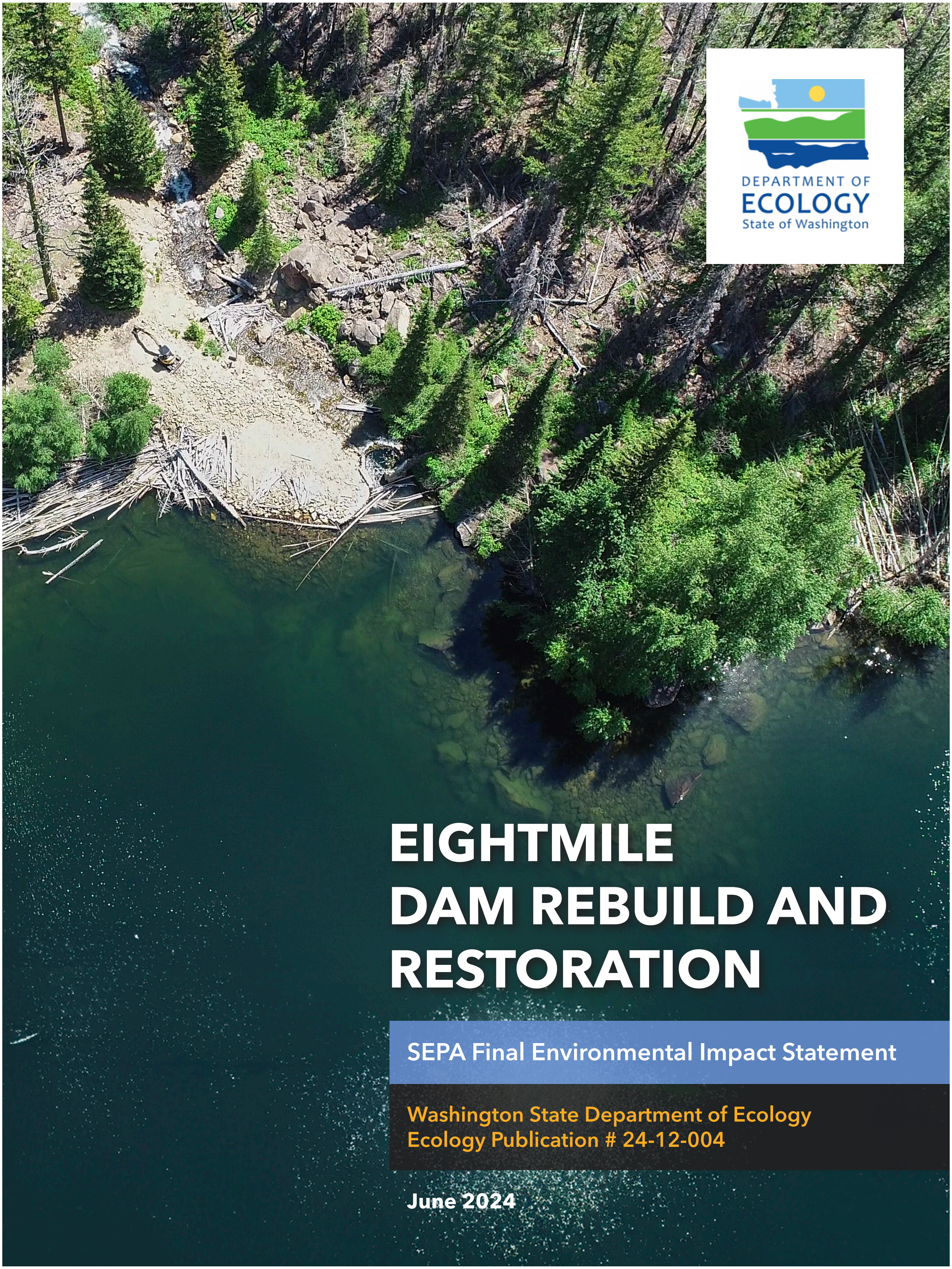

EIGHTMILE DAM REBUILD AND RESTORATION

SEPA Final Environmental Impact Statement

Washington State Department of Ecology
Ecology Publication # 24-12-004

June 2024

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Office of Columbia River
1250 West Alder St., Union Gap, WA 98903-0009 • 509-575-2490

June 21, 2024

Eightmile Dam Restoration and Replacement Project Final Environmental Impact Statement

Dear Interested Parties:

The Washington Department of Ecology (Ecology) Office of Columbia River (OCR) is pleased to issue the Final Environmental Impact Statement (Final EIS) for rebuilding Eightmile Dam, a 95-year-old dam located in the Alpine Lakes Wilderness west of Leavenworth. The dam is owned and operated by the Icicle and Peshastin Irrigation Districts (IPID).

Eightmile Dam has suffered damage due to natural events, including flooding, over the years. In 2017, the Jack Creek Fire and subsequent reclassification of the dam to a High Hazard dam accelerated the need to rebuild the dam to current dam safety standards and restore active water storage capacity. In spring 2018, the dam was assessed as being in an unsatisfactory condition, leading to emergency repairs. Repairs made in 2018 are temporary and address the immediate threat of dam failure but are not adequate under current dam safety requirements. In the meantime, IPID has undertaken preliminary analysis and planning toward bringing the dam into compliance. The dam needs to be rebuilt to current safety standards to protect human health & safety and downstream property, meet dam safety requirements and maintain reliable irrigation water supplies for area farmers.

As the dam owner, IPID has worked with Ecology to identify the environmental impacts of three action alternatives and a “no action” alternative (as required under the State Environmental Policy Act [SEPA]). The alternatives balance the priorities of protecting the integrity of the Alpine Lakes Wilderness, ensuring public safety by meeting current dam safety requirements, and providing durable solutions for water management and delivery. Based on comments received on the Draft EIS, Ecology in coordination with IPID, has identified Alternative 2 as the preferred alternative for the dam rebuild and restoration project.

- Alternative 1: Narrow spillway with gates
- Alternative 2: Wide spillway without gates (IPID’s preferred alternative)
- Alternative 3: Narrow spillway without gates
- No Action Alternative: Operating the current dam with no changes

Reconstructing the aging dam structure at Eightmile Lake is crucial to protecting downstream residents, the water use of area irrigators, and the natural shorelines and habitats of Icicle Creek near Leavenworth in Chelan County. The preferred alternative (Alternative 2) balances the priorities of protecting the integrity of the Alpine Lakes Wilderness, ensuring public safety by meeting dam safety requirements and providing durable solutions for water management and delivery.

The EIS helps inform what provisions and mitigation measures may be required when state and local jurisdictions consider permits based on which resources may experience probable, significant and/or adverse impacts as a result of the rebuild and restoration of Eightmile Dam. This Final EIS is not a decision document and does not determine whether a project moves forward. An EIS is an impartial, comprehensive study used as a resource for decision-makers and the public. Implementation of any of the action alternatives would require a number of permits and approvals from federal, state, and local jurisdictions prior to construction.

The Draft EIS was issued on April 19, 2023, and the comment period was open until June 5, 2023. Ecology received 6,942 comment submissions on the Draft EIS via email, letter, the project website, and at three public hearings. Those comments and responses to them are included in Volume 2, Appendix F (Responses to Comments on the Draft EIS) of the Final EIS. Where appropriate, small changes were made to the text in the Final EIS in response to comments or to provide clarification or updates to information presented in the Draft EIS.

The Final EIS is available for review at the following locations:

- Online at Ecology's project website: https://ecology.wa.gov/eightmile
- At Department of Ecology, Central Region Office, 1250 W. Alder St., Union Gap. Call 509-575-2490 for an appointment.

Thank you for your interest in the Eightmile Dam Rebuild and Restoration Project. We valued all the public feedback throughout this process. It is important to Ecology that the final plan for the Eightmile Lake Dam Rebuild reflects the interests and addresses the concerns of the broad community of people who live, work, and play in the Icicle Creek subbasin and Wenatchee River Basin.

Sincerely,

G. Thomas Tebb, L.H.G, L.E.G.
Director, Office of Columbia River
Washington Department of Ecology

GT:ce(240613)

Publication Information

This document is available on the Department of Ecology's website at https://apps.ecology.wa.gov/publications/SummaryPages/2412004.html.

Cover photo:

- Eightmile Lake, Chelan County Washington
  Photo by Drew Holstad, June 24, 2021

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[1] www.ecology.wa.gov/contact

FACT SHEET

Project Name

Eightmile Dam Rebuild and Restoration

Proposed Action and Alternatives

Three action alternatives and a No Action Alternative are being evaluated in the Environmental Impact Statement (EIS):

- No Action Alternative
- Alternative 1: Narrow Spillway with Gates (formerly Alternative 1A)
- Alternative 2: Wide Spillway without Gates (Preferred Alternative)
- Alternative 3: Narrow Spillway without Gates

Location

Eightmile Dam is located in the Alpine Lakes Wilderness, approximately 10 miles southwest of Leavenworth, WA, in Chelan County.

Project Proponent

Icicle and Peshastin Irrigation Districts (IPID)

State Environmental Policy Act (SEPA) Lead Agency

Washington State Department of Ecology (Ecology)

SEPA Responsible Official

G. Thomas Tebb, LG, LHG, LEG, Director, Office of Columbia River
Washington State Department of Ecology

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Date of Final EIS Issuance

June 21, 2024

Date of Draft EIS Issuance

April 19, 2023

Public Comment and Hearing on the Draft EIS

The Draft EIS was available for a 45-day public comment period.

Agencies, affected tribes, and members of the public were invited to comment on the Draft EIS. An expanded comment period was being provided pursuant to the Washington Administrative Code (WAC) 197-11-455, and included two virtual public hearings and one in-person hearing.

Document Availability and Cost

The EIS is available online at the Ecology webpage: https://ecology.wa.gov/eightmile.

Printed copies of the Final EIS are available for review at no charge at:

Office of Columbia River
Washington Department of Ecology
1250 West Alder Street
Union Gap, WA 98903

For questions or to obtain a copy of the document:

Department of Ecology; Cotton Ely; Cotton.Ely@ecy.wa.gov; (509) 506-2154.

Permits, Licenses, and Approvals Likely Required for Proposal

Permit	Agency
National Environmental Policy Act (NEPA) Review	U.S. Forest Service
Forest Service Authorizations	U.S. Forest Service
Section 404	U.S. Army Corps of Engineers (Corps)
Endangered Species Act (ESA) Section 7 Concurrence	National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS)
Magnuson-Stevens Fishery Conservation and Management Act Consultation	NMFS and USFWS
Fish and Wildlife Coordination Act Consultation	NMFS and USFWS
National Historic Preservation Act (NHPA) Section 106 Consultation, Archaeological Resources Protection Act Permit	Forest Service and Washington State Department of Historic Preservation (DAHP)
Section 401 Water Quality Certification	Ecology
Dam Construction Permit	Ecology
Water Right Donation to State Trust Water Rights Program	Ecology
Hydraulic Project Approval (HPA)	Washington Department of Fish and Wildlife (WDFW)
National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit	Ecology
Shoreline Substantial Development Permit	Chelan County
Critical Areas Ordinance Compliance	Chelan County
Fill and Grade, Building Permits	Chelan County

Authors and Contributors

A list of authors and contributors is provided in Chapter 19 of the Final EIS.

Location of Background Materials

Project-related information can be reviewed on the project website at https://ecology.wa.gov/eightmile.

Proposed Date of Implementation

The next steps of project implementation include engineering design and permitting of the preferred alternative. Project pre-construction and site preparations may begin as early as summer 2025. The rebuild construction will start in earnest when the project has been fully permitted.

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ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
µg/L	micrograms per liter
1-DMax	1-day maximum
4,4'-DDE	dichlorodiphenyldichloroethylene
7-DADMax	7-day average of daily maximum temperature
ACS	American Community Survey
AEDT	Aviation Environmental Design Tool
AEP	Annual Exceedance Probability
afy	acre-feet per year
AIRFA	American Indian Religious Freedom Act
ALIHD	Alpine Lakes Irrigation Historic District
ARPA	Archaeological Resources Protection Act
BEA	Bureau of Economic Analysis
BGEPA	Bald and Golden Eagle Protection Act
bgs	below ground surface
BMPs	best management practices
BP	years before present
CadnaA	Computer Aided Noise Abatement
CCC	Chelan County Code
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIG	Climate Impacts Group
COIC	Cascade Orchards Irrigation Company
Corps	U.S. Army Corps of Engineers
CPI	Consumer Price Index
CSZ	Cascadia Subduction Zone
CTCR	Confederated Tribes of the Colville Reservation
CWRE	Certified Water Rights Examiner
DAHP	Washington State Department of Archaeology and Historic Preservation
dBA	A-weighted decibel
DO	dissolved oxygen
DSO	Washington State Department of Ecology Dam Safety Office
EAP	Emergency Action Plan
Ecology	Washington State Department of Ecology

Abbreviation	Definition
EFH	Essential Fish Habitat
EHD	Environmental Health Disparities
EIM	Environmental Information Management
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential Unit
ESA	Endangered Species Act
ESD	Washington Employment Security Department
ESU	Evolutionarily Significant Unit
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FOS	factor of safety
FPEIS	Final Programmatic Environmental Impact Statement
FSR	U.S. Forest Service Road
ft^2/d	square feet per day
FTA	Federal Transit Administration
GCM	Global Climate Model
GDP	gross domestic product
GEO	Governor’s Executive Order
GIS	geographic information system
gpm	gallons per minute
GWIS	Geographic Water Rights Information System
HPA	Hydraulic Project Approval
HPI	Historic Property Inventory
HUC	Hydrologic Unit Code
Hz	hertz
Icicle Strategy	Icicle Creek Water Resource Management Strategy
IDF	Inflow Design Flood
IIC	Icicle Irrigation Company
IID	Icicle Irrigation District
IPaC	Information for Planning and Consultation
IPID	Icicle and Peshastin Irrigation Districts
ISF	instream flow
IWG	Icicle Work Group
IWGEJ	Interagency Working Group on Environmental Justice
JARPA	Joint Aquatic Resources Permit Application

Abbreviation	Definition
KVP	key viewpoint
L&I	Washington Labor and Industries
L1UBH	lacustrine, limnetic, unconsolidated bottom, permanently flooded
LEHD	Longitudinal Employer-Household Dynamics
Lmax	maximum sound level
LNFH	Leavenworth National Fish Hatchery
LODES	LEHD Origin-Destination Employment Statistics
mg/L	milligrams per liter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSA	Metropolitan Statistical Area
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric turbidity unit
NWI	National Wetlands Inventory
O&M	Operation and Maintenance
OCR	Office of Columbia River
PCBs	polychlorinated biphenyls
PEIS	Programmatic Environmental Impact Statement
PHS	Priority Habitats and Species
PID	Peshastin Irrigation District
POD	Point of Diversion
PUBH	palustrine, unconsolidated bottom, permanently flooded
Q	flow rate
Qa	Annual Quantity
Qi	Instantaneous Quantity
R3UBH	riverine, upper perennial, unconsolidated bottom, permanently flooded
RCNM	Roadway Construction Noise Model
RCP	Relative Concentration Pathway
RCW	Revised Code of Washington
Reclamation	United States Bureau of Reclamation
RM	river mile

Abbreviation	Definition
ROE	Report of Examination
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Office
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SPreAD	System for the Prediction of Acoustic Detectability
SU	Standard Unit (pH)
TCPs	Traditional Cultural Properties
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
Trust	State Trust Water Rights Program
U.S.C.	United States Code
UCR	Upper Columbia River
UGA	Urban Growth Area
uPa	micro pascals
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WHR	Washington Heritage Register
WISAARD	Washington Information System for Architectural & Archaeological Records Data
WRIA	Water Resource Inventory Area
WROS	Wilderness Recreation Opportunity Spectrum
WRTS	Water Rights Tracking System
WSDOT	Washington State Department of Transportation
WSEL	water surface elevation
WUE	Water Use Efficiency
WWTP	Wastewater Treatment Plant

CHAPTER 1: INTRODUCTION AND BACKGROUND

What has Changed from the Draft EIS?

- Information was added in Chapter 1 to reflect the State Environmental Policy Act (SEPA) process of going from Draft to Final Environmental Impact Statement (EIS).
- Alternative 2 was identified by the Washington State Department of Ecology (Ecology) and Icicle and Peshastin Irrigation Districts (IPID) as the preferred alternative for rebuilding the dam.
- Based on comments received on the Draft EIS, additional minor revisions were made to clarify information that was potentially unclear or incomplete in the Draft EIS. No substantive revisions were made.
- Responses to specific comments on Chapter 1 are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*
- The Executive Summary for the Final EIS (prepared as a separate document) includes a summary of potential impacts from the alternatives, a summary of mitigation measures, as well as a summary of the significant unavoidable adverse impacts.

1.1 Introduction

In January 2019, the Washington State Department of Ecology (Ecology) and Chelan County issued a Final Programmatic Environmental Impact Statement (FPEIS), evaluating the Icicle Creek Water Resource Management Strategy (Icicle Strategy). That FPEIS was the culmination of nearly 6 years of evaluating strategies within the Icicle Creek Subbasin to improve instream flows, improve sustainability of the Leavenworth National Fish Hatchery (LNFH), protect tribal and non-tribal fish harvest, improve municipal and domestic water supply and agricultural reliability, enhance habitat in Icicle Creek, and comply with state and federal law including the Wilderness Act. The FPEIS evaluated five program alternatives, and the State Environmental Policy Act (SEPA) non-project action was the adoption of the program called the Icicle Strategy. The Icicle Strategy is intended to provide a program of integrated long-term water resource management and habitat restoration actions to achieve reliable water supplies and improve instream flows.

The Eightmile Dam Rebuild and Restoration Project is one of several early actions to be implemented as part of the Icicle Strategy, and as such is the first project-level environmental impact statement (EIS) undertaken in this phased review process under SEPA. The project proponent is the Icicle and Peshastin Irrigation Districts (IPID). Over the years, wildfire, storm events, ice, and flooding have damaged the Eightmile Dam structure, raising safety concerns and reducing the reservoir's active storage capacity. The Eightmile dam infrastructure is more than 90 years old and requires substantial improvements to operate in a safe, reliable way. In 2017, the Jack Creek Fire and subsequent reclassification of the dam to an unsatisfactory condition has accelerated the need to rebuild the dam to current standards. As a result, IPID is proposing to rebuild the dam in the same location as the existing dam. Ecology's Office of Columbia River (OCR) has determined that this proposal to rebuild and restore the dam is likely to have a significant adverse impact on the environment, and accordingly, an EIS is required under Revised Code of Washington (RCW) 43.21C.030. Ecology OCR is the lead agency under SEPA and is leading the development of the EIS for the project in accordance with Washington Administrative Code (WAC) 197-11, SEPA Rules.

1.2 Project Background

Eightmile Lake is in the Icicle Creek Subbasin in Water Resource Inventory Area (WRIA) 45 (Wenatchee River Basin) in Eastern Washington. It is an alpine lake at an elevation of approximately 4,600 feet above sea level. The crest of the Cascades receives about 180 inches of precipitation annually, mostly in the form of snow, while lower elevations, near the City of Leavenworth at roughly elevation 1,170 feet, average 25 inches of precipitation a year. Water supply in the Icicle Creek Subbasin is heavily dependent on snowpack in the upper reaches. Eightmile Dam stands at the eastern end of Eightmile Lake. From the dam, Eightmile Creek flows east, joining Icicle Creek at river mile (RM) 9. Icicle Creek joins the Wenatchee River at RM 25.6, contributing 20 percent of the Wenatchee River's annual flow (Figure 1-1).

Eightmile Lake is a reservoir lake located in the Alpine Lakes Wilderness of the Okanogan-Wenatchee National Forest. The lake is approximately 10 miles southwest from the City of Leavenworth. Eightmile Lake is one of several alpine lakes in this area of the Cascade range. These lakes formed through previous mountain building and erosional glaciation. Eightmile Lake was altered to increase the storage capacity to provide irrigation water supply in 1929. In 1976, the area was designated by congress as the Alpine Lakes Wilderness because of the undeveloped natural beauty of the alpine lake complex.

Eightmile Lake is one of four lakes in the Wilderness managed by IPID for water storage. The IPID has an agreement with the U.S. Forest Service that grants IPID limited privileges, including the ability to maintain and repair its reservoirs within the Alpine Lakes Wilderness. In the 1990s, the IPID exchanged land that is now within the Alpine Lakes Wilderness for this deeded area. This area is called the Special Warranty Deed Area, which includes two parcels on which IPID retains rights related to the Eightmile Dam (see Chapter 3, *Alpine Lakes Wilderness*) (Figure 1-2). Eightmile Creek and most of Icicle Creek are also within the Okanogan-Wenatchee National Forest. Land abutting Icicle Creek includes numerous private parcels, increasing in frequency closer to Leavenworth.

The project area is also adjacent to an Inventoried Roadless Area within the Okanogan-Wenatchee National Forest. Figure 1-2 illustrates the boundaries of the Inventoried Roadless Area, the Alpine Lakes Wilderness, and the Special Warranty Deed parcels.

Eightmile Dam consists of a small dam, low-level outlet pipe, and a slide gate at the outlet of Eightmile Lake that allow controlled release of stored water to supplement flows in Icicle Creek. These flows increase the natural water supply available during low-flow periods, typically occurring during the late summer months. Icicle Creek, a tributary to the Wenatchee River, provides water for agricultural irrigation, municipal and domestic use, aquatic habitat for wild and hatchery fish, and recreation. Because of the large size of the drainage basin relative to the storage volume in the lake, Eightmile Lake has a high potential for refill, even during dry years. As a result, Eightmile Lake, high in the Alpine Lakes Wilderness, is a major source of stored water supporting streamflows in Icicle Creek, benefiting these uses.

The dam was constructed in the 1920s and consists of a rock masonry and concrete wall structure with an earthen embankment section. It is more than 90 years old and requires improvements to operate in a safe, reliable way.

Figure 1-1. Project Vicinity

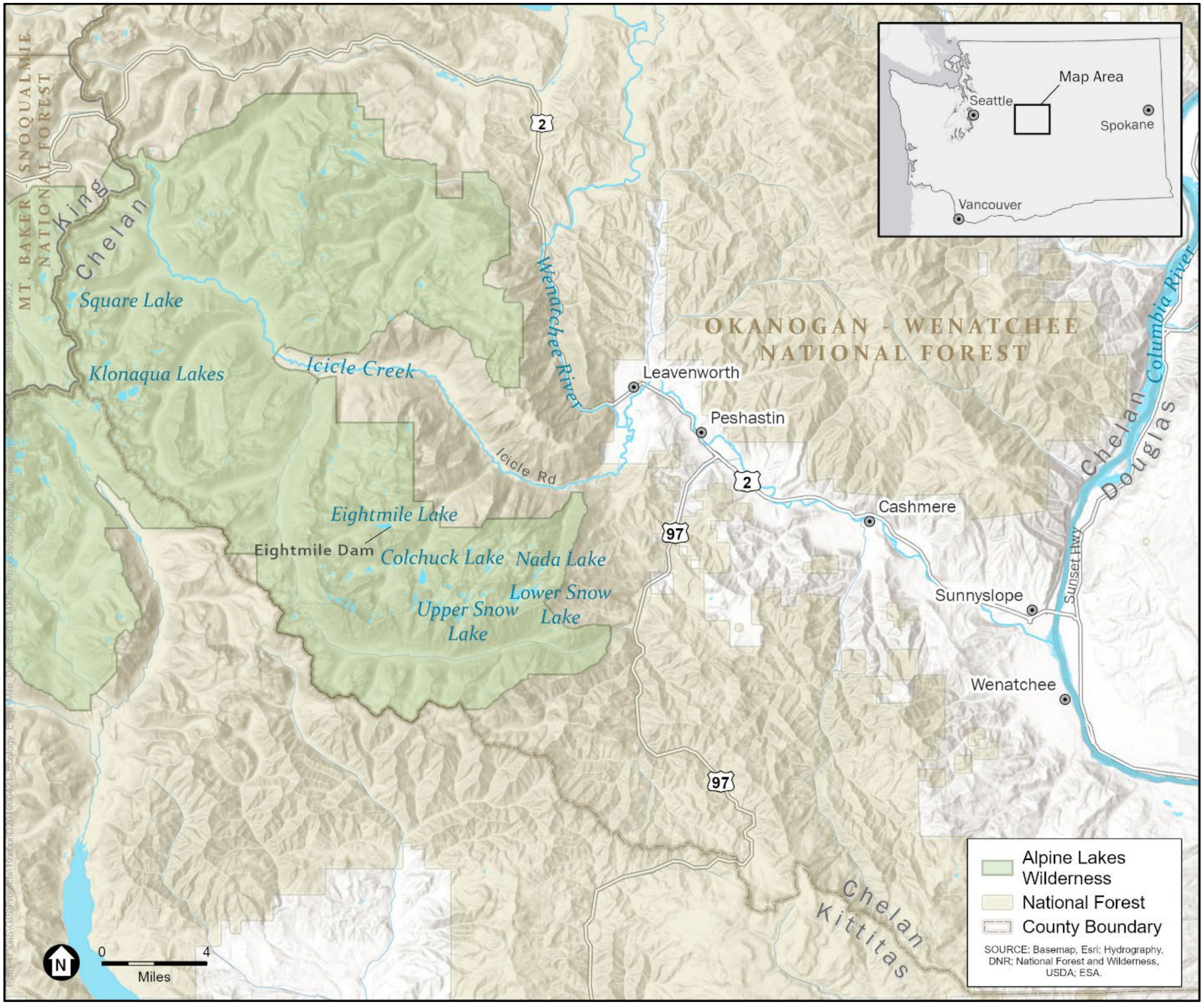
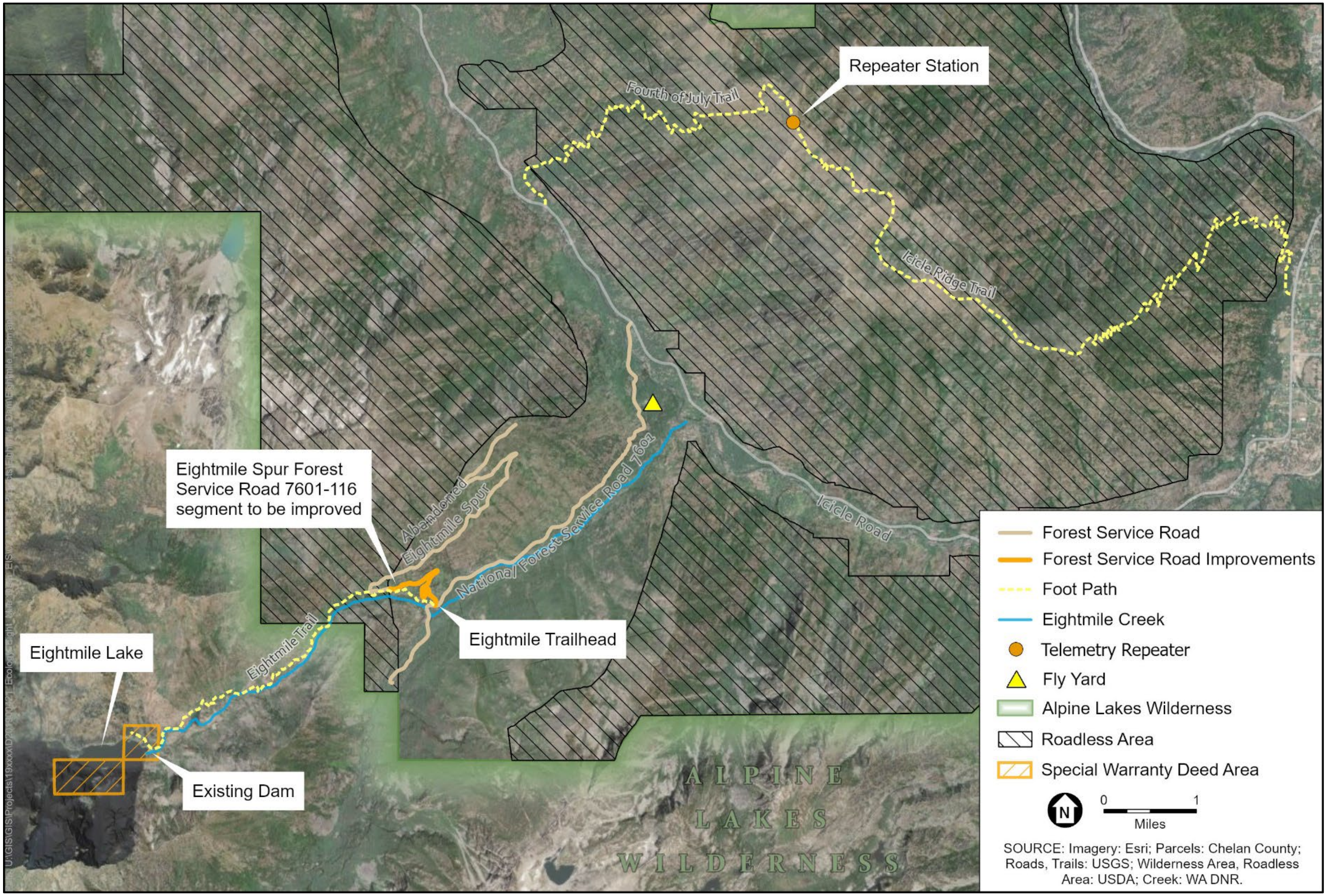


Figure 1-2. Project Area



Following the 2017 Jack Creek Fire, Ecology's Dam Safety Office (DSO) determined the dam was in a deteriorating and unsatisfactory condition, with an estimated 150 downstream residences at risk if the existing dam were to fail, resulting in a High Hazard classification. This hazard classification means that dam failure would threaten human lives and/or cause substantial economic or environmental damage. Because of these concerns, IPID and Chelan County declared an emergency at Eightmile Dam on March 13, 2018. The dam was repaired in 2018 to temporarily increase safety by widening and hardening the spillway and by replacing a segment of the low-level outlet pipe that had collapsed. While the repairs made it possible to lower the lake and provide additional spill capacity, the infrastructure does not currently meet DSO's requirements for dam safety or IPID's water supply needs. As a result of these ongoing safety concerns, DSO is requiring that the dam's outlet gate be kept open to reduce the volume of water stored and thus reduce risk of failure during the winter and early spring until permanent repairs can be made to the dam.

Table 1-1 shows a high-level history of the dam, leading up to this rebuild and restoration project.

Table 1-1. Eightmile Dam History

Activity	Year
Icicle Creek Adjudication	1929
Eightmile Dam Construction	1927–1929
Alpine Lakes Wilderness Designation	1976
Transfer to U.S. Forest Service (Special Warranty Deed)	1990
Erosion Events	Pre-1995
Most Recent Extreme Drought	2015
Jack Creek Fire	2017
Unsatisfactory Condition Determination by Ecology DSO	2018
Emergency Repair Work	2018
Icicle Strategy FPEIS	2019
Dam Rebuild Designs 0–30%	2020
Eightmile Dam Rebuild and Restoration EIS	2022

Ecology's DSO approves and permits dam construction and operation in Washington State. The following are the key concerns for Ecology's DSO and IPID for Eightmile Dam:

- **Limited Spillway Capacity** – The spillway overtopped and eroded the earthen embankment portion of the dam more than 25 years ago. This has limited IPID's ability to refill the lake to the historical spillway elevation and increased the potential for additional erosion and failure of the earthen embankment portion of the dam.
- **Jack Creek Fire** – The August 2017 Jack Creek Fire burned trees and vegetation within the Eightmile Lake watershed down to the shoreline of the lake. This created concerns of increased peak runoff into Eightmile Lake, which, combined with debris piling up on the dam, could increase the risk of dam failure.
- **Low-Level Outlet Failure** – The low-level outlet pipe at the lake is approximately 300 feet long and consists of pipe that varies in size and composition. The oldest section was replaced as part of emergency repairs completed in 2018. The pipe now functions adequately, but still requires replacement for long-term operations.

