravel launch ramp, paved parking area, picnic sites, trash facilities, and information kiosk. The facility is owned and managed by NPS.

Overall, the boat launch does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Damnation Creek Boat-in Picnic Site (NPS)

The Damnation Creek Boat-in Picnic Site is on the Skagit River between the Goodell Creek Boat Launch and Copper Creek Boat Access Site. The picnic site provides riverside opportunities for picnicking and is accessed primarily by boaters on the Skagit River. The picnic site consists of two picnic sites and a single-unit vault restroom building. The facility is owned and managed by NPS.

Overall, the picnic site does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Copper Creek Boat Access Site (NPS)

The Copper Creek Boat Access Site is on the Skagit River downstream of the Goodell Creek Boat Launch and Damnation Creek Boat-in Picnic Site. The site provides opportunities for cartop launching for non-motorized boats into the Skagit River. The facility consists of a dirt and gravel launch ramp, gravel parking area, and a single-unit vault restroom building. The facility is owned and managed by NPS, though notably the land is owned by City Light.

Overall, the site does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Marblemount Boat Launch (USFS)

The Marblemount Boat Launch is distant from the generating facilities and City Light-owned towns but was brought into the Project Boundary as required by the current Project license. The construction was funded by City Light under the current Project license and is currently managed by USFS. The Marblemount Boat Launch is on the Skagit River, just upstream of the confluence with the Cascade River and about 12 miles downstream from Newhalem. The boat launch provides a public, unpaved boat launch, gravel parking area, a portable restroom building, and an information kiosk.

Overall, the boat launch does not meet current accessibility standards, and no noticeable recreation use impacts were observed at the facility (City Light 2022a).

Recreational Use

Information on recreation use in the Project vicinity is available in NPS reports related to the broader RLNRA. Overall, visitation to RLNRA generally ranged from 700,000 to 1,100,000 visitors annually from 2010 to 2021, peaking in 2019 with 1,088,528 visitors.

City Light is currently collecting recreation use and facility occupancy data specific to the Project vicinity as part of the Recreation Use and Facility Assessment, which will not be complete until late 2022/early 2023 (i.e., data collection through October 2022; data analysis through December 2022). As part of the Updated Study Report (USR) and FLA, City Light will include the recent study-specific recreation use data and agency recreation use data for 2021 and 2022, as available.

Angling

Fishing is permitted on all three Project reservoirs. Seasons and tackle restrictions vary by reservoir. Anglers 15 years and older must have a Washington State fishing license. Bull Trout/Dolly Varden are protected and must be released if caught from all Project waters and river segments.

Ross Lake is open to fishing July 1 to October 31 (Washington Department of Fish and Wildlife [WDFW] 2022). 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 2022). 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).

Recreational River Opportunities

Angling

Fishing is permitted on the mainstem Skagit River. Seasons and tackle restrictions vary by respective river segment. Anglers 15 years and older must have a Washington State fishing license. Bull Trout/Dolly Varden are protected and must be released if caught from river segments (WDFW 2022).

Fishing on the Skagit River from Gorge Powerhouse to the Marblemount Bridge is open June 1 to January 31. The river within the RLNRA is closed to motorized boats. This section of the Skagit River 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 (WDFW 2022).

Whitewater Boating

Gorge Bypass Reach

Currently, there are no established locations for the public to access the Gorge bypass reach because, for safety and resource protection reasons, the NPS prohibits public access to the reach (NPS 2021). The Gorge bypass reach is a relatively steep, confined bedrock canyon with large boulder and cobble substrate (NPS 2020). The reach is 2.5 miles in length with an overall gradient of 97 feet per mile from the plunge pool at the base of Gorge Dam to Gorge Powerhouse. This gradient is similar to other whitewater runs with Class IV to V difficulty. The gradient varies within the Gorge bypass reach with steeper gradients at the more prominent rapids at approximately Project River Miles (PRMs) 96.75, 95.75, 95.5, and 95.25, and river sections between the rapids with lower gradient, calm, and non-turbulent water. The prominent rapids are formed by a combination of the steeper gradient and channel constrictions from the canyon walls and boulder substrate.

Based on land-based observations of the reach as part of the RA-02 Bypass Safety and Whitewater Boating Study, boaters participating in the study stated that all the rapids appeared navigable and that portage routes were likely available for all the major rapids as well (City Light 2022b). The boaters participating in the study also identified potential locations for access to the Gorge bypass reach, including put-in locations along the service road below Gorge Dam, two takeout locations in Newhalem near the Trail of the Cedars and Gorge Powerhouse, and numerous river egress options throughout the reach (City Light 2022b).

Concurrent with the land-based observations of the reach, a structured focus group discussion was conducted with the boaters which determined the following: (1) the whitewater difficulty for the Gorge bypass reach ranged from Class IV to Class V; and (2) the boatable flow range was likely between 750 and 2,000 cubic feet per second (cfs). (City Light 2022b). City Light will refine the boatable flow range for the Gorge bypass reach as part of the Level 3 multiple flow evaluation, which is expected to occur in 2023; City Light will provide a status update on implementation of the Level 3 multiple flow evaluation in the USR.

Boaters described the Gorge bypass reach as a “five-star” and “stand-out” run at 1,200 cfs (i.e., flow observed by boaters); and said there is not another run of this caliber in the Skagit River drainage, and it would likely be a top tier run in Washington (City Light 2022b). Further, the short shuttle combined with the easy access at the put-in and take-out enhance the attraction to this whitewater opportunity, particularly if scheduled releases were available in a July through September time frame (City Light 2022b).

Skagit River Downstream of Newhalem

The Skagit River downstream of Newhalem through the RLNRA (i.e., to Bacon Creek) is closed to motorized boats except for those used by City Light, Indian Tribes, and agencies for monitoring purposes, and there are no publicly 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, including during 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 public and commercial access for all types of watercraft to downstream sections of the Skagit River. Similarly, the NPS oversees the non-motorized boat launches at Goodell Creek, Damnation Creek, and Copper Creek sites. Generally, this portion of the Skagit River is divided into three segments, including Goodell Creek to Copper Creek, Copper Creek to Marblemount Boat Launch, and Marblemount Boat launch to Howard Miller Steelhead Park (Rockport). The recreational characteristics for each of these segments is summarized in Table 4.2.6-7 and discussed in detail in the following section.

Table 4.2.6-7. River recreation characteristics for three segments of Skagit River.

River Segment	Length (miles)	Gradient (feet/mile)	International Scale of Whitewater Difficulty	Guidebook Flow Range (cfs)	Watercraft Type
Goodell Creek Boat Launch to Copper Creek Boat Access Site	8.7	12	II-III	1,500-15,000	Kayaks, canoes, inflatable kayaks, stand-up paddleboards, rafts, dories
Copper Creek Boat Access Site to Marblemount Boat Launch	5.9	10	I-II	1,500-12,000	Kayaks, canoes, inflatable kayaks, stand-up paddleboards, rafts, dories
Marblemount Boat Launch to Howard Miller Steelhead Park	10.6	8	I-II	2,000-7,000	Kayaks, canoes, inflatable kayaks, stand-up paddleboards, rafts, dories, motorized boats

Goodell Creek to Copper Creek Segment

Per American Whitewater, the 8.7-mile river segment from Goodell Creek to Copper Creek is described as an excellent river section for advanced beginners to practice paddling skills. The wave train in the S-Bends Rapid is the largest hydraulic feature and is rated Class III whitewater difficulty. This segment of the river is suitable for inflatable and hard-sided watercraft. (American Whitewater 2022a)

The Goodell Creek to Copper Creek river segment is located entirely within the RLNRA. All day-use access sites are managed by the NPS, including Goodell Creek Boat Launch, Damnation Creek Boat-in Picnic Site, and Copper Creek Boat Access Site. This area is designated as the Skagit River Zone in the RLNRA General Management Plan (NPS 2012). No overnight camping is allowed on the Skagit River between the Goodell Creek Boat Launch and the RLNRA downstream boundary. Management focus for this zone in the RLNRA is non-motorized river-based recreation. The public is not allowed to use motorized watercraft on this segment of the river.

This river segment has several notable rapids, referred to as the S-Bends or Shovel Spur (North 1992), which contain the most difficult rapids on the river segment. The S-Bends are three rapids that occur in short succession starting 5.9 miles downstream from the Goodell Creek Boat Launch with individual rapids from upstream to downstream named Youssarian (Class II), Dolly Parton

(Class III), and Jack the Ripper (Class III) (North 1992). Portage routes are available on both sides of the river, though the river left option is recommended (North 1992, City Light 2022c). Additional informal river access locations to and from SR 20 exist upstream and downstream of the S-Bends.

Copper Creek to Marblemount Boat Launch Segment

The 5.9-mile river segment from Copper Creek to Marblemount is rated Class I-II whitewater difficulty. This low gradient river section offers opportunities to quietly float and observe the adjacent forest, meander bends, and gravel bars set against the broad landscape views of mountains and glaciers to the east. SR 20 is visible from the river in some locations. The Marblemount Boat Launch can be used as the take-out, although some boaters combine this segment with the section downstream choosing to boat to Howard Miller Steelhead Park (American Whitewater 2022b). Marblemount Boat Launch includes a gravel ramp for trailered boats, gravel parking lot for vehicles and trailers, restroom, and river trail (City Light 2022c). The Marblemount Boat Launch is managed by the Mt. Baker-Snoqualmie National Forest.

Marblemount Boat Launch to Howard Miller Steelhead Park Segment

The river segment from Marblemount to Howard Miller Steelhead Park is rated Class I-II whitewater difficulty. This 10.6-mile section is similar in character to the river segment from Copper Creek to Marblemount and offers opportunities to quietly float and observe the adjacent forest, meander bends, and gravel bars set against the broad landscape views of mountains and glaciers to the east. In addition, this section flows through the Skagit River Bald Eagle Natural Area (The Nature Conservancy 2021) where large populations of bald eagles spend the winter. This segment of the Skagit River is popular with floaters during the winter months to observe the bald eagles. Boaters are asked to launch after 11 am during the winter season to avoid disturbing eagles in the morning hours when they typically feed on adjacent gravel bars.

Howard Miller Steelhead Park is managed by Skagit County Parks and Recreation Department. Facilities at the 104-acre Howard Miller Steelhead Park include a paved boat ramp, restrooms, showers, playground, picnic area and shelter, trails for hiking, biking and horses, wildlife viewing, RV dump station, cabin rental, and camping (Skagit County Parks and Recreation 2022). Skagit County charges a $5 fee to use the boat ramp.

The Skagit River Bald Eagle Interpretive Center (SRBEIC) is co-located at the Howard Miller Steelhead Park. The SRBEIC hosts guided walks in December and January along the Skagit River and provides educational programs focused on the Skagit River ecosystem (SRBEIC Programs 2022).

The Sutter Creek rest area at MP 100 on SR 20 offers an alternative location to access the river. Older maps for the river corridor identify Sutter Creek as a boat ramp suitable for trailered boats. The boat ramp is no longer suitable for trailered boat access due to scour from Sutter Creek. This location is more suitable for smaller boats carried to the river down the bank. The launch site does not include parking and offers only a small turn-around not suited for trailered vehicles, though the adjacent rest area provides ample parking.

Land Use and Management

City Light-Owned Fish and Wildlife Mitigation Lands

City Light has acquired approximately 10,804 acres of river floodplain and upland forests in the Skagit, Sauk, and South Fork Nooksack watersheds for the primary purpose of fish and wildlife habitat protection and stewardship. (City Light 2019). All fish and wildlife mitigation lands are open to the public for daytime non-motorized recreation (City Light 2018). Known uses include hunting, fishing, and wildlife viewing. Visitor counts are not conducted on these lands. Overnight camping and fires are not permitted on mitigation lands, but the following activities are:

(1) Hiking and cross-country skiing;

(2) Horseback-riding on designated trails;

(3) Picnicking;

(4) Collection of berries, mushrooms, or plant material for non-commercial uses; activity must not result in degradation of habitat conditions;

(5) 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;

(6) Fishing, subject to all applicable laws and regulations;

(7) Leashed pets; hunting dogs may be used off-leash while owner is actively hunting and must always remain under owner's control; and

(8) Use of licensed motorized vehicles on open improved roads when not gated.

Shoreline Buffer Zones

The three Project reservoirs and the associated Project Boundary lie wholly within the RLNRA, which is managed by the NPS for recreation and resource protection. There are no designated shoreline zone buffers in the RLNRA. Downstream of the Project, NPS manages the Skagit River and adjacent riparian corridor within the RLNRA for natural and cultural resource preservation and river recreation (NPS 2012). This zone is approximately 0.25 miles on either side of the Skagit River through this area.

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 federal lands administered by NPS.

Designated Scenic and Protected River Segments

<u>Skagit Wild and Scenic River System</u>

On November 10, 1978, Congress designated a section of the Skagit River as a Wild and Scenic River (WSR) from "the pipeline crossing at Sedro-Woolley upstream to and including the mouth of Bacon Creek" (Public Law 95-625). The entire Skagit WSR System as designated by Congress includes a combined total of 158.5 miles of the Skagit, Sauk, Suiattle, and Cascade rivers. The Skagit River segment of the WSR extends from about River Mile (RM) 24.5 to RM 83, a reach of 58.5 miles, and is designated as recreational, whereas the Sauk, Suiattle, and Cascade River segments of the Skagit WSR System are designated as scenic (Figure 4.2.6-1). The Skagit WSR System includes about 39,000 acres within the river corridor, about 50 percent of which is privately owned, primarily in the Skagit and lower Sauk (USFS 2019a). The USFS Mt. Baker-Snoqualmie National Forest has management responsibility for the Skagit WSR System, including in-corridor land uses on federal lands and regulation of surface waters for recreational activities (USFS 1983).

The Skagit WSR System provides opportunities for whitewater boating, floating, angling, and bald eagle viewing. There are two public boat launch sites located in the Skagit WSR System on federal lands administered by the USFS that have been brought into the Project Boundary as non-continuous Project lands - Marblemount Boat Launch and Sauk River Boat Launch. The construction of both sites was funded by City Light under the current Project license and are currently managed by the USFS. The Marblemount Boat Launch 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 Boat Launch is about 35 miles from Newhalem, just off SR 530 near the confluence of the Sauk and Suiattle rivers.

Skagit WSR System Extension

Based on the findings of the Skagit Wild and Scenic River Eligibility and Suitability Study, the NPS has recommended to extend WSR designation, with the 'recreational' classification, to include the western boundary of the RLNRA to Gorge Powerhouse and two major Skagit River tributaries in this reach: Goodell Creek and Newhalem Creek. The designation amendment would include the Skagit River from Bacon Creek to Gorge Powerhouse, RM 83.18 to RM 94.2, respectively, a reach of 11 miles, 13 miles of Goodell Creek, and 9 miles of Newhalem Creek for a total distance of 33 miles (NPS 2012). As of 2022, this segment is not designated nor has legislation been put before Congress.

<u>Illabot Creek WSR</u>

On December 19, 2014, Congress designated 14.3 miles of Illabot Creek as a Wild and Scenic River, with 4.3 miles classified as wild and 10 miles classified as recreational (Public Law 113-291). As with the Skagit System, Mt. Baker-Snoqualmie National Forest is the managing agency for the Illabot Creek WSR. Approximately 2.1 miles of this wild and scenic river crosses through the City Light-owned Illabot South wildlife mitigation property.

<u>Washington State Scenic River System</u>

The Skagit, Sauk, Suiattle, and Cascade rivers are Washington rivers of statewide significance under Chapter 173-18 of the Washington Administrative Code, wherein a river of statewide significance is defined as a river west of the Cascade Mountains with a mean annual flow of 1,000 cfs or more. However, none of these rivers, nor Illabot Creek, have been included to date in the Washington State Scenic River System per the Revised Code of Washington Chapter 79.72.

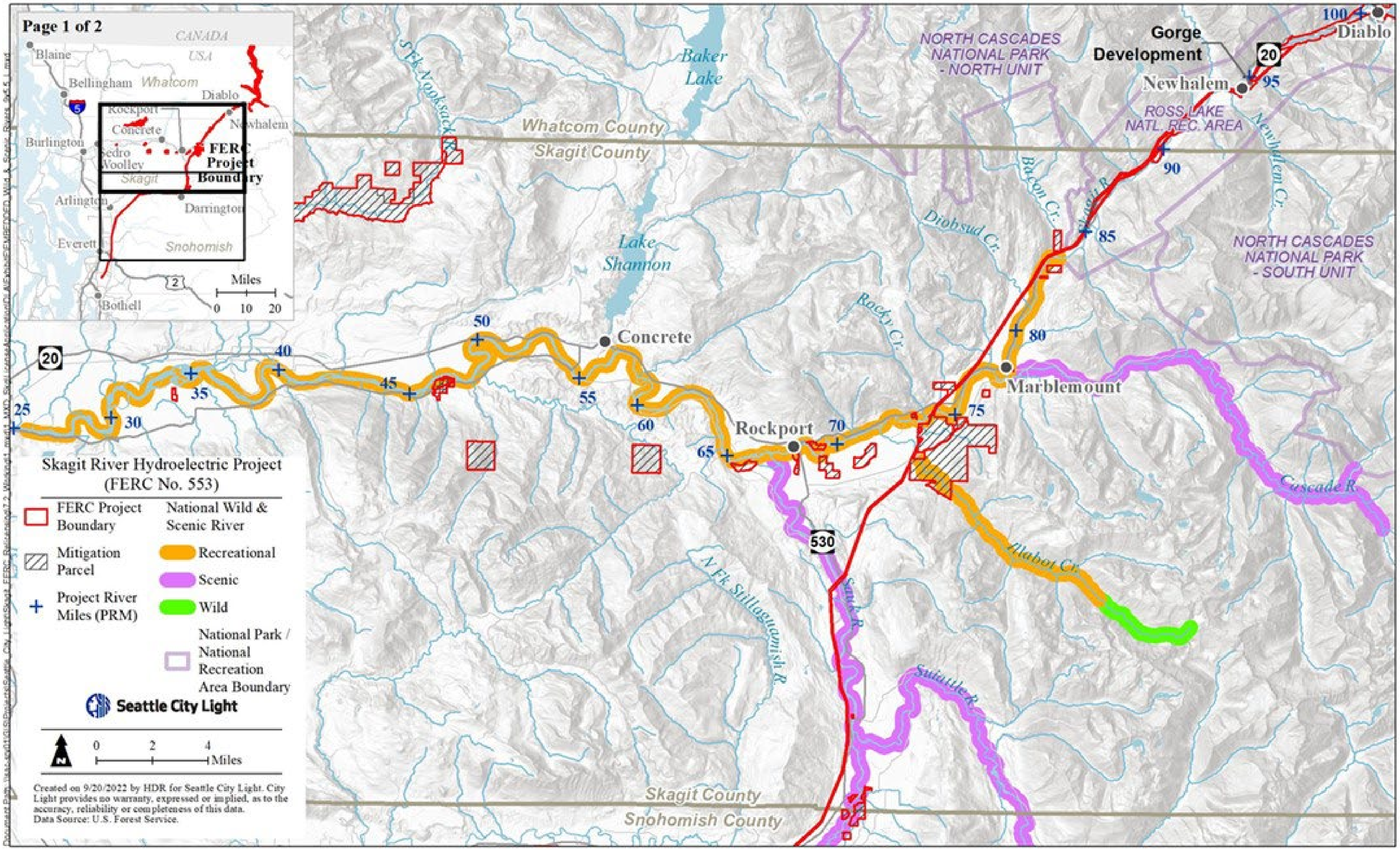


Figure 4.2.6-1. Wild and Scenic River designations in the Project vicinity (page 1 of 2).

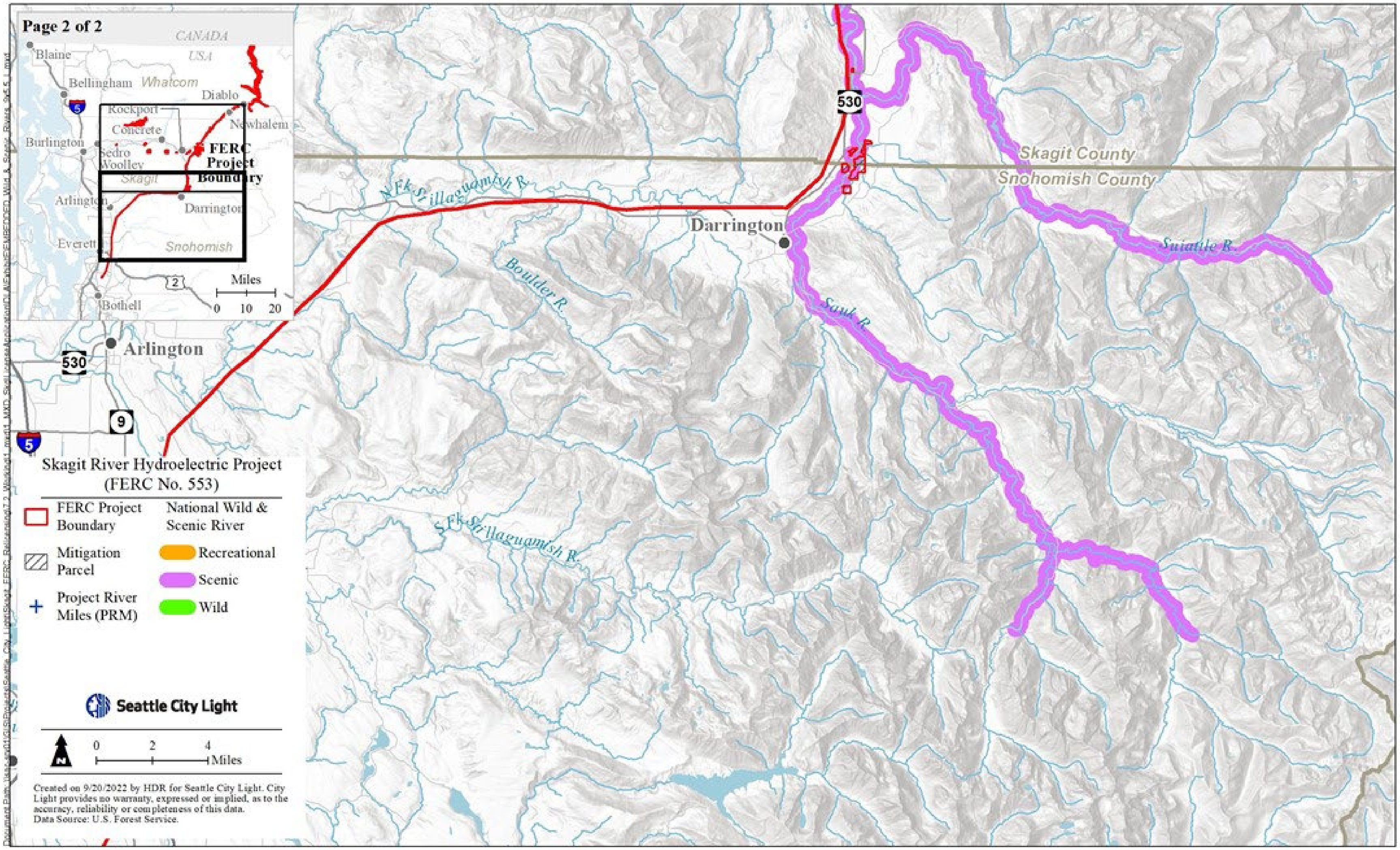


Figure 4.2.6-1. Wild and Scenic River designations in the Project vicinity (page 2 of 2).

National Trail 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 2019b).

Pacific Northwest Scenic Trail

The PNT is the only national scenic trail that intersects the Project Boundary (Figure 4.2.6-3). 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 the 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 Bureau of Land Management resource area, lands managed by the Washington Department of Natural Resources (DNR), Idaho Department of Lands, Washington State Parks, Idaho State Parks, and small sections of private land (USFS 2018). The PNT overlaps with a portion of the Pacific Crest Trail in the Pasayten Wilderness.

Pacific Crest Trail

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 4.2.6-2). 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 in the Project vicinity (Pacific Crest Trail Association [PCTA] 2019). Section L starts at the Rainy Pass Trailhead in the Okanogan-Wenatchee National Forest and continues north for 66.7 miles and 13,244 feet of cumulative elevation gain to Manning Park, BC (AllTrails 2019).

National Wilderness Preservation System

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 4.2.6-2). However, the federally designated Stephen Mather Wilderness is located on North Cascades National Park Service Complex lands surrounding and adjacent to the Project (NPS 2019c). The Stephen Mather Wilderness includes portions of the North Cascades National Park, RLNRA, and the Lake Chelan National Recreation Area (Wilderness Connect 2019). Public Law 100-668 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 is managed by NPS. Within the RLNRA, over 80,000 acres are designated wilderness. Over 5,000 additional acres within the RLNRA in the Big Beaver (1,554 acres) and Thunder Creek (3,559 acres) watersheds 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.

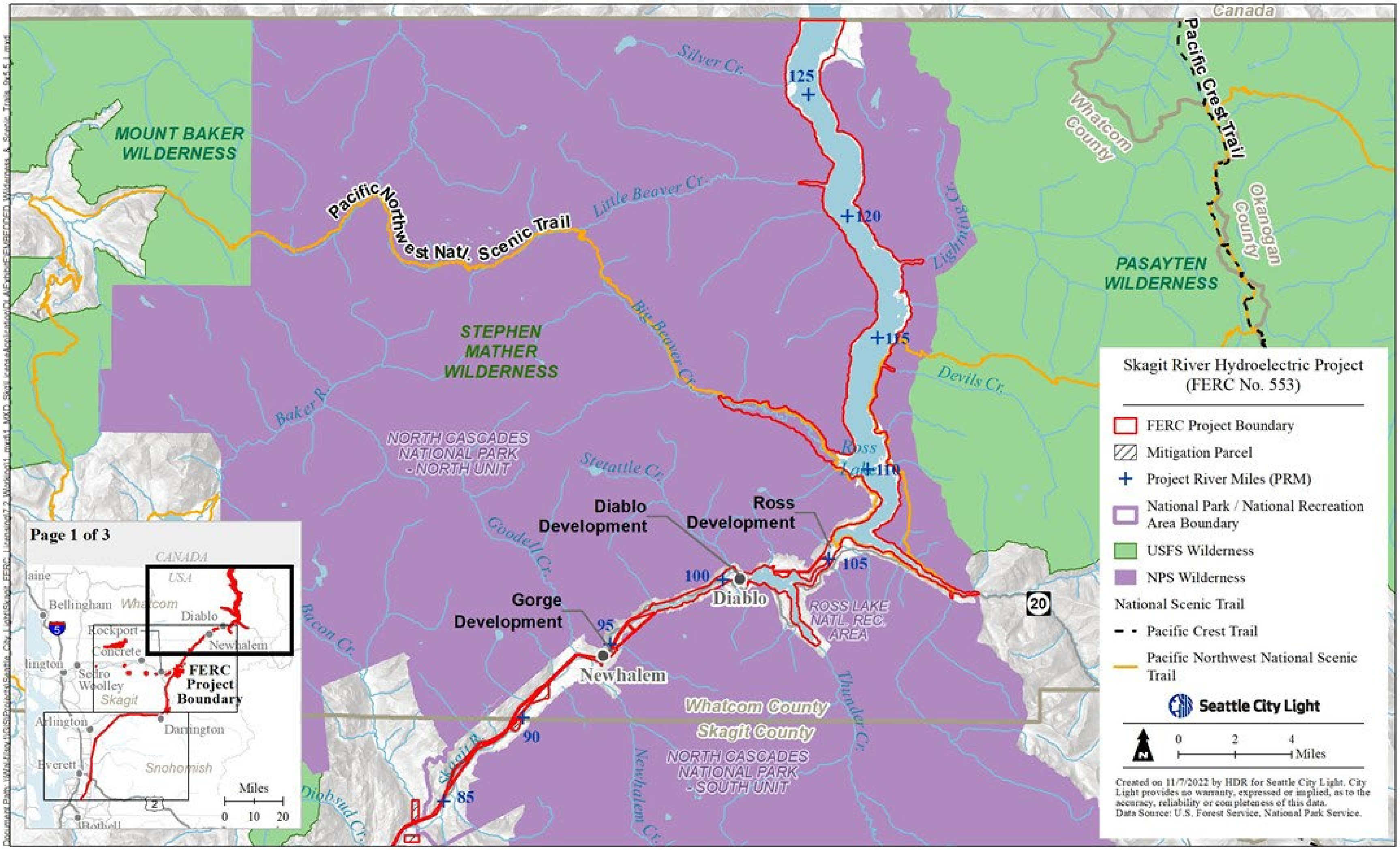


Figure 4.2.6-2. National Scenic Trails and Wilderness Areas in the Project vicinity (page 1 of 3).

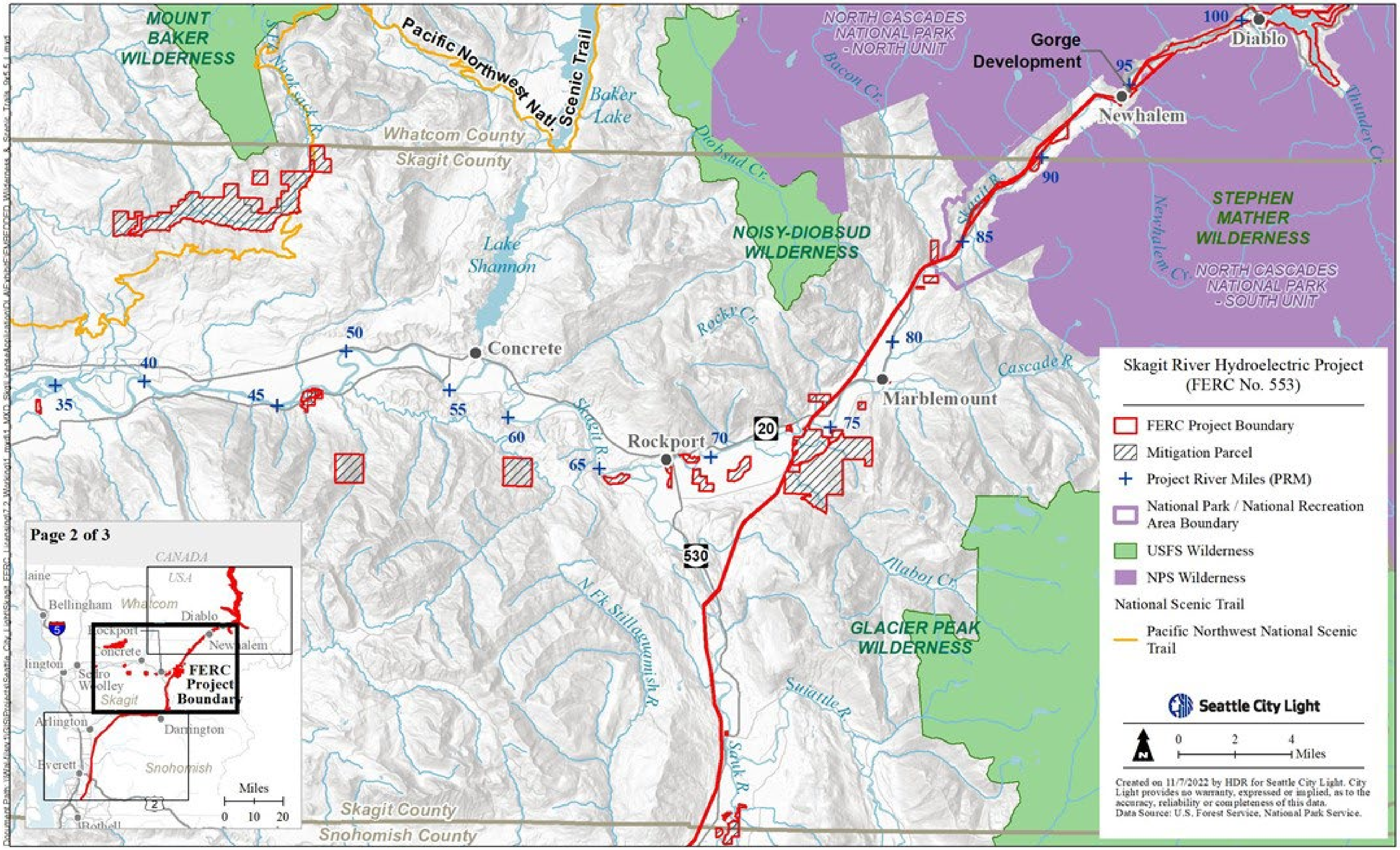


Figure 4.2.6-2. National Scenic Trails and Wilderness Areas in the Project vicinity (page 2 of 3).

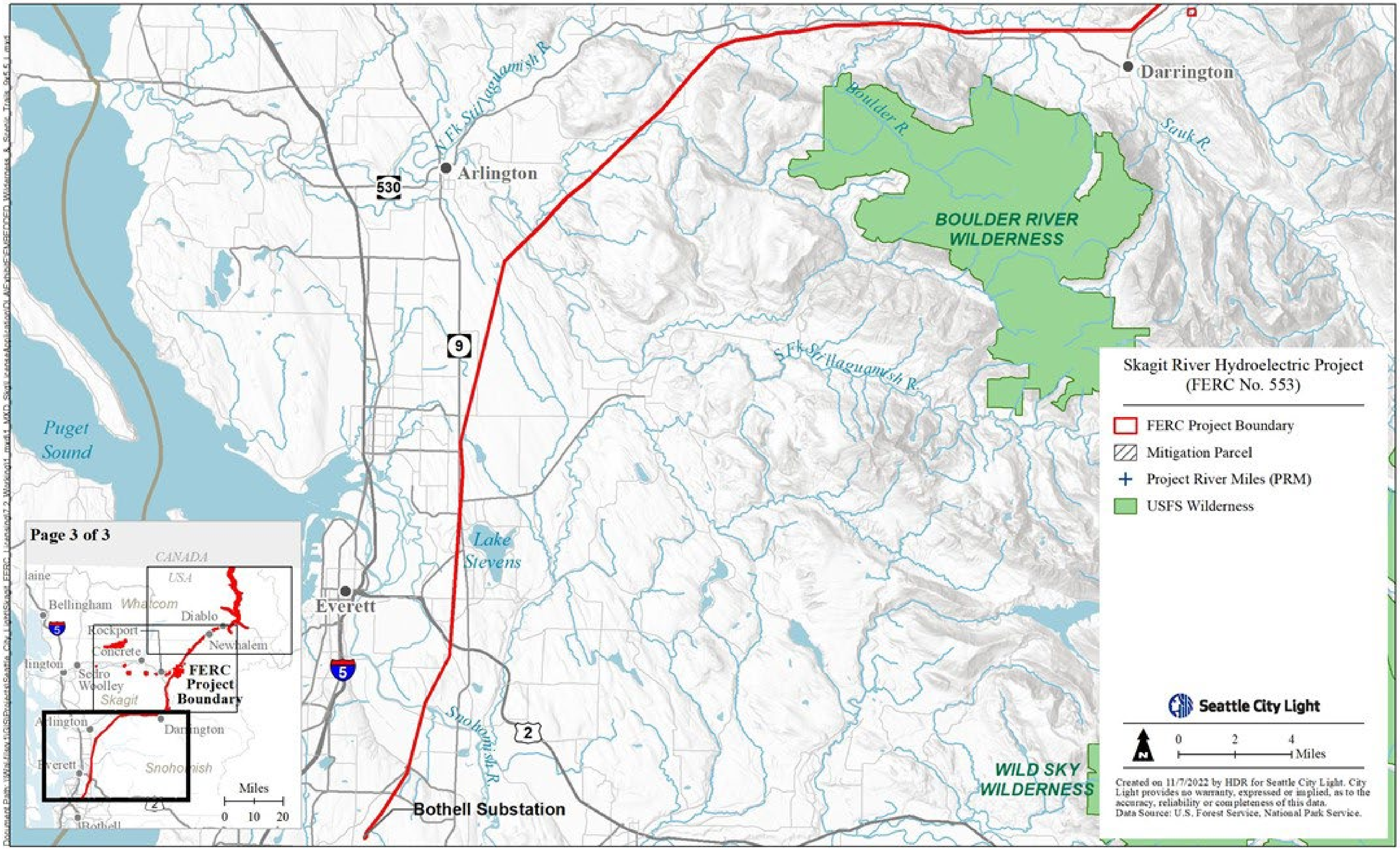


Figure 4.2.6-2. National Scenic Trails and Wilderness Areas in the Project vicinity (page 3 of 3).

Other Land Use and Management

Project Lands

The Project Boundary is comprised of the continuous Skagit River Project (for generation and transmission line corridor; approximately 21,961 acres) and non-continuous (Marblemount and Sauk River boat launches, and fish and wildlife mitigation lands; approximately 10,812 acres) for a total of approximately 32,773 acres. Of these lands, the approximate division is 59 percent federal (NPS 58.7 percent and USFS 0.1 percent), 35 percent City Light, 1.3 percent Washington DNR, and 6 percent combination of private, 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.

Adjacent Lands

The Project reservoirs and associated generation facilities are within the RLNRA. The RLNRA is part of the 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 the RLNRA in the vicinity of Ross Lake and includes the Pasayten Wilderness. These vast expanses of federal land in the Project vicinity 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 4.2.6-3). Land uses adjacent to the fish and wildlife mitigation lands are predominantly forest.

Project-Related Roads

Section 3.1.2 of this Exhibit E describes the access routes associated with the Project facilities. As stated in that section, City Light is in the process of documenting all roads used for transmission line access. Additional information regarding Project-related roads will be provided in the FLA.

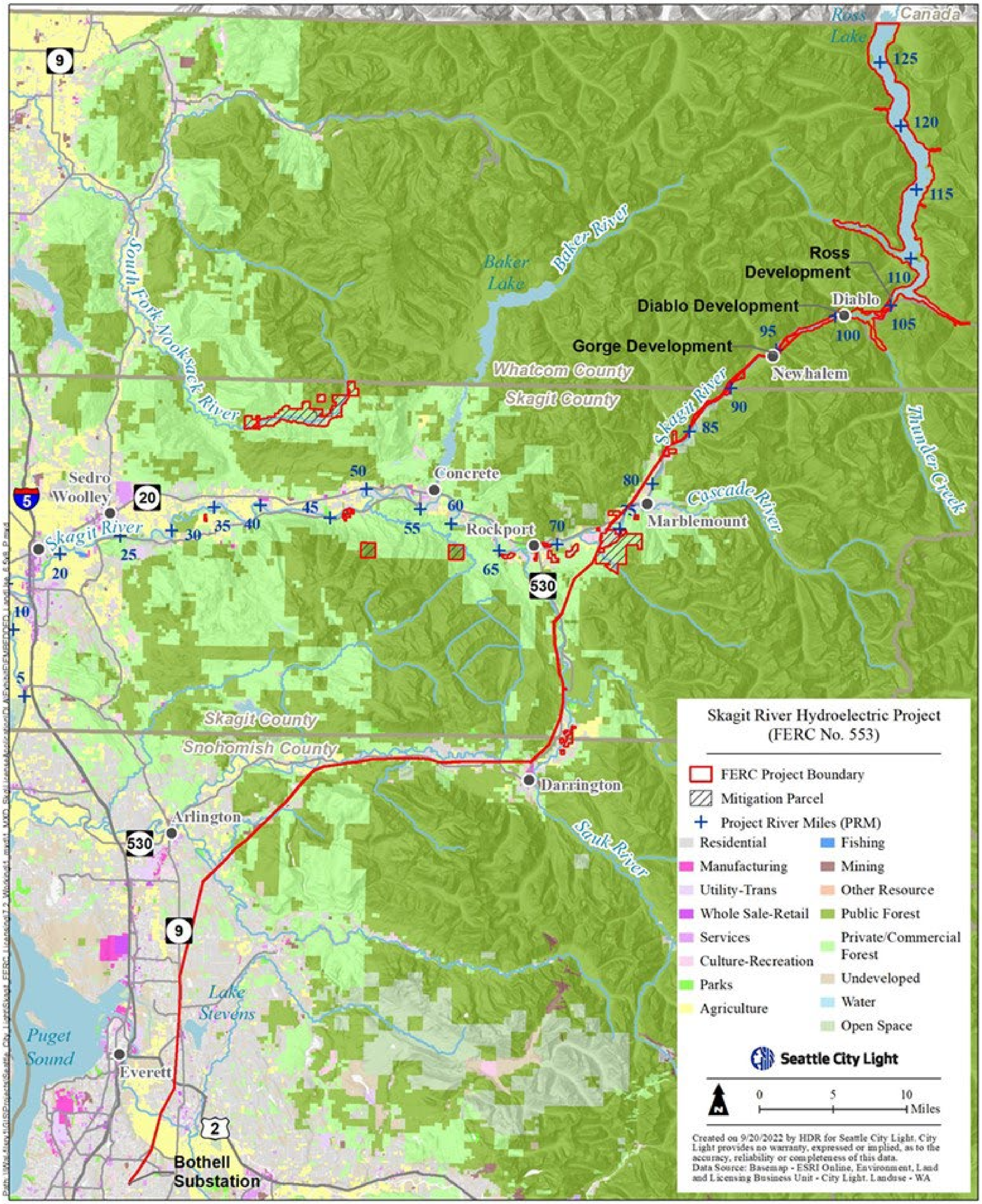


Figure 4.2.6-3. Project vicinity land use.

4.2.6.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on recreation and land use This section is divided into the following areas: (1) adequacy of recreation facilities; (2) adequacy of trails; (3) recreational river boating opportunities; and (4) effects due to recreation facilities construction to address requests in FERC's Scoping Document 2 (SD2).

Adequacy of Recreation Facilities

The adequacy and capacity of existing recreational facilities to meet current and future demand (FERC SD2).

Effects of project-related sedimentation and any proposed sediment management activities on access to recreation facilities in the Ross Lake NRA (FERC SD2).

The RA-01 Recreation Use and Facility Assessment is ongoing. City Light has completed the inventory and evaluations of existing recreation facilities (including condition, accessibility, and use impact evaluations) portion of this study. For the Project recreation facilities, all were in good condition with only a few select elements or amenities that were in fair condition. None of the facilities meets current accessibility standards, though some facilities had limited elements that met the amenity standards. None of the facilities showed signs of noticeable use impacts. For non-Project facilities, none of the facilities met current accessibility standards, though some had limited elements that met the amenity standards. Most of the facilities showed no signs of noticeable use impacts with the exception of the largest developed campground (Colonial Creek Campground) that had extensive areas of bare ground from the heavy use. It should be noted that a condition assessment of non-Project recreation facilities was not within the scope of the RA-01 Recreation Assessment.

The field data collection for the study through October 2022 has been completed. Data analysis is ongoing and will be included in the FLA.

Based on the interim results, the Project recreation facilities are generally inaccessible (i.e., ADA and ABA) with only select or limited accessible features; none of the Project recreation facilities met accessibility standards. The Trail of the Cedars in Newhalem was originally designed to meet accessibility trail standards and currently largely meets the standards outside of a few short segments with changing on-site conditions that have created running/cross slopes that exceed the standards.

The non-Project recreation facilities within and adjacent to the FERC Boundary are generally inaccessible though some facilities have select or limited accessible features. The Ross Lake recreation facilities are predominantly hike-in/boat-in and do not meet accessibility standards outside of very limited elements (i.e., boat docks). The Gorge Creek Overlook has some features that met or were originally designed to meet accessibility standards including the restroom building and the paved portion of the interpretive trail. Currently, the paved trail segment largely meets the standards, but there are several locations where trail conditions have changed since its initial construction that have resulted in short segments that do not meet the standards.

Boat Launch and Dock Facilities

At Ross Lake, the two developed, non-Project boat launch facilities (i.e., Winnebago Flats and Hozomeen) have minimum usable boat ramp elevations of 1,600.26 and 1,589.26 ft NAVD 88 (1,594 and 1,583 ft CoSD), respectively. Under the current license, City Light fills Ross Lake as early and as full as possible after April 15 each year, achieving a normal maximum water surface elevation of 1,608.76 ft NAVD 88 (1,602.5 ft CoSD) by July 31, subject to hydrologic conditions, adequate runoff, anadromous fisheries protection flows, flood protection, minimized spill, and power generation needs. Further, City Light holds Ross Lake as close to normal maximum water surface elevation as possible through Labor Day weekend, subject to the same constraints. For the period of record from 1983 to 2021, during the critical peak season of July and August, the Winnebago Flats and Hozomeen boat ramps were usable 92 and 97 percent of the time, respectively, on average. However, during other portions of the year when Ross Lake is drawn down to account for the other operational priorities identified above, the Winnebago Flats and Hozomeen boat ramps are not usable.

The boat docks at the non-Project Ross Lake boat-in camps have varying minimum usable elevations ranging from 1,606.26 to 1,588.26 ft NAVD 88 (1,599 to 1,582 ft CoSD). Similar to the Winnebago Flats and Hozomeen boat ramps, the boat docks at the boat-in campgrounds are not usable during all portions of the year; however, during the peak season (July and August), boat docks are usable 80 to 97 percent of the time, on average.

At Diablo Lake, the only public boat launch ramp is at the non-Project Colonial Creek complex. The minimum usable elevation of the launch ramp is unknown. However, during most fall/winter seasons, sediment coming down Rhode Creek is deposited at the boat launch ramp. These annual events typically deposit 50 to 100 cu yd of sediment and debris, covering the concrete ramp and altering the minimum usable elevation of the boat ramp. This condition combined with the daily water surface fluctuations due to Project operations periodically makes the launch ramp unusable and may strand boaters on the reservoir at times. Overall, the recurrent sedimentation and debris deposited in the Colonial Creek Boat Launch ramp area effects the function of the launch ramp.

At Gorge Lake, the Gorge Lake Boat Launch ramp (Project facility) has a minimum usable elevation of 878 ft NAVD 88 (871.5 ft CoSD). During the peak season (July and August), the boat ramp is usable 65 percent of the time, on average. Further, the Gorge Lake Boat Launch is located in a cove on the north side of Gorge Lake where gravel deposition in the secondary delta area results in very shallow water depths at the outlet to the boat launch cove, which precludes many large boats from using the launch to reach the lake, particularly when Gorge Lake levels are low (City Light 2022a). As such, the boat launch is generally only usable by small, motorized boats and non-motorized watercraft.

Adequacy of Trails

The adequacy and capacity of existing recreational facilities to meet current and future demand (FERC SD2).

The RA-01 Recreation Use and Facility Assessment is ongoing. City Light has completed the accessibility evaluations of existing trails. Of the Project trails (Trail of the Cedars and Ladder Creek Falls Trail), only the Trail of the Cedars is close to meeting the current accessibility standards with the primary constraints due to changing trail conditions over time (i.e., root upheaval and cross slopes). The other Project trails are steep and rugged trails that have many constraints to accessibility. None of the Project trails has a trail conditions sign. For the non-Project trails, most do not meet accessibility standards due to pervasive constraints (e.g., rocky/loose tread, tread obstacles, steep running and cross slopes, narrow trail widths). Only the Gorge Creek Overlook Trail is close to meeting the current accessibility standards with very limited constraints due to changing trail conditions over time (i.e., root upheaval/cross slopes).

The field data collection for the study through October 2022 has been completed. Data analysis is ongoing and will be included in the FLA. Based on the interim results, none of the Project or non-Project recreational trails fully complies with accessibility standards. Most of the recreational trails (Project and non-Project) are constructed in rugged, steep, and rocky terrain where meeting accessibility standards is very difficult or would require extensive engineering, which would substantially alter the existing physical environment and change the setting of these trails in predominantly natural environments. Two recreational trails or portions of recreational trails were originally designed and constructed to accessibility standards – Trail of the Cedars (Project) and Gorge Creek Overlook interpretive trail (non-Project). As noted in the section above, changing site conditions have resulted in short segments of these trails that do not meet current standards (i.e., exceed running and cross slope standards). The Thunder Creek Trailhead parking area and information kiosk also meet current accessibility standards (ABA standards), though the Thunder Creek Trail does not.

Overall, City Light observed few, if any, recreation use impacts along the trails and at trailheads. Most trailhead facilities do not have a trail conditions sign that describes the level of difficulty, trail conditions, and general accessibility constraints or obstacles, except at Gorge Creek Overlook.

Recreational River Opportunities

Effects of existing and any potential changes to project facilities and operations on angling and whitewater boating opportunities in the Gorge bypassed reach, and feasibility of providing minimum flows and access to enhance these opportunities. (FERC SD2)

The RA-05 Recreation Flow Study is ongoing. Data collection has been completed for the recreation flow survey (through September 2022) and the structured interviews (through October 2022). Analysis of the flow survey and structured interviews as well as the hydrology for the respective river segments in the Recreation Flow Study is in progress and will be included in the FLA.

Effects Due to Recreation Facilities Construction

Construction of new recreation facilities or enhancement of existing recreation facilities has the potential to affect the availability of recreation facilities and opportunities to the public. City Light anticipates discussing any potential protection, mitigation, and enhancement measures related to the construction of new or enhanced recreational facilities with licensing participants (LPs).

Nevertheless, existing Project recreation facilities will likely require rehabilitation and/or upgrades over the new license term. Much of this work will likely occur on an as-needed basis at select or limited site amenities (picnic tables, benches, signs, etc.) that will only impact small or select areas of a recreation facility. Some major rehabilitation projects may require more extensive construction projects. City Light will minimize impacts to the public availability of recreation facilities during construction by: (1) undertaking construction activities during periods outside of the facilities' peak recreation season, where possible; and (2) undertaking construction activities in a portion of the facility and keeping the remainder of the facility open to the public. By using these two approaches, the public would continue to have access to all of the types of recreation facilities and opportunities normally available except at a more limited basis. During all recreation construction work, City Light will take necessary measures to minimize potential impacts on nearby recreation users' experience such as the noise and proximity of construction equipment and staff. In addition, City Light will make recreationists aware of planned construction work by posting notices of upcoming planned work at information kiosks, websites, and other public information areas.

Effects Due to Changes in Project Facilities

Effects of activities related to road improvements and potential relocation of the Skagit Tour Ferry Dock on recreational access and use, including effects on National Park Service lands and management (FERC SD2).

Information and data analysis related to current recreational access and use is ongoing as part of the RA-01 Recreation Assessment. Additional details will be provided in the FLA.
Effects Due to Changes in Project Operation and Maintenance

Effects of existing and any potential changes to project facilities, operations, and maintenance activities on recreational use and access in the project area, including NPS recreation facilities in the Ross Lake National Recreation Area (FERC SD2).

Effects of any proposed changes to the project transmission line and rights-of-way maintenance on the Skagit River and Sauk River Wild and Scenic River corridors (FERC SD2).

Information and data analysis related to current recreational access and use is ongoing as part of the RA-01 Recreation Assessment. Additional details will be provided in the FLA.

Effects on Land Use

The Project's operation does not affect land uses in the vicinity of the Project.

4.2.6.3 Existing and Proposed Resource Measures

To protect, mitigate, and enhance recreational resources, City Light proposes to develop a Recreation Management Plan in consultation with NPS and other LPs. This plan will include measures to address: (1) accessibility; (2) improved visitor use experience; (3) ongoing maintenance of Project recreation facilities; and (4) other recreation resource needs identified in coordination with LPs. This plan would include best management practices consistent with implementation of the Historic Properties Management Plan to avoid, minimize, or mitigate adverse effects to historic properties as required by the National Historic Preservation Act. Upon FERC approval, City Light will implement this plan. Additional details will be provided in the FLA.

Additionally, City Light proposes to continue existing measures related to the operation of the ELC, Skagit tours, ferry services, and Skagit Information Center, as well as maintenance of Ladder Creek Falls Trail and Garden and Trail of the Cedars. Additional details will be provided in the FLA.

4.2.6.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to recreation and land use have been identified at this time.

4.2.7 Aesthetic Resources

To supplement existing, relevant, and reasonably available information from Seattle City Light's (City Light) Pre-Application Document (PAD), and to determine the potential effects of the Project on aesthetic resources, City Light conducted two aesthetic-related studies – RA-03 Project Facility Lighting Inventory and RA-04 Project Sound Assessment. The status of these studies is described below.

- RA-03 Project Facility Lighting Inventory. The goal of the Federal Energy Regulatory Commission (FERC)-approved study was to inventory Project facilities located within the Project Boundary and within Ross Lake National Recreation Area (RLNRA) that utilize lighting at night. The study is complete. The results were included in the Initial Study Report (ISR) and are summarized in this section.
- RA-04 Project Sound Assessment. The goal of the FERC-approved study was to develop estimates of Project-related noise to facilitate analysis of how Project-related noise may affect other resources (e.g., wildlife, cultural resources, recreation resources, etc.). The study is ongoing and preliminary results were included in the ISR and summarized in this section.

4.2.7.1 Affected Environment

This section describes the visual and auditory characteristics of the Project vicinity and describes land management plans relevant to visual resources. Specifically, this section describes the aesthetic setting of the Project, which is separated into seven zones. Relevant land management guidelines are also discussed in this section. Visual resources compose the visible character of a place and include both natural and human-made attributes. Visual resources influence how an observer experiences a particular location and distinguishes it from other locations. Such resources are important to people living in or traveling through an area and can be an essential component of historically and culturally significant settings. Noise is unwanted or unwelcome sound that is usually caused by human activity and added to the natural acoustic setting of a locale. Noise disrupts normal activities and diminishes the quality of the environment.

As described in Section 4.2.9 of this Exhibit E, tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. As such, City Light has engaged with Indian Tribes and Canadian First Nations regarding aesthetic resources to identify and address Project impacts to such resources that may represent or be associated with tribal resources. While aesthetic resources are not identified specifically in this section as tribal resources, City Light understands that Indian Tribes and Canadian First Nations have interests in aesthetic resources or related to tribal resources. City Light is consulting with the Indian Tribes and Canadian First Nations regarding proposed measures to address Project impacts on these resources.

Aesthetics Setting

The Project is in northern Washington State, across Whatcom, Skagit and Snohomish counties, and consists of three power generating developments on the Skagit River – Ross, Diablo, and Gorge – and associated lands and facilities. 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 State Route (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 entirely within 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.

Because of the extent of the Project vicinity and the diverse landscapes it traverses, the geographic area was delineated into seven discrete landscape units (or "zones") along the Skagit and Sauk rivers. The aesthetic setting of each of these units and the nighttime sky setting of the Project vicinity is described in greater detail below.

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 Hozomeen recreation complex 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 equestrians 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 4.2.7-1 and 4.2.7-2). Conversely, there are numerous views of the lake available to people using the shoreline trails, boat-in camps and Hozomeen area 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 4.2.7-1. Views of Ross Lake from one of two designated highway overlooks.

Figure 4.2.7-2. 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 reservoir, but views of Ross Lake are available along portions of these trails. The Sourdough Mountain/Pierce Creek trails connect Ross Lake to the Diablo townsite 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 is privately owned and managed and operates under a concession contract from the National Park Service (NPS). 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 and are included as part of a historic structures inventory for the CR-02 Cultural Resources Survey. 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 4.2.7-3). The reservoir is a scenic attraction and visual focal point for viewers along SR 20 and recreationalists in the 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 4.2.7-3. 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. However, Article 403 of the current license requires City Light to fill Ross Lake as soon as possible after April 15, minimizing the amount of time that drawdown conditions are visible. SR 20 is closed in the winter generally, from mid to late November through April or May (Washington State Department of Transportation [WSDOT] 2022a). 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 Environmental Learning Center (ELC), and hikers along the shore and on mountain trails (Envirosphere 1989). Zone 2 provides public views of the frontcountry of the 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 Historic Resources Mitigation and Management Plan (City Light 1991b), Visual Compatibility Guidelines for the Newhalem Historic Area: Historic Landscape Resource Management (NPS 1994), and the Transmission Right-of-way (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. There are 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 4.2.7-4). 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 4.2.7-4. 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 Lake, 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 motorized and non-motorized boats 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 4.2.6 of this Exhibit E. 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 mostly hidden from view from Diablo Lake or SR 20, as the facility is setback from the reservoir shoreline and screened by natural vegetation and forest.

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 4.2.7-5). 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 non-native tree species and turf grass. The townsite is divided into two districts, Reflector Bar and Hollywood, and contains a number of historic structures that are contributing elements of the

National Register of Historic Places (NRHP)-listed historic district (DT00066). Manmade structures on Reflector Bar include the Diablo Powerhouse, the incline lift and associated waiting station, a water tower, and a few support structures. Reflector Bar also contained several residential houses, but they were removed in 2022 and much of the area will be restored to natural habitat. Hollywood consists primarily of residential houses as well as the Ross Lodge and picnic shelter. 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 4.2.7-5. 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 milepost (MP) 123. Partially obstructed views of Gorge Lake and Gorge Dam are available from the Gorge Overlook Trail (Tripadvisor 2022; Outdoor Project 2021; NPS 2017); the lake, but not the dam, can be seen from the Gorge Creek Overlook.

The Gorge bypass reach is a river stretch located between Gorge Dam and Gorge Powerhouse, where water that once flowed through this section of river channel 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 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 visible from SR 20 and is particularly visually prominent at multiple informal pullouts along SR 20 (Envirosphere 1989).

Flows in the Gorge 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 Gorge bypass reach due to the steep canyon walls.

The Gorge 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.

Newhalem includes both historic housing, which are contributing elements of the NRHP-listed historic district (DT00066), 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 in Zone 3 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 2022). 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 3.1.2.13 of this Exhibit E, City Light owns approximately 10,804 acres of fish and wildlife habitat lands entirely within the current Project Boundary. 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 compared to the use at the Project reservoirs. The general visual characteristics of these lands are briefly described below.

<u>Skagit River Basin</u>

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 miles 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.

<u>Sauk River</u>

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.

<u>South Fork Nooksack River</u>

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. In addition, City Light conducted the RA-03 Project Facility Lighting Inventory of its facilities. The results of this study are included in the RA-03 Project Facility Lighting Inventory Draft Report (City Light 2022c).

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 of Ross Lake. 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 4.2.7-6, which shows nighttime lighting at Diablo Dam. Below Diablo Lake, the powerhouse and Town of Diablo's housing and support 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, support buildings including those within the maintenance yard, 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 NPS campgrounds at Newhalem Creek and Goodell Creek, the NPS North Cascades Visitor Center, and the Project 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 4.2.7-6. Nighttime lighting at Diablo Dam.

Relevant Land Management Guidelines

National Park Service

<u>Ross Lake Management Plan</u>

The RLNRA General Management Plan (GMP) outlines a program for managing the RLNRA (NPS 2012). Visual resources defined in the GMP as fundamental resources for the 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 the 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 the 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 the 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 (U.S. Forest Service [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). Landscape environments defined in the 1983 Skagit River Management Plan are as follows:

- **Urban:** Characteristic of a city.
- **Rural:** Open country, largely stripped of the forest cover, used for intensive farming and also containing some recreational housing development.
- **Pastoral:** Mixed forest and farmland.
- **Primitive:** Land with little or no development, where the forest cover predominates.
- **Wild:** Sparsely inhabited lands, still largely in a natural state.

As outlined in the 1983 Skagit River Management Plan, the following goals apply to management of visual resources of the Wild and Scenic Designated Skagit River and its tributaries (USFS 1983):

- Provide for the conservation and continuation of the patterns of agriculture, forests, and structures to retain the environments of primitive, rural, and pastoral landscapes.
- Protect and enhance the various landscapes visible from the river, as well as from its banks.
- Structures and Improvements
  - Existing Structures

    Utility crossings/towers, etc.: USFS will work with appropriate utility companies to diminish visual impacts.

    Building: Property owners will be encouraged to use earth tone colors. When conservation easements become necessary, USFS landscape architects will assist the landowner in the development of color schemes.

    Earth structures: Use of plantings will be encouraged.
  - The number of structures visible from the rivers will be kept to as few as practical. USFS will develop procedures with the Skagit and Snohomish counties to provide input to all zoning and platting requests. The goal should be to have all new structures take advantage of natural screening (as viewed from the river), utilize natural-appearing non-reflective materials, and earth tone colors.
  - Proposed Structures

    Within the National Forest, all proposed structures will be evaluated using the Visual Quality Objective of retention when viewed from the river and sensitivity 1 or 2 trails or roads within the corridor boundaries.

    Outside the National Forest boundary, all proposed structures will be evaluated using the respective Shoreline Management Master Program Designations of 1978. It is recommended structures not associated with farm or Forest use within the rural and conservancy environments be screened from the river.
- Visual Resources
  - On other than Federal lands, use procedures identified in the following documents (listed in order of priority) to maintain, protect, and enhance the visual resource along the Skagit WSR:

    Shoreline Management Master Program administered by County.

    State Forest Practices Act as administered by State of Washington.

    County zoning.

    If the above fail to sufficiently protect the visual resource, the USFS will obtain conservation easements where key values are in jeopardy.

- Coordinate with Skagit and Snohomish counties to achieve the following shoreline classification distribution within the river corridor.

  Rural

  - Skagit River: From the lower boundary at Sedro Woolley to the mouth of Baker River (32.5 miles).

  Pastoral

  - Skagit River: From the mouth of Baker River upstream to the upper terminus at Bacon Creek (26.0 miles).
  - Sauk River: From the mouth of the Sauk River upstream to the National Forest boundary (24.8 miles).
  - Suiattle River: From the mouth of the Suiattle River upstream to the National Forest boundary (12.2 miles).
  - Cascade River: From the mouth of the Suiattle River upstream to the National Forest boundary (7.2 miles).

  Primitive

  - Sauk River: From the National Forest boundary upstream to its terminus at Elliott Creek on the South Fork and to its terminus at the Glacier Peak Wilderness boundary on the North Fork (26.0 miles).
  - Suiattle River: From the National Forest boundary upstream to the Glacier Peak Wilderness boundary (15.2 miles).
  - Cascade River: From the National Forest boundary upstream to its boundary at the Glacier Peak Wilderness boundary and the North Cascades National Park (14.6 miles).

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, 2010, 2022b).

Key Viewing Areas

The 1989 Visual Resources Analysis used a methodology adapted from the visual management systems used by USFS, Bureau of Land Management (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, 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; and unity, the visual coherence and compositional harmony of the landscape. 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, Washington Department of Ecology, and the North Cascades Conservation Council 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 4.2.7-1.

Table 4.2.7-1. 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
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

Viewpoint Description			Visible Project Features				
Number	Name	Location	Dam	Powerhouse	T-line	Town	Shore
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		
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		

Viewpoint Description			Visible Project Features				
Number	Name	Location	Dam	Powerhouse	T-line	Town	Shore
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).

Noise

The Project facilities and operation and maintenance activities have the potential to generate noise, potentially affecting wildlife, cultural resources, and recreation resources. City Light conducted a sound assessment of its facilities, RA-04 Project Sound Assessment, using an area covering 0.6 miles from noise-generating facilities, activities, and ongoing/known maintenance and construction projects within the Project Boundary, and a 500-foot buffer on either side of Project transmission lines (City Light 2022b; Figure 4.2.7-7).

City Light reviewed land uses (areas or specific locations) within the sound assessment area and categorized these areas and locations based on several characteristics including terrain, ground cover/vegetation, noise-sensitivity, and the overall noise environment (e.g., within 100-200 feet of a road corridor; areas surrounding campgrounds; trails away from development; etc.). Using those categories, the geographic area was delineated into areas with similar soundscapes and noise sensitivities and six locations whose characteristics were representative of other areas within the sound assessment area were selected in consultation with NPS as long-term noise monitoring locations. These six noise monitoring locations are listed below and shown in Figure 4.2.7-7.

- Near Ross Dam and Ross Lake Resort;
- On Diablo Lake Trail on the north side of Diablo Lake;
- In the Newhalem area at Newhalem Creek Campground;
- In the Gorge bypass reach area;
- On Pyramid Lake Trail on the southwest side of Diablo Lake; and
- In the transmission line ROW near Caskey Lake.

The summer measurements began on August 24 and 25, 2021, and ended on September 1, 2021, to coincide with the summer recreation season. The spring measurements began on April 26, 2022, and ended on May 4, 2022, to represent off-peak use while still occurring at a time when all sites were safely accessible with the noise monitoring equipment. Results of the noise measurements are described in Section 4.2.7.2 of this Exhibit E.

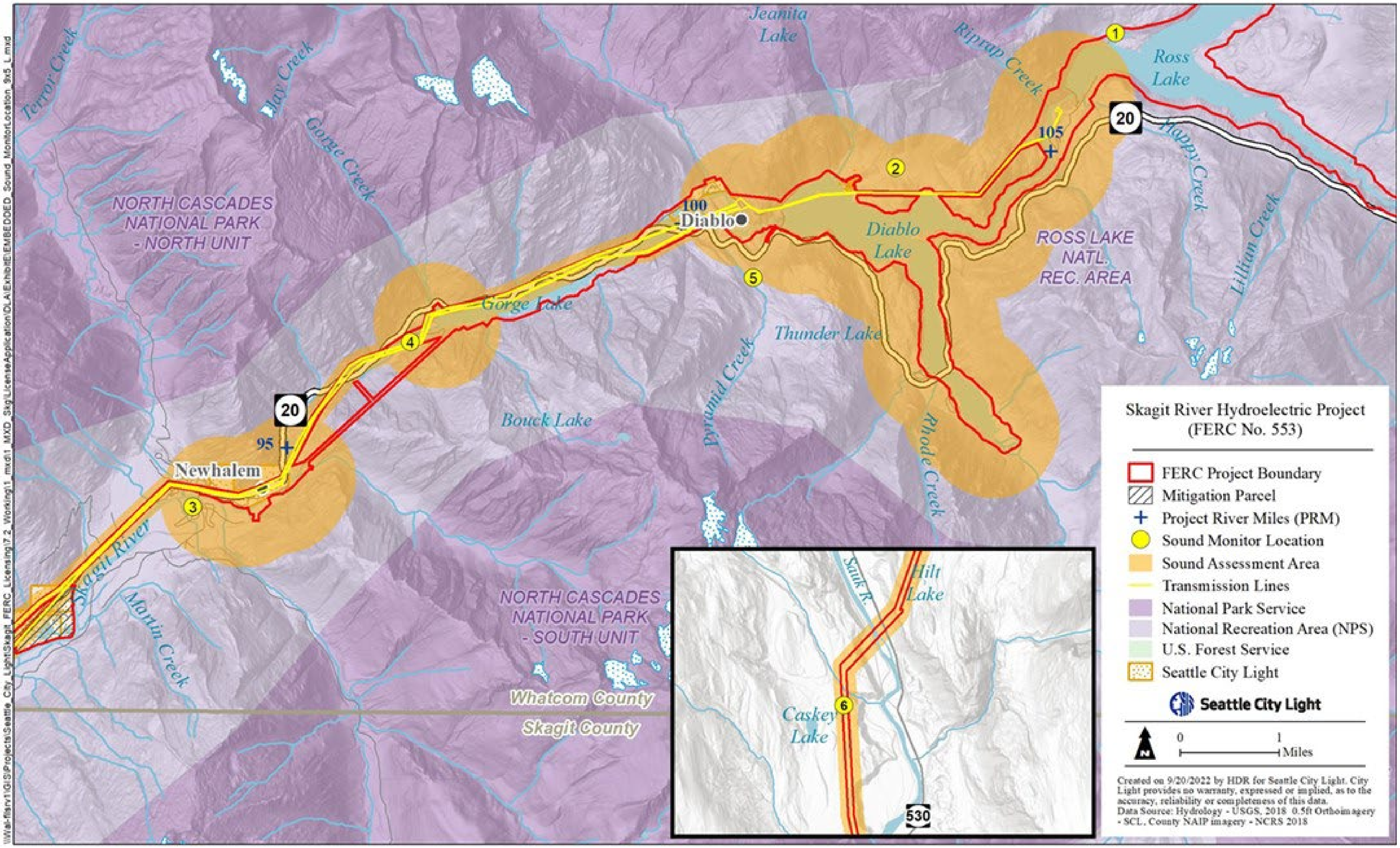


Figure 4.2.7-7. Ambient noise measurement monitoring locations.