1.2.1 Icicle Creek Water Resource Management Strategy

Adequate streamflow has long been a problem in Icicle Creek. In 1983, Ecology adopted the Wenatchee River Basin Instream Flow Rule (Chapter 173-545 WAC), which protects flows in Icicle Creek and other rivers and streams in the Wenatchee River Basin. Water supply in the Icicle Creek Subbasin is heavily dependent on snowpack in the upper reaches of the watershed. Combined with storage water from reservoirs in the upper watershed, snowmelt is crucial for summer flows and providing water for out-of-stream uses. The storage in the upper watershed occurs in seven reservoirs within the Alpine Lakes Wilderness. Four of these reservoirs (Colchuck, Eightmile, Klonaqua, and Square) have dams that were built in the 1920s to 1940s by IPID. Increased ability to manage reservoir storage and outflow during both drought and non-drought years would improve IPID's ability to adaptively operate the reservoir in response to changes in inflow timing and magnitude as a result of climate change. The ability to release flows stored during the wet season during dry periods becomes an increasingly valuable tool to sustain flows for aquatic life in Eightmile and Icicle creeks.

To find solutions for water management within the Icicle Creek Subbasin, the Chelan County Natural Resource Department (Chelan County, County) and Ecology OCR co-convened the Icicle Work Group (IWG, Work Group) in December 2012. The IWG comprises a diverse set of stakeholders representing local, state, and federal agencies; tribes; irrigation and agricultural interests; municipal/domestic water managers; and environmental organizations.

The IWG seeks collaborative solutions for water management within the Icicle Creek Subbasin. This includes balancing out-of-stream water uses, such as domestic and agricultural uses, with instream uses, such as fish habitat, recreation, and ecosystem processes, while protecting treaty and non-treaty fishing interests. The IWG's purpose is to develop a comprehensive Icicle Creek Water Resource Management Strategy (Icicle Strategy) that uses best available science to identify and support water management solutions that lead to implementation of high-priority water resource projects within the Icicle Creek Subbasin. The Icicle Strategy is a comprehensive water resource management plan designed to balance and meet out-of-stream and instream water demand and resolve habitat and fisheries issues in the Icicle Creek Subbasin.

Icicle Strategy Guiding Principles

In December 2012, the IWG developed the Guiding Principles, which are a set of objectives that all members of the IWG agreed were in their mutual best interest to collaborate on and achieve as they develop a strategy to meet the needs of the various stakeholders in the subbasin. As presented in the FPEIS, the Guiding Principles strive for:

1) Streamflow that:
    a. Provides passage,
    b. Provides healthy habitat,
    c. Serves channel formation function,
    d. Meets aesthetic and water quality objectives, and
    e. Is resilient to climate change.
2) Sustainable hatchery that:
    a. Provides healthy fish in adequate numbers,
    b. Is resource efficient,
    c. Significantly reduces phosphorus loading,
    d. Has appropriately screened diversion(s), and
    e. Does not impede fish passage.

3) Tribal treaty and federally protected fishing/harvest rights are met at all times.
4) Provide additional water to meet municipal and domestic demand.
5) Improved agricultural reliability that:
    a. Is operational,
    b. Is flexible,
    c. Decreases risk of drought impacts, and
    d. Is economically sustainable.
6) Improve ecosystem health including protection and enhancement of aquatic and terrestrial habitat.
7) Comply with state and federal law.
8) Protect Non-Treaty Harvest.
9) Comply with the Wilderness Act of 1964, the Alpine Lakes Wilderness Act of 1976, and the Alpine Lakes Wilderness Management Plan.

1.3 Regulatory Context

The proposed project, including access to the site from the intersection of Forest Service Road (FSR) 7601 with Icicle Road, is entirely on lands managed by the U.S. Forest Service. The following federal, state, and local regulations and policies apply specifically to land uses within the project area. Regulations applicable to specific resources are described in Chapters 3 through 16.

- Federal Wilderness Act
- National Forest Management Act
- State Shoreline Management Act
- State Growth Management Act
- Chelan County Comprehensive Plan
- Chelan County Critical Areas Ordinance

1.4 Project Objectives

As described above, IPID is proposing to rebuild the dam to comply with DSO safety standards. IPID's proposed rebuild and restoration of the Eightmile Dam has three objectives:

- Restore the storage capacity of Eightmile Lake so that it meets IPID's irrigation and storage needs under its existing water rights.
- Comply with DSO regulations for a High Hazard Dam.
- Provide additional water to enhance instream flow volumes in Icicle Creek and to the extent possible, time dam outflows to meet fish utilization needs.

IPID holds a state water right that authorizes it to store water at Eightmile Lake. Downstream public safety is a paramount concern and high priority. Erosion of the earthen embankment portion of the dam structure has reduced the physical component of active storage volume available for release by gravity without pumping or siphoning to less than 1,400 acre-feet under current conditions. Rebuilding the dam would restore the storage capacity to meet IPID's existing irrigation needs and could provide additional water to enhance instream flows.

Eightmile Dam would be one of the first of several projects implemented under the Icicle Creek Water Resource Management Strategy at the direction of the IWG. The proposed Eightmile Dam Rebuild and Restoration Project helps meet the Guiding Principles of the Icicle Strategy.

Three dam design alternatives are evaluated in this EIS. The alternatives, along with operational considerations, are described in Chapter 2. After considering stakeholder input and other factors, proposals that extended outside the Special Warranty Deed Area have been eliminated from consideration in the EIS.

1.5 Scoping Process and Public Comment

Scoping is one of the initial steps in the EIS process and was conducted to solicit stakeholder input on the range of issues and potential alternatives to be addressed in the EIS. A Notice of Application, Issuance of Determination of Significance, and Request for Comments on the Scope of the EIS for the Eightmile Dam Rebuild and Restoration Project were initially issued by Ecology on December 18, 2020. All comments received were considered in the development of the scope of the Draft EIS. The scoping comment period is the first of two formal opportunities in the SEPA process for the public to provide comments. The public also had an opportunity to comment on the contents of the Draft EIS (see Section 1.6).

Scoping comments included written comments submitted via an online comment form, hardcopy letters sent via mail, emails, and oral comments provided at two online scoping meetings held in January 2021. All correspondence (referred herein as "submissions") was reviewed and bracketed by theme. Over the 47-day scoping period between December 18, 2020, and February 1, 2021, Ecology received 17,624 comments in 4,894 submissions. Of these, 121 were unique submissions and 4,773 were form letter submissions. Unique submissions were submitted by federal, state, and local agencies; organizations; and individual members of the public. Some organizations and individuals provided more than one submission.

Water-related topics were the most common type of scoping comment. People commented on water rights, water conservation, irrigation, water quantity, and water quality. Many commenters were concerned about construction and operation of the dam in the Wilderness. Comments on the SEPA/National Environmental Policy Act (NEPA) process were also a common topic. Many commenters requested that a joint SEPA/NEPA document be prepared. More details on comments received can be found in Scoping Summary Report, Ecology Publication No. 21-12-008 (Ecology 2021d), available at: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-supply-projects-EW/Icicle-Creek-strategy/Eightmile-Dam.

Public comments were used to inform the development of the alternatives and identification of elements of the environment included in the EIS. As provided by SEPA (WAC 197-11-440(6)(a)), elements of the environment that are not significantly affected do not need to be included in an EIS. The following broad areas of environmental review are evaluated in the EIS:

- Alpine Lakes Wilderness
- Surface Water Resources
- Groundwater
- Water Rights
- Geology
- Plants and Animals
- Noise
- Recreation

- Visual Resources
- Public Safety
- Historic and Cultural Resources
- Tribal Resources
- Economics
- Environmental Justice

The following broad areas of environmental review are not evaluated in this EIS as they are not anticipated to be significantly affected:

- Air
- Energy
- Transportation
- Public Services

1.6 SEPA Review Process for the Draft and Final EISs

The Draft EIS was prepared pursuant to the SEPA, RCW 43.21C, and the state SEPA Rules, WAC 197-11. The project-level Draft EIS described potential adverse environmental impacts of each alternative and identified potential mitigation measures to reduce adverse impacts. The SEPA process is designed to inform decision-makers and the public regarding reasonable alternatives, potential adverse environmental impacts, and reasonable mitigation measures associated with a proposal. This EIS document is not an authorization for an action, nor does it constitute a decision or a recommendation for an action.

Following issuance of the Draft EIS, there was an extended 45-day comment period when comments on the document could be submitted to Ecology in accordance WAC 197-11-455(7). The public was encouraged to comment on the Draft EIS. Volume 2 of the Final EIS responds to all comments received on the Draft EIS. A copy of each comment along with a response is provided. As a result of some of the comments received, sections of the EIS have been revised for correction, and/or to provide additional detail and clarity. Changes made to each chapter of Volume 1 of the Final EIS are highlighted at the beginning of each chapter.

1.7 Alternatives Evaluated in the EIS

Four alternatives are analyzed in the EIS:

- No Action Alternative
- Alternative 1: Narrow Spillway with Gates
- Alternative 2: Wide Spillway without Gates (Preferred Alternative)
- Alternative 3: Narrow Spillway without Gates

Based on comments received on the Draft EIS, Ecology and IPID have identified Alternative 2 as the preferred alternative for the proposed action. Alternative 2 meets the project objectives outlined in Section 1.4 and is the least visually intrusive alternative. With no mechanical gates, Alternative 2 will blend into the landscape more than Alternative 1. The No Action Alternative and Alternative 3 do not meet all of the project objectives. Refer to Chapter 2 for detailed descriptions of each of these alternatives.

1.8 Benefits and Disadvantages of Delaying the Proposal

The EIS must discuss the benefits and disadvantages of delaying implementation of the proposal (WAC 197-11-440(5)(c)(vii)). If Ecology delays the Eightmile Dam Rebuild and Restoration Project, potential benefits would include the following:

- Delaying construction of the dam would reduce impacts and perhaps avoid conflicts with other construction projects.

The disadvantages of delaying the rebuild and restoration project include the following:

- Delay would leave the dam vulnerable to failure, which would threaten human lives downstream and create economic hardship for the IPID. Should a dam failure occur, residences, public infrastructure, and wilderness habitat would be damaged or destroyed.
- Currently, the DSO requires IPID to leave the low-level outlet gate open during the winter and early spring. The operation of the dam in this manner is not consistent with DSO regulations, does not meet the DSO's safety requirements for a High Hazard Dam, and would ultimately result in enforcement action by the DSO.
- Delay would not meet IPID's irrigation and storage needs.
- Additional water would not be available to enhance instream flows in Icicle Creek during the summer months.

1.9 Project Finance

While the IPID is responsible to pay for their proposed action and project construction, IPID is applying to receive grants to defray some costs. The IPID has applied for US Bureau of Reclamation WaterSMART federal grants, Federal Emergency Management Agency (FEMA) grants, and the Office of Columbia River grants. IPID will also be contributing in-kind and financial resources to construct the project.

The 2018 emergency repairs were paid for using a combination of funds from Ecology and the IPID.

1.10 Issues to Be Resolved

1.10.1 Water Rights

IPID's water right (Certificate No. 1228) authorizes the storage of a maximum instantaneous quantity of 25 cubic feet per second (cfs), and while the certificate does not specify any maximum annual quantity, it is IPID's position that its right authorizes the storage of a maximum annual quantity of 2,500 acre-feet per year. In recent years prior to the Jack Creek Fire, the physical component of active storage has been limited to approximately 1,151 acre-feet due to damage to the dam. In the last few years after the fire, compliance requirements from Ecology's DSO (Aspect 2022a) related to High Hazard Dam status have resulted in flash boards (boards placed at the crest of the spillway to raise the operating water level but that are easily removed) remaining out of the control notch, the gate remaining open, and an associated temporary reduction in physical storage. IPID intends to donate a portion of its water right to the State Trust Water Rights Programs (Trust) for instream flow purposes, and submitted a request to Ecology to do so in May 2024. After the Final EIS is issued, Ecology will review the request and ascertain the quantity available for donation to the Trust in accordance with the procedures in RCW 90.44.080(4). As this donation action will not include a tentative determination of extent and validity or any other actions (such as adjudication or change application) that would trigger an evaluation for tentative determination of extent validity, quantification of the annual quantity has not occurred at this time. The physical minimum active storage (1,151 acre-feet with flash boards in place) and proposed physical maximum active storage (2,000 acre-feet as dictated by the proposed design alternatives) volumes have been used for the evaluation in the Draft and Final EISs. This range of water storage and release volumes will provide a range of potential impacts, which will encompass the specific water right. For more information, refer to Chapter 6, *Water Rights*.

1.11 Forest Service and the National Environmental Policy Act

The Forest Service has reviewed the proposed action to determine its responsibilities under NEPA. The Forest Service has determined that NEPA applies based on the Council on Environmental Quality's (CEQ) revised regulations at 40 Code of Federal Regulations (CFR) 1501.1 and regulations at 36 CFR 220.4(a).

As authorized by the CEQ regulations, the Forest Service can cooperate with the State of Washington on environmental analysis and may use elements of the environmental review prepared under SEPA for NEPA analysis (40 CFR 1506.2(b)). The Forest Service will incorporate applicable sections of this SEPA EIS into the appropriate NEPA documentation.

1.12 Summary of Significant Unavoidable Adverse Impacts

The Executive Summary for the Final EIS (prepared as a separate document) includes a summary of potential impacts from the alternatives, potential mitigation measures, as well as a summary of the significant unavoidable adverse impacts.

CHAPTER 2: PROJECT ALTERNATIVES

What has Changed from the Draft EIS?

- Based on comments received on the Draft EIS, text was added to Chapter 2 to clarify information that was potentially unclear or incomplete (e.g., details on the outlet pipe). Minor edits were made to Sections 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, and 2.8. No changes were made to the design of the alternatives.
- Alternative 2 was identified by Ecology and IPID as the preferred alternative for rebuilding the dam.
- Responses to specific comments on the alternatives are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Three action alternatives and the No Action Alternative are evaluated in this EIS. The alternatives are described below, and Table 2-1 provides a comparison between alternatives. As noted in Chapter 1, based on comments received on the Draft EIS, Ecology and IPID have identified Alternative 2 as their preferred alternative for the dam rebuild project because this alternative would result in the least amount of visual intrusion in the wilderness.

2.1 Alternative Development

The August 2017 Jack Creek Fire created additional concern for the dam related to increased peak runoff into Eightmile Lake. The DSO conducted a preliminary analysis of homes that could be impacted by a potential failure and sent a letter to IPID in March 2018 that outlined measures to safely manage the situation, as well as elevate the hazard classification of the Eightmile Dam to a high hazard classification (Appendix A). Because the dam had already experienced maintenance issues, IPID began development of alternatives to replace the dam. Initially, IPID developed several conceptual alternative design configurations for consideration by DSO. Through several discussions with DSO, IPID carried two alternatives forward to roughly 30 percent design level: the Narrow Spillway with Gates (Alternative 1) and the Wide Spillway without Gates (Alternative 2). As a result of the EIS scoping process (as described in Section 1.5), a third action alternative was added for analysis in the EIS: the Narrow Spillway without Gates (Alternative 3).

2.2 No Action Alternative

The No Action Alternative serves as the baseline condition against which the action alternatives are evaluated and compared and illustrates the most likely scenario if the project is not implemented. Analysis of the No Action Alternative is required under SEPA (WAC 197-11-440 (5)(b)(ii)).

Under the No Action Alternative, the existing dam would be left as is (Figure 2-1), and it would continue to operate in its current state and manner, with a primary spillway elevation of 4,667 feet and an outlet pipe that allows drawdown of the lake to a water surface elevation (WSEL) of approximately 4,640 feet without pumping (Figures 2-2 and 2-3). The invert elevation of the low-level outlet pipe is 4,648.7 feet, but additional drawdown occurs after the lake WSEL has reached the elevation of the low-level outlet pipe due to seepage through the landslide deposits that underlie the dam. Seepage can draw the lake down to a WSEL of 4,640 feet without pumping. The DSO considers the dam vulnerable in the event of a large storm due to changed conditions in the watershed both upstream and downstream of the dam, as well as to the condition of the dam itself. The Jack Creek

Fire in 2017 burned a significant forested area in the watershed, creating conditions that generate higher peak runoff rates to the lake.

Table 2-1. Alternative Comparison

	Existing Conditions / No Action Alternative	Alternative 1: Narrow Spillway with Gates[2]	Alternative 2: Wide Spillway without Gates[2]	Alternative 3: Narrow Spillway without Gates[2]
Lake Full WSEL (feet)[1]	4,667	4,671	4,671	4,667
Total Lake Area at Maximum WSEL (acres)	76.6	81.4	81.4	76.6
Total Lake Volume at Maximum WSEL (acre-feet)	2,698	3,010	3,010	2,698
Active Storage Volume (acre-feet)	~1,151	2,000	2,000	1,698
Primary Spillway Length (feet)	65	60	180	60
Primary Spillway Elevation (feet)	4,667	4,667 (4,671 with gate up)	4,671	4,667
Intermediate Spillway	No	Yes	No	Yes
Secondary Spillway Length (feet)	12	24	24	24
Secondary Spillway Elevation (feet)	4,671	4,673	4,673	4,673
Low WSEL Without Pumping[3] (feet)	~4,640	4,636	4,636	4,636
Total Lake Area at Low WSEL (acres)	~41.2	38.7	38.7	38.7
Total Lake Volume at Low WSEL (acre-feet)	~1,158	1,010	1,010	1,010
Invert Elevation at Pipe Intake in Lake (feet)	4,648.65	4,632.0	4,632.0	4,632.0

WSEL = Water Surface Elevation.

1. Historical Lake Full WSEL is approximately 4,671 feet.
2. To comply with DSO requirements, all action alternatives require automated equipment and permanent monitoring equipment. All action alternatives have an automated low-level outlet pipe.
3. This elevation represents the lowest drawdown that would occur without pumping. Under existing conditions, the lake is typically drawn down to the low-level outlet pipe invert elevation (4,648.7 feet) during the late summer. The lake level continues to drop during the late summer due to seepage through the landslide deposits that underlie the dam until precipitation begins to refill the lake. The lowest observed drawdown in recent years is estimated to be approximately 4,640 feet. Under each of the action alternatives, IPID will monitor and manage the lake WSEL and drawdown so that the lake WSEL does not fall lower than 4,636 feet, as shown in the table.

Operation of the dam under existing conditions is not consistent with DSO regulations and does not meet the DSO's safety requirements for a High Hazard Dam. The DSO would eventually exercise enforcement actions in accordance with WAC 173-175-620 (3). However, it is not possible to predict with certainty what that action or its effects would be. DSO currently requires IPID to remove the flash boards and leave the low-level outlet open during the winter and early spring to reduce the risk of a dam failure. Consequently, for purposes of this EIS analysis, it is assumed that the existing state of the dam and its operation remain unchanged.

The No Action Alternative does not meet IPID objectives for water storage capacity for operations and irrigation water delivery. It would not contribute to the IWG Guiding Principle 1 related to streamflow improvements. The dam is currently operating in a deteriorating and unsatisfactory condition. An estimated 150 downstream residences are at risk if the existing dam were to fail, resulting in a High Hazard classification.

Figure 2-1. Existing Dam

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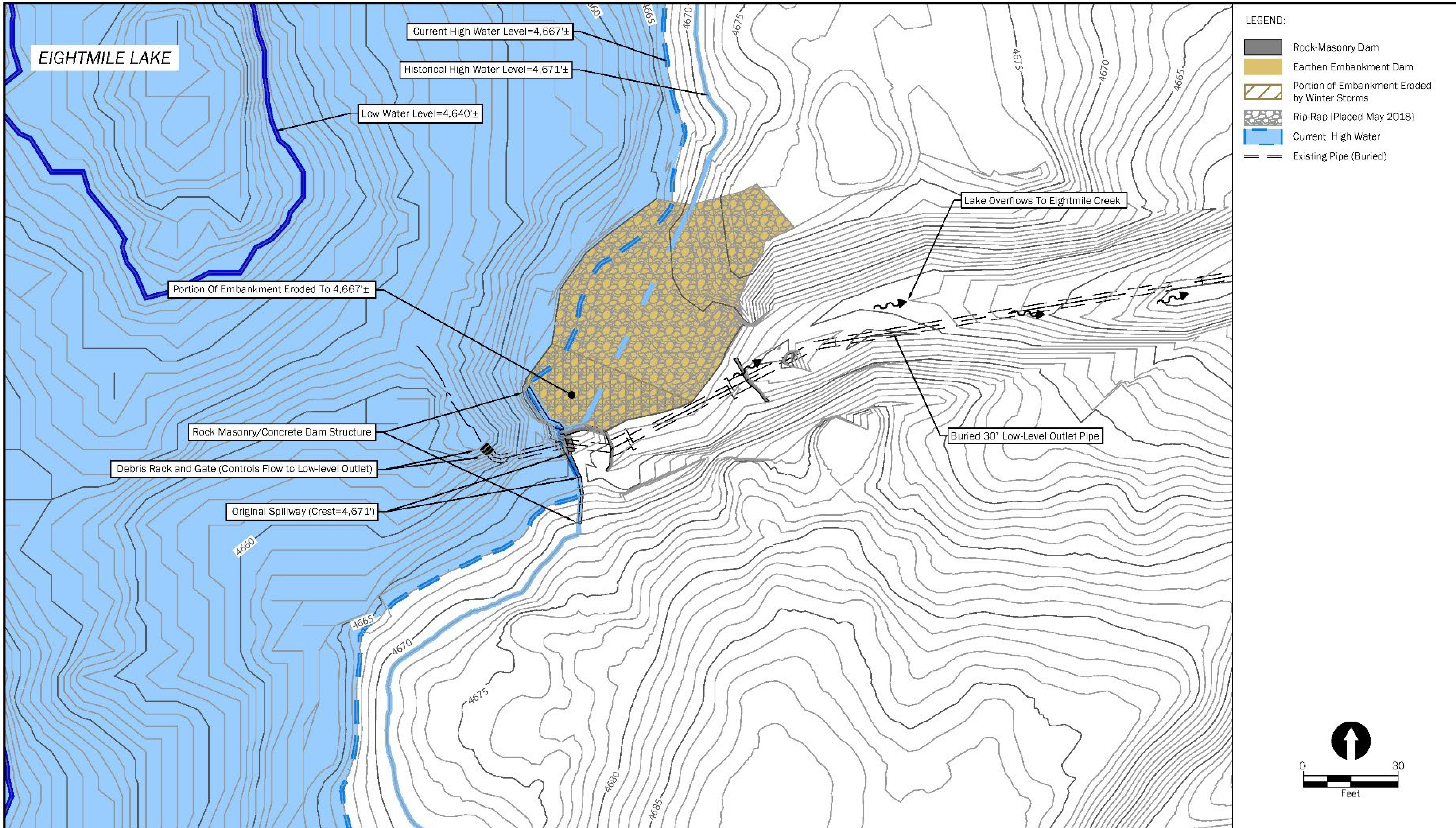
Figure 2-2. Existing Dam / No Action Alternative



Source: Prepared by Anchor QEA

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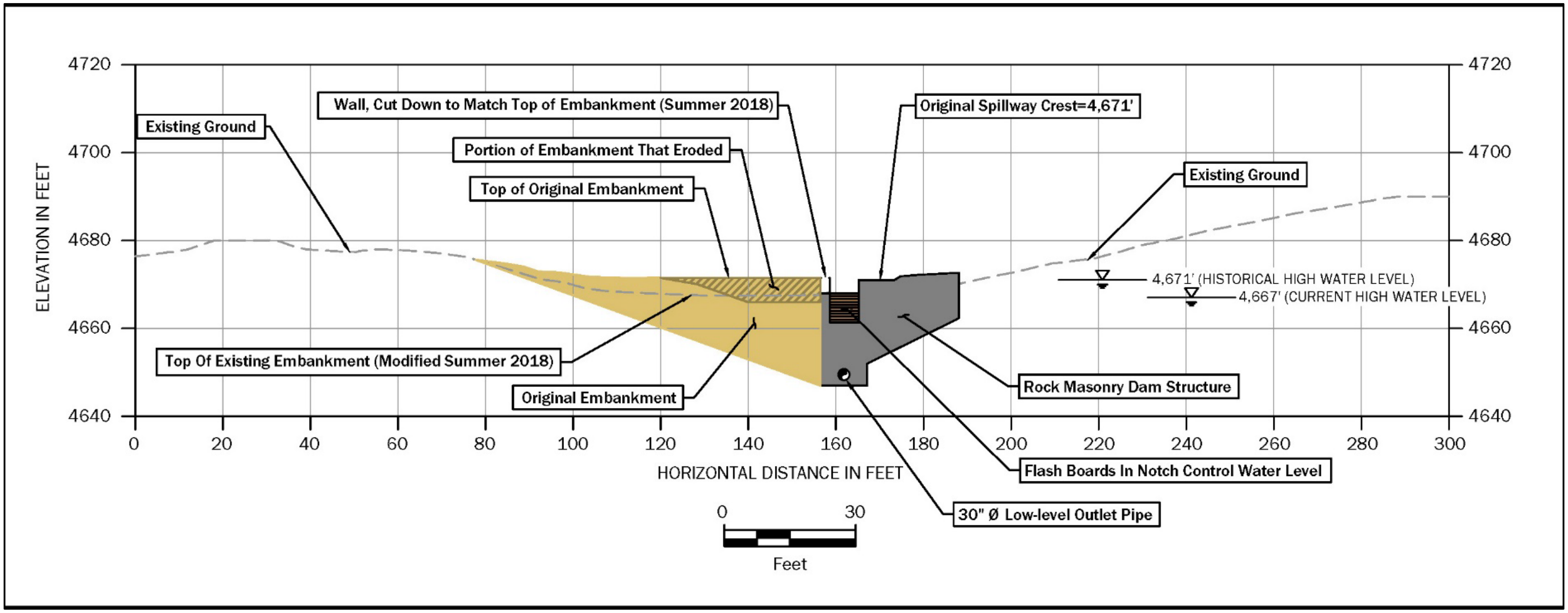
Figure 2-3. Existing Dam / No Action Alternative – Profile



Source: Prepared by Anchor QEA

2.3 Alternative 1: Narrow Spillway with Gates (formerly Alternative 1A)

2.3.1 Dam Design

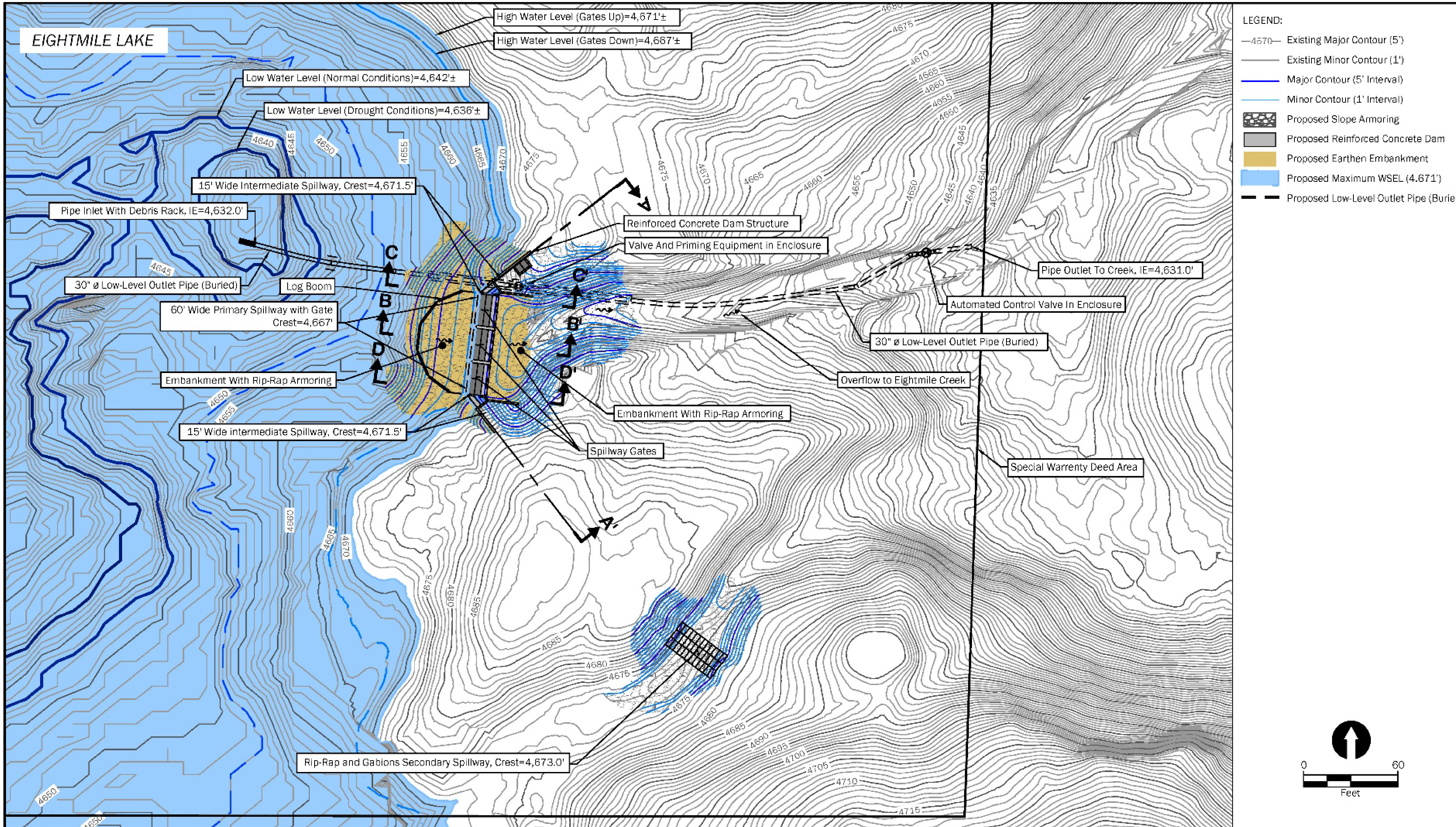
Alternative 1 includes replacement of the existing dam with an earthen embankment and reinforced concrete dam structure equipped with automated control gates over the primary spillway. Three 4-foot-high, 20-foot-long automatic level control gates would be installed on top of the primary spillway, which would have a hard crest elevation of 4,667 feet (Figures 2-4 and 2-5). The gates would allow IPID to control the water level within the top 4 feet of the lake (see Table 2-1 for a comparison between alternatives) by raising and lowering mechanically using remote control. When additional water supply is needed, IPID would raise the gates in the late spring or early summer to raise the lake to elevation 4,671 feet prior to releasing the water in the late summer. The gates would use a motor (compressor) to inflate a bladder when they are raised and would deflate passively by opening a valve to release water. The gates would automatically lower if the lake level gets too high to protect the dam and prevent overtopping. For example, if a storm occurs when the gates are up and the lake is full, the gates would automatically lower to pass peak flows generated by the storm. This design would allow for a narrow primary spillway (60 feet wide) and therefore a smaller dam footprint compared to the Wide Spillway Alternative (Alternative 2).

During extreme storm events, the lake would continue to rise above the primary spillway. Two 15-foot-wide intermediate spillways on either side of the primary spillway would provide 30 feet of additional spillway width at an elevation of 4,671.5 feet (Figure 2-4). A secondary spillway would be created in a low spot south of the main dam structure by using rock and riprap to harden an existing channel. The secondary spillway would have a crest elevation of 4,673 feet. The spillways would provide capacity to pass the design storm event required by DSO (a storm that has the probability of occurring once in 1,000,000 years) while maintaining the freeboard (the vertical distance of the crest of the dam above the maximum lake water level) in the lake required by DSO.

Water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. The low-level outlet pipe/siphon would extend from an inlet submerged in the lake approximately 150 feet west of the new dam structure to an outlet in the Eightmile Creek channel approximately 314 feet downstream of the new dam structure. This would allow the lake to be drawn down to a low-water surface elevation of 4,636 feet, which would allow access to stored water without pumping. The low-level outlet pipe would be located entirely within the Special Warranty Deed Area. IPID would release water during the late summer to maintain the water supply available for irrigation use and instream flows in Icicle Creek. Releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream IPID water supply needs and instream flow needs.

The primary spillway gates and low-level outlet valve at the lake would be powered by batteries charged by a solar panel. Lake levels, gate and valve positions, and other controls would be monitored remotely, and the equipment would be operated via radio signal requiring an antenna, which would be located at the dam site. The controls and monitoring equipment would be concealed as much as possible.

Figure 2-4. Alternative 1: Narrow Spillway with Gates



Source: Provided by Anchor QEA

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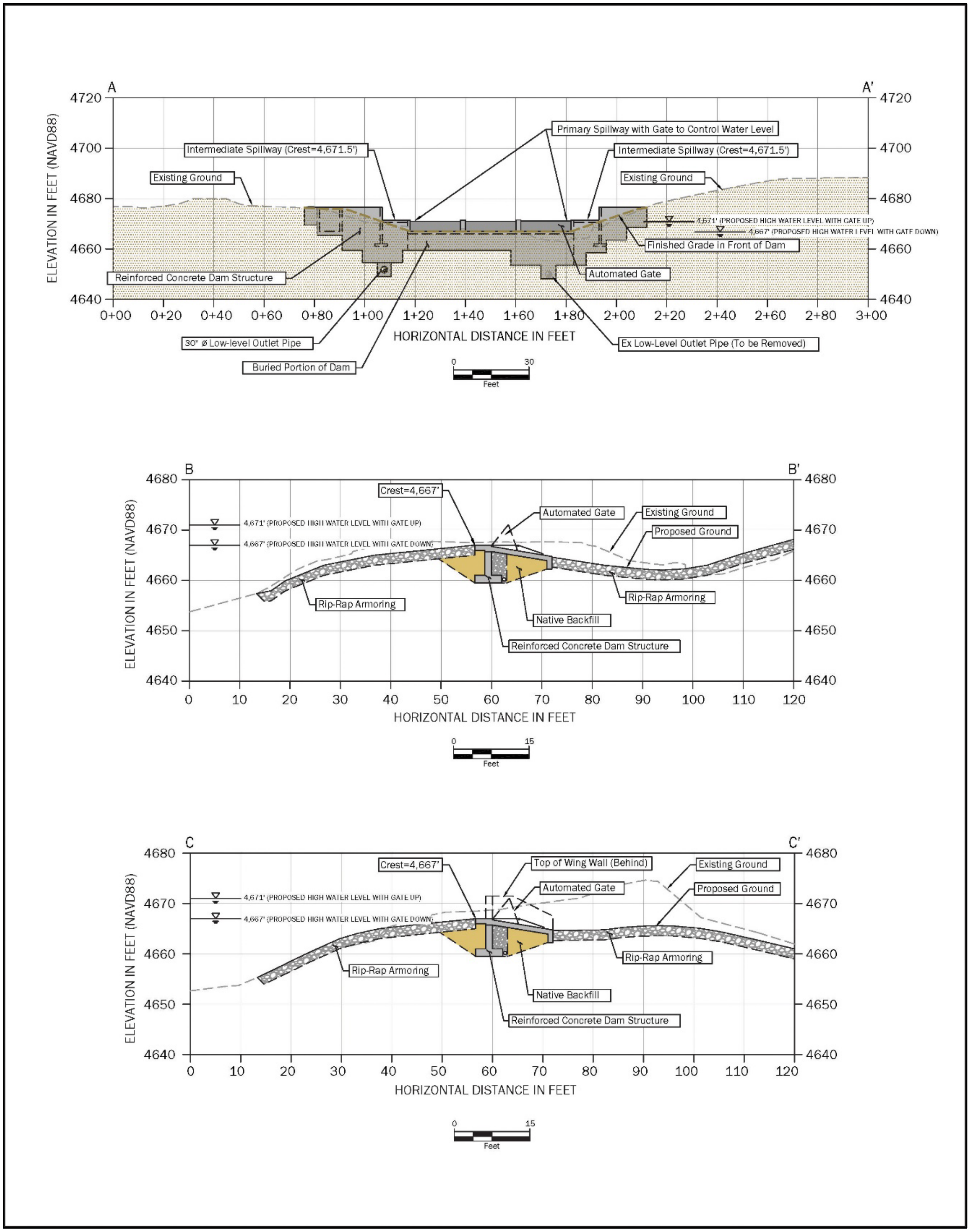
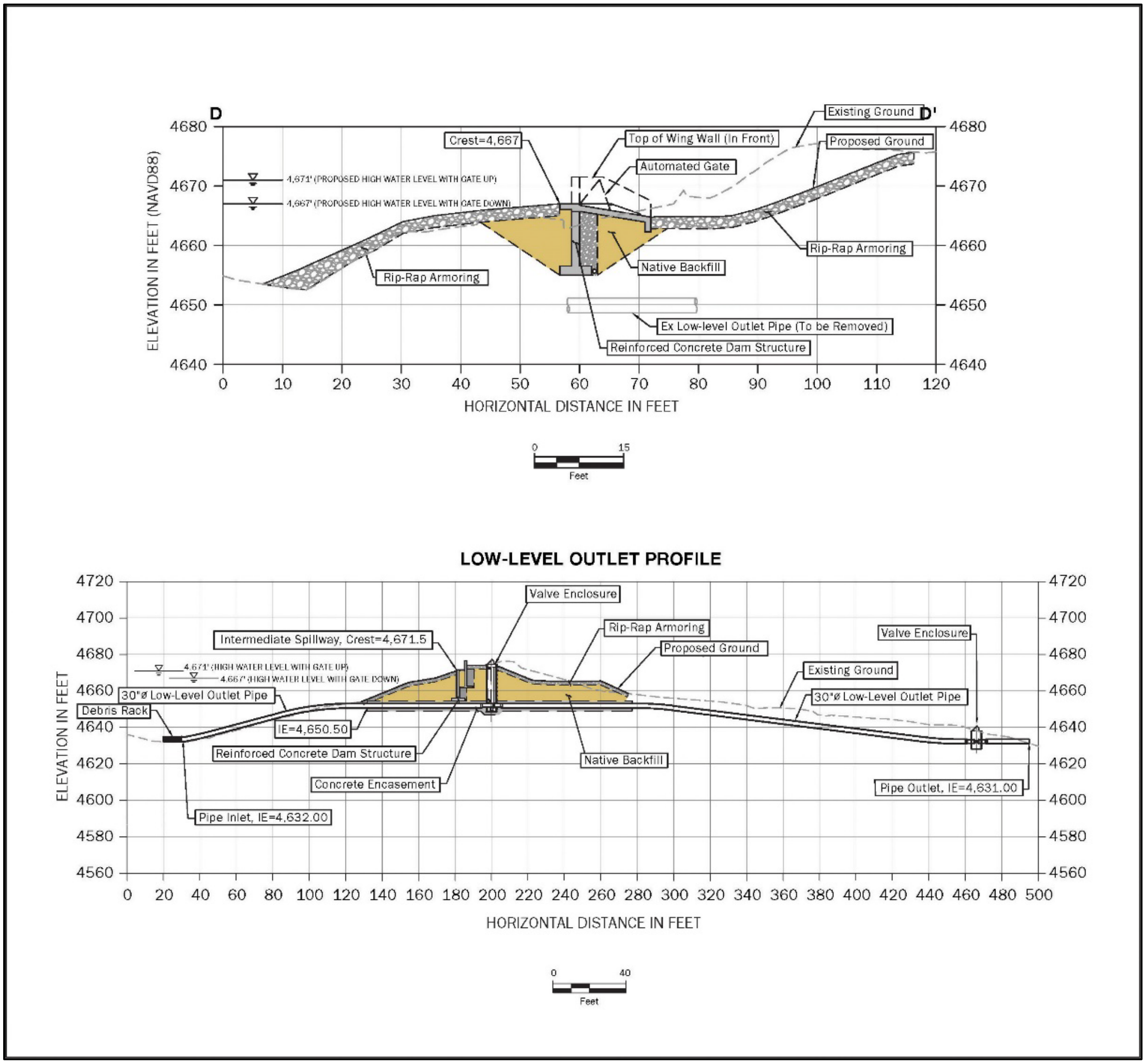
Figure 2-5. Alternative 1: Narrow Spillway with Gates – Profile



Source: Provided by Anchor QEA

Figure 2-5. Alternative 1: Narrow Spillway with Gates – Profile (continued)



Source: Provided by Anchor QEA

2.4 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Alternative 2 includes replacement of the existing dam with an earthen embankment and reinforced concrete dam with a primary spillway length of 180 feet (**Figures 2-6 and 2-7**). The primary spillway would be fixed and completely passive. No gates or automated equipment would control the spillway or adjust the spillway crest elevation. This would result in a wider spillway and a larger footprint than the Narrow Spillway Alternative (Alternative 1). See **Table 2-1** for a comparison between alternatives. There would be no intermediate spillways. The primary spillway would have a hard spillway crest at an elevation of 4,671.0 feet.

During extreme storm events, the lake would flow over the entire length of the primary spillway. A secondary spillway, the same as the Narrow Spillway Alternative, would be created in a low spot south of the main dam structure by hardening an existing channel with rock and riprap. The secondary spillway would have a crest elevation of 4,673.0 feet. The spillways would provide enough capacity to pass the design storm event while maintaining the freeboard in the lake required by DSO.

As with the Narrow Spillway Alternative, water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. Figure 2-6 illustrates the location and configuration of the inlet and outlet pipe. The operation of the low-level outlet pipe would be the same described for the Narrow Spillway Alternative, with the low-level outlet pipe located entirely within the Special Warranty Deed Area. As with Alternative 1, releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream IPID water supply needs and instream flow needs.

As with Alternative 1, the low-level outlet valve at the lake would be powered by batteries charged by a solar panel. Lake levels, valve positions, and other controls would be monitored remotely, and the equipment would be operated via radio signal requiring an antenna, which would be located at the dam site. The controls and monitoring equipment would be concealed as much as possible.

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Figure 2-6. Alternative 2: Wide Spillway without Gates

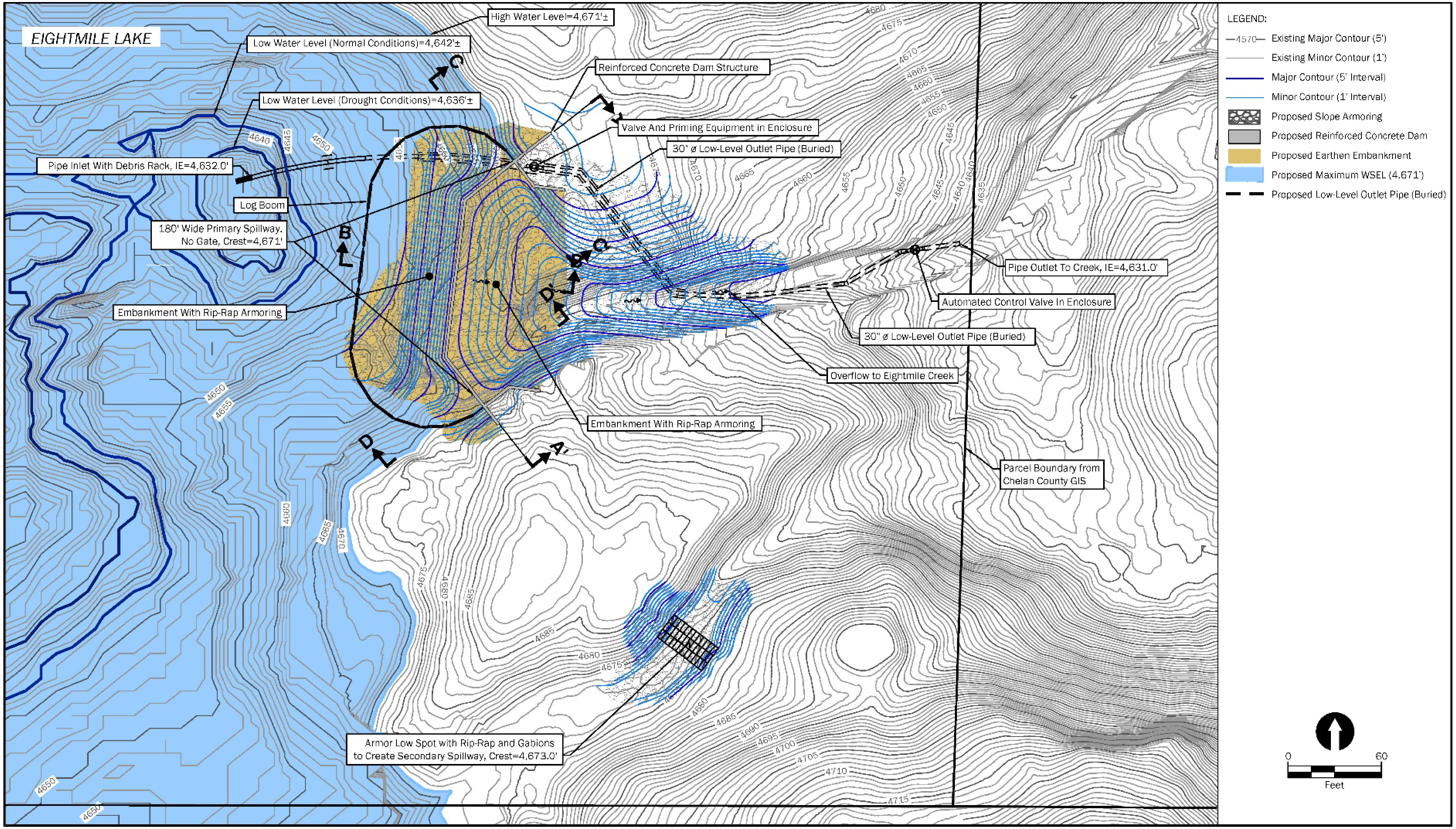

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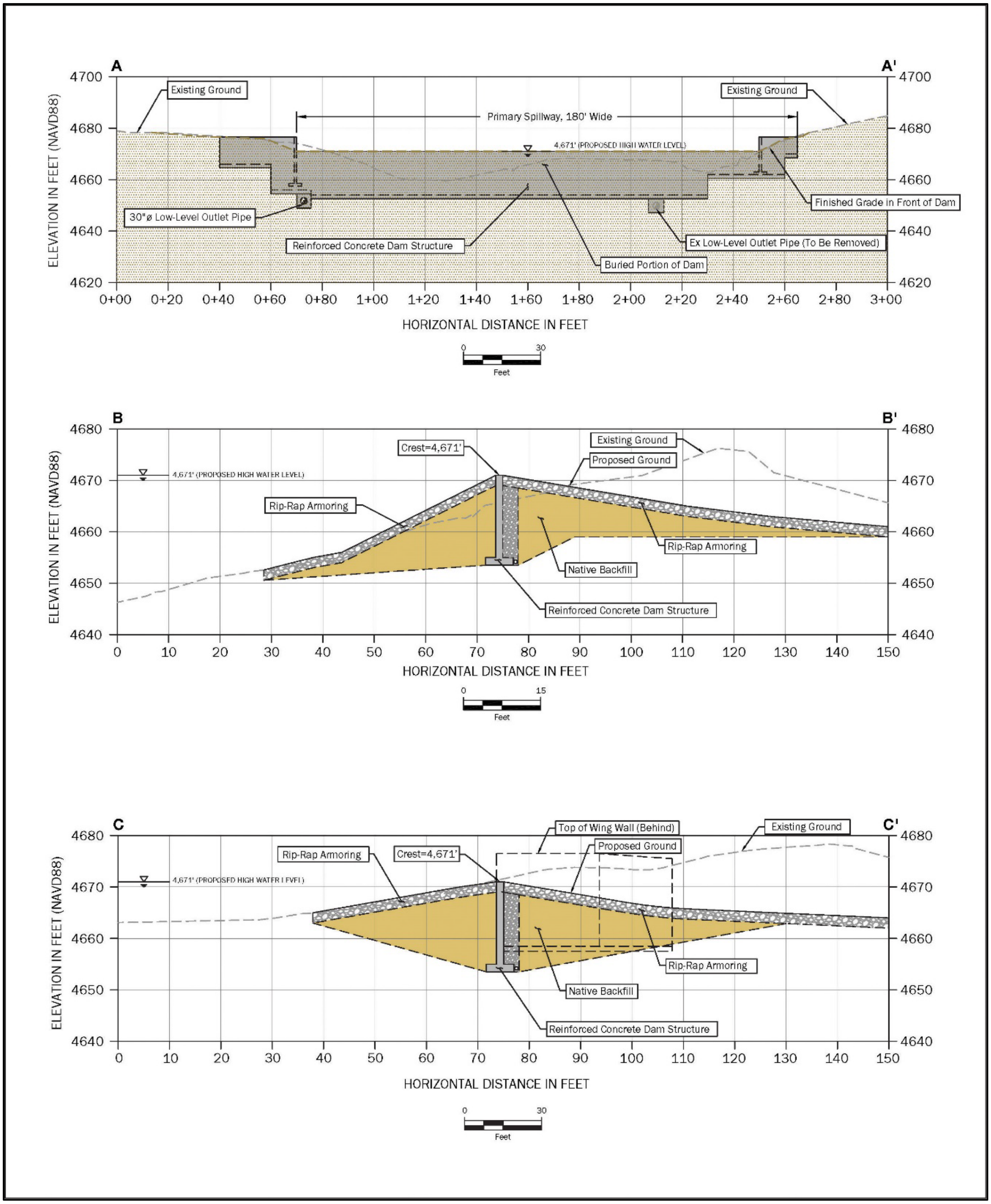
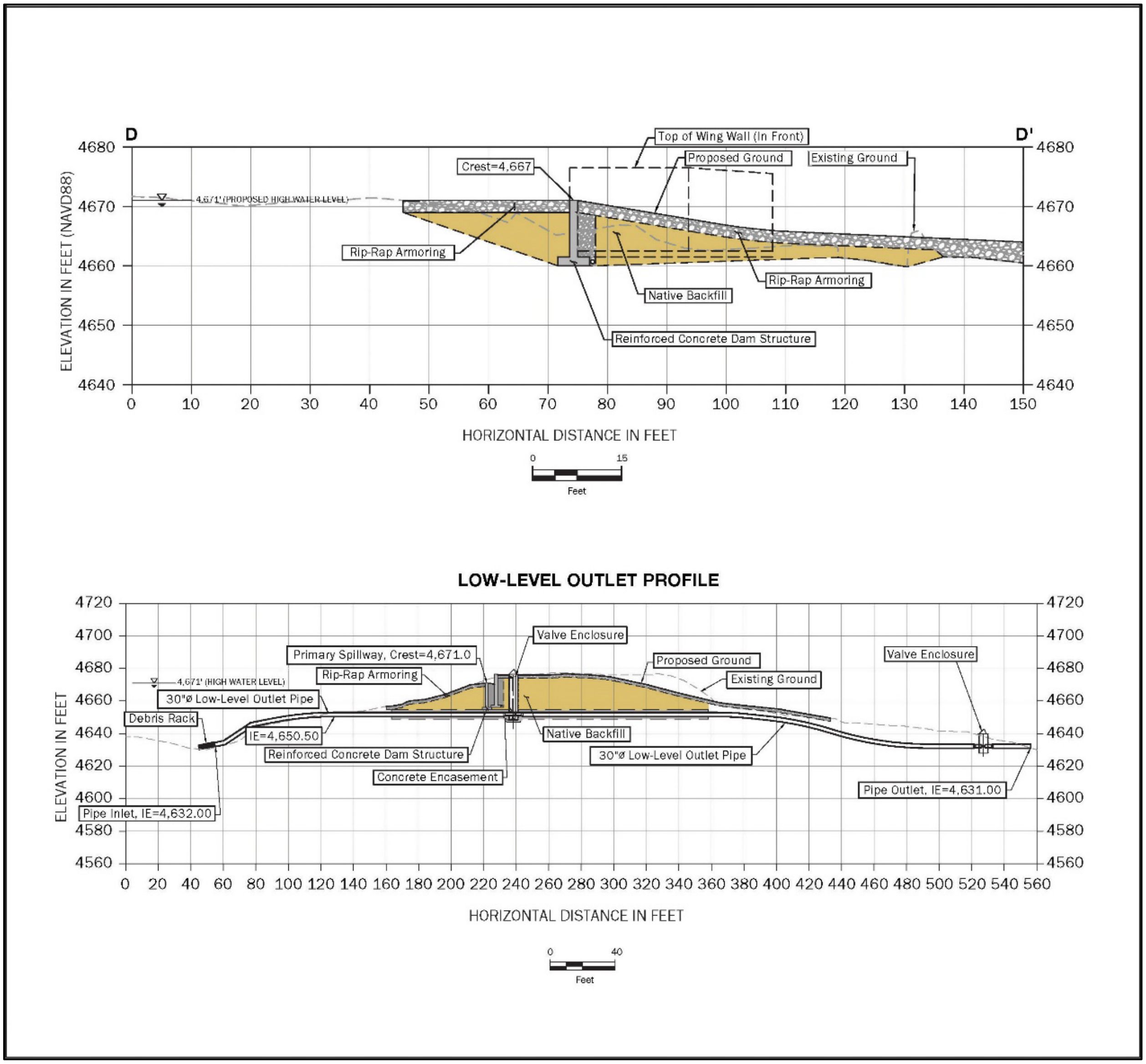
Figure 2-7. Alternative 2: Wide Spillway without Gates – Profile



Source: Anchor QEA

Figure 2-7. Alternative 2: Wide Spillway without Gates – Profile (continued)



Source: Anchor QEA

2.5 Alternative 3: Narrow Spillway without Gates

Alternative 3 was developed as a result of comments received during scoping that suggested that the EIS should include an alternative dam design that matches the existing spillway elevation of 4,667 feet.

Under Alternative 3, the dam type and configuration as well as the inlet and outlet pipe configuration would be almost identical to that of Alternative 1, having a narrow spillway and a concrete spillway apron, but with no mechanical gates. The mechanical gates that are included as part of Alternative 1 would allow IPID to store up to a maximum water surface elevation of 4,671 feet with the gates activated (Figures 2-8 and 2-9). Alternative 3 would have no gates and would be designed to store water only up to a maximum water surface elevation of 4,667 feet. This alternative would have the same inlet and outlet pipe and dam footprint as Alternative 1. Because Alternative 3 would not have mechanical gates, the primary spillway would include one continuous 60-foot-wide primary spillway section with a crest elevation of 4,667 feet (Table 2-1). The intermediate and secondary spillways for Alternative 3 would be identical to that described for both Alternatives 1 and 2.

The maximum volume of water that could be stored for release by the dam would be less with Alternative 3 than for the other two action alternatives. Alternative 3 would not meet all of IPID's objectives because there would be less potential water storage available for release to ensure against drought conditions. Because there would be less potential water available during drought conditions, this alternative may require pumping to access more than 1,698 acre-feet of water storage. Releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream IPID water supply needs and instream flow needs.

As with Alternatives 1 and 2, the low-level outlet valve at the lake would be powered by batteries charged by a solar panel. Lake levels, valve positions, and other controls would be monitored remotely, and the equipment would be operated via radio signal requiring an antenna, which would be located at the dam site.

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Figure 2-8. Alternative 3: Narrow Spillway without Gates

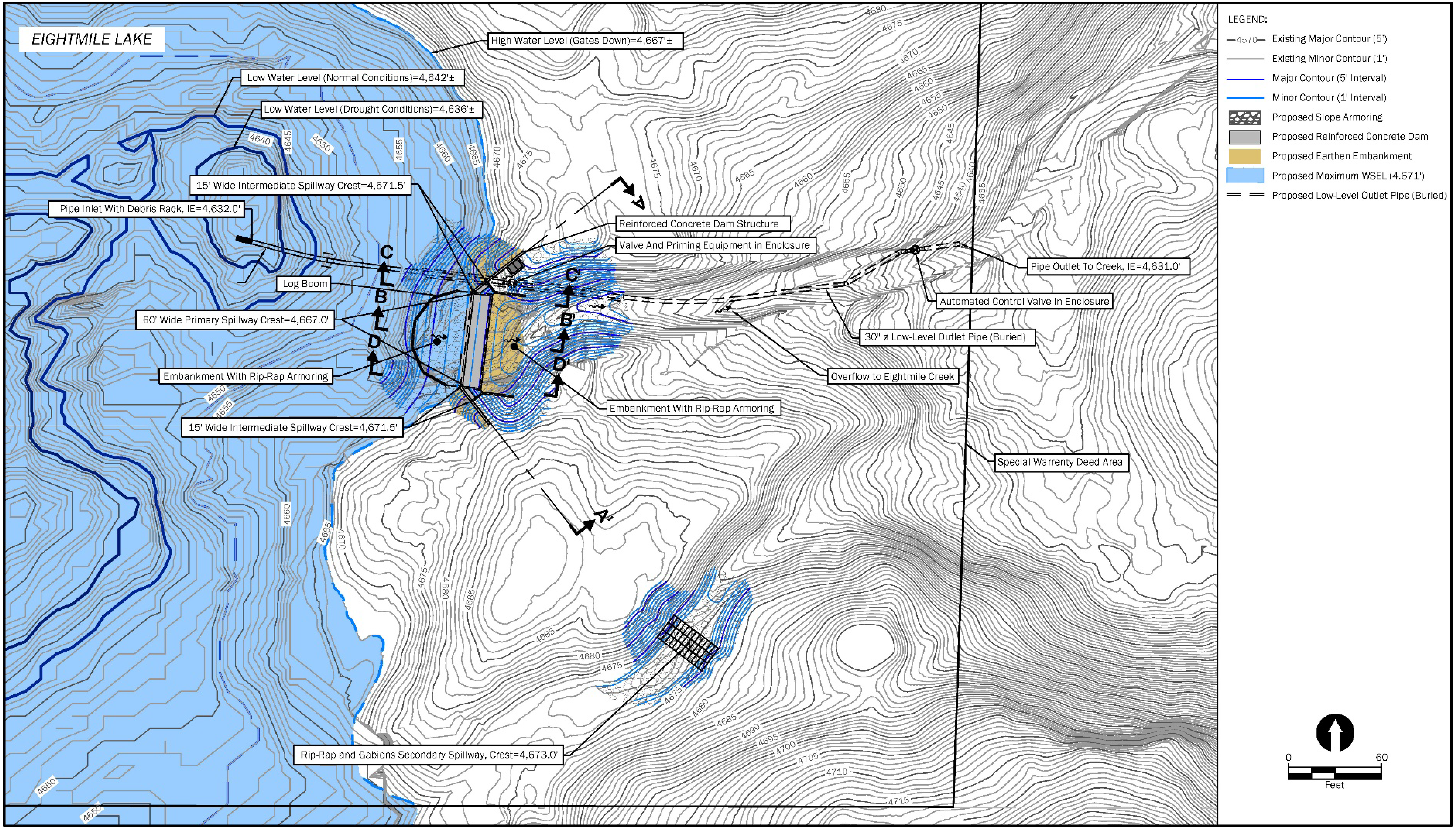

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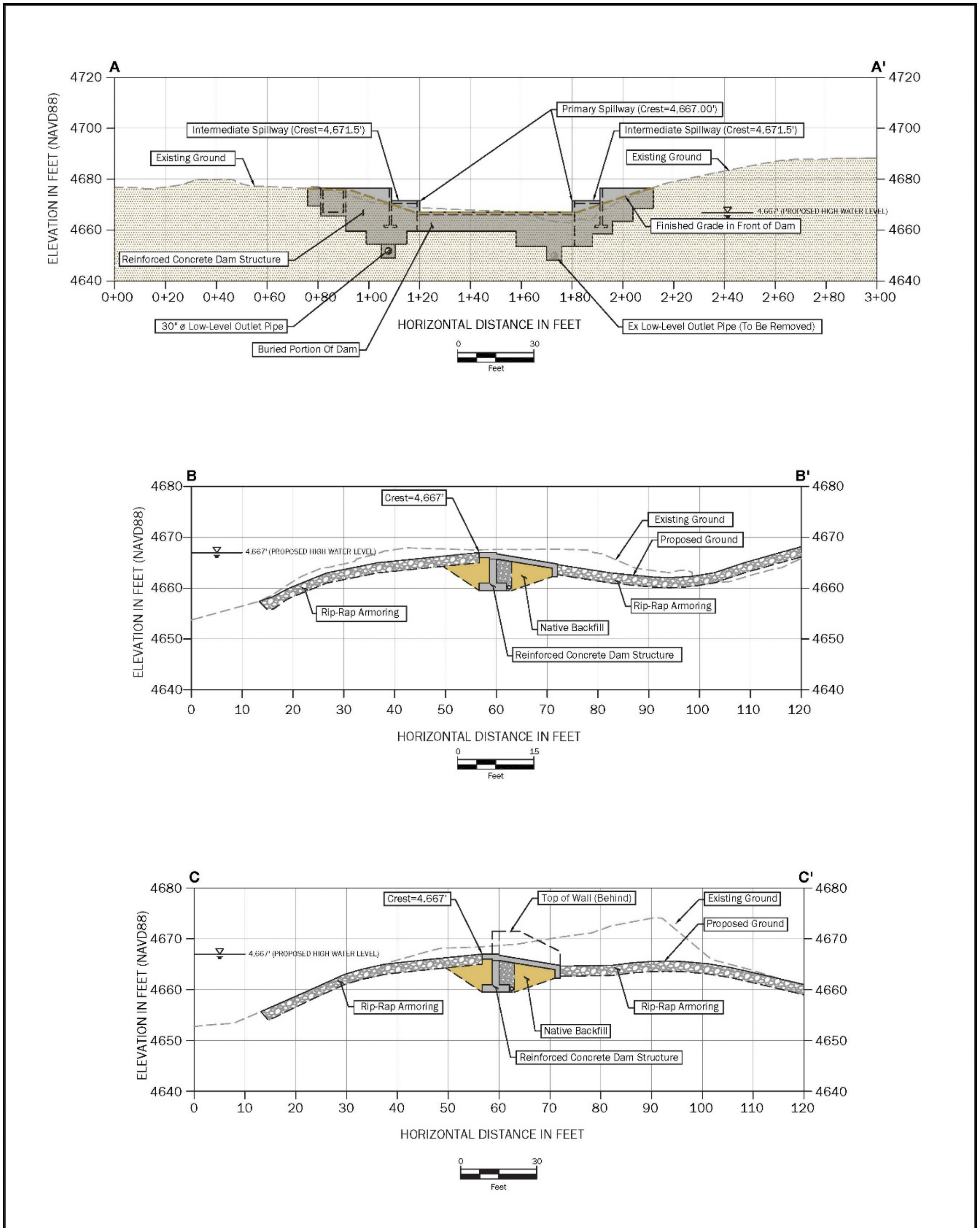
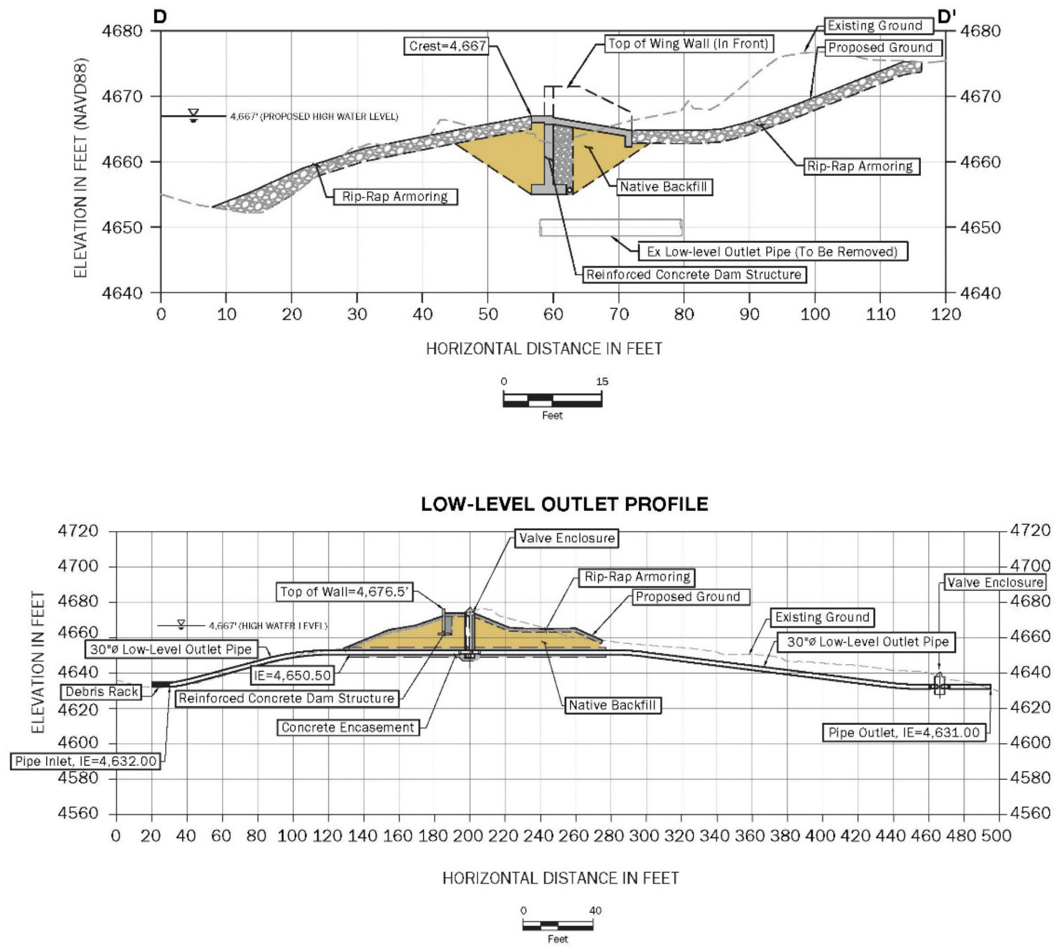
Figure 2-9. Alternative 3: Narrow Spillway without Gates – Profile



Source: Anchor QEA

Figure 2-9. Alternative 3: Narrow Spillway without Gates – Profile (continued)



Source: Anchor QEA

2.6 Dam Operation

In general, operation of Eightmile Dam would be as follows under all action alternatives:

- The lake would be allowed to fill annually through early- to late-July each year. The timing of the fill period would depend on inflows and downstream irrigation needs.
- IPID would then open the valve remotely via automation on the low-level outlet to start releasing water, as needed to meet downstream needs.
- IPID would close the valve on the low-level outlet pipe at the end of the irrigation season.
- The lake would refill through the winter and spring.