4.2.7.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on aesthetic resources. These effects include reservoir operations (e.g., reservoir drawdowns and Gorge bypass reach flows), lighting and noise. The effects are organized below to address requests in FERC's Scoping Document 2 (SD2).

Reservoir Drawdown

Effects of reservoir level fluctuations from existing and any potential changes to operations on the aesthetic resources (FERC SD2).

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 (four to five feet daily from a normal maximum water elevation of 1,205 feet) and Gorge Lake (three to five feet daily from a normal maximum water elevation of 875 feet), drawdown in these reservoirs is insignificant, 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 (1,529.26-1.534.26 feet North American Vertical Datum of 1988 [NAVD 88] (1,523–1,528 feet City of Seattle datum [CoSD]));
- 1,573.26 feet NAVD 88 (1,567 feet CoSD);
- 1,598.26 feet NAVD 88 (1,592 feet CoSD); and
- Normal maximum water surface elevation (1,608.76 feet NAVD 88 (1,602.5 feet CoSD)).

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).

Gorge Bypass Reach Flow Levels

Flow levels in the Gorge 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 cubic feet per second [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; and
- 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 Gorge 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 Gorge bypass reach, and thus the visual effect is low as it is visible from only a few viewpoints along the highway.

Project Facilities

Effects of existing and any potential changes to project facilities on aesthetic resources (FERC SD2).

The consistency of continuing project operation and any proposed project modifications with visual quality management goals and objectives of Federal and state comprehensive plans for the project area (FERC SD2).

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 in Newhalem, a few homes in Hollywood, and the houses and 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 viewer sensitivity have not been significantly altered since the 1989 Visual Resources Analysis. The results of the study are summarized in Table 4.2.7-2.

As demonstrated by Table 4.2.7-2, 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 townsites 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). City Light is addressing this effect as part of the current license.

Table 4.2.7-2. Visual effects of Project facilities.

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					

Landscape Zone Unit	Visual Quality	Visual Contrast	Viewer Exposure	Viewer Sensitivity	Visual Effect
Upper Ross Lake (Zone 1)[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
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
Transmission Line along the Sauk Scenic River (Zone 5)					
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

Landscape Zone Unit	Visual Quality	Visual Contrast	Viewer Exposure	Viewer Sensitivity	Visual Effect
Gorge Lake	Moderate Low	High	High	Moderate	High
Gorge Bypass Reach	Moderate	High	High	Moderate	High
Newhalem Townsite	Moderate High	High	High	Moderate	High
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.

Sections 3.3.5 and 3.3.6 of this Exhibit E and Exhibit A of this Draft License Application (DLA) describe the new facilities or modifications that are proposed for implementation under the new Project license. The addition of a dock along the shoreline of Diablo Lake near the ELC to facilitate Skagit Tours 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 4.2.7.1 of this Exhibit E and possibly a few additional short-term impacts from specific projects.

Night Sky and Lighting

Effects of existing and any potential changes to project facilities lighting requirements on resources within the Ross Lake NRA (FERC SD2).

The primary sources of nighttime lighting, as described in the PAD and the RA-03 Project Facility Lighting Inventory, are the Project facilities and NPS facilities in the RLNRA. Project facilities include lighting for safety, security, and operational reasons. Operation of the Project introduces a source of artificial light, which results in an adverse effect in an otherwise dark nighttime setting as detailed below.

Ross Lake

Light sources at Ross Lake are primarily limited to the Ross Dam area. The Project sources of light are the Ross Powerhouse and Ross Powerhouse Boathouse directly downstream of Ross Dam, and lighting atop Ross Dam. The Project sources of light in this area are for safety, security, and operational reasons, but result in an adverse effect on the dark nighttime setting. Ross Lake Resort upstream of Ross Dam and vehicle traffic along SR 20 are additional non-Project sources of light in this area, which also have an adverse effect on the dark nighttime setting.

Diablo Lake

Light sources at Diablo Lake are more prominent, and primarily associated with Project facility lighting across Diablo Dam and at Diablo Boathouse and the ELC. The lighting at the Diablo Boathouse and ELC facilities is necessary for safety, security, and operational reasons, but result in an adverse effect on the dark nighttime setting. The lighting on Diablo Dam is a fundamental part of the original construction of the dam with the Art Deco design including decorative arches and lighting on the crest of the dam. Vehicle traffic along SR 20 is an additional non-Project source of light in this area. Overall, these light sources result in an adverse effect on the dark nighttime setting.

Gorge Lake

Light sources at Gorge Lake are primarily associated Diablo Powerhouse (Project facility) and Diablo townsite’s residential housing and support buildings (Project facilities), as well as vehicle traffic along SR 20 (non-Project). These facilities require lighting for safety, security, and/or operational reasons, but still result in an adverse effect on the dark nighttime setting.

Gorge Bypass Reach

There is very little development along the Gorge bypass reach, where the primary source of nighttime lighting is lighting from cars traveling on SR 20.

Newhalem

Light sources in the Newhalem area are primarily related to Project facilities, including Gorge Powerhouse and Switchyard, residential housing, administrative and maintenance offices/buildings, and the Ladder Creek Falls Trail and Garden. Most of these facilities require lighting for safety, security, and operational reasons, except for the Ladder Creek Falls Trail and Garden lights, which is a historic contributing resource within the Skagit River and Newhalem Creek Hydroelectric Project historic district. The trail lighting provides an illuminated attraction dating back to the 1920s. Vehicle traffic along SR 20 is an additional non-Project source of light in this area. Overall, these light sources result in an adverse effect on the dark nighttime setting.

Noise Measurement Results

Effects of existing and any potential changes to project facilities and operations and boat activity, including recreational boating, on noise levels within the Ross Lake NRA (FERC SD2).

Table 4.2.7-3 summarizes the metrics calculated for each location by presenting averages of the hourly values across the entire noise measurement duration at each location. Metrics are summarized by three periods, including overall (all valid hours), daytime (all valid hours from 7:00 am through 9:00 pm), and nighttime (all valid hours from 10:00 pm through 6:00 am).

Table 4.2.7-4 summarizes the results of the audio review for each location by presenting the percentage of time that each source is audible. The licensing participant request to identify individual sources in the audio review came after the audio review to determine the human-made sound percentage was already underway, so the summer measurement at certain locations had the source review performed for a smaller subset of days. Specifically, the first full day at all locations, the second full day at Ross Lake, all days at Diablo Lake Trail, and the first five full days at Newhalem Creek Campground did not have the source review performed for the summer measurements. Results presented are for the remaining days.

In general, birds are a common source of sound at all sites. Vehicles and aircraft could also be heard at all sites, although vehicle noise was uncommon at Ross Lake. Some site-specific noise sources, such as heavy equipment at Ross Lake during the summer measurements, and chainsaws at Newhalem Creek Campground during the spring measurements, were likely irregular occurrences at those sites, instead just happening to occur during the same week as the measurements. Other site-specific sources such as the corona noise at Caskey Lake are a regular part of the soundscape at that location.

Helicopters were identified as one of the daily maximum instantaneous noise level (L_{max}) sources during the measurement periods. There were no Project-related helicopter flights during the 7-day ambient noise measurement period for Summer 2021. However, NPS documented 29.5 hours of NPS-approved helicopter flight time in the month of August, including 25.1 hours related to wildland fire operations, 2.7 hours of search and rescue, and 1.7 hours of project work (Torres 2022). City Light assumes the daily L_{max} helicopter noise sources identified during the 7-day ambient noise measurement period are associated with the helicopter use authorized by NPS, except for the Caskey Lake helicopter noise that is more likely associated with non-Project and non-NPS helicopter use at the nearby Darrington Municipal Airport.

During the Spring 2022 noise measurements, there were two Project-related round-trip flights on April 28 and one on April 29, from Newhalem to and from Hozomeen area at the north end of Ross Lake. These are reflected in daily L_{max} sources at all sites other than Caskey Lake.

Table 4.2.7-3. Ambient noise measurement result summary (dBA).

Measurement Location	Season	Subset[1]	Avg. Hourly L_{eq}[2]	Over-all L_{min}[3]	Avg. Hourly L_{min}	Over-all L_{max}[4]	Avg. Hourly L_{max}	Daily L_{max} Sources	Avg. Hourly L_{10}[5]	Avg. Hourly L_{33}	Avg. Hourly L_{50}	Avg. Hourly L_{90}	Avg. Hourly L_{nat}	% Human Noise	Noise-Free Interval (hh:mm)
Ross Lake	Summer 2021[6]	Overall	39	20	28	75	56	Dogs, bird, helicopter, aircraft	42	37	36	31	29	85%	00:28
		Daytime	42	21	30	75	62		45	40	38	33	31	84%	
		Nighttime	34	20	25	63	47		36	33	32	28	26	87%	
	Spring 2022	Overall	41	32	36	75	55	Bird, helicopter, wind	42	40	40	38	39	4%	9:08
		Daytime	44	32	36	75	59		45	43	42	39	41	6%	
		Nighttime	37	32	35	72	48		38	37	37	36	36	1%	
Diablo Lake Trail	Summer 2021	Overall	33	17	24	70	50	Helicopter, foliage, aircraft	35	32	30	27	30	28%	5:20
		Daytime	36	18	26	70	53		38	34	33	29	32	37%	
		Nighttime	28	17	20	58	44		30	27	26	22	26	13%	
	Spring 2022	Overall	34	24	28	70	51	Aircraft, helicopter, rain, hikers	35	33	32	30	31	5%	7:40
		Daytime	37	24	29	70	56		38	35	34	32	34	8%	
		Nighttime	30	24	26	62	43		30	29	28	27	28	1%	
Newhalem Creek Camp-ground	Summer 2021	Overall	39	32	35	84	56	Noon siren, car horn	39	38	37	36	36	55%	1:34
		Daytime	40	33	35	84	62		41	39	38	37	36	75%	
		Nighttime	36	32	34	66	47		37	36	36	35	36	22%	
	Spring 2022	Overall	40	35	37	80	53	Noon siren, helicopter, airplane	40	39	39	38	39	16%	7:38
		Daytime	41	35	37	80	58		41	40	39	38	38	25%	
		Nighttime	39	36	37	59	46		39	39	39	38	39	2%	
Gorge Bypass Reach	Summer 2021[7]	Overall	39	26	30	78	56	Helicopter, traffic, hiker	41	37	36	33	34	44%	2:04
		Daytime	42	27	31	78	59		44	40	39	34	35	54%	
		Nighttime	34	26	29	63	50		36	33	32	30	32	28%	
	Spring 2022	Overall	51	43	50	80	58	Vehicle, helicopter, airplane, bird	52	51	51	50	51	10%	8:38
		Daytime	52	43	50	80	62		53	52	52	51	52	14%	
		Nighttime	50	44	49	68	54		50	50	50	49	50	2%	

Measurement Location	Season	Subset[1]	Avg. Hourly L_{eq}[2]	Over-all L_{min}[3]	Avg. Hourly L_{min}	Over-all L_{max}[4]	Avg. Hourly L_{max}	Daily L_{max} Sources	Avg. Hourly L_{10}[5]	Avg. Hourly L_{33}	Avg. Hourly L_{50}	Avg. Hourly L_{90}	Avg. Hourly L_{nat}	% Human Noise	Noise-Free Interval (hh:mm)
Pyramid Lake Trail	Summer 2021	Overall	43	40	41	71	53	Noon siren, bird, hikers, helicopter	43	42	42	42	42	14%	5:34
		Daytime	43	40	41	71	56		44	43	42	42	42	20%	
		Nighttime	42	40	41	67	48		43	42	42	41	42	3%	
	Spring 2022	Overall	47	43	45	73	55	Noon siren, Helicopter, Hikers	47	46	46	46	46	2%	10:34
		Daytime	47	43	45	73	58		48	47	46	46	46	3%	
		Nighttime	46	44	45	66	51		46	46	46	46	46	1%	
Caskey Lake	Summer 2021	Overall	33	22	26	79	53	Helicopter, logging truck bird	33	31	30	28	26	83%	1:42
		Daytime	35	22	26	79	56		35	32	31	28	26	86%	
		Nighttime	30	23	25	76	48		31	29	28	27	26	78%	
	Spring 2022	Overall	34	26	29	87	51	Airplane, gunshot, logging truck	34	32	32	30	31	44%	3:08
		Daytime	35	26	29	87	54		35	32	31	30	30	48%	
		Nighttime	33	27	30	64	47		34	33	32	31	31	37%	

1 Overall includes all hours; Daytime includes the hours from 7:00 am–9:00 pm on all days; Nighttime includes the hours from 10:00 pm–6:00 am.
2 Energy-equivalent noise level (L_{eq}), which is a mean average noise level.
3 Minimum instantaneous noise level (L_{min}).
4 Maximum instantaneous noise level (L_{max}).
5 Statistical descriptors (L_n) that characterize noise levels exceeded n percent of the hour. L_n descriptors help explain how much sound levels vary (or how consistent they are) during each hour. The L_{50} descriptor is a median average, and a comparison of the mean (L_{eq}) and median (L_{50}) is another way to evaluate the amount of variation in sound levels during an hour. If the L_{eq} is much greater than the L_{50}, short and loud noise events were likely driving up the L_{eq}, whereas if the L_{eq} and L_{50} are similar, sound levels were likely consistent through the hour.
6 The weather station at Ross Lake was not functioning properly during the summer 2021 measurements, so weather-based exclusions were made using weather data from the nearest measurement location (Diablo Lake Trail).
7 The summer 2021 measurement in the Gorge Bypass Reach downstream of Gorge Dam started on August 25, 2021.

Table 4.2.7-4. Audio review results.

Measurement Location	Season	Subset[1]	% Of Time Audible																	
			Human-made Sounds												Natural Sounds					
			Helicopter	Airplane	Vehicles	Boats	Humans	Corona Noise	Heavy Equipment	Tree cutting	Gunshots	Generators	Trans-former	Unidentified Hum	Rain	Wind	Birds	Insects	Water	No Audible Sound
Ross Lake	Summer 2021[2]	Overall	0%	1%	<1%	22%	23%	*	1%	*	*	*	92%	*	5%	25%	8%	35%	2%	1%
		Daytime	0%	1%	<1%	33%	35%	*	2%	*	*	*	88%	*	<1%	36%	8%	11%	2%	1%
		Nighttime	0%	1%	1%	2%	4%	*	0%	*	*	*	98%	*	12%	7%	8%	75%	2%	1%
	Spring 2022	Overall	<1%	1%	1%	2%	1%	*	0%	*	*	*	0%	<1%	1%	20%	15%	0%	0%	61%
		Daytime	<1%	1%	1%	3%	1%	*	0%	*	*	*	0%	<1%	2%	31%	16%	0%	0%	48%
		Nighttime	0%	<1%	<1%	<1%	0%	*	0%	*	*	*	0%	<1%	0%	1%	13%	0%	0%	84%
Diablo Lake Trail	Summer 2021[2]	Overall	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Daytime	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
		Nighttime	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
	Spring 2022	Overall	<1%	2%	2%	1%	1%	*	*	*	*	*	*	*	2%	9%	30%	0%	*	54%
		Daytime	<1%	3%	3%	1%	1%	*	*	*	*	*	*	*	3%	14%	36%	0%	*	41%
		Nighttime	0%	1%	<1%	<1%	0%	*	*	*	*	*	*	*	0%	<1%	19%	0%	*	77%
Newhalem Creek Campground	Summer 2021[2]	Overall	<1%	3%	17%	1%	33%	*	*	*	*	23%	*	*	6%	1%	14%	<1%	100%	0%
		Daytime	<1%	3%	24%	1%	50%	*	*	*	*	36%	*	*	6%	1%	19%	<1%	100%	0%
		Nighttime	0%	2%	5%	1%	3%	*	*	*	*	0%	*	*	5%	0%	4%	<1%	100%	0%
	Spring 2022	Overall	<1%	3%	7%	*	<1%	*	*	8%	*	*	*	*	3%	1%	22%	<1%	100%	0%
		Daytime	<1%	4%	10%	*	<1%	*	*	13%	*	*	*	*	5%	1%	25%	<1%	100%	0%
		Nighttime	0%	1%	1%	*	0%	*	*	0%	*	*	*	*	1%	0%	16%	0%	100%	0%
Gorge Bypass Reach	Summer 2021[2]	Overall	<1%	2%	37%	0%	<1%	5%	*	*	*	*	*	11%	10%	3%	10%	22%	0%	26%
		Daytime	<1%	2%	53%	0%	<1%	4%	*	*	*	*	*	3%	12%	4%	13%	6%	0%	22%
		Nighttime	0%	1%	11%	0%	<1%	6%	*	*	*	*	*	25%	7%	1%	5%	49%	0%	34%
	Spring 2022	Overall	<1%	2%	6%	*	<1%	3%	*	*	*	*	*	*	<1%	<1%	26%	<1%	100%	0%
		Daytime	<1%	2%	9%	*	<1%	4%	*	*	*	*	*	*	1%	<1%	32%	<1%	100%	0%
		Nighttime	0%	<1%	1%	*	0%	1%	*	*	*	*	*	*	<1%	<1%	16%	0%	100%	0%

Measurement Location	Season	Subset[1]	% Of Time Audible																	
			Human-made Sounds												Natural Sounds					
			Helicopter	Airplane	Vehicles	Boats	Humans	Corona Noise	Heavy Equipment	Tree cutting	Gunshots	Generators	Trans-former	Unidentified Hum	Rain	Wind	Birds	Insects	Water	No Audible Sound
Pyramid Lake Trail	Summer 2021[2]	Overall	<1%	2%	12%	*	1%	*	*	*	*	*	*	*	5%	5%	9%	0%	100%	0%
		Daytime	<1%	3%	18%	*	2%	*	*	*	*	*	*	*	5%	7%	11%	0%	100%	0%
		Nighttime	0%	1%	3%	*	0%	*	*	*	*	*	*	*	5%	1%	5%	1%	100%	0%
	Spring 2022	Overall	<1%	1%	1%	*	<1%	*	*	*	*	*	*	*	2%	4%	12%	0%	100%	0%
		Daytime	<1%	2%	1%	*	1%	*	*	*	*	*	*	*	3%	6%	12%	0%	100%	0%
		Nighttime	0%	1%	<1%	*	<1%	*	*	*	*	*	*	*	<1%	<1%	13%	0%	100%	0%
Caskey Lake	Summer 2021[2]	Overall	1%	4%	30%	0%	<1%	89%	*	*	1%	*	*	*	10%	0%	24%	2%	*	6%
		Daytime	1%	5%	37%	0%	1%	92%	*	*	1%	*	*	*	5%	0%	27%	3%	*	4%
		Nighttime	0%	2%	19%	0%	<1%	83%	*	*	0%	*	*	*	17%	<1%	17%	<1%	*	10%
	Spring 2022	Overall	<1%	6%	5%	*	<1%	44%	*	*	<1%	*	*	*	17%	3%	16%	1%	*	36%
		Daytime	<1%	6%	5%	*	<1%	44%	*	*	<1%	*	*	*	17%	3%	16%	1%	*	36%
		Nighttime	0%	2%	4%	*	<1%	39%	*	*	0%	*	*	*	20%	<1%	14%	<1%	*	46%

* Source not present at this location.

† Audio review of the Summer 2021 measurement at Diablo Lake Trail was complete prior to the LP request to identify sources was received. The percentage of human noise for this location across all days can be found in Table 4.2.7-3.

1 Overall includes all hours; Daytime includes the hours from 7:00 am–9:00 pm on all days; Nighttime includes the hours from 10:00 pm–6:00 am.

2 Audio review of Summer 2021 measurements was partially complete when the LP request to identify sources was received. Results presented for all Summer 2021 measurements do not include the first full day. Results for Ross Lake do not include the first two full days, and results for Newhalem Creek Campground do not include the first five full days. The percentage of human noise for each location across all days was analyzed (Table 4.2.7-3).

Site-Specific Results

A summary of the noise measurement results at each of the six noise monitoring locations within the sound assessment area are included below.

Ross Lake

The measurement site at Ross Lake was located along a trail behind Ross Lake Resort, in a semi-forested area near the shore of Ross Lake. During the summer measurement, this site was near a transformer that generated a near-constant 120 hertz hum. During the spring measurement, the transformer was no longer present; a resort employee reported that it had failed over the winter. The resort was operational during the summer measurement but had not yet opened for the season during the spring measurement.

Typical sources of sound included boat traffic and resort operation during the summer, and distant vehicle and boat traffic during the spring. Ruffed grouse drumming could occasionally be heard during the spring. No sounds immediately identifiable with Project operation were audible during the measurement periods, however, the Ross Powerhouse phone is reportedly audible at Ross Lake Resort. City Light's noon siren was inaudible at this location. During the summer measurement, human noise was near constant, due to transformer hum and resort activities. During the spring measurement, when the resort was not operating, and the transformer was no longer present, human noise was less common.

Diablo Lake Trail

The measurement site at Diablo Lake was located off the Diablo Lake Trail, about 0.75 mile from the ELC parking lot trailhead. The surroundings were heavily forested. Audio review of the summer measurements at this site was completed before the request to include a breakdown of sources was submitted, so a detailed source summary for the summer measurements is unavailable; however, the anthropogenic noise determination was made for all full days. Typical sounds included birdsong, passing hikers, and distant vehicle and boat traffic. Project-related noise sources audible at this site included boat traffic and the noon siren. During the summer measurement, human noise was variable, with frequent noise from boat traffic on the lake and passing hikers. During the spring measurement, human noise was much less frequent.

Newhalem Creek Campground

The measurement site at the Newhalem Creek Campground was located in campsite 26, which was unoccupied for the duration of the measurements. The campground was open during the summer measurements but was still closed for the season during the spring measurements. The campground is in a forested area.

Typical sounds in the summer included birds and noise from campers. In the spring, chainsaws could be heard during working hours on weekdays. Water noise from the Skagit River could be heard throughout both measurements. No sounds immediately identifiable with Project operation were audible, other than City Light's noon siren. During the summer measurement, anthropogenic noise frequently lasted well into the night due to activity from campground guests, although overall noise levels are still markedly lower during the night. During the spring measurement, there was frequent human noise during daytime hours on weekdays due to tree cutting activity, but this was reduced on the weekend. The baseline noise level remained similar to the summer measurements due to noise from the nearby Skagit River, but variability was less outside of the tree cutting periods due to less human noise.

Gorge Bypass Reach

The measurement site in Gorge Bypass Reach was located along the access road on the south side of the Skagit River, south of the bridge below Gorge Dam. During the summer measurement the dam was not spilling, whereas during the spring measurements the dam was spilling between April 26 and April 29, 2022. Spill flow varied from approximately 430 to 4,930 cfs, with the higher flows occurring during daytime hours between 8 am and 6 pm.

Typical sounds during the summer included birds and traffic noise from SR 20, while water noise from the river dominated during the spring while the dam was spilling. Project-related sounds included the river noise (or lack thereof), as well as occasional corona noise from the power lines overhead. During the summer measurements, anthropogenic noise and overall levels follow a distinct diurnal cycle. Vehicle traffic was a primary driver of both metrics at this location. The spring measurements show very little variability, reflecting the dominance of the relatively constant river noise.

Pyramid Lake Trail

The measurement site along Pyramid Lake Trail was located about 0.75 miles from the trailhead on SR 20. Typical sounds during both spring and summer measurements included water noise from a nearby stream, passing hikers, birdsong, and distant traffic. No sounds immediately identifiable with Project operation were audible, other than City Light’s noon siren. There was very little variability at this location during both the summer and spring measurements. This reflects the prevalence of stream noise at this location, providing a consistent noise floor and masking other transient noises. Occurrences of elevated levels are largely associated with periods of elevated wind.

Caskey Lake

The measurement site at Caskey Lake was located within the transmission line corridor, just off an access road. Typical sounds during the summer measurements included birds, distant traffic on SR 530, nearby logging traffic, and corona noise from the transmission lines. Distant gunshots could also occasionally be heard during both measurements. Project-related sounds at this location included corona noise. The noon siren was not audible at this location.

Corona noise was audible nearly constantly throughout the summer measurement, as reflected in the high percentage of audible anthropogenic noise. The diurnal cycle is discernable in maximum sound levels, frequently caused by truck traffic on the logging road, while traffic noise from SR 530 was regularly audible. During the spring measurement, corona noise was still present although not as frequently, likely due to lower temperatures and lower absolute humidity. Though distant traffic on SR 530 was audible during the daytime, the primary factor driving up noise levels during the day on the last three days of the measurement was wind noise in the foliage.

4.2.7.3 Existing Resource Measures

Article 413 of the current license required the filing of a Project Visual Quality Management Plan which includes protection, mitigation, and enhancement measures designed to mitigate the visual quality impacts of the Project. Most measures included in the Visual Quality Management Plan, originally filed in 1996, have been completed, including the following:

- General landscape and painting improvements in Newhalem and Diablo
- Vegetation plantings for screening seven target sites in the transmission line ROW
- Painting the Gorge Dam access bridge
- Painting the Diablo Powerhouse surge tank
- Painting the Ross Dam broome gate shed
- Removing the Diablo person lift
- Replacing roofing and siding on Project buildings to be more visually compatible with the surrounding environment
- Removing invasive species from, and replanting in, the Reflector Bar riparian area
- Removing three storage buildings from the western end of Newhalem and revegetating the area
- Vegetation screening of the Newhalem maintenance yard
- Renovation of planting beds associated with the SR 20 and Gorge Powerhouse Overlook parking lots
- Implementation of a Transmission Line ROW Vegetation Management Plan to reduce the visual impacts of the transmission line within highly visible areas of the RLNRA while still complying with vegetation clearance requirements.

City Light continues to consult with the NPS on the appearance of any new Project facilities and major maintenance projects within the RLNRA.

Additionally, 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 action reduces the overall visual effect of reservoir drawdown by reducing the number of viewers that experience low water conditions.

In 2020, FERC approved an amendment to the Visual Quality Management Plan. The amended management plan replaced some requirements of the original plan that had not yet been implemented and were no longer considered needed or desired by signatories of the 1991 Recreation and Aesthetics Settlement Agreement. The new measures include the following, which are currently being implemented by City Light:

- Refurbishment of the irrigation system and planting of additional native and non-invasive landscape species at Ladder Creek Gardens;
- Removal of invasive landscape trees and planting of native species around visitor parking lots in Newhalem; and
- Restoration of the Reflector Bar area to native habitat.

One measure required under the Visual Quality Management Plan, painting the transmission line towers a less visually contrasting color in the course of City Light's routine maintenance schedule, remains incomplete. Industry-wide best management practices (BMPs) pertaining to recoating of transmission towers have evolved over the past twenty-five years since the issuance of the current FERC license. Modern industry-wide BMPs do not provide that the routine complete recoating of every transmission tower is necessary to maintain the structural integrity of a tower. In light of this, over twenty years ago, City Light suspended the general schedule for recoating of transmission towers. Instead, consistent with industry practices, recoating now occurs on a limited and targeted basis in response to specific maintenance and repair activities that are identified through City Light's routine inspection program. City Light is currently in discussions with signatories of the 1991 Recreation and Aesthetics Settlement Agreement to address the visual effects of the transmission line towers under the current license.

4.2.7.4 Proposed Resource Measures

Visual Resources Management Plan

To enhance visual resources and the scenic environment associated with lands and facilities within the Project Boundary, City Light proposes to develop a Visual Resource Management Plan. This plan will include environmentally sensible and economically feasible measures to mitigate for visual impacts of the Project over the new license period. These measures may pertain to the Project's built environment, including Project lighting; landscaping and vegetation management; and views of Ross Lake, among others. This plan would include BMPs consistent with implementation of the Historic Properties Management Plan (HPMP) to avoid, minimize, or mitigate adverse effects to historic properties, including landscapes and viewsheds, as required by the National Historic Preservation Act. City Light will implement this plan upon FERC approval. Additional details will be provided in the Final License Application (FLA).

A key component of the Visual Resource Management Plan will be Lighting Management measures to reduce Project lighting impacts on night skies in the RLNRA while balancing Project lighting needs for City Light to safely and efficiently operate and maintain the Project.

Sound Protection BMPs

City Light anticipates including BMPs associated with Project noise generation. In addition, these BMPs will be consistent with guidance in the HPMP to avoid, minimize or mitigate adverse effects to historic properties. Additional details will be provided in the FLA.

4.2.7.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts related to scenic and aesthetic resources are expected to occur as a result of the continued operation of the Project, as proposed.

4.2.8 Cultural Resources

Seattle City Light (City Light) has undertaken extensive investigations to identify cultural resources that could be potentially affected by continued Project operation and maintenance (O&M) activities under a new license. These investigations, which included investigations into archaeological (usually on or in the ground) and historic built environment (usually above ground and structural) resources and traditional cultural properties (TCPs), are substantially adding to the existing available information that was presented in City Light's Pre-Application Document (PAD). The studies conducted for these investigations are still underway and work to complete them is ongoing. These studies will support the development of a Historic Properties Management Plan (HPMP), a draft of which will be provided in the Final License Application (FLA). A proposed outline for the HPMP is included in Appendix B of this Exhibit E.

4.2.8.1 Affected Environment

This section describes: (1) the regulatory context related to cultural resources; (2) provides a description of the Project's Area of Potential Effects (APE); (3) outlines the cultural setting of the Project vicinity; and (4) summarizes the results of two completed cultural resources studies conducted for the Project relicensing. Two other cultural resources studies are still underway and are also briefly summarized below.

Regulatory Context

Section 106 of the National Historic Preservation Act (NHPA) of 1996, as amended, requires the Federal Energy Regulatory Commission (FERC or Commission) to evaluate potential effects on historic properties prior to an undertaking. Pursuant to the applicable regulations found at 36 Code of Federal Regulations (CFR) §800.16, an undertaking is defined as a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those requiring a federal permit, license, or approval. For this undertaking, Project-related activities associated with the day-to-day O&M of the Project and any new construction or operations activity proposed under the new license are considered because they may cause associated Project-related effects to historic properties, as defined in §800.16(1)(1).

A historic property is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register Historic Places (NRHP or National Register) maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term 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)). In most cases, cultural resources less than 50 years old are not considered eligible for the NRHP as historic properties unless they meet certain criteria considerations. Historic properties also must retain integrity (i.e., the ability to convey their significance) to qualify for listing in the NRHP. For example, dilapidated structures or heavily disturbed archaeological sites may not retain enough integrity to relay information relative to the context in which the resource is considered to be important and, therefore, are not eligible for listing in the NRHP.

Section 106 of the NHPA also requires that FERC consult with the State Historic Preservation Officer (SHPO) on any determinations of NRHP eligibility and findings of effect on historic properties, and to allow the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on any finding of adverse effects. Section 106 of the NHPA also requires that the Commission consult with potentially affected Indian Tribes that might attach religious or cultural significance to such properties (i.e., TCPs).

FERC designated City Light as its non-federal representative for carrying out informal consultation pursuant to Section 106 of the NHPA on June 26, 2020, in its public notice of City's Light NOI and PAD (FERC Filing Accession No. 20200626-3024) and again in a letter confirming this decision to the Washington SHPO dated February 26, 2021 (FERC Filing Accession No. 20210226-3004). As FERC's non-federal representative, City Light has consulted throughout the relicensing effort with the Section 106 consulting parties, including federal, state, and local agencies, Indian Tribes, Canadian First Nations, and the Washington State Department of Archaeology and Historic Preservation (DAHP), which is led by the Washington SHPO. By letter dated June 23, 2021, SHPO concurred with City Light's proposed APE. Consultation efforts have further included numerous work group meetings between City Light and the Section 106 consulting parties that focused on the development of study plans, study research designs, study implementation, and preliminary study results.

Area of Potential Effects

Cultural resources investigations were carried out in the APE. As defined in the applicable regulations found at 36 CFR §800.16(d), the APE is "...the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historical properties, if any such properties exist." Based on this regulatory definition, the APE for the Project relicensing is defined as including all lands within the FERC Project Boundary. The APE also includes lands or properties outside the Project Boundary where Project operations or Project-related recreation activities or other enhancements may cause changes in the character or use of historic properties, if any such properties exist.

It is possible that studies implemented as part of the relicensing process may identify Project-related activities that have the potential to affect historic properties outside the APE. It is also possible that during relicensing, Project improvements may be proposed that are outside the original APE. If such areas are identified, the APE will be amended to address these other areas and activities.

Cultural History Overview

Precontact Period

The earliest known ancient inhabitants of western Washington, Paleo-Indians, were people who left behind evidence of their hunting activity in the form of large, fluted projectile points (called Clovis points) dating to approximately 12,800 years before present (BP). These types of artifacts have been found throughout the state including the Puget Lowland, Cascade Mountains, and eastern Washington (Ames and Maschner 1999; Avery ca. 1991; Carlson 1990; Meltzer and Dunnell 1987; Mierendorf et al. 1998). Clovis points were found at East Wenatchee Clovis Site (45DO482) and isolated occurrences elsewhere (Kwarsick 2010). Date ranges assigned to 45DO482 span between 11,500 and 11,000 years ago (Mierendorf 1987), with other estimations assigning a date of 12,800 years BP (Ames and Maschner 1999; Carlson 1990) and 13,000 years BP (Kirk and Daugherty 2007). Some authors cite the age of surrounding ash deposits (13,600 years BP) as an indicator of even earlier site age. Another notable archaeological site discovered on Orcas Island (45SJ454) has provided important data pertaining to early occupation within the Salish Sea. The site, at Ayer Pond, consists of various *Bison antiquus* skeletal elements that feature evidence of cultural modification dating to 13,900 years BP (Kenady et al. 2006, 2011). More relevant to the Skagit River Valley are the Western-Stemmed points recovered from archaeological sites now inundated by Ross Lake (Mierendorf et al. 1998). The Western-Stemmed point tradition is temporally associated with the Paleo-Indian period during the Pleistocene-Holocene transition (roughly 13,000 – 7,000 years BP) and is a unique method of tool manufacture identified in the montane and high plains of Washington (Scott 2016).

In general, Paleo-Indian people were primarily hunter-gatherers with low population numbers and high levels of mobility who lived during the Late Pleistocene and transition to the Early Holocene during a warm episode that triggered glacial retreat. Some researchers have argued that these early people were maritime-oriented (Carlson 2003; Dixon 1993; Fedje and Christensen 1999; Fladmark 1979). In western Washington, sites from this period are rare. Much of the late Pleistocene terrain was uninhabitable because of the glaciers, and the lands that were occupied by Paleo-Indians were predominately coastal reaches. During the glaciation period, ocean levels fell almost 400 feet (ft) (120 meters [m]) globally (Clague et al. 1982; Kirk and Daugherty 2007), but with the onset of the warming Holocene, ocean levels rose and submerged many of these coastal sites. However, some sites are not submerged, and instead are located above the present shoreline due to eustatic, tectonic, and isostatic effects that vary throughout the region (Fedje and Christensen 1999).

Stone tool styles reflect that ancient people made several transitions in technology during the Archaic period, which dates from approximately 12,500 to 6,400 years BP (Ames and Maschner 1999; Carlson 1990). Archaic-period sites, similar to Paleo-Indian sites, are poorly represented in the archaeological record. Changes in sea level and vegetation during the Early to Middle Holocene warming period have obscured evidence of Archaic-period sites along the coast (Ames and Maschner 1999). However, as the glaciers receded, people were able to occupy larger expanses in the interior of Puget Sound. In western Washington, this is best exemplified at the Bear Creek site (45KI839) in Redmond, Washington (Hodges et al. 2009; Kopperl 2016; Kopperl et al. 2010; 2015). Archaic-period peoples likely maintained small populations and high levels of mobility, and focused on a combination of maritime, littoral, and terrestrial economies. Large, stemmed lanceolate projectile points and bifaces are characteristic of Archaic period stone tool assemblages, which can also include microblades and microblade cores (Ames and Maschner 1999). Microblades are well represented in archaeological sites in and near the Project, and the technique to manufacture them reflects a shift from ancient people's earlier methods of stone tool production. The earliest sites in the North Cascades also reflect vast lithic procurement strategies and use of a mountain pass, called Cascade Pass, approximately 15 miles south of the Project to access both sides of the mountains circa (ca.) 9,600 years ago (Mierendorf and Foit 2018). Archaeological evidence from the Ross Lake vicinity suggests that people occupied the area throughout the majority of the Archaic period and used particular areas more or less intensively during certain time spans (Mierendorf et al. 1998). Radiocarbon dates from a chert quarry within the APE, for example, indicate seasonal use ca. 7,600 BP, with marked increases of intensity reflected by archaeological remains around 5,000 BP, 1,500 BP, and 250 BP (Mierendorf 1993; Mierendorf et al. 1998:347).

Another stylistic shift in stone tool manufacture during the Archaic period is reflected in archaeological assemblages dating between 9,000 and 4,500 BP, known as Olcott. Olcott assemblages are interpreted as evidence of an early highly mobile hunting and gathering adaptation, and an increased human occupation in the uplands is evident throughout the Cascades after roughly 5,000 BP. Several Olcott sites lie within the APE, including the site type for Olcott near Arlington in Snohomish County. Most Olcott sites have not been radiocarbon dated because of a lack of features or stratified depositional contexts. Various beginning and ending dates of this type of site have been proposed (e.g., 9,500-7,800 BP) (Chatters et al. 2011). These sites are found mostly on glacial outwash surfaces in the Puget Lowland and inland foothill valleys (Kidd 1964; Mattson 1985). Olcott sites have distinctive stone tool assemblages, consisting of large, leaf-shaped, and stemmed points, and cobble and tools made of lithic flakes manufactured from locally available cobbles. Sites associated with the Olcott Complex in western Washington are contemporaneous with similar Cascade Phase sites identified east of the Cascade Mountains (Butler 1961; Chatters et al. 2011; Leonhardy and Rice 1970).

Pacific-period sites date from approximately 6,400 to 250 BP spanning the Middle to Late Holocene. At the end of this period, smallpox spread to the region (Ames and Maschner 1999). Archaeological investigation, focused largely on the Puget Sound lowlands and coastal areas, has demonstrated that people transitioned from a mobile strategy to settling in semi-permanent homes during the Pacific period. Since about 5,000 years BP, clusters of archaeological sites and activity areas are increasingly evident. Since about 2,500 years BP, villages and food preservation and storage features are indicators of a shift to a semi-sedentary lifestyle. This archaeological evidence demonstrates a transition for people who were no longer solely reliant on following the resources that were available seasonally, because they could now accumulate and store food for longer periods and support a larger population base in one place.

The Early Pacific period (6,400 to 3,800 BP) was marked by several other transitions including: a shift in burial practices; an increased use of marine resources; a diversification in subsistence activities; the disappearance of microblade technology; and an increased use of bone, antler, and ground stone tools. Major developments also included the appearance of ground stone celts (adze blades) and a proliferation in chipped-stone tool forms and styles and decorative/ornamental pieces that likely represent contact and trade with groups in neighboring cultural areas (Kirk and Daugherty 2007). The Middle Pacific period (3,800 to 1,800/1,500 BP) displays major developments leading to increased sedentism, such as the appearance of long-term settlements (plank houses), intensification of salmon capture and storage (appearance of wooden fish weirs and girdled/drilled net sinkers), and a diversification in tool form and style. Late Pacific period (1,800/1,500 to 250 BP) developments are represented by the appearance of heavy-duty woodworking tools, an overall decline in the use of chipped-stone tools, and an increase in funerary ritual/burial evidence. Sea levels became stable by the start of the Middle Pacific period, and archaeological sites representing the Middle and Late periods are apparent across the Northwest Coast region (Ames and Maschner 1999).

Radiocarbon dates from cultural sites in the North Cascades reflect human activity spanning the Holocene. However, this area appears to have been used most intensively during the Middle Holocene (ca. 5,000 to 3,000 BP) (Mierendorf 1993; Mierendorf et al. 1998; Miss et al. 2004, 2010). The period was marked by larger, more complex populations utilizing a wide range of resources including berries, roots, and salmon, and inland sites exhibit hunting, gathering, and riverine fishing traditions (Blukis-Onat 1987). Archaeological sites in the Cascades dating to between 3,000 and 2,000 BP are found in a wider variety of upland settings, including major ridges and rivers, small tributary streams, springs, and benches (Parvey and Rinck 2015). Sites represent short-term camps or locations associated with hunting, fishing, and gathering, and lithic procurement and manufacture. Research on precontact land use in this montane environment has progressed in recent decades and includes comparison to ethnographic information about Native American groups and practices in the upper Skagit River Valley from more recent periods to help interpret archaeological data (Collins 1974).

Historic Period

Precontact to Historic Period Transitions

The transfer of knowledge among Native peoples was through oral traditions, which are commonly recognized to contain information relevant for hundreds or even thousands of years in the past. Oral stories and songs, illustrating the connection of Native peoples to the landscape of their traditional territories, as well as day-to-day sharing of traditional practices were not written down, prior to first contact with Europeans who arrived to explore, and later settle, in the area. Written records of the early historic period and ethnographic accounts can offer valuable details about the history of land use for both Native and non-Native people and can also provide context for interpreting the archaeological record.

Traditionally, the upper Skagit Valley is generally considered to be contained within the Northwest Coast culture area, in which a series of culturally complex hunting-and-gathering societies developed based on maritime-oriented economies. More specifically, the APE falls within territory of Coast Salish tribes. Before the treaties of 1854–1855 and establishment of reservations, more than 50 named groups or Indian Tribes were identified as Southern Coast Salish based on linguistic and, to some extent, similarities in subsistence strategies (Suttles and Lane 1990). The APE is situated within the traditional territories of multiple Indian Tribes and Canadian First Nations who occupied lands between the Salish Sea and inland in the river valleys. Differences between the various Indian Tribes and Canadian First Nations are evident in their activities, practices, and language dialects; however, those living and visiting the Project vicinity subsisted on resources in the rivers and mountains, which is reflected by archaeological evidence through a mix of longer-term settlements or village clusters and transitory camp sites or activity areas used by mobile groups to continue seasonal rounds.

Cultural Geographics Consulting, LLC (CGC) completed Part 1 of the CR-01 Cultural Resources Data Synthesis on behalf of City Light (Curti et al. 2020). Part 1 contains ethnographic background information for historic properties with known or potential TCP and Traditional Cultural Landscape (TCL) significance within, or adjacent to, the geographic scope of the APE (Curti et al. 2020). The ethnographic data synthesis report (Part 1) provides a preliminary baseline of ethnographic and ethnohistoric information necessary to identify places of traditional religious and cultural importance for Indian Tribes and Canadian First Nation licensing participants (LPs) affiliated with the APE (Curti et al. 2020). The study also provides a review and listing of available information on NRHP eligible, and potentially eligible, places, properties, water/landscapes, and resources. As part of its study, CGC conducted outreach to Indian Tribe and Canadian First Nation LPs in 2019 and 2020 including: Confederated Tribes of the Colville Reservation, Lummi Nation, Muckleshoot Indian Tribe, Nlaka'pamux Nation Tribal Council[87], Nooksack Indian Tribe, Samish Nation, Sauk-Suiattle Indian Tribe, Snoqualmie Indian Tribe, Stillaguamish Tribe of Indians, S'ólh Téméxw Stewardship Alliance,[88] Suquamish Tribe, Swinomish Indian Tribal Community, the Tulalip Tribes, and Upper Skagit Indian Tribe. CGC performed background research and informational analysis and synthesis related to traditional use areas, named places, ancestral territories, treaty dynamics, post-treaty social and political developments, social and kinship

87 Subsequent to the completion of CR-01 Cultural Resources Data Synthesis Part 1 report, the Nlaka'pamux Nation Bands Coalition contacted City Light in April 2021 to consult on the Project.

88 S'ólh Téméxw Stewardship Alliance is an alliance of 16 Stó:lō First Nations. It is an organization that serves a number of Stó:lō First Nations, particularly through the Stó:lō Service Agency.

networks, spiritual, religious, and cultural practices, human-environment relationships, worldview, belief, and values systems, and associated resources, places, and land/waterscapes of traditional religious and cultural use and importance (Curti et al. 2020:1).

Ethnographic and ethnohistoric data provide important context for peoples' relationships to geography and specific types or places of cultural significance, which are often linked to villages, fishing sites, campsites, smokehouse sites, resource procurement sites, hunting areas, and important geographic features and story markers. Ethnographic documents indicate numerous place names, fishing sites, and villages within the APE, many of which are near major rivers and their tributaries (Blukis-Onat 1990; Collins 1974; Lane and Lane 1977; Smith 1988). Locations along the river were prized because of the presence of fresh water, good fishing, reliable access to other resources, and the access to river transportation (Collins 1974; Lane and Lane 1977; Smith 1988; Suttles and Lane 1990). The current location of the Newhalem townsite was once considered the most remote location for travel by canoes because of the treacherous waters present at the gorge, further to the northeast (Mierendorf et al. 1998). Lane and Lane (1977:160) noted that the last known portage and campsites were around Newhalem. Lane and Lane further stated, "The evidence suggests that salmon probably did not get beyond the gorge above Newhalem and this may have reduced the attractiveness of the region for intensive utilization" (Lane and Lane 1977:161).

There are numerous early accounts that described the traditional use of Indian trails as well as other TCPs throughout the area, though most descriptions are vague and offer little contextual information pertaining to the exact locations of the trails. *People of the North Cascades* illustrates several trails likely used along the Skagit River (now inundated by Ross Lake) and the Skagit gorge during precontact times (Mierendorf 1986:109). Collins (1974:6) noted that due to heavy vegetation, "land travel [for the Upper Skagit] was confined for the most part to places near timberline where the vegetation was relatively sparse." Blukis-Onat (1990) reported up to six trails in the region including the Niccolum trail, the Stetatultz route and raiding snowhees, the upriver trail, a trail to an unknown location/place, a mining trail, and a trail up Newhalem Creek.

As noted by Collins (1974:38), "in 1852, a trail was cut along the Skagit River. Where it began is not certain but it extended to Ruby Creek and also beyond into British Columbia." Lane and Lane (1977:155) documented a trout fishing location on Ruby Creek, but note that "Information about the occupation and use of the Skagit Valley beyond where Ross Dam was built is extremely limited. The last known [i.e., furthest upriver] portage and campsites were around Newhalem. The Miksaiwhu claimed the valley beyond and Upper Skagit thought of it as their hunting territory. However, the river extends about 79 miles beyond Ross Dam – about half of the total length (162 miles) lying beyond the last known living sites. The evidence suggests that salmon probably did not get beyond the gorge above Newhalem and this may have reduced the attractiveness of the region for intensive utilization (Lane and Lane 1977:160-161)." Smith (1988:32) noted a land trail that "ran up the Skagit River to its headwaters, although most Upper Skagit travel was by canoe. How difficult it was to negotiate I do not know, but the upper reaches of the river plainly presented real problems for canoe navigation." Early boundary surveyors including Henry Custer and George Gibbs accessed the border using the north-south oriented river valleys, documenting villages, trails, and place names (National Park Service [NPS] 2008b). Another trail appears in early maps along the east bank of the Skagit River called the Hope trail (Niccolum trail), which was used by miners to avoid the Skagit gorge but likely existed prior to Euroamerican presence in the area. Many trails were used during the winter months for trapping game (Blukis-Onat 1990:57). Cedar

Bar (located in present-day Diablo) was considered a "convenient midway point" on the trail up the Skagit River (Skagit River Journal 2002).

The earliest documented historic period inhabitant of Cedar Bar and the Skagit River Gorge was Upper Skagit elder Charlie Moses. He was an Indian healer and spiritual leader who seasonally lived in the Stetattle Creek area (Sampson 1972) and had a trapping cabin (Luxenberg 1986). He occupied the cabin on Cedar Bar until 1898, when the Davis family took over the structures built and used by Charlie Moses (Sampson 1972). Euroamerican Lucinda Davis began a roadhouse for miners at Cedar Bar in 1898, which incorporated part of Charlie Moses' trapper cabin (Luxenberg 1986; Skagit River Journal 2002). The Davis family operated the roadhouse until it was condemned in 1928 (Davis 1953; Luxenberg 1986).

Charlie Moses' presence in the Skagit River Gorge is recognized among Skagit elders as historically important as the Tribal member living farthest upriver and for his hosting of spiritual gatherings at his houses at Bacon Creek and Cedar Bar. In the early 1900s, Moses served as the Allied Tribes of the Upper Skagit's representative of the "Mis-skai-whwa" traditional lands (Sampson 1972:24), which include all of the Gorge area. The Allied Tribes of the Upper Skagit organized at this time to bring lawsuits against the federal government over unfulfilled treaty rights.

Indigenous trails were later used by historic settlers and miners in the region. In the APE, the Goat Trail/Devil's Elbow trail provided a route from Newhalem to the Diablo area above the rocky Gorge Reach. The steep geography created pinch points along the route. The historic Goat Trail followed and overlapped an indigenous foot trail that predated it. One thing that made the Goat Trail unique at the time miners entered the area was that it was a necessary portage between today's Newhalem and Diablo areas due to whitewater rapids and perhaps obstacles in the canyon (Collins 1974).

Ethnographic evidence also indicates that groups maintained ongoing social and cultural relationships with people across Cascade Pass including those living in the Chelan, Methow, and Wenatchee areas (Blukis-Onat and Hollenbeck 1981; Lane and Lane 1977). Cascade Pass is outside of the APE but would have been an important travel corridor connecting communities on the east and west sides of the mountains.

Two separate trails crossed the Cascades by way of Rainy Pass and Cascade Pass into eastern Washington and were documented by Collins (1974; see Mierendorf and Foit 2018). Recent archaeological investigations at Cascade Pass suggest two alternatives for the use of the pass. The first alternative represents travel, trade, or other trans-Cascade crossings wherein the pass and its alpine setting are not the destination; the second alternative suggests Cascade Pass was used as a field camp providing access to higher elevation resource patches (Mierendorf and Foit 2018). Multiple trails were used by Indian Tribes east of the Cascades to travel west for resources (Smith 1988).

Other early mentions of Indian trails in the region include observations from Otto Klement's 1877 expedition. As noted by the NPS (2008a), Klement described in 1877 that the Indian trails were located in the high country where possible, rather than through the thick growth of the valley bottom. Many of these trails were later modified to function as mining trails and prospecting roads.

Other accounts detail Indian trails that followed upland mountain routes to avoid other trails through the various canyons in the Skagit River watershed. “Some early miners avoided the Skagit River canyons and dangerous trails altogether by traveling far overland to Hope, Canada, then heading south about 50 miles on the Skagit-Hope Trail, which was made by Native Americans. Miners [eventually] extended this trail to reach Ruby Creek” (Olason 1989). “In the mountains, trails often led along the higher ground and ridges where the undergrowth was not so dense and where there were fewer and smaller streams to cross. There, too, the road rose and fell less and the outlook for game and enemies was wider. Where possible, trails passed through the lower gaps in the mountain ranges” (Rice 1964).

A transcription of a 1949 story, originally published in the Mount Vernon Daily Herald, details the early pioneer experience of Karl von Pressentin in the Upper Skagit River Valley. While the story centered on von Pressentin’s experience with gold mining prospects in the mid to late 1800s, the story also provided a few details on the creation of Indian trails. “Indian trails, unless heavily traveled…were a series of ‘blazes,’ marking the route through the dense forests. The Indian way of blazing the trail [consisted of] splitting the top of an evergreen sapling, an operation that could be performed by hand, and which left an unmistakable sign for a long time. The split tips stayed green but did not grow together” (Mount Vernon Daily Herald 1949).

Additional information is available in the numerous studies that have been previously completed (Ames and Maschner 1999; Amoss 1972; Blukis-Onat 1990; Blukis-Onat and Hollenbeck 1981; Collins 1974; Lane and Lane 1977; Ruby and Brown 2010; Smith 1988; Suttles and Lane 1990; Sturtevant 1990).

Brief Introduction of Indian Tribes and Canadian First Nations

This section provides a brief summary of Indian Tribes and Canadian First Nations whose traditional territories intersect with the APE. City Light recognizes that each Indian Tribe and Canadian First Nation may have differing views as to the information provided by the other Tribes and First Nations, and City Light does not opine on the correctness of such information. These descriptions are limited in scope and context and are not intended to have any legal significance outside of this relicensing proceeding.

These summaries are based on the Curti et al. 2020 report and more recent information provided directly by some of the Indian Tribes and Canadian First Nations, as described below and in alphabetical order.

Confederated Tribes of the Colville Reservation

The Confederated Tribes of the Colville Reservation consists of 12 bands. The Confederated Tribes of the Colville Reservation passed a resolution (2015-100.cul) to formally abandon the use of anglicized tribal names. The Salishan speaking bands include ščəl̓ámxəxʷ (Chelan), sx̌ʷy̓ʔiłpx (Colville), šntiyátkʷəxʷ (Entíat), sn̓ʕay̓ckstx (Lakes), sp̓aƛ̓mul̓əxʷəxʷ (Methow), škwáxčənəxʷ (Moses Columbia), Sʔukʷnaʔqín (Okanogan), nspiləm (Nespelem), sn̓pʕawílx (San Poil), šnp̓əšqʷáw̓šəxʷ (Wenatchee [sic]), and the Sahaptin speaking bands include the wal̓wáma (Chief Joseph Nez Perce), and palúspam (Palús) (Curti et al. 2020; Johnson 2021).

The ancestral territories of the Colville bands lie within the Columbia Plateau along the upper reaches of the Columbia River and its tributaries, which they inhabited and utilized from time immemorial (Curti et al. 2020:129). As noted in Curti et al. (2020:129), "While any of the Confederated Tribes could have included the Study Area in their traditional use territory, the Chelan, Methow, Entiat, and Wenatchi had clear cultural and use affiliations within the Study Area (Boxberger 1996:17). Members of these bands regularly traveled west of the Cascades to socialize, marry, and trade with peoples of the Skagit River Valley and gather resources between the mountains and the saltwater."

The original Colville Indian Reservation was established by Presidential Executive Order on April 9, 1872 (Johnson 2021). Although originally larger, portions were subsequently ceded, and in July 1872, it was exchanged for the present reservation, located immediately west of the original reservation (Johnson 2021). The Moses or Columbia Reservation was set aside for Chief Moses in 1879, which included Columbia, Chelan, Entiat, and Wenatchi tribes; however, it was returned to public domain in 1883 (Johnson 2021). In 1884, Chief Moses made an agreement to move to the Colville Reservation. The north half of the Colville Reservation was ceded to the United States by an act of Congress (27 Stat. 62) in 1892 (Johnson 2021).

Lummi Nation

According to traditional history information provided in Curti et al. (2020:65), "Lummi people, Lhaq'temish, have inhabited the northernmost coast of present Washington State and southern British Columbia since the beginning of time (Lummi Nation n.d.)." This territory includes the lower Nooksack River, Bellingham Bay, Lummi Bay, Lummi Island, San Juan Islands, and the coastal lands between the Frasier River south to Seattle (Curti et al. 2020; Lummi Nation n.d.). Lummi speak the Northern Straits Salish or the Lkungen dialect spoken by the Songish of southern Vancouver Island (Thompson and Kincade 1990:37).

The Lummi Nation was a signatory to the 1855 Treaty of Point Elliott, which set aside the Lummi Reservation (Curti et al. 2020:66; Lummi Nation n.d.). In the reservation era, many Semiahmoo and Samish settled on the Lummi reservation and their descendants are now members of the Lummi Tribe (Lane 1973a:1-2).

Muckleshoot Indian Tribe

As described in Curti et al. (2020:69), the Muckleshoot Tribe traces descent from several linguistically and culturally related bands indigenous to the Green, White, and Duwamish River watershed (Smulkamish, Skopamish, and Stkamish), and to the Duwamish and Upper Puyallup people who settled on the Muckleshoot Prairie reservation. Muckleshoot people have occupied the once-interconnected rivers and valleys since the beginning of time. Muckleshoot language is identified as Whulshootseed, a dialect of Southern Coast Salish Lushootseed (Curti et al. 2020; Thompson and Kincade 1990:35-36). Muckleshoot antecedent bands, "Smalh-kamish, Skope-ahmish, St-kah-mish", were named in the preamble of the Treaty of Point Elliott; however, Governor Isaac Stevens grouped the lake and upriver bands under the Duwamish Tribe represented by Chief Seattle as the treaty signatory (Curti et al. 2020:69). The Muckleshoot Reservation was subsequently established for the upriver people in 1857 (Muckleshoot Tribe n.d.).

Nooksack Indian Tribe

As described in Curti et al. (2020:72), “the Nooksack people have occupied the Nooksack River watershed since time immemorial.” This watershed reaches from its mouth to its headwaters surrounding Mt. Baker, extending into Skagit County in the south, from Georgia Strait in the west to the area around Mt. Baker in the east, into British Columbia in the north (Curti et al. 2020: 72; Nooksack Tribe 2020; Richardson and Galloway 2011 in Curti et al. 2020). The Nooksack language, Lhéchalosem, is a Salishan dialect closely related to Halkomelem, which is spoken by Central Salish peoples in British Columbia (Curti et al. 2020:72; Richardson and Galloway 2011 in Curti et al. 2020; Thompson and Kincade 1990:37).

Although the Nooksacks were not identified in the preamble to the Treaty of Point Elliott in 1855, they were present and participated in the treaty negotiations (Curti et al. 2020:72). The Nooksack people were not given their own reservation but were assigned to the Lummi Reservation at the mouth of the Nooksack River. Most, however, remained settled in the prairie villages until driven from their homes by Euroamerican settlers. A few Nooksack individuals sought and received homesteads, some of which are now included in the Nooksack trust lands (Curti et al. 2020:72; Nooksack Tribe 2020). As noted in Curti et al. (2020:73), the Nooksack Tribe acquired a one-acre reservation in 1970 and was federally recognized in 1973.

Samish Indian Nation

Curti et al. (2020:79) describe that since time immemorial, the Samish people have inhabited their traditional territory that includes the eastern half of Lopez Island as well as Blakely, Guemes, Cypress Islands, other islands between Lopez and the mainland, and portions of Samish Bay, Padilla Bay, and Fidalgo Island (Lane 1973a:1-2; 1975:1). Samish language is identified as *Xws7ámeshqen*, a dialect of Straits Salish (Curti et al. 2020:79; Ruby et al. 2013:257; Suttles 1974:96).

Although the Samish Nation was a party to the Treaty of Point Elliott in 1855, they were not listed in the final draft of the treaty (Curti et al. 2020). The Samish were subsequently assigned to the Lummi Reservation and some Samish families settled there, while others settled on the Swinomish Reservation; however, many Samish people refused to relocate to, or only settled briefly on, the reservations (Curti et al. 2020:79). Many Samish settled on Guemes Island. Although they remained landless, the Samish organized politically by 1907 and were not federally recognized until 1966 (Curti et al. 2020:79).

In 1966, the Samish Nation was included on an Interior Department internal list of federally recognized Indian Tribes who had not adopted a constitution under Section 16 of the Indian Reorganization Act (Curti et al. 2020; Samish Indian Nation 2017). However, they were omitted from a 1969 list of federally recognized tribes, which resulted in the federal government failure to recognize the tribe (Samish Indian Nation 2017). In 1996, the Samish Nation was formally re-recognized by the Department of the Interior, and in 2005, a federal appeals court ruled that they should have been federally recognized as a historical tribe in 1969 (Samish Indian Nation 2017). In 2006, the Samish Nation had 76 acres of land placed in trust by the United States (Ruby et al. 2013:260; Samish Indian Nation 2017).

Sauk-Suiattle Indian Tribe

Curti et al. note that "[f]rom time immemorial, Sauk-Suiattle people have inhabited the Sauk and Suiattle river valleys, including the tributaries and headwaters, and the Cascade Crest from approximately Cascade Pass to Indian Pass (Hollenbeck 1987:148). The Sauk-Suiattle people consider the entire drainage area of the Sauk, Suiattle and Cascade Rivers to be their Homelands (Sauk-Suiattle Indian Tribe 2019) and maintain vital connections to the Skagit River" (Curti et al. 2020:83). The Sauk-Suiattle people speak the Lushootseed language (Curti et al. 2020:83; Thompson and Kincade 1990:35-36).

In 1975, the Sauk-Suiattle Indian Tribe was federally recognized based on joint ownership with the Upper Skagit of a common cemetery placed in trust by the United States in 1913, and at the same time, adopted a constitution (Curti et al. 2020:83-84). Two parcels of land totaling 23 acres were taken into trust and designated as the Sauk-Suiattle Indian reservation (Curti et al. 2020:84; Ruby et al. 2013:267).

Snoqualmie Indian Tribe

As noted in Curti et al. (2020:90), Snoqualmie people have occupied the Snoqualmie River drainage from North Bend to the junction of the Skykomish and Snoqualmie Rivers from the beginning of time (Hollenbeck 1987:170). Snoqualmies speak the Nisqually dialect of the Lushootseed language (Thompson and Kincade 1990:35).

The Snoqualmie people were assigned to the Tulalip Reservation during the Treaty of Point Elliott although George Gibbs proposed a reservation on Snohomish Bay to serve the peoples of the Snoqualmie, Skykomish, and Snohomish River drainages (Curti et al. 2020:90). Subsequently, some Snoqualmie and Skykomish people settled on the Tulalip Reservation, while others returned to settle in or near their traditional territory (Curti et al. 2020:90; Lane 1975a:1-2, 6-8, 11). The non-reservation Snoqualmie people were treated as a tribal entity by the Bureau of Indian Affairs until the 1950s, at which point, the agency ceased to recognize the Snoqualmie Tribe (Curti et al. 2020:90). Due to their close affiliation with the Skykomish and because the Skykomish Tribe was no longer recognized, the Snoqualmie people filed to recover lands ceded by both Indian Tribes with the Indian Claims Commission (Curti et al. 2020:90). However, the Indian Claims Commission determined that the Snoqualmie did not demonstrate it was a successor in interest to the Skykomish ancestral territory, and therefore, that the tracts of land were separate (Curti et al. 2020:90). Upon appeal, the decision was reversed and the Snoqualmie received compensation for their alienated lands as well as those of the Skykomish (Curti et al. 2020:90). The Snoqualmie Tribe was granted federal recognition in 1999 (Snoqualmie Indian Tribe 2012).

Stillaguamish Tribe of Indians

The traditional territory of the Stillaguamish (stuləgʷábš) people includes the Stoluck-wa-mish (Stillaguamish) River drainage from the headwaters to the mouth, as well as the north and south forks of the river, which they have inhabited since the beginning of time (Curti et al. 2020:94; Stillaguamish Tribe 2019). Curti et al. (2020:94) and Bruseth (2012:10) note that the Stillaguamish indigenous territory extends from British Columbia to Oregon. The Stillaguamish people speak Lushootseed.

The Stillaguamish were party to the Treaty of Point Elliott (1855) and were placed on a temporary reservation at Holmes Harbor on Whidbey Island but returned to their traditional territory near the Stillaguamish River and lived for several years until Euroamericans settled into the region (Curti et al. 2020:94). The Stillaguamish were later assigned to a reservation at Penn Cove on Whidbey Island and to the Tulalip Reservation near Marysville, but few settled there (Curti et al. 2020:94; Hollenbeck 1987:159-160; Lane 1973b:6-10). The Stillaguamish Tribe was granted federal recognition in 1979 and in 2014, the Stillaguamish Tribe placed 64 acres into trust to establish the Stillaguamish Reservation (Curti et al. 2020; Harmon 1998:242).

Suquamish Tribe

As noted in Curti et al. (2020:102), the Suquamish people have occupied the shores of Puget Sound since time immemorial. Unlike most Coast Salish people of Puget Sound who were oriented to and identified with particular river basins, Suquamish were saltwater people and not set to one particular drainage system (2020:102). The Suquamish people speak Lushootseed.

The Suquamish were party to the Treaty of Point Elliott (1855) and were assigned to the Port Madison Reservation (Curti et al. 2020:102). The Suquamish Tribe filed a claim before the Indian Claims Commission in 1957 for alienated lands and received compensation based upon holdings on the west side of Puget Sound (Curti et al. 2020:102).

Swinomish Indian Tribal Community

As described in Curti et al. (2020:105), the Swinomish people have lived in the Skagit River Valley and the marine shorelines and islands of Puget Sound adjacent to the river's mouth since time immemorial. "Swinomish people descend from four major ancestral groups—Swinomish, Samish, Lower Skagit, and Kikiallus—as well as others who occupied territories along the Skagit River watershed and the mainland to its north and south and the adjacent islands—Whidbey, Camano, Fidalgo, Guemes, Samish, Cypress, and the San Juan islands" (Curti et al. 2020:105). The Swinomish people speak Lushootseed.

The various groups or bands whose descendants now constitute the Swinomish Indian Tribal Community were parties to the 1855 Treaty of Point Elliott, which established the Swinomish Reservation (Curti et al. 2020). Many groups from the Skagit River drainage moved to the Swinomish Reservation (Curti et al. 2020; Lane 1974). The Swinomish Indian Tribal Community has stated that they have a historical and ongoing connection to the Skagit River Basin, including upstream beyond the U.S.-Canada border (Swinomish Indian Tribal Community letter to City Light dated February 7, 2022).

The Tulalip Tribes of Washington

As described in Curti et al. (2020:112), "the Tulalip Tribes include descendants of Snohomish, Snoqualmie, Skykomish, and other allied bands who occupied and utilized territories within the Snohomish, Snoqualmie, and Skykomish River and who relocated onto the Tulalip Reservation after the Treaty of Point Elliott in 1855 (Lane 1975b:1). The Snohomish people occupied the lower reaches of the Snohomish River and its tributaries, the mainland on nearby bays, and the southern part of Whidbey Island. Snoqualmie people occupied the Snoqualmie River drainage from North Bend to the junction of the Skykomish and Snoqualmie Rivers. The Skykomish people lived along the Skykomish and Foss Rivers, primarily within the Skykomish drainage from the confluence of the Skykomish and Snoqualmie Rivers, east to the Cascades." The Tulalip tribal people speak Lushootseed.

The Tulalip organized under the Indian Reorganization Act in 1934, adopting the name Tulalip Tribes (Curti et al. 2020:112; Ruby et al. 2013:348; Tulalip Tribes 2020).

Upper Skagit Indian Tribe

Curti et al. (2020:115) note the Upper Skagit people have lived in the Skagit River watershed for thousands of years. Their traditional territory includes the entire watershed, neighboring watersheds (e.g., Samish River), and saltwater (Curti et al. 2020:115). The Upper Skagit people speak Lushootseed. The Upper Skagit Indian Tribe is a federally recognized Indian tribe composed of eleven predecessor bands, including the Nuwha'ha, Nookachamps, Bsigwigwilts, Bsxwexwehwa'1, Chobahahbish, Sabelxu, Saylayotsid, Shayayotsid, Kwabatsabsh, Sahkumehu, and Skaywih (Miller n.d.). These bands had villages along the Skagit River from the Skagit delta to Newhalem, and along Nookachamps Creek, the Samish River, and adjacent territories. Predecessor bands also harvested saltwater resources in several areas including Skagit Bay, Deception Pass, Whidbey Island, Camano Island, Padilla Bay, Samish Bay, and Chuckanut Bay (Miller n.d.).

Representatives from most of the identified Skagit bands signed the Treaty of Point Elliot in 1855 (Curti et al. 2020:116). Since the Upper Skagit people were not provided their own reservation at the time of the Treaty, some settled on or near the Swinomish reservation at the mouth of the river (Curti et al. 2020:116). However, most people returned to their traditional territory, some of whom accepted allotments under the Dawes Act in 1887 (Curti et al. 2020:116; Malone 2005). The Upper Skagit people resisted the movement of non-Native settlers up the Skagit Valley, and "conflict in 1886 led the Upper Skagit to warn all settlers to leave the area or be harmed. More than one hundred canoes of [Upper Skagit] people met with settlers to protest the seizure of their lands" (Miller n.d.).