Under Alternatives 1 and 2, lake drawdown would be to a minimum elevation of 4,636 feet. The maximum drawdown would result in an annual release of up to 2,000 acre-feet of actively stored water from Eightmile Lake (and up to 1,698 acre-feet of actively stored water with Alternative 3). Some continuing seepage loss is anticipated through the landslide deposits that underlie the dam. However, IPID would monitor lake levels and outflows and would regulate the lake so that the annual active storage and release does not exceed the maximum volume of the design alternatives considered (up to 2,000 acre-feet) and so that the Trust donation is managed properly.[1]

IPID will likely turn over control of the release of up to 600 acre-feet of stored water from the lake for augmentation of instream flows for Alternatives 1, 2, and 3, with releases scheduled based on coordination with IWG members, co-conveners, and fishery co-managers through a separate process including a decision support tool being developed through the IWG. Ecology would set the release schedules and quantities at its discretion (within limits of the Trust donation) based on the decision support tool and input from IWG, Washington State Department of Fish and Wildlife (WDFW), and other fishery co-managers. Alternative 3 and the No Action Alternative would result in less releasable water for instream flows than Alternatives 1 and 2.

Under Alternative 1: Narrow Spillway with Gates, the water surface elevation would typically be held at WSEL 4,667 feet. In the late spring and early summer, IPID would raise the gates over the primary spillway to capture additional runoff and raise the lake to a maximum WSEL of 4,671 feet. IPID would typically raise the gates in May or June and begin to draw down the lake in July. The gates would be lowered once the lake level is below the bottom of the gates (elevation 4,667 feet). Under Alternative 1, if the gates are raised and the lake fills, the gates would automatically lower to prevent the lake level from rising above 4,671 feet. During a storm, the gates would lower to provide additional spillway capacity to pass peak storm flows.

Under Alternative 2: Wide Spillway without Gates, there would be no gates or other adjustable controls. The lake would flow over the primary spillway when the lake fills to an elevation above 4,671 feet.

Alternative 3: Narrow Spillway without Gates would be passive like Alternative 2, but the maximum WSEL would be lower, set to 4,667 feet.

[1] This will be accomplished through the development of an Ecology-approved monitoring plan in which IPID will monitor and report to Ecology the total annual volume of water actively stored in the reservoir and the total annual volumes released for both instream flows and for IPID's irrigation use. The annual monitoring plan will be in place prior to storage and release of water from a rebuilt dam and reservoir. Refer to Chapter 6 for further details.

2.6.1 Telemetry

Under existing conditions, IPID staff hike to Eightmile Lake to manually release water using dam infrastructure. Under Alternatives 2 and 3, an automated release valve would be opened, adjusted, and closed remotely, thereby reducing the need for IPID personnel hiking to and from the site. Under Alternative 1, the dam would also have gates that would be raised remotely by a compressor and would automatically lower in the event of water rising over the elevation of 4671 feet. Automation would allow for improved control of water releases without hiking to the lake. Automation would require telemetry equipment at Eightmile Lake and a repeater station in a separate and appropriate location on Icicle Ridge.

At Eightmile Lake, telemetry equipment would be located on the northeast side of the dam within the Special Warranty Deed Area; the exact type and location have not yet been determined at this stage of design, but will be as inconspicuous as possible. Telemetry and batteries would likely need replacement between every 5 and 10 years. Lithium batteries would likely be used to get a longer lifespan.

The proposed repeater station would be co-located with the Forest Service's local repeater station (Figures 2-10 and 2-11). The proposed repeater station would be located on National Forest System lands on Icicle Ridge, outside of the Alpine Lakes Wilderness. A final decision on the type of telemetry equipment (antenna or solar panel) has not been determined yet, but would be similar in scale to the Forest Service's existing repeater station. Telemetry equipment and installation materials would be flown in by helicopter. The equipment would be bolted down and secured with guyed wires. Installation is anticipated to take 1 to 3 days.

Figure 2-10. Forest Service Icicle Repeater Station

2.6.2 Maintenance

IPID has an agreement with the Forest Service that grants IPID limited privileges, including the ability to maintain and repair its reservoirs within the Alpine Lakes Wilderness. IPID currently inspects and maintains the dam in accordance with Ecology DSO requirements. Currently, IPID staff hike to the dam during summer months for inspections and to adjust the flow during release periods. During the summer months (approximately June to October), the site is visited at least one time per month. When equipment is needed, helicopters are used to land at the site. Small planes are used to fly over for visual inspections typically 1 to 2 times per month beginning in April. During the winter months, the site is not inspected because the lake is frozen over.

2.7 Construction

Construction of the improvements to the dam at Eightmile Lake will involve the transport of equipment, materials, and personnel to the site, and various construction activities. No new roads would be constructed within the Alpine Lakes Wilderness as a part of this project.

Construction of the dam improvements will include the following:

- Transport of equipment, materials, and personnel to the site.
- Clearing and grading for the staging area (8,500 to 10,000 square feet; Table 2-2).
- Demolition of the existing dam.
- Decommissioning of the existing outlet pipe by removing sections and filling other sections.
- Excavation for the new outlet pipe and dam structure.
- Installation of a new outlet pipe.
- Construction of a new concrete dam structure including secondary spillway.
- Regrading after dam construction.
- Riprap armoring of the primary and secondary spillway area, including areas that will convey water upstream and downstream of each spillway.
- Installation of monitoring and control equipment.
- Site restoration.
- Transport of equipment and waste materials away from the site.
- Temporary ‘housing/camping’ for construction personnel.

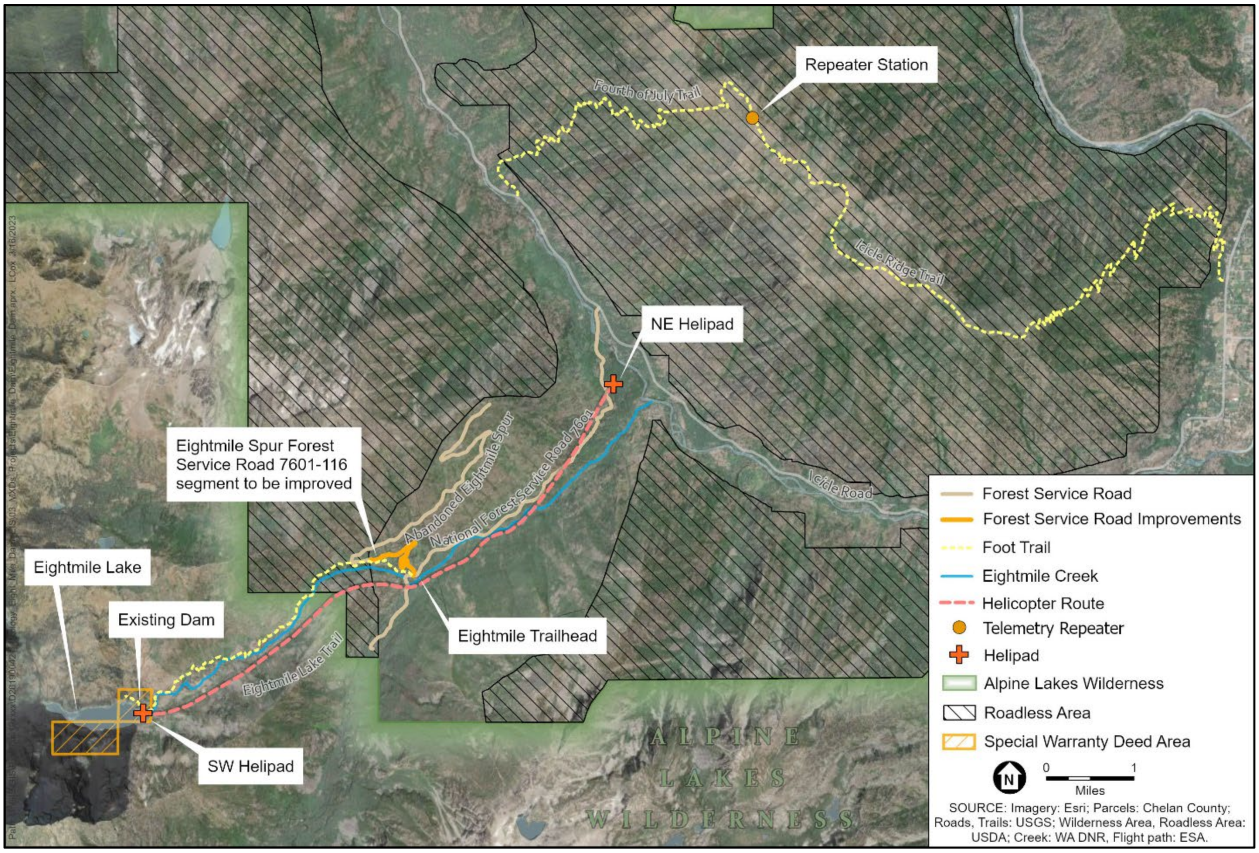
2.7.1 Transportation of Equipment and Materials

The project would require access by construction personnel and the transport of gear, food and provisions, hand tools, larger mechanical equipment (including an excavator; a small, tracked loader; equipment for mechanically sorting on-site materials; and concrete mixing equipment), cement, pipe, valves, generators, dewatering pumps, trench protection equipment, debris rack, portable latrine, and other construction materials. Rock and earthen material would be sourced from excavations associated with the new dam and piping on the Special Warranty Deed parcels.

Construction of the dam would require the transport of equipment and materials into and out of the Special Warranty Deed lands within the Alpine Lakes Wilderness. There are no roads that directly access Eightmile Lake. The lake can be accessed on-foot via the Eightmile Lake Trail (Forest Service Trail #1552), which IPID uses for routine maintenance at the dam. The trailhead is accessible from

Leavenworth by vehicle following Icicle Road and FSR 7601-116. The distance from the trailhead to the lake is approximately 4 miles. An estimated 4 to 6 construction personnel per week will likely use the upper portion of this trail for access to the site on foot, although some may choose to hike from the trailhead. As described further below, IPID proposes to improve and reopen a portion of a currently closed road located outside of the Alpine Lakes Wilderness for administrative use to bring vehicles closer to the project site. As shown in **Figure 2-11**, improvements to FSR 7601-116 would stop at the Inventoried Roadless Area, outside of the Alpine Lakes Wilderness. IPID also proposes the use of helicopters. **Figure 2-11** shows the proposed transportation routes for site access.

Figure 2-11. Transportation Routes



Helicopters would be used to move all equipment and the majority of materials to and from the site on Special Warranty Deed land. The primary determinant of the type of helicopter to be used is the maximum weight that needs to be transported. The largest payload would be the excavator, which could be partially disassembled to aid in transport and reassembled on-site.

Two types of helicopters would be used: a heavy-lift helicopter (e.g., Columbia Chinook CH-47D, or similar) with a 20,000-pound payload capacity, and a small helicopter (e.g., Bell UH-1 Huey or similar) with a 5,000-pound payload capacity (**Figure 2-12**). The size of the helicopter would determine the size of each load and also affects the number of trips needed. The larger helicopter is necessary for transporting the excavator (a 120-size or larger excavator). Because it carries a much larger payload, the larger helicopter can also reduce the number of trips carrying materials to the site. The anticipated flight path for helicopter transport is depicted in **Figure 2-11**.

Figure 2-12. Helicopter Types

Chinook CH-47

Bell UH-1 Huey

Two approaches to helicopter use are being considered. Option 1 would use the larger helicopter to transport nearly all equipment and material to the site at the beginning of the project, followed by a limited number of additional trips using the smaller helicopter to bring materials that were not anticipated initially. Option 2 would involve the limited use of the large helicopter to move only the heavy equipment and a portion of the material, followed by periodic delivery of materials as needed throughout the construction, using the smaller helicopter. Under both options, the large helicopter would be used for 1 to 2 days to remove equipment and any remaining materials at the end of construction. It is anticipated that the majority of the helicopter trips would occur on weekdays; however, some weekend flights may be necessary. **Table 2-2** shows a comparison of the two construction options.

Table 2-2. Construction Options

	Option 1. Heavy-lift Helicopter with Limited Use of Small Helicopter Throughout Construction	Option 2. Limited Use of Heavy-lift Helicopter with Small Helicopter Use for the Majority of Materials
Number of Trips with a Heavy-lift Helicopter	Approximately 70 to 105 trips over 3 to 5 days at the beginning of the project, and 11 trips at the end of the project.	Approximately 20 trips over 2 days at the beginning of the project, and 11 trips at the end of the project.
Number of Trips with a Small Helicopter	Approximately 20 trips periodically during construction, as needed for unanticipated supplies.	Approximately 245 trips throughout the project.
Size of Staging Area	Approximately 10,000 square feet.	Approximately 8,500 square feet (Approximately 15% smaller).

Equipment would be staged at the “fly yard” for transport to the project site and staging area within the Special Warranty Deed Area by helicopter (**Figure 2-11**). The fly yard is an existing improved site adjacent to Icicle Road on National Forest System lands; the fly yard is used by IPID. Helicopters would sling-load material, equipment, and supplies but not touch down at the Eightmile Dam site, except for emergencies and drop off of personnel. The initial drop zone would be on the spillway of the dam; once the staging area is graded, equipment and materials would be dropped at the staging area (**Figure 2-13**). The helicopter would land at the fish hatchery or at the fly yard (Fromm Field) (**Figure 2-11**) to fuel and stop for the day.

IPID proposes to work with the Forest Service to repair and improve an approximately three-quarter mile section of currently closed (locked gate) road (FSR 7601-116) to allow vehicular traffic for administrative use only associated with the project; the road would not be available for use by the general public and would remain locked at all times except for authorized entry. Temporarily repairing and improving this section of road would allow vehicles to bring personnel and supplies closer to the site, cutting off roughly 0.75 mile and roughly 500 feet of elevation gain as compared to using the Eightmile Lake Trail. Vehicles would travel up FSR 7601 to the Eightmile Lake Trailhead parking lot, where they would continue approximately 0.75 mile up FSR 7601-116 to the end of the repaired and improved portion of the road, east of the wilderness boundary and the Inventoried Roadless Area boundary (Figure 2-11). From this point, personnel would travel by foot to join the Eightmile Lake Trail for the remainder of the route to the dam. Repairing and improving the road would involve some heavy equipment to remove fallen trees and vegetation rooted in the roadway, as well as minor road repair. Approximately 10 feet of the existing roughly 24-foot-wide road would be cleared for access. The full 24-foot width will be cleared for the last 100-feet to allow for parking, and the last 30 feet of the road will be widened to roughly 30 feet to allow for vehicle turnaround. Following construction, the road would remain locked and closed to public entry, but would be available for occasional use by IPID.

An option involving overland transport of equipment and materials into the Alpine Lakes Wilderness to the dam is no longer being considered, see Section 2.8*, Alternatives Considered but Not Carried Forward*.

As described, two approaches to helicopter use are being considered due to helicopter cost and availability, as well as to evaluate the anticipated number of trips and potential noise generated. The two options for construction access are described in more detail below.

Option 1: Heavy-Lift Helicopter with Limited Use of Small Helicopter throughout Construction

This option would use a heavy-lift helicopter to transport the excavator, other equipment, and supplies to the site on Special Warranty Deed land at the beginning of the construction period. It would require a staging area of approximately 10,000 square feet. Dam Alternatives 1 and 3 would require approximately 70 trips using the heavy-lift helicopter, and Alternative 2 would require approximately 105 trips. The location and size of the staging area vary with the dam alternatives as described below in Section 2.7.2. The drop zone at the lake for materials and equipment would be on the existing spillway of the dam.

The administrative use-only portion of FSR 7601-116 would be used to bring additional supplies and personnel closer to the boundary of the wilderness, and terminates near the boundary of the Inventoried Roadless Area. Supplies would be transported the remainder of the way on foot. A small helicopter would be used on an as-needed basis to bring in heavy materials that were not anticipated. This could require approximately 20 trips with the small helicopter. Flights by the smaller helicopter would be on an as-needed basis and would likely take place between the hours of 7:00 a.m. and 6:00 p.m.

At the end of construction, approximately 11 trips using the heavy-lift helicopter would be required to remove equipment and waste materials.

Option 2: Limited Use of Heavy-Lift Helicopter with Small Helicopter Use for the Majority of Materials

This option would be to use a heavy-lift helicopter to transport the excavator, other equipment, and a portion of the supplies to the site at the beginning of the construction period. This would take approximately 20 trips over 2 days. After the initial trips with the heavy-lift helicopter, the smaller helicopter would make approximately 245 trips to deliver other supplies over the duration of the project construction. Helicopter flights would likely take place between the hours of 7:00 a.m. and 6:00 p.m. during weekdays. This option would allow the staging area to be approximately 15 percent smaller than the other option (roughly 8,500 square feet), because materials would be brought in as needed rather than all at once at the outset.

The administrative use-only portion of restored FSR 7601-116 would be used to bring additional supplies and personnel closer to the boundary of the wilderness. They would be transported the remainder of the way on-foot.

At the end of construction, approximately 11 trips using the heavy-lift helicopter would be required to remove equipment and waste materials.

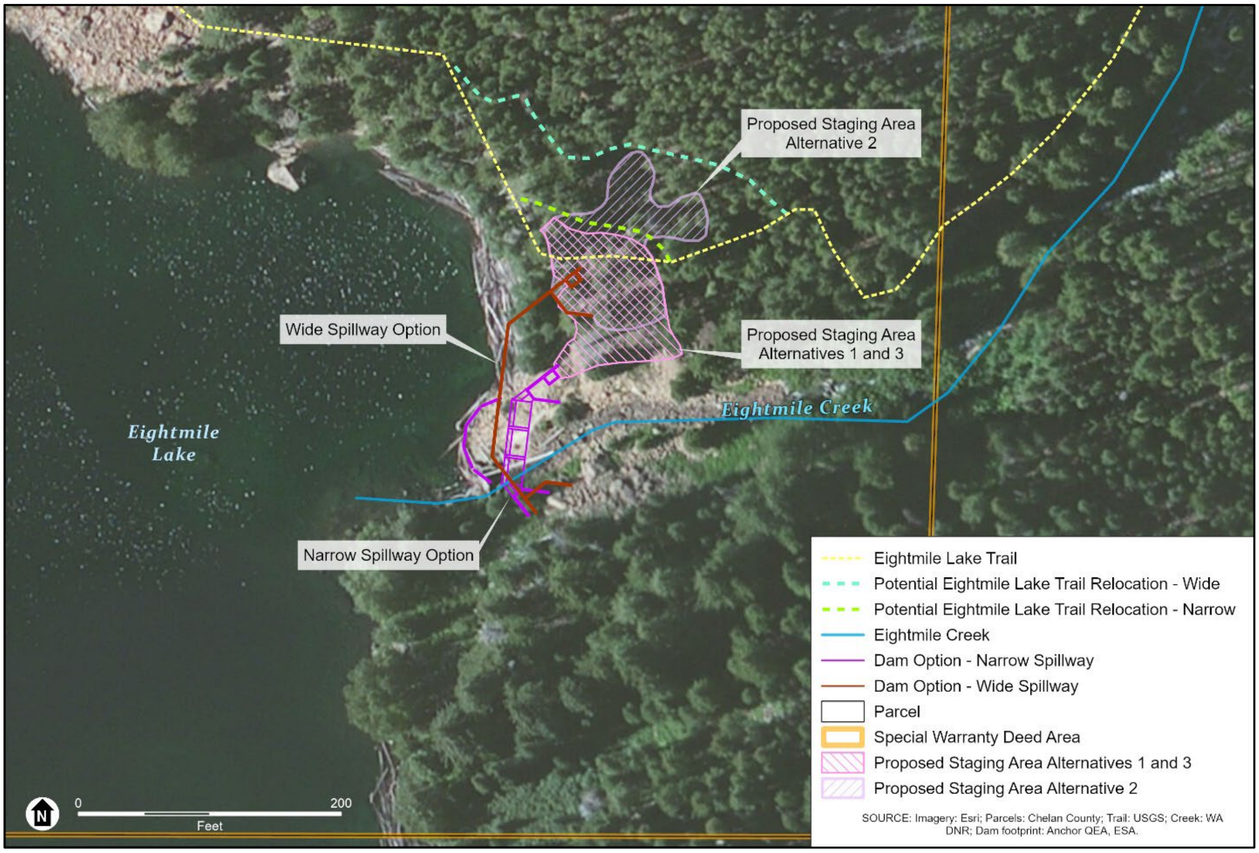
2.7.2 Dam Construction

All construction activities would occur within the Special Warranty Deed Area, including camping by personnel. Preparation of the site for dam construction would begin in mid-June or as soon as the snow conditions allow. Site preparation would include the installation of temporary erosion controls, clearing (including removal of up to 30 trees), leveling of the staging area using the existing excavator on-site, and removal of wood and debris from the lake edge within the work area. Trees would be felled using a chainsaw; the larger felled trees would be used to support and level the staging and work area. Excess limbs, trees, and wood debris would be burned on-site in accordance with Forest Service protocols, as is currently done with logs and debris that collect at the dam each year. The size of the staging area would vary by alternative, with Alternative 2 requiring the largest volume of materials to be stored on-site and therefore the largest staging area. An approximate 150- to 300-foot segment of the Eightmile Lake Trail located on the Special Warranty Deed parcel would be temporarily re-routed around the active construction and staging area to ensure hiker safety near the active construction zone. Figure 2-13 shows the staging area and possible trail relocation alignments.

Excavation work to install the new outlet pipe would begin when the lake level is below elevation 4,661 feet, at which point Eightmile Creek would be dry. For the construction year, the low-level outlet pipe will be left open at the lake so that the water level draws down as early in the summer as possible to facilitate construction. Once the lake elevation drops below 4,650 feet, the new outlet pipe would be installed. Water would exit the lake via the newly installed outlet pipe throughout construction. Once the new outlet pipe is installed, cofferdams would be installed, and the existing dam structure and outlet pipe would be removed. Pumps would be used to dewater work areas as needed. Cofferdams would be constructed using large bulk bags, which will also be used to ferry items up to the lake.

Construction of the dam would take approximately 4 to 5 months depending on the alternative and weather conditions. Dam construction methods will depend on the contractor and alternative but generally entail excavation for footings, pouring of concrete for the dam structures including the core wall, backfilling and placement of riprap, and installing gates, if applicable.

Figure 2-13. Dam Construction Staging Area



Based on geologic information collected to date, blasting with explosives is not expected to be needed for the project. However, because there is still a possibility of encountering rock that is larger than the excavator can move or break up, blasting is being covered in this EIS as a contingency. “Boulder Busters” are anticipated for use to break up smaller rocks, if needed. A Boulder Buster is a small cartridge-type tool that can be used safely to break the rocks into manageable sizes. If larger boulders are encountered, other more powerful blasting methods using explosives would be needed. Blasting with explosives is not anticipated but may be needed as part of construction if rocks larger than 10 feet in diameter are encountered. Blasting with explosives, if necessary, would likely occur over 1 or 2 days and involve a temporary trail closure, and generate a high level of noise for a brief period during the day of blasting. A blasting contractor would be called in, and would make the final determination on safety measures. The Forest Service would be notified, and safety measures would be put in place to prevent wilderness users from being injured by blasting. Safety measures would include excluding users from the area near the construction, and use of blasting mats to prevent flyrock, and limit noise and dust. Blasting with explosives is an allowed use in a wilderness. IPID has identified the following measures that would be implemented if blasting with explosives is required:

- Advance notice of 1 week would be provided to the Forest Service, and IPID would assist with descriptions of any required closure dates and times.
- IPID would establish a safety zone, which is not expected to exceed a 750-foot radius around the work site.

- Temporary trail closure would be required during the blast window, which would occur only on weekdays between 11 a.m. and 3 p.m. Blasting would be scheduled for mid-week (Tuesday–Thursday), if feasible.
- IPID would provide personnel at the trailhead, Caroline Lake Trail junction, and the camping area on the north side of Eightmile Lake.
- During closure of the safety zone, the lower portion of Eightmile Lake Trail would remain open to the Caroline Lake Trail junction, and the camping area, latrine area, and trail uphill from the camping area would also remain open.
- IPID would assist the Forest Service with project description and schedule information to be distributed in January preceding construction for people participating in the lottery for campsite permits.

When dam construction work begins, up to six construction workers would be needed. Construction workers would camp at the site during the work week. In addition, periodic visits would be made by inspectors, Forest Service personnel, and others overseeing the project.

Timing Restrictions

Typically, the lake is drawn down beginning July 1, when IPID releases water to maintain irrigation water supply. However, during the year that the improvements are constructed, IPID will need to manage its other reservoirs to allow for early drawdown of Eightmile Lake. The drawdown will still be constrained by the natural hydrologic cycle. If there is above-average snowpack and cool spring weather, the lake may still be capturing natural runoff well into late June or early July even after releases from the dam have started.

Because of the location and elevation of Eightmile Lake, snow often begins to fall in October, although substantial snow accumulation typically does not occur until November. Freezing weather may occur much earlier in the fall. In addition, October rain can impact the lake level and the ability to keep the site dry for construction. Construction would need to be managed so that the project is substantially complete before significant snow accumulation or extended freezing weather occurs.

Work to improve and restore FSR 7601-116 may take place somewhat earlier in the year since the improvements would occur at a lower elevation and the snow melts earlier in the year, allowing access to the road for improvements.

Overwintering

Every effort would be made to complete the dam construction in one season. If construction could not be completed in one season, actions would be taken to secure the dam for overwintering. Areas that could be overtopped would be secured and stabilized (hardened) with rock. All equipment would be stored on-site or removed if feasible. The outlet pipe would be in working order, and the lake would be held at the lowest level (elevation 4,632 feet) for the winter.

Should it be needed, a contingency plan for overwintering will be developed by IPID and reviewed by DSO. The following requirements are anticipated:

- The low-level outlet pipeline/siphon would be constructed first and remain open through construction (including through the winter if construction requires more than one season). The outlet pipe will not be sized to convey the full winter/spring discharge rate from the lake, so the lake would fill through the winter/spring up to wherever the dam crest is when construction is paused for the winter and would need to have a safe path to spill downstream.
- Backfill would be placed to the top elevation of whatever portion of the dam has been constructed by the time the work is paused for the winter.

- Rock armoring would be placed over all disturbed areas, including any portion of the flow path/stream channel downstream of the dam. Armoring will be at least 18 inches thick, or as determined by the dam design engineer, similar to the way it would be over the finished surface of the dam.
- Stockpiled materials would be moved to a staging area well above the crest of the unfinished dam (within the footprint depicted on Figure 2-13) and covered with plastic/secured for the winter.
- Cofferdams would remain in place, and perhaps be supplemented to keep water out of the work area as much as possible.

Project Closeout and Restoration

After construction is completed, all supplies, construction waste, and equipment, including the existing excavator at the site, would be removed with a heavy-lift helicopter. The area around the site disturbed by the work, or used for construction staging, and the temporary trail reroute would be restored. The staging area would be regraded to a more natural terrain, and the logs used for staging would be burned on-site in accordance with Forest Service protocols, as is currently done with material that collects at the dam each year.

Native vegetation would be replanted in disturbed areas as appropriate, following a plan approved by the Forest Service. Vegetation management would include the removal and monitoring of noxious weeds disturbed by the project.

2.8 Alternatives Considered but Not Carried Forward

As part of the dam design development, several dam alternative configurations and construction methodologies were initially considered and then removed from further consideration, as discussed below.

2.8.1 Alternative Dam Configurations

The design of improvements to the dam and related infrastructure at Eightmile Lake has considered a wide range of potential configurations. Four alternatives, as described in Sections 2.2 through 2.5, are considered as part of this EIS. Other alternatives that were considered during different stages of design development but were removed from further consideration in this EIS include the following:

- Appraisal Study Options 1 through 4: The original improvement concepts considered by the *Eightmile Lake Storage Restoration Appraisal Study* (Aspect Consulting and Anchor QEA 2015) included the following:
  - Option 1 – This option involved replacing the existing dam with a rock-faced concrete structure with a spillway elevation of 4,671 feet. The existing low-level outlet pipe would have been replaced with a siphon designed to draw the lake down to an elevation of 4,636 feet. This option was designed to increase the active storage capacity of Eightmile Lake to 2,000 acre-feet.
  - Option 2 – This option involved replacing the existing dam with a rock-faced concrete structure with a spillway elevation of 4,671 feet. The existing low-level outlet pipe would have been replaced with a siphon designed to draw the lake down to an elevation of 4,621 feet. This option was designed to increase the active storage capacity of Eightmile Lake to 2,500 acre-feet.

- **Option 3** – This option involved replacing the existing dam with a rock-faced concrete structure with a spillway elevation of 4,672 feet, which is 1 foot higher than the historical spillway elevation. The existing low-level outlet pipe would have been replaced with a siphon designed to draw the lake down to an elevation of 4,625 feet. This option was designed to increase the active storage capacity of Eightmile Lake to 2,500 acre-feet.
- **Option 4** – This option involved replacing the existing dam with a rock-faced concrete structure with a spillway elevation of 4,682 feet, which is 11 feet higher than the historical spillway elevation. The existing low-level outlet pipe would have been replaced with a siphon designed to draw the lake down to an elevation of 4,619 feet. This option was designed to increase the active storage capacity of Eightmile Lake to 3,500 acre-feet.

These options were developed only to the concept level for the Appraisal Study and were not reviewed for technical feasibility as part of that study, nor were they sent to DSO for review. These options were removed from consideration or replaced with revised alternatives as design development progressed. Options 3 and 4, which would have raised the spillway elevation at Eightmile Lake, were determined through additional study to not likely be feasible and were removed from further consideration. The general concepts introduced as part of Options 1 and 2 were revised as the design progressed and evaluated further as part of the *Eightmile Lake Storage Restoration Feasibility Study* (Anchor QEA 2018a).

- **Feasibility Study Alternatives Considered** – The Eightmile Lake Storage Restoration Feasibility Study included more detailed design evaluations, hydraulic calculations, and spillway sizing to refine and develop the concepts introduced during the Appraisal Study. Two different design configurations were considered and preliminary designs were developed for a preferred alternative, as follows:
  - **Gabion Baskets** – During the development of the Feasibility Study, an alternative configuration was considered that consisted entirely of gabion baskets with an upstream geomembrane liner, rather than relying on concrete as an impermeable layer within the dam.
  - **Feasibility Study Design** – Ultimately, a design configuration was provided with the Feasibility Study that included a concrete core wall with gabion baskets included to harden the spillway downstream of the concrete wall. No gates were considered, although a notch with stoplog control was included, similar to the notch in the existing dam. This alternative involved replacing the existing dam with a concrete and gabion structure with a spillway elevation of 4,671 feet. The existing low-level outlet pipe would have been replaced with a siphon designed to draw the lake down to an elevation of 4,621 feet, with an active storage capacity of 2,500 acre-feet.
- **Preliminary (30 percent Complete) Design Alternatives** – The preferred alternative from the Feasibility Study was reviewed with DSO. Additional analyses were performed to refine the design based on input from DSO and updated information collected to support the design. This effort resulted in development of Preliminary (30 percent complete) Design Drawings that reflected a preferred design alternative and two additional alternatives. The alternatives considered in this EIS represent variations on these alternatives:
  - **Preferred Alternative** – The preferred design configuration developed to the preliminary (30 percent complete) level included an early version of the Narrow Spillway with Gates Alternative (Alternative 1) considered in this EIS. The alternative included a narrow spillway with hard spillway crest elevation of 4,667 feet and automatic gates that would enable the WSEL to be raised to an elevation of 4,671 feet. The primary difference between this alternative and Alternative 1 considered in this EIS is that it would have replaced the low-level outlet pipe with a siphon designed to draw the lake down to an

elevation of 4,621 feet. This would have resulted in an active storage capacity of 2,500 acre-feet, but the siphon pipeline would have extended beyond the boundary of the Special Warranty Deed Area.

  - **Alternative 2A** – This was developed as an alternative to the preferred alternative without gates to control flow over the spillway and represents an early version of the Wide Spillway without Gates Alternative (Alternative 2) considered in this EIS. The alternative included a wide spillway with a crest elevation of 4,671 feet. The primary difference between this alternative and Alternative 2 considered in this EIS is that it would have replaced the low-level outlet pipe with a siphon designed to draw the lake down to an elevation of 4,621 feet. This would have resulted in an active storage capacity of 2,500 acre-feet, but the siphon pipeline would have extended beyond the boundary of the Special Warranty Deed Area.
  - **Alternative 2B** – This was developed as a variation on Alternative 2A to answer the question of how the sizing of the dam would be impacted if the spillway elevation were lowered 2 feet. This alternative included a concrete structure with a 100-foot-wide primary spillway with a crest elevation of 4,669 feet. No gates would be provided to control flow over the spillway. The low-level outlet pipe with a siphon was designed to draw the lake down to an elevation of 4,621 feet. This would have resulted in an active storage capacity of 2,344 acre-feet, but the siphon pipeline would have extended beyond the boundary of the Special Warranty Deed Area.

- **Other Design Alternatives Considered**
  - **Gate Options** – Several different automatic gate options were considered for inclusion in the Narrow Spillway with Gates Alternative (Alternative 1) considered in this EIS. Those options included a custom-designed metal gate with hinges powered by a motor with cables and pulleys, a fabricated gate that would be operated with mechanical hoists with cables, and hydraulically operated gates. The current option being considered for this alternative would include steel gates that are pneumatically controlled by air-filled bladders operated with a compressor based on the water level in the lake. Other options may be viable but are not included because of cost or technical feasibility. DSO has expressed concern about a custom-designed gate that does not have a proven track record of automatic operation to control water levels.
  - **Dam Removal** – Comments received in response to scoping suggested evaluation of an alternative that would include complete removal of the dam. As noted previously, if no action were taken to improve the dam to meet DSO's requirements for dam safety, DSO would eventually exercise enforcement actions in accordance with WAC 173-175-620(3). It is not possible at this time to predict with more certainty what that action(s) or its effects would be. However, such potential actions could require heavy equipment and work similar in magnitude to what would be required to replace the existing dam. It is possible that the action could result in the lake WSEL being permanently lowered to the elevation of the existing low-level outlet (~4,648 feet). Depending upon the potential action, the lake may no longer be usable as storage for IPID and would not meet IPID's operational and water delivery needs.

2.8.2 Overland Vehicle Transport

Motorized transport over land through the Alpine Lakes Wilderness was initially considered but is not analyzed in the EIS because IPID acknowledged that air transport would be preferable to both wilderness users and proponents. As a result of comments received during scoping, this construction method has been removed from further consideration. Should helicopter transport be infeasible due to an unanticipated need for additional, heavy materials (such as rocks) or heavy equipment, IPID would need to reconsider using overland transport through the wilderness area. Should overland transport be needed, additional environmental review and approval from the Forest Service would be needed beyond what is being conducted as part of this EIS.

2.8.3 Pack Animals

Transportation of materials and equipment using pack animals to the dam site was considered, but determined infeasible due to the amount, weight, and elevation gain to the dam site. Pack animals could not transport nor take an excavator or other heavy equipment to the site, so the on-site excavator would be the only piece of heavy construction equipment available. Because of its limited size and lifting capacity, use of this excavator would entail blasting and a slower work process on the dam, likely extending the construction work to two seasons and closing trails for extended periods of time.

Delivering 332 to 545 cubic yards of premixed concrete in 80-pound bags would require 7,500–12,250 trips (2 sacks/160 lbs. per animal per trip). In addition, several tons of steel rebar, pipe, and other supplies would be required. Moving the concrete up to the dam site alone would take 208–340 days with two teams working (36 animal roundtrips per day), which would extend construction to multiple seasons. Increasing the number of teams would create congestion on the trail, and result in destruction and erosion to the trail. Animal waste would need to be collected and removed from the wilderness.

Approximately 465–490 feet of 24- and 30-inch diameter high density polyethylene pipe would have to be cut in short enough sections to allow transport by animals, which would require additional time and materials to butt-fuse the pipe together at the site. Concrete mixing would have to be conducted by hand unless a small mixer could be towed up by the pack animals.

The use of pack animals to transport materials to the site is not practical, and the use of pack animals has been removed from further consideration in the EIS.

2.8.4 Municipal Supply

The City of Leavenworth has been seeking to increase its continuous, or uninterruptible, water rights, primarily through a lawsuit against Ecology concerning the interpretation of historical water rights allotments (*City of Leavenworth v. Department of Ecology*, parties entered settlement agreement in November 2023 but continue to seek water supply solutions). Ecology considered the possibility of transferring some portion of water available from the rebuild of Eightmile Dam to the city to resolve this lawsuit. This would occur through releasing some stored water to augment instream flows for mitigation of new out-of-stream uses, including for municipal water supply purposes by the City of Leavenworth. During the scoping process, several comments were received expressing concern over water from the Alpine Lakes Wilderness being used for municipal supply purposes. Based on such comments, Ecology has determined that water will not be made available for instream flow purposes for the mitigation of new out-of-stream uses, including municipal water supply use.

CHAPTER 3: WILDERNESS CHARACTER

What has Changed from the Draft EIS?

- A copy of the Special Warranty Deed has been included as Appendix E to the Final EIS.
- Clarifications have been made to the noise associated with the gate operation for Alternative 1.
- Figure 3-1 was revised to correct the study area boundary.
- Responses to specific comments on wilderness character are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key Findings for Wilderness Character

- Construction would affect wilderness character by drawing down the lake, reducing vegetation, and causing mechanical noise over one summer construction season.
- Operation of any action alternative would affect wilderness character by continuing water level manipulation and creating a more developed appearance at the dam.
- Alternative 1 would facilitate more manipulation of water level than would the other action alternatives, and would include more conspicuous man-made elements in the dam, particularly the inflatable gates.
- Alternative 2 would require more material and time to construct, and have a larger footprint area than the other action alternatives, particularly the secondary spillway that would be armored with rock and must be kept clear of trees.
- Alternative 3 would have the same footprint area as Alternative 1, would have fewer conspicuous man-made elements (no gates), and would not allow as much water storage and ease of water level manipulation as Alternative 1.
- The No Action Alternative would not result in any direct change to the wilderness but could risk failure of the dam and/or trigger enforcement action by DSO, which would have temporary impacts on the natural and undeveloped character of the wilderness but would reduce trammeling due to the dam.
- None of the action alternatives would significantly impact wilderness qualities due to the limited scale and duration of construction, and limited scale and severity of the operational impacts compared to existing conditions at Eightmile Lake.
- The operation and maintenance of the existing dam impairs some qualities of wilderness character called for by the Wilderness Act (see Section 3.1.2, *Qualities of Wilderness Character*) but is authorized by the Special Warranty Deed.
- The dam was built and in operation before the designation of the Alpine Lakes Limited Area and Alpine Lakes Wilderness.

The project is located within the Alpine Lakes Wilderness of the Okanogan-Wenatchee National Forest (**Figure 3-1;** see Figure 1.1 for a vicinity map showing the region). In 1946, 256,000 acres within the central Cascades were designated as the Alpine Lakes Limited Area by the Pacific Northwest Forester, but mineral extraction activities were allowed (USFS 1981). In 1976, 306,934 acres were designated by congress and signed into law by President Gerald Ford as the Alpine Lakes Wilderness, with 86,426 acres of land to be included after the acquisition of private lands within the wilderness boundary (USFS 1981). The Alpine Lakes Wilderness was expanded again in 2014 and now contains 414,000 acres (Wilderness.net 2022).Motorized equipment, motor vehicles, mechanical transport, temporary roads, permanent structures, or installations are not generally allowed in designated wilderness areas. Wilderness areas are to be primarily affected by the forces of nature, although the Wilderness Act does acknowledge the need to provide for human health and safety, protect private property, control insect infestations, and fight fires within the area. The Wilderness Act also contains provisions that allow pre-existing uses to remain under certain conditions.

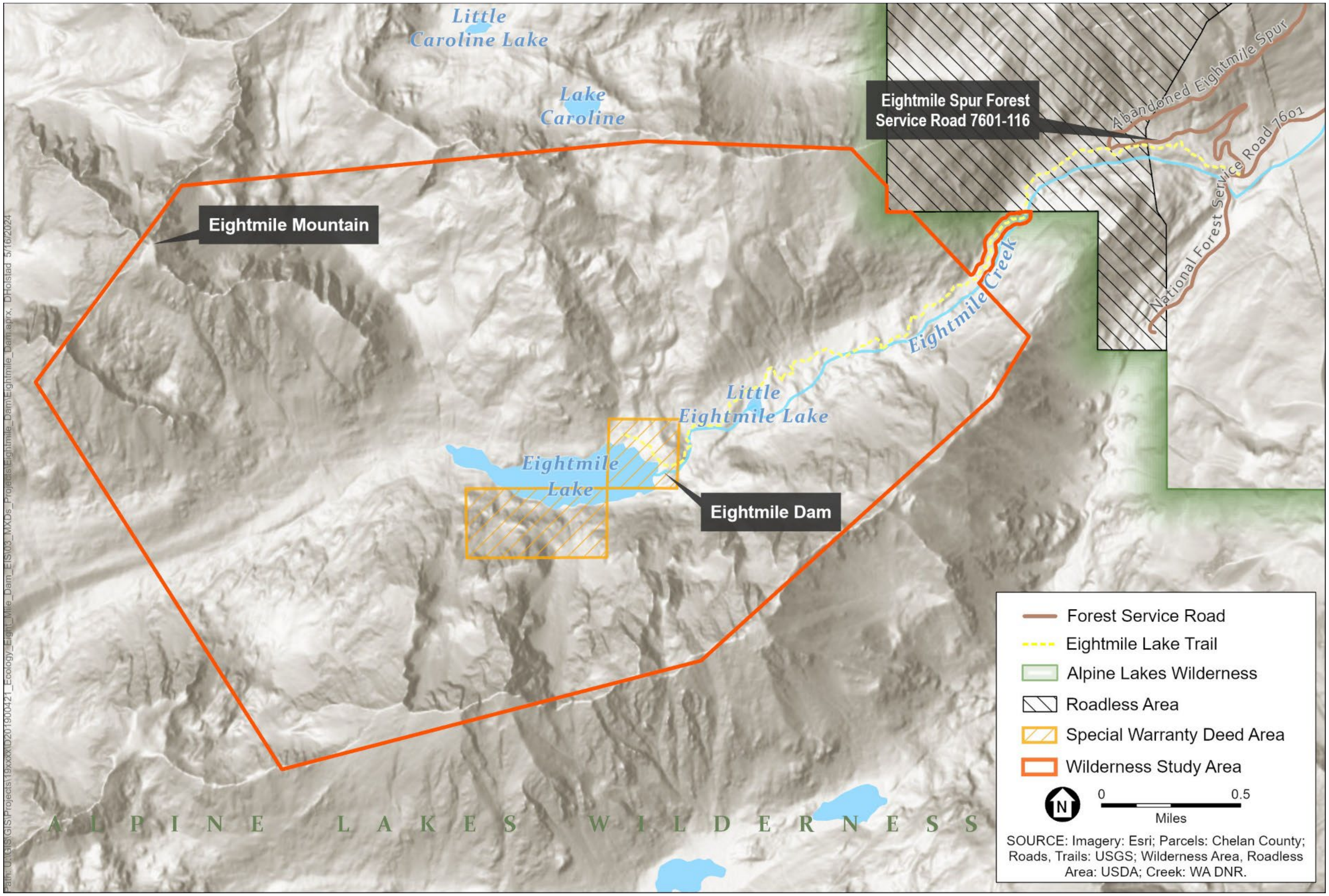
The Alpine Lakes Area Management Act of 1976 is to "…*provide for public outdoor recreation and use and for economic utilization of commercial forest lands, geological features, lakes, streams and other resources in the Central Cascade Mountains of Washington State by present and future generations …*" The project site is within the Enchantment Permit Area, a portion of the Alpine Lakes Wilderness in which permits are required for overnight camping, due to heavy recreational use of the area.

Designated wilderness is the highest level of conservation protection for federal lands, and is defined as: "*an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain.*" (Wilderness Act Section 2c)

IPID built Eightmile Dam nearly 100 years ago, before the designation of the Alpine Lakes Wilderness. The dam is at the east end of the lake, approximately 1.6 miles inside the wilderness boundary (Figure 3-1). Eightmile Dam and some of the inundated bed and shore of Eightmile Lake are on two parcels of land (120 acres) subject to a Special Warranty Deed. Through the Special Warranty Deed, IPID retained certain rights through the land exchange with the Forest Service in 1990 after the creation of the Alpine Lakes Wilderness (see Chapter 2). The Special Warranty Deed (see map in Figure 1-2) reserves IPID's rights to maintain and operate the dam and exercise their water rights. A copy of the Special Warranty Deed is included in Appendix E. (See Chapter 2 and Appendix E for discussion of the Special Warranty Deed.) These "reservations" explicitly allow uses (motorized transportation and equipment or aircraft) otherwise prohibited by the Wilderness Act. The Deed includes the following description of the rights it reserves:

> *"… a nonexclusive, perpetual easement across, through, along, and upon the property described herein for the purposes of maintenance, repair, operation, modification, upgrading and replacement of all facilities presently located in or upon the property described herein, together with a nonexclusive right of ingress to and egress from all such facilities for all such purposes, in accordance with Rules and Regulations of the Secretary of Agriculture, 36 CFR 251.17 and 251.18, attached hereto and made a part hereof, in such manner as not unreasonably to interfere with its use by the United States, its authorized users or assigns, or cause substantial injury thereto.*
>
> *The Grantor [IPID] may exercise the rights hereunder by any means reasonable for the purposes described, including but not limited to the use of motorized transportation and equipment, or aircraft. These rights include the right to regulate water level of all facilities located upon the property described herein. In performing maintenance, repair, operation, modification, upgrading and replacement of facilities located in or upon the property described herein, the Grantor will not without prior written consent of the Forest Service, which consent shall not unreasonably be withheld, materially increase the size or scope of the facilities."*

Figure 3-1. Study Area for Wilderness Character Analysis



As described in Chapter 1, IPID proposes to rebuild the Eightmile Dam to meet current safety standards. To rebuild and restore the dam, IPID will need to access the dam site, on Special Warranty Deed land, which includes traveling and transporting people and equipment into the Alpine Lakes Wilderness.

The high-water level established by the dam was originally 4,671 feet above sea level. Due to multiple factors (for example IPID's management of water levels, erosion of the dam, etc.), the high-water level at present–and for the past several years–is approximately 4,667 feet, when the lake is approximately 76.6 acres in area. An outlet pipe allows drawdown of the lake without pumping to a water level of 4,648 feet, and seepage allows the lake to fall as low as elevation 4,640 feet. (See Chapter 2 for additional details on lake levels.)

The project site would be accessed by helicopter and on land, via the Eightmile Lake Trail. The Eightmile Lake Trail (3.3 miles) leads to Eightmile Lake and is one of two non-motorized National Forest System trails located in the vicinity of Eightmile Dam. The Eightmile Lake Trailhead is approximately 1.3 miles from the wilderness boundary (Figure 3-1).

3.1 Methodology

This section describes the methods used to analyze impacts on wilderness character. The analysis examines the cumulative impacts expected from the project (visual, noise, biological, and cultural resource) on wilderness character in the Alpine Lakes Wilderness, taking into account the provisions of the Special Warranty Deed.

3.1.1 Study Area

The study area for this analysis includes Eightmile Lake, the viewshed of the lake within the Alpine Lakes Wilderness, and the area within the wilderness where noise from construction would be audible. It includes areas both in and out of the Special Warranty Deed Area.

3.1.2 Qualities of Wilderness Character

Section 2(a) of the 1964 Wilderness Act states that wilderness areas should be managed to preserve their wilderness character. Although the act does not define "wilderness character," in *Keeping in Wild 2* the Interagency Wilderness Monitoring Team describes it as a:

> *"… holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature." (Landres et al. 2015)*

Together, these values help to define wilderness character and differentiate wilderness areas from other lands. These three ideals combine and form a subtle and complex set of relationships with the land, its users, stewards, and society. Managers of wilderness have developed five key qualities of wilderness character based on the statutory definition of wilderness as defined in Section 2(c) of the Wilderness Act (Landres et al. 2015). Those qualities include:

1. Untrammeled

In the Wilderness Act, wilderness is defined as "an area where the earth and its community of life are untrammeled by man," that "generally appears to have been affected primarily by the forces of nature" and "retains its primeval character and influence." The untrammeled quality is the level to which wilderness is unhindered and free from modern human control or manipulation. The untrammeled quality is preserved when actions to manipulate or control ecological systems within the wilderness are absent. Activities to control ecological systems include, but are not limited to, stocking lakes with fish, fire suppression, removing predators, and installing water catchment features. This quality is greatly improved when efforts to modify or suppress habitat are stopped or greatly reduced (Landres et al. 2015).

2. Natural

The Wilderness Act states that wilderness is "*protected and managed so as to preserve its natural conditions.*" The natural quality is defined as ecological systems within the wilderness that are sustainably free from the effects of people and modern society. This quality is directly related to the "*biophysical environments primarily free from modern human manipulation and impact*" described under the definition of wilderness character. The natural quality of an environment is preserved when only Indigenous plant species and natural ecological functions are present. This quality also may be improved by restoring ecological conditions or by removing non-native species (Landres et al. 2015).

3. Undeveloped

The Wilderness Act defines wilderness in Section 2(c) as "*an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation*," with "*the imprint of man's work substantially unnoticeable*." The undeveloped quality implies that wilderness is without any permanent improvements or modern human occupation. The Wilderness Act also states in section 4(c) that "*there should be no temporary road, no use of motor vehicles, no landing of aircrafts, no other form of mechanical transport, and no other structure or installation*" within wilderness areas. However, it should be noted that very few wilderness areas in the United States are free from modification and modern human occupation. Many developments in wilderness areas (such as buildings, dams, roads, power lines, mines, water pipe corridors, and aircraft landing strips) have been allowed under special provisions. The presence of these structures and developments can have impacts on wilderness character, as the undeveloped quality is degraded by the presence of non-recreational structures and by the use of motorized vehicles and equipment because it increases the ability of human modification and habitation of the environment (Landres et al. 2015).

4. Solitude or Primitive and Unconfined Recreation

Section 2(c) of the Wilderness Act states that wilderness has "*outstanding opportunities for solitude or a primitive and unconfined type or recreation*." These attributes can be defined as followed:

- Solitude refers to few encounters with other people and opportunities for privacy, isolation, and self-paced activities without the distractions of modern society.
- Primitive recreation has been interpreted as travel though wilderness that relies on personal skill and does not involve mechanization (hiking, walking, horseback riding).
- Unconfined recreation provides the opportunity for self-discovery, exploration, and freedom from societal or managerial controls.

This quality of wilderness can be degraded by aspects that reduce these opportunities, including encounters with other visitors, recreational facilities, management restrictions, and other signs or modern civilization (Landres et al. 2015).

5. Other Features of Value

Other features of values are those attributes of wilderness that are not covered by the other four qualities listed above. These could include paleontological and cultural resources as well as other educational, scientific, scenic, or historical features that add value to the wilderness character of an area. Currently, the Forest Service has not designated any "other features of value" within the study area (USFS 2021a).

3.1.3 Determining Impacts

This analysis considers impacts on wilderness quality from construction and operation. Construction impacts include impacts during construction that would detract from the wilderness character in the study area, taking into account visual, noise, and other effects of human activity associated with the construction of the project, individually and cumulatively. Operational impacts include permanent or long-lasting impacts that would detract from the wilderness character in the study area, taking into account visual, noise, and other effects of human activity associated with the operation of the project, individually and cumulatively.

For the evaluation of impacts in this chapter, impacts are considered significant, as follows:

- Significant Impact: Impacts would be considered significant if the project would substantially increase trammeling in the Alpine Lakes Wilderness, reduce naturalness, increase development, or reduce opportunities for solitude and unconfined recreation.

3.2 Regulatory Context

Wilderness character within the study area is protected by a variety of federal laws, plans, and policies that promote the preservation of wilderness character. The applicable laws and policies are listed in Table 3-1.

Table 3-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
Wilderness Act 1964 (43 CFR Part 19)	The Wilderness Act created the National Wilderness Preservation System and provides the highest level of conservation protection of federal lands. The purpose of the Act is to manage wilderness areas to preserve and, where possible, to restore their wilderness character.
National Wilderness Preservation System	Designates more than 111 million acres of protected wilderness areas in the United States for enjoyment of the public.
Alpine Lakes Area Management Act of 1976 (Public Law 94-357)	This act designated the wilderness, an intended wilderness, and a management unit. This legislation recognized that there were valid existing rights within the area, which included the Eightmile Dam and other properties.
Alpine Lakes Area Land Management Plan 1981 (USFS 1981)	This plan provides direction for management of the Alpine Lakes Wilderness for recreation and economic utilization of the forest by present and future generations.
Alpine Lakes Wilderness regulations and restrictions	Describes regulations for recreation within the Alpine Lakes Wilderness, including, permit information, group size limitations, trail use, equipment restrictions, restoration areas, dog use and stock, camping, and fire restrictions.

3.3 Affected Environment

This section describes the existing wilderness character of the study area.

The Alpine Lakes Wilderness covers a 414,322-acre area in the North Cascade mountains that is dominated by a mix of forest zones, subalpine meadow communities, and alpine communities (Wilderness.net. 2022; Franklin and Dyrness 1973). It encompasses the headwaters of Icicle Creek, as well as several lakes and tributaries. In addition to Eightmile Lake, the lakes include Upper and Lower Snow Lakes, Nada Lake, Colchuck Lake, Klonaqua Lakes, and Square Lake. The tributaries to Icicle Creek include Eightmile, French, Leland, and Snow creeks. Of these, only Eightmile Creek is within the study area (Figure 3-1).

3.3.1 Wilderness Character

The existing wilderness character is described below in terms of the principal qualities of wilderness described in the Wilderness Act of 1964: untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined recreation (Landres et al. 2015). Because no other features of value have been identified, no analysis is provided for "other features."

Untrammeled

The Alpine Lakes Wilderness is affected by historic and current trammeling actions and impacts. There are six other lakes with dams not including Eightmile Lake. In addition, 40 percent of the lakes have been stocked with game fish, many of which were previously fishless (USFS 2021a).

Eightmile Lake is considered a "high lake," which means it was created by tectonic activity and glaciers and is in the high mountains. Past trammeling activities at Eightmile Lake include operation of the dam to manipulate the water storage and flow, and stocking the lake with fish. Manipulation of water levels during summer months is ongoing. The lake is no longer restocked with fish.

The dam was installed in 1929 to store water and release it as needed for use downstream for irrigation. Water levels are highest in the spring and early summer as the snow melts. Water is released in late summer and early fall. Water levels reach their lowest levels during drought periods.

The level of the lake is controlled by an outflow pipe that was installed beneath the dam and by the elevation of the spillway. Flow through the outflow pipe is shut off to force the lake to fill, then opened to release water as needed. The elevation of the intake for the outflow pipe establishes the lower limit that the lake level can be controlled without pumping. As currently configured, the lake covers approximately 41 acres at this low water level. Because of the geology, water can continue to seep and the lake can drop even lower. There is no exact record of the high-water elevation prior to construction of the dam. As originally designed at elevation 4,671 feet, the lake would cover approximately 81 acres at high water. After the dam was constructed, stop logs were placed in the dam each spring to raise the lake to elevation 4,671 feet, to store water for release later in the summer (Anchor QEA 2018a). However, erosion of the dam and current water management restrict the maximum water level to elevation 4,667 feet, which limits the maximum lake area to approximately 77 acres (Anchor QEA 2018a).

Maintenance at the dam includes the removal and burning of naturally occurring woody debris that accumulates near the dam. This maintenance occurs on the Special Warranty Deed parcels and typically includes the use of mechanized equipment such as chainsaws, and helicopter use for access to the site.

Eightmile Lake was previously stocked with trout, a manipulation of the environment for human use. Prior to the introduction of sport fish, Eightmile Lake likely lacked suitable spawning habitat or productive conditions for rearing juveniles, and like the majority of the high lakes, probably contained no fish (Wydoski and Whitney 2003). However, fish stocking has not occurred at the lake since 2005

(WDFW 2021a). Therefore, the only effect of this trammeling is the continued presence of trout in the lake.

The dam is a form of human manipulation of the water level and flow that existed prior to the establishment of the Alpine Lakes Wilderness, and its continued use is authorized by the Special Warranty Deed (refer to Chapter 2 for discussion of current operations). Assuming the dam was constructed no higher than the existing lake, the primary manipulation is that the dam slows the release of water in late spring and early summer, and increases flows during the drier months of late summer and early fall. These water level changes are often apparent by the “bathtub” ring left from when the water was held at a higher level. As noted, however, the condition prior to construction is not precisely known, in which case the trammeling may include an increase in the lake level.

Natural

The natural character of the Alpine Lakes Wilderness is largely preserved but has been disturbed by human activity, particularly camping and hiking that affect vegetation in high use areas. Within the Eightmile Creek Subbasin, there has been recent change due to wildfire (USFS 2021a). The Jack Creek Fire of 2017, started by a lightning strike, was a natural event that altered the character of the area surrounding Eightmile Lake (USFS 2017a). Prior to the fire, the area was dominated by conifer trees; the area is now dominated by snags, with surviving confers interspersed throughout the burned area. Several rare, sensitive, threatened, and endangered species are present in the study area, as discussed in Chapter 8, *Plants and Animals*.

The Alpine Lakes Area Land Management Plan established standards to protect the natural conditions and wilderness character of the area, as well as protection for the visitor experience (USFS 1981). These standards include locating recreational facilities such as trails and campsites in areas that minimize impacts on key interest features (lake and stream edges, scenic meadows, cultural sites, etc.) and sensitive areas; prohibiting the construction of permanent structures in areas that would detract from the natural landscape; and reducing the impacts of temporary man-made structures on the landscape by ensuring their designs incorporate natural form, lines, color, and textures.

As discussed under the “untrammeled” quality, the natural quality of wilderness character in the study area has been affected by the installation of the dam, which alters the lake’s water levels, and the historic stocking of the lake with trout.

Storing and releasing water in Eightmile Lake differs from the natural condition, but fluctuation of the water level is not new. Similar to other undammed lakes in the wilderness, the water level of Eightmile Lake likely fluctuated before it was dammed due to normal variation in rainfall and snowmelt. After installation of the dam, seasonal water level fluctuation continued, but the maximum level has been held until later in the summer, with the water level falling more slowly than in the natural condition. Due to the rocky shoreline, manipulation of water levels has generally not affected shoreline vegetation. One exception is at the west end of the lake. With the current lake full water level (elevation 4,667 feet) being lower than it may have been prior to the installation of the dam and to which the lake level was raised each spring after dam installation (elevation 4,671 feet), a lacustrine wetland has formed in the shallow and relatively flat area at the west end of the lake opposite from the dam, in an area that may have been open water at high water in the time before the dam was built, and which was inundated in the spring each year after the dam existed until it was eroded. Because existing dam affects the lake water level and flow downstream, Eightmile Lake and Eightmile Creek are not free from the effects of modern society.

Trout were not native to the lake but continue to inhabit it. Although fish are no longer stocked in the lake, these introduced fish still live in the lake and will likely persist there because the habitat to support them is intact. The fact that fish still live in the lake means the lake is not free from the effects of modern society, although in this case, the current condition may be sustainable without human intervention.

Recreational use has also affected the natural ecosystem. The Enchantment Permit Area, which includes Eightmile Lake, experiences heavy summer use by hikers and campers, and degradation of the natural conditions has been a concern for many years (USFS 2017b). Concerns include devegetation of camping and day use areas from trampling and associated soil erosion and compaction and improperly disposed of human waste, with associated impacts on water quality. Within the Okanogan-Wenatchee National Forest, some areas are closed for restoration to give the natural vegetation an opportunity to recover after years of heavy recreational use. Camping and walking in restoration areas are prohibited (USFS 2021b). At least one area near the northeastern shoreline of Eightmile Lake is closed for restoration.

Undeveloped

The Alpine Lakes Wilderness is largely undeveloped, as are Eightmile Lake and Eightmile Creek. The primary "imprint of man's work" evident throughout the Alpine Lakes Wilderness is the presence of Forest Service-maintained trails and trail signs, primitive latrines, and dispersed camping areas created by use. Campsites are unimproved, except for visitor improvements such as log or rock benches (USFS 2021c). Along the north side of the lake, just west of the Special Warranty Deed parcels, primitive campsites are available, and a limited number of Alpine Lakes Enchantment Permits are available for overnight use (see Chapter 10, *Recreational Resources,* for more information).

Within the Special Warranty Deed parcels, the project area is primarily undeveloped, except for the dam and associated communications devices. The dam covers less than a quarter of an acre and is composed of native rock, weathered concrete, and soil. It blends into the natural landscape when viewed from a distance. From the upstream side of the dam, which includes any views from the Eightmile Trail and the camp site, the dam structure is most prominent when water levels are low. When the lake is at its highest, a 4-foot-high portion is visible from the lake side, and that is often partially obscured with wood debris that accumulates near the dam. The most pronounced views are those from adjacent to the dam, which can be accessed by a spur trail. This trail and the dam are a common destination for day hikers. See Chapter 11, *Visual Resources*, for additional information about visual impacts, including visual simulations.

Emergency repairs to the dam in 2018 required the use of an excavator that was flown in by helicopter. Near the dam, evidence of the recent repairs to the dam are noticeable due to lighter colored rock on the armored embankment that has not yet weathered, and the presence of the excavator, which remains near the dam. (See Chapter 1 for additional information about the history of the dam.) Trees are not allowed to grow on the armored embankment to protect the integrity of the dam.

The dam does not include any motorized components, and the site is not accessible by motor vehicles. Motorized transport, including by helicopter, is prohibited in the wilderness with limited exceptions. The Forest Service has approved the use of helicopters for servicing six vault toilets in the Alpine Lakes Wilderness, which results in approximately 13 trips annually throughout the wilderness. The Forest Service has also allowed IPID to inspect its four dams using helicopter access, which has historically resulted in one trip annually. However, since the Jack Creek Fire in 2017, more than one trip per year has been required to inspect the Eightmile Dam (personal communication, A. Jantzer 2021). These are all flights that include landing in the wilderness, and would result in approximately 15 minutes of flight time each. IPID also occasionally flies over its dams to inspect them from the air, an activity not regulated by the Forest Service.

During extreme conditions, IPID has considered pumping water for irrigation supply; however, this option is only rarely considered due to the high cost of transporting pumps and fuel, and operation of pumps in such a remote location, as well as helicopter availability to transport equipment.

Other permanent human features within the Special Warranty Deed parcels include water level monitoring structures, the trail, recreational signs, and a backcountry latrine.

Solitude or Primitive and Unconfined Recreation

The Alpine Lakes Wilderness provides ample opportunity for solitude in its remotest areas. The Alpine Lakes Wilderness provides numerous opportunities for primitive and unconfined recreation, including hiking, backpacking, rock climbing, and fishing. No mechanized travel is allowed with the project area, and only primitive campsites are present. Helicopters are permitted in wilderness areas for authorized use only, including emergency situations, latrine transport, and FS approved operations. However, the Enchantment Permit Area is heavily used during summer months, and there are no restrictions on day use. Because of the relatively short distance to Eightmile Lake from the trailhead, day use is heavy, and campsites are nearly always fully reserved through the summer. Due to the popularity of day use, encounters with other groups are common, as are the sights and sound of others camped in the area (USFS 2022). See Chapter 10, *Recreational Resources,* for additional detail on recreational use.