In 1913, the Upper Skagit Indian Tribe purchased a parcel of land already in use as a tribal cemetery, which was placed in trust, although the tribe remained without a reservation until 1981 when one was established in Skagit County (Curti et al. 2020:116). In 1951, the Upper Skagit Tribe entered claims before the Indian Claims Commission and received compensation for ceded lands (Curti et al. 2020:116).

Nlaka'pamux Nation

The Nlaka'pamux Nation are Interior Salish people, formerly identified as the Couteau or Thompson River Indians, who have traditionally occupied the Fraser/Thompson canyons and the Nicola River and Upper Skagit River watersheds for millennia in what is now the U.S. and British Columbia, Canada. The Nlaka'pamux use area extends across the U.S.-Canada border and, to the south, includes parts of the Nooksack and Skagit Rivers (Curti et al. 2020:142; Teit 1900 in Curti et al. 2020). The Nlaka'pamux Nation is organized in two administrations in the activities involved in the Project relicensing: the Nlaka'pamux Nation Bands Coalition and Nlaka'pamux Nation Tribal Council.

The Nlaka'pamux Nation Bands Coalition was organized in 2021 in response to the Project relicensing efforts and the coalition's member communities' desire to represent the Nlaka'pamux Nation (Cauvel 2021). The Nlaka'pamux Nation Bands Coalition includes the following: Ashcroft Indian Band, Boston Bar Indian Band, Coldwater Indian Band, Cooks Ferry Band, Kanaka Bar Band, Lower Nicola Indian Band, Nicomen Indian Band, Nooaitch Indian Band, Siska Indian Band, Skackan Indian Band, and Spuzzum Indian Band.

Nlaka'pamux Nation Tribal Council was established in the early 1980s (Nlaka'pamux Nation Tribal Council and Province of British Columbia 2017). The Nlaka'pamux Nation Tribal Council is a governing entity of the Nlaka'pamux and currently includes the following communities: Lytton First Nation, Boothroyd, Oregon Jack Creek (Snepa and Ntequem), and Skuppah Indian Bands. "The Nlaka'pamux Nation Tribal Council is committed to protecting, asserting and exercising Nlaka'pamux Title and Rights to bring about the self-sufficiency and well-being of the Nlaka'pamux people" (Nlaka'pamux Nation Tribal Council and Province of British Columbia 2017).

Stó:lō Nations

Stó:lō is the Halq'eméylem word for "river" and also for the Halq'eméylem-speaking people who live within the lower Fraser River watershed and connected watersheds (S'ólh Téméxw Stewardship Alliance [STSA] 2022). Stó:lō peoples represent a collective community that holds rights and title within all of S'ólh Téméxw – "our world" or "our land" (STSA 2022). S'ólh Téméxw is defined through the known extent of occupation and land use of the Halq'eméylem speaking peoples of mainland British Columbia (STSA 2022). S'ólh Téméxw is Stó:lō territory, including the lower Fraser River watershed downriver of Sailor Bar Rapids in the lower Fraser River Canyon. It extends from 5 Mile Creek near Yale in the northeast, to the Fraser River estuary in Delta and to the north bank of the Nooksack River in the U.S. The eastern extent reaches the Skagit Valley and Ross Lake north, and the Coquihalla River Valley (STSA 2022).

The STSA was established to support Stó:lō Peoples (who are the Aboriginal title holders) in making strong collective stewardship decisions that honour and maintain the integrity of Stó:lō Peoples' relationship with S'ólh Téméxw (STSA 2022). The STSA is an alliance of 17 communities who believe that Stó:lō best care for the land and resources by working together (STSA 2022). The STSA member First Nations are: Chawathil First Nation, Cheam First Nation, Kwaw'Kwaw'Apilt First Nation, Scowlitz First Nation, Seabird Island Band, Shxw'ow'hamel First Nation, Skawahlook First Nation, Skwah First Nation, Sumas First Nation, Yale First Nation and Aitchelitz First Nation, Shxwhà:y First Nation, Skowkale First Nation, Soowahlie First Nation, Squiala First Nation, Tzeachten First Nation, Yakweakwioose First Nation as represented by Ts'elxwéyeqw Tribe Management Ltd.

The STSA and the geographical extent of S'ólh Téméxw have been recognized in several negotiated agreements (STSA 2022). The 2019 S'ólh Téméxw Stewardship Alliance – Canada Consultation and Engagement Protocol affirms the definition and map of S'ólh Téméxw and provides for a 'Nation-to-Nation Framework' for consultation with the Federal Government. Similarly, the S'ólh Téméxw Stewardship Alliance – Strategic Engagement Agreement affirms the definition of S'ólh Téméxw for consultations with the Province of British Columbia, and it has been in force in various Agreements since 2012. These agreements illustrate recognition for Stó:lō rights, title, and interests, even as they evolve in relation to shifting regional relationships and regulatory processes (STSA 2022).

Historic Land Use by Non-Native People

Early Euroamerican Industries

Historically significant industries in the APE included mining, logging, and farming. While prospectors started coming to the Skagit River in the North Cascades as early as the 1850s, the first notable gold rush resulted from the discovery of gold on Ruby Creek circa 1858 lasting until the 1880s (Collins 1974; Luxenberg 1986; Pitzer 2001). Additional mines established in 1879 were the Nip and Tuck mine staked by Albert Bacon eight miles above Ruby Creek and the Discovery Mine at Canyon Creek, staked by Jack Rowley (Pitzer 2001). The first mining claims near Darrington, a small mining and logging boom town, occurred in the early 1890s (Oakley 2009). An early non-Native settler to the area, Knute Neste, founded the Morning Star Lode and the Jumbo Mine. Other early miners in the Darrington area included Loren Robinson, Charles Burns, William Geisler, John Robinson, C. C. Scholman, and George Knudson. Later mining activities took place at higher elevations of the North Cascades, including around Cascade Pass, Thunder Creek, and along the Stehekin River drainage which are in Whatcom and Chelan counties (NPS 2020a; Western Mining History 2020a, 2020b).

Generally speaking, the topography, weather, and lack of transportation infrastructure hampered long-term, productive mining activities in the North Cascades (NPS 2020a). Existing trails were improved to allow for access into the Skagit River; however, riverways were often still used to access the Skagit area rather than the difficult trails (Smith 1988). Native Americans who fished in the area certainly encountered these early miners and were sometimes guides and ferried equipment, and may have worked for them at the mines (Collins 1974; Lane and Lane 1977). Pitzer (2001:4) notes two Indian brothers, Charlie and Joe Seam, who worked as guides in 1877 for early settlers (Otto Klement, Charles von Pressentin, Jack Rowley, Frank Scott, John Duncan, and John Sutter) traveling to Lake Chelan.

The steep walled canyon of the Skagit gorge, east of the Town of Newhalem, presented a challenge to miners who needed to get their product to market. The route was so treacherous that miners sometimes chose to travel north to British Columbia, head east to Hope, then south down the Skagit River.

By the 1880s, the earliest version of the Goat Trail (or Skagit Trail or Ruby Trail depending upon location), which utilized portions of the prior Native American trail system, was further carved out of the canyon walls along the north bank of the river to allow for easier access to the upper valley (Colón et al. 2021). Additional indigenous trails were used by the miners and early settlers, many developing early maps of the area (NPS 2008a; Mierendorf 1986; NPS 2008b).

Logging was an important industry in the Pacific Northwest throughout Euroamerican history in the APE. The NPS (2020b) notes that, in the 1870s, natural logjams in the lower Skagit River were cleared away, opening up the river valley to commercial logging (NPS 2020b). In 1882, there were reportedly more than 400 men based in logging camps on the Skagit River (Seattle Daily Post-Intelligencer 1882:5). Downstream settlements provided the sawmills for the raw timber (NPS 2020b). The towns of Darrington and Arlington, located roughly 30 miles apart, have a long history of logging (Oakley 2007, 2009). Darrington served as a jumping off point for logging and mineral exploration, and Arlington was home to several shingle mills and sawmills beginning in the 1890s when the town welcomed a rail line and train depot. At the end of the 19th century, Seattle & International Railway began building a rail line up the Stillaguamish Valley that would connect these two communities. Before the work was finished, the Northern Pacific took over the Seattle & International Railway. The first train arrived in Darrington in 1901 and opened the town up to more industry. Soon the United States Lumber Company established a mill in Darrington that employed 100 men and cut 23,000 board feet per day. Additionally, a number of other logging companies came to town and built spur lines that connected to the main line of the railroad to transport logs. Marysville, Lake Stevens, and Snohomish are also communities in the APE that are known to have had sawmills. Following the establishment of the Washington Forest Reserve in 1897, most commercial logging in the APE took place outside of the current limits of the North Cascades National Park. The main exception is the logging that took place during the construction of the Skagit River Hydroelectric Project, when millions of board feet were extracted from the upper Skagit Valley (NPS 2020b; Seattle Daily Times 1926:4).

Agriculture, one industry that is common to the early settlement elsewhere in Washington State, did not feature significantly in historical development of the North Cascades. While there were a few homesteads reported in General Land Office records near Newhalem and Diablo prior to Project construction, the challenging topography, extreme weather, and limited transportation infrastructure hampered commercial-scale farming (Luxenberg 1986; Seattle Daily Times 1928:15). Farming was also restricted in the Cascade Mountains because of the establishment of the Washington Forest Reserve in 1897. This federal action protected over 3.5 million acres of land between Canada and Glacier Peak from private settlement (Danner 2017:10).

However, agriculture was important to the history of a large section of the APE, namely the lowlands of Skagit and Snohomish Counties. The 1862 Homestead Act led to a major influx of new Euroamerican settlers. Under the act, a U.S. citizen who was at least 21 years of age and the head of a household could file a claim for 160 acres of land for a nominal fee. If the claimant proved they had lived on and improved the land for 5 years, they became owners of the property by patent (Thirty-Seventh Congress 1862:392-393). The fertile valleys of Skagit and Snohomish counties drew settlers during the late nineteenth century to claim land under the act (Rowe 2018). To use an example from the APE, three Homestead Act claims in Section 20 of Township 30 North, Range 6 East, Willamette Meridian, in Snohomish County resulted in patents between 1891 and 1892 that covered three-quarters of the section (Bureau of Land Management 2020).

Homesteaders began to settle the upper sections of the Skagit River in the 1880-90s and established several roadhouses along the Skagit trail to serve miners and other travelers. The first of these roadhouses was established in 1879 by Nathan Edward Goodell, which stood along the Skagit River just upstream of the mouth of Goodell Creek and supplied the mining population (Luxenberg 1986). Goodell's Landing was located between Goodell and Newhalem creeks along the north side of the Skagit River. Other roadhouses appeared shortly afterwards including one at Marblemount, Bacon Creek, Thornton Creek, Cedar Bar (near Diablo) and Ruby Creek (now under Ross Lake).

Mining homesteads also continued through the late 1800s. Goodell sold his roadhouse to Henry Davis, who sold it to August Dohne in 1897 (Pitzer 2001:15). Dohne originally moved to a claim in the valley in 1893, which was downriver from Goodell's. Dohne improved the property and added multiple buildings including a cedar cabin, a bunkhouse, a barn, and associated out buildings (Pitzer 2001:15). Dohne's roadhouse burned in 1913, and he left the valley in 1918 when he became sick and later died. Bacon sold the Nip and Tuck mine to George Holmes, a black prospector, who had mining claims at Himlock Mine along Ruby Creek where he lived until 1924 (Pitzer 2001:4-5). The Holmes cabin consists of structural remnants and mining equipment, which were recorded as an archaeological site (Harry 1991). Additional homesteads, such as those of Tommy Rowland and John McMillian have been recorded as archaeological sites in the APE near Big Beaver Creek. Two cabins were constructed by Jack Durand in the 1890s, who formed the Colonial Company: Middle Cabin on Thunder Creek outside the APE and Log House Inn in Marblemount (Pitzer 2001:7) The historic Log House Inn, today, still forms the structural core of a renovated modern-day lodge (now called the North Cascades Inn) for overnight travelers.

Historic Land Ownership and Governance

The creation of the Washington Forest Reserve, described above, illustrates another important historical factor in the APE: federal land ownership and management. Established in 1897 by President Grover Cleveland, the Washington Forest Reserve totaled roughly three and a half million acres of land and included the area now known as the Ross Lake National Recreation Area (RLNRA). After its first decade, operation of the reserve was transferred to the Department of Agriculture's newly established Forest Service (NPS 1999). By the 1930s, the United States Forest Service (USFS) had constructed trails, backcountry shelters and fire lookouts for both recreational use and for fire protection (Luxenberg 1984). Under USFS management, special use permits were issued to private individuals and companies which allowed operation of private business on public lands, including mining claims, resorts, and hydroelectric operations (NPS 1999).

Most of the federal land within the APE is owned and managed by the NPS and USFS. The boundaries between the lands managed by each of these agencies took over half of a century to be determined, only solidifying when the North Cascades National Park Complex was established in 1968 out of USFS lands. The drawn-out controversy stemmed in part from the potentially conflicting interests of natural resource protection and public recreation. There was also some dispute over which agency would be best placed to manage the environmental conservation of the North Cascades (Danner 2017). The Wilderness Act of 1964 provided for the protection of wilderness areas under the direction of the NPS (U.S. Department of Justice 2020). This act helped pave the way for the creation of the North Cascades National Park Complex in 1968 (Danner 2017). Striking a balance between potentially conflicting values and missions was evident in the legislation establishing the RLNRA (Public Law Number 90-544, 82 Statute 926 [1968]), which became part of the North Cascades National Park Complex and had an existing set of hydroelectric developments (federally permitted since 1917) within the proposed boundaries of it. While wilderness was a key focus for other parts of the national park, Section 201 of the 1968 enabling legislation for the recreation area provided for outdoor recreation and public enjoyment but Section 505 also acknowledged that, "Nothing in this Act shall be construed to supersede, repeal, modify, or impair the jurisdiction of the Federal Power Commission ["FPC", predecessor agency to the Federal Energy Regulatory Commission] under the Federal Power Act (41 Stat. 1063), as amended (16 United States Code [U.S.C.] 791a et seq.), in the recreation areas." A primary purpose of the Federal Power Act and Commission was, and still is, to coordinate effectiveness of hydroelectric and other power generating developments in providing electricity on regional and national scales. A modern-day mission statement for FERC is to, "Assist consumers in obtaining reliable, safe, secure, and economically efficient energy services at a reasonable cost through appropriate regulatory and market means, and collaborative efforts" (FERC 2022). Alternately, a mission statement for the National Park Service, based on the Organic Act of 1916 (16 U.S.C. 1, 2, 3, and 4), is to preserve "unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations." Balancing these different missions and jurisdictions, in a National Park unit containing a federally-regulated hydroelectric project that preceded establishment of the National Park in the first place, is still a challenge today.

Most of the land in the APE not managed by the NPS or USFS is privately owned. For the most part, this land is rural and located in unincorporated areas rather than within the limits of any cities or towns. The APE crosses three western Washington counties: Whatcom, Skagit, and Snohomish. These counties were established during the early Euroamerican settlement period prior to statehood. All three counties in the APE were originally part of one large county, Island County, which was established when Washington Territory was formed in 1853.

Whatcom County was the first to break away in name and was formed in 1854 (Oakley 2004, 2005). Whatcom County was reportedly named after a Nooksack Indian Tribe chief whose name meant "noisy water" (Oakley 2005). Snohomish County was established in 1861, named for the ancestors of the Snohomish Tribe of Indians (Riddle 2006). Skagit County eventually separated from Whatcom County in 1883. The name is also tribal in origin, based on a Hudson Bay Company employee's belief that all Native Americans in the area were "Scaadchet" [sic] or "Skagit" Indians (Oakley 2004).

The APE passes through or within a mile of a number of communities as outlined in Table 4.2.8-1. These communities were established in the historic period due to economic opportunities present in their vicinities, which had prior history of occupation or use by Native American people. The communities that later organized into municipal cities—Marysville, Lake Stevens, Snohomish, and Mill Creek, are all located in Snohomish County at the southern end of the APE. Their expansion in the twentieth century was influenced to a large degree by the ongoing suburban expansion of the larger regional cities of Everett and Seattle, as is evidenced by the relatively late incorporations of Lake Stevens and Mill Creek.

Table 4.2.8-1. Establishment of Modern Communities, Towns, and Cities located within the APE.

Community	County	Type of Municipality	Summary of Historical Establishment	Source
Diablo	Whatcom	Unincorporated County	Construction camp in 1927; construction of new residences and community buildings for company town between 1952 and 1953.	Johnson 2010
Newhalem	Whatcom	Unincorporated County	Start of construction of company town in 1917; 14 of 23 extant historic buildings built between 1920 and 1923.	Johnson 2010
Marblemount	Skagit	Unincorporated County	Ranger station construction from 1933.	Dolan 1999

Community	County	Type of Municipality	Summary of Historical Establishment	Source
Sauk-Suiattle Reservation	Skagit	Reservation	Established in 1980s	Ruby et al. 2010:266-268
Darrington	Skagit	Town	Originally Indian portage (“*Kudsl Kudsl*”); Euroamerican settlement from early 1890s; incorporated in 1945.	Oakley 2009
Marysville	Snohomish	City	Trading post established in 1872; logging town platted in 1885; incorporated in 1891.	Dougherty 2007
Lake Stevens	Snohomish	City	Lake named by 1855; sawmill and railroad established ca. 1907; resorts developed between 1906 and 1926; incorporated in 1960.	Blake 2017
Snohomish	Snohomish	City	Ferry landing established in 1840s (“Cadyville”); platted in 1868; first sawmill in 1876; incorporated in 1890.	Blake 2008
Mill Creek	Snohomish	City	Developed as country club community in 1976; incorporated in 1983.	Dougherty 2020

Project History and Context

The development of hydroelectric generating facilities on the Skagit River was permitted by the federal government on December 22, 1917, but the origins of Seattle’s municipally-provided electricity began at the start of the twentieth century. Public versus private power in the 1920s to 1930s was a key theme during development of the Project. As discussed in the 2010 National Register nomination form (Johnson 2010), the Skagit River and Newhalem Creek Hydroelectric Projects is a historic district eligible for the NRHP under multiple Criteria for Evaluation:

- Criterion A: The district is associated with events that have made a significant contribution to the broad patterns of our history relating to Politics and Government. “The entire project is representative of American utility politics and development, spanning over 50 years, beginning near the end of the Progressive Era of American city government and the era of standardization in hydroelectric plants. Its development ensured the existence of the City’s Lighting Department, engaged in direct competition with an investor-owned utility for 50 years, and influenced the public power movement in the 1920s and beyond.”
- Criterion B: The district is associated with the lives of significant persons in Politics and Government, Entertainment/Recreation, and Landscape Architecture. “The project is inextricably intertwined with the aspirations of James Delmage Ross, the City's superintendent of the Lighting Department for 28 years. The project was a nationally known showcase promoting hydroelectricity and municipal ownership of hydroelectric power. The Diablo Dam and Powerhouse were intentionally outfitted with unique features, such as a goldfish pond in the powerhouse lobby, that were designed to appeal to the public for tours. Thousands of

tourists flocked to the Skagit each summer to participate in two-day tours of the project by rail and boat, including visits to an unusual designed landscape created by Ross, which featured tropical and native plants displayed in a carefully orchestrated *son e lumiére* show."

- Criterion C: The district embodies the distinctive characteristics of a type, period, or method of construction that represents 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 in Community Planning and Development, Engineering, Architecture, and Transportation. "The project represents the general trend of developing more costly and remote hydroelectric sites in the 1920s. Its construction in the rugged terrain of the Skagit gorge required new solutions for significant engineering problems. Its 120-mile distance from Seattle required the construction of two towns developed over decades with dozens of buildings for employees. Both are rare examples of municipally owned towns, still in operation today. Also, a rail transportation system extending 30 miles from Rockport to Diablo along the rough terrain of the Upper Skagit Valley was constructed for this work and tours. The three plants on the Skagit River are representative of the technology developed in the West to store water in isolated and remote locations, utilizing the thin arch design in dam construction to reduce amount and cost of materials, high heads, and sophisticated long, high voltage, point-to-point transmission. Many of the engineering procedures used to build the dams were unique solutions to construction problems posed by the rugged terrain. While the plants are generally representative of typical hydroelectric technology of the 1920s and 1930s, with features common to other plants built during the same period, some features in the Skagit plants are significant for being the first of their type. Some of the country's best-known engineers were associated with the planning, design, and construction of the plants."

Development of electricity started in 1886 in Seattle with the construction of the first Edison incandescent central station lighting plant by the Seattle Electric Light Company (Johnson 2010). Shortly thereafter, an electrified street railway was operated by the Seattle Electric Railway and Power Company (Johnson 2010). In 1899, Stone and Webster, a Boston-based electrical engineering and management firm, organized several competing Seattle utilities to form the Union Electric Company, which was later reorganized as the Seattle Electric Company (Johnson 2010). The Snoqualmie Falls Power Company, under the direction of a civil engineer, Charles Baker, used the 268-foot falls on the Snoqualmie River to bring the first hydroelectric power to the state and Seattle in 1899 (Johnson 2010). The Snoqualmie Falls Company was selling power to the Stone and Webster Company by 1902, who did the retail distribution to Seattle, effectively establishing a monopoly at the time (Johnson 2010). The Seattle Electric Company competed with the City of Seattle in providing electric power to its citizens for the next half century until it became the Puget Sound Power and Light Company (Johnson 2010).

The notion of municipal ownership of a lighting plant for the city surfaced as early as the 1890s; however, the City was busy expanding other services, such as streets and sewers (Johnson 2010). In response to a private monopoly by the Seattle Electric Company, the Seattle voters approved bonds in 1902 to pay for the construction of a municipal hydroelectric dam on the Cedar River, the City of Seattle's first hydroelectric project near North Bend, Washington. The Cedar River timber crib dam was completed in 1904 under the management of James Delmage ("J.D.") Ross (Johnson 2010; Lentz 1997). The masonry dam was built between 1912 and 1914 (Johnson 2010). The City's Lighting Department was formally established as an independent city department in

1910 (Crowley 2000) and Ross became superintendent of the utility in 1911. Ross was fired by the City's mayor Frank Edwards in 1931 in response to the placement of a charter amendment measure on that year's election ballot (Johnson 2010). Ross, who had long been dissatisfied with having to work with the City Engineer's Office, sought to allow the Lighting Department to establish its own engineering department, answerable to the superintendent (Johnson 2010). Ross's opponents attacked the plan as self-serving and Mayor Edwards viewed the addition as costly to the City payroll (Johnson 2010). Even before the election results were in, the Citizen's Municipal Utilities Protective League began planning for Edwards' recall on the grounds of Ross' dismissal for false reasons (Johnson 2010). During the next few months, Ross worked as a consulting engineer for the St. Lawrence hydroelectric project, during which he met then-Governor of New York, Franklin Roosevelt (Johnson 2010). Mayor Edwards was recalled from office on July 13, 1931, and City Councilman Robert Harlin was elected to serve as interim mayor the following day (Johnson 2010). Harlin immediately reappointed Ross as superintendent of the Lighting Department (Johnson 2010). Ross ran the utility until his death in 1939 (Stein 2002).

Within a few years of the completion of the Cedar River hydroelectric facility, the Lighting Department was under pressure to build another facility, not only to meet customer demand but also to remain competitive with private power companies. The Skagit River in the Cascade Mountains was chosen as a site, but the Lighting Department's attempts to acquire rights to build a hydroelectric facility there in 1915 were initially blocked by a private company, Skagit Power Company, which had already filed a claim.

The Skagit Power Company was formed in 1905 in Denver, and shortly afterwards, made plans to build five dams on the Skagit – one at Box Canyon (renamed Diablo Canyon), one at Goodell Creek (about three miles upriver from August Dohne's claim), one at Ruby Creek (near present day Ross Dam), one below Cedar Bar called the Davis dam site, and finally, one at Hanging Rock at the confluence of Gorge Creek and the Skagit River (Luxenberg 1986; Pitzer 2001:23). Road construction began at Goodell's Landing (Creek), which was difficult due to the hard bedrock, and eventually stalled out (Pitzer 2001:23). The Skagit Power Company was sold in 1910 to a Boston-based holding company, Stone and Webster (Pitzer 2001). Soon, Stone and Webster turned their focus to the Baker River and dropped the name Skagit Power Company, transferring the company to one of its subsidiaries, the Puget Sound Traction, Power and Light Co. (Pitzer 2001). Since dam construction had not begun, the Puget Sound Traction, Power and Light Co. water-right notices expired in 1916, however, they were extended one year (Pitzer 2001). The Lighting Department, and their superintendent J. D. Ross, became interested in the Skagit River prior to the sale of the Skagit Power Company to Stone and Webster. However, the Lighting Department was unable to file its application for a dam in Diablo Canyon until the Stone and Webster permits expired, which they ultimately did in 1917 (Pitzer 2001). The Lighting Department appealed to the government on the grounds that more power was needed for Seattle's role in the war effort and was finally awarded the rights to develop hydropower in the Skagit gorge on December 22, 1917, by the Department of Agriculture (Johnson 2010; Luxenberg 1986; Pitzer 2001).

In 1919, the Lighting Department began construction on Gorge Dam (timber crib) 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. By 1920, the Lighting Department extended the Skagit River Railway 23 miles from Rockport to Newhalem along the north bank of the Skagit River. This allowed for easier transportation of laborers and supplies to Newhalem, which was the first established work camp. A sawmill was constructed along the western bank of Goodell Creek, which provided lumber for concrete forms and for residential needs in Newhalem. Other sawmills are known in the APE, such as one located along Happy Creek; however, these may not have been directly related to hydropower construction.

The earliest completed dam was built on Newhalem Creek (1921) to supply power for the construction of the Gorge Dam and the associated work camp at Newhalem (Luxenberg 1986). This early dam, referred to as the Newhalem Powerhouse and Dam (now called the Newhalem Creek Hydroelectric Project), was intended to be a temporary plant to support the construction of the Skagit River Hydroelectric Project (Johnson 2010). Hundreds of men were employed to help construct the dams. Newhalem expanded to support a growing town, including 75 three-room houses, six bunkhouses, a cook house, warehouse, a school, and many other buildings.

Three dams were built on the Skagit River in roughly the same area near the mouth of Gorge Creek between 1919 and 1961. A high dam was originally planned and later a plan for a low masonry dam was added. However, the project was over budget and behind schedule before construction began, so a temporary rock-filled timber crib diversion dam was built first (Johnson 2010:Sec. 8, p. 7). The dam raised the river level 30 ft and diverted the flow into a concrete-lined power tunnel that was drilled through 11,000 ft of bedrock. The crib dam was also planned to serve as a diversion weir during later construction of the high dam (Johnson 2010:Sec. 8, p. 7). The tunnel, with a surge tank (a water storage device used as a pressure neutralizer in hydropower water conveyance systems) at the lower end, is considered a significant design development as the first powerhouse in Washington to have a surge tank before the penstocks rather than the typical forebay with surge tanks (Johnson 2010:Sec. 7, p. 29).

In 1921, construction of the Gorge Powerhouse began, and in 1922, clearing and construction of a 100-mile-long transmission line from the Gorge Powerhouse to a substation north of Seattle started. Construction of the powerhouse and transmission line were completed in 1924, and on September 14, 1924, the first electric power from the Project to Seattle was generated.

In 1929, the height of the crib dam was raised 2 ft. In 1948-1949, a 100-ft extension to the Gorge Powerhouse, an additional power tunnel to carry water to the new generating unit, and a new transmission line from Gorge Powerhouse to Seattle were built (Johnson 2010:Sec. 7, p. 28-29.). In 1950, the second Gorge Dam, a low concrete diversion structure, replaced the timber crib dam. The last generator was installed in 1956. Within a decade of the construction of the second Gorge Dam, the concrete Gorge High Dam was built as a permanent replacement for the earlier dam, fulfilling the original vision of a high dam at Gorge Creek. Construction began in 1957, was largely completed in 1960, and the dam was dedicated in 1961.

Diablo Dam construction began in 1927, the same year that the FPC, issued the first license to the City of Seattle for the Gorge and Diablo facilities as the Skagit River Hydroelectric Project (Project No. 553). The Diablo Dam and Powerhouse, along with related infrastructure, were completed in 1936.

Through a series of amendments, the FPC subsequently authorized the construction of Ross Dam and Powerhouse (City Light 2020:3-8 – 3-9). In 1937, construction began on a dam near the mouth of Ruby Creek. Originally called Ruby Dam, it was renamed Ross Dam in 1946 in honor of project superintendent J. D. Ross, who had died in 1939. Ross Dam was planned to be built in three stages. During the first stage, from 1937-1940, the dam was constructed to a height of 300 ft, with a 15-ft-high temporary timber crib dam built on top (Johnson 2010:Sec. 7, p. 52). After delays caused by World War II, the second and third stages were built in a single phase. Construction resumed in 1943 and expanded in 1946. The dam reached its full height of 540 ft in 1949. The Ross Powerhouse was built in 1948-1952 and began operating on one generator in 1952. Once the fourth and final generator was installed in 1956, the project was complete (Johnson 2010:Sec. 7, p. 50).

A plan to raise Ross Dam by 125 ft (High Ross Dam) was proposed in the 1960s and approved by the FPC in 1977. However, the project was suspended with the signing of the High Ross Treaty[89] between the U.S. and Canada in 1984. Under the terms of the treaty, which can be terminated no sooner than January 1, 2065, the dam would remain at its existing height and the U.S. would purchase power from British Columbia (City Light 2022b; Wilma 2003). In 1978, the Lighting Department was reorganized and the current name of the agency, Seattle City Light, was adopted.

The first license for the Project was issued by the FPC in 1927 for 50 years, expiring in 1977. The first relicensing process took nearly 18 years, from 1977 until 1995, during which time, City Light operated the Project under annual licenses. The relicensing process 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 non-governmental organizations (NGOs). The intent was to negotiate a collection of settlement agreements (SAs) to mitigate Project impacts and benefit the Skagit River ecosystem. Signed in 1991, it was the first comprehensive SA in the country to be developed for a major hydroelectric project. The SAs 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 terms of the SAs (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.[90] 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.[91] The second power tunnel has not been constructed, and there have been no major modifications to the Project under the current license.

The current license 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. The most recent amendment issued in 2013 not only authorized construction of a second power tunnel, which was never built, at the Gorge Development; but also incorporated

89 The full title of the “High Ross Treaty” is *Treaty with Canada Relating to the Skagit River and Ross Lake in the State of Washington, and the Seven Mile Reservoir on the Pend d’Oreille River in the Province of British Columbia*.

90 71 FERC ¶ 61,159 (1995).

91 144 FERC ¶ 62,044 (2013).

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.

Implementation of the current license resulted in some significant changes in Project operations, particularly at the Gorge Development. The flow-management plan, which was 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 using seasonal, monthly, and daily flow adjustments. Other notable measures included in 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 North Cascades Environmental Learning Center (ELC), which provides environmental education to over 6,000 students and adults annually; protection of archaeological sites and historic built environment resources in the Project Boundary; and continuation of the historic Skagit Tours.

The three Skagit River Project developments (dam and powerhouses at Gorge, Diablo and Ross) are hydraulically coordinated to act as a single project and supply approximately 20 percent of City Light's power requirements today. In addition, the Newhalem Creek Hydroelectric Project continued to operate until a fire destroyed it in 1966; however, it was rebuilt and went back online in 1970 (Johnson 2010). The Newhalem Creek Hydroelectric Project has not been in consistent service since 2010 (City Light 2021). While the equipment and structural issues associated with the initial 2010 shutdown were addressed, others arose, including a wildfire in 2015 that burned many of the original wooden penstock saddles, necessitating a multi-year replacement project, and leaks in the power tunnel when trying to start up after the fires in 2017 (City Light 2021). The Project has not operated since and City Light has filed an application to surrender its FERC license and decommission the project due to the leaks in the power tunnel, maintenance needs at the headworks and powerhouse, and access road safety concerns (City Light 2021).

A summary of the construction and license milestones and other significant events relating to operation of the Skagit River Project is provided in Table 4.2.8-2. Further details are available in the Exhibit C of this Draft License Application.

Table 4.2.8-2. 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) (the Federal Power Act was enacted in 1920 and amended in 1935)
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)
1926-27	Railroad extended to Diablo

Year(s)	Event/Milestone
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 (this is the same year that the Federal Power Commission was first convened)
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 ft high)
1942	City Light's planned Phase 4 for Ross Dam is approved by the International Joint Commission; Phase 4 would raise the level of Ross Dam by 121 ft to a height of 661 ft (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 ft 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
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

Year(s)	Event/Milestone
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 (EA) and include all elements of the Settlement Agreement (June 14)
1996	FERC issues rehearing 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 (which has not yet been built); Order contains Reasonable and Prudent Measures identified in the Biological Opinions issued for listed fish species and expands Project boundary to include fish and wildlife mitigation lands purchased to date, the Marblemount and Sauk River boat launches and the ELC

Results of Relicensing Studies

There are four cultural resources studies supporting the Project relicensing efforts:

- CR-01 Cultural Resources Data Synthesis
- CR-02 Cultural Resources Survey
- CR-03 Gorge Bypass Reach Cultural Resources Survey (Bypass Cultural Resources Survey)
- CR-04 Inventory of Historic Properties with Traditional Cultural Significance Study (Properties with Traditional Cultural Significance Study)

Of these four studies, the CR-01 Cultural Resources Data Synthesis and the CR-03 Bypass Cultural Resources Survey have been completed.[92] The other two studies, the CR-02 Cultural Resources Survey and the CR-04 Properties with Traditional Cultural Significance Study, are ongoing, updates for which will be included in the FLA.

The results of the CR-01 Cultural Resources Data Synthesis (for archaeological and historic built environment resources only) and the CR-03 Bypass Cultural Resources Survey are summarized below. The progress for the CR-02 Cultural Resources Survey is also briefly described below. The progress for the CR-04 Properties with Traditional Cultural Significance Study is briefly described

[92] City Light is consulting with DAHP regarding their review of the CR-03 Bypass Cultural Resources Survey study report. The CR-01 Cultural Resources Data Synthesis study reports have DAHP concurrence and have been filed with FERC as described in this section.

in Section 4.2.9 of this Exhibit E, Tribal Resources, as this study documents TCPs that are cultural resources, which are also tribal resources.

CR-01 Cultural Resources Data Synthesis

City Light and its study team (HDR Engineering, Inc., Cardno, Inc., Cascadia Archaeology, LLC, and CGC) conducted a background review of cultural resources for the CR-01 Cultural Resources Data Synthesis for the Project. The need for the Cultural Resources Data Synthesis was first identified in, and emerged out of, a Cultural Resources Work Group (CRWG) formulated in 2019. The CRWG is one of multiple working groups created by City Light for the purpose of organizing coordination with participants engaging in the Project relicensing process. Initially, the 2019 CRWG included City Light, three federally recognized Indian Tribes (Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, and Upper Skagit Indian Tribe), and the NPS. City Light expanded the CRWG in 2020 to invite additional potentially interested parties to the relicensing process[93]. The Cultural Resources Data Synthesis was subsequently planned and executed in 2020 and 2021 through coordination with the expanded CRWG with the intent to form a baseline understanding of existing information and identify data gaps where additional work is needed.

The CR-01 Cultural Resources Data Synthesis did not include field investigations, nor are the study results intended to provide a complete dataset of cultural resources in the study area. Instead, the purpose of the study was to bring together available existing information at the time it was conducted (2020-2021) to provide context for cultural resources within the APE, which is the study area. It is anticipated that potential acoustic and visual impacts from the Project are possible throughout the APE. However, based upon review of City Light's operations, activities, and facilities, a smaller area within the APE has been identified where physical impacts could occur as a part of Project O&M and could potentially cause Project-related effects to historic properties (where they are present). The Cultural Resources Data Synthesis has been completed and reported on three parts (Part 1, 2, and 3), each of which corresponds to three categories of cultural resources background information: ethnographic/ethnohistoric data relevant to TCPs (Part 1), archaeological (Part 2), and historic built environment (Part 3). Reporting for the study included confidential and public reports, and each part (Parts 1, 2, and 3) was completed as a separate report. The ethnographic data synthesis report (Part 1; Curti et. al 2020) and the archaeological resources synthesis report (Part 2; City Light 2022a) are considered and treated as confidential in accordance with the Revised Code of Washington 42.56.300 and 16 U.S.C. § 470hh(a). Non-confidential information from those study efforts are summarized in the public-facing Part 3 report, and briefly in this public license application. The ethnographic data synthesis report was filed in FERC's privileged/confidential files on July 20, 2021, and the archaeological resources synthesis report

[93] The CRWG now includes the following entities in alphabetical order: Confederated Tribes of the Colville Reservation, DAHP, Department of Interior, FERC, Lummi Nation, Muckleshoot Indian Tribe, National Park Service, Nlaka'pamux Nation Bands Coalition, Nlaka'pamux Nation Tribal Council, Nooksack Indian Tribe, North Cascades Conservation Council, North Cascades Institute, Samish Tribe, Sauk-Suiattle Indian Tribe, Skagit County, Skagit River System Cooperative, Snohomish County, Snohomish County Public Utility District No. 1, Snoqualmie Indian Tribe, S'ólh Téméxw Stewardship Alliance, Stillaguamish Tribe of Indians, Suquamish Tribal Council, Swinomish Indian Tribal Community, Tulalip Tribes of Washington, United States Bureau of Indian Affairs, USFS, Upper Skagit Indian Tribe, Washington State Department of Ecology, Washington State Department of Fish and Wildlife, Washington State Department of Natural Resources, and Washington State Parks and Recreation Commission.

was also filed as privileged with FERC in November 2022. The historic built environment data and previous investigations (Part 3), along with non-confidential summaries of Parts 1 and 2 as described above, are presented in a public summary report that is not privileged/confidential and was filed with FERC in November 2022 (Part 3; City Light 2022b). All three Cultural Resources Data Synthesis reports were submitted by City Light to NHPA Section 106 consulting parties for review and comment, followed by submittal to the DAHP for review, comment, and concurrence. The DAHP provided concurrence on all three Cultural Resources Data Synthesis reports before City Light filed them with FERC.

To implement the study, City Light and its consultant team reviewed relevant existing records of previous cultural resources studies and findings housed at the DAHP, NPS, USFS, Canadian Register of Historic Places (CRHP), British Columbia Heritage Resource Inventory Application, and the Indian Claims Commission. City Light also reviewed its internal records, the Treaty of Point Elliott, and online libraries, when available. Several repositories were inaccessible due to COVID-19 restrictions, including historical societies and public libraries. City Light also completed outreach with the Indian Tribes and Canadian First Nations identified in the Cultural History Overview above. After express permission was granted, City Light and their consultant team also reviewed resources from participating Indian Tribes and Canadian First Nations repositories including available ethnohistories, ethnographies, place name documents, cultural resources reports, and environmental reports. Information from the PAD filed with FERC in 2020 was also incorporated, as appropriate (City Light 2020).

To determine where in the APE different types of risks to historic properties could reasonably occur, information was collected regarding the locations of Project infrastructure and current and anticipated Project operations and activities and was compared to the locations of documented cultural resources. Information was organized into two areas of potential risk to historic properties from reasonably anticipated Project effects:

(1) Cultural resources studies and findings were compared to areas where physical infrastructure or activities, such as reservoir erosion/deposition, Project digging, vegetation removal, or physical updates to historic structures could potentially occur causing physical, on-the-ground risks (i.e., anticipated potential physical effects); and

(2) Cultural resources studies and findings were compared to areas where auditory or visual effects, such as equipment noise, lighting, and visual barriers, could potentially extend beyond physical on-the-ground infrastructure and activities and potentially cause auditory or visual risks (i.e., anticipated potential visual and auditory effects).

Both geographic zones, described above, make up the APE and study area and are delineated in a set of maps for the study (City Light 2022b).

As of January 2021, 143 of the cultural resources investigations documented in Washington Information System for Architectural and Archaeological Records Data (WISAARD) had taken place within the APE. These studies include cultural resources surveys, archaeological monitoring reports, data recovery projects, desktop reviews, and historic inventories, all of which provide information on archaeological resources, historic built environment resources, or both. Of this total, 71 studies were conducted within the area of anticipated potential physical effects. Of these, 22 were conducted in Whatcom County, 25 in Skagit County, 20 in Snohomish County, and four were conducted across multiple counties. Visual and auditory effects can potentially reach beyond the Project's physical APE, and an additional 72 studies were identified where visual and auditory effects could reasonably be anticipated to reach further geographically. These include two studies conducted within Whatcom County, 12 in Skagit County, and 58 within Snohomish County.

Based upon these records, City Light has identified 3,474 cultural resources within the study area. Of these resources, 6 are historic districts, 8 are isolated finds, 56 are traditional cultural property types, 288 are archaeological sites, and 3,116 are historic built environment resources. These resource counts, along with the NRHP eligibility status of these resources based on WISAARD, are summarized in Table 4.2.8-3. and further discussed below.

Table 4.2.8-3. Summary of results for the CR-01 Cultural Resources Data Synthesis (identified cultural resources within the study area).

Resource Type	NRHP Status (based on WISAARD)				Totals
	Not Eligible	Unevaluated	Eligible	Listed	
Isolated Find	0	8	0	0	**8**
Archaeological Site	28	240	20	0	**288**
Historic Built Environment Resource	120	2,966	24	6	**3,116**
Historic District	n/a	n/a	2[2]	4	**6**
Traditional Cultural Property/ Traditional Cultural Landscape	0	56[1]	0	0	**56**
Totals	**148**	**3,270**	**46**	**10**	**3,474**

1 One TCP/TCL in this tally is a historic district with traditional cultural significance (45WH450). Though not identified as such in the WISAARD database, this resource is eligible for the NRHP.

2 One historic district with traditional cultural significance (45WH450), is counted under the TCP/TCL resource type.

The six NRHP-listed or eligible historic districts in the study area consist of historic built environment and historic archaeological resources. These include: (1) the Skagit River and Newhalem Creek Hydroelectric Projects (NR No. 11000016; DT00066); (2) the Gorge Hydroelectric Power Plant (NR No. 89000499, 45WH00613), which is also included as contributing to the district DT00066, Skagit River and Newhalem Creek Hydroelectric Projects; (3) the Diablo Hydroelectric Power Plant (NR No. 89000498, 45WH00612), which is also contributing to the district DT00066, Skagit River and Newhalem Creek Hydroelectric Projects; (4) the Marblemount Ranger Station (DAHP Property No. 51542); (5) the Darrington Ranger Station (NR No. 91000155; 45SN00354); and; (6) the Upper Skagit River Valley Archaeological District (DT00212), which consists of precontact archaeological resources.

There are 296 previously recorded archaeological sites and isolates within the study area, of which 205 are precontact, 80 are historic, and 11 are considered multicomponent in age. Of the total 296 previously recorded archaeological sites and isolates, 20 have been determined eligible for listing in the NRHP, 248 are unevaluated, and 28 have been determined not eligible. In addition, there are 20 archaeological resources located in Canada within the portion of Ross Lake that extends across the U.S.-Canada border and a 1-mile buffer that are included in the British Columbia Provincial Inventory; however, none are listed in the CRHP.

A total of 56 cultural resources with TCP/TCL significance were identified within or intersecting with the study area. While none of the 56 cultural resources have been formally evaluated for NRHP eligibility, six are recommended eligible and 50 are recommended for further evaluation. Work will be conducted as part of the CR-04 Properties with Traditional Cultural Significance Study to document resources within the APE with enough detail to evaluate NRHP eligibility using National Register bulletins and criteria.

In total, there are 3,121 previously recorded historic built environment resources and built environment historic districts within the study area. A vast majority, 2,853, were identified in a systematic DAHP project to upload limited county assessor data into WISAARD. These records provide potential locations of historic resources. These 2,853 resources have not been formally recorded or field verified, nor do they provide an evaluation of eligibility for listing in the NRHP or sufficient information to do so. Of the total 3,121 historic built environment resources, 235 are located within the portion of the APE where Project activities or operations occur that could cause physical effects and 2,886 are located outside of or beyond where Project activities or operations have potential to cause physical effects but other types of effects could occur (such as acoustic or visual effects).

Within the study area, 24 of the total historic built environment resources have been determined eligible for listing in the NRHP, including one historic district. Ten historic built environment resources are listed in the NRHP, including four historic districts. There are 120 historic built environment resources that have been previously determined not eligible for listing in the NRHP. There are 2,966 historic built environment resources that have not been formally evaluated for listing in the NRHP (including the 2,853, based on unverified County assessor data, listed above, and 113 recorded in various other efforts).

CR-02 Cultural Resources Survey

The CR-02 Cultural Resources Survey was conducted to assist FERC with its NHPA Section 106 compliance requirements by identifying and evaluating the NRHP eligibility of archaeological and historic built environment resources that could be affected by Project O&M, including assessing potential Project-related effects to those NRHP eligible or unevaluated resources. The findings of this study will be used in the development of the HPMP. The study area for the Cultural Resources Survey is the portion of the APE where potential Project-related physical effects could occur. This study includes background research and field survey (pedestrian and subsurface), which involves identification and evaluation of historic and precontact archaeological and historic built environment resources. The survey utilizes standard techniques, methods, and reporting requirements, for different types of cultural resources. Survey reports, historic property inventory (HPI) forms, and archaeological site forms, were used to document findings, following guidelines provided by the DAHP. Field efforts for this study began on September 7, 2021. Pedestrian and subsurface surveys have been completed on accessible properties (i.e., where survey could be conducted safely and where access was permitted by the landowner), as the study duration allowed. The study teams are now in the process of drafting resource records and reports to document the results of the study. This will include evaluating identified resources regarding their eligibility for inclusion in the NRHP and assessing potential Project-related effects to eligible and unevaluated resources. An update on the study progress will be provided in the FLA.

CR-03 Gorge Bypass Reach Cultural Resources Survey

The purpose of this study was to complete a cultural resources survey to identify, document, and evaluate archaeological and historic built environment resources in a particular area within the APE – the Gorge bypass reach study area.[94] Similar to the CR-02 Cultural Resources Survey that covered a much broader study area, the survey for CR-03 Bypass Cultural Resources Survey utilizes standard techniques, methods, and reporting requirements, for different types of cultural resources. Survey reports and archaeological site forms were used to document findings, following guidelines provided by the DAHP, however, the built environment resources identified in the study area were already recorded and all but one are part of a historic district (DT00066) that is already listed on the NRHP. HPI forms were therefore not utilized for these resources because the NRHP nomination form for this historic district was already in the process of being updated as part of implementation of the HPMP for the 1995 Skagit License. Recording them again would duplicate efforts.

During pedestrian and subsurface survey for this study, 19 archaeological sites were recorded or revisited in the study area. These include 18 historic sites and the historic component of one multi-component site.[95] Archaeological sites recorded as part of this study were evaluated for eligibility to be listed in the NRHP as individual historic properties and, if they were associated with the Project, they were evaluated for eligibility as a contributing site to the Skagit River and Newhalem Creek Hydroelectric Projects (DT00066) historic district.

As described above, City Light is currently updating the NRHP nomination form for the Skagit River and Newhalem Creek Hydroelectric Projects (DT00066) historic district as part of a separate effort for current FERC license compliance, due to be completed in 2022. Accordingly, the existing NRHP eligibility of the historic built environment components of the historic district identified in the study area are being reviewed as part of that effort and are not duplicated as part of this study.

The NRHP nomination for the Skagit River and Newhalem Creek Hydroelectric Projects established a framework for evaluating the eligibility of individual resources as part of the historic district (Johnson 2010). The Project was nominated for listing in the NRHP under Criteria A, B, and C, as summarized below. The district has not been evaluated under Criterion D.

- Criterion A. The Project is significant under Criterion A for its association with American utility politics and development as a publicly owned utility. Areas of Significance include Politics and Government.
- Criterion B. It is significant under Criterion B for its association with James Delmage Ross, who was the superintendent of City Light for 28 years, and whose vision and persistence led to the development of the nationally known hydroelectric system and development of the company towns and a tourist attraction, including the Ladder Creek Falls Gardens. Areas of Significance include Politics and Government, Entertainment/Recreation, and Landscape Architecture.

---

94 The Gorge bypass reach study area for the CR-03 Bypass Cultural Resources Survey is a 589-acre portion of the APE along a portion of the Skagit River, known as the Gorge bypass reach, north of Newhalem, Washington. The study area includes the Gorge bypass reach from Gorge Dam to the Gorge Powerhouse.

95 The precontact portion of the multicomponent site (45WH00698) was recently tested (Nelson et al. 2022) and not re-surveyed as part of CR-03 Gorge Bypass Reach Cultural Resources Survey.

- Criterion C. The Project is significant under Criterion C for the engineering of the hydroelectric system, including dams, powerhouses, and transmission lines, which had to overcome challenging and remote terrain; for the company towns developed to support the Project; and for development of the Skagit River Railway to facilitate transportation to the Project. The Areas of Significance include Community Planning and Development, Engineering, Architecture, and Transportation.

The period of significance for the historic district is 1917-1961. For sites to contribute to the historic district, they must fall within the period of significance, and be evaluated under the applicable criteria (A, B, or C). As described below, the archaeological sites in the study area were evaluated as individual resources under all four NRHP criteria (A, B, C, and D).

A summary of the NRHP eligibility recommendations is reflected in Table 4.2.8-4. This table also identifies Project and non-Project related effects to those resources that are listed or recommended eligible for listing in the NRHP or are unevaluated, along with recommended future management for such resources. The future management recommendations will inform development of the HPMP that will be developed by City Light in coordination with the LPs to manage and consider historic properties within the APE during the term of the new license.

Table 4.2.8-4. NRHP eligibility recommendations for archaeological sites recorded in the study area for CR-03 Bypass Cultural Resources Survey.

Site No.	Site Type	Description	NRHP Eligibility Recommendation Individual/ Contributing (Criterion)	Potential Project and Non-Project Effects
CR03-1H	Historic hydroelectric, Historic debris scatter	Constructed landform features and debris scatter, related to construction of Gorge High Dam (1954-1960)	Individually: not eligible DT00066: eligible, contributing (C)	Project related: Gorge Dam water spills; Non-Project related: slope erosion, rockfall
CR03-5H	Historic debris scatter	Concrete slabs and non-diagnostic historic debris possibly related to machinery or vehicle maintenance for Gorge High Dam construction	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-8H	Historic trail, Historic debris scatter	Trail or access road associated with the Gorge Power Tunnel (1921-1924) and construction and food-related debris scatter	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-10H	Historic debris scatter	Industrial debris jumbled on rockfall slope	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-12H	Historic debris scatter	Food cans and bottle (ca. 1900-1920) in shovel probe; other scattered debris; possible association with Goat Trail	Individually: unevaluated, potentially eligible (A and D) DT00066: not associated	Project related: ROW vegetation clearing, ROW trail access; Non-Project related: visitor access from SR 20

Site No.	Site Type	Description	NRHP Eligibility Recommendation Individual/ Contributing (Criterion)	Potential Project and Non-Project Effects
CR03-13H	Historic public works	Four eyebolts lodged in bedrock bench	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-15H	Historic debris scatter	Industrial or logging debris on slope	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-16H	Historic debris scatter	Industrial and food-related debris scatter	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-17H	Historic debris scatter, Historic hydroelectric	Industrial debris scatter, access road, and retaining wall	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-22H	Historic debris scatter, Historic hydroelectric	Large industrial/construction debris scatter with a few domestic food-related items associated with Gorge Powerhouse facilities (1947 and ca. 1930s-1960s)	Individually: eligible (D) DT00066: eligible, contributing to DT00066 (C)	Project related: maintenance; Non-Project related: access by off-trail visitors
CR03-23H	Historic debris scatter	Industrial/construction debris on boulder river bar	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-25H	Historic debris scatter, historic culturally modified tree	Springboard notched stump and sparse industrial debris scatter on alluvial fan	Individually: not eligible DT00066: not eligible, non-contributing	N/A
CR03-28H	Historic public works	Ceramic insulators and coiled wire rope (cable)	Individually: not eligible DT00066: not eligible, non-contributing	N/A
45SK00230	Historic railroad property; historic debris scatter	Two segments of grade and bridge footings of the Skagit River Railway (1920-1954); few scattered industrial and food-related debris	Individually: not eligible DT00066: not eligible, non-contributing	N/A
45WH00184	Historic trail, historic debris scatter	Two segments of the Goat Trail (ca. 1890s-1920s)	Individually: eligible, previous segment listed (1974) (A, C, D) DT00066: not associated	Project related: none; Non-Project related: erosion, rockfall

Site No.	Site Type	Description	NRHP Eligibility Recommendation Individual/ Contributing (Criterion)	Potential Project and Non-Project Effects
45WH00698	Multi-component site; precontact rockshelter; historic debris scatter	Historic component in previously recorded precontact rockshelter site	Individually: Historic component evaluated not eligible; Precontact component previously evaluated as eligible (SHPO determination pending) (D) DT00066: not associated	Project related: transmission line maintenance; Non-Project related: visitor access from SR 20
45WH00699	Historic debris scatter; historic public works	Transmission line debris (cables, eyebolts), industrial/construction debris, personal debris, and food-related debris on steep mountain slope (ca. 1920s-1970s)	Individually: not eligible DT00066: not eligible, non-contributing	N/A
45WH01014	Historic trail	Trail related to construction and maintenance of Ladder Creek water system and recreation	Individually: not eligible DT00066: eligible, contributing (C)	Project related: Maintenance or cleanup of trail or nearby areas; Non-Project related: forest fire, visitor access
45WH01015	Historic debris scatter	Industrial and food-related debris associated with Ladder Creek water system (1950s-present)	Individually: not eligible DT00066: not eligible, non-contributing	N/A

4.2.8.2 Environmental Analysis

Studies to identify cultural resources in the APE that are eligible for listing in the NRHP, or are already listed, and therefore constitute historic properties, are not yet complete. However, the continued O&M of the Project and any proposed changes to the Project under the new license have the potential to affect historic properties. Types of effects may include direct (i.e., the result of Project activities at the same time and place with no intervening cause), indirect (i.e., the result of Project activities later in time or further removed in distance but reasonably foreseeable), and/or cumulative (e.g., caused by a Project activity in combination with other non-Project past, present, and foreseeable future activities) effects (ACHP 2019). Certain Project activities may affect historic properties within the Project Boundary or outside the Project Boundary if related to Project activities.

Adverse effects are activities that may alter those characteristics of a historic property that contribute to its NRHP eligibility in a manner diminishing the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. There are multiple activities that could potentially adversely affect historic properties within the APE, including, but not limited to, modifications that include new areas of excavation or ground disturbance, use and maintenance of Project facilities and roads, maintenance to historic buildings or other structures, vegetation management activities, recreational site use, erosion caused by wave action and fluctuating water levels of the Project reservoirs, and sedimentation also caused by erosion and other aggrading processes occurring around the Project reservoirs. Examples of adverse effects would include excavation work or road maintenance that affects a previously undisturbed archaeological deposit, or a facility upgrade project that removes the windows or doors of a historic powerhouse and does not replace them in kind with new windows and doors of a similar style and material. In addition, certain kinds of Project-related activities may not have a direct effect on historic properties but may create the conditions by which damage occurs. For example, a Project road may not directly affect historic properties, but may enable public access to areas that contain such historic properties, resulting in increased public use and subsequent damage from looting or vandalism that occurs over time.

By contrast, there are Project activities that may occur within or near historic properties but do not have an adverse effect on these properties and there may also be historic properties within the APE that are not subject to Project activities because they are not located in the vicinity of such activities. For example, the continued use of a paved Project access road that is closed to the public and travels through a historic property that is an archaeological site will likely not be considered an adverse effect. In addition, a historic property comprised of a Project facility will likely not be adversely affected by continued use and maintenance of the facility, if the facility is used as it has been in the past and any maintenance activities maintain the existing integrity of the facility. Furthermore, there may be historic properties located within the APE that are substantially above the high waterline of the Project reservoirs and nowhere near any other Project facility or within the vicinity of Project activities. Subsequently, Project activities may not adversely affect these historic properties.

City Light has not yet determined what Project-related activities are adversely affecting or will adversely affect historic properties within the APE under the new FERC license. These details will be further addressed in the FLA and through continued NHPA Section 106 consultation. However, the following sections describe some of the activities that occur in the APE with potential to affect historic properties. This section is organized to address requests in FERC's Scoping Document 2 (SD2).

Effects of existing and any potential changes to project facilities; operations; including reservoir fluctuations, transmission line corridors, and maintenance activities; on historic properties and archaeological resources, including TCPs and the exercise of tribal treaty rights (FERC SD2).

Protection, Mitigation, and Enhancement Measures. City Light anticipates proposing several protection, mitigation, and enhancement (PME) measures under the new FERC license that may include new Project operations protocols, construction of new facilities, modification of existing facilities, and new best management practices. Each of these PME measures may have the potential to affect historic properties and will require assessment regarding this potential effect prior to implementation. City Light expects that the potential effects of the PME measures on historic properties, once proposed and included in the new FERC license, will be addressed under the HPMP. The HPMP will be developed and implemented to consider and manage effects on historic properties under the new license.

Routine Operation and Maintenance of Historic and Modern Buildings and Structures. The Project's hydroelectric operating system includes dams, powerhouses, penstocks, etc., and associated features, many of which are part of a NRHP listed historic district (DT00066). A few additional buildings, associated with other historic activities not directly related to the hydroelectric system, were also identified within the APE. As these facilities age, they may require maintenance to maintain operational efficiency or usefulness as a storage or residential facility. Maintenance can affect the character-defining features of a building or structure that contribute to its significance. Future projects might include structural, mechanical or electrical upgrades of these facilities, maintenance or repair of buildings and other structures, replacement of windows, doors, roofing, or other building components; expansion or improvement of parking and storage area; and similar activities. Moreover, historic built environment resources often require consideration of the integrity of their viewscape as an important factor. Viewscapes can contribute to a resource's significance and eligibility to the NRHP, and to the integrity of setting, association, and feeling of a resource. Planned and unplanned O&M tasks associated with structures and buildings, including repairs, upgrades, or viewscape changes, could result in negative or adverse effects on those built or engineered resources that are considered eligible for listing in the NRHP and must be considered.

Vegetation Management. Routine management of vegetation within the Project APE is necessary to maintain safe distance between Project transmission line conductors and poles and the adjacent vegetation, or with other facilities within the APE. Additionally, hazard trees adjacent to or within the boundaries of historic properties may need to be trimmed or cut down to reduce dangers. However, timber felling, skidding of downed trees, and use of harvesting equipment all have the potential to affect historic properties.

Road Maintenance, Construction and Use. Numerous road maintenance and construction activities have the potential to affect historic properties. Dirt access roads within the Project are maintained by graveling and grading, which can affect historic properties that may lie buried beneath or adjacent to them. In addition, ditches excavated for roadway drainage may cause further impacts to archaeological sites. Vehicular traffic on dirt roadways can also damage historic properties by traveling through or over, depending on the condition of the road, the season of use, and the types of vehicles that travel the roads. Roads also make historic properties more accessible to the public, in some cases increasing their vulnerability to looting, vandalism, and general damage.

Emergency Repair and Response. Emergency repairs to Project facilities, including dams, penstocks, powerhouses, etc., along with other emergency actions, may be necessary in response to serious threats to life or property, or to the safe operation of City Light's hydroelectric facilities. Such actions, however, have the potential to affect historic properties. For example, a historic dam may require repair that does not use materials in-kind, or the creation of a fire break could affect a lithic scatter.[96]

[96] City Light notes that independent of its operations, natural events such as forest fires and storms have the potential to adversely affect Project operations as well as historic properties. While City Light may coordinate with other groups to predict and respond to emergency situations stemming from natural events by adjusting operations

Effects of project-related erosion, sedimentation, and any proposed sediment management activities on cultural resources (FERC SD2).

Reservoir Fluctuation/Sedimentation. Historic properties within a reservoir basin may be consistently inundated by water or subject to wet and dry cycles and wave action associated with annual and daily fluctuations in the reservoir water levels. The effects of these Project conditions may include erosion, deflation, hydrologic sorting or displacement of artifacts, and are primarily dependent on where within the reservoir basin a site is located (Lenihan et al. 1981). Sedimentation also occurs within reservoirs, both from sediments transported into the reservoir inundation zone from tributaries that flow into the reservoir and from sediments eroding downslope from the reservoir shoreline caused by the fluctuating water levels and wave action. Fully inundated sites are usually subject to less impact than sites within the annual fluctuation zone, although sedimentation can also fill sites in and cause them to be in accessible, which could also be considered a potential impact to the site.

Effects of project-related recreational access and use on historic properties and archaeological resources, including TCPs (FERC SD2).

Recreation. Recreational activities common in the APE include boating, fishing, hiking, picnicking, and camping. These activities can expose historic properties to public use and can lead to disturbance of intact archaeological deposits, increased erosion or deterioration of sites, unauthorized artifact collection, or more severe vandalism and looting. Ongoing maintenance at recreational facilities, formal and informal improvements, and infrastructure development can also affect significant cultural values. Historic properties that are accessible to the public are more likely to be affected by recreational activities.

Artifact Collection/Vandalism. Vandalism, looting, and destruction or defacement pose potential threats to historic properties within the APE and would constitute a violation of the Archaeological Resources Protection Act on federal lands. These offenses are punishable by law and can be associated with fines and imprisonment. Looting includes the casual collection of surface artifacts as well as deliberate unauthorized digging and theft of cultural resources. Vandalism includes looting, but also includes other forms of physical destruction or defacement of cultural resources. The more accessible historic properties are to public visitation, the more likely they are to be affected by vandalism. Archaeological sites that have been impacted by looting in the past are prone to additional looting. Such vandalism is often related to a site's proximity to recreation areas rather than the operation of the Project.

4.2.8.3 Existing and Proposed Resource Measures

Under its current Project license, City Light implements two cultural resources management plans – the Archaeological Resources Mitigation and Management Plan and the Historic Resources Mitigation and Management Plan in cooperation with LPs for the current (1995-2025) license.

and/or supporting a response with staff and resources, the natural events themselves are not triggered by City Light's activities and therefore would not be considered Project-related effects.

For the new license, City Light anticipates that FERC will develop a Programmatic Agreement (PA) or Memorandum of Agreement with the licensee, SHPO, and the ACHP (if they choose to participate) to facilitate coordination among parties, fulfill NHPA obligations, and enable carrying out a more detailed plan for managing historic properties during the new license period. City Light will develop a new HPMP in consultation with NHPA Section 106 consulting parties to outline the steps for managing potential adverse effects on known and unknown historic properties and potential historic properties (e.g., unevaluated cultural resources) within the APE. Upon FERC approval of the HPMP, City Light and PA signatory parties will implement the steps identified in the plan. A preliminary annotated outline of the HPMP, prepared by City Light in consultation with the Section 106 consulting parties, is included in Appendix B of this Exhibit E. City Light plans to include a draft of the HPMP in the FLA.

4.2.8.4 Unavoidable Adverse Impacts

To determine whether Project activities are resulting in or have the potential to result in unavoidable adverse effects on historic properties, City Light will include provisions for completing NRHP evaluations for unevaluated cultural resources in the HPMP, in consultation with Indian Tribes, Canadian First Nations, agencies, and DAHP. The HPMP will also provide a schedule and plan for resolving adverse effects on historic properties that are caused by Project O&M.

4.2.9 Tribal Resources

This section describes tribal resources associated with the Project. It also discusses any identified tribal resources that may be affected by continued operation of the Project under a new license. Tribal resources include interests and/or rights in natural resources of traditional, cultural, and spiritual value. Tribal resources are located both on and off reservation lands and are used for commercial, subsistence, and ceremonial purposes. Fish and aquatics, plant, and wildlife species of special significance are discussed in Sections 4.2.3, 4.2.4, and 4.2.5 of this Exhibit E, respectively. This document acknowledges that each federally-recognized Indian Tribe and Canadian First Nation is in the best position to define their own rights and cultural and economic interests. Accordingly, this document is not intended to describe, characterize, or define the legally identified reserved rights of any individual Indian Tribe or Canadian First Nation referenced herein.

The unique and distinct political relationship between the United States (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, which defines 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).

Treaties provided that Indian Tribes would relinquish and cede large expanses of land to the U.S. government while reserving certain lands and rights specifically for Indian Tribes for future generations. Lands were reserved permanently for Indian Tribes by treaty, act of Congress, or executive order, and the federal government retained the title to those lands and held them in trust on behalf of the Tribes. Often the actions of the federal government resulted in lands set aside for Indians that required them to relocate or they were forcibly relocated to the homelands or traditional territories of neighboring Tribes. The reserved rights vary by treaty, but generally, in present-day Washington State, include a portion of land for a homeland and/or hunting, fishing, and gathering rights, both on and off Indian reservations (12 Stat. 927 1855 [Articles 2 and 5]). 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 usual and accustomed (U&A) areas and on their ceded lands.

The Treaty of Point Elliott is the treaty that pertains to the lands within the Project Boundary (12 Stat. 927). The rights reserved by this treaty have been litigated by several Tribes and the United States against the State of Washington in a long running case, U.S. v. Washington (384 F. Supp. 312, W. Dist. WA, (1974)). The rulings in U.S. v. Washington have defined and clarified the treaty rights that individual tribes hold pursuant to the treaty. This Project will not impact or affect those court rulings regarding the reserved treaty rights and Indian Tribes exercise their treaty rights independent of this Project.

To fulfill the federal trust responsibility to Indian Tribes, Federal Energy Regulatory Commission (FERC or Commission) will consult on its environmental documents and decisions (18 Code of Federal Regulations [CFR] § 2.1c) for the Project regarding potential impacts on reserved treaty rights of Indian Tribes (FERC 2019). FERC will also implement its Policy Statement of Consultation with Indian Tribes in Commission Proceedings, as amended, 169 FERC 61, 036 (2019).

4.2.9.1 Affected Environment

This section identifies the Indian Tribes potential affected by the Project relicensing and Canadian First Nations that have a stated tribal resource interest in the Project vicinity. This section also describes how tribal resources were considered in the relicensing process, along with describing the results and status of cultural resources studies undertaken for the relicensing that relate to tribal resources. Finally, this section briefly highlights other resource studies undertaken that consider tribal resources.

United States Federally-Recognized Indian Tribes

Based on ethnographic and ethnohistoric records, several federally-recognized Indian Tribes were identified to have potential tribal, cultural, or economic interests in the Project vicinity that may be affected by the Project relicensing (listed in alphabetical order):

- 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

Suquamish Tribe

Swinomish Indian Tribal Community

Tulalip Tribes of Washington

Upper Skagit Indian Tribe

Based on available information, none of the identified federally-recognized Indian Tribes have reservations or trust lands directly within the Project Boundary. However, there are four reservations located 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.

Canadian First Nations

The term "Canadian First Nations" is used to refer to aboriginal peoples in Canada who are not Métis or Inuit. Several Canadian First Nations groups have stated tribal resource interests in the Project vicinity due to a history of land use prior to establishment of the U.S./Canadian border.

The Canadian First Nations entities with these stated interests include the following listed in alphabetical order:

Nlaka'pamux Nation Bands Coalition

- Ashcroft Indian Band
- Boston Bar First Nation
- Coldwater Indian Band
- Cooks Ferry Indian Band
- Kanaka Bar Indian Band
- Lower Nicola Indian Band
- Nicomen Indian Band
- Nooaitch Indian Band
- Siska Indian Band
- Shackan Indian Band
- Spuzzum First Nation

Nlaka'pamux Nation Tribal Council

- Boorhroyd Indian Band
- Lytton First Nation
- Ntequem Band
- Skuppah Indian Band

S’ólh Téméxw Stewardship Alliance

- Chawathil First Nation
- Cheam First Nation
- Kwaw’Kwaw’Apilt First Nation
- Scowlitz First Nation
- Seabird Island Band
- Shxw’ow’hamel First Nation
- Skawahlook First Nation
- Skwah First Nation
- Sumas First Nation
- Yale First Nation

and as represented by Ts’elxwéyeqw Tribe Management Limited:

- Aitchelitz First Nation
- Shxwhà:y First Nation
- Skowkale First Nation
- Soowahlie First Nation
- Squiala First Nation
- Tzeachten First Nation
- Yakweakwioose First Nation

Tribal Resources Considerations in the Relicensing Process

Tribal resources are being considered throughout the relicensing process and in a number of forums including interactive coordination with participating Indian Tribes and Canadian First Nations in technical working groups, through on-the-ground site visits, and in broader perspective discussions on a variety of topics including potential Project effects to fish and aquatics, water quality, wildlife, plants, and cultural resources. Several of the relicensing studies have potential to intersect with areas of tribal interests, which is why the Indian Tribes and Canadian First Nations participation throughout the relicensing study development and implementation process has been especially valuable. Cultural resources studies include contextual information related to various tribal resources topics, while focusing specific goals and methods to fulfill National Historic Preservation Act (NHPA) Section 106 investigation on identifying, documenting, and evaluating potential historic properties that may have traditional cultural significance (i.e., such as traditional cultural properties [TCPs] and traditional cultural landscapes [TCLs]) and/or archaeological significance, or both, and may be affected by the ongoing operation of the Project.

Results of Cultural Resources Relicensing Studies

Previously recorded and unrecorded physical archaeological evidence can provide important data points for demonstrating tribal connections to resources in the Project vicinity. Project relicensing studies CR-02 Cultural Resources Survey and CR-03 Gorge Bypass Reach Cultural Resources Survey, which are summarized in Section 4.2.8 of this Exhibit E, have included on-the-ground investigations in portions of the Area of Potential Effects (APE) to document archaeological resources. Based upon findings of these surveys, both studies are relevant to tribal resources and places of traditional cultural significance because it includes documentation of pre-contact archaeological sites that relate to tribal history.

Two Project relicensing studies in particular have been specifically guided by Indian Tribes and Canadian First Nations' perspectives on tribal resources and the potential for the Project to adversely affect historic properties of traditional cultural or religious significance. These are the CR-01 Cultural Resources Data Synthesis study, and CR-04 Inventory of Historic Properties with Traditional Cultural Significance (Properties with Traditional Cultural Significance Study). These studies partially fulfill the purposes of Section 106 of the NHPA compliance and are described in greater detail below.

CR-01 Cultural Resources Data Synthesis (Traditional Cultural Properties)

The CR-01 Cultural Resources Data Synthesis study focused on compiling existing information about different types of cultural resources and has been completed. To implement this study, City Light and its study team conducted a background (desktop) review of cultural resources for the Cultural Resources Data Synthesis for the Project FERC relicensing efforts. The Cultural Resources Data Synthesis only presents available existing information and is not intended to provide a complete dataset of cultural resources in the study area, which is comprised of the APE for the Project relicensing. Reporting for this study has been completed in three parts (Part 1, 2, and 3). Part 1 reported on cultural resources background information based on ethnographic/ethnohistoric data relevant to TCPs and the study area vicinity. Part 2 reported on prior archaeological investigations in the APE and includes privileged/confidential information with limited distribution. Part 3 includes a summary of the existing historic built environment documentation for the historic resources in the APE and summarized the public-facing content regarding from the two prior reports (Parts 2 and 3). The ethnographic data synthesis report (Part 1; Curti et al. 2020) was filed in FERC's privileged/confidential files on July 20, 2021. The results of the ethnographic data synthesis report are summarized below, and the results of the archaeological and historic built environment, reported on in Parts 2 and 3, are summarized in Section 4.2.8 of this Exhibit E. The results from the Cultural Resources Data Synthesis are intended to inform the development and implementation of other relicensing studies (including cultural resources field surveys), support initial assessment of potential Project-related adverse effects on historic properties, and provide context for the development of the Historic Properties Management Plan (HPMP) that will be prepared for the new license.

Part 1 of the study implementation included outreach to Indian Tribes and Canadian First Nations to ensure that relevant tribally-held information could be incorporated, if desired by those groups. Available ethnohistories, ethnographies, place name documents, cultural resources reports, and environmental reports from repositories associated with participating Indian Tribes and Canadian First Nations were reviewed after express permission was granted. Information was also incorporated from the Pre-Application Document filed with FERC in 2020, as appropriate (City Light 2020).

For Part 1 of the study, City Light's consultant, Cultural Geographics Consulting, LLC (CGC), completed a desktop overview of properties with known or potential TCP and TCL significance within the study area (e.g., Part 1; Curti et al. 2020). The overview included a review of information geographically relevant for up to 3 miles beyond the study area for additional consideration of TCPs that may intersect, envelop, or otherwise be associated with the study area (Curti et al. 2020:2). Curti et al. (2020) reached out to the participating Indian Tribes and Canadian First Nations including (alphabetically): 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, Suquamish Tribe, Swinomish Indian Tribal Community, the Tulalip Tribes of Washington, and Upper Skagit Indian Tribe; and Canadian First Nations: Nlaka'pamux Nation Tribal Council and Stó:lō Nation[97]. Since the research period of the study, an additional Canadian First Nations group, Nlaka'pamux Nation Bands Coalition, identified themselves to City Light and stated their interest in participating in the relicensing process. This group was added to the list of interested parties participating in the NHPA Section 106 consultation, and have chosen to take part in the subsequent CR-04 Properties with Traditional Cultural Significance Study.

The ethnographic data synthesis report (Part 1) includes background research and informational analysis, and summaries of traditional use areas, named places, ancestral territories, treaty dynamics, post-treaty social and political developments, social and kinship networks, spiritual, religious, and cultural practices, human-environment relationships, worldview, belief, and values systems, and associated resources, places, and land/waterscapes of traditional religious and cultural use and importance. The ethnographic data synthesis report results are summarized below (see Curti et al. 2020: Appendix B).

In total, 144 cultural resources with identified or potential TCP/TCL significance were identified up to 3 miles from the APE (i.e., the study area). Of these, there are 56 cultural resources with identified or potential TCP/TCL significance that are either within or intersect the APE in Skagit, Snohomish, and Whatcom counties. The remaining 88 cultural resources are outside the APE.

Of the 56 cultural resources identified within the APE, six are recommended eligible for listing in the National Register of Historic Places (NRHP) and 50 are recommended for further evaluation. Four of the resources recommended eligible are located within the portion of the APE where Project operations and maintenance (O&M) activities occur and therefore have potential to cause physical effects to the resources. The other two resources recommended eligible for NRHP listing are located outside of or beyond the area where physical Project activities are occurring or expected to occur, but where other types of effects, that could be relevant for a greater distance, (e.g., such as equipment noise or visual obstructions) could occur. Many of these resources are being

[97] For their study, CGC reached out to the Stó:lō Research and Resource Management Centre and People of the River Referrals Office, which facilitates meaning engagement and consultation on behalf of the S'ólh Téméxw Stewardship Alliance communities (S'ólh Téméxw Stewardship Alliance 2022). The Nlaka'pamux Nation Bands Coalition was not yet participating in the Project FERC relicensing process at the time of this outreach.

documented in greater detail in the CR-04 Properties with Traditional Cultural Significance Study, to enable National Register evaluations and recommendations using the criteria for evaluation and guidance in National Register Bulletin 38.

CR-04 Properties with Traditional Cultural Significance Study

The CR-04 Properties with Traditional Cultural Significance Study is not yet complete; it is ongoing and updates for this study will be included in the Final License Application (FLA). The Properties with Traditional Cultural Significance Study is designed to partially fulfill Section 106 requirements for due diligence to identify NRHP-eligible historic properties that could potentially be adversely affected by the Project and to build upon the contextual information gathered through desktop review in the CR-01 Cultural Resources Data Synthesis study report. In this study, historic properties with traditional cultural significance to Indian Tribes and Canadian First Nations, which would also be considered tribal resources, will be identified within the APE. Such properties will be evaluated using NRHP criteria for evaluation, and potential Project-related adverse effects to them will be preliminarily assessed. As described above, historic properties with traditional cultural significance are TCPs and are one kind of tribal resource that can only be identified, "from the standpoint of those who may ascribe such significance to them" (Parker and King 1998:4). The basic steps for implementing this study include coordinating closely with Indian Tribes and Canadian First Nations groups participating in the study to: (1) select and hire ethnographers to work directly with each individual Indian Tribes or Canadian First Nations group; (2) conduct initial outreach to develop a research design and establish confidentiality protocols; (3) gather data to identify resources in the APE; (4) assess resources regarding their traditional cultural significance and evaluate eligibility of those resources for listing in the NRHP using National Register Bulletin 38; (5) identify potential Project-related adverse effects to NRHP-eligible TCPs; and (6) report results.

<u>Preliminary Results</u>

For the selection of ethnographers, early solicitation was sought from the Indian Tribes and Canadian First Nations regarding ethnographers they recommended for the study during the November 16, 2020, Cultural Resources Work Group (CRWG) meeting and in follow-up emails. City Light and its consultant, HDR Engineering, Inc., initiated outreach to a pool of potential ethnographers in December 2020. Virtual interviews with interested and qualified ethnographers were conducted in January and February 2021. It became clear during the process of coordinating on this study, that an important element of successful implementation was for each participating Indian Tribe/Canadian First Nation entity to work collaboratively with an ethnographer of their choice. Equally important for successful implementation of the study was to identify a lead team of ethnographers to assist the process, answer questions, and offer support and additional expertise.

City Light provided the names and qualifications of ethnographers to the CRWG in March-April 2021. City Light made a final selection of the lead ethnographers to oversee study coordination, based on input received from the CRWG, in July/August 2021, and notified the CRWG of the tentative selection of the lead ethnographers in September 2021. All three lead ethnographers, listed below meet the ethnography qualifications outlined in National Register Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties* (Parker and King 1998).

- Co-lead: Joyce LeCompte-Mastenbrook, PhD (Camassia Resource Stewardship);
- Co-lead: Mario Battaglia, MA (Algonquin Consultants, Inc.); and
- Senior Advisor: Doug Deur, PhD (Portland State University).

The nine Indian Tribes and Canadian First Nations listed below have elected to participate in the study. Several of these Indian Tribes and Canadian First Nations are working with additional ethnographers to support the specific steps of their part of the study (as listed below). All ethnographers are under contract with either HDR Engineering, Inc. or the participating Indian Tribes/Canadian First Nations and are in the process of implementing the study. Further work on this study will include the following groups:

- Confederated Tribes of the Colville Reservation (completing study within the Confederated Tribes of the Colville Reservation History and Archaeology Department);
- Nlaka'pamux Nation Bands Coalition (working with ethnographer Richard Inglis, MA);
- Nlaka'pamux Nation Tribal Council (working with ethnographer Mario Battaglia, MA);
- Nooksack Indian Tribe (currently coordinating with City Light on their process for implementing the study);
- Sauk-Suiattle Indian Tribe (working with ethnographer Sara Breslow, PhD);
- Stillaguamish Tribe of Indians (working with CGC);
- S'ólh Téméxw Stewardship Alliance (completing study within the Stó:lō Research and Resource Management Centre);
- Swinomish Indian Tribal Community (working with CGC); and
- Upper Skagit Indian Tribe (providing existing material from prior work with qualified ethnographers Bruce Miller, PhD, Bill Angelbeck, PhD, and Molly Malone, PhD).

The study is underway and a variety of strategies including archival research, in-person interviews, and fieldwork/site visits, are being employed by the participating groups. All study results will be reported in forthcoming study reports.

Other Relicensing Studies

As described above, other resource areas are important to Indian Tribes and Canadian First Nations. For example, the Fish and Aquatic Resources section (4.2.3) of this Exhibit E, discusses anadromous and native resident fish species within the Project vicinity and analyzes potential Project-related effects on them. These species include Chinook, Coho, Pink, and Chum salmon; steelhead; Coastal Cutthroat Trout; native char (Bull Trout and Dolly Varden); and Rainbow Trout. The Botanical Resources section (4.2.4) describes 118 plant species that occur within the Project Boundary that Indian Tribes or Canadian First Nations consider culturally important. The Wildlife Resources section (4.2.5) also describes animal species of interest to Indian Tribes and Canadian First Nations, including black-tailed deer, elk, moose, cougars, and beavers.

4.2.9.2 Environmental Analysis

Impacts to tribal resources from the Project relicensing are still being determined in consultation with participating Indian Tribes and Canadian First Nations. City Light recognizes that Indian Tribes and Canadian First Nations are the most authoritative sources with regard to identifying tribal resources. Accordingly, City Light's approach is to consult and engage with Indian Tribes and Canadian First Nations directly, in confidential settings as needed, to assess Project-related impacts to tribal resources. An update on this environmental analysis for tribal resources will be provided in the FLA.

4.2.9.3 Proposed Resource Measures

Proposed protection, mitigation, and enhancement (PME) measures for tribal resources are being identified through consideration of on-going relicensing studies and discussions with Indian Tribes and Canadian First Nations and will be included in City Light's FLA submittal in April 2023. PMEs (including various resource management plans) identified for aquatic, botanical, wildlife, recreation, cultural, and other resources are expected to address tribal resources. City Light expects that these PMEs will be developed in consultation with Indian Tribes, Canadian First Nations, and other licensing participants. Tribal resources that are historic properties or potential historic properties will be considered and managed under the HPMP, as described in Section 4.2.8 of this Exhibit E. Cultural resource studies and the NHPA Section 106 process will continue into the post-FLA filing period to determine the effects of continued operation of the Project on historic properties and identify any additional measures necessary. City Light has and continues to engage with participating Indian Tribes and Canadian First Nations regarding PME measures for tribal resources, including conducting the NHPA Section 106 consultation.

4.2.9.4 Unavoidable Adverse Impacts

To determine whether Project-related O&M activities are resulting in, or have the potential to result in, unavoidable adverse impacts to tribal resources, including adverse effects on tribal resources that are historic properties as defined in 36 CFR 800.16(l)(1), City Light will continue to consult with Indian Tribes and Canadian First Nations. PMEs being developed for the Project, as well as the HPMP, will provide for a schedule and plan for resolving adverse impacts and effects to tribal resources caused by Project-related O&M.

4.2.10 Socioeconomic Resources

This section presents information on the socioeconomics, including land use patterns, population, and employment, of people in the Project vicinity and the State of Washington. The Project's three generating facilities are in Whatcom County, and the primary transmission lines cross through Whatcom, Skagit, and Snohomish counties. The Project fish and wildlife mitigation lands are also within Whatcom, Skagit, and Snohomish counties. Given that relatively limited information exists on socioeconomics in the Project vicinity, this section relies on available county and state data.

4.2.10.1 Affected Environment

Land Use and Real Estate

Land Use Patterns

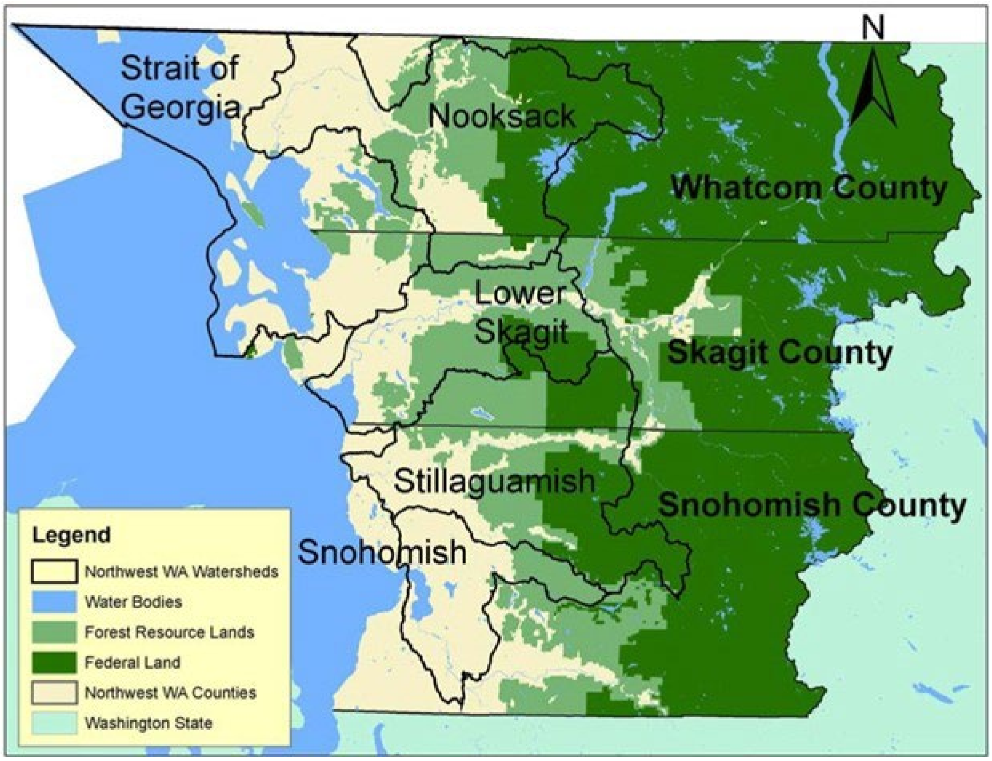
Lands within the Project Boundary include a mix of federal, state, county, and private lands, with most of the federal lands located north of Marblemount. Project generating facilities are entirely within the Ross Lake National Recreation Area (RLNRA). The Project transmission lines cross a mixture of public lands managed mostly by federal and state agencies, and private lands owned by Seattle City Light (City Light), individuals, corporations, and timber companies. Land uses adjacent to the transmission lines 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: Nooksack, Lower Skagit, Stillaguamish, and Snohomish, 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 4.2.10-1). 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 4.2.10-1 shows the designated forest resource lands and federal lands as identified in the comprehensive plans for Whatcom, Skagit, and Snohomish counties as cited in White (undated).

Table 4.2.10-1. 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

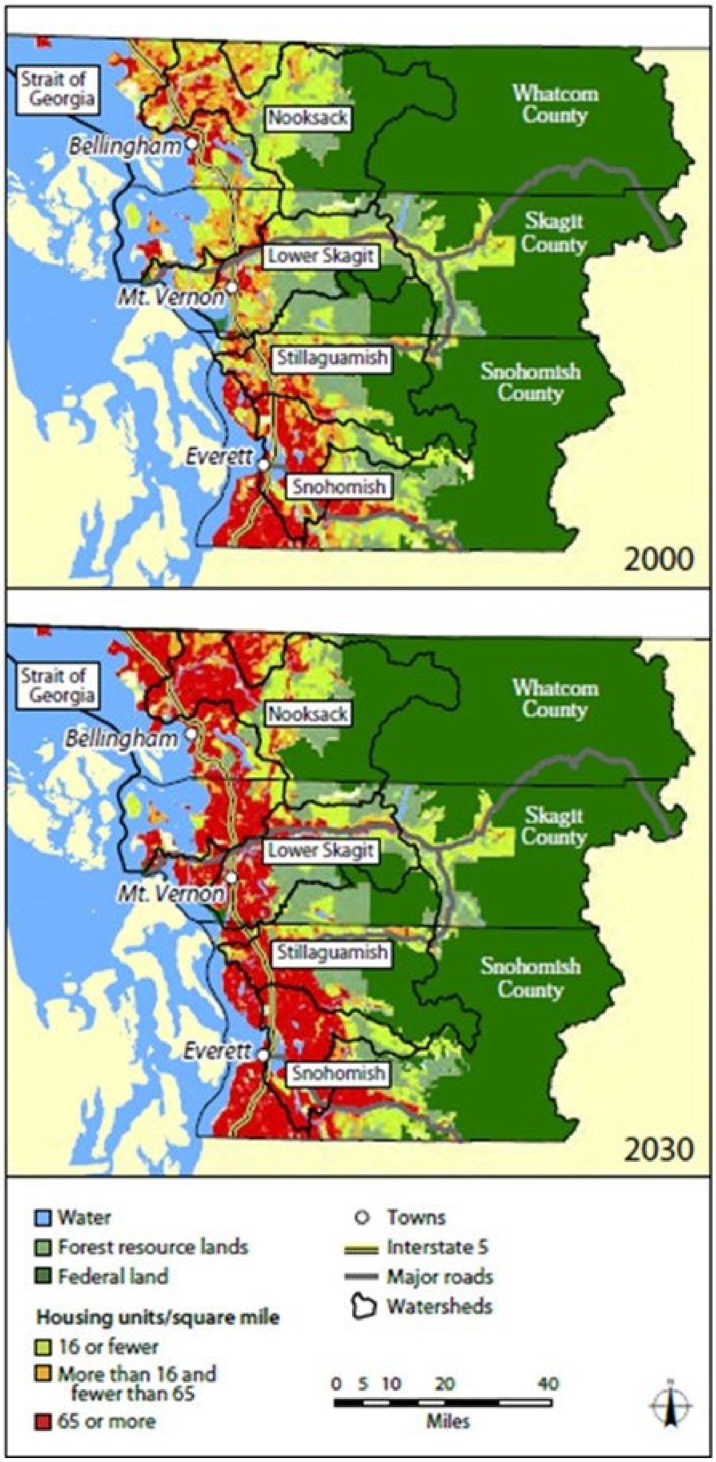
Source: White (undated).



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 4.2.10-1. Designated forest resource lands and federal lands as identified in the 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 4.2.10-2 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 4.2.10-2. Year 2000 northwest Washington watersheds baseline housing unit density and projections for 2030 as identified for the U.S. Department of Agriculture (USDA) Forest Service "Forests on the Edge" project.

Population and Housing

The state population of Washington has increased approximately 15 percent between 2010 and 2021, with a total estimated population of 7,738,692 people (U.S. Census Bureau [USCB] 2021). Whatcom County contains seven incorporated cities and 12 census designated places (WA HomeTownLocator 2022c) with a total estimated population of 228,831 (USCB 2021). Skagit County contains four incorporated cities, four incorporated towns, and ten census designated places (WA HomeTownLocator 2022a) with a total estimated population of 130,696 (USCB 2021). Snohomish County, which is immediately south of Skagit County, contains 18 incorporated cities, two incorporated towns, and 48 census designated places (WA HomeTownLocator 2022b) with a total estimated population of 833,540 (USCB 2021).

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 operation and maintenance (O&M). Currently, about 32 of the 92 full-time employees who work at the Skagit River Project live in the two towns. Some of the housing in Newhalem and Diablo is 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 National Park Service (NPS) and North Cascades Institute (NCI). There are a few very small towns in the vicinity of the Project, mostly located along State Route (SR) 20.

Demographics

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. Sixty-five 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 2021, at 29 percent, followed by Snohomish and Pierce at 16 and 12 percent, respectively. The state's 20 nonmetropolitan counties accounted for 0.3 percent of population growth (Office of Financial Management [OFM] 2022a). Table 4.2.10-2 shows the estimated populations in Whatcom, Skagit, and Snohomish counties compared to Washington State's population estimates from 2010 through 2021. Snohomish County is the most heavily populated of the three counties with Project facilities. In 2021, the population of Whatcom County decreased by 0.24 percent and increased by 0.37 percent in Skagit County, and 1.19 percent in Snohomish County. The shift to online learning and the resulting loss of student group quarters at college campuses during the COVID-19 pandemic is the primary contributing factor leading to a decline in population for Whatcom County (OFM 2022a).

Table 4.2.10-2. Estimated populations in Washington State and Whatcom, Skagit, and Snohomish counties (2010-2021).[1]

Year	Washington State	Whatcom County	Skagit County	Snohomish County
2021	7,766,975	226,300	130,000	837,800
2020	7,707,047	226,847	129,523	827,957
2019	7,546,400	225,300	129,200	818,700
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: OFM 2022a.

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.

Age and Education Distributions

In 2020, the estimated median age in all three counties ranged from 39.17 to 43.54 (OFM 2022b). Approximately 16.7 percent of Washington State residents were age 65 or above in 2021, with 19.7 percent in Whatcom County, 23.2 percent in Skagit County, and 14.8 percent in Snohomish County (OFM 2022a).

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 4.2.10-3). Individuals with a bachelor's degree or higher are under the state's percentage for all three counties (USCB 2021).

Table 4.2.10-3. 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	91.7%	92.7%	90.6%	92.5%
Bachelor's Degree or Higher	36.7%	35.3%	27.4%	32.8%

Source: USCB 2021.

1 Values are based on persons age 25 years+ from 2016-2020.

Household and Housing Patterns

The average persons per household from 2016 to 2020 in Washington State was 2.53, with 83 percent living in the same house for more than one year; compared to 2.47 and 80.7 percent in Whatcom County, 2.55 and 86.1 percent in Skagit County, and 2.68 and 85.4 percent in Snohomish

County (USCB 2021). Table 4.2.10-4 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.

Washington state added 46,500 housing units in 2021, which is a 2.3 percent increase over 2020, and exceeds the previous decade annual average of 31,500 units (OFM 2022a).

Table 4.2.10-4. Estimated number of housing units in Washington State and Whatcom, Skagit, and Snohomish counties for 2010, 2020, and 2021.

Type of Housing	Washington State			Whatcom County			Skagit County			Snohomish County		
	2010	2020	2021	2010	2020	2021	2010	2020	2021	2010	2020	2021
One Unit	1,876,367	2,025,337	2,043,558	57,295	62,407	62,818	37,078	40,583	40,722	191,686	211,762	213,581
Two or More Units	759,497	921,891	948,650	22,766	27,092	27,817	7,913	8,556	8,680	75,546	90,200	93,537
Mobile Homes and Specials	249,813	255,011	256,505	10,604	10,565	10,608	6,482	6,605	6,638	19,427	19,561	19,605
Total Housing Units	2,885,677	3,202,329	3,248,713	90,665	100,064	101,243	51,473	55,744	56,090	286,659	321,523	326,723

Source: OFM 2022a.

Income Levels and Poverty Rates

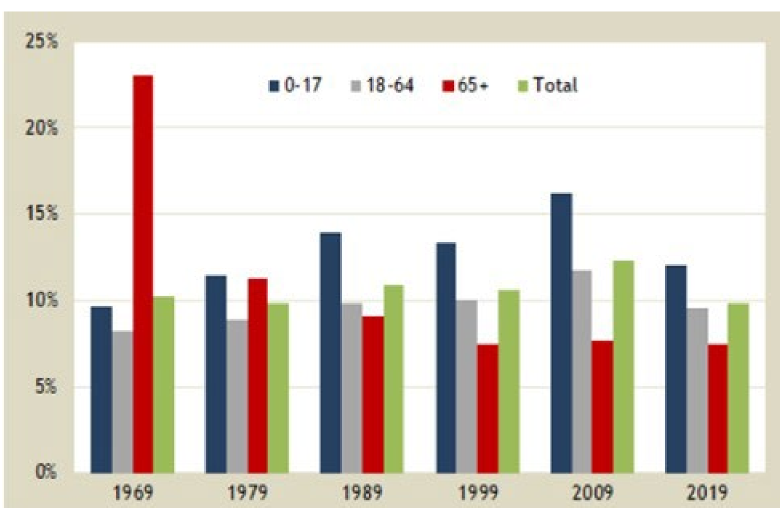
In general, the median household income in Washington State has continued to increase over the years. Table 4.2.10-5 shows the median household income estimates for the state and the three counties in which the Project is located. In 2020, the estimated median household incomes for Whatcom and Skagit counties were well below the state projected median income, while the projected median income for Snohomish County was significantly higher than the state average.

Table 4.2.10-5. Median household income estimates in Washington State and Whatcom, Skagit, and Snohomish counties.

Year	Washington State	Whatcom County	Skagit County	Snohomish County
2020[1]	$80,319	$70,463	$78,798	$93,589
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: OFM 2022c.
1 Values for 2020 are preliminary estimates.

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 2022) (Figure 4.2.10-3). The only population group in Washington to show a significant long-term decline in poverty is the elderly. In 1969, 23 percent of the elderly, more than one in five, lived in poverty. By 2019, following national trends, this percentage dropped to 7.5 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 2009 partially because of the severity of the recession and its lingering effects, with a decrease in 2019 (OFM 2020).



Source: OFM 2020.

Figure 4.2.10-3. Washington State percent of population in poverty.

The total number of individuals living in poverty in 2021 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 4.2.10-6).

Table 4.2.10-6. Estimated percentage of population living in poverty in 2021.

Group	Washington State	Whatcom County	Skagit County	Snohomish County
Persons in Poverty	9.5%	11.7%	9.5%	7.1%

Source: USCB 2021.

Race and Ethnicity

The largest population group in Washington State is non-Hispanic white persons, followed by Hispanic or Latino persons (Table 4.2.10-7). There are twenty-nine federally recognized Indian Tribes in Washington State. In Skagit County, American Indian or Alaskan Native (AIAN) populations make up approximately 2.82 percent of the population. In Snohomish County and Whatcom counties, AIAN populations make up approximately 1.57 and 3.14 percent of the population, respectively (OFM 2022d). All racial and ethnic populations have increased substantially from 2000 to 2020 in the state and in all three counties.

Table 4.2.10-7. Race and ethnicity population figures in Washington State and Whatcom, Skagit, and Snohomish counties, 2000, 2010, and 2020.

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	% of County 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	3.11	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	2.70	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	1.56	67,988	12.7	29,538	10.6	64,249	8.5

2020	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	% of County Population	Number of People	% of State Population	Number of People	% of State Population	Number of People	% of State Population
WA State	5,629,426	--	325,634	--	148,997	--	--	746,279	--	787,330	--	1,085,366	--
Whatcom County	185,147	3.3	2,691	0.8	7,118	4.8	3.14	10,453	1.4	20,613	2.6	23,625	2.2
Skagit County	108,311	1.9	1,115	0.3	3,653	2.5	2.82	2,996	0.4	12,963	1.7	24,323	2.2
Snohomish County	590,931	10.5	30,890	9.5	13,009	8.73	1.57	103,428	13.9	84,210	10.70	98,424	9.1

Source: OFM 2022d.

1 Black = Black or African American

2 AIAN = American Indian or Alaska Native

3 API = Asian and Native Hawaiian and Other Pacific Islander

Industry and Employment

Local Industries and Major Employers

In 2021, Whatcom County had approximately 6,859 businesses (USCB 2021). The county's largest job-providing sector is the private service-providing sector, making up about 61.1 percent of the total nonfarm employment in 2019 (Employment Security Department 2021; Table 4.2.10-8).

Table 4.2.10-8. Top ten employers in Whatcom County, WA.

Company	Total Employees in 2020
St. Joseph Hospital	3,116 [a]
Lummi Nation	2,083 [a]
Western Washington University	2,060
Bellingham Public Schools	1,606
BP Cherry Point	975
The City of Bellingham	917
Matrix Service Inc.	870 [a]
Ferndale School District	847 [a]
Whatcom County	825.5
Haggen	750
Fred Meyer	603

Source: Western Washington University (WWU) 2020b.
a. Based on 2019 numbers.

In 2021, Skagit County had approximately 3,540 businesses (USCB 2021). The county's largest job-providing sector is the private service-providing sector, making up about 56 percent of the total nonfarm employment in 2021 (Employment Security Department 2022a; Table 4.2.10-9). As in Whatcom County, health care facilities employ the greatest percentage of Skagit County's residents.

Table 4.2.10-9. Top ten employers in Skagit County, WA.

Company	Total Employees in 2020
Skagit Regional Health	3,000 [a]
Mount Vernon School District	1,147
Draper Valley Farms	1,038
Skagit County Government	757.5
Island Hospital	751
Janicki Industries	692
Sedro-Woolley School District	489
Shell Puget Sound Refinery	475
Skagit Valley Casino Resort	450
Burlington Edison School District	435

Source: WWU 2020a.
a. Based on 2019 numbers.

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 10 largest employers account for over 60,00 jobs (Economic Alliance Snohomish County 2022: Table 4.2.10-10).

Table 4.2.10-10. Top ten employers in Snohomish County, WA.

Company	Total Employees in 2021
The Boeing Company	27,700
Providence Regional Medical Center	7,350
The Everett Clinic	6,951
Naval Station Everett	4,300
The Tulalip Tribes	3,413
Washington State Government (includes colleges)	3,319
Snohomish County Government	2,87
Edmonds School District	2,850
Everett School District	2,533
Mukilteo School District	2,500

Source: Economic Alliance Snohomish County 2022.

Employment by Industry

Whatcom County averaged 95,900 nonfarm jobs in 2019, with 77,100 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 10,700 jobs, and the largest goods-producing industry is private service, providing 58,600 jobs (Employment Security Department 2021). 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 49,200 nonfarm jobs in 2021, with 39,800 of those jobs in service-providing industries and 9,400 of those jobs in goods-producing industries. The largest service-producing industry in the county is manufacturing, providing 5,600 jobs, and the largest goods-producing industry is private service, providing 27,700 jobs (Employment Security Department 2022a). 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 277,300 nonfarm jobs in 2021, with 202,500 of those jobs in service-providing industries and 74,800 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 aerospace, providing 31,600 jobs (Employment Security Department 2022b). 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).

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 the RLNRA. City Light currently offers four types of guided tours and in 2019,[98] over 4,700 people participated in the Skagit Tours. From 2013 to 2019, 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 4.2.6 of this Exhibit E.

98 Tours in 2020 and 2021 were canceled due to the COVID-19 pandemic, and tours have been canceled in 2022 due to construction.

In partnership with NPS and City Light, NCI operates the Environmental Learning Center (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 2017 through 2021 is provided in Table 4.2.10-11.

Table 4.2.10-11. Number of participants in programs available through the ELC (2017-2021).

Program	Number of Participants				
	2017	**2018**	**2019**	**2020**	**2021**
Adult and Family	2,003	1,935	1632	687	2296
Youth Leadership	92	79	36	31	57
Community	174	195	109	466	114
School Programs	3,268	4,265	4122	290	784
Graduate	28	25	9	9	0
Conferences	1,057	800	962	112	260
Skagit Tours	4,807	4,966	4787	0	1560
Total	**11,429**	**12,265**	**11657**	**1595**	**5071**

Source: NCI 2019; 2022.

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 motorboats, 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 4.2.10-12 provides the annual number of overnight stays for each year.

Table 4.2.10-12. Number of overnight stays at Ross Lake Resort (2014-2021).

Year	Number of Overnights Stays
2014	6,375[1]
2015	7,146
2016	7,949
2017	7,871
2018	8,328
2019	7,938
2020	3,623[2]
2021	5,755[3]

Source: Hollis 2022.
1 There was no data for October.
2 2020 and 2021 stays were likely affected by the COVID-19 pandemic.

Labor Force and Unemployment Rates

Whatcom County's 2019 resident civilian labor force averaged 115,413, with an unemployment rate of 5.0 percent. Within this estimate, 109,672 Whatcom County residents were counted among the employed and 5,741 were counted among the unemployed (i.e., active job seekers) (Employment Security Department 2021).

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 about a year, until the 2020 pandemic, which led to an unemployment rate of 17.7 percent in April 2020. As of November 2020, the unemployment rate in Whatcom County was 7 percent (Employment Security Department 2021).

Skagit County’s 2021 resident civilian labor force averaged 61,943, with an unemployment rate of 6.0 percent. Within this estimate, 58,039 Skagit County residents were counted among the employed and 3,904 were counted among the unemployed (i.e., active job seekers) (Employment Security Department 2022a).

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 COVID-19 pandemic-induced recession, the unemployment rate peaked at 18.8 percent and then dropped rapidly to 6.0 percent in Skagit County (Employment Security Department 2022a).

Snohomish County’s 2021 labor force averaged 437,145, with an unemployment rate of 5.0 percent. Within this estimate, 415,354 Snohomish County residents were counted among the employed and 21,791 were counted among the unemployed (Employment Security Department 2022b).

During the COVID-19 related recession and recovery, peak unemployment rates in Snohomish County reached 19.5 percent in April 2020. Since 2020, the unemployment rate has been on a consistent downward trend and is estimated at 2.3 percent as of April 2022 (Employment Security Department 2022b).

The unemployment rates in all three counties are higher than both the state and nation, which were 3.9 percent and 3.6 percent, respectively, in May 2022. Skagit County has the highest unemployment rate at 6.0 percent for the three counties in which the Project is located (Employment Security Department 2021, 2022a, 2022b).

Currently, City Light maintains a total of approximately 92 full-time employees at the Project. Additionally, 15-20 seasonal employees work at the Skagit River Project. Throughout the course of any given year there are a large number of temporary 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 benefits 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.

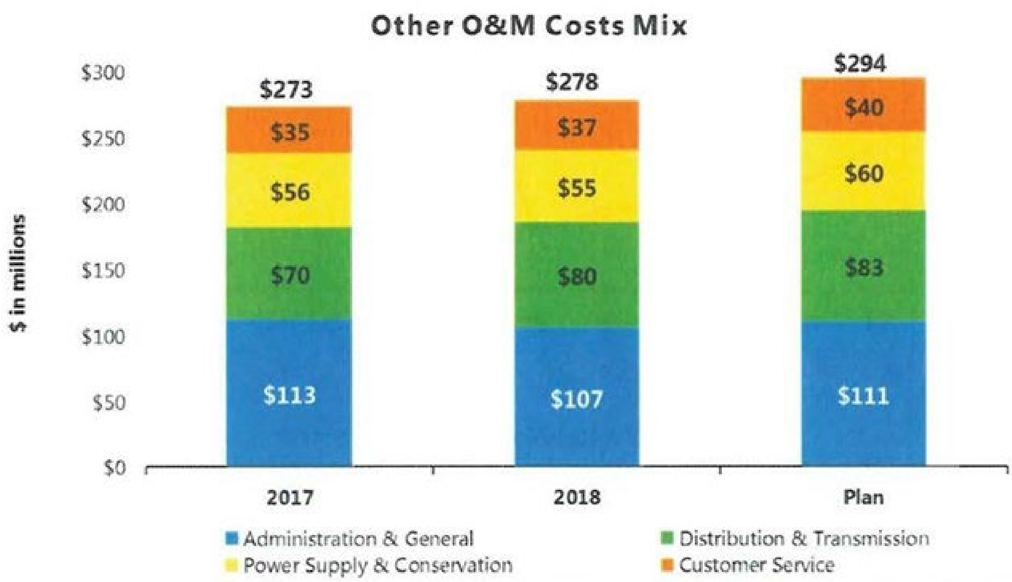
Public Sector (Taxes and Services)

Taxes and Local Revenues

As of July 2022, City Light’s current outlook for 2022 financial performance is strong, attributed to higher than planned retail revenues driven by colder temperatures in the heating season during the first half of the year. 2022 Retail revenue is expected to be $985 million, $23 million higher than planned. Net wholesale revenues are expected to be $84 million, $44 million higher than planned with all surplus amounts being deposited into the Rate Stabilization Account. Operational expenses are expected to come in near planned levels. Debt Service Coverage is expected to be 2.11.

Expenditure 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 4.2.10-4. 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 2018).



Source: City Light 2018.

Figure 4.2.10-4. Actual and forecasted O&M costs for 2018.

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 4.2.10-13.

Table 4.2.10-13. 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.

Electricity

The Skagit River Project supplies approximately 20 percent of City Light's power requirements to serve 426,359 residential customers and 51,219 non-residential customers (City Light 2020). City Light's five largest industrial customers in 2018 were the University of Washington, Nucor, Boeing, King County, and the Sabey Corporation.

Electricity Prices

As of April 2022, residential electricity rates in Washington State average 10.12 cents per kilowatt hour (kWh). This average electricity rate is 31.5 percent less than the national average residential rate of 14.77 cents per kWh (U.S. Energy Information Administration [USEIA] 2022).

As of April 2022, commercial electricity rates in Washington State average 9.38 cents per kWh. This average electricity rate is 21.3 percent less than the national average commercial rate of 11.92 cents per kWh (USEIA 2022).

As of April 2019, industrial electricity rates in Washington State average 6.02 cents per kWh. This average electricity rate is 23.1 percent less than the national average industrial rate of 7.83 cents per kWh (USEIA 2022).

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 4.2.10-14 and 4.2.10-15.

Table 4.2.10-14. City Light electricity prices for residential customers for 2022.

2022	
Base Service Charge per day	$0.1974
First Block per kWh[1]	$0.1056
End Block per kWh	$0.1307

Source: City Light 2022.
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.

Electricity Consumption

As of March 2019, electricity consumption in Washington State was 37,282,901 megawatt hours (MWh) annually for residential customers, 29,799,505 MWh for commercial customers, and 24,858,604 MWh for industrial customers.

Table 4.2.10-15. City Light electricity prices for small, medium, and large general service customers for 2020 and 2022.

	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	
	2020	**2022**	**2020**	**2022**	**2020**	**2022**	**2020**	**2022**	**2020**	**2022**	**2020**	**2022**	**2020**	**2022**	**2020**	**2022**
Per kWh	$0.1057	$0.1075	$0.1057	$0.1075	$0.1057	$0.1075	$0.0811	$0.0815	$0.0992	$0.1006	$0.0811	$0.0815	--	--	--	--
Minimum Bill per Meter per Day	$0.40	$0.42	$0.40	$0.42	$0.40	$0.42	$1.26	$1.33	$1.26	$1.33	$1.26	$1.33	$29.85	$31.47	$29.85	$31.47
Per kWh Peak	--		--		--		--		--		--		$0.0919	$0.0930	$0.1050	$0.1067
Per kWh Off-Peak	--		--		--		--		--		--		$0.0612	$0.0606	$0.0699	$0.0698

Source: City Light 2022.

4.2.10.2 Environmental Analysis

This section analyzes the potential effects of City Light's Project O&M on socioeconomic resources. This section is organized to address requests in FERC's Scoping Document 2 (SD2).

Effects of any proposed modifications to project facilities, operations, and maintenance (including fish and wildlife mitigations lands) on the local economy, infrastructure, and government services including employment, housing, transportation, and tourism.

Effects of any potential changes to project facilities and operation regarding environmental justice considerations including any disproportionate effects on tribal communities (FERC SD2).

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 right-of-way, 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 2022). City Light and the Skagit River Project provide a valuable renewable energy resource in the region.

The Project provides approximately 92 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's unique location within the RLNRA supports a variety of recreational attractions and opportunities. Due to its location in the 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 provides capital funding for NPS to construct and upgrade a variety of recreational facilities in the RLNRA. Specifically, 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 to the area create demand for various support establishments, including hotels, restaurants, and recreation-based businesses, which contributes to local economies in northwest Washington.

City Light provides annual payments to Whatcom County per the 2009 Impact Payment Agreement as described above. 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.

Environmental justice considerations, including disproportionate effects on Indian Tribes and Canadian First Nations from any potential changes to project facilities and operation are discussed in Section 4.2.9 (Tribal Resources) and 4.2.11 (Environmental Justice) of this Exhibit E.

4.2.10.3 Proposed Resource Measures

City Light does not anticipate any adverse effects of the continued operation of the Project and is not proposing any protection, mitigation, and enhancement measures related to socioeconomic resources.

4.2.10.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to socioeconomic resources have been identified at this time.

4.2.11 Environmental Justice

This section presents information on the environmental justice (EJ), including race and ethnicity, income status, and English proficiency of people in the Project vicinity. The Project's three generating facilities are located in Whatcom County, and the primary transmission lines cross through Whatcom, Skagit, and Snohomish counties. Given that relatively limited information exists on EJ in the Project vicinity, this section relies on available U.S. Census Bureau data for the respective state, county, census tract, and block group.

The term *environmental justice* means "fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no population bears a disproportionate share of negative environmental consequences resulting from industrial, municipal, and commercial operations or from the execution of federal, state, and local laws; regulations; and policies. Meaningful involvement requires effective access to decision makers for all, and the ability in all communities to make informed decisions and take positive actions to produce environmental justice for themselves." (United States Department of Energy 2022)

Pursuant to Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, and Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, as amended, the Federal Energy Regulatory Commission (FERC or Commission) is required to complete an analysis of potential impacts from Project operations on the local community in the vicinity of the Project to understand the impacts to human health and the environment as they relate to EJ communities, or communities that stand to be disproportionately impacted by construction of a new facility or the continued operation of an existing facility, including socioeconomic and/or sociocultural impacts.

Additionally, FERC plays an integral role in regulating large parts of the United States energy industry, having far-reaching impacts to the nation, especially regarding the move toward cleaner energy (FERC 2022). Although FERC is not required to comply with Executive Order 13985, *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*, FERC has voluntarily elected to participate in the process, in an effort to ensure everyone can benefit from the clean energy transition (FERC 2022). Pursuant to Executive Order 13985, FERC has developed an Equity Action Plan and recognizes that many of the licensed hydropower projects were constructed prior to implementation of the National Environmental Policy Act (NEPA), or the issuance of executive orders related to equity or EJ (FERC 2022). The information compiled in this section is meant to support FERC's consideration of EJ communities as they relate to the relicensing process.

4.2.11.1 Affected Environment

The Skagit River Project is in the upper Skagit River Watershed, within the North Cascades National Park Complex and portions of Whatcom, Skagit, and Snohomish counties, Washington. Within a 1-mile buffer of the Project Boundary each state, county, and census block were analyzed for racial and ethnic statistics (Table B03002) and poverty statistics (Table B17017) using the 2020 U.S. Census Bureau, 2016-2020, American Community Survey 5-year Estimate (Table 4.2.11-1).

The presence of EJ communities within the geographic scope of the Project was evaluated through the methods included in the Environmental Protection Agency's (EPA) Promising Practices for EJ Methodologies in NEPA Reviews (2016). Within one-mile of the Project there are 100 block groups, either partially or fully within the Project's area of analysis, that could potentially be impacted by the relicensing and continued operation of the Project. The assessment identified eight EJ communities as minority populations using the fifty percent analysis, thirteen as minority populations using the meaningfully greater analysis, and thirty-one as low-income populations using the low-income threshold analysis. Four block groups, included in the analysis results above, were identified as an EJ community based on the fifty percent or meaningfully greater analysis, as well as low-income threshold analysis. The 100 block groups are detailed in Table 4.2.11-1 with their EJ classification by analysis method. The block groups that were identified as EJ communities and their location in relation to the Project Boundary are shown on maps provided in Appendix F of this Exhibit E.

Sensitive receptor locations are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Sensitive receptor locations (e.g., daycare facilities, schools, elderly housing, hospitals, etc.) within the geographic scope of analysis are also labeled on maps provided in Appendix F of this Exhibit E. The distances of the sensitive receptor location from the Project's transmission line are provided in Table 4.2.11-2. No sensitive receptor locations were identified in close proximity to Project facilities such as powerhouses, dams, substations, or reservoirs.

EJ Communities Classification

Fifty Percent Analysis

The term *minority* means "individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic" (Council on Environmental Quality [CEQ] 1997). A population is identified as minority in a potentially affected area by either a fifty percent analysis or meaningfully greater analysis. The fifty percent analysis highlights populations with a cumulative minority population that exceeds fifty percent in the affected area (CEQ 1997). The following block groups were identified as EJ communities in the area of analysis using the fifty percent analysis method (Table 4.2.11-1, illuminated in red). These communities and their location in relation to the Project are shown on the maps included in Appendix F of this Exhibit E.

Census Tract 416.09, Block Group 3 in Snohomish County, Washington;
Census Tract 520.06, Block Group 1 in Snohomish County, Washington;
Census Tract 520.08, Block Group 3 in Snohomish County, Washington;
Census Tract 520.09, Block Group 3 in Snohomish County, Washington;
Census Tract 520.10, Block Group 1 in Snohomish County, Washington;

Census Tract 520.10, Block Group 2 in Snohomish County, Washington;
Census Tract 525.05, Block Group 4 in Snohomish County, Washington; and
Census Tract 527.10, Block Group 3 in Snohomish County, Washington.

Meaningfully Greater Analysis

The meaningfully greater analysis highlights populations with a cumulative minority population percentage that is meaningfully greater than the minority population percentage in the general population. (CEQ 1997). The following block groups were identified as EJ communities in the area of analysis using the meaningfully greater analysis method of ten percent higher minority population than their respective county (Table 4.2.11-1, illuminated in pink). These communities and their location in relation to the Project are shown on the maps included in Appendix F of this Exhibit E.

Census Tract 9511.02, Block Group 2 in Skagit County, Washington;
Census Tract 416.10, Block Group 3 in Snohomish County, Washington;
Census Tract 520.05, Block Group 2 in Snohomish County, Washington;
Census Tract 520.05, Block Group 4 in Snohomish County, Washington;
Census Tract 520.07, Block Group 2 in Snohomish County, Washington;
Census Tract 520.08, Block Group 1 in Snohomish County, Washington;
Census Tract 520.08, Block Group 2 in Snohomish County, Washington;
Census Tract 520.09, Block Group 1 in Snohomish County, Washington;
Census Tract 520.09, Block Group 2 in Snohomish County, Washington;
Census Tract 520.10, Block Group 3 in Snohomish County, Washington;
Census Tract 521.14, Block Group 2 in Snohomish County, Washington;
Census Tract 521.21, Block Group 2 in Snohomish County, Washington; and
Census Tract 527.11, Block Group 1 in Snohomish County, Washington.

Low-Income Threshold Analysis

The low-income threshold analysis highlights populations within the affected area with an income below poverty level percentage, which is equal or greater than the respective county. The following block groups were identified as EJ communities in the area of analysis area using the low-income threshold analysis method (Table 4.2.11-1, illuminated in aqua). Communities denoted with an asterisk are also identified as an EJ community with the fifty percent and/or meaningfully greater analysis method (Table 4.2.11-1, illuminated in purple). These communities and their location in relation to the Project are shown on the maps included in Appendix F of this Exhibit E.

Census Tract 9510, Block Group 1 in Skagit County, Washington;
Census Tract 9510, Block Group 2 in Skagit County, Washington;
Census Tract 9511.01, Block Group 1 in Skagit County, Washington;
Census Tract 9511.01, Block Group 2 in Skagit County, Washington;
*Census Tract 9511.02, Block Group 2 in Skagit County, Washington;
Census Tract 9511.02, Block Group 3 in Skagit County, Washington;
Census Tract 520.04, Block Group 3 in Snohomish County, Washington;
Census Tract 520.07, Block Group 3 in Snohomish County, Washington;
*Census Tract 520.08, Block Group 2 in Snohomish County, Washington;
*Census Tract 520.10, Block Group 1 in Snohomish County, Washington;
Census Tract 521.05, Block Group 1 in Snohomish County, Washington;

Census Tract 521.22, Block Group 1 in Snohomish County, Washington;
Census Tract 525.05, Block Group 3 in Snohomish County, Washington;
*Census Tract 525.05, Block Group 4 in Snohomish County, Washington;
Census Tract 526.03, Block Group 1 in Snohomish County, Washington;
Census Tract 526.04, Block Group 2 in Snohomish County, Washington;
Census Tract 526.04, Block Group 3 in Snohomish County, Washington;
Census Tract 527.06, Block Group 3 in Snohomish County, Washington;
Census Tract 527.06, Block Group 4 in Snohomish County, Washington;
Census Tract 527.08, Block Group 1 in Snohomish County, Washington;
Census Tract 527.09, Block Group 1 in Snohomish County, Washington;
Census Tract 527.10, Block Group 1 in Snohomish County, Washington;
Census Tract 527.11, Block Group 2 in Snohomish County, Washington;
Census Tract 527.11, Block Group 3 in Snohomish County, Washington;
Census Tract 535.05, Block Group 1 in Snohomish County, Washington;
Census Tract 535.05, Block Group 2 in Snohomish County, Washington;
Census Tract 535.05, Block Group 3 in Snohomish County, Washington;
Census Tract 535.06, Block Group 3 in Snohomish County, Washington;
Census Tract 537, Block Group 1 in Snohomish County, Washington;
Census Tract 537, Block Group 2 in Snohomish County, Washington; and
Census Tract 101.03, Block Group 2 in Whatcom County, Washington.

Non-English Speakers

There are minimal non-English-speaking groups within the geographic scope of analysis that may potentially be affected by the continued operation of the Project. The census tracts listed below have been identified as having non-English speaking communities, regardless of whether the census tract has been identified as an EJ community.

The presence of non-English communities within the geographic scope of the Project was evaluated through the methods included in EPA's 2016 Technical Guidance using a one-mile buffer of the Project Boundary. Within a 1-mile buffer of the Project Boundary each state, county, and census tract were analyzed for non-English statistics (Table S1601) using the 2020 U.S. Census Bureau, 2016-2020, American Community Survey 5-year Estimate (Table 4.2.11-1). The Project Boundary buffer has 41 census tracts, either partially or fully within the Project's boundary of analysis, that could potentially be impacted by relicensing. The assessment identified six non-English communities using the meaningfully greater analysis.

The following tracts were identified as non-English speaking communities in the area of analysis using the meaningfully greater analysis method (Table 4.2.11-1, illuminated in green).

Census Tract 416.09 in Snohomish County, Washington with 1 percent Spanish and 20 percent Asian/ Pacific Island;
Census Tract 520.06 in Snohomish County, Washington with 0.7 percent Spanish, 1.8 percent Indo-European, 8.8 percent Asian/ Pacific Island, and 0.2 percent other;
Census Tract 520.07 in Snohomish County, Washington with 0.9 percent Spanish, 4.3 percent Indo-European, 7.2 percent Asian/ Pacific Island, and 0.5 percent other;
Census Tract 520.10 in Snohomish County, Washington with 1.6 percent Spanish, 4.6 percent Indo-European, and 16.3 percent Asian/ Pacific Island;

Census Tract 521.19 in Snohomish County, Washington with 1.1 percent Indo-European, 2.4 percent Asian/ Pacific Island, and 5.7 percent other; and

Census Tract 527.10 in Snohomish County, Washington with 3.9 percent Spanish, 6.8 percent Indo-European, and 0.5 percent Asian/ Pacific Island.

Table 4.2.11-1. American Community Survey information for Census Tracts within 1-mile of the Project Boundary.[1]

Race and Ethnicity Data											Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	**Total Population (count)**	**White Alone Not Hispanic (count)**	**African American (count)**	**Native American/ Alaska Native (count)**	**Asian (count)**	**Native Hawaiian & Other Pacific Islander (count)**	**Some Other Race (count)**	**Two or More Races (count)**	**Hispanic or Latino (count)**	**Total Minority (%)**	**Below Poverty Level (%)**	**Spanish (%)**	**Indo-European (%)**	**Asian/ Pacific Island (%)**	**Other (%)**	**Total non-English (%)**
Washington	**7,512,465**	**5,067,909**	**279,720**	**75,677**	**656,578**	**49,219**	**23,363**	**388,477**	**971,522**	**33**	**10**	**3.3**	**1.1**	**2.7**	**0.5**	**7.6**
Skagit County	**127,442**	**93,874**	**809**	**2,042**	**2,252**	**186**	**351**	**4,198**	**23,730**	**26**	**9**	**5.5**	**0.4**	**0.3**	**0.2**	**5.9**
Census Tract 9510, Block Group 1	1,685	1,368	1	88	13	1	0	97	117	19	9	2.7	0.0	0.0	0.2	2.9
Census Tract 9510, Block Group 2	1,092	863	3	9	6	0	0	39	172	21	9					
Census Tract 9511.01, Block Group 1	594	452	0	0	0	0	0	0	142	24	20	0.0	0.0	0.0	0.0	0.0
Census Tract 9511.01, Block Group 2	724	611	0	0	7	0	0	20	86	16	13					
Census Tract 9511.02, Block Group 2	710	449	0	168	0	0	0	9	84	37	33	0.0	0.0	0.2	0.0	0.2
Census Tract 9511.02, Block Group 3	1,903	1,700	0	0	14	0	170	12	7	11	11					
Census Tract 9512, Block Group 2	1,172	1,061	0	0	0	0	6	17	88	9	4	0.4	0.0	0.0	0.0	0.4
Snohomish County	**811,572**	**552,513**	**25,918**	**6,582**	**91,482**	**3,811**	**3,510**	**42,435**	**85,321**	**32**	**7**	**2.5**	**1.6**	**3.4**	**0.7**	**8.2**
Census Tract 416.07, Block Group 3	1,429	1,071	0	0	121	14	0	176	47	25	0	0.3	1.4	3.7	0.0	5.5
Census Tract 416.09, Block Group 2	1,069	825	0	0	109	25	0	0	110	23	0	1.0	0.0	20.0	0.0	21.0
Census Tract 416.09, Block Group 3	1,781	611	0	0	876	0	0	90	204	66	0					

Race and Ethnicity Data											Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	**Total Population (count)**	**White Alone Not Hispanic (count)**	**African American (count)**	**Native American/ Alaska Native (count)**	**Asian (count)**	**Native Hawaiian & Other Pacific Islander (count)**	**Some Other Race (count)**	**Two or More Races (count)**	**Hispanic or Latino (count)**	**Total Minority (%)**	**Below Poverty Level (%)**	**Spanish (%)**	**Indo-European (%)**	**Asian/ Pacific Island (%)**	**Other (%)**	**Total non-English (%)**
Census Tract 416.10, Block Group 1	1,272	1,151	0	25	0	38	0	58	0	10	0					
Census Tract 416.10, Block Group 2	1,290	905	48	0	161	0	18	33	125	30	0	0.0	1.0	0.3	0.0	1.2
Census Tract 416.10, Block Group 3	1,555	968	0	0	184	0	69	329	5	38	0					
Census Tract 520.04, Block Group 1	1,491	871	279	0	325	0	0	0	16	42	0	1.5	1.6	2.3	0.0	5.4
Census Tract 520.04, Block Group 3	1,189	691	0	14	98	0	0	345	41	42	10					
Census Tract 520.05, Block Group 1	1,247	1,151	0	0	89	0	0	7	0	8	0					
Census Tract 520.05, Block Group 2	973	632	33	0	148	0	0	160	0	35	0	0.0	0.0	1.8	2.0	3.8
Census Tract 520.05, Block Group 4	2,149	1,352	0	0	594	0	0	78	125	37	0					
Census Tract 520.06, Block Group 1	1,399	602	16	0	653	0	0	26	102	57	0					
Census Tract 520.06, Block Group 2	1,213	795	34	0	230	0	1	35	118	34	3	0.7	1.8	8.8	0.2	11.6
Census Tract 520.06, Block Group 3	1,530	1,108	111	0	117	0	0	17	177	28	2					
Census Tract 520.07, Block Group 2	1,778	945	35	0	674	0	0	0	124	47	0	0.9	4.3	7.2	0.5	12.8
Census Tract 520.07, Block Group 3	1,097	877	0	0	123	0	0	63	34	20	7					

<table>
<tr><th colspan="11">Race and Ethnicity Data</th><th>Low-Income Data</th><th colspan="5">Primary Language – Speak English Less Than “Very Well”</th></tr>
<tr><th>Geography</th><th>Total Population (count)</th><th>White Alone Not Hispanic (count)</th><th>African American (count)</th><th>Native American/ Alaska Native (count)</th><th>Asian (count)</th><th>Native Hawaiian & Other Pacific Islander (count)</th><th>Some Other Race (count)</th><th>Two or More Races (count)</th><th>Hispanic or Latino (count)</th><th>Total Minority (%)</th><th>Below Poverty Level (%)</th><th>Spanish (%)</th><th>Indo-European (%)</th><th>Asian/ Pacific Island (%)</th><th>Other (%)</th><th>Total non-English (%)</th></tr>
<tr><td>Census Tract 520.08, Block Group 1</td><td>1,631</td><td>851</td><td>98</td><td>0</td><td>369</td><td>0</td><td>0</td><td>20</td><td>293</td><td>48</td><td>3</td><td rowspan="3">2.9</td><td rowspan="3">1.0</td><td rowspan="3">4.0</td><td rowspan="3">1.0</td><td rowspan="3">8.9</td></tr>
<tr><td>Census Tract 520.08, Block Group 2</td><td>1,252</td><td>681</td><td>13</td><td>0</td><td>376</td><td>0</td><td>0</td><td>0</td><td>182</td><td>46</td><td>9</td></tr>
<tr><td>Census Tract 520.08, Block Group 3</td><td>1,327</td><td>646</td><td>56</td><td>27</td><td>272</td><td>0</td><td>27</td><td>234</td><td>65</td><td>51</td><td>0</td></tr>
<tr><td>Census Tract 520.09, Block Group 1</td><td>1,219</td><td>661</td><td>13</td><td>0</td><td>462</td><td>0</td><td>0</td><td>33</td><td>50</td><td>46</td><td>4</td><td rowspan="3">0.0</td><td rowspan="3">5.9</td><td rowspan="3">2.4</td><td rowspan="3">0.3</td><td rowspan="3">8.7</td></tr>
<tr><td>Census Tract 520.09, Block Group 2</td><td>1,241</td><td>644</td><td>0</td><td>0</td><td>396</td><td>0</td><td>0</td><td>41</td><td>160</td><td>48</td><td>0</td></tr>
<tr><td>Census Tract 520.09, Block Group 3</td><td>1,455</td><td>279</td><td>0</td><td>39</td><td>833</td><td>0</td><td>0</td><td>73</td><td>231</td><td>81</td><td>3</td></tr>
<tr><td>Census Tract 520.10, Block Group 1</td><td>782</td><td>330</td><td>26</td><td>0</td><td>224</td><td>0</td><td>0</td><td>90</td><td>112</td><td>58</td><td>9</td><td rowspan="3">1.6</td><td rowspan="3">4.6</td><td rowspan="3">16.3</td><td rowspan="3">0.0</td><td rowspan="3">22.6</td></tr>
<tr><td>Census Tract 520.10, Block Group 2</td><td>1,816</td><td>774</td><td>0</td><td>81</td><td>731</td><td>0</td><td>0</td><td>126</td><td>104</td><td>57</td><td>6</td></tr>
<tr><td>Census Tract 520.10, Block Group 3</td><td>1,713</td><td>1,063</td><td>0</td><td>23</td><td>586</td><td>0</td><td>0</td><td>41</td><td>0</td><td>38</td><td>0</td></tr>
<tr><td>Census Tract 521.04, Block Group 2</td><td>980</td><td>759</td><td>26</td><td>1</td><td>7</td><td>0</td><td>0</td><td>44</td><td>143</td><td>23</td><td>3</td><td>0.0</td><td>0.0</td><td>6.2</td><td>0.6</td><td>6.8</td></tr>
<tr><td>Census Tract 521.05, Block Group 1</td><td>805</td><td>731</td><td>0</td><td>0</td><td>22</td><td>0</td><td>0</td><td>0</td><td>52</td><td>9</td><td>7</td><td>2.1</td><td>0.2</td><td>1.0</td><td>0.0</td><td>3.3</td></tr>
<tr><td>Census Tract 521.14, Block Group 1</td><td>767</td><td>657</td><td>0</td><td>1</td><td>52</td><td>0</td><td>0</td><td>56</td><td>1</td><td>14</td><td>3</td><td rowspan="2">0.0</td><td rowspan="2">1.7</td><td rowspan="2">4.1</td><td rowspan="2">0.2</td><td rowspan="2">6.0</td></tr>
<tr><td>Census Tract 521.14, Block Group 2</td><td>1,388</td><td>887</td><td>0</td><td>0</td><td>184</td><td>0</td><td>20</td><td>207</td><td>90</td><td>36</td><td>0</td></tr>
</table>

	Race and Ethnicity Data										Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	**Total Population (count)**	**White Alone Not Hispanic (count)**	**African American (count)**	**Native American/ Alaska Native (count)**	**Asian (count)**	**Native Hawaiian & Other Pacific Islander (count)**	**Some Other Race (count)**	**Two or More Races (count)**	**Hispanic or Latino (count)**	**Total Minority (%)**	**Below Poverty Level (%)**	**Spanish (%)**	**Indo-European (%)**	**Asian/ Pacific Island (%)**	**Other (%)**	**Total non-English (%)**
Census Tract 521.14, Block Group 3	961	706	19	0	78	0	21	83	54	27	3					
Census Tract 521.14, Block Group 4	1,545	1,368	0	0	123	0	0	42	12	11	0					
Census Tract 521.19, Block Group 1	1,354	1,019	0	36	121	0	0	148	30	25	0	0.0	1.1	2.4	5.7	9.3
Census Tract 521.19, Block Group 2	1,897	1,250	465	0	132	0	0	8	42	34	4					
Census Tract 521.20, Block Group 1	1,331	973	0	0	22	0	0	66	270	27	4	4.3	0.0	0.0	0.5	4.8
Census Tract 521.20, Block Group 2	1,268	1,029	0	0	47	0	0	74	118	19	0					
Census Tract 521.20, Block Group 3	1,070	917	0	0	107	0	0	46	0	14	0					
Census Tract 521.21, Block Group 1	1,526	1,196	0	0	93	0	0	23	214	22	0	0.0	2.8	1.8	0.0	4.7
Census Tract 521.21, Block Group 2	672	413	0	16	131	0	0	95	17	39	0					
Census Tract 521.21, Block Group 3	1,746	1,303	0	0	188	0	35	56	164	25	0					
Census Tract 521.22, Block Group 1	1,792	1,433	43	0	160	0	0	121	35	20	29	0.7	0.7	5.3	0.0	6.6
Census Tract 521.22, Block Group 2	1,268	916	18	0	162	0	15	28	129	28	3					
Census Tract 524.01, Block Group 3	1,541	1,427	0	0	13	0	0	101	0	7	5	0.5	0.8	0.6	0.0	1.8

Geography	Race and Ethnicity Data										Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
	Total Population (count)	White Alone Not Hispanic (count)	African American (count)	Native American/ Alaska Native (count)	Asian (count)	Native Hawaiian & Other Pacific Islander (count)	Some Other Race (count)	Two or More Races (count)	Hispanic or Latino (count)	Total Minority (%)	Below Poverty Level (%)	Spanish (%)	Indo-European (%)	Asian/ Pacific Island (%)	Other (%)	Total non-English (%)
Census Tract 525.02, Block Group 1	1,260	1,125	0	0	11	0	0	95	29	11	2	1.6	0.2	0.0	0.0	1.9
Census Tract 525.02, Block Group 2	1,279	1,120	0	0	31	0	0	40	88	12	2					
Census Tract 525.02, Block Group 3	1,076	836	76	0	9	0	0	124	31	22	6					
Census Tract 525.02, Block Group 4	1,463	1,233	0	0	11	90	0	92	37	16	0					
Census Tract 525.04, Block Group 1	1,495	1,160	0	6	70	0	0	25	234	22	5	5.2	1.0	0.6	0.0	6.8
Census Tract 525.04, Block Group 2	1,274	1,109	1	0	32	0	0	42	90	13	5					
Census Tract 525.05, Block Group 1	934	805	0	0	29	24	0	53	23	14	3	0.0	0.0	0.0	0.0	0.0
Census Tract 525.05, Block Group 2	1,296	894	0	0	32	0	0	300	70	31	0					
Census Tract 525.05, Block Group 3	1,157	884	78	0	27	0	0	59	109	24	14					
Census Tract 525.05, Block Group 4	1,207	590	0	97	193	0	104	0	223	51	11					
Census Tract 525.06, Block Group 1	1,114	989	0	0	41	18	0	66	0	11	0	0.9	0.5	2.7	0.3	4.5
Census Tract 525.06, Block Group 2	2,036	1,389	0	62	64	0	0	73	448	32	3					
Census Tract 525.06, Block Group 3	1,909	1,695	0	0	95	0	0	38	81	11	4					

Race and Ethnicity Data											Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	Total Population (count)	White Alone Not Hispanic (count)	African American (count)	Native American/ Alaska Native (count)	Asian (count)	Native Hawaiian & Other Pacific Islander (count)	Some Other Race (count)	Two or More Races (count)	Hispanic or Latino (count)	Total Minority (%)	Below Poverty Level (%)	Spanish (%)	Indo-European (%)	Asian/ Pacific Island (%)	Other (%)	Total non-English (%)
Census Tract 526.03, Block Group 1	1,131	1,012	6	9	9	0	0	23	72	11	7	2.3	0.6	0.4	0.0	3.4
Census Tract 526.03, Block Group 2	1,505	1,204	2	4	23	205	5	47	15	20	2					
Census Tract 526.04, Block Group 1	2,072	1,684	1	2	198	0	0	67	120	19	2	0.6	1.3	2.3	0.2	4.4
Census Tract 526.04, Block Group 2	1,302	877	12	0	96	0	0	51	266	33	14					
Census Tract 526.04, Block Group 3	1,581	1,247	0	10	114	0	0	9	201	21	11					
Census Tract 526.07, Block Group 2	1,121	933	6	12	22	0	0	47	101	17	0	1.7	2.2	0.6	0.0	4.5
Census Tract 526.07, Block Group 3	1,692	1,424	0	0	25	0	0	72	171	16	2					
Census Tract 527.01, Block Group 1	1,896	1,621	0	21	37	0	0	94	123	15	1	0.0	0.0	0.0	0.0	0.0
Census Tract 527.06, Block Group 1	1,475	1,124	141	0	67	11	0	80	52	24	0	1.2	0.5	1.4	0.0	3.1
Census Tract 527.06, Block Group 2	1,773	1,185	35	8	43	12	0	208	282	33	7					
Census Tract 527.06, Block Group 3	1,224	935	8	0	0	0	0	24	257	24	15					
Census Tract 527.06, Block Group 4	2,008	1,492	24	0	115	0	0	109	268	26	9					
Census Tract 527.07, Block Group 1	1,978	1,647	15	24	53	0	0	73	166	17	0	1.8	0.2	0.4	0.0	2.4

Race and Ethnicity Data											Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	**Total Population (count)**	**White Alone Not Hispanic (count)**	**African American (count)**	**Native American/ Alaska Native (count)**	**Asian (count)**	**Native Hawaiian & Other Pacific Islander (count)**	**Some Other Race (count)**	**Two or More Races (count)**	**Hispanic or Latino (count)**	**Total Minority (%)**	**Below Poverty Level (%)**	**Spanish (%)**	**Indo-European (%)**	**Asian/ Pacific Island (%)**	**Other (%)**	**Total non-English (%)**
Census Tract 527.07, Block Group 2	1,075	960	0	0	48	0	0	13	54	11	0					
Census Tract 527.07, Block Group 3	1,532	1,298	8	0	15	0	0	73	138	15	1					
Census Tract 527.08, Block Group 1	1,688	1,314	0	0	175	0	0	41	158	22	10	2.0	1.4	0.2	0.0	3.6
Census Tract 527.08, Block Group 2	1,200	901	0	0	54	0	0	182	63	25	3					
Census Tract 527.08, Block Group 3	1,107	903	18	19	0	0	0	31	136	18	2					
Census Tract 527.08, Block Group 4	1,837	1,459	0	14	34	0	0	222	108	21	0					
Census Tract 527.09, Block Group 1	1,422	1,184	22	37	0	0	0	17	162	17	7	2.4	1.2	1.7	0.0	5.4
Census Tract 527.09, Block Group 2	2,036	1,664	0	0	92	0	0	161	119	18	4					
Census Tract 527.10, Block Group 1	1,076	836	11	0	127	0	18	84	0	22	9	3.9	6.8	0.5	0.0	11.2
Census Tract 527.10, Block Group 2	1,626	1,376	0	0	13	0	0	228	9	15	0					
Census Tract 527.10, Block Group 3	2,004	909	0	0	673	0	0	0	422	55	0					
Census Tract 527.11, Block Group 1	2,156	1,193	219	0	368	0	0	80	296	45	5	0.2	0.0	0.9	0.0	1.1
Census Tract 527.11, Block Group 2	938	816	0	0	12	0	0	14	96	13	16					

Race and Ethnicity Data											Low-Income Data	Primary Language – Speak English Less Than "Very Well"				
Geography	**Total Population (count)**	**White Alone Not Hispanic (count)**	**African American (count)**	**Native American/ Alaska Native (count)**	**Asian (count)**	**Native Hawaiian & Other Pacific Islander (count)**	**Some Other Race (count)**	**Two or More Races (count)**	**Hispanic or Latino (count)**	**Total Minority (%)**	**Below Poverty Level (%)**	**Spanish (%)**	**Indo-European (%)**	**Asian/ Pacific Island (%)**	**Other (%)**	**Total non-English (%)**
Census Tract 527.11, Block Group 3	1,386	1,218	0	41	95	0	0	11	21	12	7					
Census Tract 535.05, Block Group 1	812	737	0	26	10	0	0	30	9	9	9					
Census Tract 535.05, Block Group 2	1,210	1,162	0	0	3	0	8	37	0	4	8	1.2	0.0	0.0	0.0	1.2
Census Tract 535.05, Block Group 3	1,341	1,050	0	18	9	0	0	102	162	22	7					
Census Tract 535.06, Block Group 1	1,668	1,495	0	0	65	0	0	108	0	10	0					
Census Tract 535.06, Block Group 2	1,586	1,365	0	0	0	0	0	52	169	14	4	0.0	0.0	0.6	0.0	0.6
Census Tract 535.06, Block Group 3	942	862	23	0	15	0	0	42	0	8	14					
Census Tract 535.11, Block Group 2	1,329	892	133	0	101	0	0	32	171	33	0	3.3	0.2	0.0	0.0	3.4
Census Tract 537, Block Group 1	1,654	1,454	7	15	0	0	22	78	78	12	11	0.2	0.5	0.0	0.0	0.7
Census Tract 537, Block Group 2	1,451	1,331	0	72	7	0	0	13	28	8	20					
Whatcom County	**224,538**	**175,337**	**2,123**	**5,185**	**9,003**	**518**	**484**	**10,154**	**21,734**	**22**	**14**	**1.7**	**0.9**	**0.7**	**0.1**	**3.4**
Census Tract 101.03, Block Group 2	227	181	0	0	0	0	0	41	5	20	35	0.5	0.2	0.2	0.1	0.9

1 Calculations performed adhered to the methods included in EPA's Promising Practices for EJ Methodologies in NEPA Reviews (2016). Race and ethnic, and low-income percent analysis calculations have been rounded to the nearest whole number, and non- English percent analysis calculations have been rounded to the nearest tenth providing a more conservative and inclusive assessment of EJ communities in the area of analysis.