The Forest Service has analyzed travel encounter data for each Wilderness Recreation Opportunity Spectrum (WROS) classification in the Enchantment Permit Area. WROSs are defined in the 1981 Alpine Lakes Area Land Management Plan and include four zones: transitional, semi-primitive, primitive, and trailless. The Eightmile Lake Trail, Snow Lakes Trail, and a portion of the Stuart Lake Trail are all transitional zones of the Enchantment Permit Area. The transitional zone has the lowest expectation of solitude and is usually located adjacent to major trailheads, where users make the transition from motorized to horse or foot travel and are first introduced into the wilderness. The Forest Service found that daily group encounters within this zone average 54 group encounters per day (USFS 2017b). See Chapter 10, *Recreation* for a description of other recreational zones within the Enchantment Permit Area.

Winter recreation within the project area is extremely limited due to the seasonal closure of FSR 7601 and the weather conditions of the area. The low number of users during this time of year indicates that opportunities for solitude are available.

Operation of the existing dam includes occasional trips by IPID personnel to the site to adjust the flow in the outlet pipe, to clear floating debris from the inlet and dam spillway, and other tasks, which often include the use of handheld motorized equipment, such as chainsaws. These activities occasionally include the use of a helicopter for access. When woody debris is removed, it is typically stacked and burned in the fall after the first snow. As described in Chapter 2, emergency repairs to the dam in 2018 were completed with use of an excavator, which has remained on-site since that date, in anticipation of future replacement of the dam. These types of activities affect solitude at the site and are retained rights under the Special Warranty Deed.

Other Features of Value

As previously noted, the Forest Service has not designated any other features of value within the study area (USFS 2021a).

3.4 Construction Impacts

This section describes how construction would affect wilderness qualities. It references other sections of this EIS for specific impacts including noise, water, recreation, and others. This section examines two options for transporting and staging construction materials, as well as the impacts on wilderness character from construction under the various dam alternatives.

The use of a Special Warranty Deed by IPID provides them retained rights that allow the use of motorized transportation, including aircraft and motorized equipment required to repair or maintain the dam, that would otherwise be prohibited by the Wilderness Act. Although authorized under the Wilderness Act [Section 4(c)], they can adversely affect wilderness qualities.

3.4.1 No Action Alternative

Under the No Action Alternative, no construction would occur; therefore, there would be no construction impacts on wilderness character. There would be a risk of dam failure, which could lead to additional emergency repairs. In addition, if DSO were to exercise enforcement action in accordance with WAC 173-175-620(3), impacts like those described for construction would occur. Abatement would likely require the use of helicopters for access. The duration of removal activities would be substantially shorter than for construction of any of the action alternatives.

3.4.2 Dam Construction

Construction Activities Common to All Action Alternatives

For any of the action alternatives, all construction, construction staging, and camping by personnel at the project site would occur within the Special Warranty Deed Area. Site preparation would begin as soon as permits for the project are issued, and snow conditions allow. Personnel would walk to the site using the Eightmile Lake Trail, both within the Alpine Lakes Wilderness and outside of it. Up to six construction personnel would camp at the project site for the duration of construction. Inspectors and other personnel would make day hikes to the site periodically throughout construction.

A staging area would be established next to the existing dam. This would require temporary relocation of the Eightmile Lake Trail to ensure hiker safety near the active construction zone (see Figure 2-13). Site preparation would include the installation of temporary erosion controls, clearing and leveling of the staging area (including removal of up to 30 trees and all ground cover), and removal of wood and debris from the lake edge within the work area. Excess limbs and wood debris would be burned on-site in accordance with Forest Service protocols.

The lake level would be lowered to allow removal of the existing dam and outflow pipe. Cofferdams made of large bulk bags would be used to constrict water flow, and pumping would be necessary to keep the construction area dry.

Excavators and other equipment such as boulder busters would be used to move rock and earth to construct the dam. Based on geologic information collected to date, blasting with explosives is not expected to be needed for the project. However, because there is still a possibility of encountering rock that is larger than the excavator can move or break up, blasting is being covered in this EIS as a contingency. If needed, blasting with explosives would occur in a single day, involve a temporary trail closure, and generate a high level of noise for a brief period during the day of blasting. A blasting contractor would be called in, likely taking at least one week to schedule. The Forest Service would be notified, and safety measures would be put in place to prevent wilderness users from being injured by blasting. Safety measures would include excluding users from the area near the construction, and use of blasting mats to prevent flyrock, and limit noise and dust. Blasting with explosives is an allowed use in a wilderness.

Access would also include helicopter flights from a fly yard outside of the Alpine Lakes Wilderness to the project site. Section 3.4.3 discusses two options for helicopter use.

After construction of the dam, the staging area and other areas disturbed during construction will be restored with native vegetation. The trail detour would be closed and restored, and the trail routed back to its current location.

Construction would adversely affect all four qualities of wilderness character. Construction would increase human intervention in the landscape (trammeling); alter natural conditions (lake level, streamflow, vegetative cover); increase the area that appears developed; and affect the solitude of recreationists for an entire summer season, with the possibility of extending into a second season.

Construction Activities that Differ Among Action Alternatives

A larger staging area would be required to construct Alternative 2 than would be required for Alternatives 1 and 3, because Alternative 2 requires a larger quantity of concrete and materials. Figure 2-13 shows the staging area and possible trail relocation alignments. While blasting with explosives could occur with any action alternative, the likelihood of blasting may be slightly greater under Alternative 2 because the dam structure is larger and more excavation is required.

Potential construction impacts on wilderness character for all action alternatives are summarized in Table 3-2.

Table 3-2. Summary of the Effects of Dam Construction on Wilderness Character, by Alternative

Wilderness Quality	Alternatives 1 and 3	Alternative 2
Untrammeled	Lowering of lake level for the entire construction season.	Lowering of lake level for the entire construction season.
Natural	Removal of trees, stumps and ground cover for staging area and relocated trail. Leveling of staging area, some of which was previously modified to build the dam. Staging area up to 8,500 square feet in area. Tree and ground cover removal required for staging would have a minor effect on habitat. Lowering lake during dam construction would have a minor effect on habitat in Eightmile Creek. Approximately 20 to 25 trees (and stumps) removed.	Similar to Alternatives 1 and 3, but larger staging area (up to 10,000 square feet) means up to 30 trees removed and a larger area leveled.
Undeveloped	Eightmile Lake Trail would be temporarily moved, then restored after construction. Does not require any permanent improvement or habitation except that the 8,500-square-foot staging area would be leveled and remain so. Clearing for staging area could mean that the dam is more visible from the trail until vegetation grows back. Temporary cofferdam would be visible from trail and lakeshore, including the campsites. Site restoration would remove all construction equipment and include replanting disturbed areas.	Similar to Alternatives 1 and 3 but with a larger staging area (up to 10,000 square feet) and a longer duration of activities.

Wilderness Quality	Alternatives 1 and 3	Alternative 2
Solitude or Primitive and Unconfined Recreation	Temporary and localized adverse effects on solitude due to noise intrusion from construction equipment, including helicopters (7 a.m. to 6 p.m.), excavators, and other equipment. Minor increase in human presence with construction staff camped near and working at the dam throughout construction. Recreationists would be prohibited from entering the dam area throughout construction. If blasting is required, the Eightmile Lake Trail would be closed for several hours, until the blasting has been completed. Noise would adversely affect solitude, and recreation would be restricted for the day of blasting.	Similar to Alternatives 1 and 3 but with a longer duration of activities due to larger scale of dam, but construction is not anticipated to last more than one season.

Helicopter Transportation Options

Most materials would be transported to a staging area at the project site by helicopter from a fly yard outside of the Alpine Lakes Wilderness. The size of the helicopter used would affect the number of trips and size of the staging area needed because the larger helicopter would deliver more materials to the site, initially requiring more on-site storage than the smaller helicopter, which would deliver materials throughout the course of construction. See Chapter 2, *Project Alternatives* for more details on the helicopter use options and their impacts on the size of the staging area. Regardless of the size of helicopters used, for the summer of construction, this would mean a substantial increase in helicopter trips as compared the current level of helicopter use. Two options for helicopter access are described below, and their impacts are summarized in in Table 3-3.

Table 3-3. Comparison of the Effects of the Helicopter Transportation Options 1 and 2 on Wilderness Character

Wilderness Quality	Option 1. Heavy-lift Helicopter with Limited Use of Small Helicopter Throughout Construction	Option 2. Limited Use of Heavy-lift Helicopter with Small Helicopter Use for the Majority of Materials
Untrammeled	No effect.	No effect.
Natural	Requires the largest staging area and more tree and ground cover removal than Option 2. Minor impact on natural quality.	Similar to Option 1 but roughly 15% smaller staging area and less tree and ground cover removal.
Undeveloped	Staging area would larger than for Option 2 and be conspicuous from the trail. Minor impact on undeveloped quality.	Staging area would be smaller and less conspicuous from the trail than Option 1. Minor impact on undeveloped quality.
Solitude or Primitive and Unconfined Recreation	Temporary and localized adverse effects on solitude due to noise intrusion. Higher noise level for initial transport of materials than for Option 2, but for only 3 to 5 days due to the larger size of the helicopter. An estimated 11 heavy lift helicopter trips will be required at the end of the project.	Similar to Option 1, but with lower helicopter noise level, and material transport lasting for 9 days more than Option 1, due to the smaller size of helicopter. An estimated 11 heavy lift helicopter trips will be required at the end of the project.

Option 1. Heavy-lift Helicopter with Limited Use of Small Helicopter Throughout Construction

Under this option, to minimize the total number of helicopter trips, a heavy-lift helicopter would be used. Most of the materials and all equipment needed would be transported over a 3– to 5-day period (8-hour days) in June or July as soon as snow conditions would allow. Between 70 and 105 round-trip flights to the site are anticipated (approximately 20 flights per day), with the larger number required for construction of Alternative 2. After the initial week, a smaller helicopter would be used for approximately 20 flights periodically throughout construction to transport supplies such as heavy materials that were not anticipated, and latrine servicing. A heavy-lift helicopter would be used again at the end of construction. The heavy-lift helicopter would conduct approximately 11 flights over a 2-day period to remove material and equipment. In total, approximately 5 to 7 full days of heavy-lift helicopter activity are anticipated with this option, along with up to 20 individual flights with the smaller helicopter (approximately two flights per week) over the construction period.

Because most materials would be brought in at once, this option requires the largest staging area (8,500 to 10,000 square feet, with the larger area required for Alternative 2). This would require the removal of approximately 30 trees (for the largest staging area), which would be a minor effect on the natural quality and would not reduce ecological functions. Because the staging area would be conspicuous from the trail and contain materials and equipment, it would adversely affect the undeveloped quality of wilderness.

Helicopter noise would adversely affect the solitude quality of wilderness, not just at the site but through other portions of the Enchantment Permit Area, primarily in the Stuart and Colchuck Zones. The heavy-lift helicopter would cause louder noise than a small helicopter. This option would cause higher noise levels (affecting a larger area) but over a shorter duration that Option 2. Noise impacts are described in greater detail Chapter 9, *Noise*.

Option 2. Limited Use of Heavy-lift Helicopter with Small Helicopter Use for the Majority of Materials

Under Option 2, supplies would be brought to the site in stages as the project progresses, rather than all at once in the beginning. In the first 2 days, items that cannot be delivered by smaller helicopter (such as heavy equipment and a portion of the materials) would be delivered by heavy-lift helicopter, approximately 20 flights over two 8-hour days. The remainder of supplies would be delivered by smaller helicopter, spread out over the 4-month construction period–an additional 242 flights, over twelve 8-hour days (approximately 20 trips per day). A heavy-lift helicopter would be used again at the end of construction. The heavy-lift helicopter would conduct approximately 11 flights over a 2-day period to remove material and equipment. In total, approximately 4 full days of heavy-lift helicopter activity and 12 full days of small helicopter activity are anticipated with Option 2.

This option would allow a smaller staging area than Option 1 because materials would be brought to the site in stages, rather than having to be stored on-site from the beginning. The staging area for Option 2 would be approximately 15 percent smaller than the staging area needed for Option 1, as shown in Figure 2-13. An estimated 20–25 trees would be removed, fewer than under Option 1 and therefore less of an impact on the natural quality of wilderness. Being smaller than the staging area for Option 1, the staging area for Option 2 would also be less conspicuous and therefore less of an impact on the undeveloped quality.

Noise levels would not be as great under Option 2 as Option 1 (see Chapter 9, *Noise*). However, Option 2 would involve up to 9 more days of helicopter use than Option 1, which would be a greater impact on solitude.

Summary of Construction Impacts

Construction of the project would adversely affect wilderness character. Clearing, grading, transporting materials using helicopters, and using heavy equipment and power tools would temporarily increase human intervention (trammeling), alter natural conditions, increase the area that appears developed, and affect the solitude of recreationists over one entire summer season. Blasting with explosives is not expected to be necessary and is not prohibited in the wilderness. It is covered in this analysis as a contingency because, if it occurs, it would further affect solitude and recreation.

None of the action alternatives would significantly impact wilderness qualities due to the limited scale and duration of the project. Alternatives 1 and 3 would have slightly fewer impacts than Alternative 2 because of the difference in staging area size, and the longer duration of construction for Alternative 2. Helicopter use under either option would be an increase from normal helicopter use in the wilderness, and would be noticeable by visitors during the construction season, but neither would constitute a substantial change in wilderness quality because of the limited duration.

3.5 Operational Impacts

As described in the introduction to this chapter, IPID has the right to maintain and operate the dam and exercise their water rights within their Special Warranty Deed Area within the Alpine Lakes Wilderness. Permanent changes to the dam itself and lake levels would be visible from locations outside of the Special Warranty Deed Area.

3.5.1 No Action Alternative

Under the No Action Alternative, the dam would be left as is and would continue to operate in its current state and manner. DSO currently requires IPID to leave the low-level outlet gate open during the winter and early spring to reduce the risk of a dam failure. DSO considers the dam to have a high risk of failure in the event of a large storm.

Under the No Action Alternative, the existing dam would be left as is (Figure 2-1), and it would continue to operate in its current state and manner, with no change to operating water levels (Figures 2-2 and 2-3). The DSO considers the dam vulnerable in the event of a large storm. Operation of the dam under existing conditions is not consistent with DSO regulations, so the DSO would eventually exercise enforcement action in accordance with WAC 173-175-620(3) to reduce the downstream risks. However, it is not possible to predict with certainty what that action or its effects would be. DSO currently requires IPID to leave the low-level outlet gate open during the winter and early spring to reduce the risk of a dam failure. Consequently, for purposes of this EIS analysis, it is assumed that the existing state of the dam and its operation remains unchanged.

If the dam is not replaced and does not fail, there would be no change in wilderness character compared to existing conditions, until DSO took enforcement action in accordance with WAC 173-175-620(3). The dam has stood for nearly 4 years since it was repaired in 2018 and could stand for several more years without failing. However, if the dam is not replaced, it is certain that DSO would proceed with enforcement, and dam failure could occur before the dam is removed.

Should a dam failure occur, habitat downstream within the wilderness area would be damaged or destroyed, affecting the wilderness character. The degree of damage within the Alpine Lakes Wilderness would depend on the scale of the failure, but in the worst case, severe damage would occur to riparian vegetation downstream of the dam. Partial or total dam failure could result in debris torrents that cause severe channel scour (potentially to bedrock), denude riparian areas, deposit large volumes of sediment, cause widespread flooding, and potentially lead to debris jams and stream avulsions. In the worst case, if the entire dam and low-level outlet pipe were to fail, the lake level would fall by approximately 25 feet, dropping the high-water level approximately to the current low-water level. In summer months, the lake would likely dry out and shrink further. Substantial portions of Eightmile Lake and Little Eightmile Lake would likely become streambeds with no riparian cover until the ecosystem was able to recover, which could take years or decades. The worst-case failure would also likely leave dam debris such as the low-level outlet pipe scattered downstream.

Should IPID be required to remove the dam, the lake level would be lowered gradually, and the structure and low-level pipe would be excavated and removed. The resulting lake high-water level would fall by approximately 25 feet, dropping the high-water level approximately to the current low-water level. In summer months, the lake would likely dry out and shrink further.

Table 3-4 summarizes the effects on the qualities of wilderness character of each of these possible scenarios under the No Action Alternative.

Table 3-4. Summary of the Effects of the No Action Alternative on Wilderness Character

Wilderness Quality	Failure Scenario	Removal Scenario
Untrammeled	Failure may or may not remove the entire dam structure, but any remaining parts would likely be required to be removed later by DSO. No further manipulation of water levels would occur, reducing trammeling.	With restoration of vegetation after removal, the dam site would appear less trammeled. No further manipulation of water levels would occur. The lowering of the lake due to dam removal may be seen as a trammeling, because the original lake level was higher. However, this scenario would also eliminate human intervention in lake levels, thus reducing trammeling.
Natural	Damage from initial failure to downstream habitats, and changes in lake shoreline due to lowering of lake level. Streamflows in summer would be lower. Eventually, ecological equilibrium would likely return. Natural quality would not be substantially changed in the long term.	Changes in lake shoreline habitats from lowering of lake level. Streamflows in summer would be lower. Eventually, ecological equilibrium would likely return. Natural quality would not be substantially changed in the long term.
Undeveloped	Failure may or may not remove all of the dam structure. Any remaining portions would be more conspicuous due to lower water level. Debris from the dam could be scattered downstream. Removal could improve the undeveloped quality, but dam remnants or debris would detract from this quality.	Reduced appearance of human manipulation since dam would be removed. Removal would improve the undeveloped quality.
Solitude or Primitive and Unconfined Recreation	No change or possible minor effect to the solitude or primitive and unconfined recreation quality.	No change or possible minor effect to the solitude or primitive and unconfined recreation quality.

The No Action Alternative would likely adversely affect wilderness character regardless of which scenario, failure or removal, occurs.

Impacts from the No Action Alternative on wilderness character would not be significant. The No Action Alternative would have adverse impacts on the qualities of wilderness character. However, it would not substantially increase the degree of overall impact on the wilderness. If the dam were to fail or be removed, it would reduce trammeling, a benefit to wilderness quality.

3.5.2 Alternative 1: Narrow Spillway with Gates

Under Alternative 1, the dam would be replaced with a new, larger concrete dam with gates that could be raised and lowered mechanically using remote control. The gates would use a motor to inflate a bladder when they are raised and would deflate passively by opening a valve. The gate-bladders would be used to raise the lake water level during late spring with the last freshets. An air compressor would be used to fill the bladders to raise the gates and would have some noise associated with the compressor operation. It is anticipated that this would occur once per year. Lowering the gates would not require the compressor, and there would be no noise associated with the gate lowering. The high-water level with the gates up would make the lake approximately 81 acres in area, a 6 percent increase in size when compared to the existing lake full level. In an average year, the deeper lake and remote control would allow IPID to meet its water needs with more targeted and controlled releases than occurs under current management.

This alternative would also have an outlet that is 4 feet lower than the existing low-level outlet. Therefore, in drought years, the lake could be drawn down further than at present. At low WSEL without pumping, the lake could be approximately 2 acres (approximately 6 percent) smaller than the lake would be with the existing low-level outlet.

The dam would have 15-foot-wide concrete intermediate spillways on the north and south flanks of the primary spillway. There would also be a smaller secondary spillway to the south of the dam. The spillway would be armored and would be maintained clear of any trees for the life of the project.

Table 3-5 summarizes the effects on the qualities of wilderness character of the Narrow Spillway with Gates Alternative.

Table 3-5. Summary of the Operational Effects of Alternative 1 on Wilderness Character

Wilderness Quality	Alternative 1: Narrow Spillway with Gates
Untrammeled	Manipulation of water levels would continue in a similar manner as at present. The footprint of the dam would be similar to the existing dam including armored embankment but would also include the secondary spillway to the south of the dam (see Table 2-1).
Natural	Manipulation of water levels would continue in a similar manner as at present, with some benefit to downstream habitat. Change in wetland habitat at west end of lake with higher water level. These changes would not substantially change the natural quality.
Undeveloped	The dam structure would be more conspicuous, with prominent wing walls and not made with native stone as portions of the current dam are. Operation of the inflatable gates on the dam would require a motor. Trees would need to be suppressed on both spillways. These features would reduce the undeveloped quality near the dam.
Solitude or Primitive and Unconfined Recreation	Use of a compressor motor for inflatable gates would generate noise that could affect a sense of solitude if it occurred when people are present. Inflation of the gates is expected to occur at least once each year, but not likely more than once per year. No substantial change in solitude or primitive and unconfined recreation quality.

Impacts from this alternative on wilderness character would not be significant. Alternative 1 would have adverse impacts on all four qualities of wilderness character. However, all of these effects are similar to the effects of current operations and do not substantially increase the degree of overall impact on the wilderness.

3.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

The dam would be operated in the same manner as described for Alternative 1: Narrow Spillway with Gates; therefore, impacts related to water level would be the same. Alternative 2 would include a 180-foot-wide spillway made of concrete, but it would be mostly obscured by an armored embankment on both sides. Vegetation on the downstream embankment would be allowed to grow but be kept clear of trees. Similar to Alternative 1, there would be a secondary spillway to the south of the dam that would be armored and be kept clear of trees for the life of the project.

Table 3-6 summarizes the effects on the qualities of wilderness character of the Wide Spillway without Gates Alternative.

Table 3-6. Summary of the Operational Effects of Alternative 2 on Wilderness Character

Wilderness Quality	Alternative 2: Wide Spillway without Gates Alternative
Untrammeled	Manipulation of water levels would continue in a similar manner as at present.
Natural	Manipulation of water levels would continue in a similar manner as at present, with some benefit to downstream habitat. Changes in wetland habitat at west end of lake with higher water level. The natural quality would not be substantially affected.
Undeveloped	Undeveloped quality would be reduced because the dam would be more conspicuous due to the wider dam and cleared area for the spillways. Trees would need to be suppressed on both spillways. The concrete portion would be more visible than the current condition but less conspicuous than under Alternative 1, because most of it would be covered with rock and earth.
Solitude or Primitive and Unconfined Recreation	No substantial change in solitude or primitive and unconfined recreation quality.

Impacts from Alternative 2 on wilderness character would not be significant. Like Alternative 1, Alternative 2 would have adverse impacts on the qualities of wilderness character. However, these effects are similar to the effects of current operations and do not substantially increase the degree of overall impact on the wilderness.

Alternative 2 would have a larger overall footprint than Alternative 1, but the armored embankment would obscure more of the concrete portion of the dam, with the result that the dam would blend in visually from a distance more than Alternative 1.

3.5.4 Alternative 3: Narrow Spillway without Gates

The dam would be operated in a similar manner as described for the other action alternatives, but this alternative would keep the maximum lake level the same as at present. Otherwise, impacts related to water levels would be the same.

Table 3-7 summarizes the effects on the qualities of wilderness character of the Narrow Spillway without Gates Alternative.

Table 3-7. Summary of the Operational Effects of Alternative 3 on Wilderness Character

Wilderness Quality	Alternative 3: Narrow Spillway without Gates Alternative
Untrammeled	Manipulation of water levels would continue in a similar manner as at present. The footprint of the dam would be similar to the existing dam including armored embankment but would also include the secondary spillway to the south of the dam.
Natural	Manipulation of water levels would continue in a similar manner as at present, with some benefit to downstream habitat. These changes would not substantially change the natural quality.
Undeveloped	The dam structure would be more conspicuous, with prominent wing walls and not made with native stone as portions of the current dam are. Trees would need to be suppressed on both spillways. These features would reduce the undeveloped quality near the dam. This alternative would not have inflatable gates and therefore would have slightly less impact on the undeveloped quality than Alternative 1.
Solitude or Primitive and Unconfined Recreation	No substantial change in solitude or primitive and unconfined recreation quality.

Impacts from Alternative 3 on wilderness character would not be significant. Like Alternative 1, Alternative 3 would have adverse impacts on the qualities of wilderness character. However, these effects are similar to the effects of current operations and do not substantially increase the degree of overall impact on the wilderness.

The dam under Alternative 3 would cover the same area as Alternative 1.

3.5.5 Summary of Operational Impacts

Operation of the project in a manner similar to existing conditions would also adversely affect qualities of wilderness character, although none of the impacts would be significant. The degree of human intervention (trammeling) in the landscape would be similar to existing conditions, but the footprint of the dam and spillways would be larger than at present. Alternative 2 would have the largest human-made footprint. Natural conditions would largely be restored following construction to their present state and would not be further altered by operation, with the exception that trees would not be allowed to grow on the armored face of the secondary dam spillway. All action alternatives would add a human-made element that would be visible to trail users from the lakeshore and campsites but not conspicuous, except to those who walk the spur trail to the dam. Alternative 1 would have the most conspicuous human-made elements, but Alternative 2 would have a larger spillway area that would need to be kept clear of trees.

Alternative 3 would be similar to Alternative 1 but would not have one of the more conspicuous mechanical components (gates). (See Chapter 11, *Visual Resources*, for additional information on visual impacts, including visual simulations.)

The No Action Alternative could also affect wilderness character. If the dam is not replaced, it would have to be removed or would likely fail. In either case, the result would be a much smaller lake than existed prior to the dam, but it would also end the trammeling effect of the dam, a benefit to wilderness quality.

3.6 Avoidance, Minimization, and Mitigation Measures

3.6.1 Construction

During construction, impacts on wilderness character can be minimized by the following, to be reflected in the construction plans where applicable:

- Minimize clearing area for staging and construction activities.
- Establish and maintain clear construction boundaries.
- Maintain detour trail around site during construction.
- After construction is complete, restore trail and cleared areas to Forest Service standards, consistent with the Wilderness and Backcountry Site Restoration Guide (Therrell et al. 2006).
- Coordinate with the Forest Service to forewarn visitors of potential disruption of wilderness experience due to construction activities, including notice to people seeking reservations through the lottery and to those awarded reservations.
- Provide signage to alert trail users regarding construction activity, including dates and hours of helicopter use, heavy equipment operation, and blasting.
- Provide a general description of work period and work impacts, including potential areas that will be closed to the public such as the staging and construction areas, prior to the Forest Service lottery for overnight permits in the Enchantment Permit Area.
- Design constructed features to match the natural environment to the extent feasible
- Provide alert of construction on the Forest Service Website for Alpine Lakes Wilderness: Okanogan-Wenatchee.
- Provide notification and signage at the Leavenworth Ranger Station and suggestions of other recreational opportunities in the area.
- Measures to reduce impacts from blasting with explosives include:
  - Minimize trail closure extent and duration.
  - Use blasting mats to reduce noise and dust and prevent flyrock.
  - Limit the Eightmile Lake Trail closure to the segment from the Caroline Lakes Trail Junction westward to the minimum safe distance from the blast location.
  - Identify extent of blast safety zone on a map.
  - Identify camping areas outside of safety zone that can be used during blasting if desired.
  - Provide personnel at Eightmile Lake Trailhead, Caroline Lakes Trail junction, and upper limit of safety area on trail, on the day of blasting.
  - Schedule blasting to minimize impact on trail users:
    - Schedule for midweek (Tuesday through Thursday), and non-holiday (if July 4th falls on a mid-week day).
    - Avoid full-day trail closure by scheduling blasting to occur between 11:00 a.m. and 2 hours before sunset.

- Allow trail users to use the trail in the morning before blasting or in the evening after blasting.
- Providing a general description of work period and work impacts, including potential for closure for blasting, prior to the Forest Service lottery for overnight permits in the Enchantment Permit Area (by October 1).
- Providing description of closure area and timing to Forest Service once known, at least 10 days prior to blasting.
- Posting notices at Eightmile, Caroline Lake, and Jack Creek trailheads. These notices should be pre-approved by the Forest Service prior to posting.
- Notifying occupants of campsites on Eightmile Lake the day before blasting that there will be a temporary trail closure.
- Providing notice, such as a press release, to organizations such as Washington Trails Association, The Mountaineers, Sierra Club, and Alpine Lake Protection Society once schedule is known. The notice should be pre-approved by the Forest Service prior to sending.

3.6.2 Operation

During operation, impacts on wilderness character can be minimized by the following:

- The dam's materials and colors that will visually blend with the landscape around the dam, to the extent feasible, to minimize visual impacts.
- Use the quietest available motor for the inflatable gates.
- Avoid using the motor to inflate the gates at night and on weekends or holidays, to the extent feasible.

3.7 Significant Unavoidable Adverse Impacts

None of the action alternatives would have significant unavoidable impacts on wilderness character when compared to existing dam operations/conditions.

CHAPTER 4: SURFACE WATER RESOURCES

This chapter describes the environmental setting of Eightmile Lake and waterbodies within its area of influence that may be affected by the project. The organization of this chapter addresses each environmental resource separately, including:

- Surface Water Quantity
- Surface Water Quality
- Climate Change, which is a factor that affects both surface water quantity and quality.

For each environmental resource, discussion is provided for the methodology, regulatory context, and impacts associated with the project alternatives as described in Chapter 2. Issues and considerations related to water rights, which are closely tied to surface water resources, are included in Chapter 6, and groundwater resources are described in Chapter 5.

What has Changed from the Draft EIS?

- An error about water surface elevation was corrected in Table 4-2. No other substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS.
- Responses to specific comments on surface water resources are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key Findings for Water Resources

- Given the increased ability to manage reservoir storage and outflow during both drought and non-drought years, the project would improve IPID's ability to adaptively operate the reservoir in response to changes in inflow timing and magnitude, including seasonal drought and adaptive response to climate change.
- Under the action alternatives:
    - Maximum summer flow releases may be increased over 10 percent.
    - Active storage will increase over 30 percent.
    - A 15 percent increase in drawdown volume would be available.
    - Summer minimum flows would not change without further investigation of leakage from the lake.

4.1 Methodology

Water resources were characterized by reviewing existing studies and data that describe water quantity, water quality, and climate associated with the study area. The Icicle Creek Water Resource Management Strategy FPEIS (Ecology 2019a) is referenced for much of the background information described in this chapter. Additional information sources include published environmental planning documents and design reports by technical experts.

The project site is in the Alpine Lakes area of the Eightmile Creek watershed (Hydrologic Unit Code [HUC] #170200110405) and the Icicle Creek watershed (HUC #170200110406) (**Figure 4-1**). The study area extends between the Eightmile Lake watershed to the confluence with the Wenatchee River (**Figure 4-2**).