Color Indicators: Red shading denotes a minority population EJ community by 50 percent analysis. Pink shading denotes a minority population EJ community by meaningfully greater analysis. Aqua shading denotes a low-income population EJ community by low-income threshold analysis. Purple shading denotes a minority and low-income population EJ community. Green shading denotes a non-English speaking community by meaningfully greater analysis.

Table 4.2.11-2. Sensitive receptor locations within 1-mile of the Project Boundary.

County	Owner Name	Use Code	Distance from Project's Transmission Line (feet)
Skagit	Concrete School	(6E2SCHL) All County Exempt School	879.1
Skagit	Concrete Schools No. 11	(27EXMPTLND) All County Exempt Excess Land	2,013.5
Skagit	Concrete School	(6E2SCHL) All County Exempt School	2,335.7
Skagit	Darrington City School District	(27EXMPTLND) All County Exempt Excess Land	1,373.8
Skagit	Darrington City School District	(27EXMPTLND) All County Exempt Excess Land	1,850.1
Snohomish	OSO Community College	699 Other Miscellaneous Services NEC	3,309.3
Snohomish	Emergency Management System – Fire Protection Department #25	672 Protective Functions & Related Activities	4,352.8
Snohomish	Emergency Management System – Sauk Suiattle Indian Tribe	672 Protective Functions & Related Activities	3,494.8
Snohomish	Emergency Management System – Fire District 24	672 Protective Functions & Related Activities	989.9
Snohomish	Mansford Grange Community College	699 Other Miscellaneous Services NEC	5,222.0
Snohomish	Lake Stevens City School District	681 Nursery, Primary & Secondary School	528.7
Snohomish	Lake Stevens City School District	681 Nursery, Primary & Secondary School	3,379.9
Snohomish	Parkview Group Home	188 SFR Converted to Group Home	1,934.1
Snohomish	Sherwood Nursery – Community College	681 Nursery, Primary & Secondary School	205.4
Snohomish	LAKE STEVENS CSD	681 Nursery, Primary & Secondary School	1,457.7
Snohomish	SNOHOMISH CSD	421 Bus Transportation	416.9
Snohomish	SNOHOMISH CSD	421 Bus Transportation	0.1
Snohomish	Snohomish Elementary School	681 Nursery, Primary & Secondary School	1,680.7
Snohomish	Nursery School	681 Nursery, Primary & Secondary School	4,723.5
Snohomish	Playground	742 Playgrounds & Athletic Areas	3,760.5
Snohomish	Medical Center	651 Medical & Other Health Services	1,774.7
Snohomish	Nursery School	681 Nursery, Primary & Secondary School	5,127.6
Snohomish	Snohomish City School District	681 Nursery, Primary & Secondary School	1,929.8
Snohomish	Everett City School District	681 Nursery, Primary & Secondary School	4,558.0
Snohomish	AC – YMCA	742 Playgrounds & Athletic Areas	1,362.9
Snohomish	Snohomish City School District	681 Nursery, Primary & Secondary School	4,358.3

County	Owner Name	Use Code	Distance from Project's Transmission Line (feet)
Snohomish	Silver Firs Elementary School	681 Nursery, Primary & Secondary School	2,789.7
Snohomish	Snohomish City School District	681 Nursery, Primary & Secondary School	6,216.0
Snohomish	Everett City School District	111 Single Family Residence - Detached	1,861.2
Snohomish	Everett City School District	681 Nursery, Primary & Secondary School	4,487.6
Snohomish	Everett City School District	681 Nursery, Primary & Secondary School	3,136.2
Snohomish	NNA School District	681 Nursery, Primary & Secondary School	1,649.5
Snohomish	Everett City School District	683 Special Training & Schooling	4,056.2
Snohomish	Medical Center	651 Medical & Other Health Services	3,750.0
Snohomish	Marysville City School District	910 Undeveloped (Vacant) Land	3,091.6
Snohomish	Stillaguamish Tribe Facility		2,060.3

4.2.11.2 Environmental Analysis

The Project includes 100 block groups, either partially or fully within the Project's one-mile area of analysis. The assessment identified forty-eight percent of the block groups as potentially impacted by the relicensing and continued operation of the Project under one or more analysis method. EJ communities identified by minority populations includes twenty-one block groups and thirty-one by low-income, of which four block groups overlap.

The Project relicensing was initiated with the filing of the Pre-Application Document and associated Notice of Intent on April 27, 2020. FERC issued Scoping Document 1 on June 26, 2020. Due to COVID-19, FERC waived 18 CFR § 5.8(b)(viii) and notified the public that it does not intend to conduct a public scoping meeting or site visit to the Skagit River Project. Instead, FERC solicited written comments, recommendations, and information, on the SD1. If needed, a site visit may be held later in the relicensing process. Proposed and Revised Study Plans were developed and filed with FERC on December 8, 2020, and April 7, 2021, respectively. City Light will notify resource agencies, Indian Tribes and Canadian First Nations, local governments, non-governmental organizations, and members of the public on the Project's distribution list of the availability of this Draft License Application (DLA). All relicensing documents noted above are public documents and are posted to FERC's eLibrary. Throughout the relicensing process, City Light has conducted extensive outreach and collaboration with licensing participants (LPs). City Light is currently assessing the need to conduct additional outreach to EJ communities that may not have participated to date in the relicensing process.

Following this outreach and review of potential impacts on identified communications, additional information and analysis related to EJ will be included in the Final License Application (FLA).

4.2.11.3 Proposed Resource Measures

Currently City Light is proposing to continue operating the Project with the resource measures identified in Section 3.3.3 and others under development with LPs for inclusion in the FLA. City Light is currently assessing potential impacts to EJ communities in the vicinity of the Project from its continued operation. Potential impacts and protection, mitigation, and enhancement measures related to EJ communities will be discussed in the FLA.

4.2.11.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts to environmental justice communities have been identified at this time.

5.0 CUMULATIVE EFFECTS OF THE PROPOSED ACTION

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (50 Code of Federal Regulations 1508.7), a cumulative effect is the effect on the environment that results from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities (FERC 2020b). Based on preliminary staff analysis, FERC identified in its Scoping Document 1[99] fisheries resources as resources that could be cumulatively affected by the proposed continued operation and maintenance of the Skagit River Project in combination with other hydroelectric projects and activities in the Skagit River Basin.

5.1 Geographic Scope

FERC's geographic scopes for the cumulative effects analyses associated with the Project are defined by the physical limits or boundaries of the Proposed Action's effect on given resources and contributing effects from other hydropower and non-hydropower activities in the Skagit River basin. Because the Proposed Action will affect each resource differently, the geographic scope varies among resource areas.

For fisheries resources, FERC has tentatively identified the geographic scope to include the entire Skagit River from its headwaters to where it empties into Puget Sound, choosing this geographic scope because the operation and maintenance of the Skagit River Project, in combination with other activities such as road and railroad construction and maintenance, timber harvest, agriculture, fish hatchery production, commercial and recreational fisheries, non-native fish species, floodplain development, and mining in the upper portion of the watershed above Ross Lake may affect the fisheries resources of Skagit River.

5.2 Temporal Scope

The temporal scope of City Light's cumulative effects analysis includes a brief discussion of past, present, and reasonably foreseeable future actions, to the extent feasible. Based on the potential term of a new license, the temporal scope would extend 30 to 50 years into the future, with a focus on the effects of reasonably foreseeable future actions. The effects of historical activities are generally evaluated in the discussion of the affected environment and are, by necessity, limited to the amount of information available for each resource.

5.3 Actions in and Outside of the Skagit River Basin

5.3.1 Summary of the Chronology of In-Basin and Out-of-Basin Actions

The continued operation of the Project, along with a variety of other actions, would contribute to cumulative effects on water and fish and aquatic resources in the Skagit River Basin. These activities include: (1) diking and hydromodification; (2) floodplain development; (3) U.S. Army Corps of Engineers' (USACE) flood risk management operations within the Skagit River basin;

[99] City Light prepared its cumulative effects analysis pursuant to CEQ's current regulations at 40 CFR § 1508.7.

(4) timber harvest and associated road construction; (5) agriculture and livestock grazing; (6) municipal water uses and discharges; (7) fish passage barriers; (8) mining; (9) hatchery practices; (10) commercial; recreational, and Tribal salmonid harvest; (11) ocean conditions; (12) climate change; and (13) habitat protection and restoration actions.

Skagit County was established in 1883 and was developed slowly relative to other areas in the region (Smith 2003). Settlement was slowed by two large logjams near what is now Mount Vernon that prevented upstream navigation. The jams were removed in the 1870s, after which upstream settlement accelerated. Between 1898-1908, thousands of additional snags were removed from the river.

Commercial fishing, and operation of its associated canneries, began in the late 1890s (Smith 2003). Around the same time, the intensity of other types of development, such as dikes, draining of wetlands, land clearing, and timber harvest, increased. Agriculture became important in the lowlands with oats, barley, hay, and other crops grown on floodplain soils. The first dikes along the lower Skagit River are thought to have been constructed in 1863 (Breslow 2011, as cited in Lee and Hamlet 2011), and the dominant flow in the Skagit River estuary was shifted from the South Fork to the North Fork around 1937.

The first steam locomotive was used in Skagit County in 1889, and by 1901 the larger towns in Skagit County were connected to Seattle by rail lines (Smith 2003). Around the same time, the upper valley rail line was established to Baker and Rockport. Railroad and road construction proliferated in the early 1900s, which resulted in increased mining, timber harvest, and milling in the basin. Logging in the Sauk River basin started in the 1930s, and in the 1940s cable logging and hauling timber via trucks began. Logging on steeper slopes began in the 1970s.

The Baker River Hydroelectric Project, located on the Baker River, consists of the Lower and Upper Baker developments. There are two powerhouses for the Lower Baker Project, one constructed in 1925 and the second in 2013. The upper Baker development was completed in 1959. The Skagit River Hydroelectric Project was developed over a 42-year period, beginning with construction of Gorge Powerhouse and a timber-crib dam in 1919, and ending with the completion of the Gorge Development in 1961. In the 1950s, the Shell and Texaco oil refineries were constructed near Anacortes, followed by the construction of many marinas and development of boat-related industries (Smith 2003).

5.3.2 Skagit River Hydroelectric Project

See Section 3 for a description of (1) Project location; (2) existing Project facilities; (3) Project safety; (4) Project operations; (5) Project capacity, production, and outflow records; (6) existing resource measures; and (7) City Light's Proposed Action for the new license term.

5.3.3 Non-Skagit River Project In- and Out-of-Basin Actions

The following sections account for the effects of human actions generally, and in some cases identify specific actions and effects by location, depending on available information. A primary purpose of these sections is to broadly characterize the range of activities that have affected, both positively and negatively, the Skagit River basin and surrounding area over and above Project actions, which are described in Section 4 of this Exhibit E. Each of the following sections are organized generally from downstream to upstream within the Skagit River basin, followed by a general characterization of broader, out-of-basin actions.

5.3.3.1 Estuary and Delta Habitat

The Skagit River delta, with its numerous distributary channels, consists of a tidal estuarine mixing zone and riverine tidal areas. The tidal estuarine zone includes the channeled emergent and scrub-shrub marshes where freshwater and saltwater mix, forested riverine tidal zone where transitional salinities and forested marshes provide productive habitats, and the riverine tidal zone, where freshwater is tidally pushed but not mixed with marine water. Within these areas, a diversity of habitat is formed and maintained by tidal and riverine processes, creating a mosaic of channels and wetlands. Historically, the delta was an important salmon rearing region, with sloughs, highly productive low-velocity rearing and refuge habitats, and a large degree of connectivity among habitats.

The nearshore and marine environments of Puget Sound have been significantly altered relative to their condition prior to settlement by people of European descent. The loss of habitat functions resulting from these impacts is one factor contributing to the decline of the region's salmon and Bull Trout (*Salvelinus confluentus*) populations (anadromous Bull Trout are affected by both habitat alteration and reductions in juvenile salmon, upon which they prey). Human activities have modified, and continue to alter, nearshore ecosystems by constraining, redirecting, disrupting, or eliminating processes that control the delivery and distribution of sediment, water, energy, organic matter, and nutrients in nearshore environments (Redman et al. 2005). Major stressors include: (1) loss and simplification of deltas and delta wetlands; (2) flow alteration in major rivers; (3) shoreline modification from bank armoring, overwater structures, and impacts to riparian vegetation; (4) nearshore and marine contamination; (5) alteration of biotic communities; (6) impacts from urbanization; and (7) changes to habitat due to colonization by invasive species (Redman et al. 2005). Flow patterns in the delta have been altered by tidegates (Redman et al. 2005). These one-way check valves allow water to flow from a drainage into a marine watercourse during low tide but prevent saltwater from entering the drainage when the tide rises, which can adversely affect fish access to once important rearing areas. Road density in the lower Skagit River floodplain is excessive as the result of development (Smith 2003). Aquaculture facilities can have ecological effects due to "operational leakage" from damaged holding pens (Redman et al. 2005), and overwater structures can reduce the extent of eelgrass beds, with significant losses in areas with large numbers of docks (Fresh et al. 1995, as cited in Redman et al. 2005).

The loss and degradation of estuarine habitat is one of the most prominent impacts on salmonids in the Skagit River basin (Smith 2003). The Chinook Recovery Plan (Beamer et al. 2005a) identifies rearing habitat losses in the Skagit River delta as the primary habitat factor limiting recovery of Skagit River Chinook Salmon (*Oncorhynchus tshawytscha*) populations. According to the Skagit Watershed Council (SWC; 2022), only 27 percent of Skagit River tidal delta habitats, 2 percent of Skagit River non-tidal delta habitats, 14 percent of pocket estuaries in the Whidbey basin, and 63 percent of side channel habitats in the Skagit River basin remain intact relative to historic conditions. Moreover, restoration of salmonid habitats is often constrained by competing land and water uses, especially downstream of Sedro-Woolley. Beamer et al. (2005b) estimated that the 1991 estuarine footprint was 3,397 hectares (ha) (8,394 acres [ac]), representing a significant reduction from the estimated 13,373 ha (33,045 ac) that existed historically.[100] The estimated 1991 footprint for the portion of the delta extending from southern Padilla Bay to Camano Island (i.e., the portion of the geomorphic delta that was historically contiguous and directly connected to the Skagit River) was 3,118 ha (7,705 ac), which when compared to the estimated historic area of 11,483 ha (28,375 ac) represents about a 73 percent loss (Beamer et al. 2005b).

Aerial photographs taken between 1937 and the present show that Skagit River delta tidal marshes have been prograding into Skagit Bay for most of the period of record, but progradation rates have been steadily declining (Hood et al. 2016). As a result, marshes have eroded in recent decades despite suspended sediment loads supplied by the Skagit River. Where the delta is isolated from the riverine sediment supply of historical distributaries, marsh cliffs as tall as 0.5 meter (m; 1.6 feet [ft]), along with concave marsh profiles, indicate that wave erosion is contributing to marsh retreat.

Hood et al. (2016) state that obstructions and levee construction along the remaining distributaries likely increase the jet momentum of river discharge, forcing much suspended sediment to bypass tidal marshes and be exported from Skagit Bay; sediment loads reaching Skagit Bay increased 3 percent from the 1940s to the early 1990s and then abruptly decreased by 11 percent from their maxima. Sediment delivery trends have been correlated with timber harvest and landslide rates, which increased from the 1960s through the early 1980s and then declined from the 1990s to the present, with landslides lagging behind timber harvest (landslides are often linked to roads constructed to enable timber harvest).

In addition to total habitat loss, habitat fragmentation also adversely affects juvenile salmon abundance in the delta by disrupting fish movement among habitats. The Swinomish Channel area once connected Skagit Bay with Padilla Bay through a wide estuarine wetland and slough corridor. The area has been converted into a dredged navigation channel with only 14 small patches of marsh along its length Beamer et al. (2005b). Southern Padilla Bay has lost most of its emergent wetlands because of diking and curtailment of river sediment, and the emergent wetland area along the bayfront of Fir Island has narrowed, and its distributaries have been separated from the main river channel.

Beamer et al. (2005b) note that despite the roughly 75 percent loss of estuary area, the loss of open channel distributary area is only about 30 percent relative to historical levels, resulting in approximately a 20 percent loss of distributary edge habitat. The authors note that both the North Fork and Swinomish Channel have widened, and the North Fork delta has prograded (Collins 1998 as cited in Beamer et al. 2005b), which has resulted in an increase in the size and number of overall distributaries and, as a result, edge habitat area. However, the authors note that there has been a 95 percent loss in blind channel habitat due to impacts associated with isolated and obliterated tidal channels on the landward side of dikes (Hood 2004, as cited in Beamer et al. 2005b).

[100] These estimates apply to the entire geomorphic Skagit River delta, extending northward from Camano Island and including Samish Bay.

Pocket estuaries,[101] which serve as important rearing habitats for outmigrating salmon, are substantially smaller and more fragmented than they were historically. This fragmentation contributes to reduced habitat access for displaced fry migrant Chinook Salmon, whose abundance can exceed delta rearing capacities (Beamer et al. 2005b). Survival of surplus fry outmigrants that leave the delta is much lower than that of individuals that rear in the delta, and fry migrants that can access pocket estuary rearing habitat have similar survival to that of delta rearing fry migrants. Beamer et al. (2005b) assessed pocket estuaries within Whidbey Basin, into which Skagit River Chinook Salmon migrate after leaving the river delta. The authors found that over two thirds of all Whidbey Basin pocket estuaries are completely lost to juvenile salmon use, and the remaining one third have been reduced in size by approximately 50 percent. Pocket estuaries in close proximity to the Skagit River delta have been reduced from 340.7 ha (842 ac) historically to 47.5 ha (117 ac) under present-day conditions, approximately an 86 percent loss.

As noted above, overwater structures can reduce the extent of native eelgrass (*Zostera* spp.) beds, with significant losses occurring in areas with large numbers of docks (Fresh et al. 1995, as cited in Redman et al. 2005). In addition, colonization of Puget Sound habitats by invasive plant species, including *Spartina* spp. and *Sargassum muticum*, have altered native plant communities and sedimentation patterns. *Spartina* and *Sargassum*, both of which proliferate aggressively, out-compete native species and have transformed shorelines more than all other non-native plant species (Redman et al. 2005). Native eelgrass species and macroalgae have been supplanted by *Spartina*, resulting in negative effects on juvenile Chinook Salmon and Chum Salmon habitats (Thom et al. 1989; Aitken 1998; Grette et al. 2000; Weitkamp 2000; and Nightingale and Simenstad 2001, all as cited in Redman et al. 2000).

In recent years, however, there have been some gains in tidal delta habitat due to restoration projects. Beamer et al. (2005a) report that when implementation of the Chinook Recovery Plan began, the extent of tidal delta habitat associated with the Skagit River was approximately one third of what existed historically and approximately 80 percent of the desired future condition (DFC) (i.e., the DFC was 37 percent of the tidal delta's historic extent) identified by National Marine Fisheries Service (NMFS) (Beamer and Wolf 2017). Between 2004 and 2013, there had been a net increase of 83 ha (205 ac) of intertidal footprint, increasing the extent of tidal habitat to 30.3 percent of its historic condition and 81.9 percent of the DFC. The increase over the nine-year period resulted from tidal restoration outpacing both natural and human causes of habitat loss; a total of 122 ha (301 ac) was restored over the nine-year period, an average of 13.6 ha (34 ac) per year. If net gains continue at the same pace as that observed from 2004-2013, the Skagit River's DFC for tidal delta extent would be achieved in 2096, 91 years after initial implementation of the Chinook Recovery Plan (Beamer and Wolf 2017).

More recent work, i.e., SWC (2021), documents that pocket estuary counts have increased between 2005 and 2014 (from 24 to 25) due to 94 ha (232 ac) of restoration at Crescent Harbor. An additional 10.8-ha (27-ac) increase is attributed to two smaller projects at Lone Tree Lagoon and Turner's Bay. The authors note, however, that differences in mapping methods, image resolution, and surveyor bias likely affected the estimated differences over time. Evaluation of tidal channel

[101] Pocket estuaries are small-scale estuaries that form behind areas of coastal accretion, at embayments created by submerged valleys, or at creek deltas. Pocket estuaries have substrates, gradients, and vegetation characteristic of low energy environments and local freshwater inputs that depress salinity, typically in winter and spring.

function revealed that 4 of 25 mapped pocket estuaries had impaired tidal channels in 2015. Pocket estuaries benefit surplus fry migrants (Beamer and Larsen 2004; Beamer et al. 2015), but the amount of pocket estuary habitat and restoration potential were identified as insufficient to resolve the density-dependent patterns observed in the Skagit River estuary without additional restoration actions (Beamer and Larsen 2004).

Beamer et al. (2019) identify the following specific restoration projects, at various stages of completion, being conducted by the Swinomish Indian Tribal Community, Skagit River System Cooperative (SRSC), Washington Department of Fish and Wildlife (WDFW), Skagit County, The Nature Conservancy (TNC), and USACE.

- Fornsby Creek/Smokehouse Floodplain: The Swinomish Indian Tribal Community completed the Fornsby Creek Self-Regulating Tidegate Project,[102] a fish passage and habitat restoration project located along the Swinomish Channel. The project involved replacing three traditional tidegates with two self-regulating tidegates and a new traditional gate. One auxiliary screw gate was installed, and two bridges were constructed to replace culverts. The tidegate replacement restored tidal inflow to the channels, enabled fish passage, and increased the amount of available blind channel, distributary, and tributary habitat for salmonids. Allowing a wide range of tidal influence to interact with the remnant channels' freshwater flows on the floodplain will create freshwater-saltwater mixing zones, which constitute important rearing habitat for juvenile salmonids. Habitat restoration took place on 1.3 miles of the reopened channel habitat. In total, the project reopened more than 5 miles of channel to fish and improved over 50 acres of aquatic habitat.
- Milltown Island: As part of the Milltown Island Restoration,[103] several dikes were breached from 1999-2014. From 2006-2007, 1,100 ft of levee were removed, and 3,725 ft of channel were constructed. In 2011, 370 ft of levee were removed, and 1,200 ft of channel were constructed. In 2014, 65 ft of levee were removed. In addition to dike breaching and channel excavation, SRSC has been working to restore natural plant communities on the island.
- South Fork Levee Setback: The South Fork Skagit River Delta Restoration Project[104] increased tidal flow and channel length in areas restricted by levees. In 2004, 2,550 ft of levee were set back and replaced by 1,800 ft of new levee, which resulted in restoration of 22 ac of tidal backwater wetland and channel habitats. The improved habitat provided rearing and transitional habitat for several salmon species, including Chinook and Coho (*O. nerka*) salmon. A total of 37 ac of tidal wetland and 7,500 ft of tidal channels have been restored, which provide habitat for approximately 14,600 young Chinook Salmon. Conservation easements were also included in the restoration. Invasive plants were removed from 21 ac.
- Wiley Slough: The Wiley Slough Restoration[105] included activities implemented in 2008-2009, which were aimed at restoring tidal inundation and fish access to approximately 156 ac of estuarine wetlands by removing dikes around the project area's perimeter. This was accomplished through removal of 6,500 lineal ft (LF) of dike, construction of 2,840 LF of set-back dikes along the pre-1956 levee footprint, and augmenting an additional 2,200 LF of

102 SRP Project (wa.gov)
103 Milltown Island Restoration | Skagit River System Cooperative (skagitcoop.org)
104 South Fork Restoration Project (skagitcounty.net)
105 Wiley Slough Estuary Restoration | Skagit River System Cooperative (skagitcoop.org)

previously existing dikes around the site perimeter. An existing tidegate on Wiley Slough was removed, and a new larger tide gate was constructed at the new diked perimeter of the site. Lastly, 3,470 LF of borrow ditches were filled to promote sheet-flow and drainage to historic channels. In 2009-2010, following the completion of major construction activities, native vegetation was planted on 3.8 ac in zones adjacent to areas affected by tidal flows.

- Fir Island Farms: The Fir Island Farms project, completed on WDFW property in 2016, resulted in the restoration of 131 acres of habitat to tidal inundation along the bayfront of the island within the Skagit River delta. Fish use monitoring of the area was completed for two years prior to (2015-2016) and following (2017-2018) project completion. Following restoration, catches of juvenile salmon and estuarine fish species increased upstream of the removed tidegate, and catches of Three-Spined Stickleback (*Gasterosteus aculeatus*) declined.
- Deepwater Slough Phase 2: Several restoration alternatives are currently being assessed, including no restoration, partial restoration, and full restoration of the 268-ac Deepwater/Island Unit site. If a partial or full restoration alternative is selected, the project could be implemented as early as 2023 (Beamer et al. 2019).
- Fisher Slough: The Fisher Slough Project,[106] which will involve the relocation of a levee and replacement of floodgates and other aging infrastructure, will help restore tidal flow to support Chinook Salmon populations while increasing flood protection for local farmers.
- McGlinn Island Causeway: Beamer et al. (2019) state that the McGlinn Island Causeway Project, which at the time of their report was at the 30-percent design phase, could, if completed, provide some level of mitigation for the maintenance-dredging of the Swinomish Channel.

Additional restoration projects are described below.

- Cottonwood Island Slough: This channel restoration will provide sustainable water velocity, depth, and other ecological benefits to rearing Chinook Salmon over the long term.[107] The project design includes an engineered inlet structure intended to minimize sediment deposition in the restored channel during floods. The project is expected to create 9.4 ac of off-channel salmonid rearing habitat.
- Telegraph Slough Phase 1: Phase 1 of the project is expected to restore approximately 90 ha (222 ac) of marsh,[108] and Phase 2 is anticipated to provide an additional 100 ha (247 ac) of marsh and a distributary connection.
- Skagit Delta Tidegates and Fish Initiative: Western Washington Agricultural Association (WWAA) et al. (2010) describe the Skagit Delta Tidegates and Fish Initiative, a multi-stakeholder process that was convened to identify pathways for permitting tidegate and floodgate repair and replacement in the Skagit River and Samish River deltas. Parties involved formulated an agreement that a maximum of 2,700 ac of delta agricultural lands could be converted to estuarine habitat, consistent with goals and objectives of the Skagit Chinook Recovery Plan (Beamer et al. 2005a). However, on behalf of its membership, WWAA's board

[106] Fisher Slough restoration: levee removal - Habitat Conservation - NOAA Fisheries Video Gallery
[107] SRP Project (wa.gov)
[108] SRP Project (wa.gov)

of directors voted unanimously to withdraw from the initiative.[109] WWAA determined that "recent decisions by the National Oceanic and Atmospheric Administration and USACE to reinitiate Section 7 Endangered Species Act consultation of the Tidegates and Fish Initiative Implementation Agreement was procedurally improper and without cause. Under these circumstances, WWAA believes that it is no longer in the best interest of its farmers to continue to participate in the Agreement."

Despite the benefits of restoration efforts to date, habitat in the Skagit River delta and Puget Sound is likely to be altered further as the region's human population grows. Environmental alterations to support new industrial, commercial, and residential development could further degrade nearshore and marine habitats (Redman et al. 2005).

5.3.3.2 Freshwater Rearing Habitat and Riparian Conditions

When compared to historical conditions, Beamer et al. (2005c) identified a 98 percent loss of area where non-tidal delta habitat can form, which significantly limits potential freshwater rearing and refuge habitat for parr migrant and yearling Chinook Salmon. Hydromodifications, such as bank armoring, dikes, and floodplain roads reduce the complexity of bank habitat, thereby degrading habitat quality. Hydromodifications also isolate floodplain areas from the river channel, which alters the distribution and type of habitats in the mainstem and floodplains.

Smith (2003) stated, "Much of the upper Skagit sub-basin (streams upstream of the Sauk River confluence) is within National Forest boundaries or protected in the National Park, a national recreation area, or a designated wilderness area. Because of this, habitat conditions are generally good." However, Smith (2003) noted that there is a relatively high road density (2.9 mi/mi^2) in the upper Skagit River floodplain and poor riparian conditions and/or sedimentation issues in reaches of some tributaries, including lower Jordan, Shoemaker, Boulder, Razorback, and Lookout creeks. According to Smith (2003), many of the known impacts to salmonid habitat in the Sauk River basin are in areas with high road densities, typically on state or private lands. The Skagit River downstream of the Sauk River confluence, except for the Baker River, contains the most highly degraded freshwater salmonid habitat in the Skagit River basin, with considerable impacts in nearly all habitat categories, and a large loss of freshwater rearing habitat has occurred in the non-tidal region of the Skagit River delta (Smith 2003).

Beamer et al. (2005c) conducted a hydromodification inventory of 31 mainstem reaches (channels > 50 m [164 ft] bankfull width) in the Skagit, Sauk, Suiattle, Cascade, and Whitechuck rivers and found 31 percent of the floodplain area in these reaches had been isolated from the river channel. The authors also found over 98 kilometers (km) (61 miles [mi]) of hardened streambank throughout the river network, which reduced freshwater habitat capacity for juvenile Chinook Salmon and constrained the natural formation of habitat during floods.

Beamer et al. (2005c) estimate that floodplain modifications have reduced effective floodplain width in the system by an average of 28.6 percent when compared to historic conditions, a change that has dramatically reduced the amount of off-channel habitat available to juvenile salmon. Floodplain modifications have also affected mainstem habitat: regression analysis showed that effective floodplain width was a reliable predictor of the amount of mainstem edge habitat. Wider

109 Policy & Action | WWAA (westag.org)

(and lower slope) floodplains allow for the formation of greater amounts of backwater edge. In contrast, narrower floodplains constrain the mainstem and reduce bank edge habitat as channels become progressively straighter.

Hinton et al. (2018) used orthophotography to classify Skagit River basin floodplain, floodplain channels, mainstem edge habitats, hydromodifications, and tributary riparian extent and continuity into categories consistent with previously conducted mapping. The study focused on the mainstem, floodplains, and select tributaries in the anadromous fish zone downstream of the Gorge Development during 2015.

Hinton et al. (2018) estimated that floodplain area exposed to hydrologic processes was 10,861.8 ha (26,840 ac) and floodplain impaired by roads or hydromodifications made up about 28 percent of that area. When comparing 1998 to 2015 conditions, the authors estimated that the total new area exposed to floodplain processes was 352 ha (870 acres); an increase accounted for by newly mapped areas of erosion and changes in the presence of roads and hydromodification.

Mainstem channel edge was compared between 2006 and 2015, and after accounting for differences due to the seasons under which mapping had been conducted, total edge lengths were 500.7 km and 501.2 km (both = 311 mi), respectively. In 1998, total hydromodified edge within the range of freshwater salmonid rearing (i.e., excluding non-tidal delta) was 49,418 m (162,133 ft). In 2006, it was 41,375 m (135,745 ft), and in 2015, it was 39,886 m (130,860 ft), a positive trend over time.

In 2006, mainstem salmonid habitat area was 1,855 ha (4,584) (Hinton et al. 2018), and in 2015 it was 1,784 ha. Total mainstem and floodplain channel habitat together was essentially unchanged, 2,415 (5,968) ha in 2006 and 2,428 ha (6,000) in 2015. However, from 2006-2015 there was a decrease in backwater perimeter of 3,614 m (11,860 ft).

Environmental Science Associates (2017) assessed riparian conditions in Tier 1, Tier 2, and Tier 2S (for Chinook Salmon and steelhead) target areas for habitat restoration and protection in the Skagit River basin identified in the 2015 update to the Strategic Approach (SWC 2015, as cited in Environmental Science Associates 2017) and the 2016 Interim Steelhead Strategy (SWC 2016, as cited in Environmental Science Associates 2017). The assessment included an analysis of the extent of altered or developed land adjacent to the river channel. Within the study area, riparian cover was classified for 62,683 ac of mainstem and floodplain; of the 62,683 ac, approximately 42 percent of the area was within Water Resources Inventory Area (WRIA) 3, and 58 percent was in WRIA 4. Overall, approximately 26 percent of the study area was composed of altered cover types. In WRIA 3, 41 percent of the riparian cover was considered altered, whereas only 7 percent of the riparian cover was altered in WRIA 4. In the Lower Skagit River basin, where agricultural, residential, and commercial land uses are prevalent, forest cover decreases with distance from the active channel. In the upper basin, however, where natural resource land uses dominate, and residential uses are sparse, forest cover typically does not decline with distance from the active channel. The lower watershed also has markedly lower riparian canopy heights than upstream reaches, due to a higher percentage of shrub cover and fewer and smaller trees in the lower watershed.

Several study reaches in the upper watershed, including Downey, North Fork Sauk, Cascade Upper, Whitechuck, Illabot, Upper Skagit, Suiattle Middle, and Finney,[110] were almost entirely forested (i.e., ≥ 95 percent) (Environmental Science Associates 2017). Conversely, reaches near Mount Vernon and Burlington-Sedro Woolley both had less than 45 percent forest cover within 40 m (131 ft) of the active channel. In the mainstem reaches of the Sauk and Suiattle rivers, forest cover increased with distance from the channel because of the alluvial nature of these systems. The Sauk and Suiattle reaches also have relatively higher percentages of tall trees close to the active channel and in the floodplain, and consequently numerous logjams.

Environmental Science Associates (2017) documented a loss of 165.1 ac of forest from anthropogenic activities between 2006-2013, of which 117.4 ac were in the connected floodplain. There was twice the loss of forest cover from anthropogenic activities in WRIA 4 (115.5 ac) than there was in WRIA 3 (49.6 ac). However, there was a gain of 1,171.6 ac of riparian plantings and associated increased riparian function (Environmental Science Associates 2017). Approximately 60 percent of this revegetation occurred in WRIA 3. The authors computed a net gain in riparian vegetation across both WRIAs of 881.7 ac, approximately a 3.1 increase in WRIA 3 and 1.1 increase in WRIA 4.

Hinton et al. (2018) assessed riparian conditions in the anadromous fish zone downstream of the Gorge Development during 2015. Percent functional riparian vegetation increased from 2006-2015 (from 70.0-72.4 percent, respectively), and percent dysfunctional vegetation decreased (26.1-23.6 percent, respectively). Watersheds near urban centers were the most degraded, whereas tributaries in the Cascade foothills were much more intact. Hinton et al. (2018) noted that improvements in riparian conditions in the basin are mostly due to restorative plantings.

A recent report prepared by SWC (2021) documents changes in the Skagit River mainstem, most of them positive: (1) mainstem Skagit River edge length remained about the same from 1998 to 2015–after accounting for variation in assessment methods and river flow/stage–increasing from 500.7 km to 501.2 km (311 miles [mi]); (2) mainstem hydromodified edge length (bank armoring and levees) decreased between 1998 and 2015 from 49.4 km (30.7 mi) to 39.9 km (24.8); differences were due to natural erosion, restoration efforts, and channel migration; (3) mainstem backwater perimeter length decreased from 23.7 km (14.7 mi) to 20.1 km (12.5 mi) between 2006 and 2015; (4) floodplain channel area changed little, i.e., 2,415 ha (5,968 ac) in 2006 and 2,428 ha (6,000 ac) in 2015; however, total new area exposed to floodplain processes between 1998 and 2015 was 352 ha (870 ac), a reduction in floodplain impairment from 31 percent to 28 percent; and (5) although about 280 ac of functional riparian land was lost between 2006 and 2013, mostly to logging, about 1,170 ac were replanted between 1998 and 2016; this net gain equates to an increase in functional riparian area of 3 percent in WRIA 3 and about 1 percent in WRIA 4. In addition, much work has been conducted to reduce road related sedimentation on federally managed land, and many sediment-impaired watersheds have been rehabilitated (SWC 2022).

5.3.3.3 Landslides

Veldhuisen (2018) assessed landslide rates along the Skagit River in six areas with ongoing timber management. Landslides, which are a primary source of sedimentation in streams and rivers, were documented from the 1950s through 2011, and data were compiled by decade to assess temporal

[110] See Environmental Science Associates (2017) for a delineation of reaches.

patterns. The inventory areas were mainly on private and state-owned forest lands subject to clearcut logging on rotations of 40-70 years. The study area boundaries excluded most federally owned lands, so results do not represent forests managed by the U.S. Forest Service and NPS, i.e., most of the eastern portion of the basin.

There was a consistent relationship between landslides and harvest intensity from the 1970s through the 1990s. Landslide rates dropped sharply from 2002 to 2011, apparently as the result of reduced logging intensity and improved forestry mitigation practices. Of the 42 landslides identified for the period 2002-2011, 78 percent originated in areas last logged before 1987 or from roads, particularly older roads. Only four landslides (10 percent) were from sites logged after 2001, again supporting the notion that improved harvest practices are reducing the occurrence of landslides.

5.3.3.4 Changes to the Historical Extent of Glaciers

According to Riedel and Larrabee (2016), in 1959 approximately 396 glaciers covered approximately 170 kilometer squared (km^2) (66 mile squared [mi^2]) of the Skagit River basin, but since then, glacier area has decreased by approximately 32 km^2 (12 mi^2) (19 percent), with most of the loss occurring between elevations of 1,600 and 2,100 m (5,249-6,890 ft). Riedel and Larrabee (2016) state that 50 years ago surface melting of snow, firn,[111] and ice from Skagit River basin glaciers provided from 0.44 to 0.74 cubic kilometer (km^3) (0.11-0.18 cubic mile [mi^3]) of water to the Skagit River at Concrete from May through September; the surface melt has decreased by about 24 percent and now ranges from 0.33 km^3 (0.01 mi^3) of water in cool-wet years to 0.56 km^3 (0,13 mi^3) in warm-dry years. Cold glacial meltwater is concentrated in the following tributaries: Thunder Creek, Whitechuck River, Suiattle River, Baker River, and Cascade River.

5.3.3.5 Habitat Access and Fish Passage at Culverts

Barriers, including culverts and other structures that provide road crossings at streams and wetlands, can impede the passage of anadromous and resident salmonids by creating conditions that exceed the swimming and/or jumping abilities of adult or juvenile fish. According to WDFW (2019, as cited in Mickelson et al. 2020), culvert crossings, by a large margin, constitute the greatest proportion of anthropogenic fish passage barriers in Washington. In the Skagit River Basin, culverts account for more than 70 percent of the known fish passage barriers (WDFW 2019, as cited in Mickelson et al. 2020). Small dams, diversions, and similar structures, while not as common as culverts, also have impacts.

Beginning in 2015, Mickelson et al. (2020) consolidated and updated available culvert data and documented new barriers in the Skagit River basin. For the analysis, the authors filtered out the Samish River watershed, the Skagit River estuary, Fidalgo Island, and the Skagit River watershed upstream of the Gorge Development. Fish passage statuses of the culverts evaluated during the study are shown in Table 5.3-1, and salmonid habitat area upstream of culverts is shown in Table 5.3-2.

[111] Granular snow, especially on the upper part of a glacier, where it has not yet been compressed into ice.

Table 5.3-1. Upstream fish passage status of culverts in the Skagit River basin evaluated by Mickelson et al. (2020); see text for study area delineation.

Passage Status	Land Ownership at Culvert			Total
	County	Private	Other public	
Total barrier	32	33	24	89
Partial barrier	63	90	46	199
Barrier (passage status not computed)	12	44	8	64
Undetermined	15	37	39	91
Total	122	204	117	443

Table 5.3-2. Salmonid habitat area upstream of culverts in the Skagit River basin evaluated by Mickelson et al. (2020); see text for study area delineation.

Ownership (Total Culverts)	Habitat Area Upstream of Culvert				
	>10,000 m^2	1,000-10,000 m^2	200-1,000 m^2	<200m^2	No habitat
County (122)	6	28	34	21	33
Private (204)	5	28	47	63	61
Other Public (117)[1]	3	4	9	5	24
Total	14	60	90	89	118

1 No weighted habitat area estimate was available for 72 culverts categorized as "other public."

5.3.3.6 Flood Alterations

Runoff patterns have been altered in much of the Skagit River by urbanization, road building, large reductions in the number of beavers, and timber harvest; such activities change water infiltration and storage within the watershed so that high flows become flashier and low-flow conditions are exacerbated (USACE 2010). Widespread logging, especially in the headwaters, has contributed to more severe effects of rain-on-snow events, the effects of which propagate downstream (USACE 2010). However, many smaller floods that once scoured the river and inundated the adjacent floodplain no longer occur because of storage patterns in upstream reservoirs (Collins 2000, as cited in USACE 2010).

Flood control in the Skagit River basin is conducted with a system of levees at lower elevations and flood control operations at upper basin reservoirs (USACE 2010). Ross Dam (discussed in Section 3.1.4 of this Exhibit E) and the Upper Baker Dam on the Baker River are formally operated to significantly reduce the magnitude, and as a result also influence the duration and at times frequency, of both large and small floods. The two projects together control 38 percent of the Skagit River basin's drainage area (USACE 2010). However, the remaining 62 percent of the watershed is uncontrolled.

5.3.3.7 Mining Upstream of the Project

In its comments on City Light's PAD (NPS 2020), NPS identified the Azurite Mine in the headwaters of Ruby Creek and Silverdaisey Mine, located on a tributary to the Skagit River in Canada, as two operations that should be accounted for in the context of Project relicensing.

Azurite Mine

The Azurite Mine is located approximately 20 miles northwest of Mazama, Washington. Gold and silver were mined at the site in the 1930s.[112] Ore was extracted and milled on site, and contaminated waste rock and mill tailings are eroding into nearby Mill Creek. Clean-up of the site is ongoing to address the tailings and other hazards, and National Forest Land around the mine is currently closed to public access for safety while heavy equipment is mobilized. Work is expected to progress until fall 2022 snows limit access.

Silverdaisey Mine

In 2007-2008, the Skagit Environmental Endowment Commission (SEEC) contracted with Limnotek to develop a water quality and benthic macroinvertebrate (BMI) monitoring plan in the Upper Skagit watershed (SEEC and Hope Mountain Centre for Outdoor Learning [HMCOL] 2020). Forty-nine reference sites were set up to establish a reference condition, against which results from ten test sites could be evaluated (SEEC and HMCOL 2020). One of the sites (SKGT024) is located downstream of “point-source acid mining pollution” where the historic Silverdaisey mineshaft leaches directly into Silverdaisey Creek.

Monitoring of the SKGT024 site in 2007 and 2008 revealed a “divergent” BMI community, “likely due to toxicity of metals drainage from historic mining sites… (SEEC and HMCOL 2020).” Continued sampling from 2011-2017 produced results ranging from “mildly divergent” to “highly divergent.” In 2019, concentrations of aluminum, cadmium, lead, nickel, silicon, and zinc were higher at SKGT024 than at any of the other test sites.

5.3.3.8 Existing Water Quality

Urbanization creates impervious surfaces, which can alter runoff patterns by reducing infiltration rates. Industrial and municipal wastewater discharges, stormwater runoff, spills of oil and other hazardous substances, and sewage effluent, can contaminate water. Discharges from container ships, tankers, cruise ships, tugs and barges, and other vessels at port and while in transit through Puget Sound introduce contaminants to the marine ecosystem. Toxic contamination has been observed in Puget Sound food webs (Puget Sound Action Team 2002, as cited in Redman et al. 2005). Nutrient enhancement from agriculture and effects from timber harvest and associated road construction also have the potential to impact water quality. The Washington Department of Ecology’s 303(d) listings (categories 4 and 5) for the Skagit River basin are shown in Table 5.3-3.

Most of the lower Skagit tributaries, including reaches in Nookachamps, Hansen, Coal, Wiseman, Morgan, Sorensen, Mannser, Red Cabin, Day, Cumberland, lower Finney, Grandy, and Jackman creeks and Gages and Hart sloughs have high summer water temperatures (Smith 2003). According to Smith (2003), the Nookachamps watershed also has elevated nutrients and turbidity and low dissolved oxygen levels.

[112] Okanogan-Wenatchee National Forest - Projects (usda.gov).

Table 5.3-3. Category 4 and Category 5 303(d) listings for WRIA 4 (Upper Skagit) and WRIA 3 (Lower Skagit).

Parameter	Category[1]	Waterbody	Listing ID	TMDL (Approval Date)
Temperature	5	Sauk River (WRIA 4)	72516	
	5	Skagit River (WRIA 3)	73541	
	5	Skagit River (WRIA 3)	73560	
pH	5	Skagit River (WRIA 3)	14485	
Fecal coliform	5	Prairie Creek (WRIA 4)	42075	
	4a	Skagit River (WRIA 3)	9765	9/1/2000
PCBs (tissue)	5	Skagit River (WRIA 3)	14036	
Instream Flow	4c	Newhalem Creek (WRIA 4)	6186	

Source: Ecology 2014.

1 Category 4a: EPA-approved TMDL in place and implemented; Category 4c: Impairment by a non-pollutant; TMDL development not required; Category 5: 303(d)–Listings - Confirmed violations of water quality criteria.

5.3.3.9 Hatchery Programs

There are substantial recreational fisheries for hatchery spring Chinook, Coho, odd-year Pink Salmon, Bull Trout, and winter steelhead from the mouth of the Skagit River up the mainstem and into the major tributary systems of the Cascade and Sauk rivers (NMFS 2014). The Marblemount and Baker Lake hatcheries, which currently operate within the Skagit River basin, produce summer and spring Chinook, Coho, and Sockeye salmon to augment the natural production of these species[113] (NMFS 2015). The Upper Skagit Indian Tribe and Sauk-Suiattle Indian Tribe also collect Chum Salmon broodstock in the basin. Fisheries for Sockeye and Coho salmon are primarily supported by a combination of hatchery and natural-origin populations. The spring Chinook fishery consists of a targeted harvest on a hatchery stock, and the summer Chinook hatchery program is relatively small and operated as an indicator stock program[114] (NMFS 2014).

In 2015, the Northwest Fisheries Science Center (NWFSC) concluded that all Puget Sound Chinook Salmon populations were still well below escapement levels needed to support recovery and found that hatchery-origin spawners were present in high fractions in most populations outside the Skagit River watershed (Ford 2022).

The long-term abundance of adult steelhead returning to many Puget Sound rivers has decreased significantly since the late 1970s. However, more recently there have been some improvements in abundance and productivity (Ford 2022). High ocean temperatures in 2014 and 2015 and high stream temperatures and low summer streamflows during 2015 decreased marine and freshwater survival. However, reduced harvest and declining hatchery production were determined to have modestly decreased risks to natural spawners.

113 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).

114 Indicator stocks are used to model the effects of mixed stock fisheries on wild salmon populations.

Harvest of Puget Sound steelhead is limited to terminal tribal net and recreational fisheries. Harvest rates were curtailed in 2003, with "wild" harvest rates held below 10 percent (Ford 2022). Recreational fisheries are mark-selective for hatchery stocks, but some natural-origin fish succumb to hooking mortality and poaching.

Hatchery steelhead production for harvest consists mainly of Chambers Creek winter-run stock and Skamania Hatchery summer-run stock, both selected for run timing that precedes that of natural stocks to reduce interaction between hatchery and naturally spawned fish. To reduce the risk of introgression between native and hatchery-origin fish, Chambers Creek releases were discontinued in the Skagit River (Ford 2022). Although the risk posed by hatchery programs to naturally spawning populations has recently decreased, it is unclear how long it will take for the genetic legacy of introgression to subside.

Despite the recovery benefits resulting from programs governed by Hatchery and Genetic Management Plans (HGMP) and supplementation of fish harvest, hatchery programs have been shown to have a range of effects on wild fish populations throughout the Pacific Northwest. Pflug et al. (2013) examined the effects of ecological and genetic interactions between hatchery- and natural-origin steelhead (*O. mykiss*) in the Skagit River basin. The authors identify two types of interaction occurring during the juvenile life-stage: (1) ecological interactions during the freshwater and early marine outmigration period and (2) ecological and genetic interactions between stray hatchery adults and wild fish on spawning grounds. Competitive interactions among hatchery and wild fish, for both physical habitat and food, during the freshwater, estuarine, and early marine stages of emigration can affect the growth potential and survival of natural origin smolts. The earlier fry emergence timing of hatchery influenced juveniles allows them to occupy habitat before the later emerging natural-origin fry, which confers a competitive advantage on the hatchery influenced fish. Austin et al. (2021) found that shifts in spawning timing (toward earlier spawning) of wild runs were linked to hatchery practices.

Pflug et al. (2013) note that hybrid and naturally spawned hatchery juveniles have been found in the Skagit River mainstem, the Sauk, Suiattle and Cascade rivers, and many smaller tributaries, regardless of distance from the hatchery source. At the time Pflug et al. (2013) was published, the proportion of hybrids in the basin ranged from 4 percent in the Sauk River collection area to 26 percent in Finney Creek. The authors suggest that introgression was most pronounced where the greatest temporal overlap of stray hatchery and natural steelhead spawning occurred. Introgression likely lowers the productivity of wild steelhead, because hatchery fish have substantially lower marine survival rates than wild fish.

Pflug et al. (2013) state that hatchery steelhead smolt releases had a highly significant, negative effect on native steelhead returns in the Skagit River that was independent of long-term trends in marine and freshwater conditions. The authors conclude, "The regional analysis on the effects of hatchery smolt releases on native steelhead productivity among Puget Sound watersheds suggests that hatchery releases have had a long-term negative impact on steelhead population growth rates."

5.3.3.10 Fish Harvest

Fish harvest rates for Skagit River stocks are addressed in Section 4.2.3 of this Exhibit E.

5.3.3.11 Effects of Ocean Conditions

Large-scale climatic processes (El Niño Southern Oscillation and Pacific Decadal Oscillation) influence marine survival of salmon and steelhead, with average marine survival varying by a factor of three depending on climate regime (Beamer et al. 2005b). Marine survival has a significant impact on the number of returning adult salmon and steelhead. Beamer et al. (2005b) state that modeling indicates a Chinook smolt outmigration of 5,100,000 could yield as few as 4,159 adults under very poor marine conditions or as many as 57,895 adults under more favorable ocean conditions. Because large-scale climatic processes influence ocean survival of salmon, and marine survival is linked to size at outmigration, it is critical to account for the effects of ocean conditions and early growth on adult recruitment when planning restoration (Beamer et al. 2005b).

5.3.3.12 Influence of Future Climate Change

Average temperatures in the Skagit River basin by the 2080s are projected to be between 4.0 and 5.8°F (2.2-3.2°C) higher than the 20th century baseline (Lee and Hamlet 2011). In addition to increases in water temperature brought about by climate change, seasonal changes in precipitation are expected to be substantial. By the end of the 21st century, average precipitation in the Skagit River basin is projected to increase by 9.8 percent in winter, 8.0 percent in spring, and 19.2 percent in fall (Lee and Hamlet 2011). In contrast, summer precipitation is expected to decrease by 27.6 percent. Despite increasing cool season precipitation, reductions in April 1 snow-water equivalent are projected for the Pacific northwest. Such reductions in natural storage are expected to be most pronounced at moderate elevations where temperatures are near freezing in midwinter. Hood et al. (2016) note that increases in winter river flows and reductions in summer flows due to decreased snowpack will further increase the asynchrony between sediment delivery and marsh vegetation growth, resulting in decreased sediment retention efficiency in delta marshes. Reduced survival of salmon under poor ocean conditions indicates that climate change could impact marine survival (Beamer et al. 2005b).

As discussed above, glaciers significantly influence the flow regime in the Skagit River basin, providing cold water during summer low flows (Lee and Hamlet 2011). Projected warming for the 21st century is expected to accelerate glacial retreat, which will reduce summer base flows, especially during drought years, resulting in higher water temperatures in the basin (Lee and Hamlet 2011). Increased temperatures will adversely affect salmon, steelhead, and Bull Trout in the Skagit River basin. Changes in summer flows are also likely to influence water allocation and generation of hydroelectric power. In addition to low-flow impacts, floods are expected to become more intense due to increasing fall and winter precipitation and higher freezing elevations during winter.

Sea level is projected to increase substantially by the end of the 21st Century, from 18 centimeter (cm; 7.1 inches [in]) to 59 cm (23.2 in), depending on the volume of carbon emissions (Lee and Hamlet 2011). Studies of sea level rise projections are progressing rapidly, and more recent work suggests that sea level rise could occur at even higher rates than previously projected. Estuarine marshes are especially vulnerable to sea level rise, with potential effects magnified by declining natural progradation rates and sediment retention (Hood et al. 2016).

5.4 Water Resources

Because the Project has minimal effects on water quality, the Project does not contribute to adverse cumulative effects on water quality in the Project reservoirs or downstream in the Skagit River. Total dissolved gas (TDG) exceedances in the Gorge bypass reach are localized and concentrations dissipate to below the 110-percent criterion downstream of the Gorge bypass reach. No other sources of human-induced TDG exceedances are present in the Skagit River upstream of the Sauk River (at which point any trace of TDG from the Project is attenuated), so slightly elevated TDG concentrations immediately downstream of Gorge Powerhouse do not contribute to cumulative effects below the Project.

The Project does alter the flow regime of the basin. However, flow-related protection, mitigation, and enhancement measures have been designed to support anadromous and resident salmonids at all times of year downstream of the Project (see Section 4.2.3.3 of this Exhibit E for a description of flow-related measures to be implemented for the benefit of fish and aquatic resources).

As explained above, climate models predict that air temperatures in Washington will be significantly warmer in the future. Predictions also indicate that there will be increases in cool-season precipitation, decreases in summer precipitation, and a shift from snow to rainfall during winter. Warmer air temperatures will lead to higher water temperatures, and with 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, releases of which, particularly in summer, may contribute positively to cumulative effects in the Skagit River basin in the future.

5.5 Fish and Aquatics

A wide range of activities (see Section 5.3 of this Exhibit E) in the Skagit River watershed, Skagit River delta and estuary, the Puget Sound, and Pacific Ocean affect fish and aquatic resources that may also be affected by the continued operation of the Skagit River Project. These activities include: (1) the existence and operation of the Baker River Hydroelectric Project; (2) complying with flood risk management operations requested by the USACE; (3) timber harvest and associated degradation of upland and riparian habitats; (4) construction and maintenance of roads and railroads; (5) impacts of agriculture, including irrigation withdrawals and returns, floodplain alteration, degradation of riparian habitats, and potentially unscreened irrigation water intakes; (6) livestock grazing; (7) municipal water uses; (8) floodplain development and construction; (9) diking and hydromodification in the mainstem Skagit River, its tributaries, and the estuary; (10) mining; (11) hatchery practices and fish releases; (12) in-river fish harvest; (13) commercial harvest in the Puget Sound and Pacific Ocean; and (14) urban development, agriculture, and habitat alteration in and adjacent to Puget Sound.

Operations of the Skagit River and Baker River projects alter the natural hydrology and geomorphology of 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.[115] 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 (Hatchery Scientific Review Group 2003). These activities and 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 Endangered Species Act.

In addition to these past and present impacts, continued climate change will 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 peak floods could increase on average by approximately 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, fisheries resources, domestic water supply, and irrigation. However, as noted above, the large volume of cold water stored in Ross Lake will become a valuable fish management tool in the future, particularly in summer, thereby contributing positively to cumulative effects in the Skagit River basin.

Future mining activities also have the potential to cumulatively affect aquatic resources in the Skagit River basin. Future mining activities would likely involve road building and use, 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 the 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), SWC Strategic Plan for Salmon Habitat Restoration (SWC 2000), and the WDFW/Tribal Hatchery and Harvest Programs. Puget Sound Energy's (PSE) Baker River Project Settlement Agreement also includes numerous PME measures designed to mitigate the effects of that project on aquatic resources (PSE 2004). Specific non-Project restoration activities occurring in the basin are described in Section 5.3 of this Exhibit E, and City Light owns multiple parcels of land in the Skagit, Sauk, and South Fork Nooksack watersheds that are managed for fish habitat enhancement (see Section 3.1 of this Exhibit E).

Actions proposed by City Light for implementation under the next Project license, 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.

[115] The RLNRA is partially developed, including roads with a high level of use by recreationists, unlike the wilderness portions of the North Cascades National Park Complex.

6.0 DEVELOPMENTAL ANALYSIS

The following subsections are intended to provide Seattle City Light's (City Light) analysis of the effect of costs associated with proposed protection, mitigation, and enhancement (PME) measures on power generation and economic benefits of the Project. For this Draft License Application (DLA), only the power and economic benefits of the Project are provided. In addition, for the Final License Application (FLA), City Light's analysis will include an estimate of the costs of PME measures, by resource area, and a comparison of costs under City Light's Proposed Action with those associated with the No Action alternative. The Project's net economic benefit under a given alternative will be the difference between the cost of producing power and the value of that power. Consistent with the Federal Energy Regulatory Commission's (FERC or Commission) approach to economic analysis, the power benefit of the Project will be estimated based on the cost of obtaining an equivalent amount of energy and capacity using the most likely alternative generating resources in the region. The analysis will be based on 2021 electric power cost conditions and will not consider future escalation of fuel prices in estimating the value of the Project's benefits.

6.1 Power and Economic Benefits of the Project

As City Light's within-hour, load-following resource the Skagit River Project is of significant value to City Light's ratepayers. In addition to the power used to serve load, the net excess generation is sold on the secondary market, and the net wholesale revenue is used to maintain stable, affordable rates for City Light's ratepayers.

For the No Action alternative, total energy output from the Project is approximately 2.4 million megawatt hours (MWh) (see Exhibit B, Section 3 of this DLA). Purchasing an equivalent quantity of energy from the Mid-Columbia trading hub would have cost City Light approximately $116.2 million, given relative on-peak and off-peak output and prices in 2021, resulting in an average price, weighted by the on-peak and off-peak production, of $46.94/MWh (see Exhibit D, Section 6 of this DLA). The annual costs (i.e., production costs and an allocated share of debt service) for the Project totaled $58.4 million in 2021, resulting in an average cost of $23.60/MWh. An estimate of the net 2021 value of the Project is approximately $57.8 million, which is the difference between the gross value of the energy ($116.2 million) and the annual costs ($58.4 million). However, the 2021 market price does not capture all the benefits or monetize all the values of the Project. These values include ancillary services, load following, price-following, and resource reliability to City Light (see Exhibit D, Section 6 of this DLA).

A summary of parameters and assumptions used for the economic analysis of the Project are provided in Table 6.1-1. Greater detail regarding the values included in the table can be found in exhibits B and D of this DLA.

Table 6.1-1. Summary of parameters and assumptions used for the economic analysis of the Skagit River Project.

Parameter	Value
Costs	
Period of analysis (years)	50 years
Weighted cost of capital (nominal)	5.41 percent [1]
Weighted cost of capital (real)	2.91 percent
Inflation and escalation	2.50 percent
Property taxes	N/A [2]
Federal tax rate	Exempt [2]
Combined state and local sales tax rate (2021)	8% Whatcom 8.1% Skagit 9.2% Snohomish[2]
Taxes paid to the City of Seattle	Undefined (see Exhibit D, Section 5.2)
State taxes based on retail revenue	Undefined (see Exhibit D, Section 5.2)
Total annual costs (2021)	$58.4 million [3]
• Production expenses (2021)	$41.6 million [3]
• Allocated debt service (2021)	$16.8 million [3]
Cost to develop License Application	To be provided with FLA
Power value	
Average annual generation (historical)	2,474,942 MWh [4]
Approximate alternative power value	$116.2 million [3]

1 From Exhibit D, Section 5.1, Table 5.1-1.
2 From Exhibit D, Section 5.2.
3 From Exhibit D, Section 6.
4 From Exhibit B, Section 3.

6.2 Costs of Resource Measures

As the costs associated with the proposed PME measures of City Light's Proposed Action are under development, they will be detailed in the FLA.

6.3 Comparison of Alternatives

As the economic analysis of City Light's Proposed Action is under development, the economic comparison of alternatives will be detailed in the FLA.

7.0 CONSISTENCY WITH COMPREHENSIVE PLANS

In accordance with 18 Code of Federal Regulations § 5.6(d)(4)(iii and iv), Seattle City Light (City Light) reviewed the Federal Energy Regulatory Commission (FERC or Commission) List of Comprehensive Plans (December 2019) applicable to the State of Washington under Section 10(a)(2)(A) of the Federal Power Act (FPA). Of these 95 listed plans, 35 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. Based on a review of the 35 potentially relevant comprehensive plans, City Light believes that the Project as described in the Proposed Action is consistent with each of these plans.

7.1 Bureau of Land Management. Forest Service. 1994. Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Washington, D.C. April 13, 1994.

This plan presents land allocations for the protection and habitat enhancement of late-successional and old-growth forest related species and details standards and guidelines for the management of these land allocations.

Under the current license, City Light has collaborated with agencies, Indian Tribes, and non-governmental organizations (NGO) to identify and implement measures to protect and benefit botanical resources in the Project vicinity through land acquisition of wildlife mitigation lands, which includes prioritizing the management of old-growth forests. City Light is not proposing specific measures for late successional or old growth forest. However, City Light is proposing to develop a Vegetation Management Plan that will address special-status plant protection and protection of streams, wetlands, riparian areas, and other priority habitats. City Light is also proposing to develop an Invasive Plants Management Plan which will address townsites, transmission line corridors, and fish and wildlife mitigation lands. Additionally, City Light is proposing to develop a Wildfire Management Plan to address fire prevention and fuel management. City Light will also develop a comprehensive Transmission Line Corridor Management Plan that includes best management practice (BMP) measures to protect natural resources from direct and indirect impacts from Project operations and maintenance (O&M) activities. Therefore, the Project, as proposed, is compliant with this plan.

7.2 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.

Under its current license, City Light implements multiple protection, mitigation, and enhancement (PME) measures to support recreational services within the Project Boundary including the maintenance of Ross Lake surface elevations, installing interpretive displays, providing a ferry service on Diablo Lake, constructing and operating the Skagit Information Center, constructing expanded restrooms and parking, maintaining Ladder Creek Falls, providing tours to the public, and supporting the maintenance of recreational facilities. City Light is proposing to develop a Recreation Management Plan in consultation with NPS and other LPs to address accessibility, improved visitor experience, ongoing maintenance of recreation facilities, and other recreation resource needs. Additionally, City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light proposes to continue operation of the Environmental Learning Center (ELC), Skagit tours, ferry services, Skagit Information Center, and maintenance of Ladder Creek Falls. Therefore, the Project, as proposed, is compliant with this plan.

7.3 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 the Revised Code of Washington (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.

Under its current license, City Light implements multiple PME measures to support recreational services within the Project Boundary as described above. City Light is proposing to develop a Recreation Management Plan in consultation with NPS and other LPs to address accessibility, improved visitor experience, ongoing maintenance of recreation facilities, and other recreation resource needs. Additionally, City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light proposes to continue operation of the ELC, Skagit tours, ferry services, Skagit Information Center, and maintenance of Ladder Creek Falls. Therefore, the Project, as proposed, is compliant with this plan.

7.4 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.

Under its current license, City Light implements multiple PME measures to support recreational services within the Project Boundary. Regarding trails, City Light maintains Ladder Creek Falls and Garden, has improved several trails, and has developed Americans with Disabilities Act (ADA) accessible trails. City Light is proposing to develop a Recreation Management Plan in consultation with NPS and other LPs to address accessibility, improved visitor experience, ongoing maintenance of recreation facilities, and other recreation resource needs. Additionally, City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light proposes to continue operation of the ELC, Skagit tours, ferry services, Skagit Information Center, and maintenance of Ladder Creek Falls. Therefore, the Project, as proposed, is compliant with this plan.

7.5 National Park Service. 1988. North Cascades National Park Complex General Management Plan: Lake Chelan National Recreation Area and North Cascades National Park. Department of the Interior, Sedro Woolley, Washington. June 29, 1988.

The plan addresses the North Cascades National Park Complex, as per Congress' intent to manage North Cascades National Park, Ross Lake National Recreation Area (RLNRA), and Lake Chelan National Recreation Area as one natural ecosystem under one administration. The General Management Plan (GMP) provides direction for natural and cultural resources management, visitor use, and administrative activities. With the completion of the RLNRA GMP and Lake Chelan National Recreation Area GMP, this plan now applies only to North Cascades National Park. The Project resides in the North Cascades National Park Complex.

Under its current license, City Light implements several PME measures to manage natural and cultural resources management, which can be referenced in Section 4 of the Pre-Application Document. These PME measures cover erosion, fish and aquatic resources, botanical resources, wildlife resources, recreation, aesthetics, and cultural resources. City Light is proposing to implement several PME measures, including developing the following management plans: (1) Reservoir Shoreline Erosion Management Plan; (2) Project Roads and Transmission Line Right-of-way (ROW) Management Plan; (3) Water Quality Monitoring and Data Management Plan; (4) Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (5) Aquatic Invasive Species Management Plan; (6) Anadromous Fish Flow Plan; (7) Vegetation Management Plan; (8) Invasive Plants Management Plan; (9) Wildfire Management Plan; (10) Wildlife Protection and Enhancement Plan; (11) Avian Species Protection Plan; (12) Wildlife Mitigation Lands Management Plan; (13) Recreation Management Plan; (14) Visual Resources Management Plan; and (15) Historic Properties Management Plan (HPMP). Additionally, City Light is proposing to establish a flow regime in Gorge bypass reach, consult with LPs regarding fish passage at Gorge Dam, continue to fund the Rainbow Trout Broodstock Program, continue to remove potential upstream fish migration barriers, implement wetland management actions along Ross Lake shoreline, anticipates including BMPs associated with Project noise generation, and provide Wildlife Monitoring and Education funds and Wildlife Research Grants. Other PME measures will be developed resulting from consultation with stakeholders. Therefore, the Project, as proposed, is compliant with this plan.

7.6 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 U.S. Department of the Interior (USDOI), NPS of more than 3,200 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.

Portions of the Project are listed in the NRI. 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.

Under its current license, City Light provided capital funding to USFS to develop and improve multiple recreational sites within the Skagit River Wild and Scenic River System and along State Route 20. City Light also implements several fish and wildlife PME measures as described above. City Light is proposing a Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light is not proposing additional PME measures as the Project is located upstream of the Skagit River Wild and Scenic River and does not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the wild and scenic river segment. Therefore, the Project, as proposed, is compliant with this statute.

7.7 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. Most of the portion of the Project Boundary near Ross Lake is in the Wildland Fire Use Zone, except for the northern extent near the U.S.-Canada border, which is in the Suppression Zone.

City Light is a FireWise USA member, which requires engagement with the community, having a fire mitigation plan, and implementing FireWise activities. In preparation of becoming a FireWise member, City Light cleared vegetation around homes and other buildings, planted fire-resistant plants, followed outdoor burning rules, and has a plan for fires. Furthermore, City Light intends to collaborate with NPS to develop a Wildfire Management Plan specific to the Ross Lake National Recreation Area. Therefore, the Project, as proposed, is compliant with this plan.

7.8 National Park Service. 2008. North Cascades National Park Complex Mountain Fishery Management Plan. Sedro-Woolley, Washington. June 2008.

This plan guides management actions by the National Park Service (NPS) and Washington Department of Fish and Wildlife (WDFW) to conserve native biological integrity, provide a spectrum of recreational opportunities and visitor experiences, and resolve fish stocking conflicts in the Northern Cascades Complex. A total of 91 lakes are under an adaptive management framework, some of which are within the Project Boundary.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light proposes to develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan, an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan, a Reservoir Fish Stranding and Trapping Program, and an Aquatic Invasive Species Management Plan. City Light also proposes to consult with LPs regarding fish passage at Gorge Dam, continue to fund the Rainbow Trout Broodstock Program, and continue to remove potential upstream fish migration barriers. Therefore, the Project, as proposed, is compliant with this plan.

7.9 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. This plan applies to the entire North Cascades National Park Complex, in which the Project resides.

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. City Light is proposing to develop a Vegetation Management Plan that will address special-status plant protection and protection of streams, wetlands, riparian areas, and other priority habitats. Additionally, City Light is proposing to develop an Aquatic Invasive Species Management Plan and an Invasive Plants Management Plan. Therefore, the Project, as proposed, is compliant with this plan.

7.10 National Park Service. 2011. Ross Lake National Recreation Area General Management Plan. Department of the Interior, Seattle, Washington. 2011.

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.

Under its current license, City Light implements multiple PME measures to support recreational services and natural resources within the Project Boundary as noted above. Of note, City Light operates a Skagit Information Center, has developed interpretive displays and recreational facilities, and provides funding for wildlife education and management of recreational facilities. City Light is proposing to develop a Recreation Management Plan in consultation with NPS and other LPs to address accessibility, improved visitor experience, ongoing maintenance of recreation facilities, and other recreation resource needs. Additionally, City Light is proposing to develop a

Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light proposes to continue operation of the ELC, Skagit tours, ferry services, Skagit Information Center, and maintenance of Ladder Creek Falls. Additionally, City Light is proposing to provide a Wildlife Monitoring and Education Fund which can be used for educational activities. City Light is also proposing several natural resource PME measures, as noted above. Therefore, the Project, as proposed, is compliant with this plan.

7.11 National Park Service. 2014. Mount Rainier and North Cascades National Park Complex Fisher Restoration Plan. Ashford and Sedro-Woolly, Washington. 2014.

This purpose of this plan is to reestablish self-sustaining fisher populations in the southwestern and northwestern Cascades of Washington State, including Mount Rainier National Park and North Cascades National Park Service Complex, for the purpose of contributing to the statewide restoration of this state-listed endangered species. The focus area of this plan includes the North Cascades National Park Service Complex, in which the Project resides.

Under the current Project license, City Light has developed and implemented wildlife-focused protection and enhancement measures. City Light is proposing to provide a Wildlife Monitoring and Education fund which will contribute to long-term ecological monitoring of wildlife, including fishers. Additionally, City Light will continue to provide wildlife research grants to improve methods for managing wildlife and their habitats in the North Cascades Ecosystem. Additionally, City Light is proposing to develop a Wildlife Protection and Enhancement Plan and a Wildlife Mitigation Lands Management Plan in collaboration with LPs. Therefore, the Project, as proposed, is compliant with this plan.

7.12 National Marine Fisheries Service. Pacific Fishery Management Council. 1978. Fishery management plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California commencing in 1978. March 1978. [Updated in 2021].

This plan implements fishery management measures for salmon fisheries of Washington, Oregon, and California coasts. The management measures are intended to prevent overfishing and to apportion the ocean harvest equitably among treaty Indian, non-Indian commercial, and recreational fisheries. Additionally, these measures allow a portion of the salmon runs to escape the ocean fisheries in order to provide for spawning escapement, comply with applicable law, and provide fishing opportunity for inside fisheries. Amendment 21 of the plan, implemented in 2021, describes the relatively constant management boundaries of the annual regulations including the Puget Sound Evolutionary Significant Unit in which a portion of the Project resides.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. Specific to salmon, City Light has conducted salmon fry stranding surveys, implements specific flow measures for salmon spawning, salmon fry protection, and salmon yearling protection. Non-flow plan measures also benefit salmon. Additionally, City Light acquired conservation land which protects important migration, spawning, and rearing habitat for salmon. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan;

(4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.13 National Marine Fisheries Service. 2006. Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan. Seattle, Washington. November 2006.

This plan is the National Marine Fisheries Service (NMFS) Final Supplement to the Puget Sound Salmon Recovery Plan prepared by the Shared Strategy for Puget Sound. These documents constitute the Endangered Species Act Recovery Plan for the Puget Sound Chinook Salmon. The Final Supplement accepts the 2005 Skagit Chinook Recovery Plan developed by the Swinomish Indian Tribal Community, the Sauk-Suiattle Indian Tribe, and the WDFW as the local recovery plan for the Skagit Basin chapter of the greater Puget Sound. The Project is located within the Skagit Basin.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light has implemented specific salmon PME measures as noted above. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.14 National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales. Seattle, Washington. January 2008.

The purpose of this plan is to restore the endangered Southern Resident killer whale by reviewing and assessing potential factors affecting Southern Residents and detailing a recovery program to address each of the threats. The distribution of Southern Resident Killer whales is outside the Project boundary and is limited to the outer Pacific Ocean coast and inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound). However, the Project is located within the Skagit River Basin, which is hydrologically linked to the Puget Sound.

City Light is not proposing specific measures to address Southern Resident killer whales. However, City Light is proposing to address aquatic ecosystems and salmon populations, the prey of Southern Residents. Specifically, City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.15 National Marine Fisheries Service. 2019. ESA Recovery Plan for the Puget Sound Steelhead Distinct Population Segment (Oncorhynchus mykiss). Seattle, Washington. December 2019.

This plan provides guidance for the protection and recovery of Puget Sound steelhead, a listed threatened species under the federal Endangered Species Act (ESA). The purpose of this plan is to recover the species to the point that it can be self-sustaining in the natural environmental over the long term. This plan involves the Puget Sound distinct population segment, which includes all naturally spawned steelhead originating below natural and manmade impassible barriers in rivers flowing into the Puget Sound from the Elwha River. This area includes portions of the Project. Additionally, the plan details the need for coordinating management with the hydropower management sector.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. Specific to steelhead, City Light has conducted steelhead fry stranding surveys, implements specific flow measures for steelhead spawning, steelhead fry protection, and steelhead yearling protection. Additionally, City Light acquired conservation land that protects important migration, spawning, and rearing habitat for steelhead. Non-flow plan measures also benefit steelhead. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.16 Pacific Fishery Management Council. 2014. Eighteenth amendment to the fishery management plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California. Portland, Oregon. September 2014.

Amendment 18 revises the description and identification of essential fish habitat (EFH) for Pacific salmon managed under the Fisheries Management Plan, designates habitat areas of particular concern, updates information on fishing activities, and updates the list of non-fishing related activities that may adversely affect EFH and potential conservation and enhancement measures to minimize those effects. The amendment identifies the geographic extent of freshwater EFH as all water bodies currently or historically occupied by Council-managed salmon. The plan specifies that the EFH in the Project area extends to Gorge Lake Dam.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light has implemented specific salmon PME measures as noted above. City Light is proposing to: (1) consult with licensing participants (LPs) regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping

Program. Therefore, the Project, as proposed, is compliant with this plan.

7.17 Shared Strategy for Puget Sound. 2007. Puget Sound Salmon Recovery Plan. Seattle, Washington. January 2007.

The purpose of this plan is to recover self-sustaining, harvestable salmon runs in a manner that contributes to the overall health of Puget Sound and its watershed. NMFS adopted and expanded this recovery plan to meet its obligations under the ESA. The Project is included in the Puget Sound Salmon Recovery Region.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light has implemented specific salmon PME measures as noted above. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.18 Skagit River System Cooperative and Washington Department of Fish and Wildlife. 2005. Skagit Chinook Recovery Plan. La Conner, Washington.

This plan provides the basis of the Skagit Basin chapter of the greater Puget Sound Chinook recovery. The goal of this plan is to provide a detailed pathway by which Skagit Chinook populations can recover to sustained numbers that meet recovery goals established, by agreement, between fisheries co-managers. This plan applies to the Skagit River Basin, in which the Project resides.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light has implemented specific salmon PME measures as noted above. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.19 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. 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 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.

Under its current license, City Light has developed and currently operates recreational facilities along the Skagit River Wild and Scenic River. City Light also implements several fish and wildlife PME measures as described above. City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environment associated with the Project. City Light is not proposing additional PME measures as the Project is located upstream of the Skagit River Wild and Scenic River and does not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the wild and scenic river segment. Therefore, the Project, as proposed, is compliant with this statute.

7.20 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 the U.S. Fish and Wildlife Service (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, National Environmental Policy Act, and the FPA, among others. This policy applies to recreational fisheries at a national level, including those managed by USFWS and recreational fisheries managed in cooperation with the private sector.

Under its current Project license and Settlement Agreement, City Light implements a number of PME measures focused on fish and aquatic resources. City Light is proposing to: (1) consult with LPs regarding fish passage at Gorge Dam; (2) develop a Mainstem, Side Channel and Off-Channel Aquatic Habitat Enhancement Plan; (3) develop an Aquatic Invasive Species Management Plan; (4) develop an Anadromous Fish Flow Plan and Short-Term Anadromous Fish Flow Plan; (5) continue to remove potential upstream fish migration barriers; (6) continue funding the Rainbow Trout Broodstock Program; and (7) develop a Reservoir Fish Stranding and Trapping Program. Therefore, the Project, as proposed, is compliant with this plan.

7.21 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. This plan has an international scope and serves as a guide for the participation of various private organizations and the public in the conservation and management of waterfowl.

Under its current license, City Light implements wildlife-focused protection and enhancement measures, including the acquisition and management of wildlife mitigation lands, restoration of riparian and wetland habitats, monitoring for migratory birds, loons, and harlequin ducks, funding wildlife research grants, maintaining an Avian Protection Plan, and implementing helicopter noise protection measures. City Light is proposing to develop an Avian Species Protection Plan, a Wildlife Protection and Enhancement Plan, a Wildlife Mitigation Lands Management Plan, and to provide wildlife monitoring and research funds. Additionally, City Light proposes to implement management actions to protect or enhance wetland habitats along the Ross Lake shoreline that are consistent with woody debris management in the reservoir. City Light also anticipates including BMPs associated with Project noise generation. Therefore, the Project, as proposed, is compliant with this plan.

7.22 U.S. Forest Service. 1989. Okanogan National Forest land and resource management plan. Department of Agriculture, Okanogan, Washington.

This plan describes resource management practices, levels of resource production and management, and the availability and suitability of land for resource management for the Okanogan National Forest and those portions of the Wenatchee and Mt. Baker-Snoqualmie National Forests that are administered by the Okanogan National Forest. The plan is administered by Washington State Department of Natural Resources (DNR) on private and state lands and USFS on lands under its jurisdiction.

The Okanogan-Wenatchee National Forest abuts the Project to the east of Ross Lake; however, it is not within the Project Boundary. Under its current license, City Light provides capital funding to the United States Forest Service for O&M of multiple recreational sites within the Skagit River Wild and Scenic River System and along SR 20. Although City Light is not proposing new PME measures, consultation with the USFS will continue through the relicensing process. Therefore, the Project, as proposed, is compliant with this plan.

7.23 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. Portions of the Project are located within the Mt. Baker-Snoqualmie National Forest.

Under its current license, City Light has collaborated with agencies, Indian Tribes, and NGOs to identify and implement measures to protect and benefit botanical resources in the Project vicinity through land acquisition of wildlife mitigation lands, which includes prioritizing the management of old-growth forests and other priority habitats. City Light is proposing to develop a Vegetation Management Plan that will address special-status plant protection and protection of streams, wetlands, riparian areas, and other priority habitats. Additionally, City Light proposes to develop an Invasive Plants Management Plan, Wildfire Management Plan, and a Project Roads and Transmission Line ROW Management Plan that includes BMPs to protect natural resources from direct and indirect impacts from Project O&M activities. Therefore, the Project, as proposed, is compliant with this plan.

7.24 Washington Department of Ecology. 1986. Application of shoreline management to hydroelectric developments. Olympia, Washington. September 1986.

This document discusses general shoreline management at hydroelectric projects. These apply to all activities conducted by federal agencies or by holders of federal permits and licenses if those activities occur in, or may directly affect, land or waters in Washington’s 15 coastal counties.

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. City Light is proposing to develop a Reservoir Shoreline Erosion Management Plan that will include treatment, monitoring, and reporting of identified erosion sites. Additionally, City Light proposes to develop a Project Roads and Transmission Line ROW Management Plan, which will include the identification, treatment, monitoring, and reporting of erosion sites on Project roads. Therefore, the Project, as proposed, is compliant with this requirement.

7.25 Washington Department of Fisheries. 1987. Hydroelectric project assessment guidelines. Olympia, Washington.

These guidelines outline policies related to hydropower development, including guidance on conducting studies to assess potential impacts of a project and consultation with agencies. City Light is conducting several studies and will continue consultation throughout the relicensing process for the Project. Therefore, the Project, as proposed, is compliant with this guidance.

7.26 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.

Under its current license, City Light had developed and implemented wildlife-focused protection and enhancement measures including the acquisition and management of fish and wildlife mitigation lands, funding long-term ecological monitoring and wildlife education, providing wildlife research grants, implementing avian protection measures, and implementing helicopter noise protection measures. City Light is proposing to develop a Wildlife Mitigation Lands Management Plan to incorporate newly acquired lands and include site-specific management activities to protect or enhance wildlife habitat conditions. City Light is also proposing to develop a Wildlife Protection and Enhancement Plan and an Avian Species Protection Plan. Finally, City Light is proposing to provide wildlife monitoring and education funds and wildlife research grants for long-term ecological monitoring and to facilitate the development of improved methods for managing wildlife. Therefore, the Project, as proposed, is in compliance with this requirement.

7.27 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 Washington Natural Heritage Program 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.

City Light has consulted with WDFW regarding priority species and ecosystems and has identified the occurrence of 13 priority species and several priority habitats in Snohomish, Whatcom, and Skagit counties. City Light completed a Northern Goshawk Habitat Analysis study as requested by WDFW. City Light is proposing to develop a Wildlife Protection and Enhancement Plan, Avian Species Protection Plan, Wildlife Mitigation Lands Management Plan. These plans are expected to include measures for protecting and enhancing wildlife habitat and include BMPs to reduce O&M impacts. Additionally, City Light is proposing to provide wildlife monitoring and education funds and wildlife research grants. Therefore, the Project, as proposed, is in compliance with this requirement.

7.28 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.

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 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.

Under its current license, City Light has developed and currently operates recreational facilities along the Skagit River Wild and Scenic River. City Light also implements several fish and wildlife PME measures as described above. City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environmental associated with lands and facilities within the Project Boundary. City Light is not proposing additional PME measures as the Project is located upstream of the Skagit River Wild and Scenic River and does not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the wild and scenic river segment. Therefore, the Project, as proposed, is compliant with this statute.

7.29 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.

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 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.

Under its current license, City Light has developed and currently operates recreational facilities along the Skagit River Wild and Scenic River. City Light also implements several fish and wildlife PME measures as described above. City Light is proposing to develop a Visual Resources Management Plan to enhance visual resources and the scenic environmental associated with lands and facilities within the Project Boundary. City Light is not proposing additional PME measures as the Project is located upstream of the Skagit River Wild and Scenic River and does not invade the area or unreasonably diminish the scenic, recreational, and fish and wildlife values present in the wild and scenic river segment. Therefore, the Project, as proposed, is compliant with this statute.

7.30 Washington State Energy Office. 1992. Washington State hydropower development/resource protection plan. Olympia, Washington.

This plan is Washington’s first comprehensive hydropower plan, which directs that future development of hydropower and protection of river-related resources shall be guided by policies and programs that serve the broad public interest. These interests include the development of cost-effective electricity and conservation of river-related environmental values. This plan applies to new hydropower development at sites that do not have existing hydropower generation, and therefore does not apply to this Project.

7.31 Washington Department of Ecology. 1994. State wetlands integration strategy. Olympia, Washington. December 1994.

The State Wetlands Integration Strategy (SWIS) aims to develop and implement a more effective, efficient, and coordinated system to better protect the wetland resources of Washington State. The SWIS includes 47 recommendations that require a variety of actions for implementation: development of legislation or administrative rules, local government action, and state/ federal action regarding wetlands.

Under its current license, City Light has several existing PME measures for wetland habitats, including the acquisition of fish and wildlife mitigation lands that are accompanied by riparian and wetland habitat management priorities. City Light is proposing to develop a Vegetation Management Plan that will address the protection of streams, wetlands, riparian areas, and other priority habitats. Additionally, City Light is proposing to implement management actions to enhance or protect wetland habitats along the Ross Lake shoreline. City Light will also consider NPS riparian restoration activities conducted in Dry Creek Bay. Therefore, the Project, as proposed, is compliant with this strategy.

7.32 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. WDFW has developed statewide riparian management recommendations based on the best available science.

Under its current license, City Light has several existing PME measures for wetland habitats, including the acquisition of fish and wildlife mitigation lands that are accompanied by riparian and wetland habitat management priorities. City Light is proposing to develop a Vegetation Management Plan that will address the protection of streams, wetlands, riparian areas, and other priority habitats. Therefore, the Project, as proposed, is compliant with these recommendations.

7.33 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 United States Code [U.S.C.] 1531 et seq.). The plan covers approximately 1.6 million acres of state trust lands managed by the Washington DNR within the range of the northern spotted owl.

The land covered by the Habitat Conservation Plan includes all DNR-managed forest lands within the range of the northern spotted owl. City Light has collaborated with agencies, Indian Tribes, and NGOs to identify and implement measures to protect and benefit botanical resources in the Project vicinity through the proposed Wildlife Mitigation Lands Management Plan, which includes prioritizing the management of old-growth forests. Therefore, the Project, as proposed, is in compliance with this plan.

7.34 Washington Department of Fish and Wildlife. 2004. Management recommendations for Washington's priority species, Volume IV: Birds. Olympia, Washington. May 2004.

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. This document details recommendations pertaining to avian priority species.

Under its current license, City Light has developed and implemented wildlife-focused protection and enhancement measures including the acquisition and management of fish and wildlife mitigation lands, funding long-term ecological monitoring and wildlife education, providing wildlife research grants, implementing avian protection measures, and implementing helicopter noise protection measures. City Light has consulted with WDFW regarding priority species and ecosystems and is performing a Northern Goshawk Habitat Analysis study as requested by WDFW. City Light is proposing to develop an Avian Species Protection Plan to protect avian species. Additionally, City Light is proposing to develop a Vegetation Management Plan, which will include measures for protecting priority habitats. City Light is also proposing to develop an updated Wildlife Mitigation Lands Management Plan to incorporate newly acquired lands and include site-specific management activities to protect or enhance wildlife habitat conditions. Finally, City Light is proposing to develop a Wildlife Protection and Enhancement Plan that includes measures for Project O&M actions and BMPs, habitat management and enhancements, and monitoring and reporting. Therefore, the Project, as proposed, is in compliance with this requirement.

7.35 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.

As described above, City Light has developed and implemented wildlife-focused protection and enhancement measures. City Light is proposing to develop a Wildlife Protection and Enhancement Plan, Avian Species Protection Plan, Wildlife Mitigation Lands Management Plan. These plans are expected to include measures for protecting and enhancing wildlife habitat and include BMPs to reduce O&M impacts. Additionally, City Light is proposing to provide wildlife monitoring and education funds and wildlife research grants. City Light is proposing to develop a Vegetation Management Plan which will incorporate priority habitat protection. Therefore, the Project, as proposed, is in compliance with this requirement.

8.0 REFERENCES

Section 1.0 Introduction

Federal Energy Regulatory Commission (FERC). 2008. Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff. September 2008.

_____. 2020a. Scoping Document 1 for the Skagit River Hydroelectric Project, P-553-235. June 26, 2020.

_____. 2020b. Scoping Document 2 for the Skagit River Hydroelectric Project, P-553-235. December 4, 2020.

National Park Service (NPS). 2019. National Trails System Act Legislation. [Online] URL: https://www.nps.gov/subjects/nationaltrailssystem/national-trails-system-act-legislation.htm. Accessed September 20, 2019.

Seattle City Light (City Light). 1991. Offer of Settlement, Skagit River Hydroelectric Project, FERC No. 553. Seattle, WA. April 1991.

_____. 2011. Biological Evaluation Skagit River Hydroelectric Project License (FERC No. 553) Amendment: Addition of a Second Power Tunnel at the Gorge Development. June 2011.

_____. 2019. Power System Engineering Information.

_____. 2020a. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2020b. Proposed Study Plan (PSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2021. Revised Study Plan (RSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2021.

_____. 2022. Initial Study Report (ISR) for the Skagit River Hydroelectric Project, FERC Project No. 553. March 2022.

Wilderness Connect. 2019. Stephen Mather Wilderness. [Online] URL: https://wilderness.net/visit-wilderness/?ID=577. Accessed June 21, 2019.

Section 2.0 Consultation

Federal Energy Regulatory Commission (FERC). 2020a. Scoping Document 1 for the Skagit River Hydroelectric Project, P-553-235. June 26, 2020.

_____. 2020b. Scoping Document 2 for the Skagit River Hydroelectric Project, P-553-235. December 4, 2020.

Seattle City Light (City Light). 2020a. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2020b. Proposed Study Plan (PSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2021. Revised Study Plan (RSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2021.

_____. 2022. Initial Study Report (ISR) for the Skagit River Hydroelectric Project, FERC Project No. 553. March 2022.

Section 3.0 Proposed Action and Alternatives

Anderson, J.H.; Pess, G.R.; Carmichael, R.W.; Ford, M.J.; Cooney, T.D.; Baldwin, C.M.; and M. McClure. 2014. Planning Pacific Salmon and Steelhead Reintroductions Aimed at Long-Term Viability and Recovery, North American Journal of Fisheries Management, 34:1, 72-93.

Federal Energy Regulatory Commission (FERC). 2020. Scoping Document 2 for the Skagit River Hydroelectric Project, P-553-235. December 4, 2020.

McClure, M., J. Anderson, G. Pess, T. Cooney, R. Carmichael, C. Baldwin, J. Hesse, L. Weitkamp, D. Holzer, M. Sheer, and S. Lindley. 2018. Anadromous Salmonid Reintroductions: General Planning Principles for Long-Term Viability and Recovery. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-141. https://doi.org/10.7289/V5/TM-NWFSC-141

Seattle City Light (City Light). 2011. Biological Evaluation Skagit River Hydroelectric Project License (FERC No. 553) Amendment: Addition of a Second Power Tunnel at the Gorge Development. June 2011.

United States Army Corps of Engineers (USACE). 1967. Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA. May 1967.

_____. 2002. Skagit River Project, Water Control Manual. June 2002.

Section 4.0 Environmental Analysis

Section 4.1 General Description of the River Basin

Abatzoglou, J.T. and R. Barbero. 2014. Observed and projected changes in absolute temperature records across the contiguous United States. Geophysical Research Letters, Volume 41, Issue 18.

Abatzoglou J.T., D.E. Rupp, and P.W. Mote. 2014. Seasonal climate variability and change in the Pacific Northwest of the United States. Journal of Climate. Mar; 27(5):2125–42.

Annear, R. and D. Stuart. 2022. Downstream extent of temperature modeling. PowerPoint presentation given at the January 25, 2022 Skagit River Hydroelectric Project Water Quality Work Group Meeting.

Gergel, D.R., B. Nijssen, J.T. Abatzoglou, D.P. Lettenmaier, and M.R. Stumbaugh. 2017. Effects of climate change on snowpack and fire potential in the western USA. Climatic Change 141:287–299.

Granshaw, F. 2002. Glacier Change in the North Cascades National Park Complex, Washington State, USA, 1958-1998. Thesis. Portland State University, Portland, USA.

Hamlet, A. F., M. M. Elsner, G. S. Mauger, S. Y. Lee, I. Tohver, and R. A. Norheim. 2013. An overview of the Columbia Basin climate change scenarios project: Approach, methods, and summary of key results. Atmosphere-Ocean 51:392-415.

Kharin, V. V., F. W. Zwiers, X. Zhang, and M. Wehner. 2013. Changes in temperature and precipitation extremes in the CMIP5 ensemble. Climatic Change, 119, 345–357.

Lee, Se-Yeun, and A.F. Hamlet. 2011. Skagit River Basin Climate Science Report, a summary report prepared for Skagit County and the Envision Skagit Project by the Department of Civil and Environmental Engineering and The Climate Impacts Group at the University of Washington.

Luce, C.H., and Z.A. Holden. 2009. Declining annual streamflow distributions in the Pacific Northwest United States, 1948–2006. Geophysical Research Letters 36:1–6.

Luce, C.H., V. Lopez-Burgos, and Z. Holden. 2014. Sensitivity of snowpack storage to precipitation and temperature using spatial and temporal analog models. Water Resour.Res. 50, 9447–9462.

Marlier, M.E., M. Xiao, R. Engel, B. Livneh, J.T. Abatzoglou, and D.P. Lettenmaier. 2017. The 2015 drought in Washington State: a harbinger of things to come? Environmental Research Letters 12:114008.

Mauger, G.S., S. Y. Lee, C. Bandaragoda, Y. Serra, J.S. Won. 2016. Effect of Climate Change on the Hydrology of the Chehalis Basin. Report prepared for Anchor QEA, LLC. Climate Impacts Group, University of Washington, Seattle.

Mote, P.W., and E.P. Salathé Jr. 2010. Future climate in the Pacific Northwest. Climate Change 102(1):29-50.

National Oceanic and Atmospheric Administration (NOAA). 2022. National Weather Service, Seattle/Tacoma, WA – NOAA National Weather Data. Online [URL]: https://www.weather.gov/wrh/climate?wfo=sew. Accessed: August 1, 2022.

Neiman, P. J., L.J. Schick, F.M. Ralph, M. Hughes, and G.A. Wick. 2011. Flooding in western Washington: The connection to atmospheric rivers. Journal of Hydrometeorology, 12, 1337–1358.

Nigus, M, S. Richards, B. Taylor, and T. Haag. 2014. No ordinary fish tale: Design-build of a new powerhouse for Lower Baker. Hydro Review. 7:33. September 26, 2014.

Polade, S., D.W. Pierce, D.R. Cayan, A. Gershunov, and M.D. Dettinger. 2015. The key role of dry days in changing regional climate and precipitation regimes. Scientific Reports, 4, 4364.

Puget Sound Energy (PSE). 2004. Baker River Hydroelectric Project (FERC No. 2150), Application for New License, Major Project-Existing Dam, Volume I, Part 1 of 2, Exhibits A, B, C, D and H, 18 CFR, Part 4, Subpart F, Section 4.51. Prepared by Puget Sound Energy, Bellevue, Washington. April 2004.

Rauscher, S.A., J.S. Pal, N.S. Diffenbaugh, and M.M. Benedetti. 2008. Future changes in snowmelt-driven runoff timing over the western US. Journal of Geophysical Research: Atmospheres, 35:L16703.

Rupp, D.E., P. Mote, and J.T., Abatzaoglou. 2016. Projections of 21st century climate of the Columbia River Basin. Climate Dynamics 49(5-6):1-17.

Salathé, E.P., A.F. Hamlet, C.F. Mass, M. Stumbaugh, S-Y. Lee, R. Steed. 2014. Estimates of 21st Century Flood Risk in the Pacific Northwest Based on Regional Scale Climate Model Simulations. J. Hydrometeorology. 15, 1881–1899.

Stewart, I.T., D.R. Cayan, and M.D. Dettinger. 2004. Changes toward earlier streamflow timing across western North America, J. Clim.,18(8), 1136–1155.

Tohver, I.M., A.F. Hamlet, and S.Y. Li. 2014. Impacts of 21st-Century Climate Change on Hydrologic Extreme in the Pacific Northwest Region of North America. Journal of the American Water Resource Association, 50(6).

United States Army Corps of Engineers (USACE). 2013. Skagit River Basin, Skagit River flood risk management feasibility study. Final Report Hydrology Technical Documentation. August 2013.

United States Geological Survey (USGS). 2019. Stream Stats. [Online] URL: https://streamstats.usgs.gov/ss/. Accessed November 2019.

University of Idaho. 2019. The Climate Toolbox. [Online] URL: climatetoolbox.org. Accessed November 2019.

Section 4.2 Proposed Action and Action Alternatives

[No references]

Section 4.2.1 Geology and Soils

Armstrong, J., D. Crandell, D. Easterbrook, and J. Noble. 1965. Late Pleistocene stratigraphy and chronology in southwestern British Columbia and northwestern Washington. Geological Society of America Bulletin 76:321–330.

Cascades Volcano Observatory. 2019. Glacier Peak website. [Online] URL: https://volcanoes.usgs.gov/volcanoes/glacier_peak/glacier_peak_hazard_88.html. Accessed June 7, 2019.

Chennault, J.W. 2004. Modeling the contributions of glacial meltwater to streamflow in Thunder Creek, North Cascades National Park, Washington. WWU Graduate School Collection 442.

Debose, Alfonso, and Michael W. Klungland. 1983. Soil survey of Snohomish County Area, Washington.

Dragovich, Joe D., Robert L. Logan, Henry W. Schasse, Timothy J. Walsh, William S. Jr. Lingley, David K. Norman, Wendy J. Gerstel, Thomas J. Lapen, J. Eric Schuster, Karen D. Meyers. 2002. Geologic map of Washington--Northwest quadrant: Washington Division of Geology and Earth Resources Geologic Map GM-50, 3 sheets, scale 1:250,000, with 72 p. text.

Dubé, K., W. Megahan, and M. McCalmon. 2004. Washington road surface erosion model. Manual prepared for Washington Department of Natural Resources (DNR). February 20, 2004.

Ebasco Environmental and National Park Service (NPS). 1990. Skagit River Hydroelectric Project FERC No. 553 Erosion control plan. Submitted to FERC by City of Seattle City Light

Department. November 1990.

Granshaw, F. 2002. Glacier Change in the North Cascades National Park Complex, Washington State, USA, 1958-1998. Thesis. Portland State University, Portland, USA.

Hartson, R., and J. Shannahan. 2015. Inventory and Assessment of Hydromodified Bank Structures in the Skagit River Basin: Chinook Bearing Streams. Upper Skagit Indian Tribe, Sedro-Woolley, Washington.

Haugerud, R. and R. Tabor. 2009. Geologic Map of the North Cascade Range, Washington. USGS Scientific Investigations Map 2940.

Johnson, S.Y., S.V. Dadisman, and D.C. Mosher. 2001. Active tectonics of the Devil's Mountain fault and related structures, northern Puget Lowland and eastern Strait of Juan de Fuca region, Pacific Northwest. US Geological Survey, Professional Paper 1643.

Klungland, Michael W., and Michael McArthur. 1989. Soil survey of Skagit County Area, Washington.

National Park Service (NPS). 2016. Skagit River Hydroelectric Project (#553) Erosion Control and Revegetation Completion Report 2014-15.

_____. 2018. Skagit River Hydroelectric Project (#553) Erosion Control and Revegetation Completion Report 2016-17.

_____. 2020. Personal communication. Excel file emailed to Kathy Dubé (Watershed GeoDynamics) by Jon Riedel (NPS) on April 9, 2020

_____. 2021. Personal communication. GIS shapefile emailed to Kathy Dubé (Watershed GeoDynamics) by Sharon Sarrantonio (NPS) on November 3, 2021.

Porter, S. and T. Swanson. 1998. Radiocarbon age constraints on rates of advance and retreat of the Puget Lobe of the Cordilleran Ice Sheet during the last glaciation, Quaternary Research 50:205-213.

Riedel, J. 1990. Skagit River Project FERC # 553 Report on Existing Conditions of Reservoir and Streambank Erosion.

Riedel, J., B. Stoker, and J. Harbor. 1991. Skagit Hydroelectric Project Erosion Control Plan.

Riedel, J.L., R.A. Haugerud, and J.J. Clague. 2007. Geomorphology of a Cordilleran Ice Sheet drainage network through breached divides in the North Cascades Mountains of Washington and British Columbia. Geomorphology 91:1-18.

Riedel, J. L., P.T. Pringle, and R.L. Schuster. 2009. Deposition of Mount Mazama Tephra in a Landslide-Dammed Lake on the Upper Skagit River, Washington, USA. In Volcaniclastic Sedimentation in Lacustrine Settings (eds J. D. White and N. R. Riggs).

Riedel, J., S. Brady, S. Dorsch, N. Bowerman, and J. Wenger. 2012. Geomorphology of the Upper Skagit watershed: Landform mapping at North Cascades National Park Service Complex, Washington. Natural Resource Technical Report NPS/NCCN/NRTR—2012/568. National Park Service, Fort Collins, Colorado.

Schoblom, A. 2021. Personal communication between Alan Schoblom (NPS Skagit District Maintenance Supervisor) and Kathy Dubé (Watershed GeoDynamics), November 4-5, 2021.

Seattle City Light (City Light). 2020. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project FERC No. 553. April 2020.

_____. 2022a. GE-01 Reservoir Shoreline Erosion Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Watershed GeoDynamics. March 2022.

_____. 2022b. GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-Of-Way Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by American Forest Management, Inc., Shannon and Wilson, Inc., and Watershed GeoDynamics. March 2022.

_____. 2022c. GE-03 Sediment Deposition in Reservoirs Affecting Resource Areas of Concern Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Watershed GeoDynamics. March 2022.

Sherrod, Brian L.; Richard J. Blakely, Craig S. Weaver, Harvey M. Kelsey, Elizabeth Barnett, Lee Liberty, Karen L. Meagher, Kristin Pape. 2008. Finding concealed active faults--Extending the southern Whidbey Island fault across the Puget Lowland, Washington: Journal of Geophysical Research, v. 113.

Skagit Climate Science Consortium. 2015. Identify Modern, and Project Future, Glacial Contribution to Summer Stream Flows in the Skagit River Watershed. [Online] URL: http://www.skagitclimatescience.org/research/current-research/riedel-glacier-modeling/ Accessed October 17, 2022.

Tabor, R. and R. Haugerud. 1999. Geology of the North Cascades: A mountain mosaic. The Mountaineers, Seattle, Washington, USA.

The Diggings 2019. Online Mining Claim Database. [Online] URL: https://thediggings.com/. Accessed May 10, 2019.

United States Army Corps of Engineers (USACE). 1994. Channel stability assessment for flood control projects. Engineering manual 1110-2-1418. October 1994.

United States Department of Agriculture (USDA). 2019. Web Soil Series, Barneston Series. [Online] URL: https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BARNESTON.html. Accessed June 9, 2019.

United States Department of Agriculture (USDA). 2019. Natural Resources Conservation Service and U.S. Department of Interior, National Park Service. Soil survey of North Cascades national park Complex, Washington

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transactions of American Geophysical Union 35: 951-956.

Section 4.2.2 Water Resources

Archambault, C. (NPS). 2022. Personal communication via email between Carmen Archambault (NPS) and Jeff Fisher (Seattle City Light). August 3, 2022.

Barnett, T. P., D.P. Pierce, H.G. Hidalgo, C. Bonfils, B.D. Santer, T. Das, B. Govindasamy, A.W. Wood, T. Nozawa, A.A. Mirin, D.R., Cayan, M.D. Dettinger. 2008. Human-induced changes in the hydrology of the western United States. Science, 319, 1080–1083.

Connor, E. 2016. Gorge Bypass Reach. Seattle City Light Unpublished Technical Memorandum.

Connor, E. 2019. Personal communication between Ed Connor, Seattle City Light and R. Filbert, HDR, May 9, 2019 and transmittal of unpublished NPS and City Light water quality data.

Dettinger, M. 2011. Climate change, atmospheric rivers, and floods in California - a multimodel analysis of storm frequency and magnitude changes. , Journal of the American Water Resources Association 347, 514-523.

Elsner, M.M., L. Cuo, N. Voisin, J. S. Deems, A. F. Hamlet, J. A. Vano, K. E. B. Mickelson, S. Y. Lee, and D. P. Lettenmaier. 2010. Implications of 21st century climate change for the hydrology of Washington State, Climatic Change.

Gergel, D.R., B. Nijssen, J.T. Abatzoglou, D.P. Lettenmaier, and M.R. Stumbaugh. 2017. Effects of climate change on snowpack and fire potential in the western USA. Climatic Change 141:287–299.

Gordon, Robert. 2021. Personal communication via email between Robert Gordon (City Light) and Mike Bonoff (Meridian Environmental, Inc.). November 10, 2021.

Grosell M, R. M. Gerdes, K. V. Brix. 2006. Chronic toxicity of lead to three freshwater invertebrates--*Brachionus calyciflorus*, *Chironomus tentans*, and *Lymnaea stagnalis*. Environ Toxicol Chem. 2006 Jan 25(1):97-104. doi: 10.1897/04-654r.1. PMID: 16494229.

Hamlet, A.F., and Lettenmaier, D.P., 2007. Effects of 20th Century Warming and Climate Variability on Flood Risk in the Western U.S. Water Resources Research, 43, W06427.

Hamlet, A. F., M. M. Elsner, G. S. Mauger, S. Y. Lee, I. Tohver, and R. A. Norheim. 2013. An overview of the Columbia Basin climate change scenarios project: Approach, methods, and summary of key results. Atmosphere-Ocean 51:392-415.

Hart Crowser. 2013. Piezometer installation and testing, Diablo, Washington. Prepared by A. Goodwin and R. Stainsby, Hart Crowser. July 2013.

Johnson, A., K. Seiders, and D. Norton. 2010. An Assessment of the PCB and Dioxin Background in Washington Freshwater Fish, with Recommendations for Prioritizing 303(d) Listings. Washington State Department of Ecology, Olympia, WA. Publication No. 10-03-007. January 2010. https://fortress.wa.gov/ecy/publications/SummaryPages/1003007.html.

_____. and M. Friese. 2013. An Assessment of the Chlorinated Pesticide Background in Washington State Freshwater Fish and Implications for 303(d) Listings. Washington State Department of Ecology, Olympia, WA. Publication No. 13-03-007. January 2013. https://fortress.wa.gov/ecy/publications/SummaryPages/1303007.html.

Johnston, J.M. 1989. Ross Lake: the Fish and Fisheries. Report No. 89-6. Fisheries Management Division, Washington Department of Wildlife, Olympia. 170 pp.

Lavers, D.A., R.P. Allan, G. Villarini, B. Lloyd-Hughes, D.J. Brayshaw, and A.J. Wade. 2013. Future changes in atmospheric rivers and their implications for winter flooding in Britain. Environmental Research Letters, 8 (2013) 034010.

Lee, Se-Yeun, and A.F. Hamlet. 2011. Skagit River Basin Climate Science Report, a summary report prepared for Skagit County and the Envision Skagit Project by the Department of Civil and Environmental Engineering and The Climate Impacts Group at the University of

Washington.

Looff, A.C. 1995. Ross Lake Rainbow Trout Study 1994-95 Final Report. SEEC Project No. 94-08. Washington Department of Fish and Wildlife, Fisheries Management Division. Olympia.

Luce, C.H., and Z.A. Holden. 2009. Declining annual streamflow distributions in the Pacific Northwest United States, 1948–2006. Geophysical Research Letters 36:1–6.

Luce, C.H., V. Lopez-Burgos, and Z. Holden. 2014. Sensitivity of snowpack storage to precipitation and temperature using spatial and temporal analog models. Water Resour.Res. 50, 9447–9462.

Marlier, M.E., M. Xiao, R. Engel, B. Livneh, J.T. Abatzoglou, and D.P. Lettenmaier. 2017. The 2015 drought in Washington State: a harbinger of things to come? Environmental Research Letters 12:114008.

Mote, P. W., A. F. Hamlet, M. P. Clark, and D. P. Lettenmaier. 2005. Declining mountain snowpack in western North America. Bull. Am. Meteorol. Soc. 86, 39–49.

Mote, P.W., D.E. Rupp, S. Li, D.J. Sharp, F. Otto, P.F. Uhe, M. Xiao, D.P. Lettenmaier, H. Cullen, and M.R. Allen. 2016. Perspectives on the causes of exceptionally low 2015 snowpack in the western United States. Journal of Geophysical Research: Atmospheres, 43:10-980–988.

Neiman, P. J., L.J. Schick, F.M. Ralph, M. Hughes, and G.A. Wick. 2011. Flooding in western Washington: The connection to atmospheric rivers. Journal of Hydrometeorology, 12, 1337–1358.

Rauscher, S.A., J.S. Pal, N.S. Diffenbaugh, and M.M. Benedetti. 2008. Future changes in snowmelt-driven runoff timing over the western US. Journal of Geophysical Research: Atmospheres, 35:L16703.

Salathé, E.P., A.F. Hamlet, C.F. Mass, M. Stumbaugh, S-Y. Lee, R. Steed. 2014. Estimates of 21st Century Flood Risk in the Pacific Northwest Based on Regional Scale Climate Model Simulations. J. Hydrometeorology. 15, 1881–1899.

Seattle City Light (City Light). 2011. Biological Evaluation Skagit River Hydroelectric Project License (FERC No. 553) Amendment: Addition of a Second Power Tunnel at the Gorge Development. June 2011.

_____. 2020. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2022a. FA-02 Instream Flow Model Development Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Northwest Hydraulic Consultants, Inc. and HDR Engineering, Inc.

_____. 2022b. GE-04 Skagit River Geomorphology between Gorge Dam and the Sauk River Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Natural Systems Design, Inc., Northwest Hydraulic Consultants, Inc., and Fain Environmental.

_____. 2022c. FA-01a Water Quality Monitoring Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Meridian Environmental, Inc. and Four Peaks Environmental, Inc.

_____. 2022d. FA-01b Water Quality Model Development Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Geosyntec Consultants, Inc. and Northwest Hydraulic Consultants, Inc.

_____. 2022e. FA-05 Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Northwest Hydraulic Consultants, Inc. and HDR Engineering, Inc.

_____. 2022f. GIS-Based Reservoir Littoral Zone Evaluation, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Four Peaks Environmental, Inc.

Seiders, K. and C. Deligeannis. 2009. Washington State Toxics Monitoring Program: Freshwater Fish Tissue Component, 2007. Washington State Department of Ecology, Olympia, WA. Publication No. 09-03-003.

_____. 2018. Freshwater Fish Contaminant Monitoring Program, 2015 Results. Washington State Department of Ecology, Olympia, WA. Publication No. 18-03-011. March 2018.

Seiders, K., C. Deligeannis, P. Sandvik, and M. McCall. 2014. Washington State Toxics Monitoring Program: Contaminants in Fish Tissue from Freshwater Environments in 2012. Washington State Department of Ecology, Olympia, WA. Publication No. 14-03-020. https://fortress.wa.gov/ecy/publications/summarypages/1403020.html.SPU Geotechnical Engineering 2013.

SPU Geotechnical Engineering. 2013. Geotechnical memorandum, Diablo facility – large onsite sewage systems (LOSS) project, subsurface infiltration characteristics. Prepared by S. Caraway and A. Clark, SPU Geotechnical Engineering. April 2013.

Stewart, I.T., D.R. Cayan, and M.D. Dettinger. 2004. Changes toward earlier streamflow timing across western North America, J. Clim.,18(8), 1136–1155.

Stober, Q.J., S.C. Crumley, D.E. Fast, E.S. Killebrew, R.M. Woodin, G. Engman, and G. Tutmark. 1982. Effects of Hydroelectric Discharge Fluctuation on Salmon and Steelhead in the Skagit River, Washington. Final report: December 1979 to December 1982. Prepared for the City of Seattle, Department of Lighting, Office of Environmental Affairs, Seattle, Washington. 174 pp.

Tohver, I.M., A.F. Hamlet, and S.Y. Li. 2014. Impacts of 21st-Century Climate Change on Hydrologic Extreme in the Pacific Northwest Region of North America. Journal of the American Water Resource Association, 50(6).

U.S. Climate Data. 2019. U.S. climate data. [Online] URL: https://www.usclimatedata.com/climate/washington/united-states/3217. Accessed November 2019.

United States Army Corps of Engineers (USACE). 1967. Details of Regulation for Use of Storage Allocated for Flood Control in Ross Reservoir, Skagit River, WA. May 1967.

_____. 2002. Skagit River Project, Water Control Manual. June 2002.

_____. 2013. Skagit River Basin, Skagit River Flood Risk Management Feasibility Study. Final Report Hydrology Technical Documentation. August 2013.

United States Environmental Protection Agency (EPA). 2007. Aquatic Life Ambient Freshwater

Quality Criteria–Copper, 2007 Revision. Office of Water 4304T. EPA-822-R-07-001, February 2007.

_____. 2002. Methods for Evaluating Wetland Condition: Wetlands Classification. Office of Water, U.S. Environmental Protection Agency, Washington, DC. EPA-822-R-02-017, accessed online 10/18/2022, https://www.epa.gov/sites/default/files/documents/wetlands_7classification.pdf

United States Geological Survey (USGS). 2019a. Stream Stats. [Online] URL: https://streamstats.usgs.gov/ss/. Accessed November 2019.

_____. 2019b. USGS National Water Information System: Web Interface. [Online] URL: https://nwis.waterdata.usgs.gov/wa/nwis/uv/?cb_00060=on&cb_00060=on&format=rdb&site_no=12178000&period=&begin_date=2014-12-01&end_date=2015-03-31. Accessed November 2019.

Washington Department of Ecology (Ecology). 2014. 2014 Washington State Water Quality Assessment. [Online] URL: https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d. Accessed April 12, 2019.

_____. 2016. Water Resources Program, Focus on water availability, Upper Skagit Watershed WRIA 4. Revised November 2016.

_____. 2022. Freshwater Information Network, Environmental Information Management System. [Online] URL: https://apps.ecology.wa.gov/eim/search/SMP/RiverStreamSingleStationOverview.aspx?FocusTab=True&ResultType=RiverStreamDiscreteList&RiverStreamSearchResults&StudyMonitoringProgramUserId=RiverStream&StudyMonitoringProgramUserIdSearchType=Equals&LocationUserIds=04A100&LocationUserIdSearchType=Equals&LocationUserIDAliasSearchFlag=True. Accessed July 22, 2022.

Warner, M. D., C. F. Mass, and E. P. Salathé. 2015. Changes in winter atmospheric rivers along the North American West Coast in CMIP5 climate models. J. Hydrometeor., 16, 118–128.

Zhang, Y., B. Qin, W. Hu, S. Wang, Y. Chen, and W. Chen. 2006. Temporal-spatial variations of euphotic depth of typical lake regions in Lake Taihu and its ecological environmental significance. Science in China Series D 49(4):431–42. doi: 10.1007/s11430-006-0431-4.

Section 4.2.3 Fish and Aquatics Resources

Anaka, R.J., K.J. Scott, and R.A. Masson. 2012. Snorkel survey of trout and char in the Canadian Skagit River, 2011, dated May 2012. Prepared for Skagit Environmental Endowment Commission, Ministry of Environment, North Vancouver, British Columbia, CA, Prepared by Scott Resource Services Inc. Mission, British Columbia, CA. B.C., Project No. 540.04.

Anthony, H.D., R.S. Glesne. 2014. Upper Skagit River Reservoir Fish Population Monitoring, 2010 - 2012. Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Anthony, H.D., and A.K. Rawhouser. 2017. Ross Lake creel survey, 2011. Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Araki, H., B. A. Berejikian, M. J. Ford, and M. S. Blouin. 2008. Fitness of hatchery-reared salmonids in the wild. Evolutionary Applications 1: 342– 355.

Armstrong, J., D. Crandell, D. Easterbrook, and J. Noble. 1965. Late Pleistocene stratigraphy and chronology in southwestern British Columbia and northwestern Washington. Geological Society of America Bulletin 76:321–330.

Baird, R. W. 2001. Status of killer whales, *Orcinus orca*, in Canada. Canadian Field-Naturalist 115:676- 701.

Baird R.W., J. Mann, R.C. Connor, P.L. Tyack, and H. Whitehead. 2000. The killer whale-foraging specializations and group hunting, Cetacean societies: field studies of dolphins and whales, Chicago (IL)University of Chicago Press (pg. 127-153).

Barnhart, Roger A. 1991. Trout. Edited by Judith Stolz and Judith Schnell. The Wildlife Series.

Barrett-Lennard, L.G. 2000. Population structure and mating patterns of killer whales (*Orcinus orca*) as revealed by DNA analysis. Ph.D. Dissertation, University of British Columbia, Vancouver, BC, Canada. 97 p.

Bauersfeld, K. 1978. Stranding of Juvenile Salmon by Flow Reductions at Mayfield Dam on the Cowlitz River. WDF, Olympia, WA, Tech. Rep. 36:36pp.

Beamer, E. M., B. Hayman, and D. Smith. 2005a. Linking freshwater rearing habitat to Skagit Chinook salmon recovery: Appendix C of the Skagit Chinook recovery plan. Report by Skagit River System Cooperative, La Conner, Washington.

Beamer, E., B. Hayman, and S. Hinton. 2005b. Linking Watershed Conditions to Egg-to-Fry Survival of Skagit Chinook Salmon. Appendix B to Skagit River System Cooperative and Washington Department of Fish and Wildlife (2005). Skagit River Chinook Recovery Plan.

Beauchamp, D. A. (in development). Factors limiting native salmonids above Skagit River dams study (Food Web Study). U.S. Geological Survey.

Beck Associates, R.W. 1989. Skagit River Salmon and Steelhead Fry Stranding Studies. Prepared by R.W. Beck Associates for the Seattle City Light Environmental Affairs Division, March 1989. Seattle, WA, 300 pp.

Bell, M.C. 1986. Fisheries Handbook of Engineering Requirements and Biological Criteria. U.S. Army Corps of Engineers, Office of the Chief of Engineers, Fish Passage Development and Evaluation Program, Portland, Oregon.

_____. 1990. Fisheries Handbook of Engineering Requirements and Biological Criteria, 3rd Edition. Fish Passage Development and Evaluation Program, U.S. Army Corps of Engineers, North Pacific Division, Portland, OR.

Bell, E., Kramer, S., Zajanc, D., and J. Aspittle. 2008. Salmonid fry stranding mortality associated with daily water level fluctuations in Trail Bridge Reservoir, Oregon. North American Journal of Fisheries Management 28:1515-1528.

Bigg, M. 1982. An assessment of killer whale (*Orcinus orca*) stocks off Vancouver Island, British Columbia. Report of the International Whaling Commission 32:655-666. https://www.noaa.gov/sites/default/files/legacy/document/2020/Oct/07354626357.pdf.

Bigg, M.A., P.F. Olesiuk, G.M. Ellis, J.K.B. Ford, and K.C. Balcomb. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Report of the International Whaling Commission, Special Issue 12:383-398.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of Salmonids in streams. American Fisheries Society, Special Publication 19:83–138.

Bodensteiner, L. 2020. Assessment of resident rainbow trout contribution to returning adult steelhead in the Skagit River, WA. Final Report to the Upper Skagit Indian Tribe. WWU Project #54130. Department of Environmental Sciences, Western Washington University, Bellingham, WA.

British Columbia Ministry for Environment. 2008. Upper Skagit Watershed Fish and Wildlife Management Plan. Lower Mainland Region, Ecosystem Branch, Environmental Stewardship Division.

Burgner, R.L. 1991. The life history of sockeye salmon (*Oncorhynchus nerka*). In C. Groot and L. Margolis (eds.), Pacific salmon life histories, p. 3-117. Univ. B.C. Press, Vancouver, B.C.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (*Oncorhynchus mykiss*) in offshore waters of the North Pacific Ocean. Int. North Pac. Fish. Comm. Bull. 51.

Burnett, K.M., G.H. Reeves, D.J. Miller, S. Clarke, K. Vance-Borland, K. Christiansen. 2007. Distribution of salmon-habitat potential relative to landscape characteristics and implications for conservation. Ecological Applications, 17(1), pages 66-80.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Technical Memorandum NMFS-NWFSC-27.

Čada, G.F., and P.E. Schweizer. 2012. The application of traits-based assessment approaches to estimate the effects of hydroelectric turbine passage on fish populations. Oak Ride National Laboratory ORNL/TM-2012/110. Prepared for the U.S. Department of Energy. April 2012.

Carretta, J.W., E.M. Olson, K.A. Forney, M.M. Muto, D.W. Weller, A.R. Lang, J. Baker, B. Hanson, A.J. Orr, J. Barlow, J.E. Moore, R.L. Brownell. 2021. U.S. Pacific Marine Mammal Stock Assessments: 2020. NOAA- TM-NMFS-SWFSC-646.

Cauvel, K. 2019. Skagit River Chum returns continue to decline. [Online] URL: https://www.goskagit.com/news/local_news/skagit-river-chum-returns-continue-to-decline/article_b94adf5b-aeee-5beb-b5ef-60f9a410ab03.html.

Center for Whale Research. 2021. https://www.whaleresearch.com/orcasurvey.

Center for Whale Research. 2022. Southern Resident killer whale Census 2022 https://www.whaleresearch.com/orca-population.

Collins, B.D. 1998. Preliminary assessment of historic conditions of the Skagit River in the Fir Island area: implications for salmonid habitat restoration. Report to Skagit River System Cooperative, La Conner, WA, 72p.

Connor, E. 2016. Gorge Bypass Reach. Seattle City Light Unpublished Technical Memorandum.

Connor, E., and D. Pflug. 2004. Changes in the Distribution and Density of Pink, Chum, and Chinook Salmon Spawning in the Upper Skagit River in Response to Flow Management Measures. North American Journal of Fisheries Management 24: 835-852.

Connor, E., Lowery, E., Light, S.C., Hartson, R., Tribe, U.S.I., Brocksmith, R. and Council, S.W. 2015. Tributary assessment for potential Chinook Salmon rearing habitat and recommendations for prioritizing habitat protection and restoration.

Conte, F.S., S.I. Doroshov, P.B. Lutes, and E.M. Strange. 1988. Hatchery Manual for the White Sturgeon (Acipenser transmontanus) with Application to Other North American Acipenseridae. Cooperative Extension, University of California, Division of Aquaculture and Natural Resources, Publication 3322.

Cooper, E.J., A.P. O'Dawd, J.J. Graham, D.W. Mierau, W.J. Trush, and R. Taylor. 2020. Salmonid habitat and population capacity estimates for steelhead trout and Chinook salmon upstream of the Scott Dam in the Eel River, California. NW. Sci. 94(1):70-96.

Cramer, S. P., and N. K. Ackerman. 2009a. Linking stream carrying capacity for salmonids to habitat features. In E. E. Knudsen and J. H. Michael Jr. (editors), American Fisheries Society Symposium 71, American Fisheries Society, Bethesda, MD. Pp. 225-254.

_____. 2009b. Prediction of stream carrying capacity for steelhead trout: the Unit Characteristic Method. In E. E. Knudsen and J. H. Michael Jr. (editors), American Fisheries Society Symposium 71, American Fisheries Society, Bethesda, MD. Pp. 255-288.

Derenne, E. 2014. Dietary characteristics of juvenile trout and char in seasonally inundated stream segments in Ross Lake, Washington. Masters Thesis, Western Washington University. WWU Graduate School Collection 382, https://cedar.wwu.edu/wwuet/382.

Downen, M. 2004. North Cascades National Park high lakes fishery management: historic, current, and proposed future management of sport fish in high-elevation park lakes. Washington Department of Fish and Wildlife, La Conner, WA.

_____. 2006. Skagit Bull Trout Monitoring Program: 2002-2005 report. Report prepared for Seattle City Light. WDFW, La Conner, Washington.

_____. 2014. Final report: Ross Lake rainbow broodstock program, upper Skagit reservoir fish community surveys and management plan, dated September, 2014. Washington Department of Fish and Wildlife, Shelton, WA.

Duda, J. (in development). Intrinsic Potential modeling of salmonid habitat in tributaries to Skagit River Project reservoirs. U.S. Geological Survey.

Eaton, B. 2007. The University of British Columbia Regime Model (UBCRM) - User's manual: Draft. University of British Columbia. Vancouver, BC pp.

Eckmann, M. 2015. Bioenergetic Evaluation of Diel Vertical Migration by Bull Trout. Master's Thesis, Oregon State University.

Envirosphere. 1988. Study of Skagit Dams Original Impacts on Wildlife and Fish Habitats and Populations. Final report prepared for Seattle City Light by Envirosphere Company, Bellevue, Washington.

Envirosphere. 1989. Skagit River Project, Submitted to the FERC in Response to a Request for

Supplemental Environmental Information FERC No. 553. Submitted October 31, 1989.

Electric Power Research Institute (EPRI). 1997. Turbine Entrainment and Survival Database – Field Tests. Prepared by Alden Research Laboratory, Inc., Holden, Massachusetts. EPRI Report No. TR-108630. October 1997Department of Energy, Energy Efficiency and Renewable Energy. PNNL-15370. Richland, VA.

Federal Energy Regulatory Commission (FERC). 2006. Final Environmental Impact Statement for the Baker River Hydroelectric Project No. 2150-033. September 8, 2006.

Federal Power Commission Bureau of Power. 1974. Final Environmental Impact Statement Ross Development of Project No. 553 Skagit River, Washington. March 1974.

Federal Register (FR). 1999. Endangered and threatened wildlife and Plants; determination of threatened status for bull trout in the coterminous United States. A rule by the Department of Interior, Fish and Wildlife Service, 50-CFR Part 17 RIN 1018-AF01, November 1, 1999.

Ford, J.K.B. and G.M. Ellis. 1999. Transients: mammal-hunting killer whales of British Columbia, Washington, and southeastern Alaska. UBC Press, Vancouver, British Columbia.

_____. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. Marine Ecology Progress Series 316:185-199.

Ford, J.K.B., G.M. Ellis, and K.C. Balcomb. 2000. Killer whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. 2nd ed. UBC Press, Vancouver, British Columbia.

Ford, J.K.B., J.F. Pilkington, A. Reira, M. Otsuki, B. Gisborne, R.M. Abernethy, E.H. Stredulinsky, J.R. Towers, and G.M. Ellis. 2017. Habitats of special importance to resident killer whales (*Orcinus orca*) off the west coast of Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/035. viii + 57 p.

Ford, M.J., editor. 2022. Biological Viability Assessment Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-171.

Ford, M., T. Cooney, P. McElhany, N. J. Sands, L. Weitkamp, J. J. Hard, M. McClure, R. Kope, J. M. Myers, A. Albaugh, K. Barnas, D. Teel, P. Moran, and J. Cowen. 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113.

Furey, N.B., S.G. Hinch, A.G. Lotto, and D.A. Beauchamp. 2015. Extensive feeding on sockeye salmon *Oncorhynchus nerka* smolts by bull trout *Salvelinus confluentus* during initial outmigration into a small, unregulated and inland British Columbia river. Journal of Fish Biology, 86, 392–401.

Furey, N.B., S.G. Hinch, M.G. Mesa, and D.A. Beauchamp. 2016. Piscivorous fish exhibit temperature-influenced binge feeding during an annual prey pulse. Journal of Animal Ecology, 85, 1,307–1,317.

Gibbs, G. 1858. Notebooks of scientific observations of the Pacific Northwest.

Goetz, F. 1989. Biology of the Bull Trout (*Salvelinus confluentus*) a literature review. Willamette

National Forest. Eugene, Oregon.

Gonor, J.G., J.R. Sedell, and P.A. Benner. 1988. What we know about large trees in estuaries, in the sea, and on coastal beaches. In: Maser, Chris; Tarrant, Robert F.; Trappe, James M.; Franklin, Jerry F., tech. eds. 1988. From the forest to the sea: a story of fallen trees. Gen. Tech. Rep. PNW-GTR-229. 153 p.

Gunkel, S.L., A.R. Hemmingsen, J.L. Li. 2002. Effects of Bull Trout and Brook Trout interactions on foraging habitat, feeding behavior, and growth. Transactions of the American Fisheries Society 131:1119-1130.

Hanson, B., R.W. Baird, and G. Schorr. 2005. Focal behavioral observations and fish-eating killer whales: improving our understanding of foraging behavior and prey selection. Abstract at the 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California.

Hard, J.J., R.G. Kope, W.S. Grant, F.W. Waknitz, L.T. Parker, and R.S. Waples. 1996. Status review of pink salmon from Washington, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-25, 131 p.

Hard, J.J., J.M. Myers, M.J. Ford, R G. Cope, G.R. Pess, R S. Waples, G.A. Winans, B.A. Berejikian, F.W. Waknitz, P.B. Adams, P.A. Bisson, D.E. Campton, and R.R. Reisenbichler. 2007. Status review of Puget Sound Steelhead (*Oncorhynchus mykiss*). U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-81.

Hard, J.J., J.M. Myers, E.J. Connor, R.A. Hayman, R.G. Kope, G. Lucchetti, A.R. Marshall, G.R. Pess, and B.E. Thompson. 2015. Viability criteria for Steelhead within the Puget Sound distinct population segment. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-129.

Hartson, R., and J. Shannahan. 2015. Inventory and Assessment of Hydromodified Bank Structures in the Skagit River Basin: Chinook Bearing Streams. Upper Skagit Indian Tribe, Sedro-Woolley, Washington.

Hauser, D.D.W. 2006. Summer space use of Southern Resident killer whales (*Orcinus orca*) within Washington and British Columbia inshore waters. Ms Thesis. University of Washington.

Hayes, M.C., R. Hays, S.P. Rubin, D.M. Chase, M. Hallock C. Cook-Tabor, C.W. Luzier, and M.L. Moser. 2013. Distribution of Pacific Lamprey *Entosphenus tridentatus* in watersheds of Puget Sound based on smolt monitoring data. Northwest Science 87:95-105.

HDR. 2022. Woody debris management summary of activities to date memorandum. Skagit River Hydroelectric Project FERC No. 553. Prepared for Seattle City Light. Prepared by HDR Inc. March 2022.

Healey, M.C. 1991. The Life History of Chinook Salmon (*Oncorhynchus tshawytscha*). In C. Groot and L. Margolis (eds.), Pacific Salmon Life Histories, p. 311-393. Univ. B.C. Press, Vancouver, B.C.

Heard, W.R. 1991. Life history of pink salmon. In Pacific salmon life histories. Edited by C. Groot and L. Margolis. University of British Columbia Press, Vancouver.

Heimlich-Boran, J. R. 1988. Behavioral Ecology of Killer Whales (*Orcinus Orca*) in the Pacific Northwest. Canadian Journal of Zoology 6(3): 565-578.

Heyning, J.E., Dahlheim, M.E. *Orcinus orca*, Mammalian Species, Issue 304, 15 January 1988, Pages 1–9.

Hoelzel, A. R., M. E. Dahlheim, and S. J. Stern. 1998. Low genetic variation among killer whales (*Orcinus orca*) in the eastern North Pacific, and genetic differentiation between foraging specialists. J. Hered. 89:121-128.

Hudson, J.M, B.P. Silver, J.R. Cook, and T.A. Whitesel. 2017. Effective population size, connectivity, and occupancy of bull trout: tools to assist in recovery, 2005-2013 synthesis report. U.S. Fish and Wildlife Service, Columbia River Fish & Wildlife Conservation Office, Vancouver, Washington.