Figure 4-1. Alpine Lakes Region and the Eightmile Creek Watershed and Lower Icicle Creek Watershed 12-digit HUC Boundaries

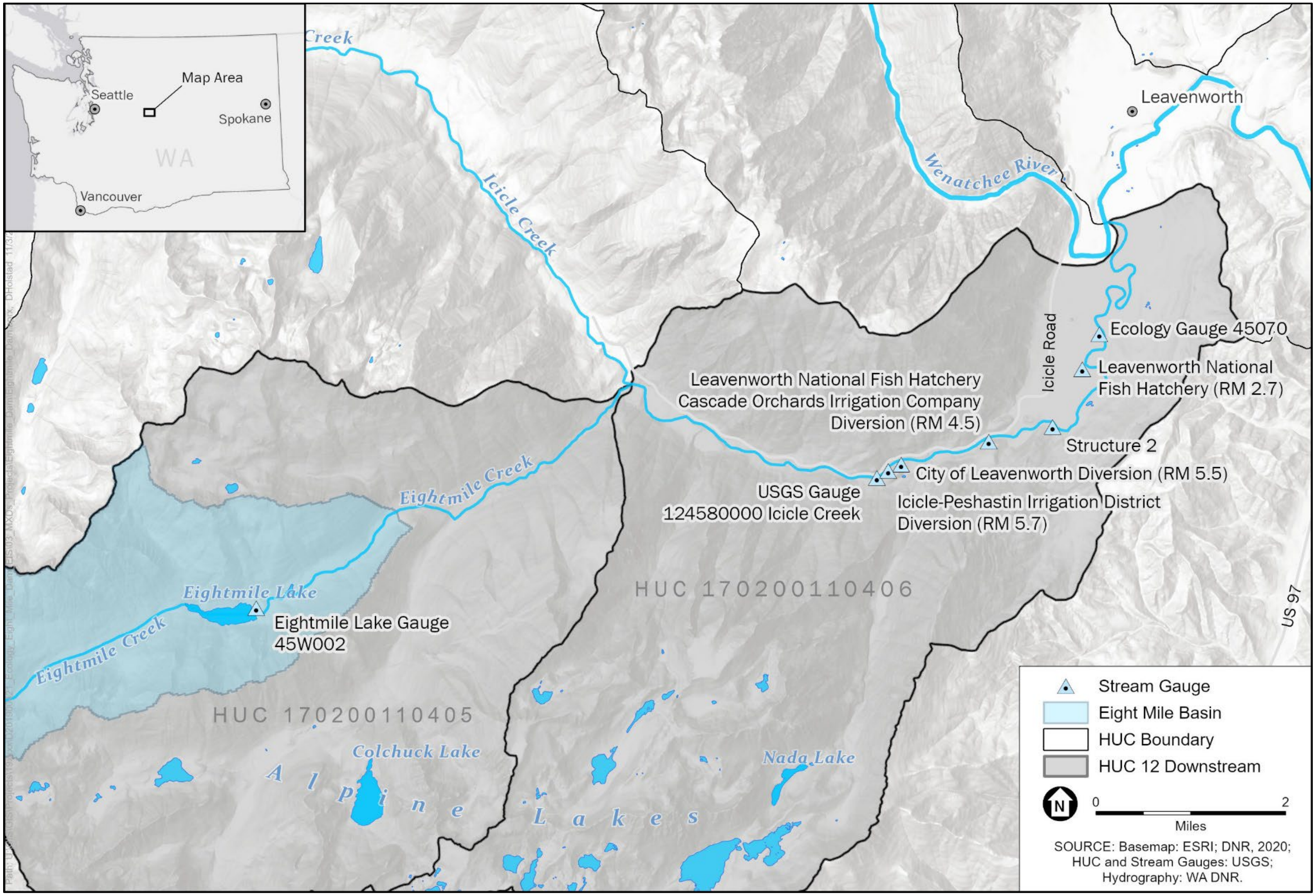
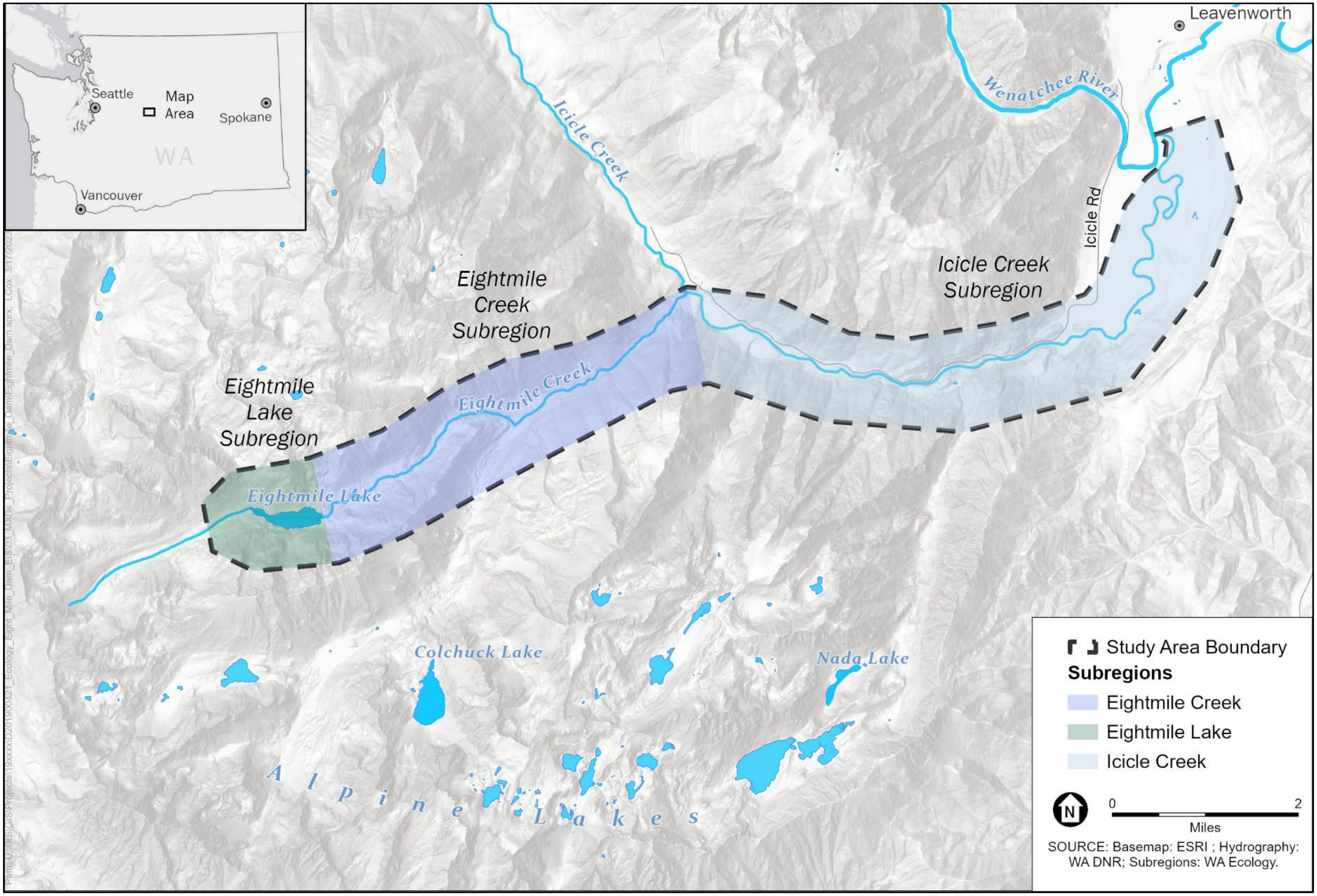


Figure 4-2. Study Area and Subregions for the Surface Water Analysis



The Wenatchee River corridor is not included as part of the surface water study area due to the small relative size of the Eightmile Creek watershed (31 square miles) compared to the Wenatchee River watershed upstream of the Icicle Creek confluence (910 square miles). Potential impacts in the Wenatchee River attributed to changes in surface water hydrology from the Eightmile Lake watershed would be relatively minor, as the contributing streamflow of Eightmile Creek is approximately 1 percent of the total streamflow in the mainstem Wenatchee River. Surface water resources in the watershed above the Eightmile Lake shoreline and Icicle Creek above the confluence with Eightmile Creek would not be affected by the project and are not considered part of the study area for surface water resources.

Resources were evaluated using different spatial extents (subregions) depending on the character of the resource and the extent of reasonably foreseeable project-related impacts (Figure 4-2). The subregions included in this chapter are described below.

- The Eightmile Lake and shoreline subregion encompasses the immediate mountainous region, part of the Alpine Lakes Wilderness, surrounding Eightmile Lake.
- The Eightmile Creek subregion consists of the mainstem of Eightmile Creek from the mouth Eightmile Lake to the confluence with Icicle Creek.
- The Icicle Creek subregion consists of the mainstem Icicle Creek floodplain and valley walls from the confluence with Eightmile Creek at River Mile (RM) 9.0 to the confluence with the Wenatchee River.

Potential impacts from the project alternatives include both short-term impacts related to construction of the action alternatives, and long-term impacts from operation of the dam under the No Action and action alternatives. When federal and state regulations directly relate to the analysis of impacts, the resource sections include a description of the regulatory setting. Section 4.2 includes a summary of federal, state, and local regulations and policies that relate to the project.

Potential significant impacts are defined below; impacts that do not reach these thresholds are considered less-than-significant.

Criteria for Construction Impacts on Surface Water Quantity:

Construction impacts would be significant if a temporary change from typical reservoir storage and release substantially reduced the magnitude and duration of downstream flow within the construction year that would reduce instream flows to levels that are detrimental to aquatic life and/or reduce the ability of water rights holders to make withdrawals.

Criteria for Operational Impacts on Surface Water Quantity:

Operational impacts would be significant if a permanent change from existing reservoir operation and release substantially reduced reservoir storage and streamflow during the months of June through October of each year. Substantial reductions in storage and streamflow during these months would reduce instream flows to levels that are detrimental to aquatic life and/or reduce the ability of water rights holders to make withdrawals.

Criteria for Construction and Operational Impacts on Surface Water Quality:

Construction and operational impacts would be significant if water quality conditions are predicted to be out of compliance with Washington surface water quality standards and if existing background conditions are predicted to be degraded beyond variations allowed by Washington State standards for fresh waters (WAC 173-201A). Allowable variations in background water quality conditions due to human activity per Washington State standards (WAC 173-201A) are:

- **Temperature:** up to 0.3°C increase.[1]
- **Turbidity:** 5 Nephelometric turbidity units (NTUs) over background.
- **Dissolved Oxygen (DO)**: decrease of no more than 0.2 milligram per liter.[1]
- **pH:** variation of no more than 0.2 Standard Units.

Minor-to-Moderate Benefits

A minor-to-moderate benefit would be achieved if the alternative increases IPID's ability to manage reservoir storage and streamflow during non-drought, typical water years for the benefit of fish use and recreation, without reducing water supply to existing water rights.

Substantial Benefits

A substantial benefit would be achieved if the alternative increases IPID's ability to manage reservoir storage and streamflow during drought years as it relates to fish use, recreation, or water rights. This would include increased resilience and adaptive capacity with climate change (increased ability to adaptively manage the system).

4.2 Regulatory Context

Several federal and state regulations apply to water resources for the Eightmile Lake Rebuild and Restoration Project. **Table 4-1** summarizes the programs, policies, and regulations that apply to water quantity, water quality, and climate change in the study area. Regulations relating to water rights are described in Chapter 5.

Table 4-1. Regulations and Guidelines Applicable in the Study Area

Regulation, Policy, or Guideline	Description
Executive Order 11988: Floodplain Management	Executive Order 11988 requires federal agencies to reduce the risk of floodplain loss, minimize the adverse impacts of floods, and restore and preserve the natural functions provided by floodplains. Individual projects involving federal permits or approvals will further ensure consistency with this executive order.
U.S. Forest Service Authorization	A Forest Service authorization is a legal document, such as a permit, lease, or easement, that allows occupancy, use, rights, or privileges on National Forest land. The authorization is granted for a specific use of the land for a specific period of time. The Alpine Lakes Wilderness is jointly administered by the Okanogan-Wenatchee National Forest and the Mt. Baker-Snoqualmie National Forest. IPID has an agreement with the Forest Service that grants IPID limited privileges, including the ability to maintain and repair its reservoirs within the Alpine Lakes Wilderness. IPID currently

[1] These criteria for temperature and dissolved oxygen are not currently in effect for Clean Water Act purposes as a result of EPA's 2021 reconsideration and disapproval of Washington's natural conditions criteria in the water quality standards. These criteria remain in effect for other statewide water quality actions. Ecology has initiated rulemaking to revise the natural condition provisions that will respond to EPA's concern and will again meet Clean Water Act approval. For more information, please visit Ecology's website (https://ecology.wa.gov/Regulations-Permits/Laws-rules-rulemaking/Rulemaking/WAC-173-201A-Natural-Conditions).

Regulation, Policy, or Guideline	Description
	inspects and maintains the dam in accordance with Ecology DSO requirements.
WDFW Hydraulic Project Approval (HPA)	The WDFW administers the Hydraulic Project Approval (HPA) program under the State Hydraulic Code (WAC 220–660), which is specifically designed to protect fish life. Construction projects or other activities in or near state waters require an HPA. Individual projects with the potential to affect state waters and fish require an HPA.
Washington State Department of Natural Resources Aquatic Use Authorization	An Aquatic Use Authorization is required from the Washington State Department of Natural Resources (WDNR) for use of use of state-owned aquatic lands. State-owned aquatic lands are navigable lakes, rivers, streams, and marine waters. WDNR may also require surveys or a legal description of the property, a plan of development/operations, bonds, and insurance. SEPA approval and the HPA need to be completed prior to WDNR issuing the Aquatic Use Authorization.
Shoreline Management Act Permit	Compliance with the Shoreline Management Act (Chapter 90.58 RCW) is required for development in proximity to waterbodies of a certain size. In Chelan County, these waterbodies include lakes greater than 20 acres and streams and rivers over 20 cfs. Shoreline Management Act jurisdiction also includes upland areas associated with these waterbodies—specifically lands within 200 feet of ordinary high-water mark, floodways, some floodplains, and associated wetlands. Shoreline permitting applies to new structures (buildings, docks, etc.), grading, and other activities.
Instream Flow Rule	Washington State relies on notice-and-comment rulemaking related to instream flows. Chapters 90.22.010, 90.22.020, and 90.54 RCW provide the framework for establishing or modifying instream flows. Prior to modifying instream flow rules, Ecology must provide public notice and conduct a public hearing in the same county where the waterbody is located.
Clean Water Act	
Clean Water Act (33 U.S. Code 1251 et seq.)	The Clean Water Act establishes the basic structure for regulating pollutant discharges into waters of the U.S. and makes it unlawful to discharge any pollutant from a point source into those waters without a permit. The following rows identify key sections of the Clean Water Act relevant to water quality standards and permitting facilities for which construction or operation would result in a discharge into waters of the U.S.
Clean Water Act Section 303(c)	Section 303(c) directs states to adopt water quality standards for their waters subject to the Clean Water Act. Ecology's surface water quality standards are the basis for water quality protection in Washington and are documented in WAC 173-201A. The standards specify designated uses for waters and establish numeric and narrative water quality criteria protective of those uses.
Clean Water Act Sections 303(d) (Impaired Waters and Total Maximum Daily Loads; TMDLs) and 305(b) (Water Quality Assessment Report)	Section 303(d) establishes a process to identify and clean up polluted waters, and Section 305(b) requires states to submit a report on the water quality status of waters to the U.S. Environmental Protection Agency (EPA) every 2 years. In Washington, Ecology performs the Water Quality Assessment, develops the 303(d) list of impaired waters, and leads TMDL development.

Regulation, Policy, or Guideline	Description
Clean Water Act Section 401 (Water Quality Certification)	Section 401 provides states the authority to ensure that federal agencies do not issue permits or licenses that violate state water quality standards or other protections of the Clean Water Act.
Clean Water Act Section 402 (National Pollutant Discharge Elimination System [NPDES])	Section 402 establishes the NPDES program, requiring pollutant discharges to surface waters be authorized by a permit. NPDES permit requirements initially applied to point source discharges, but the program was expanded in 1987 to explicitly include stormwater discharges, including construction stormwater discharges. Ecology administers the NPDES permitting program in Washington for non-federal operators for projects that have the potential to discharge stormwater to surface waters.
Clean Water Act Section 404 (Dredged/Fill Material Discharge Permits)	Section 404 establishes a program to regulate the discharge of dredged or fill material into waters of the U.S., including wetlands. The U.S. Army Corps of Engineers (Corps) issues Section 404 permit decisions.
Dam Safety	
WA Ecology Dam Safety Office (DSO) Construction Permit	Ecology's DSO requires a construction permit before repair, modification, or construction of a dam storing 10 or more acre-feet of water. Permits may require dams to be designed to withstand a 1 million year storm event. Dams must also include outlet facilities that provide controlled releases of water and limit seepage or uncontrolled releases. A minimum freeboard of 0.75 foot is required at spillways under design inflow conditions.
Climate Change	
Chelan County Climate Resilience Strategy	Chelan County establishes and evaluates progress toward climate resilience goals in the recently released Climate Resilience Strategy. This document summarizes climate-related vulnerabilities in the region and outlines climate resilience initiatives. Many of the outlined climate strategies relate to water resources, including increasing water storage solutions for agricultural producers, drought planning, rural water management, flood risk reduction programs, and instream flow protection.
North Cascadia Adaptation Partnership (NCAP)	NCAP is a National Park Service – Forest Service collaboration that focuses on vulnerability assessment and adaptation planning for federal lands in the North Cascadia region.
Guidance for NEPA and SEPA Project-Level Climate Change Evaluations	This guidance document produced by Washington State Department of Transportation (WSDOT) outlines recommended procedures for evaluating climate change risks for proposed infrastructure projects.

4.3 Affected Environment

4.3.1 Surface Water Quantity

This section summarizes the surface water quantity in the study area (Figure 4-2) and describes the overall water budget pertaining to the study area. This review includes discussion of reservoir storage, release, and withdrawal as it pertains to the short-term and long-term impacts associated with the project. This analysis does not include a review of the validity and extent of surface water rights, and does not determine the validity of quantities of water that are authorized for use under such water rights. For information on water rights, see Chapter 6, *Water Rights.*

General Hydrology in the Study Area

The hydrology of the study area is typical of largely undisturbed, subalpine forest sites. The Alpine Lakes and their outlet streams within the study area are primarily snow-fed systems. Snow accumulates within the basin typically between September and April of each year. Peak snowmelt occurs in June, and melt continues well into summer. Although the basin is snow-dominated, design storm flows are based on major rainfall events (e.g., the 100-year, 6-hour duration storm), which are typically associated with thunderstorms in eastern Washington. Rain-on-snow events can cause high peak runoff volumes in the small, steep catchment areas.

The only hydrologic input to the study area is in the form of precipitation. Mean annual precipitation is 65.1 inches of water equivalent (Anchor QEA 2019). Outflows from the basin include evapotranspiration, discharge from Icicle Creek to the Wenatchee River, and several water diversions that occur within the lower reaches of Icicle Creek.

As described in Chapter 6, *Water Rights*, IPID holds several water rights on Icicle Creek for irrigation use, only one of which specifies an annual quantity limit. The combined diversion right is approximately 118 cfs, and IPID generally diverts the full authorized amount at its diversion structure. The IPID diversion is located at Icicle Creek RM 5.7. The City of Leavenworth municipal diversion is located slightly downstream at RM 5.5. The City has a combined water right of approximately 4.7 cfs at this diversion point, and its water rights primarily authorize the use of water for municipal supply purposes. Further discussion of diversions and water right is included in Chapter 6.

A diversion at RM 4.5 serves both the Leavenworth National Fish Hatchery (LNFH) and the Cascade Orchards Irrigation Company (COIC). The hatchery, owned and operated by the U.S. Fish and Wildlife Service (USFWS), has a diversion right of 42.0 cfs with an annual limit of 27,482 acre-feet per year. A second contingency diversion structure for the hatchery is located at RM 2.8. The water use at LNFH is considered non-consumptive, and the water is discharged back to Icicle Creek at RM 2.6. COIC's water right at the joint diversion structure allows for a diversion of 11.9 cfs for irrigation. LNFH maintains the joint LNFH–COIC diversion structure at RM 4.5.

Eightmile Lake and Shoreline

Eightmile Lake is one of four lakes in the Alpine Lakes Wilderness managed by IPID to provide storage for diversion and irrigation. The lake captures water from approximately 3,822 acres of surrounding hillslope (approximately 6 square miles), and the drainage basin is predominantly covered with rocky outcrops and exposed bedrock. The lake has a surface area of approximately 41.2 acres at the low lake level and 6,400 linear feet of shoreline. The average reservoir depth is 91.3 feet, estimated between the crest of the existing spillway and the bottom of the lake (Anchor QEA 2019). Sub-alpine forest covers approximately 30 percent of the watershed; however, much of the forest was burned down to the waterline in the Jack Creek Fire during August 2017.

Two Special Warranty Deed parcels were established on the shore of Eightmile Lake that preserve IPID's rights to maintain and operate the dam and exercise their water rights. These warranty deeded parcels consist of approximately 0.72 mile of shoreline and include approximately 120.5 acres of land (see Figure 1-2).

The lakes in the Alpine Wilderness generally begin to fill by the beginning of the water year (October) and continue filling through spring, even in dry years. For lakes with dams, once Eightmile Lake is full to the designed spillway or overflow elevation, water is released over the spillway to Eightmile Creek. Controlled releases from the alpine lakes typically begin in July or early August in response to seasonal flow triggers in lower Icicle Creek, to offset diversions by IPID and the USFWS. Water is released through a low-level outlet system, a gated pipeline that extends under the existing spillway that is located immediately south of the earthen embankment.

IPID currently manages Eightmile Lake and holds a water right that authorizes 25 cfs of water for storage in the lake (with no maximum annual quantity specified on their water right certificate). Due to the large size of the drainage basin relative to the storage volume in the lake, Eightmile Lake retains a high potential for annual refill during both wet and dry years. A hydrologic analysis was performed as part of the *Appraisal Study, Alpine Lakes Optimization and Automation* (Aspect Consulting and Anchor QEA 2015) to approximate a mean annual watershed yield of approximately 19,686 acre-feet; the annual volume typically stored within the lake is a small percentage of the total watershed yield, even under drought conditions. IPID further describes their refill practices at the lake during the summer in the Eightmile Lake multi-fill analysis (Aspect 2022a).

The existing facility controlling reservoir operations from Eightmile Lake includes an earthen dam, low-level outlet pipe, and a slide gate to regulate the release of stored water to increase water supply within Icicle Creek during periods of low flow. The original spillway crest was set at elevation 4,671.3 feet, and the 30-inch diameter low-level outlet pipe provided drawdown to elevation 4,648.7 feet based on a revised topographic survey conducted in 2016. These elevations represent an operation range of approximately 23 feet. Table 4-2 summarizes historic reservoir operational elevation and associated storage volumes at Eightmile Lake (Anchor QEA 2019; Aspect 2022a).

Table 4-2. Eightmile Lake Volume and Operation Summary (adapted from Anchor QEA 2019)

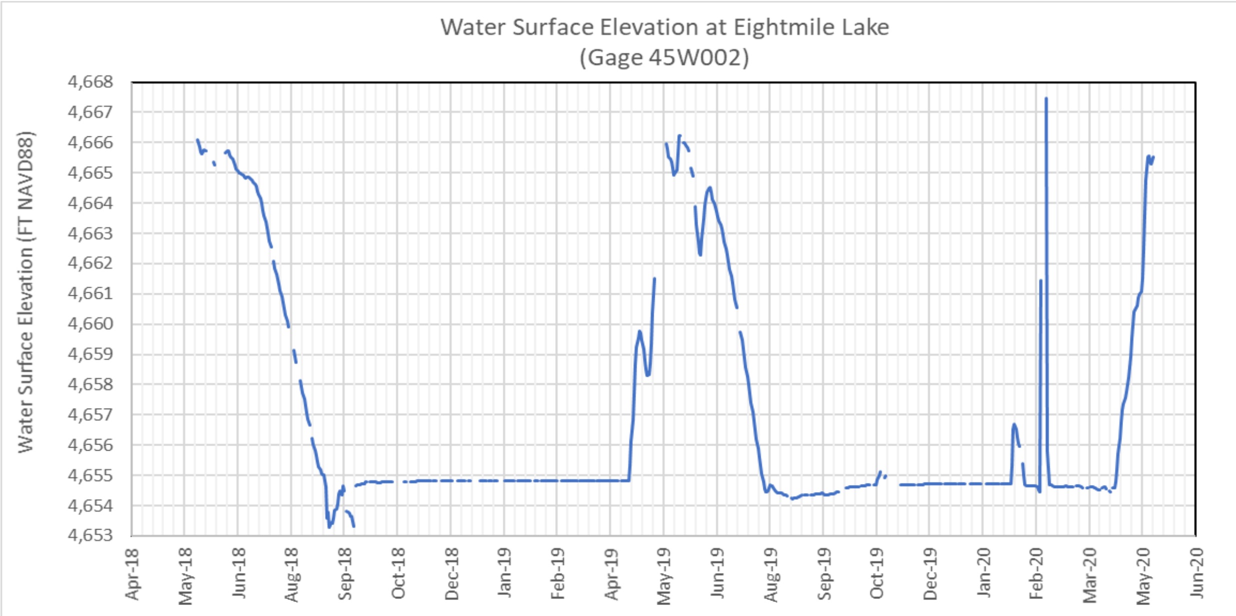
<table>
<tr><th></th><th>Water Surface Elevation (feet)</th><th>Water Surface Area (ac)</th><th>Total Storage Volume (ac-ft)</th><th>Active Storage Volume (ac-ft)</th><th>Usable Storage Volume (ac-ft)</th></tr>
<tr><td>Low Lake Level</td><td>4,640.0</td><td>44.1</td><td>1,331</td><td></td><td></td></tr>
<tr><td>Low-Level Outlet</td><td>4,648.7</td><td>47.9</td><td>1,547</td><td rowspan="3">1,151[1]</td><td rowspan="4">1,600[2]</td></tr>
<tr><td>Top of Weir</td><td>4,664.6</td><td>73.7</td><td>2,514</td></tr>
<tr><td>Existing High Water Surface</td><td>4,667.0</td><td>76.6</td><td>2,698</td></tr>
<tr><td>Spillway Crest</td><td>4,671.3</td><td>81.7</td><td>3,035</td><td></td></tr>
</table>

1. Active storage between the low-level outlet and the invert of spillway (no stop logs) (Aspect 2022a).
2. Seepage below the low-level outlet pipe continues to draw the lake below the low lake level of 4,644 feet. IPID estimates that the total usable storage including the additional seepage is approximately 1,600 acre-feet, measured between the low-level outlet and the existing high water surface.

Currently, the embankment has partially eroded to elevation 4,667 feet (the elevation of the existing emergency spillway). Damages have reduced the capacity of the lake to store water, which limits the rate at which IPID can release water to Icicle Creek. The dam is currently unable to impound water to the full level at which it was designed and presumably historically operated, due to partial erosion of the embankment. Total potential storage volume, measured from the top of the stop logs, has been reduced by approximately by 320 acre-feet to less than 1,400 acre-feet. The low-level outlet pipe, previously damaged, was repaired in the summer of 2018.

In May 2018, Ecology installed a telemetry gage, ID 45W002, to measure water surface elevation at the outlet of Eightmile Lake. A review of available data indicates that the water surface elevation remains below the minimum measurable gage elevation for most of the year, near elevation 4,655 feet, while IPID drains the lake in anticipation of spring snowmelt. Water surface elevation is observed to rise to a maximum storage elevation of near 4,667 feet during the summer. A summary graph of available water surface elevation data between October 2018 and June 2020 is provided in Figure 4-3.

Figure 4-3. Recorded Reservoir Elevation, October 2018 – June 2020



Source Data: Ecology (2022a) – The data presented are considered preliminary and have not been validated for accuracy.

Eightmile Creek

Eightmile Creek spans approximately 5 miles between Eightmile Lake and the confluence with Icicle Creek at approximately RM 9.0. The Eightmile Creek watershed covers approximately 31 square miles. The creek parallels FSR 7601 for approximately 12,000 linear feet in the lower portion of the watershed (between the confluences with Icicle Creek and Mountaineer Creek). Mountaineer Creek is the largest tributary to Eightmile Creek with a drainage area of approximately 15 square miles. Upstream of Mountaineer Creek is Colchuck Lake, with an outlet structure and active storage volume of 1,480 acre-feet. Colchuck Lake regulates approximately 15 percent of the contributing area to Mountaineer Creek.

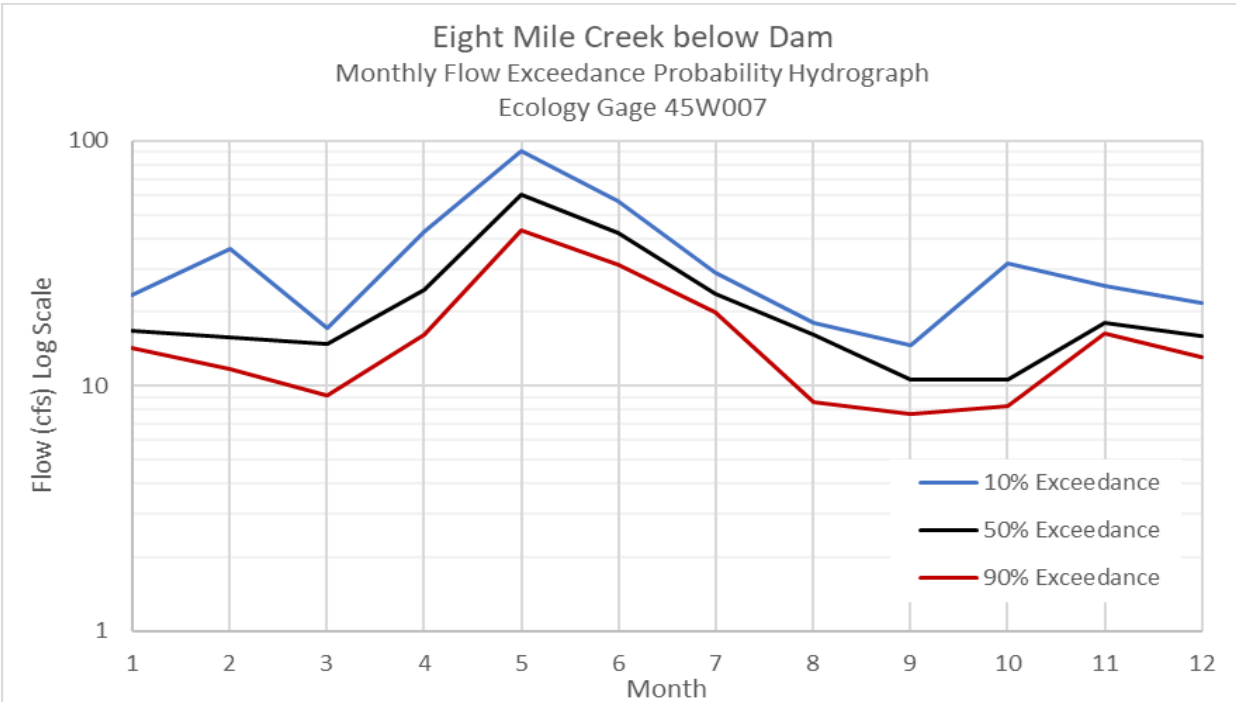
Discharge immediately downstream of Eightmile Lake is dependent on reservoir level and gate operation. An Ecology telemetry gage, ID 45W003, measuring discharge and water surface elevation was installed at Eightmile Creek below the dam in May 2018. The gage is downstream of the existing outlet pipe for Eightmile Dam. A review of available streamflow data indicates a minimum discharge no less than 7.6 cfs occurring annually during summer months (**Figure 4-4**). Maximum streamflow below the dam is observed to be 102 cfs in early June, which coincides with the maximum storage elevation observed following snowmelt. To describe the seasonal variation of flow as measured at the gaging station, monthly flow exceedance values are summarized in **Table 4-3** and shown in **Figure 4-4.** These exceedance discharge values describe the percentage of time an observed streamflow is greater than or equal to the indicated discharge. No other gages are located within the Eightmile Creek watershed.

Table 4-3. Flow Exceedance Values (cfs) at Eightmile Creek, Water Year 2018 to 2020

Exceedance (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90%	14.3	11.7	9.1	16.3	43.3	31.4	20.1	8.6	7.7	8.3	16.3	13.2
50%	16.9	15.8	14.8	24.6	60.3	41.9	23.7	16.2	10.6	10.6	18.2	15.9
10%	23.6	36.3	17.2	42.5	91.1	56.5	28.9	18.0	14.6	31.7	25.7	21.8

Source data: Ecology 2022a

Figure 4-4. Flow Exceedance Values (cfs) at Eightmile Creek, Water Year 2018 to 2020



Source data: Ecology 2022a

Icicle Creek

Icicle Creek extends from the headwaters at Josephine Lake near RM 32 to the confluence with the Wenatchee River. Icicle Creek drains approximately 213 square miles in the Alpine Lakes Wilderness and is the largest subbasin in the Wenatchee River watershed. Major tributaries of Icicle Creek include Leland, French, Eightmile, and Snow creeks. Eightmile Creek enters the mainstem of Icicle Creek near RM 9.0, contributing less than 10 percent of the mean daily flow. The mainstem of Icicle Creek has been divided into five distinct reaches based on major infrastructure and operation (Ecology 2019a). The confluence of Eightmile Creek at Icicle Creek is located within Reach 1. This reach tends to have higher flow than downstream reaches, with significant inflow and few outputs (diversions and withdrawals). Reach 1 ends at the IPID diversion at RM 5.7 where flows become diminished by IPID during the irrigation season (April through September).