Ihnat, J.M. and R.V. Bulkley. 1984. Influence of Acclimation Temperature and Season on Acute Temperature Preference of Adult Mountain Whitefish (*Prosopium williamsoni*). Environmental Biology of Fishes, 11:29-40.

Johnson, O.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U. S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-32, 280 p.

Johnson, R.C., D.A. Beauchamp, and J.D. Olden. In revision. Bioenergetics model for the invasive Redside Shiner (*Richardsonius balteatus*). Transactions of the American Fisheries Society.

Johnston, J.M. 1989. Ross Lake: the Fish and Fisheries. Report No. 89-6. Fisheries Management Division, Washington Department of Wildlife, Olympia. 170 pp.

Kassler, T.W. and K.I. Warheit. 2012. Genetic evaluation of steelhead and resident rainbow trout in the Skagit River Basin. Saltonstall-Kennedy Skagit River Steelhead Program.

Katopodis, C. and R. Gervais. 2016. Fish swimming performance database and analyses. Prepared for Fisheries and Oceans Canada, Central and Arctic Region. January 2016.

Kendall, N.W., J.R. McMillan, M.R. Sloat, T.W. Buehrens, T.P. Quinn, G.R. Pess, K.V. Kuzishchin, M.M. McClure, R.W. Zabela. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. Canadian Journal of Fisheries and Aquatic Sciences, 2015, 72(3): 319-342.

Kinsel, K., M. Zimmerman, L. Kishimoto, and P. Topping. 2008. 2007 Skagit River Wild 0+ Chinook Production Evaluation. Annual Rept. to Salmon Recovery Funding Board. WDFW, Olympia, Washington. 62 pp.

Krahn, M. M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, and R. S. Waples. 2004. 2004 status review of southern resident killer whales (*Orcinus orca*) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-62, U.S. Department of Commerce, Seattle, Washington.

Krahn, M. M., P. R. Wade, S. T. Kalinowski, M. E. Dahlheim, B. L. Taylor, M. B. Hanson, G. M. Ylitalo, R. P. Angliss, J. E. Stein, and R. S. Waples. 2002. Status review of southern resident killer whales (*Orcinus orca*) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-54, U.S. Department of Commerce, Seattle, Washington.

Lane, R.B., and B. Lane. 1977. Indians and Indian Fisheries of the Skagit River System.

Leatherwood, J. S., and M. E. Dahlheim. 1978. Worldwide distribution of pilot whales and killer whales. Naval Ocean Systems Center, Tech. Rep. 443:1-39.

Lowery, E.D. 2019. Personal communication between Erin Lowery, Seattle City Light and G. Gilmour, Meridian. June 2019.

Lowery, E.D. and D.A. Beauchamp. 2015. Trophic Ontogeny of Fluvial Bull Trout and Seasonal Predation on Pacific Salmon in a Riverine Food Web. Transactions of the American Fisheries Society, 144:4, 724-741.

Malick, M. J. , Cox, S. P. , Mueter, F. J. , Dorner, B. , & Peterman, R. M. 2017. Effects of the North Pacific Current on the productivity of 163 Pacific salmon stocks. Fisheries Oceanography, 26, 268–281. 10.1111/fog.12190.

Mallat, J. 1983. Laboratory Growth of Larval Lampreys (*Lampetra tridentata*) at Different Food Concentrations and Animal Densities. Journal of Experimental Biology 22:293-301).

Mathews, W.H. 1968. Geomorphology of Lightning Creek valley, Manning Park, southwest B.C. Syesis 1:65-78.

McClure M, R. Carmichael, T. Cooney, P. Hassemer, P. Howell, D. McCullough, C. Petrosky, H. Schaller, P. Spruell, and F. Utter. 2003. Independent Populations of Chinook, Steelhead and Sockeye for Listed Evolutionarily Significant Units within the Interior Columbia River Domain. Interior Columbia Basin Technical Recovery Team. 171 p.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-42,156 pp.

McPhail, J.D. and E.B. Taylor. 1995. Final Report to Skagit Environmental Endowment Commission. Skagit Char Project (94-1). Dept. of Zoology, University of British Columbia, Vancouver, Canada.

Meridian Environmental, Inc. 2019. Lost Lake White Paper. Prepared for Seattle City Light. September 2019.

Mesa, M.G., Weiland, L.K., Christiansen, H.E., Sauter, S.T., and Beauchamp, D.A. 2013. Development and evaluation of a bioenergetics model for bull trout. Transactions of the American Fisheries Society, 142, 41–49.

Millar, R., B. Eaton, and M. Church. 2014. UBC Regime Model. [Online] URL: http://blogs.ubc.ca/beaton/working-code. Accessed December 19, 2021.

Moore, M.E., B.A. Berejikian, and E.P. Tezak. 2010. Early marine survival and behavior of steelhead smolts through Hood Canal and the Strait of Juan de Fuca. Trans. Am. Fish. Soc. 139:49-61.

Moore, J.W., J.D. Yeakel, D. Peard, J. Lough, and M. Beere. 2014. Life-history diversity and its importance to population stability and persistence of a migratory fish: steelhead in two large North American watersheds. J. Anim. Ecol. 83(5): 1035–1046.

Moore, M.E., B.A. Berejikian, F.A. Goetz, A.G. Berger, S.S. Hodgson, E.J. Connor, and T.P. Quinn. 2015. Multi-population analysis of Puget Sound steelhead survival and migration behavior. Mar Ecol Prog Ser 537: 217−232.

Murray, R.B., and M.N. Gaboury. 2005. Fish Habitat Assessment and Char Utilization for the Upper Skagit River Watershed, BC. LGL Limited. Prepared for Ministry of Water, Land and Air Protection, British Columbia.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook Salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-35, 443 p.

Myers, J.M., J.J. Hard, E.J. Connor, R.A. Hayman, R.G. Kope, G. Lucchetti, A.R. Marshall, G.R. Pess, and B.E. Thompson. 2015. Identifying historical populations of Steelhead within the Puget Sound distinct population segment. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-128.

National Marine Fisheries Service (NMFS). 2007. Endangered Species Act – Section 7 Formal Consultation, Biological Opinion, Effects of the 2007 U.S. Fraser Panel Fisheries on the Southern Resident Killer Whale (Orcinus orca) Distinct Population Segment. National Marine Fisheries Service, Seattle, WA. 82p.

_____. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

_____. 2012. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation, License Amendment of Seattle City Light's Skagit River Hydroelectric Project, FERC No. P-533. NMFS Consultation Number 2011/06440.

_____. 2014. Draft Environmental Impact Statement on Two Joint State and Tribal Resource Management Plans for Puget Sound Salmon and Steelhead Hatchery Programs. National Oceanic and Atmospheric Administration. July 2104.

_____. 2015. 2015 5-Year Review - Listing Status under the Endangered Species Act for Hatchery Programs Associated with 28 Salmon Evolutionarily Significant Units and Steelhead Distinct Population Segments. National Marine Fisheries Service, West Coast Region. September, 2015.

_____. 2016. 2016 5-year Review: Summary and Evaluation of Puget Sound Chinook Salmon, Hood Canal Summer-run Chum Salmon, Puget Sound Steelhead. National Marine Fisheries Service, West Coast Region, Portland, OR.

_____. 2018. Proposed Recovery Plan for the Puget Sound Steelhead Distinct Population Segment (*Oncorhynchus mykiss*). National Marine Fisheries Service. Seattle, WA.

National Marine Fisheries Service (NMFS). 2021. Southern Resident killer whales (*Orcinus orca*) 5-year review: summary and evaluation. National Marine Fisheries Service. West Coast Region. Seattle, WA. 103p.

Nelson, T.C., C. Mussell, and J. Rissling. 2004. Upper Skagit Watershed Native Char Project. Progress Report 2003 prepared for Ministry of Water, Land and Air Protection, Surrey, BC and BC Parks, North Vancouver, BC.

Northcote, T.G. and D.Y. Atagi. 1997. Ecological Interactions in the Flooded Littoral Zone of Reservoirs: The Importance and Role of Submerged Terrestrial Vegetation with Special

Reference to Fish, Fish Habitat and Fisheries in the Nechako Reservoir of British Columbia, Canada. Skeena Fisheries Report SK- 111. 64 pp.

Natural Systems Design (NSD). 2017. Skagit River Large Woody Debris Assessment: Connecting LWD to the 2005 Skagit Chinook Recovery Plan. Prepared for: Skagit Watershed Council. November 13, 2017.

Northwest Fisheries Science Center (NWFSC). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. Available at https://www.nwfsc.noaa.gov/assets/11/8623_03072016_124156_Ford-NWSalmonBioStatusReviewUpdate-Dec%2021-2015%20v2.pdf.

Osborne, R. W. 1999. A historical ecology of Salish Sea "resident" killer whales (*Orcinus orca*): with implications for management. Doctoral dissertation. University of Victoria, Victoria, British Columbia.

Ostberg, C.O., D.M. Chase, M.C. Hayes, J.J. Duda. 2018. Distribution and seasonal differences in Pacific Lamprey and *Lampetra spp*. eDNA across 18 Puget Sound watersheds. Peer J6:e4496. https://doi.org/10.7717/peerj.4496

Paulson, K. 1997. Estimating Changes in Sediment Supply due to Forest Practices: A Sediment Budget Approach Applied to the Skagit River Basin in Northwestern Washington, Unpublished Master's Thesis, University of Washington, Seattle, Washington.

Peven, C.M. 1990. The life history of naturally produced Steelhead trout from the mid- Columbia River Basin. M.S. Thesis, University of Washington, Seattle, WA 96 p.

Pflug, D., E. Connor, B. Hayman, T. Kassler, K. Warheit, B. McMillan, and E. Beamer. 2013. Ecological, genetic, and productivity consequences of interactions between hatchery and natural origin steelhead of the Skagit Watershed. Report prepared for the Skagit River System Cooperative. Funding No. NMFS-FHQ-2008-2001011.

Pacific Fishery Management Council (PFMC). 1999. Description and identification of essential fish habitat, adverse impacts and recommended conservation measures for salmon. Amendment 14 to the Pacific Coast Salmon Plan, Appendix A. PFMC, Portland, OR.

_____. 2019. Review of 2018 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

_____. 2021. Review of 2021 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pearson, S., S. Jeffries, M. Lance, and A. Thomas. 2015. Identifying potential juvenile steelhead predators in the marine waters of the Salish Sea. Washington Department of Fish and Wildlife, Wildlife Science Division, Olympia.

Phelps, S. R., S. A. Leider, P. L. Hulett, B. M. Baker, and T. Johnson. 1997. Genetic analyses of Washington steelhead. Preliminary results incorporating 36 new collections from 1995 and 1996. WDFW, Olympia.

Plumb, M. and M. Blanchard. 2021. Pacific Lamprey 2021 regional implementation plan for the Washington coast/Puget Sound regional management units. Submitted to the Conservation Team, August 12, 2021.

Porter, S. and T. Swanson. 1998. Radiocarbon age constraints on rates of advance and retreat of the Puget Lobe of the Cordilleran Ice Sheet during the last glaciation. Quaternary Research 50:205-213.

Puget Sound Partnership. 2021. Factors Limiting progress in salmon recovery. Salmon Science Advisory Group. Puget Sound Partnership, Olympia, Washington.

Puget Sound Technical Recovery Team (PSTRT). 2005. Supplement to the Draft Puget Sound Salmon Recovery Plan. National Marine Fisheries Service. Northwest Region.

Quinn, T.P., and K.W. Myers. 2004. Anadromy and the marine migrations of Pacific salmon and trout: Rounsefell revisited. Rev. Fish Biol. Fish. 14(4):

Reeves, G.H., F.H. Everest, T.E. Nickelson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. USDA Forest Service General Technical Report. PNW-GTR-245.

Reiser, D.W., C.M. Huang, S. Beck, M. Gagner, and E. Jeanes. 2006. Defining flow windows for upstream passage of adult anadromous salmonids at cascades and falls, Transactions of the American Fisheries Society, 135:3, 668-679, DOI: 10.1577/T05-169.1.

Riedel, J. 1990. Skagit River Project FERC # 553 Report on Existing Conditions of Reservoir and Streambank Erosion.

Riedel, J. 2007. Late Pleistocene glacial and environmental history of the Skagit Valley, Washington and British Columbia. PhD Dissertation, Department of Earth Sciences, Simon Fraser University, British Columbia,

Riedel, J., S. Sarrantonio, K. Ladig, and M. Larrabee. 2020. Draft Skagit River Geomorphology Inventory Report: Part I – Gorge Dam to Sauk River. Report to Seattle City Light by the U.S. National Park Service (NPS).

Ruckelshaus, M.H., K.P. Currens, W.H. Graeber, R.R. Fuerstenberg, K. Rawson, N.J. Sands, and J.B. Scott. 2006. Independent Populations of Chinook Salmon in Puget Sound. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-78, 125 p.

Ruff, C. 2019. Retrospective analysis of Skagit River Chum productivity. Presentation to the NCC October, 31 2019.

R2 Resource Consultants. 2009. Fish Migration in Studies in Ross Lake. Draft data report prepared for Seattle City Light. R2 Resource Consultants, Redmond, Washington.

Salo, E.O. 1991. Life History of Chum Salmon (*Oncorhynchus keta*). In Groot, C., and L. Margolis (eds.), Pacific salmon life histories, p. 231-309. Univ. B.C. Press, Vancouver, B.C., Canada.

Sandercock, F. K. 1991. Life History of Coho Salmon (*Oncorhynchus kisutch*). In C. Groot and L. Margolis (editors), Pacific salmon life histories, p. 396-445. Univ. British Columbia Press, Vancouver.

Sauk-Suiattle Indian Tribe, Swinomish Indian Tribal Community, Upper Skagit Indian Tribe, Skagit River System Cooperative, and WDFW. 2018. Supplemental Skagit RMP information sent to James Dixon, NMFS. February 2, 2018.

Scott, K.J. and H.R Neuman. 1988 draft. Aspects of Skagit River rainbow trout life history based on 1986 tagging and test fishing studies and scale analysis. Prepared for B.C. Ministry of Environment, Lands and Parks by Scott Resource Services Inc., 70 p.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Bulletin 184SBSRTC 2002.

Seamons, J.R., C. Bowman, and A. Terepocki. 2021. Species ID Report- Species identification of three fish reportedly captured in the Skagit River in the area of the Gorge Dam tailrace. Washington Department of Fish and Wildlife Molecular Genetics Laboratory.

Seattle City Light (City Light). 1989a. Ross Lake Tributary Stream Catalog. Environmental Affairs Division, Seattle, Washington.

_____. 1989b. Resident Fisheries Study for Ross, Diablo, and Gorge Lakes. Environmental Affairs Division, Seattle, Washington. September 1989.

_____. 1991. Offer of Settlement, Skagit River Hydroelectric Project, FERC No. 553. Seattle, WA. April 1991.

_____. 2011. Biological Evaluation Skagit River Hydroelectric Project License (FERC No. 553) Amendment: Addition of a Second Power Tunnel at the Gorge Development. June 2011.

_____. 2012. Biological evaluation – supplement: impacts of entrainment on bull trout - Skagit River hydroelectric project license (FERC no. 553) amendment: addition of a second power tunnel at the gorge development – final. July 2012.

_____. 2016. Annual Incidental Take Report for 2015 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, March 31, 2016.

_____. 2017. Annual Incidental Take Report for 2016 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, April 14, 2017.

_____. 2018. Annual Incidental Take Report for 2017 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, April 30, 2018.

_____. 2019. Annual Incidental Take Report for 2018 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, May 31, 2018.

_____. 2020a. Annual Incidental Take Report for 2018 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, June 30, 2020.

_____. 2020b. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2021. Annual Incidental Take Report for 2018 – Bull Trout Skagit Hydroelectric Project (FERC 553) Seattle City Light. Prepared by: Ed Connor, Aquatic Ecologist, March 31, 2021.

_____. 2022a. FA-06 Reservoir Native Fish Genetics Baseline Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Cramer Fish Sciences, Inc.

_____. 2022b. GIS-Based Reservoir Littoral Zone Evaluation, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Four Peaks Environmental, Inc.

_____. 2022c. FA-03 Reservoir Fish Stranding and Trapping Risk Assessment, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Four Peaks Environmental, Inc.

_____. 2022d. FA-08 Fish Entrainment Study , Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by and HDR Engineering, Inc.

_____. 2022e. FA-07 Reservoir Tributary Habitat Assessment, Skagit River Hydroelectric Project, FERC Project No. 553. In preparation by Cramer Fish Sciences, Inc.

_____. 2022f. Hydraulic Connectivity Assessment of the Reach between Diablo Dam and Diablo Powerhouse, Prepared by HDR Engineering, Inc. and HEC.

_____. 2022g. FA-05 Skagit River Gorge Bypass Reach Hydraulic and Instream Flow Model Development Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Northwest Hydraulic Consultants, Inc. and HDR Engineering, Inc.

_____. 2022h. FA-02 Instream Flow Model Development Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Northwest Hydraulic Consultants, Inc. and HDR Engineering, Inc.

_____. 2022i. FA-04 Fish Passage Study City Light, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc.

_____. 2022j. GE-04 Skagit River Geomorphology between Gorge Dam and the Sauk River Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Natural Systems Design, Inc., Northwest Hydraulic Consultants, Inc., and Fain Environmental.

_____. 2022k. GE-02 Erosion and Geologic Hazards at Project Facilities and Transmission Line Right-of-Way Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by American Forest Management, Inc., Shannon and Wilson, Inc., Watershed GeoDynamics.

Shared Strategy for Puget Sound. 2007. Puget Sound Salmon Recovery Plan. Plan adopted by the National Marine Fisheries Service January 19, 2007.

Simenstad, C.A., K.L. Fresh, E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. In: Kennedy, V.S. (Ed.), Estuarine Comparisons. Academic Press, New York, NY, pp. 343–364.

Skagit River System Cooperative (SRSC) and Washington Department of Fish and Wildlife (WDFW). 2005. Skagit Chinook Recovery Plan. Skagit River System Cooperative, LaConner, Washington, and Washington Department of Fish and Wildlife, Olympia. Stober, Q.J., S.C. Crumley, D.E. Fast, E.S. Killebrew, R.M. Woodin, G. Engman, and G. Tutmark. 1982. Effects of Hydroelectric Discharge Fluctuation on Salmon and Steelhead in the Skagit River, Washington. Final report: December 1979 to December 1982. Prepared for the City of Seattle, Department of Lighting, Office of Environmental Affairs, Seattle, Washington. 174 pp.

Small, M.P., E. Martinez, and S. Peterson. 2013. Genetic analysis of native char collected in Diablo Lake, Ross Lake, Gorge Reservoir, Skagit mainstem, and Skagit Bay. WDFW Molecular Genetics Lab, Olympia WA.

Small, M.P., S. Bell, and C. Bowman. 2016. Genetic analysis of native char collected in Diablo Lake, Gorge Reservoir, and Ross Lake in the Skagit River basin. Washington Department of Fish and Wildlife Molecular Genetics Lab, Olympia, Washington.

Small, M. E. Lowery, and T. Seamons. 2020a. Final Report: Gorge Lake Rainbow Trout genetic analysis. March 12, 2020

Small, M., E. Lowery, and M. Kissler. 2020b. Genetic analysis of Char from Gorge Lake, Upper Skagit River, Washington. Final Report.

Smith, M. 2010. Final report, population structure and genetic assignment of bull trout (*Salvelinus confluentus*) in the Skagit River Basin, dated December 2010. School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA.

_____. 2019. The influence of Pleistocene glaciations on the genetic population structure of Bull Trout in the Skagit River, WA. Presentation to the Skagit River Hydroelectric Project, Fish Passage Subgroup, October 3, 2019.

Smith, E.V., and M.G. Anderson. 1921. A Preliminary Biological Survey of the Skagit and Stillaguamish Rivers. University of Washington.

Stober, Q.J., S.C. Crumley, D.E. Fast, E.S. Killebrew, R.M. Woodin, G. Engman, and G. Tutmark. 1982. Effects of Hydroelectric Discharge Fluctuation on Salmon and Steelhead in the Skagit River, Washington. Final report: December 1979 to December 1982. Prepared for the City of Seattle, Department of Lighting, Office of Environmental Affairs, Seattle, Washington. 174 pp.

Takami, T., F. Kitano, and S. Nakano. 1997. High water temperature influences on foraging responses and thermal deaths of Dolly Varden *Salvelinus malma* and white-spotted char *S. leucomaenis* in a laboratory. Fisheries Science 63:6–8.

Triton. 2008. Reconnaissance (1:20,000) fish and fish habitat inventory of the Skagit River watershed, watershed code: 970-110000, dated March 2008. Prepared by Triton Environmental Consulting Ltd., Vancouver, British Columba Canada, prepared for Ministry of Environment, Lower Mainland Region, Surrey, British Columbia, Canada.

Triton. 2017. 2016 Skagit River Snorkel Survey Report, Skagit Environmental Endowment Commission. Prepared by Triton Environmental Consulting Ltd., Vancouver, British Columba, Canada.

Trotter, P. 1989. Coastal Cutthroat Trout: a life history compendium. Transactions of the American Fisheries Society, Volume 188, Issue 5, pages 463-473.

U.S. Department of Agriculture, Forest Service . 2016. Stream Inventory Handbook: Level I & II. USFS Pacific Northwest Region, Region 6. V. 2.16. Available at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd538833.pdf.

United States Department of Agriculture, Natural Resources Conservation Service (USDA), and United States Department of the Interior, National Park Service (NPS). 2012. Soil survey of North Cascades National Park Complex, Washington.

United States Fish and Wildlife Service (USFWS). 2004. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Puget Sound Management Unit. Portland Oregon. 410 pp.

_____. 2013. Biological Opinion for the Seattle City Light Skagit River Hydroelectric Project, Federal Energy Regulatory Commission Number 553-221 in Skagit and Whatcom Counties, Washington. US Fish and Wildlife Reference Number 01EWFW00-2012-F-0302.

_____. 2015a. Recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xii + 179 pages.

_____. 2015b. Coastal Recovery Unit implementation plan for bull trout (*Salvelinus confluentus*), dated September 2015. USFWS Washington Fish and Wildlife Office, Lacey, Washington and Oregon Fish and Wildlife Office Portland, Oregon.

_____. 2020. TBSA Model: A Desktop Tool for Estimating Mortality of Fish Entrained in Hydroelectric Turbines. Excel file dated December 9, 2020.

United States Forest Service (USFS). 2002. Upper Skagit River watershed native char project, upper Canyon Creek habitat surveys, upper Canyon Creek snorkel surveys, Canyon and Ruby Creek bull trout spawning surveys – 2001. Okanogan-Wenatchee National Forest, Methow Valley Ranger District. Report prepared April 2002.

United States Geological Survey. (USGS). 2019a. Nonindigenous Aquatic Species: Asian clam. [Online] URL: https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=92&State=WA&HUCNumber=17110005. Accessed October 2019.

_____. 2019b. Nonindigenous Aquatic Species: Eurasian watermilfoil. [Online] URL: https://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=237&State=WA&HUCNumber=17110007. Accessed October 2019.

Upper Skagit Indian Tribe. 2016. Summary of Activities of May 9, 2016 Gorge Bypass Survey.

_____. 2022a. Upper Skagit Indian Tribe Bypass Trip Report 05/19/2022.

_____. 2022b. Upper Skagit Indian Tribe Bypass Trip Report 06/08/2022.

Vander Zanden, M. J., and Y. Vadeboncoeur. 2020. Putting the lake back together 20 years later: what in the benthos have we learned about habitat linkages in lakes? Inland Waters 10(3):305–21. doi: 10.1080/20442041.2020.1712953.

Waitt, R.B. Jr. 1977. Evolution of glaciated topography of upper Skagit drainage basin, Washington. Arctic and Alpine Research, 9:183-192.

Wald, A.R. 2009. High flow for fish and wildlife in Washington. Report of investigation in instream flow. Washington Department of Fish and Wildlife (WDFW). [Online] URL: https://wdfw.wa.gov/sites/default/files/publications/00578/wdfw00578.pdf. Accessed in February 2022.

Washington Department of Fisheries (WDF). 1975. A Catalog of Washington Streams and Salmon Utilization, Volume 1, Puget Sound Region. Washington Department of Fisheries, Olympia, Washington.

Washington Department of Fish and Wildlife (WDFW). 1998. Washington Salmonid Stock Inventory: Bull Trout/Dolly Varden. Washington Department of Fish and Wildlife. 441 pp.

_____. 2002. Salmonid Stock Inventory. Washington Department of Fish and Wildlife. [Online]

URL: http://wdfw.wa.gov/fish/sasi/index.htm. Accessed: June 17, 2019.

_____. 2004. Draft Environmental Impact Statement for the Lower Skagit River Steelhead Acclimation and Rearing Facility. Washington Department of Fish and Wildlife, Olympia, Washington.

_____. 2019. SCoRE (Salmon Conservation and Reporting Engine). [Online] URL: https://fortress.wa.gov/dfw/score/score/. Accessed on June 8, 2019.

_____. 2021. Gorge bypass reach trip report, 11/04/2021.

Washington Department of Fisheries (WDF), Washington Department of Wildlife (WDW), and the Western Washington Treaty Indian Tribes (WWTIT). 1994 Washington State Salmon and Steelhead Stock Inventory (SASSI). Washington Department of Fish and Wildlife, 212 pages + three appendices.

Washington Department of Fish and Wildlife (WDFW) and the Western Washington Treaty Indian Tribes (WWTIT). 2003. 2002 Washington State Salmon and Steelhead Stock Inventory, Olympia, Washington.

Washington State Recreation and Conservation Office, Washington Invasive Species Council. 2019. Invasive crayfish. [Online] URL: https://invasivespecies.wa.gov/priorityspecies/non-native-crayfish/. Accessed October 2019.

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-24. Seattle, WA.

Welch, C.A. 2012. Seasonal and age-based aspects of diet of the introduced redside shiner (*Richardsonius balteatus*) in Ross Lake, Washington. WWU Graduate School Collection. 227. https://cedar.wwu.edu/wwuet/227.

Whitesel, T., A.R. Hemmingsen, S.L. Gunckel, and P.J. Howell. 2001. Bull Trout Life History, Genetics, Habitat Needs and Limiting Factors in Central and Northeast Oregon, Annual 1999, Report to Bonneville Power Administration, Contract No. 1994BI343421, Project No. 199405400, 44 electronic pages (BPA Report DOE/BP-34342-3).

Wiles, G. J. 2004. Washington State status report for the killer whale. Washington Department Fish and Wildlife, Olympia, Washington.

Wolman, M.G. 1954. A method of sampling coarse river-bed materials. Transactions of the American Geophysical Union, 35(6), 951–956.

Wydoski, R.S. and R.R. Whitney. 2003. Inland fishes of Washington. University of Washington Press, Seattle, Washington. Second Edition.

Zhang, Y., B. Qin, W. Hu, S. Wang, Y. Chen, and W. Chen. 2006. Temporal-spatial variations of euphotic depth of typical lake regions in Lake Taihu and its ecological environmental significance. Science in China Series D 49(4):431–42. doi: 10.1007/s11430-006-0431-4.

Zohary, T. and A. Gasith. 2014. The littoral zone. Lake Kinneret: Ecology and Management.

Section 4.2.4 Botanical Resources

Bayard, D. 2019. Personal communication between David Bayard, Seattle City Light, and Rory Denovan, City Light. September 5, 2019.

Bivin, M. 2019a. Personal communication between Mignonne Bivin, National Park Service, and Rory Denovan, Seattle City Light. October 2, 2019.

_____. 2019b. Personal communication between Mignonne Bivin, National Park Service, and Rory Denovan, Seattle City Light. November 13, 2019.

Bivin, M., and R. Rochefort. 2010. Vascular plant inventory of North Cascades National Park Service Complex. Natural Resource Technical Report NPS/NCCN/NRTR–2010/369. National Park Service, Fort Collins, Colorado.

Bureau of Land Management (BLM). 2017. Idaho BLM Special Status Plant Survey and Clearance Protocols. Boise District. BLM Idaho District. Boise, Idaho. [Online] URL: https://www.blm.gov/policy/im-id-2017-011. Accessed April 2020.

Camp, P., and J.G. Gamon (editors). 2011. Field guide to the rare plants of Washington. University of Washington Press, Seattle, Washington.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service.

Dudney, J., R.A. York, C.L. Tubbesing, A.T. Roughton, D. Foster, S.L. Stephens, J.J. Battles. 2021. Overstory removal and biological legacies influence long-term forest management outcomes on introduced species and native shrubs. Forest Ecology and Management, 491, p.119149. [Online] URL: https://www.sciencedirect.com/science/article/abs/pii/S0378112721002371. Accessed December 21, 2021.

Franklin, Jerry F., and C.T. Dyrness. 1988. Natural Vegetation of Oregon and Washington. Oregon State University Press. 452 pp.

Heffley, Mark. 1990. Seattle City Light Riparian Zone Management Plan. Prepared for Seattle City Light. November 1990.

Hitchcock. A.S. 1971. Manual of the Grasses of the United States, Volume One. Dover Publications, Inc. New York, New York.

Hoffman, R.L., A. Woodward, P. Haggerty, K. Jenkins, P. Griffin, M.J. Adams, J. Hagar, T. Cummings, D. Duriscoe, K. Kopper, J. Riedel, L. Marin, G.S. Mauger, K. Bumbaco, and J.S. Littell. 2015. North Cascades National Park Service Complex: Natural resource condition assessment. Natural Resource Report NPS/NOCA/NRR—2015/901.

Hruby, T. 2014. Washington State Wetland Rating System for Western Washington: 2014 Update. (Publication #14-06-029). Olympia, WA: Washington Department of Ecology.

Inter-Ministry Invasive Species Working Group (IMISWG). 2014. Invasive Species Early Detection and Rapid Response Plan for British Columbia. [Online] URL: https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/guidance-resources/prov_edrr_is_plan.pdf. Accessed September 8, 2021.

Jakubowski, A.r., Casler, M.D., and R.D. Jackson. 2012. Genetic evidence suggest a widespread distribution of native North American populations of reed canarygrass. Biological Invasions 15, 261-268. Published August 4, 2012. [Online] URL: https://link.springer.com/article/10.1007/s10530-012-0300-3#citeas. Accessed January 31, 2022.

Kavova, T., B. Kubatova, V. Curn, and N. Anderson. 2018. Genetic Variability of U.S. and Check Phalaris Arundinacea Wild and Cultivated Populations. 10.5772/Intechopen. 69669. [Online] URL: https://openresearchlibrary.org/viewer/e30a0bcf-cc56-4554-a49f-e8fac29cca70. Accessed January 31, 2022.

McIntosh, T. 2006. Invasive Plant Species Inventory for the Skagit Valley Provincial Park. Biospherics Environmental Inc. Vancouver, BC. [Online] URL: http://a100.gov.bc.ca/pub/eirs/finishDownloadDocument.do?subdocumentId=4202. Accessed December 20, 2021.

National Park Service (NPS). 2010. Wildland Fire Management Plan, North Cascades National Park Service Complex. October 2007, revised April 2010.

______. 2011. Invasive Non-Native Plant Management Environmental Assessment. November 2011.

______. 2015. North Cascades 2015 Fires Post-Fire Response Plan – North Cascades National Park Complex. Prepared by National Park Service North Cascades National Park Complex Fires BAER Team. September 18, 2015.

______. 2017a. Ross Lake Invasive Weed Survey by Boat. Map. 1 pp. June 2017.

______. 2017b. Project Report: Big Beaver Creek Drainage Reed Canary Grass Survey. August 24 through August 29, 2017.

______. 2019. Invasive Plant Management Team Project Report: Big Beaver Creek Drainage Reed Canary Grass Survey. July 31 through August 7, 2019.

Nielsen, E.M., C. Copass, R.L. Brunner, and L.K. Wise. 2021. North Cascades National Park Complex vegetation classification and mapping project report. Natural Resource Report NPS/NCCN/NRR—2021/2254. National Park Service, Fort Collins, Colorado. URL: https://doi.org/10.36967/nrr-2286418.

Rew, L., and M.L. Pokorny. 2006. Inventory and Survey Methods for Nonindigenous Plant Species. Editors. Bozeman (MT): Montana State University Extension. 75 p.

Seattle City Light (City Light).1990. Transmission Rights of Way Vegetation Management Plan Final Report. Prepared by Compliance Services International (CSI), Dames and Moore, Inc., and Don Shimono Associates. February 1990.

_____. 2006. Management Plan – Skagit Wildlife Mitigation Lands.

_____. 2020a. Pre-Application Document (PAD) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2020.

_____. 2020b. Communication summary for August 20 site visit to Big Beaver Valley for reed canarygrass assessment. August 20, 2020.

_____. 2022a. TR-02 Wetland Assessment, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022b. TR-03 Rare, Threatened, and Endangered Plants Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022c. TR-04 Invasive Plants Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022d. TR-02 Wetland Assessment, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

Skagit Fisheries Enhancement Group (SFEG). 2017. Skagit Cooperative Weed Management Area Upper Skagit Knotweed Control Program –2017 Season Ending Report. October 2017.

Skagit River System Cooperative (SRSC). 2020. 2020 Savage Slough Maintenance Summary. April 7, 2020.

Thurston County Noxious Weed Control Board (TCNWCB). 2017. Thurston County Noxious Weed Fact Sheet for Mouseear Hawkweed. [Online] URL: https://www.co.thurston.wa.us/tcweeds/factsheets/MouseearHawkweed_2017.pdf. Accessed October 2021.

Tressler, R. 2019. Personal communication between Ron Tressler, Seattle City Light, and Jessica Redman, Environmental Science Associates. September 12 and November 18, 2019.

Tressler, R. 2021. Personal communication between Ron Tressler, Seattle City Light, and Jessica Redman, Environmental Science Associates. November 12, 2021.

University of Washington. 2019. Burke Herbarium Image Collection. [Online] URL: http://biology.burke.washington.edu/herbarium/imagecollection.php. Accessed December 2019.

Waggy, Melissa A. 2010. Phalaris arundinacea. In: Fire Effects Information System, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [Online] URL: https://www.fs.fed.us/database/feis/plants/graminoid/phaaru/all.html. Accessed January 2021.

Washington Department of Natural Resources (DNR). 2021a. Wetlands of High Conservation Value Map Viewer. [Online] URL: https://www.dnr.wa.gov/NHPwetlandviewer. Accessed April 14, 2021.

Washington Department of Natural Resources (Washington DNR). 2021b. 2021 Washington Vascular Plant Species of Conservation Concern. Prepared by Walter Fertig, Washington Natural Heritage Program. Natural Heritage Report 2021-04, August 31, 2021. [Online] URL: https://www.dnr.wa.gov/publications/amp_nh_vascular_ets.pdf. Accessed September 2022.

Washington State Noxious Weed Control Board. 2021. Printable Noxious Weed list. [Online]

URL: https://www.nwcb.wa.gov/printable-noxious-weed-list. Accessed October 2021.

Whiteaker, L., J. Henderson, R. Holmes, L. Hoover, R. Lesher, J. Lippert, E. Olson, L. Potash, J. Seevers, M. Stein, and N. Wogen. 1998. Survey protocols for survey and manage strategy 2 vascular plants. V 2.0. Bureau of Land Management. [Online] URL: http://www.blm.gov/or/plans/surveyandmanage/SP/VascularPlants/cover.htm. Accessed April 2020.

Wildflower Search. 2021. Wildflower Identification Website. [Online] URL: https://wildflowersearch.org/. Accessed November 2021.

Vanbianchi, Ronald and Wagstaff, Stephen J. 1987. A Floristic Survey of Big Beaver Valley. Accessed August 2021.

Section 4.2.5 Wildlife Resources

Akins et al., 2022. Unpublished PowerPoint presentation by Jocelyn Akins, Jocelyn, Logan Whiles, Heather Rolph, Dan Thornton, Lisa Shipley, and Jason Ransom, “Rare Carnivores of the High Cascades”. Provided by J Akins (Cascade Carnivore Project) to Ron Tressler (City Light). January 13, 2022.

Almack, J.A., W.L. Gaines, R.H. Naney, P.H. Morrison, J.R. Eby, G.F. Wooten, M.C. Snyder, S. H. Fitkin, and E.R. Garcia. 1993. North Cascades Grizzly Bear Ecosystem Evaluation. Final Report. Denver, CO. Interagency Grizzly Bear Committee. 169 pp.

Amartuvshin, P., and S. Gombobaatar. 2012. The assessment of high risk utility lines and conservation of globally threatened pole nesting steppe raptors in Mongolia. Ornis Mongolica 1:2-12.

American Ornithologists’ Union (AOU). 1957. Check-list of North American Birds. 5th edition. Lord Baltimore Press, Baltimore, Maryland.

Aubry, K.B., K.S. McKelvey, and J.P. Copeland. 2007. Distribution and broadscale habitat relations of the wolverine in the contiguous United States. Journal of Wildlife Management. 71:2147-2158.

Aubry, K.B., J. Rohrer, C.M. Raley, R.D. Weir, and S. Fitkin. 2012. Wolverine distribution and ecology in the North Cascades Ecosystem, 2012 annual report. 44 pp. November 21, 2012.

Aubry, K.B., J. Rohrer, C.M. Raley, and S. Fitkin. 2014. Wolverine Distribution and Ecology in the North Cascades Ecosystem. 2014 Annual report. 50 pp. December 30, 2014. Available at: Wolverine Distribution and Ecology in the North Cascades Ecosystem: 2014 Annual Report (wa.gov).

Aubry, K.B., J. Rohrer, C.M. Raley, and S. Fitkin. 2016. Wolverine Distribution and Ecology in the North Cascades Ecosystem Final Progress Report. February 9, 2016. Available at: Distribution and Ecology of Wolverines in the North Cascades (wolverinefoundation.org).

Audubon Society. 2022. North Cascades National Park. Accessed August 27, 2022. https://www.audubon.org/climate/national-parks/north-cascades-national-park.

Avian Power Line Interaction Committee (APLIC). 2012. Reducing avian collisions with power lines – the state of the art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Barbour, R.W., and W.H. Davis. 1969. Bats of America. Lexington: University of Kentucky Press.

286 pp.

Barrientos, R., J.C. Alonso, C. Ponce, C. Palacin. 2011. Meta-analysis of the effectiveness of marked wire reducing avian collisions with power lines. Conservation Biology 25: 893-903.

Beever, E. A., J. D. Perrine, T. Rickman, M. Flores, J.P. Clark, C. Walters, S. S. Wever, B. Yardley, D. Thoma, T. Chesley-Preston, K. I. Goehring, M. Magnuson, N. Nordensten, M. Nelson, and G. H. Collins. 2016. Pika (*Ochotona princeps*) losses from two isolated regions reflect temperature and water balance, but reflect habitat area in a mainland region. J. of Mammalogy 97: 1495-1511.

Bernardino, J., K. Bevanger, R. Barrientos, J. F. Dwyer, A. T. Marques, R. C. Martins, J. M. Shaw, J. P. Silva, and F. Moreira. 2018. Bird collisions with power lines: State of the art and priority areas for research. Biological Conservation 222:1–13.

Bevanger, K. 1998. Biological and conservation aspects of bird mortality caused by electricity power lines: a review. Biol. Conservation 86: 67–76.

Bevanger, K., and H. Brøseth. 2004. Impact of power lines on bird mortality in a subalpine area. Biodiversity and Conservation 27: 67–77.

Bohannon, J.S., D.R. Gay, M.P. Hayes, C.D. Danilson, and K.I. Warheit. 2016. Discovery of the Oregon Spotted Frog in the Northern Puget Sound Basin, Washington State. Northwest Naturalist. 97:82-97.

Brown, H.A., R.B. Bury, D.M. Darda, L.V. Diller, C.R. Peterson, and R.M. Storm. 1995. Reptiles of Washington and Oregon. Seattle Audubon Society, Seattle, WA. R.M. Storm and W.P. Leonard Coordinating Editors. viii + 176 pp.

Bruce, A. M., R.J. Anderson, and G.T. Allen. 1982. Observations of golden eagles nesting in western Washington. Raptor Research 16(4):132-134.

Bruggeman, J. E., 2010. Pilot Study on Factors Affecting Pika Populations in the North Cascades Ecosystem. Seattle City Light Wildlife Research Program.

Buchanan, J.B. 2016. Draft periodic status review for the Northern Spotted Owl in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 13 + iv pp.

Burger, A.E. 2002. Conservation assessment of Marbled Murrelets in British Columbia: a review of the biology, populations, habitat associations, and conservation. Technical Report Series No. 387. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Buskirk, S.W., and R.A. Powell. 1994. Habitat ecology of fishers and American martens. Pp. 283-296 In: Martens, Sables and Fishers: Biology and Conservation (Buskirk, S.W., A.S. Harestad, M.G. Raphael, and R.A. Powell (eds.)). Ithaca, New York: Cornell University Press.

Cassirer, E.F., and C.R. Groves. 1994. Ecology of harlequin ducks in northern Idaho. Unpublished Report, Idaho Department of Fish and Game, Boise, ID.

Chapman, J. A. and G.A. Feldhamer. 1982. Wild Mammals of North America. Johns Hopkins University Press. Baltimore, Maryland.

Christophersen R.G. 2006. Supplemental Forest Carnivore Surveys in North Cascades National

Park Service Complex, Washington. USDI National Park Service. Sedro-Woolley, WA. NPS/PWR-NCCN/INV-2006/01. NPS D280. 30 pp.

Christophersen, R.G. 2016. 2016 FERC Wildlife Monitoring Report. Unpublished memo report by NOCA Biologist. September 19, 2016.

Christophersen, R.G., and R.C. Kuntz II. 2003. A Survey of Bat Species Composition, Distribution, and Relative Abundance in North Cascades National Park Complex, WA. Technical Report NPS/NOCA/NRTR-2003/01.

Christophersen, R. G., and J. I. Ransom. 2022. Osprey, peregrine falcon, and bald eagle nesting in North Cascades National Park Service Complex, Washington. Natural Resource Report NPS/NOCA/NRR—2022/2353. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/nrr-2289987.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2002. COSEWIC assessment and status report on the western toad *Bufo boreas* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 31 pp.

Cooper, B. A., M. G. Raphael, and M. Z. Peery. 2006. Trends in radar-based counts of Marbled Murrelets on the Olympic Peninsula, Washington, 1996–2004. Condor 108: 936–947.

Copeland, J.P. 1996. Biology of the wolverine in central Idaho. Thesis, University of Idaho, Moscow.

Copeland, J.P., J.M. Peek, C.R. Groves, W.E. Melquist, K.S. McKelvey, G.W. McDaniel, C.D. Long, and C.E. Harris. 2007. Seasonal habitat associations of the wolverine in central Idaho. Journal of Wildlife Management 71:2201-2212.

Cruickshank, H. S. 2014. Prey selection and kill rates of cougars in northeastern Washington. Master's Thesis, Washington State University, Department of Natural Resources. Pullman, Washington.

Davis, R. and J. Lint. 2005. Habitat status and trends. Pages 21–82 in J. Lint (technical coordinator), Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 pp.

Davis, R.J., K.M. Dugger, S. Mohoric, L. Evers, and W.C. Aney,. 2011. Northwest Forest Plan—the first 15 years (1994–2008): status and trends of northern spotted owl populations and habitats. Gen. Tech. Rep. PNW-GTR-850. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 147 pp.

Davis, R.J., J. L. Ohmann, R.E. Kennedy, W.B. Cohen, M.J. Gregory, Z. Yang, H.M. Roberts, A.N. Gray, and T.A. Spies. 2015. Northwest Forest Plan—the first 20 years (1994–2013): status and trends of late-successional and old-growth forests. Gen. Tech. Rep. PNW-GTR-911. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 112 pp.

Davis, R.J., B. Hollen, J. Hobson, J.E. Gower, and D. Keenum. 2016. Northwest Forest Plan—the first 20 years (1994–2013): status and trends of northern spotted owl habitats. Gen. Tech. Rep. PNW-GTR-929. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 54 pp.

Desimone, S. M. 2016. Periodic status review for the marbled murrelet in Washington. Washington Department of Fish and Wildlife (WDFW), Olympia, Washington. 28 pp.

Dwyer, J.F., A.K. Pandey, L.A. McHale, R.E. Harness. 2019. Near-ultraviolet light reduced Sandhill Crane collisions with a power line by 98%. The Condor: Ornithological Applications 121: 1-10.

eBird. 2021. An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. [Online] URL: http://www.ebird.org. Accessed January 3, 2021.

Eccleston, D.T., and R.E. Harness. 2018. Raptor electrocutions and power line collisions. Pages 273-302 in Birds of Prey, editors J.H. Sarasola, J.M. Grande, and J.J. Negro. Springer Nature, Switzerland.

Federal Energy Regulatory Commission (FERC). 2001. Order modifying and approving final bald eagle/transmission line interactions report. Issued June 29, 2001. Project No. 553-129.

Ferrer, M., V. Morandini, R. Baumbusch, R. Muriel, M. De Lucas, and C. Calabuig. 2020. Efficacy of different types of "bird flight diverter" in reducing bird mortality due to collision with transmission power lines. Global Ecology and Conservation 23 (2020): e01130.

Finney and Gouvenain, "Forest fire history of Desolation Peak, Washington", Sept 1989. Accessed online 10/21/2022. https://w3.ric.edu/faculty/rdegouvenain/Ageeetal1990.PDF

Forsman, E.D., S.G. Sovern, M. Taylor, and B.L. Biswell. 2015. Home range and habitat selection by northern spotted owls on the eastern slope of the Cascade Mountains, Washington. Journal of Raptor Research. 49: 109–128.

Funk, W.C, C. A. Pearl, H.M. Draheim, M. J. Adams, T.D. Mullins, and S.M. Haig. 2008. Range-wide phylogeographic analysis of the spotted frog complex (*Rana luteiventris* and *Rana pretiosa*) in northwestern North America. Molecular Phylogenetics and Evolution 49:198-210.

Grubb, T.G., L.L. Pater, A.E. Gatto, and D.K. Delaney. 2013. Response of nesting northern goshawks to logging truck noise in Northern Arizona. Journal of Wildlife Management 77:1618-1625.

Grummer, J.A., and A.D. Leache. 2016. Survey for *Batrachochytrium dendrobatidis* in the North Cascades National Park Complex, Washington, USA. Herpetological Review 47:392-394.

Grummer, J.A., and A.D. Leache. 2017. Do dams also stop frogs? Assessing population connectivity of coastal tailed frog (*Ascaphus truei*) in the North Cascades National Park Service Complex. Conservation Genetics 18:439-451.

Hall, J. and J.P. Shannahan. 2009. Management of beaver in constructed off-channel spawning habitat for salmon on the upper Skagit River floodplain. Report prepared for Skagit River Non-Flow Plan Coordinating Committee. Prepared by Hall and Associates Consulting, Inc. and Upper Skagit Indian Tribe. 27pp.

Hallock, L. 2013. Draft State of Washington Oregon Spotted Frog Recovery Plan. Washington State Department of Fish and Wildlife, Olympia. 93 pp.

Hamer Environmental. 2010. Use of audio-visual surveys to determine the presence/probable absence of marbled murrelets in North Cascades National Park, Washington. Final Report. Prepared for North Cascades National Park. October 14, 2010.

Hamer, T. 1995. Inland habitat associations of marbled murrelets in western Washington. Pages 163–175. In: Ecology and Conservation of the Marbled Murrelet. C.J. Ralph, G.L. Hunt, M.G. Raphael, and J.F. Piatt (eds.). U.S. Forest Service, Albany, California.

Hamer, T. E., and D. J. Meekins. 1998. Marbled murrelet habitat selection on the western Olympic Peninsula, Washington. Olympia, WA, Washington State Department of Natural Resources, U.S. Fish and Wildlife Service (USFWS), and Rayonier Northwest Forest Resources, 31 pp.

Hamer, T. E. and S.K. Nelson. 1995. Characteristics of marbled murrelet nest trees and nesting stands. pp. 69-82 In: Ralph, C. J., G. L. Hunt Jr., M. G. Raphael, and J. F. Piatt, tech. eds. Ecology and conservation of the marbled murrelet. USDA Forest Service, Pac. Southwest. Res. Sta., Gen. Tech. Rep. PSW-GTR-152. Albany, CA.

Hamer, T.E., D.C. Hays, C.M. Seager, and E.D. Forsman. 2001. Diet of northern barred owls and northern spotted owls in an area of sympatry. U.S. Department of Agriculture, Forest Service Pacific Northwest Research Station. Corvallis, OR.

Hansen, L. 2017. Breeding Ecology of Golden eagles in Western Washington. University of Washington, Seattle, WA.

Harness, R.E., S. Milodragovich, and J. Schomburg. 2003. Raptors and power line collisions. Colorado Birds 37: 118–122.

Harris, R., S. Hansen, J. Oyster, K. Mansfield, E. Rowan, J. Goerz, and M. Mitchell. 2015. Moose abundance, distribution, and demographic characteristics in eastern Washington. Progress report – Year 1. Washington Department of Fish and Wildlife.

Hawkes, V.C., and K.N. Tuttle. 2013. CLBMON-37. Kinbasket and Arrow Lakes Reservoirs: Amphibian and Reptile Life History and Habitat Use Assessment. Year 5 Annual Report – 2012. LGL Report EA3303. Unpublished report by LGL Limited environmental research associates, Sidney, BC, for BC Hydro Generations, Water License Requirements, Burnaby, BC. 67 pp.

Hawk Migration Association of North America (HMANA). 2021. Chelan Ridge HawkWatch Migration Timing. [Online] URL:https://www.hawkcount.org/siteinfo.php?rsite=611. Accessed September 29, 2021.

Hayes, G., and G.J. Wiles. 2013. State of Washington Bat Conservation Plan. Washington Department of Fish and Wildlife. Olympia, Washington. 138 pp.

Hoffman, R.L., A. Woodward, P. Haggerty, K. Jenkins, P. Griffin, M.J. Adams, J. Hagar, T. Cummings, D. Duriscoe, K. Kopper, J. Riedel, L. Marin, G.S. Mauger, K. Bumbaco, and J.S. Littell. 2015. North Cascades National Park Service Complex: Natural resource condition assessment. Natural Resource Report NPS/NOCA/NRR—2015/901. National Park Service, Fort Collins, Colorado.

Holmes R. E. and R. S. Glesne. 1997. NOCA NRPP Amphibian Inventory Big Beaver Watershed 1996 – Progress Report. North Cascades National Park, Sedro-Woolley, Washington.

Holmes, R. and R. Glesne. 2000. Wildlife Research Program (Seattle City Light). Status Report: Species Identification and Genetic Differentiation Among Ranid Frog Populations in the Skagit River Watershed, North Cascades National Park. November 6, 2000.

Holmgren, A. L., R. L. Wilkerson, R. B. Siegel, and P. J. Happe. 2015. North Coast and Cascades Network landbird monitoring: Report for the 2014 field season. Natural Resource Report NPS/NCCN/NRR—2015/1048. National Park Service, Fort Collins, Colorado.

Huff, M. H., M. G. Raphael, S. L. Miller, S. K. Nelson, and J. Baldwin. 2006. Northwest Forest Plan - The first 10 years (1994-2003): Status and trends of populations and nesting habitat for the marbled murrelet. U.S. Department of Agriculture, Forest Service, General Technical Report: PNW-GTR-650, Portland, Oregon. June 2006.

Janss, G. F. 2000. Avian mortality from power lines: a morphologic approach of a species-specific mortality. Biological Conservation, 95: 353-359.

Jenkins, A.R., J.J. Smallie, and M. Diamond. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective.

Jenkins, K., K. Beirne, P. Happe, R. Hoffman, C. Rice, and J. Schaberl. 2011. Seasonal distribution and aerial surveys of mountain goats in Mount Rainier, North Cascades, and Olympic National Parks, Washington. U.S. Geological Survey Open-File Report 2011-1107, 56 p.

Johnston, C.A. and R.J. Naiman. 1987. Boundary dynamics at the aquatic-terrestrial interface: the influence of beaver and geomorphology. Landscape Ecology 1:47-57.

Jones, L.C., D.H. Olson, and W.P. Leonard. 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society, Seattle, Washington. 227 pp.

Kalisz, G., 2020. Personal communication between Glen Kalisz (WSDOT) and Ron Tressler (City Light) providing unpublished data for fisher carcass observations. October 28, 2020.

_____. 2022. Personal communication between Glen Kalisz (WSDOT) and Ron Tressler (City Light) providing unpublished data for lynx observations. October 12, 2022. Kertson, B.N., R.D. Spencer, and C.E. Grue. 2013. Demographic influences on cougar residential use and interactions with people in western Washington. Journal of Mammalogy 94: 269-281.

Kuntz, R.C. II, and R.G. Christophersen. 1996. A survey of Northern Spotted Owls in North Cascades National Park Service Complex. Technical Report NPS/CCSONOCA/NRTR-96/05.

Larrison, E.J. and K.G. Sonnenberg. 1968. Washington birds: their location and identification. Seattle Audubon Society, Seattle, WA.

Lewis, J.C. 2013. Implementation plan for reintroducing fishers to the Cascade Mountain Range in Washington. Washington Department of Fish and Wildlife, Olympia. 29 pp.

_____. 2016. Periodic Status Review for the Lynx in Washington. Washington Department of Fish and Wildlife, Wildlife Program. Olympia, Washington.

Lewis, J.C., J.R. Akins, and T. Chestnut. 2021. DRAFT Status report for the Cascade Red Fox in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 15+iii pp.Ligouri, J. 2005. Hawks from Every Angle: How to Identify Raptors in Flight. Princeton University Press, Princeton, New Jersey.

Long, R.A., J.S. Begley, P. MacKay, W.L. Gaines, and A.J. Shirk. 2013. The Cascades Carnivore Connectivity Project: A landscape genetic assessment of connectivity for carnivores in Washington's North Cascades Ecosystem. Unpublished Final report for the Seattle City Light Wildlife Research Program, Seattle, Washington. Western Transportation Institute, Montana State University, Bozeman. 57 pp.

Loss, S.R, T. Will, and P.P. Marra. 2014. Refining estimates of bird collision and electrocution mortality at power lines in the United States. PLOS ONE 9: e101565.

Luzenski, J., C. E. Rocca, R. E. Harness, J. L. Cummings, D. D. Austin, M. A. Landon, and J. F. Dwyer. 2016. Collision avoidance by migrating raptors encountering a new electric power transmission line. The Condor: Ornithological Applications 118: 402–410.

Lyons, A.L., W.L. Gaines, J. Begley, and P. Singleton. 2016 Grizzly Bear Carrying Capacity in the North Cascade Ecosystem. Submitted to the Skagit Environmental Endowment Commission Seattle, Washington Contract #US 15-05.

Macfarlane W.W., J.M. Wheaton, and M.L. Jensen. 2014. The Utah Beaver Restoration Assessment Tool: A decision support & planning tool. Ecogeomorphology and Topographic Analysis Lab, Utah State University, Prepared for Utah Division of Wildlife Resources, Logan, Utah, 142 pp. [Online] URL: http://etal.usu.edu/BRAT/. Accessed: January 9, 2020.

Madsen, S., D. Evans, T. Hamer, P. Henson, S. Miller, S.K. Nelson, D. Roby, and M. Stapanian. 1999. Marbled murrelet effectiveness monitoring plan for the Northwest Forest Plan. USDA, U.S. Forest Service. PNW-GTR-439. 51 pp.

Maletzke, B.T., R.B. Wielgus, G. Koehler, M. Swanson, H. Cooley, and R. Alldredge. 2014. Effects of hunting on cougar spatial organization. Ecology and Evolution 4:2178-2185. Available at: https://doi.org/10.1002/ece3.1089.

Manville, A.M. 2005. Bird strikes and electrocutions at power lines, communication towers, and wind turbines: state of the art and state of the science – next steps toward mitigation. USDA Forest Service General Technical Report PSW-GTR-191. P. 1051-1064.

McAllister, K.R. 1995. Distribution of amphibians and reptiles in Washington State. Northwest Fauna 3: 81-112.

McAllister, K.R., W.P. Leonard, and R.M. Storm. 1993. Spotted frog (*Rana pretiosa*) surveys in the Puget Trough of Washington, 1989-1991. Northwestern Naturalist 74:10-15.

McClaren, E.L., T. Mahon, F.I. Doyle, and W.L. Harrower. 2015. Science-Based Guidelines for Managing Northern Goshawk Breeding Areas in Coastal British Columbia. Journal of Ecosystems and Management 15(2): 1-91.

McGrath, M.T., S. DeStefano, R.A. Riggs, L.L. Irwin, and G.J. Roloff. 2003. Spatially explicit influences on Northern Goshawk nesting habitat in the interior Pacific Northwest. Wildlife Monographs 154:1–63.

Mcintyre, J.W., and J. F. Barr. 1997. Common Loon. No. 313 in A. Poole and F. Gill, editors. The Birds of North America. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, D.C.

McShane, C., T. Hamer, H. Carter, G. Swartzman, V. Friesen, D. Ainley, R. Tressler, K. Nelson,

A. Burger, L. Spear, T. Mohagen, R. Martin, L. Henkel, K. Prindle, C. Strong, and J. Keany. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished Report. EDAW, Inc., Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service (USFWS), Region 1, Portland, Oregon.

McShane, C. 2019. Personal communication between Colleen McShane, City Light, and Jim Keany, Environmental Science Associates. November 2019.

Mojica, E. K., C.E. Rocca, J. Luzenski, R.E. Harness, J.L. Cummings, J. Schievert, and M.A. Landon. 2020. Collision avoidance by wintering Bald Eagles crossing a transmission line. Journal of Raptor Research 54: 147-153.

Mule Deer Working Group. 2017. Western Association of Fish and Wildlife Agencies. Range-Wide Status of Black-Tailed Deer and Mule Deer.

Muths, E. and P. Nanjappa. 2005. Bufo boreas Baird and Girard 1852(b). Western Toad. Pp. 392-396. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Naiman, R.J., C.A. Johnston, and J.C. Kelley. 1988. Alteration of North American streams by beaver. BioScience 38:753-761.

National Park Service (NPS). 2008. North Coast and Cascades Network Landbird Monitoring. Report for the 2007 Field Season. Natural Resource Technical Report NPS/NCCN/NRTR 2008/114. 56 pp.

_____. 2009. North Coast and Cascades Network Landbird Monitoring. Report for the 2008 Field Season. Natural Resource Technical Report NPS/NCCN/NRTR-2009/222. 55 pp.

_____. 2010. North Coast and Cascades Network Landbird Monitoring. Report for the 2009 Field Season. Natural Resource Technical Report NPS/NCCN/NRTR-2010/392. 58 pp.

_____. 2011. North Coast and Cascades Network Landbird Monitoring. Report for the 2010 Field Season. Natural Resource Technical Report NPS/NCCN/NRTR-2011/473. 58 pp.

_____. 2012. North Coast and Cascades Network Landbird Monitoring. Report for the 2011 Field Season. Natural Resource Technical Report NPS/NCCN/NRTR-2012/605. 70 pp.

_____. 2013. North Coast and Cascades Network Landbird Monitoring. Report for the 2012 Field Season. Natural Resource Data Series NPS/NCCN/NRDS-2013/523. 65 pp.

_____. 2014. North Coast and Cascades Network Landbird Monitoring. Report for the 2013 Field Season. Natural Resource Data Series NPS/NCCN/NRDS-2014/691. 62 pp.

_____. 2015. North Coast and Cascades Network Landbird Monitoring. Report for the 2014 Field Season. Natural Resource Report NPS/NCCN/NRR-2015/1048. 64 pp.

_____. 2017. North Coast and Cascades Network Landbird Monitoring. Report for the 2016 Field Season. Natural Resource Technical Report NPS/NCCN/NRR-2017/1495. 68 pp.

_____. 2019. North Coast and Cascades Network Landbird Monitoring. Report for the 2018 Field Season. Natural Resource Data Series NPS/NCCN/NRDS-2019/1224. 77 pp.

_____. 2020a. North Coast and Cascades Network Landbird Monitoring. Report for the 2019 Field Season (Revised with Costs). Natural Resource Data Series NPS/NCCN/NRDS-

2020/1296. 72 pp.

_____. 2020b Unpublished data on goshawk detections provided by Jason Ransom, NPS, April 14, 2020.

_____. 2021a. First wild fishers found in the North Cascades. Press release, May 17, 2021. Available at: Fishers Born Press Release - North Cascades National Park (U.S. National Park Service) (nps.gov).

_____. 2021b. North Coast and Cascades Network Landbird Monitoring. Report for the 2020 Field Season. Natural Resource Data Series NPS/NCCN/NRDS-20211337. 70 pp.

_____. 2021c. North Cascades National Park Complex Golden Eagle Observations. Spatial database in MS Excel format provided by Jason Ransom, NPS, to Nathan Jones, HDR, via email on August 11, 2021.

Nelson, S. K. 1997. Marbled murrelet (*Brachyramphus marmoratus*). In The Birds of North America, No. 276. A. Poole and F. Gill, editors. Academy of Natural Sciences, Philadelphia, PA, and American Ornithologists Union, Washington, D.C.

Nielsen, E. M., C. Copass, R. L. Brunner, and L. K. Wise. 2021. North Cascades National Park Complex vegetation classification and mapping project report. Natural Resource Report NPS/NCCN/NRR—2021/2254. National Park Service, Fort Collins, Colorado. Accessed online 11/11/2021. https://doi.org/10.36967/nrr-2286418.

North, M.P., J.F. Franklin, A.B. Carey, E.D. Forsman, and T.E. Hamer. 1999. Forest stand structure of the northern spotted owl's foraging habitat. Forest Science 45:520-527.

Nussbaum, R.A., E.D. Brodie, Jr., and R.M. Storm. 1983. Amphibians and Reptiles of the Pacific Northwest. The University Press of Idaho, Moscow, Idaho.332 pp.

Oberholser, H. C. and E. B. Kincaid, Jr. 1974. The bird life of Texas. Volume 1. University of Texas Press, Austin, Texas.

Ovaska, K., L. Sopuck, and C. Engelstoft, J. Hobbs, and C.C. Helbing. 2019. Clarifying Distributions of Four Species of *Rana* in Southwestern British Columbia Using eDNA methods. Final report, 2016-2018. Habitat Conservation Trust Foundation. 54 pp.

Pearl, C.A. and J. Bowerman. 2006. Observations of rapid colonization of constructed ponds by western toads (Bufo boreas) in Oregon, USA. Western North American Naturalist 66:397-401. Available at: https://scholarsarchive.byu.edu/wnan/vol66/iss3/14.

Pearl, C.A., and M.P. Hayes. 2005. *Rana pretiosa* Baird and Girard, 1953c. Oregon Spotted Frog. Pp. 577-580. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Pelton, M. R. 2000. Black Bear. Pp 389-408 in: Demarais, S. and P. R. Krausman, Eds. Ecology and Management of Large Mammals in North America. Prentice Hall, Upper Saddle River, New Jersey.

Pilliod, D.S. and J.A Fronzuto. 2005. *Ambystoma macrodactylum* Baird, 1950 “1849.” Long-toed Salamander. Pp. 617-621. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Pilliod, D.S., C.R. Peterson, and P.I Ritson. 2001. Seasonal migration of Columbia spotted frogs

(*Rana luteiventris*) among complementary resources in a high mountain basin. Canadian Journal of Zoology 80:1849-1862.

Pollock, M.M., G.M. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors). 2018. The beaver restoration guidebook: working with beaver to restore streams, wetlands, and floodplains. Version 2.01. United States Fish and Wildlife Service, Portland, Oregon. 18 pp. [Online] URL: http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/ Beaver.asp. Accessed October 2021.

Ransom, J. 2019. Personal communication between Jason Ransom, National Park Service, and Jim Keany, Environmental Science Associates. March 12, 2019.

Rawhouser, A. 2021. Personal communication between Ron Tressler (City Light) and Ashley Rawhouser (NPS). June 24, 2021.

Rawhouser, A.K., R.E. Holmes, and R.S. Glesne. 2009. A survey of stream amphibian species composition and distribution in the North Cascades National Park Service Complex, Washington State (2005). Natural Resource Technical Report NPS/NCCN/NRTR–2009/169. National Park Service, Fort Collins, Colorado.

Ray, C., J.F. Saracco, M.L. Holmgren, R.L. Wilkerson, R.B. Siegel, K.J. Jenkins, J.I. Ransom, P.J. Happe, J.R. Boetsch, and M.H. Huff. 2018. Landbird population trends in mountain and historical parks of the North Coast and Cascades Network 2005–2016 synthesis. Natural Resource Report NPS/PWR/NRR-2018/1673. National Park Service, Fort Collins, Colorado. 85 p.

Rayner, J.M. V. 1988. Form and Function in Avian Flight, Pages 1-66 in: Johnston, R.F. (Editor), Current Ornithology, Vol. 5. Springer US, Boston, MA.

Reaser, J.K. and D.S. Pilliod. 2005. *Rana luteiventris* Thomson, 1913. Columbia Spotted Frog. Pp. 559-563. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Reed, P. 2021. Personal communication between Phyllis Reed, U.S. Forest Service (USFS), and Erin Colclazier, Hamer Environmental. December 29, 2021.

Richardson, S., D. Hays, R. Spencer, and J. Stofel. 2000. Washington State Status Report for the Common Loon. Washington Department of Fish and Wildlife, Olympia. 53 pp.

Rine, K. M., R. G. Christophersen, and J. I. Ransom. 2022. Harlequin duck (Histrionicus histrionicus) occurrence and habitat selection in North Cascades National Park Service Complex, Washington. Natural Resource Report NPS/NOCA/NRR—2022/2370. National Park Service, Fort Collins, Colorado. https://doi.org/10.36967/nrr-2293127.

Rioux, S., J-P.L. Savard, A.A. Gerick. 2013. Avian mortalities due to transmission line collisions: a review of current estimates and field methods with an emphasis on applications to the Canadian electric network. Avian Conservation Ecology.

Robertson, G. J. and R. I. Goudie. 1999. Harlequin Duck (*Histrionicus histrionicus*), version 2.0. in: The Birds of North America (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

Romain-Bondi, K.A., R.B. Wielgus, L. Waits, W.F. Kasworm, M Austin, and W. Wakkinen. 2004. Density and population size estimates for North Cascade grizzly bears using DNA hair-sampling techniques. Biological Conservation 117:417-428.

Rombough, C. 2012. Instructional manual and frog survey protocols for Region 1 National Wildlife Refuges, East-side Zone (Great Basin and Great Northern LCCs). Report to the US Fish and Wildlife Service, Region 1 Inventory and Monitoring Program, Vancouver, Washington.

Rorabaugh, J.C. and M.J. Lannoo. 2005. *Pseudacris regilla* (Baird and Girard, 1852[b] Pacific Treefrog. Pp. 478- 484. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Rubenstein, M.A., R. Christophersen, and J. I. Ransom. 2018. Trophic implications of a phenological paradigm shift: Bald eagles and salmon in a changing climate. J. of App. Ecol. 2018:1-10.

Rubolini, D., M. Gustin, G. Bogliani, and R. Garavaglia. 2005. Birds and powerlines in Italy: an assessment. Bird Conservation International. 15:131–145.

Schuett-Hames, J.P. and B.J. Blessing-Earle. 2021. Western toad (*Anaxyrus boreas*) breeding timing and larval development in Lake Cushman reservoir, Washington State. Northwestern Naturalist 102:140-149.

Seattle City Light (City Light). 2006. Management Plan – Skagit Wildlife Mitigation Lands.

_____. 2013. Unpublished data – Barnaby Surveys.

_____. 2014. Unpublished data – Barnaby Bat Survey.

_____. 2021. Revised Study Plan (RSP) for the Skagit River Hydroelectric Project, FERC Project No. 553. April 2021.

_____. 2022a. TR-05 Marbled Murrelet Study, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Hamer Environmental. March 2022.

_____. 2022b. TR-10 Northern Spotted Owl Habitat Analysis, Draft Report Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

_____. 2022c. TR-08 Special-Status Amphibian Study, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

_____. 2022d. TR-07 Northern Goshawk Habitat Analysis, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by Environmental Science Associates. March 2022.

_____. 2022e. TR-06 Golden Eagle Habitat Analysis, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

_____. 2022f. TR-09 Beaver Habitat Assessment, Interim Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

Sevigny, Summers, Kalisz, and McAllister, "Identification of Elk-vehicle incident hotspots on state route 20 in Washing State", published 4 April 2021. Landscape Ecol (2021) 36:1685–

1698. Accessed online 10/24/2022. https://link.springer.com/content/pdf/10.1007/s10980-021-01238-2.pdf

Shaffer, H.B. 2005. Ambystoma gracile (Baird, 1859) Northwestern Salamander. Pp. 609-611. In: Lannoo, M. (Editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, June 2005.

Siegel, R.B., R.C. Kuntz II, R.L. Wilkerson, K.D. Kuhlman, and M.C. Toshack. 2012. Surveying for spotted owls in the Upper Skagit watershed of North Cascades National Park Complex, 2009-2010. Natural Resource Technical Report NPS/NOCA/NRTR—2012/597. National Park Service, Fort Collins, Colorado.

Singh, N.J., E.H.R. Moss, T. Hipkiss, F. Ecke, H. Dettki, P. Sandstrom, P. Bloom, J. Kidd, S. Thomas, B. Hornfeldt. 2016. Habitat selection by adult golden eagles (*Aquila chrysaetos*) during the breeding season and implications for wind farm establishment. Bird Study 63(2): 233-240.

Slater, S. J., Dwyer, J. F., and Murgatroyd, M. 2020. Conservation Letter: Raptors and Overhead Electrical Systems. Journal of Raptor Research. 54: 198-203.

Sovern, S.G., E.D. Forsman, K.M. Dugger, and M. Taylor. 2015. Roosting habitat use and selection by northern spotted owls during natal dispersal. Journal of Wildlife Management. 79(2): 254–262. doi:10.1002/jwmg.834.

Sporer, M.K., J.F. Dwyer, B.D. Gerber, R.E. Harness, A.K. Pandey. 2013. Marking power lines to reduce avian collisions near the Audubon National Wildlife Refuge, North Dakota. Wildlife Society Bulletin 329: 1-9.

Springwood. 2001. Skagit River Bald Eagle-Seattle City Light Transmission Line Interaction Study. May 29, 2001.

Squires, J.R., and P.L. Kennedy. 2006. Northern goshawk ecology: an assessment of current knowledge and information needs for conservation management. Studies in Avian Biology 31: 862. eBird. 2020. eBird database maintained by Cornell Lab of Ornithology. [Online] URL: https://ebird.org/region/US-WA?yr=all. Accessed January 2, 2020.

Squires, J.R., J.P. Copeland, T.J. Ulizio, M.K. Schwartz, and L.F. Ruggiero. 2007. Sources and patterns of wolverine mortality in western Montana. Journal of Wildlife Management 71:2213-2220.

Stehn, T.V., and T. Wassenich. 2008. Whooping crane collisions with power lines: an issue paper. Pages 25-36, In: Folk, MJ and SA Nesbitt, editors. Proceedings of the Tenth North American Crane Workshop, Feb. 7-10, 2006, Zacatecas City, Zacatecas, Mexico: North American Crane Working Group.

Stinson, D. 2001. Washington state recovery plan for the lynx. Washington Department of Wildlife, Olympia, Washington. 78 pp.

Stinson, D.W. 2016. Periodic status review for the Streaked Horn Lark in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 21+iii pp.

Swan, K.D, V.C. Hawkes, and P.T. Gregory. 2015. Breeding phenology and habitat use of amphibians in the drawdown zone of a hydroelectric reservoir. Herpetological Conservation and Biology 10: 864-873.

Tressler, R. 2022a. Personal communication between Ron Tressler, Seattle City Light, and Stephen Nyman, HDR, Inc. October 7, 2022.

Tressler, R. 2022b. Personal communication between Ron Tressler, Seattle City Light, and Susan Imholt, HDR, Inc. October 9, 2022.

United States Department of the Interior (USDOI). 2017. Draft Grizzly Bear Restoration Plan/Environmental Impact Statement. U.S. Fish and Wildlife Service (USFWS) and National Park Service. 198 pp + Appendices. January 2017.

United States Fish and Wildlife Service (USFWS). 1993. Grizzly Bear Recovery Plan. Missoula, Montana. 181 pp. September 10, 1993.

_____. 1997. Recovery Plan for the Threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. Portland, Oregon. 203 pp.

_____. 2004. Northern Spotted Owl Five-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Portland, Oregon. November 15, 2004.

_____. 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon. xvi + 258 pp.

_____.2012. Guidance for Identifying Marbled Murrelet Nest Trees in Washington State. U.S. Fish and Wildlife Service and Washington Fish and Wildlife Office (WFWO).

_____. 2014. Endangered and threatened wildlife and plants; determination of threatened status for the western distinct population segment of the Yellowbilled Cuckoo (*Coccyzus americanus*). Federal Register 79(192):59992–60038.

_____. 2017. Species Status Assessment for the Canada lynx (*Lynx canadensis*) Contiguous United States Distinct Population Segment. Version 1.0. US Fish and Wildlife Service, Mountain-Prairie Region, Lakewood Colorado. 292 pp. October 1, 2017.

_____. 2018. Species Status Assessment for the North American Wolverine (*Gulo gulo luscus*). Version 1.2. US Fish and Wildlife Service, Mountain-Prairie Region, Lakewood, Colorado. 168 pp. March 1, 2018.

_____. 2019. ECOS Environmental Conservation Online System. [Online] URL: http://criticalhabitat.fws.gov/flex/crithabMapper.jsp. Accessed December 31, 2019.

_____. 2020. Monarch (*Danaus plexippus*) Species Status Assessment Report. V2.1 96 pp.

_____.2021. Endangered and threatened wildlife and plants; designation of critical habitat for the western distinct population segment of the Yellow-billed Cuckoo. Federal Register 86(75):20798-21005.

_____. 2022. Species Status Assessment for the Grizzly Bear (*Ursus arctos horribilis*) in the Lower-48 States. Version 1.2. U.S. Fish and Wildlife Service, Grizzly Bear Recovery Office, Missoula, Montana. 369 pp. January 22, 2022.

United States Forest Service (USFS). 2004. Region 6 Sensitive Species List. [Online] URL: https://www.fs.usda.gov/detail/r6/landmanagement/resourcemanagement/?cid=fsbdev2_027059. Accessed September 2022.

United States Geologic Survey (USGS).2018. North American Breeding Bird Survey. Raw Results. U.S. Department of the Interior, Patuxent Wildlife Research Center, Laurel, MD, USA. Last Modified: March 27, 2018. [Online] URL: https://www.pwrc.usgs.gov/BBS/RawData/. Accessed August 26, 2021.

Vekasy, M.S. and G.E. Hayes. 2016. Periodic status review for the peregrine falcon in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 16 pp.

Washington Department of Fish and Wildlife (WDFW). 2010. Priority Habitats and Species Data Records. [Online] URL: https://geodataservices.wdfw.wa.gov/hp/phs/. Accessed August 30, 2021.

_____. 2015a. Game Management Plan: July 2015-June 2021.

______. 2015b. Species of Greatest Conservation Need. Chapter 3 pp. 3-1-3:50, In: 2015 State Wildlife Action Plan.

_____. 2018. North Cascades Elk Herd Management Plan. Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA. September 2018.

_____. 2019a. PHS on the Web. Priority Habitats and Species Program. [Online] URL: http://apps.wdfw.wa.gov/phsontheweb/. Accessed April 28, 2019.

_____. 2019b. Game harvest statistics. [Online] URL: https://wdfw.wa.gov/hunting/management/game-harvest. Accessed June 20, 2019.

_____. 2020. Monarch butterfly (Danaus plexippus). Online [URL]: https://wdfw.wa.gov/species-habitats/species/danaus-plexippus#climate. Accessed August 2022.

_____.2021a. Priority Habitat and Species Program species marbled murrelet and northern spotted owl location data and maps provided by WDFW data request to Seattle City Light on May 8, 2021.

_____. 2021b. Northern goshawk (*Accipiter gentilis*). [Online] URL: https://wdfw.wa.gov/species-habitats/species/accipiter-gentilis#conservation. Accessed December 13, 2021.

_____. 2022a. Washington Gray Wolf Conservation and Management 2021 Annual Report. Prepared by the Washington Department of Fish and Wildlife, Confederated Tribes of the Colville Reservation, Spokane Tribe of Indians, USDA-APHIS Wildlife Services, and U.S. Fish and Wildlife Service. April 2022.

___. 2022b. PHS on the Web. Priority Habitats and Species Program. [Online] URL: http://apps.wdfw.wa.gov/phsontheweb/. Accessed July 30, 2022.

Washington Department of Fish and Wildlife, Confederated Colville Tribes, Spokane Tribe of Indians, USDS-APHIS Wildlife Services, and U.S. Fish and Wildlife Service. 2019. Washington Gray Wolf conservation and management 2018 Annual Report. Washington Department of Fish and Wildlife, Ellensburg, WA.

Washington Department of Natural Resources (DNR). 2006. Lynx Habitat Management Plan for DNR-Managed Lands. Land Management Division. April 2006.

_____. 2018. 2017 Washington Timber Harvest Report. Published August 2018.

Washington Natural Heritage Program, Washington Department of Wildlife, U.S. Department of the Interior, Bureau of Land Management, and U.S. Forest Service. 2009. Washington Herp Atlas [On-line]. Available at: https://wdfw.wa.gov/sites/default/files/publications/02135/wdfw02135.pdf.

Watson, J.W., D.W. Hays, S.P. Finn, and P. Meehan-Martin. 1998. Prey of breeding Northern Goshawks in Washington. J. Raptor Res. 32(4):297-305.

Watts, B. D., E. K. Mojica, and B. J. Paxton. 2015. Using Brownian bridges to assess potential interactions between Bald Eagles and electrical hazards within the upper Chesapeake Bay. Journal of Wildlife Management 79: 435–445.

Weber, S., A. Woodward, and J. Freilich. 2009. North Coast and Cascades Network vital signs monitoring report (2005). Natural Resource Report NPS/NCCN/NRR—2009/098. National Park Service, Fort Collins, Colorado.

White, K.R. 2009. Prey use my male and female cougars in an elk and mule deer community. Masters thesis. Washington State University, Department of Natural Resources. Pullman, Washington.

Wiken, E., F.J. Nava, and G. Griffith. 2011. North American Terrestrial Ecoregions—Level III. Commission for Environmental Cooperation, Montreal, Canada.

Wiles, G.J., H.L. Allen, and G.E. Hayes 2011. Wolf conservation and management plan for Washington. Washington State Department of Fish and Wildlife.

Wiles, G.J., and Kalasz, K.S. 2017. Status report for the Yellow-billed Cuckoo in Washington. Washington Department of Fish and Wildlife, Olympia, Washington, 32+iv pp.

Wilkerson, R. L. and R. B. Siegel. 2007. Interpreting the Northwest Forest Plan's Northern Spotted Owl habitat suitability model for use in North Cascades National Park. The Institute for Bird Populations, Point Reyes Station, CA. 94 pp.

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White. 1990. California's Wildlife Volume II. Birds. California Wildlife Habitat Relationships. California Department of Fish and Game, Sacramento, California.

Section 4.2.6 Recreation and Land Use

AllTrails. 2019. PCT: WA Section L – Rainy Pass to Manning Park, BC. [Online] URL: https://www.alltrails.com/trail/us/washington/pct-wa-section-l-rainy-pass-to-manning-park-bc. Accessed June 21, 2019.

American Whitewater. 2022a. River Info: Skagit River – Goodell Creek to Copper Creek. [Online] URL: https://www.americanwhitewater.org/content/River/view/?#/riverdetail/2206/main. Accessed June 20, 2022.

_____. 2022b. River Info: Skagit River – Copper Creek to Rockport. [Online] URL: https://www.americanwhitewater.org/content/River/view/river-detail/2205/main. Accessed June 20, 2022.

Anthony, H.D., and A.K. Rawhouser. 2017. Ross Lake creel survey, 2011. Natural Resource Technical Report NPS/XXXX/NRTR—20XX/XXX. National Park Service, Fort Collins, Colorado.

Dowen, M.A. 2004. North Cascades National Park High Lakes Fishery Management: Historic, Current, and Proposed Future Management of Sport Fish in High-Elevation Park Lakes. Washington Department of Fish and Wildlife, La Conner District Office. May 2004.

National Park Service (NPS). 2012. Ross Lake National Recreation Area. General Management

Plan. National Park Service, U.S. Department of the Interior. July 2012.

_____. 2019a. North Cascades National Park Camping. [Online] URL: https://www.nps.gov/noca/planyourvisit/camping.htm#CP_JUMP_628817. Accessed April 24, 2019.

_____. 2019b. National Trails System Act Legislation. [Online] URL: https://www.nps.gov/subjects/nationaltrailssystem/national-trails-system-act-legislation.htm. Accessed September 20, 2019.

_____. 2019c. Backcountry Reservations. [Online] URL: https://home.nps.gov/noca/planyourvisit/loader.cfm?csModule=security/getfile&PageID=414444. Accessed September 16, 2019.

_____. 2020. DRAFT Skagit River geomorphology inventory report: Part I – Gorge Dam to Sauk River. Report to Seattle City Light by the U.S. National Park Service.

_____. 2021. Superintendent's Compendium. II. 36 CFR §1.5 – Visiting hours, public use limits, closures, and area designations for specific use or activities. [Online] URL: https://www.nps.gov/noca/learn/management/superintendent-compendium.htm#visiting%20hours. Accessed November 15, 2021.

_____. 2022a. North Cascades National Park Boating on Ross Lake. [Online] URL: https://www.nps.gov/noca/planyourvisit/boating-on-ross-lake.htm. Accessed June 20, 2022.

_____. 2022b. North Cascades National Park Trail Guide. [Online] URL: https://www.nps.gov/noca/planyourvisit/trailguide.htm. Accessed June 20, 2022.

_____. 2022c. North Cascades Park Visitor Centers. [Online] URL: https://www.nps.gov/noca/planyourvisit/visitorcenters.htm. Accessed 20, 2022.

The Nature Conservancy. 2021. Skagit River Bald Eagle Natural Area. [Online] URL: https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/skagit-river/. Accessed June 20, 2022.

North, D. 1992. Washington Whitewater: The 34 Best Whitewater Rivers. Revised 1999. The Mountaineers, Seattle, WA.

Pacific Crest Trail Association (PCTA). 2019. Pacific Crest Trail Maps. [Online] URL: https://www.pcta.org/discover-the-trail/maps/. Accessed June 21, 2019.

Pacific Northwest Trail Association (PNTA). 2019. Pacific Northwest National Scenic Trail Maps. [Online] URL: https://www.pnt.org/wp-content/uploads/2019/06/2019-PNT-_Overview-Maps-FWV.pdf. Accessed June 20, 2022.

Seattle City Light (City Light). 1991. Memorandum of Agreement, North Cascades Environmental Learning Center. Seattle, Washington.

_____. 2018. Policy Statement, Public Use of Seattle City Light Fish and Wildlife Conservation Lands. June 19, 2018.

_____. 2019. Protecting and improving wildlife habitat in the North Cascades Ecosystem. [Online] URL: http://www.seattle.gov/light/skagit/wildlife.asp. Accessed May 26, 2019

_____. 2022a. RA-01 Recreation Use and Facility Assessment Study, Skagit River Hydroelectric

Project, FERC Project No. 553. Prepared by HDR Engineering, Inc.

_____. 2022b. RA-02 Gorge Bypass Reach Safety and Whitewater Boating Study, Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by River Sciences Institute.

_____. 2022c. RA-03 Project Facility Lighting Inventory, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

Skagit County Parks and Recreation. 2022. Howard Miller Steelhead Park. [Online] URL: https://www.skagitcounty.net/Departments/ParksAndRecreation/parks/howardmiller.htm. Accessed June 20, 2022.

Skagit River Bald Eagle Interpretive Center (SRBEIC). 2022. Programs. [Online] URL: https://skagiteagle.org/programs/. Accessed June 20, 2022.

United States Forest Service (USFS). 1983. River Management Analysis (Final), Skagit River. Department of Agriculture. National Wild and Scenic River Systems. Mt Baker-Snoqualmie National Forest.

_____. 2018. Pacific Northwest Trail, Questions and Answers. July 5, 2018.

_____. 2019a. National Wild and Scenic River System, Skagit River, Washington. [Online] URL: https://www.rivers.gov/rivers/skagit.php. Accessed June 21, 2019.

_____. 2019b. Pacific Crest National Scenic Trail. [Online] URL: https://www.fs.usda.gov/pct. Accessed June 21, 2019.

Washington Department of Fish and Wildlife (WDFW). 2022. Washington Sport Fishing Rules. [Online] URL: https://www.eregulations.com/washington/fishing/. Accessed on June 20, 2022.

Washington Trails Association. 2022. Washington Trails. [Online] URL: https://www.wta.org/. Accessed: June 20, 2022.

Wilderness Connect. 2019. Stephen Mather Wilderness. [Online] URL: https://wilderness.net/visit-wilderness/?ID=577. Accessed June 21, 2019.

Section 4.2.7 Aesthetic Resources

Envirosphere. 1989. Skagit River Project, Submitted to the FERC in Response to a Request for Supplemental Environmental Information FERC No. 553. Submitted October 31, 1989.

Methow Rafting. 2022. Skagit River Whitewater Rafting. [Online] URL: https://www.methowrafting.com/river-rafting/skagit-river-whitewater-rafting/. Accessed July 21, 2022.

National Park Service (NPS). 1994. Visual Compatibility Guidelines for the Newhalem Historic Area: Historic Landscape Resource Management, Newhalem, Washington. National Park Service, Pacific Northwest Region, Cultural Resources Division. November 1994.

_____. 2000. Bird Finding Guide County Line Ponds and Aggregate Ponds. [Online] URL: http://npshistory.com/publications/noca/birdguide/birdingguide1a.htm.

_____. 2006. Management Policies 2006.

_____. 2012. Ross Lake National Recreation Area. General Management Plan. National Park Service, U.S. Department of the Interior. July 2012.

_____. 2017. Accessibility at Gorge Overlook Trail. [Online] URL: https://www.nps.gov/noca/planyourvisit/accessibility-at-gorge-overlook-trail.htm. Accessed July 21, 2022.

_____. 2022. Sustainable Outdoor Lighting. [Online] URL: https://www.nps.gov/subjects/nightskies/sustainable-outdoor-lighting.htm. Accessed August 22, 2022.

Outdoor Project. 2021. Gorge Overlook. [Online] URL: https://www.outdoorproject.com/united-states/washington/gorge-overlook.

Parametrix. 1989. Skagit River Project Ross Lake Early Season Recreational Activity and Visual Quality Assessment. October 1989.

Seattle City Light (City Light). 1990. Transmission Rights of Way Vegetation Management Plan Final Report. Prepared by Compliance Services International (CSI), Dames and Moore, Inc., and Don Shimono Associates. February 1990.

_____. 1991a. Skagit River Hydroelectric Project FERC No. 553: Report on Aesthetics: Visual Quality Mitigation Analysis. April 1991.

_____. 1991b. Skagit River Hydroelectric Project, FERC No. 553, Historic Resources Mitigation and Management Plan. April 1991.

_____. 2022a. RA-03 Project Facility Lighting Inventory, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

_____. 2022b. RA-04 Project Sound Assessment, Draft Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. March 2022.

Torres, Brandon. 2022. Personal communication between Mike Aronowitz (City Light) and Brandon Torres (NPS). January 3 and 10, 2022.

Tripadvisor. 2022. Review of Gorge Creek Falls. [Online] URL: https://www.tripadvisor.com/ShowUserReviews-g143046-d4681635-r417105400-Gorge_Creek_Falls-North_Cascades_National_Park_Washington.html. Accessed July 21, 2022.

United States Forest Service (USFS). 1983. Skagit River Management Plan.

_____. 1990. Mt Baker-Snoqualmie National Forest Land and Resource Management Plan. June 1990.

Washington Department of Transportation (WSDOT). 2010. Development of a Resource Planning Index for Washington's Scenic and Recreational Highways. February 2010.

_____. 2018. Transportation Asset Management Plan. April 2018.

_____. 2022a. Mountain Pass Closure and Opening Dates: North Cascades SR 20. [Online] URL: https://wsdot.wa.gov/travel/roads-bridges/mountain-pass-closure-and-opening-dates. Accessed July 21, 2022.

_____. 2022b. Standard Plans. [Online] URL: https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/standard-plans. Accessed July 21, 2022.

Section 4.2.8 Cultural Resources

Advisory Council on Historic Preservation (ACHP). 2019. Memorandum: Recent court decision regarding the meaning of “direct” in Sections 106 and 110(f) of the National Historic Preservation Act. [Online] URL: http://shpo.nv.gov/uploads/documents/OGC_memo_to_ACHP_staff_re_meaning_of_direct_6-7-19.pdf. Accessed November 19, 2020.

Ames, K.M. and H.D.G. Maschner. 1999. Peoples of the Northwest Coast: Their Archaeology and Prehistory. Thames and Hudson, London.

Amoss, Pamela T. 1972. The Persistence of Aboriginal Beliefs and Practices among the Nooksack Coast Salish. Unpublished dissertation, Department of Anthropology, University of Washington, Seattle.

Avery, M. ca. 1991. Fluted Point Occurrences in Washington State. Ft. Steilacoom Community College, Steilacoom, Washington.

Blake, Warner. 2008. Snohomish–thumbnail history, HistoryLink Essay 8508. [Online] URL: https://www.historylink.org/File/8508. (Accessed June 15, 2020.)

_____. 2017. Lake Stevens – thumbnail history, HistoryLink Essay 20491. [Online] URL: https://www.historylink.org/File/20491. Accessed June 15, 2020.

Boxberger, D. 1996. An Ethnographic Overview and Assessment of North Cascades National Park Service Complex. Prepared for National Park Service Pacific Northwest Region, Seattle.

Blukis-Onat, A.R. 1987. Resource Protection Planning Process Identification of Prehistoric Archaeological Resources in the Northern Puget Sound Study-Unit. BOAS, Inc., Seattle, Washington.

_____. 1990. Skagit Hydroelectric Project Relicensing Survey and Evaluation of Traditional Cultural Values, Properties, and Significance of the Project Area to Indian Tribes. Prepared for EBASCO Environmental and Seattle City Light. Copy on file, Seattle City Light, Seattle.

Blukis-Onat, A.R., and J.L. Hollenbeck (ed). 1981. Inventory of Native American Religious Use, Practices, Localities and Resources. Study Area on the Mt. Baker—Snoqualmie National Washington State. Copy on file, Seattle City Light, Seattle.

Bruseth, N. 2012 (1926). Indian Stories and Legends of the Stillaguamish, Sauks and Allied Tribes. Literary Licensing, LLC, Whitefish, Montana.

Bureau of Land Management. 2020. General Land Office Records. [Online] URL: https://glorecords.blm.gov/search/default.aspx#searchByTypeIndex=0&searchTabIndex=0. Accessed June 16, 2020 and October 22, 2021.

Butler, B.R. 1961. Old Cordilleran Culture in the Pacific Northwest. Occasional Papers of the Idaho State College Museum No. 5. Pocatello.

Carlson, C.C. 2003. The Bear Cove Fauna and the Subsistence History of Northwest Coast Maritime Culture. In Archaeology of Coastal British Columbia: Essays in Honour of Philip

M. Hobler, edited by R.L. Carlson, pp. 65–86. Archaeology Press, Simon Fraser University, Burnaby.

Carlson, R.L. 1990. Cultural Antecedents. In Northwest Coast, edited by Wayne Suttles, pp. 60–69. Handbook of North American Indians, Vol. 7, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Cauvel, Kimberly. 2021. Dam relicensing process delayed for additional comment. goskagit.com Online [URL]: https://www.goskagit.com/news/environment/dam-relicensing-process-delayed-for-additional-comment/article_65987ea9-729a-50e4-8373-8ae8aafe4741.html. Accessed: October 21, 2022.

Chatters, J.C., J.B. Cooper, P.D. LeTourneau, and L.C. Rooke. 2011. Understanding Olcott: Data Recovery at 45SN28 and 45SN303, Snohomish County, Washington. Prepared for Snohomish County Department of Public Works, Snohomish, Washington by AMEC Earth & Environmental, Bothell, Washington.

Clague, J., J. Harper, R.J. Hebda, and D.E. Howes. 1982. Late Quaternary Sea Levels and Crustal Movements, Coastal British Columbia. Canadian Journal of Earth Sciences 19:597-618.

Collins, June M. 1974. Valley of the Spirits: The Upper Skagit Indians of Western Washington. University of Washington Press, Seattle.

Cólon, J.B., T.H. Payne, and J.M. Ferris. 2021. Goat Trail Cultural Resources Survey, Whatcom County, Washington. Prepared for Seattle City Light. Prepared by Cardno, Inc. and HDR, Inc. On file, Department of Archaeology and Historic Preservation, Olympia.

Crowley, Walt. 2000. City Light's birth and Seattle's early power struggles, 1886-1950, HistoryLink Essay 2318. [Online] URL: https://www.historylink.org/File/2318. Accessed June 16, 2020.

Curti, Gorgio, Dayna Bowker Lee, and Christopher M. Moreno. 2020. Skagit River Hydroelectric Project (FERC No. 553) Traditional Cultural Property Synthesis Study. Prepared by Cultural Geographics Consulting, LLC, Seattle. Prepared for Seattle City Light.

Danner, Lauren. 2017. Crown Jewell Wilderness: Creating North Cascades National Park. Washington State University Press, Pullman, Washington.

Davis, Glee. 1953. Pioneering in upper Skagit recalled by early settler Glee Davis. Bellingham Herald, June 26, 1953.

Dixon, E.J. 1993. Quest for the Origins of the First Americans. University of New Mexico Press, Albuquerque.

Dolan, Susan. 1999. Historic Property Inventory Form: Marblemount Ranger Station, Property ID 51542. Recorded May 1. On file, Department of Archaeology and Historic Preservation, Olympia.

Dougherty, Phil. 2007. Marysville – thumbnail history, HistoryLink Essay 8227. [Online] URL: https://www.historylink.org/File/8227. Accessed June 15, 2020.

_____. 2020. Mill Creek incorporates on September 30, 1983, HistoryLink Essay 21024. [Online] URL: https://historylink.org/File/21024. Accessed June 15, 2020.

Fedje, D.W. and T. Christensen. 1999. Modeling Paleo Shorelines and Locating Early Holocene

Coastal Sites in Haida Gwaii. American Antiquity 64:635–652.

Federal Energy Regulatory Commission (FERC). 2022. What is FERC? Overview. [Online] URL: https://www.ferc.gov/what-ferc. Accessed October 21, 2022.

Federal Energy Regulatory Commission (FERC) and Advisory Council on Historic Preservation (ACHP). 2002. Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects. Washington D.C.

Fladmark, K.R. 1979. Routes: Alternate Migration Corridors for Early Man in North America. American Antiquity 44:55–69.

Hodges, C.M., B.A. Rinck, and A. Earley. 2009. Cultural Resource Assessment for the Lower Bear Creek Rehabilitation Project, King County, Washington. NWAA Report No. WA08-64. Prepared for David Evans and Associated, Inc. Prepared by Northwest Archaeological Associated. On file, Department of Archaeology and Historic Preservation, Olympia.

Harmon, A. 1998. Indians in the Making: Ethnic Relations and Indian Identities around Puget Sound. University of California Press, Berkeley.

Harry, D. 1991. State of Washington Archaeological Site Inventory Form: 45WH00570. On file, Department of Archaeology and Historic Preservation, Olympia.

Hollenbeck, J.L. 1987. A Cultural Resource Overview: Prehistory, Ethnography, and History – Mt. Baker-Snoqualmie National Forest. U.S. Forest Service, Pacific Northwest Region, U.S. Department of Agriculture.

Johnson, Larry E. 2010. National Register of Historic Places Registration Form: Skagit River and Newhalem Creek Hydroelectric Projects. Signed by Washington State Historic Preservation Officer on December 21, 2010.

Johnson, T. 2021. A Brief History. Prepared by History and Archaeology Department, Confederated Tribes of the Colville Reservation, Nespelem, Washington. [Online] URL: https://storymaps.arcgis.com/stories/bb31cd48d0284fa59d6f454cafabe962.

Kenady, S.M., M.C. Wilson, and R.F. Schalk. 2006. State of Washington Archaeological Site Inventory Form: 45SJ454. On file, Department of Archaeology and Historic Preservation, Olympia.

Kenady, S.M., M.C. Wilson, R.F. Schalk, and R. Mierendorf. 2011. Late Pleistocene butchered Bison antiquus from Ayer Pond, Orcas Island, Pacific Northwest: Age Confirmation and Taphonomy. Quaternary International 233:130-141.

Kidd, R.S. 1964. A Synthesis of Western Washington Prehistory from the Perspective of Three Occupational Sites. Unpublished M.A. thesis, Department of Anthropology, University of Washington. On file, Department of Archaeology and Historic Preservation, Olympia.

Kirk, R. and R.D. Daugherty. 2007. Archaeology in Washington. University of Washington Press, Seattle.

Kopperl, R.E. (editor). 2016. Results of Data Recovery at the Bear Creek Site (45KI839), King County, Washington. Prepared for David Evans and Associates, Inc., and the City of Redmond, Washington. Prepared by SWCA. On file, Department of Archaeology and Historic Preservation, Olympia.

Kopperl, R.E., C.J. Miss, and C.M. Hodges. 2010. Results of Testing at the Bear Creek Site, 45-KI-839, Redmond, King County, Washington. Northwest Archeological Associates, Inc., Seattle. On file, Department of Archaeology and Historic Preservation, Olympia.

Kopperl, R.E., A.K. Taylor, C.J. Miss, K.M. Ames, and C.M. Hodges. 2015. The Bear Creek Site (45KI839), a Late Pleistocene-Holocene Transition Occupation in the Puget Sound Lowland, Kind County, Washington. Paleoamerica 1(1):116-120.

Kwarsick, K.C. 2010. Lithic Raw Material Procurement and the Technological Organization of Olympic Peninsula Peoples. Master's Thesis, Washington State University, Pullman. [Online] URL: http://www.dissertations.wsu.edu/Thesis/Spring2010/k_kwarsick_040910.pdf. Accessed June 2022.

Lane, Barbara. 1973a. Anthropological Report on the Identity, Treaty Status, and Fisheries of the Lummi Tribe of Indians. Prepared for the U.S. Department of the Interior in United States v. Washington.

_____. 1973b. Anthropological Report on the Identity, Treaty Status, and Fisheries of the Stillaguamish Indians. In Political and Economic Aspects of Indian-White Culture Contact in Western Washington in the Mid-19th Century. Unpublished report.

_____. 1974. Anthropological Report on the Identity, Treaty Status and Fisheries of the Swinomish Indian Tribal Community. Prepared for the U.S. Department of the Interior in United States v. Washington.

_____. 1975a. Identity, Treaty Status and Fisheries of the Snoqualmie Tribe of Indians. Prepared for the U.S. Department of the Interior in United States v. Washington.

_____. 1975b. Identity, Treaty Status and Fisheries of the Tulalip Tribe of Indians. Prepared for the U.S. Department of the Interior and the Tulalip Tribe of Indians.

Lane, R., and B. Lane. 1977. Indians and Indian Fisheries of the Skagit River System. Skagit Salmon Studies, St. Johns. On file, Seattle City Light, Seattle.

Lenihan, Daniel J, Toni Carrell, Stephen Fosberg, Larry Murphy, Sandra Rayl and John Ware. 1981. The Final Report of the National Reservoir Inundation Study – Volume 1. National Park Service Library, Denver, Colorado.

Lentz, Florence K. 1997. National Register Nomination for the Seattle Municipal Light and Power Plant #97001077. Accepted by the Keeper in 1997.

Leonhardy, Frank C. and David G. Rice. 1970. A Proposed Culture Typology for the Lower Snake River Region, Southeastern Washington. Northwest Anthropological Research Notes 4(1): 1-29.

Lummi Nation. n.d About Us. Prepared by Lummi Nation. [Online] URL: https://www.lummi-nsn.gov/Website.php?PageID=388, accessed September 2021.

Luxenberg, G.A. 1986. Historic Resource Study, North Cascades National Park Service Complex, Washington. Cultural Resources Division, Pacific Northwest Region, national Park Service, Seattle.

Malone, M.S. 2005. Where the Water Meets the Land: Between Culture and History in Upper

Skagit Aboriginal Territory. Unpublished dissertation, Anthropology, University of British Columbia, Vancouver.

Mattson, J.L. 1985. Puget Sound prehistory: Postglacial Adaptations in the Puget Sound with Archaeological Implications for a Solution to the “Cascade Problem”. Ann Arbor, Michigan, University Microfilms International. Ph.D. Dissertation, University of North Carolina at Chapel Hill. On file, Department of Archaeology and Historic Preservation, Olympia.

Meltzer, D.J. and R.C. Dunnell. 1987. Fluted Points from the Pacific Northwest. Current Research in the Pleistocene 4:64–67.

Mierendorf, R.R. 1986. People of the North Cascades. National Parks Service, Pacific Northwest Region, Seattle, Washington.

_____. 1987. Washington Archaeological Site Inventory Form: 45DO482: East Wenatchee Clovis Site. On file, Department of Archaeology and Historic Preservation, Olympia.

_____. 1993. Chert Procurement in the Upper Skagit River Valley of the Northern Cascade Range, Ross Lake National Recreation Area, Washington. Technical Report NPS/PNRNOCA/CTRTR-93-001, North Cascades National Park Service Complex, Sedro Woolley, Washington. On file, Department of Archaeology and Historic Preservation, Olympia.

Mierendorf, R.R. and F.F. Foit. 2018. Holocene Geochronology and Archaeology at Cascade Pass, Northern Cascade Range, Washington. Journal of Northwest Anthropology Memoir 16.

Mierendorf, R.R., D.J. Harry, and G.M. Sullivan. 1998. An Archeological Site Survey and Evaluation in the Upper Skagit River Valley, Whatcom County, Washington. Technical Report NPS/CCCNOCA/CRTR-98/01. Prepared for City of Seattle, City Light Department, Seattle, Washington. National Park Service, U.S. Department of the Interior. On file, Department of Archaeology and Historic Preservation, Olympia.

Miller, Bruce. n.d. Upper Skagit Tribal Historical Overview. Online [URL]: https://upperskagittribe-nsn.gov/who-we-are/. Accessed: October 21, 2022.

Miss, C.J., J. Piper, and K. Bush. 2004. Draft Baker River Hydroelectric Project (FERC No. 2150) Application for New License Major Project-Existing Dam, Volume III, Historic Properties Management Plan. Prepared for Puget Sound Energy, Bellevue, Washington. Northwest Archaeological Associates, Inc., Seattle, Washington. On file, Department of Archaeology and Historic Preservation, Olympia.2010. Baker River Hydroelectric Project FERC No. 2150 Application for New License Major Project – Existing Dam, Volume III, Historic Properties Management Plan. Prepared for Puget Sound Energy, Bellevue, Washington. Northwest Archaeological Associates, Inc., Seattle, Washington. On file, Department of Archaeology and Historic Preservation, Olympia.

_____. 2010. Baker River Hydroelectric Project FERC No. 2150 Application for New License Major Project – Existing Dam, Volume III, Historic Properties Management Plan. Prepared for Puget Sound Energy, Bellevue, Washington. Northwest Archaeological Associates, Inc., Seattle, Washington. On file, Department of Archaeology and Historic Preservation, Olympia.2004. Draft Baker River Hydroelectric Project (FERC No. 2150) Application for New License Major Project-Existing Dam, Volume III, Historic Properties Management

Plan. Prepared for Puget Sound Energy, Bellevue, Washington. Northwest Archaeological Associates, Inc., Seattle, Washington. On file, Department of Archaeology and Historic Preservation, Olympia.

Mount Vernon Daily Herald. 1949. Crossing the Country and Searching for Gold with the von Pressentins. [Online] URL: http://www.stumpranchonline.com/skagitjournal/Upriver/Uto-Conc/Press/Press09-PaulFamGold49.html, accessed December 2020.

Muckleshoot Indian Tribe. n.d. About Us. [Online] URL: http://www.muckleshoot.nsn.us/about-us/overview.aspx, accessed September 2021.

National Park Service (NPS). 1999. Contested Terrain: North Cascades National Park Complex. An Administrative History. Published by the History and Education Department of the NPS, U.S. Department of the Interior. [Online] URL: https://www.nps.gov/parkhistory/online_books/noca/adhi/index.htm. Accessed October 10, 2022.

_____. 2008a. North Cascades: Historic Basic Data. Chapter 1: The Indians. [Online] URL: https://www.nps.gov/parkhistory/online_books/noca/hbd/chap1.htm, accessed September 2021. 1997. National Register Bulletin 15, How to Apply the National Register Criteria for Evaluation. Published by the History and Education Department of the NPS, U.S. Department of the Interior

_____. 2008b. North Cascades National Park: An Ethnographic Overview and Assessment of North Cascades National Park Service Complex. Chapter 2: A Review of the Ethnographic and Ethnohistoric Data Base. [Online] URL: http://www.nps.gov/publications/noca/ethnographic-overview/chap2.htm, accessed September 2021.

_____. 2020a. North Cascades National Park: miners. [Online] URL: https://www.nps.gov/noca/learn/historyculture/miners.htm. Accessed June 16, 2020.

_____. 2020b. North Cascades National Park: Loggers. [Online] URL: https://www.nps.gov/noca/learn/historyculture/loggers.htm. Accessed June 16, 2020.

Nlaka'pamux Nation Tribal Council and Province of British Columbia. 2017. Nlaka'pamux Nation Tribal Council - Province of British Columbia, Political Accord on Advancing Recognition, Reconciliation, and Implementation of Title and Rights. Online [URL]: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/agreements/nntc_final_27nov2017_accord_bc.pdf. Accessed: October 17, 2022.

Oakley, Janet. 2004. Skagit County – thumbnail history, HistoryLink Essay 5663. [Online] URL: https://www.historylink.org/File/5663. Accessed June 15, 2020.

_____. 2005. Whatcom County – Thumbnail history, HistoryLink Essay 7327. [Online] URL: https://www.historylink.org/File/7327. Accessed June 15, 2020.

_____. 2007. Arlington – thumbnail history, HistoryLink Essay 8416. [Online] URL: https://www.historylink.org/file/8416. Accessed October 21, 2022.

_____. 2009. Darrington – thumbnail history, HistoryLink Essay 8798. [Online] URL: https://www.historylink.org/File/8798. Accessed June 15, 2020.

Olason, S. 1989. The Planet, 1989, Fall. The Planet. Huxley College of the Environment, Western Washington University. [Online] URL: https://cedar.wwu.edu/cgi/viewcontent.cgi?article=1094&context=planet, accessed November 2020.

Parvey, M. and B. Rinck. 2015. Cultural Resources Assessment for the Seattle City Light NERC Violations Assessment Project, Snohomish, Skagit, and Whatcom Counties, Washington. Report prepared for Seattle City Light. Report prepared by SWCA Environmental Consultants. On file, Department of Archaeology and Historic Preservation, Olympia.

Pitzer, P. 2001. Building the Skagit. Second Edition. Seattle City Light, Seattle, Washington.

Rice, D. 1964. Indian Utilization of the Cascade Mountain Range in South Central Washington. In The Washington Archaeologist, edited by C.G. Nelson, Vol. 8, No. 1. [Online] URL: http://www.chaz.org/Arch/WASHINGTON_ARCHAEOLOGIST/WAS_8-1.pdf, accessed November 2020.

Richardson, A. and B. Galloway. 2011. Nooksack Place Names: Geography, Culture, and Language. UBC Press, Vancouver, BC.

Riddle, Margaret. 2006. Snohomish County – thumbnail history, HistoryLink Essay 7877. [Online] URL: https://www.historylink.org/File/7877. Accessed June 15, 2020.

Rowe, Kara. 2018. Agriculture in Washington 1792 to 1900, HistoryLink Essay 20523. [Online] URL: https://www.historylink.org/File/20523. Accessed June 16, 2020.

Ruby, Robert H., and John A. Brown. 2010. A Guide to the Indian Tribes of the Pacific Northwest. University of Oklahoma Press, Norman.

Ruby, R.H., J.A. Brown, and C.C. Collins. 2013. A Guide to the Indian Tribes of the Pacific Northwest. University of Oklahoma Press, Norman.

Samish Indian Nation. 2017. Samish Culture. [Online] URL: https://www.samishtribe.nsn.us/who-we-are/culture, accessed September 2021.

Sampson, Chief Martin J. 1972. Indians of Skagit County. Skagit County Historical Series No. 2. Skagit County Historical Society, Mount Vernon, Washington.

Sauk-Suiattle Indian Tribe. 2019. About Us. [Online] URL: http://www.sauk-suiattle.com/, accessed September 2021.

Scott, L.D. 2016. The Western Stemmed Point Tradition: Evolutionary Perspectives on Cultural Change in Projectile Points During the Pleistocene-Holocene Transition. Master's Thesis, University of Montana, Missoula, MT. [Online] URL: https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=11684&context=etd, accessed January 2021.

Seattle City Light (City Light). 1991. Offer of Settlement, Skagit River Hydroelectric Project, FERC No. 553. Seattle, WA. April 1991

_____. 2020. Pre-Application Document: Skagit River Hydroelectric Project, FERC No. 553. Report submitted to the Federal Energy Regulatory Commission. April.

_____. 2021. Application for Surrender of License, Pre-submittal Review Draft. Newhalem Creek Hydroelectric Project (FERC No. 2705). November 11, 2021.

_____. 2022a. CR-01 Cultural Resources Data Synthesis, Archaeological Resources (Part 2), Final Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. with contributions from Cardno, Inc. and Cascadia Archaeology, LLC.

_____. 2022b. CR-01 Cultural Resources Data Synthesis, Public Summary and Historic Built Environment Resources (Part 3), Final Report for the Skagit River Hydroelectric Project, FERC Project No. 553. Prepared by HDR Engineering, Inc. with contributions from Cardno, Inc.

Seattle Daily Post-Intelligencer. 1882. Whatcom County news. Seattle Daily Post-Intelligencer, July 4, p 5.

Seattle Daily Times. 1926. Logs from Mt. Baker Forest to be shipped. The Seattle Daily Times, May 8, p 4.

_____. 1928. Funeral held for oldest resident of Upper Skagit. The Seattle Daily Times, March 2, p 15.

Skagit River Journal. 2002. Profiles of the Davis family of Cedar Bar, Skagit River, Part One. [Online] URL: http://www.skagitriverjournal.com/upriver/cascades/pioneer/davis/davis02-bioarticles1.html. Accessed June 2022.

Smith, Allan. 1988. Ethnography of the North Cascades. Center for Northwest Anthropology Project Report No. 7, Washington State University, Pullman, WA.

Snoqualmie Indian Tribe. 2012. About the Snoqualmie Tribe. [Online] URL: https://www.snoqualmietribe.us/about, accessed September 2021.

Stein, Alan J. 2002. Ross, James Delmage (J.D.) (1872-1939), HistoryLink Essay 2557. [Online] URL: https://historylink.org/File/2557. Accessed June 16, 2020.

Stillaguamish Tribe of Indians. 2019. Traditional Cultural Property Statement for Sxǝ̆dǝlwaʔs (Mt. Higgins). Prepared to inform the Washington State Historic Preservation Officer of the National Register of Historic Places Eligibility. Stillaguamish Tribe of Indian, Arlington, and Cultural Geographics Consulting, Rollingbay, Washington.

Sturtevant, William C. 1990. Handbook of North American Indians, Volume 7: Northwest Coast. Smithsonian Institution, Washington, DC.

Suttles, W. 1974 (1967). The Economic Life of the Coast Salish of Haro and Rosario Straits. In Coast Salish and Western Washington Indians I. Garland Press, New York and London.

Suttles, W., and B. Lane. 1990. Prehistory of the Puget Sound Region. In Northwest Coast, edited by Wayne Suttles, pp. 485–502. Handbook of North American Indians, Vol. 7, William C. Sturtevant, general editor, Smithsonian Institution, Washington, DC.

S'ólh Téméxw Stwardship Alliance (STSA). 2022. CR01 edits to Stó:lō Reference. On file, Seattle City Light, Seattle.

Swinomish Indian Tribal Community 2022. Letter sent to Seattle City Light, Re: Swinomish Indian Tribal Community Comments on CR-01, dated February 07, 2022.

Teit, J.H. 1900. The Thompson Indians of British Columbia. Memoirs of the American Museum of Natural History 2 (4). Published by order of the Trustees, New York.

Thirty-Seventh Congress. 1862. An act to secure homesteads to actual settlers on the public domain, 12 Stat. 392, Homestead Act, May 20. In The Statutes at Large, Treaties, and Proclamations of the United States of America from December 5, 1859, to March 3, 1863, edited by George P. Sanger. Little, Brown and Company, Boston, Massachusetts. [Online] URL: https://digitalcommons.csumb.edu/cgi/viewcontent.cgi?article=1011&context=hornbeck_usa_2_d. Accessed June 16, 2020.

Tulalip Tribes. 2020. We Are Tulalip. [Online] URL: https://www.tulaliptribes-nsn.gov/. Accessed September 2021.

Thompson, L.C. and M.D. Kincade. 1990. Languages. In Handbook of North American Indians: Volume 7, Northwest Coast, Wayne Suttles, vol. ed., 30-51. Smithsonian Institution, Washington, D.C.

United States Department of Justice. 2020. The Wilderness Act of 1964. [Online] URL: https://www.justice.gov/enrd/wilderness-act-1964. Accessed June 16, 2020.

Western Mining History. 2020a. Skagit County, Washington mines. [Online] URL: https://westernmininghistory.com/mine_county/washington/skagit/. Accessed June 16, 2020.

_____. 2020b. Snohomish County, Washington mines. [Online] URL: https://westernmininghistory.com/mine_county/washington/snohomish/. Accessed June 16, 2020.

Wilma, David. 2003. Upper Skagit River Hydroelectric Project. [Online] URL: HistoryLink.org Essay 5347. Accessed September 6, 2021.

Section 4.2.9 Tribal Resources

Curti, Gorgio, Dayna Bowker Lee, and Christopher M. Moreno. 2020. Skagit River Hydroelectric Project (FERC No. 553) Traditional Cultural Property Synthesis Study. Prepared by Cultural Geographics Consulting, LLC, Seattle. Prepared for Seattle City Light.

Federal Energy Regulatory Commission (FERC). 2019. Policy Statement on Consultation with Indian Tribes in Commission Proceedings. 84 FR 56940. Oct. 24, 2019. [Online] URL: https://www.federalregister.gov/documents/2019/10/24/2019-23099/revision-to-policy-statement-on-consultation-with-indian-tribes-in-commission-proceedings. Accessed October 30, 2019.

Indian Office. 1902. Executive Orders Relating to Indian Reserves From May 14, 1855 to July 1, 1902. Government Printing Office, Washington, DC. [Online] URL: http://lcweb2.loc.gov/service/gdc/scd0001/2012/20120509002ex/20120509002ex.pdf. Accessed May 2019.

Kappler, Charles J. 1972. Indian Treaties 1778-1883. Reprinted. Amereon House, Mattituk, New York. Originally published 1904, Indian Affairs: Laws and Treaties, vol. 2, Treaties, US Government Printing Office, Washington, DC. [Online] URL: https://babel.hathitrust.org/cgi/pt?id=hvd.32044103155032&view=1up&seq=5. Accessed May 2019.

Newton, Nell J. 1982. Enforcing the Federal-Indian Trust Relationship After Mitchell. 31 CATH. U.L. REV. 635. [Online] URL: https://scholarship.law.nd.edu/law_faculty_scholarship/1201/. Accessed December 15, 2019.

Parker, P.L. and T.F. King. 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin 38. U.S. Department of the Interior, National Park Service, National Register, History and Education. Washington D.C., 1990. Revised 1998.

Seattle City Light (City Light). 2020. Pre-Application Document: Skagit River Hydroelectric Project, FERC No. 553. Report submitted to the Federal Energy Regulatory Commission. April.

S'ólh Téméxw Stwardship Alliance (STSA). 2022. People of the River Referrals Office. [Online] URL: https://thestsa.ca/stsa-operations/prro/. Accessed June 2022.

Section 4.2.10 Socioeconomic Resources

Census of Agriculture. 2017a. Skagit County Washington. [Online] URL: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/cp53057.pdf. Accessed August 25, 2022.

Census of Agriculture. 2017b. Snohomish County Washington. [Online] URL: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/cp53061.pdf. Accessed August 25, 2022.

Census of Agriculture. 2017c. Whatcom County Washington. [Online] URL: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/cp53073.pdf. Accessed August 25, 2022.

Economic Alliance Snohomish County. 2022. Industry Sectors and Top Employers. [Online] URL: https://www.economicalliancesc.org/workforce/major-employers /. Accessed July 18, 2022.

Employment Security Department. 2021. Whatcom County Profile. [Online] URL: https://esd.wa.gov/labormarketinfo/county-profiles/whatcom. Accessed July 14, 2022.

_____. 2022a. Skagit County Profile. [Online] URL: https://esd.wa.gov/labormarketinfo/county-profiles/skagit. Accessed July 15, 2022.

_____. 2022b. Snohomish County Profile. [Online] URL: https://esd.wa.gov/labormarketinfo/county-profiles/snohomish. Accessed July 15, 2022.

Hollis, Baily. 2022. Personal communication between Bailey Hollis, Ross Lake Resort, and Mike Aronowitz, Seattle City Light. 2014-2021. August 23, 2022.

National Bureau of Economic Research. 2022. US Business Cycle Expansions and Contractions. [Online] URL: https://www.nber.org/cycles.html. Accessed August 25, 2022.

North Cascades Institute (NCI). 2019. Personal communication between. Jason Ruvelson, North Cascades Institute, and Mike Aronowitz, Seattle City Light. 2014-2018 Program Chart (Excel file). June 2019.

_____. 2022. Personal communication between. Jason Ruvelson, North Cascades Institute, and Mike Aronowitz, Seattle City Light. 2019-2021 Program Chart (Excel file). September

2022.

National Park Service (NPS). 2017. National Park Service – North Cascades. [Online] URL: https://www.nps.gov/noca/learn/news/economic-benefits.htm. April 21, 2017. Accessed August 25, 2022.

Office of Financial Management (OFM). 2020. Washington Precent of Population in Poverty. [Online] URL: https://ofm.wa.gov/washington-data-research/statewide-data/washington-trends/social-economic-conditions/population-poverty. Washington Data and Research. Accessed July 14, 2022.

_____. 2022a. State of Washington 2021 Population Trends. [Online] URL: https://www.ofm.wa.gov/sites/default/files/public/dataresearch/pop/april1/ofm_april1_poptrends.pdf Forecasting & Research Division. March 2022.

_____. 2022b. Population Estimates by Age and Sex 2020, 2021 (Preliminary). [Online] URL: https://ofm.wa.gov/washington-data-research/population-demographics/population-estimates/estimates-april-1-population-age-sex-race-and-hispanic-origin. Revised January 6, 2022.

_____. 2022c. Washington State Median Household Income Estimates by County: 1989 to 2019; Preliminary estimates for 2020 and Projects for 2021 in Current Dollars. [Online] URL: https://ofm.wa.gov/sites/default/files/public/dataresearch/economy/median_household_income_estimates.pdf. Revised May 13, 2022.

_____. 2022d. April 1 Population by Race and Hispanic Origin, 2010, 2020, 2021 (Preliminary). [Online] URL: https://ofm.wa.gov/washington-data-research/population-demographics/population-estimates/estimates-april-1-population-age-sex-race-and-hispanic-origin. Revised January 4, 2022.

Seattle City Light (City Light). 2020. Seattle City Light 2020 Annual Report. [Online] URL: https://www.seattle.gov/documents/Departments/CityLight/2020CityLightAnnualReport.pdf. Accessed July 19, 2022.

_____. 2022. 2022 Effective Rates (Adopted Rates with BPA Passthrough).

Seattle City Light and Whatcom County. 2009. Impact Payment Agreement between Seattle City Light and County of Whatcom.

Skagit County. 2001. Comprehensive plan and zoning districts. Environmental Systems Research Institute (ESRI) shapefile. ftp://ftp.skagitcounty.net/GIS/Documents/AccessGiS/CompPlan/compplan-shp.zip. (23 June 2006).

Snohomish County Planning and Development Services. 2003. Future land use. Environmental Systems Research Institute (ESRI) coverage. ftp://ftp.co.snohomish.wa.us/Planning%20&%20Devel%20Services/GMA%20Future%20Land%20Use%20Plan/SHAPEFILES%20General%20Policy%20Plan%20Maps%201-6%20.pdf/. (23 June 2006).

Theobald 2004. bhc2000 v.1. Environmental Systems Research Institute (ESRI) raster digital data. On file with: David M. Theobald, Natural Resource Ecology Lab, Colorado State University.

U.S. Census Bureau (USCB). 2021. United States Census Bureau. QuickFacts, Snohomish County, Washington; Skagit County, Washington; Whatcom County, Washington. [Online] URL: U.S. Census Bureau QuickFacts: Snohomish County, Washington; Skagit County, Washington; Whatcom County, Washington; Washington. Accessed July 12, 2022.

U.S. Energy Information Administration (USEIA). 2022. Electricity. [Online] URL: https://www.eia.gov/electricity/data.php. Accessed July 19, 2022.

Whatcom County Planning and Development Services. 2005. Whatcom County planning/zoning shapefile. Environmental Systems Research Institute (ESRI) shapefile. On file with Sarah Watts, Whatcom County Planning and Development Services – GIS, Northwest Annex, 5280 Northwest Drive, Bellingham, WA 98226-9099.

WA HomeTownLocator. 2022a. Skagit County WA Cities, Towns, & Neighborhoods. [Online] URL: https://washington.hometownlocator.com/counties/cities,cfips,057,c,skagit.cfm. Accessed July 14, 2022.

_____. 2022b. Snohomish County WA Cities, Towns, & Neighborhoods. [Online] URL: https://washington.hometownlocator.com/counties/cities,cfips,061,c,snohomish.cfm. Accessed July 14, 2022.

_____. 2022c. Whatcom County WA Cities, Towns, & Neighborhoods. [Online] URL: https://washington.hometownlocator.com/counties/cities,cfips,073,c,whatcom.cfm. Accessed July 14, 2022.

Western Washington University (WWU). 2020a. Skagit County 2020 Top Employers. [Online] URL: https://cbe.wwu.edu/files/2021-11/2020%20Skagit%20County%20Top%20Employers.pdf. Accessed August 25, 2022.

_____. 2002b. Whatcom County 2020 Top Employers. [Online] URL: https://cbe.wwu.edu/files/2021-11/2020%20Whatcom%20County%20Top%20Employers.pdf. Accessed July 14, 2022.

White, Eric M. undated. Forests on the Edge: A Case Study of Northwest Washington. USDA Forest Service, Pacific Northwest Research Station. Corvallis, OR.

_____. 2008. A Closer Look at Forests on the Edge. Future Development on Private Forests in Three States. USDA Forest Service, Pacific Northwest Research Station.

Section 4.2.11 Environmental Justice

Council on Environmental Quality (CEQ). 1997. Environmental Justice: Guidance Under the National Environmental Policy Act. [Online] URL: http://www3.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf. Accessed September 12, 2022.

Federal Energy Regulatory Commission (FERC). 2022. Equity Action Plan. [Online] URL: https://www.ferc.gov/equity. Accessed August 29, 2022.

Federal Interagency Working Group on Environmental Justice & NEPA Committee. 2016. Promising Practices for EJ Methodologies in NEPA Reviews. [Online] URL: https://www.epa.gov/sites/default/files/2016-

08/documents/nepa_promising_practices_document_2016.pdf. Accessed August 31, 2022.

United States Census Bureau (USCB). 2020a. 2016-2020 American Community Survey 5-Year Estimates – Table B03002: Hispanic or Latino Origin by Race. [Online] URL: https://data.census.gov/cedsci/table?q=B03002%3A%20HISPANIC%20OR%20LATINO%20ORIGIN%20BY%20RACE&tid=ACSDT5Y2020.B03002. Accessed July 25, 2022.

_____. 2020b. 2016-2020 American Community Survey 5-Year Estimates – Table B17017: Poverty Status in the Past 12 Months by Household Type and Age of Householder. [Online] URL:https://data.census.gov/cedsci/table?q=B17017%3A%20POVERTY%20STATUS%20IN%20THE%20PAST%2012%20MONTHS%20BY%20HOUSEHOLD%20TYPE%20BY%20AGE%20OF%20HOUSEHOLDER&tid=ACSDT5Y2020.B17017. Accessed July 25, 2022.

_____. 2020c. 2016-2020 American Community Survey 5-Year Estimates – Table S1601: Language Spoken at Home. [Online] URL: https://data.census.gov/cedsci/table?q=S1601%3A%20LANGUAGE%20SPOKEN%20AT%20HOME&tid=ACSST5Y2020.S1601. Accessed September 1, 2022.

United States Department of Energy (DOE). 2022. What is Environmental Justice? [Online] URL: https://www.energy.gov/lm/services/environmental-justice/what-environmental-justice. Accessed October 17, 2022.

United States Environmental Protection Agency (USEPA). 2016. Technical Guidance for Assessing Environmental Justice in Regulatory Analysis. [Online] URL: https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf. Accessed August 30, 2022.

Section 5.0 Cumulative Effects of the Proposed Action

Aitken, J. K. 1998. The importance of estuarine habitats to anadromous salmonids of the Pacific Northwest: a literature review. U.S. Fish and Wildlife Service, Lacey, Washington. 25 pp.

Austin, C.S., T. E. Essington, and T. P. Quinn. 2021. In a warming river, natural-origin Chinook salmon spawn later but hatchery-origin conspecifics do not. Canadian Journal of Fisheries and Aquatic Sciences 78(1):68–77.

Beamer, E., R. Bernard, B. Hayman, B. Hebner, S. Hinton, G. Hood, C. Kraemer, A. McBride, J. Musslewhite, D. Smith, L. Wasserman, and K. Wyman. 2005a. Skagit Chinook recovery plan 2005. Report prepared by Skagit River System Cooperative and Washington Department of Fish and Wildlife.

Beamer E., C. Greene, and M. LeMoine. 2019. Skagit River Estuary Intensively Monitored Watershed annual report for 2019. Report prepared for the Washington State Salmon Recovery Funding Board Monitoring Panel, Olympia.

Beamer, E. M., B. Hayman, and D. Smith. 2005c. Linking freshwater rearing habitat to Skagit Chinook salmon recovery: Appendix C of the Skagit Chinook recovery plan. Report by Skagit River System Cooperative, La Conner, Washington.

Beamer, E. M., and K. Larsen. 2004. The importance of Skagit Delta habitat on the growth of wild ocean-type Chinook in Skagit Bay: implications for delta restoration. Report prepared by Skagit River System Cooperative and United States Geological Survey, Biological Resource Division.

Beamer, E., A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice, and K. Fresh. 2005b. Delta and nearshore restoration for the recovery of wild Skagit River Chinook salmon: linking estuary restoration to wild Chinook Salmon populations. Supplement to Skagit Chinook Recovery Plan.

Beamer, E., A. McBride, K. Wolf, A. Hook, and W.G. Hood. 2015. Skagit monitoring pilot project: methods and results for estuarine and nearshore habitat targets identified in the 2005 Skagit Chinook Recovery Plan. Report prepared by Skagit River System Cooperative, La Conner, WA.

Beamer, E., and K. Wolf. 2017. Skagit Chinook habitat monitoring status and trends: change in Skagit tidal delta habitat extent, 2004-2013. Report prepared by Skagit River System Cooperative, Research Program, La Conner, Washington.

Breslow, S.J., 2011. Salmon Habitat Restoration, Farmland Preservation and Environmental Drama in the Skagit River Valley. Unpublished dissertation. University of Washington, Seattle, WA.

Collins, B. 1998. Preliminary Assessment of Historic Conditions of the Skagit River in the Fir Island Area: Implications for Salmonid Habitat Restoration. Report to Skagit System Cooperative. Available at www.skagitcoop.org.

Collins, B. 2000. Mid-19th century stream channels and wetlands interpreted from archival sources for three north Puget Sound estuaries. Prepared for: Skagit System Cooperative, Bullitt Foundation, Skagit Watershed Council. Prepared by: Brian Collins, University of Washington, Seattle, WA. Aug. 1, 2000.

Downen. 2014. Final report: Ross Lake rainbow broodstock program, upper Skagit reservoir fish community surveys and management plan, dated September, 2014. Washington Department of Fish and Wildlife, Shelton, WA.

Environmental Science Associates (ESA). 2017. Riparian assessment. Report prepared by ESA for Skagit Watershed Council, Mount Vernon, Washington.

Fresh, K.L., B. Williams, and D. Pentilla. 1995. Overwater Structures and Impacts on Eelgrass (Zostera marina) in Puget Sound, Washington. Pp. 537-543 in Proceedings of Puget Sound Research 95, Vol. 2, Seattle Washington.

Grette, G., D. Weitkamp, G. Ruggerone, and S. White. 2000. Tri County Model 4d Rule Response Proposal. A Salmon Conservation Program. Appendix C: Habitat Assessment: Technical Rationale and Sample Application. Prepared for The Urban Caucus of Tri-Negotiation Team, Seattle, Washington. 103 pp.

Hatchery Scientific Review Group (HSRG) – Lars Mobrand (chair), John Barr, Lee Blankenship, Don Campton, Trevor Evelyn, Conrad Mahnken, Paul Seidel, Lisa Seeb and Bill Smoker. 2003. Hatchery Reform Recommendations for the Skagit River Basin, Nooksack and Samish Rivers, Central Puget Sound. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, Washington 98101 (available from www.hatcheryreform.org).

Hinton, S., K. Ramsden, E. Mickelson, and B. Clifton. 2018. Skagit River basin habitat status and trends for freshwater rearing targets. Report by Skagit River System Cooperative, La Conner, Washington.

Hood, W.G. 2004. Indirect environmental effects of dikes on estuarine tidal channels: thinking outside of the dike for habitat restoration and monitoring. Estuaries 27:273-282.

Hood, W. G., E. E. Grossman, and C. Veldhuisen. 2016. Assessing tidal marsh vulnerability to sea-level rise in the Skagit Delta. Northwest Science 90(1):79-93.

Lee, Se-Yeun, and A.F. Hamlet. 2011. Skagit River Basin Climate Science Report, a summary report prepared for Skagit County and the Envision Skagit Project by the Department of Civil and Environmental Engineering and The Climate Impacts Group at the University of Washington.

National Marine Fisheries Service (NMFS). 2018. Proposed Recovery Plan for the Puget Sound Steelhead Distinct Population Segment (*Oncorhynchus mykiss*). National Marine Fisheries Service. Seattle, WA.

National Park Service (NPS). 2012. Ross Lake National Recreation Area. General Management Plan. National Park Service, U.S. Department of the Interior. July 2012.

_____. 2020. North Cascades National Park Service Complex comments on Skagit Project (#553) Pre-application Document, Scoping Document 1, and NPS Study Requests. October 23, 2020.

Nightingale B.J., and C.A. Simenstad. 2001. Overwater Structures: Marine Issues. White Paper. Research Project T1803, Task 35. Washington State Transportation Center, Seattle, Washington, prepared for the Washington State Transportation Commission in cooperation with the U.S. Department of Transportation. 133 pp+ appendices.

Pflug, D., E. Connor, B. Hayman, T. Kassler, K. Warheit, B. McMillan, and E. Beamer. 2013. Ecological, genetic and productivity consequences of interactions between hatchery and natural origin steelhead of the Skagit watershed. Report prepared for Skagit River System Cooperative, La Conner, Washington.

PSAT (Puget Sound Action Team). 2002b. Puget Sound's Health 2002. Puget Sound Action Team. Olympia, Washington.

Puget Sound Energy (PSE). 2004. Baker River Hydroelectric Project Comprehensive Settlement Agreement. Puget Sound Energy, Bellevue, Washington.

Redman, S., D. Myers, and D. Averill (editors). 2005. Regional nearshore and marine aspects of salmon recovery in Puget Sound. Report prepared for Shared Strategy for Puget Sound, Seattle, Washington.

Riedel, J. L., and M. A. Larrabee. 2016. Impact of recent glacial recession on summer streamflow in the Skagit River. Northwest Science 90(1):5-22.

Shared Strategy for Puget Sound. 2007. Puget Sound Salmon Recovery Plan. Plan adopted by the National Marine Fisheries Service January 19, 2007.

Skagit County. 2012. Skagit County Habitat Improvement Plan. Skagit County Public Works Department, Natural Resources Division. August 2012.

Skagit County Planning and Development Services. 2021. Proposed Marblemount Quarry. [Online] URL: https://www.skagitcounty.net/Departments/PlanningAndPermit/MarblemountQuarry.htm. Accessed June 2022.

Skagit Environmental Endowment Commission (SEEC) and Hope Mountain Centre for Outdoor Learning (HMCOL). 2020. Monitoring stream water quality, upper Skagit River watershed. June 2020.

Skagit River System Cooperative (SRSC) and Washington Department of Fish and Wildlife (WDFW). 2005. Skagit Chinook Recovery Plan. Skagit River System Cooperative, LaConner, Washington, and Washington Department of Fish and Wildlife, Olympia.

Skagit Watershed Council (SWC). 2015. Year 2015 Strategic Approach. Adopted March 5, 2015.

_____. 2016. 2016 Interim Steelhead Strategy. Adopted March 3, 2016.

_____. 2000. Application of the Skagit Watershed Council's Strategy, River Basin Analysis of the Skagit and Samish Basins: Tools for Salmon Habitat Restoration and Protection. Prepared by the Habitat Restoration and Protection Committee of the Skagit Watershed Council.

_____. 2022. Year 2022 Strategic. February 15, 2022.

Small, M.P., S. Bell, and C. Bowman. 2016. Genetic analysis of native char collected in Diablo Lake, Gorge Reservoir, and Ross Lake in the Skagit River basin. Washington Department of Fish and Wildlife Molecular Genetics Lab, Olympia, Washington.

Smith, C. J. 2003. Salmon and steelhead habitat limiting factors water resource inventory areas 3 & 4, the Skagit and Samish basins. Report prepared by Washington State Conservation Commission, Lacey, Washington.

Thom, R.T., C.A. Simenstad, J.R. Cordell, and E.A. Salo. 1989. Fish and their epibenthic prey in a marina and adjacent mudflats and eelgrass meadow in a small estuarine bay. Unpublished report to Port of Bellingham by Fisheries Research Institute, University of Washington, Seattle, Washington. 27 pp.

U.S. Army Corps of Engineers (USACE). 2010. DRAFT Skagit river flood risk reduction study, environmental without-project condition report. Report prepared for Skagit River Basin, Skagit County, Washington.

Veldhuisen, C. 2018. Temporal trends and potential contribution factors to shallow landslide rates in timberlands of the Skagit River basin, Washington. Report by Skagit River System Cooperative, La Conner, Washington.

Washington Department of Fish and Wildlife (WDFW). 2019. Washington State Fish Passage Web App. Online water crossing database. Last accessed December 2019.

Weitkamp, D.E. 2000. Young salmon in estuarine habitats, Review Draft. Report by Parametrix, Inc., Kirkland, Washington. 101 pp.

Western Washington Agricultural Association (WWAA), National Marine Fisheries Service (NMFS), and Washington Department of Fish and Wildlife (WDFW). 2010. Skagit Delta tidegates and fish initiative implementation agreement.

Section 6.0 Developmental Analysis

[No references]

Section 7.0 Consistency with Comprehensive Plans

[No references]

This page intentionally left blank.