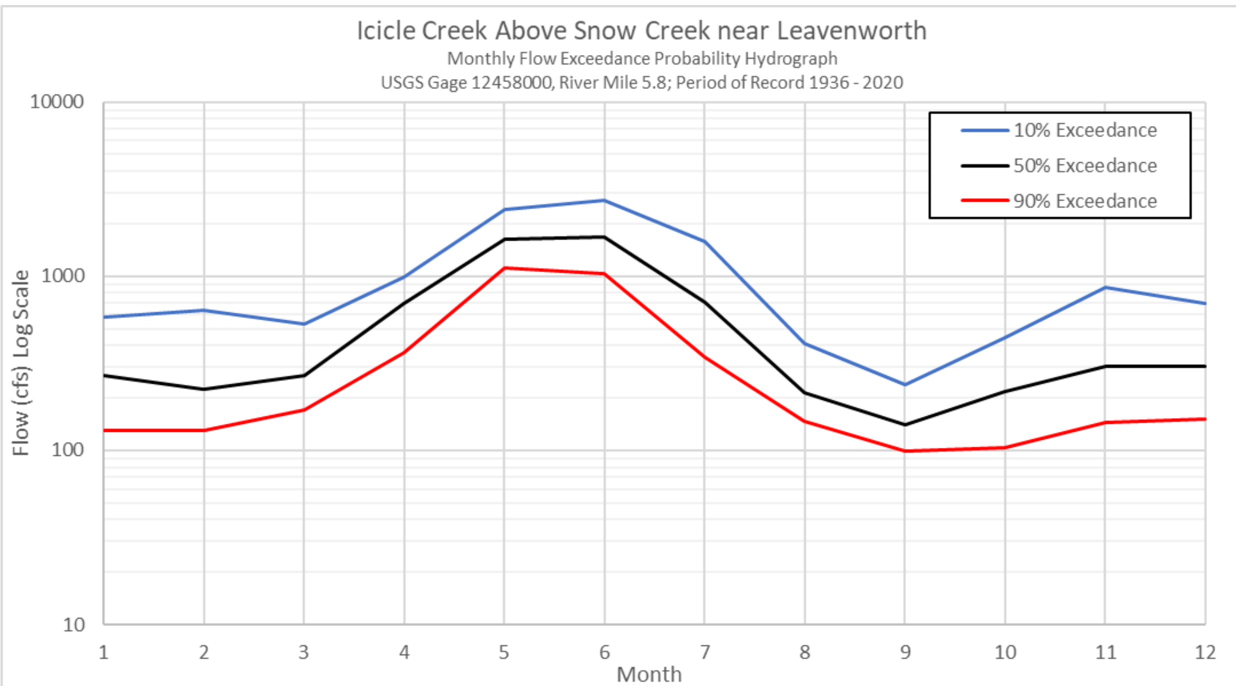
A U.S. Geological Survey (USGS) gaging station (#12458000) is located approximately 3.2 miles downstream of the confluence of Eightmile Creek and Icicle Creek at RM 5.8, which is upstream of any significant flow diversion or withdrawal. Review of the available gage data shows that streamflow peaks in June with snowmelt and steadily declines throughout the rest of summer. Typical low flow occurs by September through early October, until streamflow begins to rise in response to fall precipitation. To describe the seasonal variation of flow as measured at the gaging station, monthly flow exceedance values are summarized in **Table 4-4** and shown in **Figure 4-5**. Flow within Icicle Creek is partially dependent on storage and release of water in the Eightmile Lake and the surrounding Alpine Lakes Wilderness.

Table 4-4. Flow Exceedance Values (cfs) at USGS Gage 12458000 (1936 – 2021)

Exceedance (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
90%	579	634	534	988	2428	2714	1573	411	238	443	866	697
50%	271	224	269	695	1639	1677	706	216	141	216	303	304
10%	131	131	171	361	1122	1036	343	148	99	104	146	152

Source data: USGS 2022

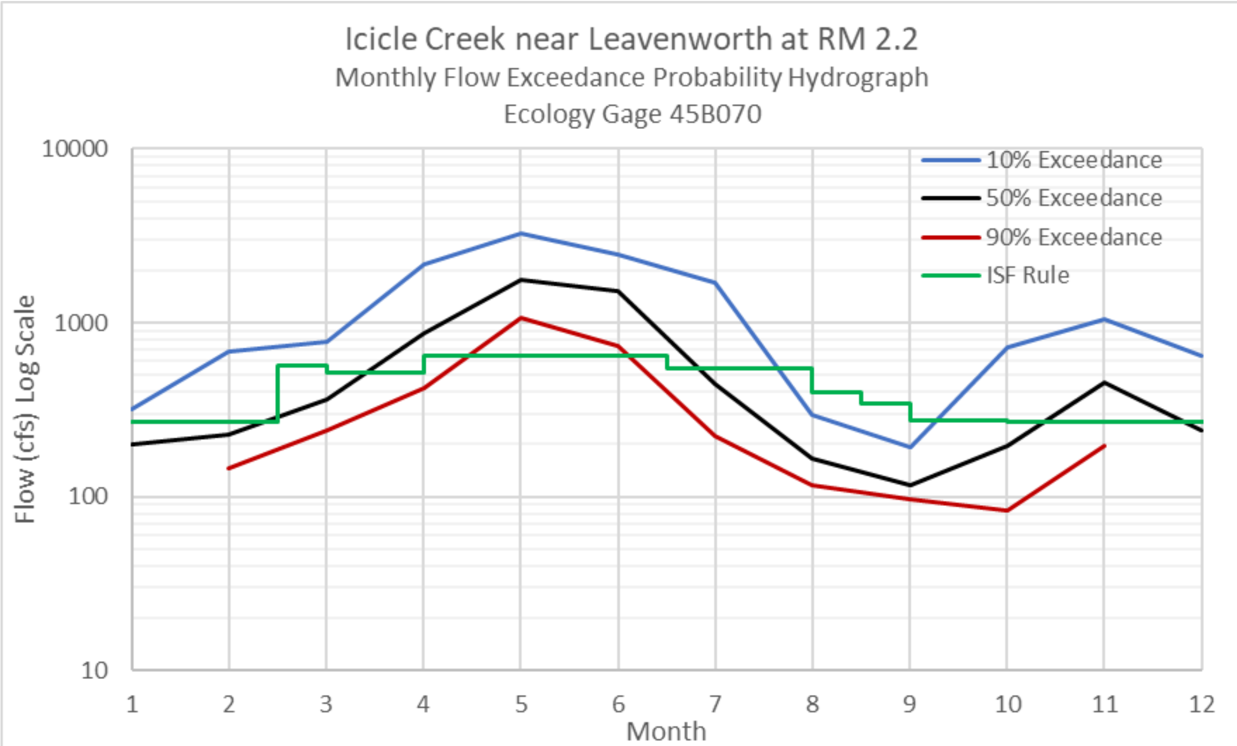
Figure 4-5. Flow Exceedance Values (cfs) at USGS Gage 12458000 (1936 – 2021)



Source data: USGS 2022

An additional stream gage, owned and operated by Ecology (45B070), is located at RM 2.2 within Icicle Creek downstream of the USGS gage. The Ecology gage provides record beginning in May 2007 (**Figure 4-6**). Streamflow within Icicle Creek at RM 2.2 is subject to multiple diversions and withdrawals compared to the upstream USGS gage previously described. Furthermore, Snow Creek enters the mainstem of Icicle Creek between the USGS gage and Ecology gage. Included in Figure 4-6 is the monthly minimum instream flow (ISF) rule specified within WAC 173-545-030. The ISF guides water resource decision-making and management as it relates to minimum surface water flows for ecological resources and communities.

Figure 4-6. Flow Exceedance Values (cfs) at Ecology Gage 45B070 (2007 –2021)



Source data: Ecology 2022a

The Ecology gage is useful for understanding how water management within the Eightmile Creek watershed affects surface water quantity in the lower watershed. A discussion on ISF rules and other water rights that affect flows in Icicle Creek can be found in Chapter 6 of this EIS, including diversions and withdrawals of water.

4.3.2 Water Quality

This section describes water quality conditions for surface waters in the study area, which includes Eightmile Lake, Eightmile Creek to the confluence with Icicle Creek, and Icicle Creek from its confluence with Eightmile Creek downstream to the Wenatchee River (Figure 4-3). In general, the available data and the relatively pristine and undeveloped condition of the contributing watershed suggest generally good water quality conditions in Eightmile Lake and Eightmile Creek. Neither Eightmile Lake nor Eightmile Creek has ever been identified on Ecology's U.S. Environmental Protection Agency (EPA) approved 303(d) list as impaired for any parameter (Ecology 2018a). Ecology's currently approved 303(d) list is from the 2018 Water Quality Assessment, which received final EPA approval on August 26, 2022.

The lower portion of Icicle Creek is identified as impaired for dichlorodiphenyldichloroethylene (4,4'-DDE) and polychlorinated biphenyls (PCBs) in Ecology's current EPA-approved 303(d) list (Ecology 2018a). Portions of Icicle Creek have also been identified in historic 303(d) lists as impaired for parameters including temperature, dissolved oxygen (DO), and pH. The Wenatchee River Watershed Temperature Total Maximum Daily Load (TMDL) (Ecology 2007b) and the Wenatchee River Dissolved Oxygen and pH TMDL (Ecology 2009) were developed in response to listings for those parameters in the Wenatchee River and its tributaries, including Icicle Creek.

Water Quality Standards

Based on the nature of the construction activities and water management operations considered in this EIS, and on the status of the receiving waters, the water quality parameters most relevant to assessing the effects of the project alternatives are temperature, DO, turbidity, and pH. Water quality standards for each of those parameters are identified below, to establish a basis for evaluating the significance of effects on water quality.

Temperature

Washington's temperature standards are established to protect aquatic life, and the criteria that apply to a specific stream are based on designated fish uses of that stream. The applicable criteria for surface waters in the study area are summarized in Table 4-5 and in the following text.

In addition to the numeric temperature criteria shown in Table 4-5, Ecology's surface water quality standards contain other narrative criteria and guidelines for temperature, including the following:

- Moderately acclimated (16°C to 20°C) adult and juvenile salmonids will generally be protected from acute lethality by discrete human actions maintaining the 7-day average of daily maximum (7-DADMax) temperature at or below 22°C and the 1-day maximum (1-DMax) temperature at or below 23°C (WAC 173-201A-200(1)(c)(vii)(A)).
- When a waterbody's temperature is warmer than the criteria (or within 0.3°C of the criteria) and that condition is due to natural causes, then human actions considered cumulatively may not cause the 7-DADMax temperature of that waterbody to increase more than 0.3°C (WAC 173-201A-200(1)(c)(i))[2].
- For lakes, human actions considered cumulatively may not increase the 7-DADMax temperature more than 0.3°C above natural conditions (WAC 173-201A-200(1)(c)(v)).

Table 4-5. Designated Aquatic Life Uses and Temperature Criteria

Stream Segment	Designated Aquatic Life Uses	Criteria (7-DADMax)
Icicle Creek: Upstream from the mouth to the National Forest boundary, including tributaries	Core summer salmonid habitat	16°C*
	Supplemental spawning and incubation (August 15 to July 15)	13°C
Icicle Creek: Upstream from the National Forest boundary to confluence with Jack Creek (approximately 8 miles upstream from the Icicle-Eightmile Creek confluence), including tributaries	Core summer salmonid habitat	16°C
Eightmile Lake and Eightmile Creek	Core summer salmonid habitat**	16°C

Notes:
7-DADMax: 7-day average of daily maximum temperature.
* Applies year-round except when superseded by supplemental spawning and incubation criteria.
** All surface waters within National Parks, National Forests, and/or wilderness areas are to be protected for the designated use of core summer salmonid habitat (WAC 173-201A-600(a)(i)).

[2] These criteria are not currently in effect for Clean Water Act purposes as a result of EPA's 2021 reconsideration and disapproval of Washington's natural conditions criteria in the water quality standards. These criteria remain in effect for other statewide water quality actions. Ecology has initiated rulemaking to revise the natural condition provisions that will respond to EPA's concern and will again meet Clean Water Act approval. For more information, please visit Ecology's website (https://ecology.wa.gov/Regulations-Permits/Laws-rules-rulemaking/Rulemaking/WAC-173-201A-Natural-Conditions).

Dissolved Oxygen

DO is an important water quality parameter because many aquatic species, including fish, need it to survive. Water's capacity to hold DO decreases with increasing temperature, and DO levels are generally lower in summer when flows are lower and temperatures and biological activity are higher.

Similar to temperature, Washington's water quality criteria for DO are based on designated aquatic life uses. The criterion for core summer salmonid habitat is a 1-day minimum of 10.0 milligrams per liter (mg/L) or 95 percent saturation; this applies to Eightmile Lake, Eightmile Creek, and Icicle Creek within the study area.

Washington's water quality criteria for DO state that when DO levels in a stream are lower than the criteria, and that condition is due to natural causes, then human actions considered cumulatively may not cause the DO level of that waterbody to decrease more than 0.2 mg/L (WAC 173-201A-200(1)(d)(i))[2]. For lakes, human actions considered cumulatively may not decrease the DO concentration more than 0.2 mg/L below natural conditions (WAC 173-201A-200(1)(d)(ii)).

Turbidity

Turbidity is a measure of water clarity that is largely influenced by suspended sediments, with higher total suspended solids levels generally associated with higher turbidity levels. Algae can also contribute to elevated turbidity levels. Excessive instream turbidity and suspended sediment can adversely affect fish and aquatic habitat in several ways, including by reducing the amount of light available for aquatic plants, interfering with fish feeding behavior, clogging gills, and silting in spawning gravels. Instream turbidity levels are naturally highly variable. Levels are typically highest in winter months during periods of heavy precipitation and high runoff rates, and lowest in summer when precipitation and runoff are low.

The aquatic life turbidity criteria of WAC-173-201A-200(e), which are applicable to Eightmile Lake, Eightmile Creek, and Icicle Creek in the study area, state that turbidity shall not exceed 5 NTUs over background when the background is 50 NTUs or less, or exceed a 10 percent increase in turbidity when the background is more than 50 NTUs.

The water quality standards of WAC-173-201A-200(e) allow temporary areas of mixing during and immediately after in-water construction activities that disturb sediments, where the turbidity criteria compliance point is some distance from the activity. For construction within or along lakes or other non-flowing bodies of water, the point of compliance is at a radius of 150 feet from the activity. For streams up to 10 cfs flow at the time of construction, the point of compliance is 100 feet downstream. For streams above 10 cfs up to 100 cfs (typical flow conditions in Eightmile Creek below the dam), the point of compliance is 200 feet downstream of the activity.

pH

Water pH is a measure of acidity or basicity, with lower pH values (below 7 Standard Units [SUs]) more acidic and higher pH values more basic. In surface waters, pH is influenced by chemical interactions between water and sediments as well as photosynthesis by aquatic plants and algae. Pollutant discharges that change water chemistry and aquatic biological functions can lead to excessively low or high instream pH, which can be harmful to aquatic organisms that require a limited pH range to survive.

Washington's water quality criteria state in WAC-173-201A-200(g) that freshwater pH should be within the range of 6.5 to 8.5 SUs. Allowable human-caused variation to the standard is limited to 0.2 SUs in areas protected as core summer salmonid habitat.

Eightmile Lake

Published water quality monitoring data for Eightmile Lake are limited. Ecology's Washington State Lakes Environmental Data portal, which includes available information from Ecology's lake water quality monitoring reports and data from Ecology's Environmental Information Management (EIM) database, contains no records for Eightmile Lake (Ecology 2022b).

The USGS monitored water quality in Eightmile Lake on a single date in summer 1974 and a single date in summer 1978. For both monitoring events, samples were collected from two depths: a near-surface sample at 1-meter depth and a deeper sample at 20+ meter depth (23 meters in 1974 and 20 meters in 1978). Overall, the monitoring data showed low nutrient (nitrogen and phosphorus) concentrations, low fecal coliform bacteria levels, low conductivity, high water clarity, and temperature and dissolved oxygen concentrations that reflected warmer summer water temperatures at the lake surface and cooler water temperatures at depth.

Table 4-6 summarizes the monitoring data from the USGS reports for the 1974 and 1978 monitoring events (Dion et al. 1976; Dethier et al. 1979). While these data were not collected recently, they are the best available for the lake and remain relevant because lake operations and the management of the surrounding lands have not changed substantially since the 1970s.

Table 4-6. USGS Monitoring Data for Eightmile Lake

Sample Date	July 31, 1974		August 10, 1978	
Sample Time	1,430	1,435	1,800	1,805
Sample Depth (m)	1	23	1	20
Total nitrite plus nitrate (mg/L)	0.01	0.01	–	–
Total Kjeldahl nitrogen (mg/L)	0.08	0.11	0.10	0.12
Total ammonia (mg/L)	0.05	0.03	0.02	0.02
Total organic nitrogen (mg/L)	0.03	0.08	0.08	0.10
Total phosphorus (mg/L)	0.003	0.005	0.007	0.012
Specific conductance (micromhos)	18	18	20	24
Water temperature (°C)	11.8	4.7	16.0	5.4
Secchi-disc visibility (m)	11		–	
Dissolved oxygen (mg/L)	9.8	10.2	8.2	9.0
Fecal coliform, min., max., and mean (col./100mL)	<1	–	–	–

Source: Dion et al. 1976; Dethier et al. 1979

As shown in Table 4-6, the highest water temperature (16.0°C) and lowest DO concentration (8.2 mg/L) were both recorded in the near-surface sample on August 10, 1978, and the lowest temperature (4.7°) and highest DO concentration (10.2 mg/L) were both recorded in the deep sample (23 meters) on July 31, 1974. Temperature differences between near-surface and deeper samples ranged from 7.1°C for the 1974 sampling and 11.6°C for the 1978 sampling. The datasheet for the 1974 monitoring event included a note stating, "*the DO concentration was high throughout the entire water column,*" and the reports for both years noted little to no coverage of the lake surface or shoreline by emersed plants.

Lake operations for water storage and the surrounding land management (as a National Forest with Wilderness designation established in 1976) are similar today to when the USGS conducted water quality monitoring in the 1970s. Because of the lake's remote location and wilderness protections, the potential for pollutant problems is generally low and limited to the recreational use of the area, which can contribute pollutants including bacteria, nutrients, and sediment to the lake. There are no NPDES-permitted outfalls or other point source discharges to the lake, and no pollution-generating impervious surface contributing stormwater runoff to the lake.

In August 2017, the Jack Creek Fire burned much of the Eightmile Basin adjacent to and upstream of Eightmile Lake, with a substantial portion of the burned area (64 percent) experiencing moderate to high soil burn severities (USFS 2021g). The rates of soil erosion and sediment delivery to Eightmile Lake and Eightmile Creek were likely higher from those areas of moderate and high soil burn severity following the fire and may have contributed to temporarily elevated turbidity levels during periods of heavy precipitation and/or runoff. The erosion potential of the burned areas may remain higher than the pre-fire condition, but the natural re-establishment of vegetation since the fire has reduced erosion potential over time and is expected to continue to reduce the potential for excessive sediment delivery and turbidity in Eightmile Lake and Eightmile Creek, as vegetation continues to mature and vegetation coverage continues to increase.

Ecology has not identified Eightmile Lake as impaired or a water of concern for any parameter on the current EPA-approved Water Quality Assessment or in past assessments (Ecology 2018a).

Eightmile Creek

There are no permanent Ecology water quality monitoring stations on Eightmile Creek, but monitoring data have been collected as part of previous studies documented in Ecology's EIM database. Continuous water temperature monitoring was conducted on Eightmile Creek at two locations in summer 2002. One location (Location ID 45EC02.7) was at RM 2.7 just upstream of the confluence with Mountaineer Creek, and one location was near the mouth, just upstream of the Icicle Creek confluence (Location ID 45EC00.1). Data collected from both stations showed no exceedances of the 16.0°C standard for core summer salmonid habitat for the summer 2002 monitoring period (Ecology 2022b).

Monitoring at the Eightmile Creek station located near the mouth also included periodic sample collection for other parameters from June 2002 to January 2003. Sample parameters included DO, turbidity, pH, nutrients, and others. Sample results indicated good water quality conditions on all sample dates, with high DO concentrations ranging from a low of 9.7 to a high 13.6 mg/L, low stream turbidity (1.4 NTUs or lower for all samples), pH within standards in a range of 7.4 to 8.1 SU, and low levels of nitrogen and phosphorus (Ecology 2022b).

Ecology's current EPA-approved Water Quality Assessment identifies the lower portion of Eightmile Creek (where water quality data have been collected) as a "Category 1" water, which means that it meets water quality standards. Eightmile Creek has no listed impairments on the current or historic Water Quality Assessment and 303(d) lists (Ecology 2018a).

There are no NPDES-permitted outfalls to Eightmile Creek (Ecology 2022c, EPA 2022).

Icicle Creek

Monitoring data for Icicle Creek have indicated exceedances of water quality criteria for temperature, DO, and pH. Ecology has documented temperature criteria exceedances in sections of Icicle Creek both upstream of the Eightmile Creek confluence as well as within the study area between Eightmile Creek and the Wenatchee River. Documented DO and pH criteria exceedances have been limited to the lower portion of the Icicle Creek near the confluence with the Wenatchee River (Ecology 2018a).

The temperature listings are addressed in the Wenatchee River Watershed Temperature TMDL, which was approved by EPA in August 2007. The temperature TMDL establishes load allocations for effective shade targets for Icicle Creek and other streams in the watershed. The load allocation for effective shade for all perennial streams in the watershed is the potential shade that would occur from mature riparian vegetation (Ecology 2007b). The temperature TMDL also establishes wasteload allocations for selected NPDES-permitted point source dischargers, including the Leavenworth Wastewater Treatment Plant (WWTP) and the LNFH, both of which discharge to Icicle Creek.

The DO and pH criteria exceedances are addressed in the Wenatchee River Watershed Dissolved Oxygen and pH TMDL: Water Quality Improvement Plan, which was approved by EPA in August 2009. The Water Quality Improvement Plan identifies the need for large reductions in point sources and non-point sources of phosphorus loading in the Wenatchee River and Icicle Creek to achieve DO and pH targets. Point sources include NPDES permitted discharges and fish hatcheries, and the TMDL established wasteload allocations for the Leavenworth WWTP and the LNFH (Ecology 2009). Non-point sources of phosphorus loading include leaking septic systems.

Ecology's current EPA-approved 303(d) list identifies a portion of lower Icicle Creek in the vicinity of the East Leavenworth Road Bridge as impaired for 4,4'-DDE and PCBs. 4,4'-DDE is an organochlorine pesticide and a breakdown product of DDT. PCBs are a class of chlorinated hydrocarbons that were historically used in various commercial and industrial applications (e.g., electrical transformers and other electrical equipment, fluorescent light ballasts, plasticizers), prior to the banning of their manufacture in the U.S. in 1979. The 303(d) listings for 4,4'-DDE and PCBs in lower Icicle Creek are based on results of tissue samples from mountain whitefish (*Prosopium williamsoni*) that showed fish tissue equivalent concentration exceedances (Ecology 2018a). The sampled fish were collected from lower Icicle Creek approximately 2.6 miles upstream of the confluence with the Wenatchee River.

Ecology conducted a source assessment of DDT and PCBs in the Wenatchee River watershed (Hobbs and Friese 2016) in response to their detected presence in fish tissue samples in multiple locations in the watershed, including the Icicle Creek location noted above. The investigation identified two distinct sources of PCBs in the Wenatchee River, both of which are in the lower river downstream of Cashmere and outside of the study area for this EIS. Ecology determined that the main known sources of DDT–which was widely applied to orchard crops in the Wenatchee River watershed prior its federal ban in 1972–are within the Mission and Chumstick Creek sub-basins. The study concluded that the diet of mountain whitefish is selective (caddis flies and mayflies) and the location of the contaminated food source is confined to the lower Wenatchee River. The source assessment specifically noted that the source of PCBs to the Wenatchee River is approximately 10 miles downstream of where the fish tissue samples were collected in Icicle Creek (Hobbs and Friese 2016).

4.3.3 Climate Change and Surface Water

Climate change represents a challenge for planning, usage, and protection of surface water and associated surface water resources in the Icicle–Eightmile Creek Watershed. During the past 100 years, the Pacific Northwest has become warmer and wetter (Mote et al. 2005), and models predict a continuation in this trend. These changes may result in increased uncertainty in the timing, form, and distribution of precipitation and water demand. This section provides a regional context of the Eightmile Lake climate and changes anticipated based on available research and collected data.

The study area is in Climate Region 14 as documented by the Technical Note 3 of the Department of Ecology Dam Safety Guidelines (Ecology 1993). Eightmile Lake and the surrounding Alpine Lakes Wilderness are east of the Cascade crest, where the climate is generally warmer and drier in contrast to valleys surrounding the Puget Sound. The Cascade crest creates a regional dichotomy in climate, with rain-shadow effects driving drier conditions and creating a barrier between the maritime low pressure and continental high pressure. This pattern holds true for the lower Icicle Creek watershed. The low-level outlet pipe at Eightmile Lake is at an elevation of approximately 4,648.7 feet with the basin extending up to 7,780 feet, where considerable precipitation in the upper watershed falls as snow, while precipitation in the lower watershed comes predominantly as rain. Because of its location and elevation, the Eightmile Lake watershed receives approximately 65 inches of precipitation, primarily as snowfall (Anchor QEA 2019). In the eastern lowlands below Eightmile Lake, average annual precipitation is generally less than 20 inches, with some areas receiving as little as little as 7 inches (Ecology 2019a).

The Climate Impacts Group (CIG) at the University of Washington made regionalized climate projections as part of their *2009 Washington Climate Change Impacts Assessment* (CIG 2009). The CIG projected that probable climate impacts within the Pacific Northwest include a decreased April 1 snowpack by as much as 40 percent in the 2040s and an average annual temperature warming rate of approximately +0.5°F per decade in the 21st century (CIG 2009). The conclusions of the assessment include a shifting seasonality for the onset of snowmelt earlier in the water year, driven by more transient precipitation occurring as rainfall. The combination of reduced snowpack and shifting seasonality earlier in the water year will result in reduced reservoir storage refill in the late spring and early summer months, and therefore less water available for supply and irrigation during critical months toward the end of the water year.

Climate modeling indicates that the changes described will have substantial impacts on streamflow in Icicle Creek (Mauger et al. 2017), which includes smaller tributaries such as Eightmile Creek. Within Icicle Creek, climate modeling predicts that the minimum average flow will decrease by as much as 75 percent by 2050 for a 2-year return period. In contrast, an increase in peak flow is predicted by up to 58 percent, which suggests that surface waters will generally become flashier with lower baseflow and a higher peak flow. Table 4-7 provides the average monthly change in streamflow. Although these changes in streamflow were calculated for Icicle Creek, a similar percent change in streamflow can be assumed for Eightmile Creek, which is a tributary to Icicle Creek. Eightmile Creek is subject to the same climatic changes as Icicle Creek and therefore will likely experience similar percent changes in streamflow, not considering dam operations.

Table 4-7. Average Streamflow Percent Change in Icicle Creek from Climate Change Modeling for 2050 (Mauger et al. 2017)

Month	Low	Mid	High
October	5	8	9
November	27	32	55
December	16	63	106
January	14	63	201
February	32	57	206
March	41	67	244
April	9	102	143
May	-7	4	35
June	-50	-28	9
July	-71	-41	-28
August	-75	-62	-31
September	-41	-39	-20

Climate predictions are based on Global Climate Models (GCMs). To obtain localized projections of climate change and resulting impacts, statistical downscaling is applied to GCMs using empirical relationships between observed, site-specific climatology and coarser-scale modeling. Downscaling is the process of extracting localized data from global or regional climate models. Specific to the study area, downscaling was performed in 2017 as part of the Icicle Work Group (IWG) *Changing Streamflow in Icicle, Peshastin, and Mission Creeks* to inform water management decision-making. Downscaling is based on 1/16-degree gridded historic observed temperature and precipitation (Mauger et al. 2017).

A summary of anticipated hydrologic changes specific to the study area is provided based on the GCM 2050 low greenhouse gas modeling scenario, known as Relative Concentration Pathway (RCP) 4.5. For both Eightmile Lake and Icicle Creek, results of climate change modeling indicate a reduction in peak flow of approximately 15–20 percent and a shift in peak flow timing from June to May in 2050. Winter flows were observed to increase approximately 40–60 percent because of a greater amount of precipitation occurring as rainfall. Changes become more significant moving downstream in the watershed and further in time through the 2080 modeling scenario. Under medium and high greenhouse gas emission modeling scenarios (Scenario A1B and RCP 8.5), the results become accelerated and exaggerated.

Figure 4-7 and Figure 4-8 show the 2050 projection for monthly streamflow under a low greenhouse gas emissions scenario for both Eightmile Lake and Icicle Creek. In Figure 4-7 the historical streamflow is shown in orange, with peak streamflow occurring around late June and exceeding 90 cfs. Throughout most of the late-summer through early spring, flows are low, less than 10 cfs. Under the various climate models shown in light blue (with dark blue representing the average of the ensembled models), the peak streamflow shifts forward to early May with a decrease in peak streamflow rate. The flows in winter and spring are considerably higher than under historical conditions, averaging around 15 cfs. Mid- and late-summer flows are considerably lower under the climate change conditions, primarily because the falling limb of the hydrograph has shifted forward in the year. This means that in June, July, and August, streamflow will be much lower than under historical conditions. These mid- to late-season flows in the upper Eightmile watershed contribute to Eightmile Lake reservoir refill.

Figure 4-8 shows a similar trend for Icicle Creek, with an even more pronounced shift and drop in peak streamflow timing and magnitude. In mid- to late-summer, flows in Icicle Creek are predicted to decrease substantially to flow rates less than 300 cfs. This has major implications for water users and water withdrawals from Icicle Creek.

Figure 4-7. Eightmile Lake Modeled 2050 Flows (Low Greenhouse Gas Emissions) (Mauger et al. 2017)

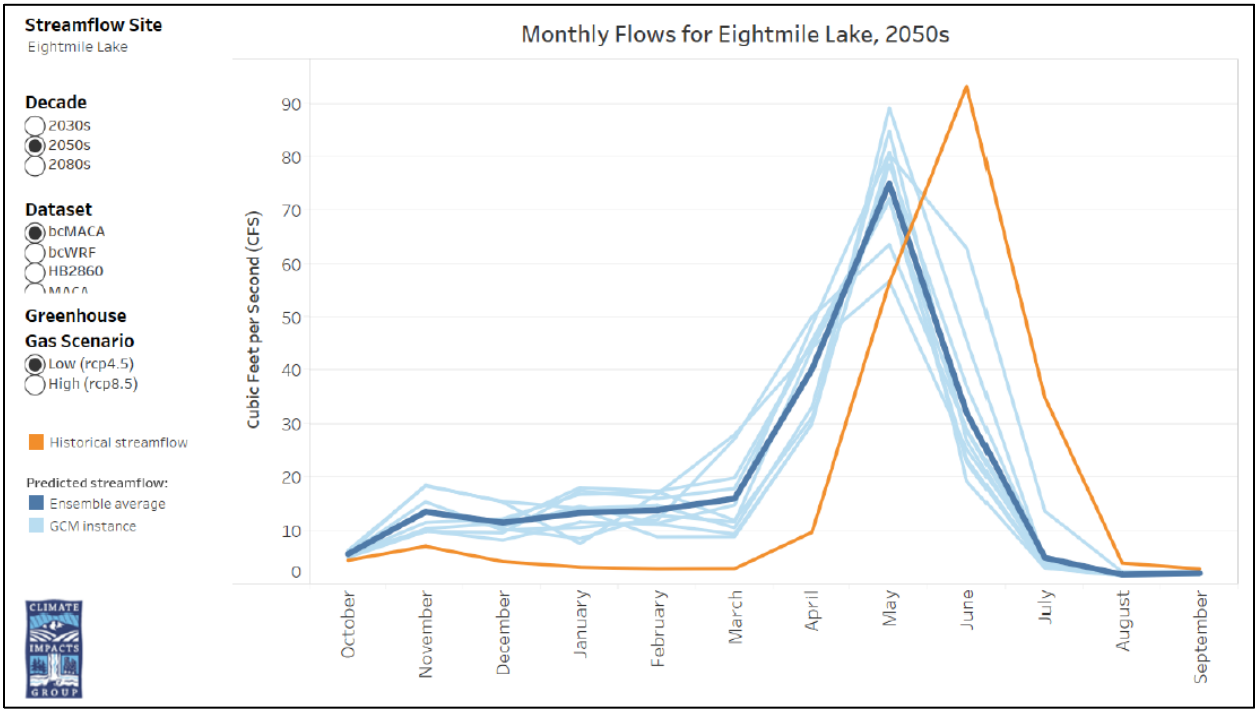
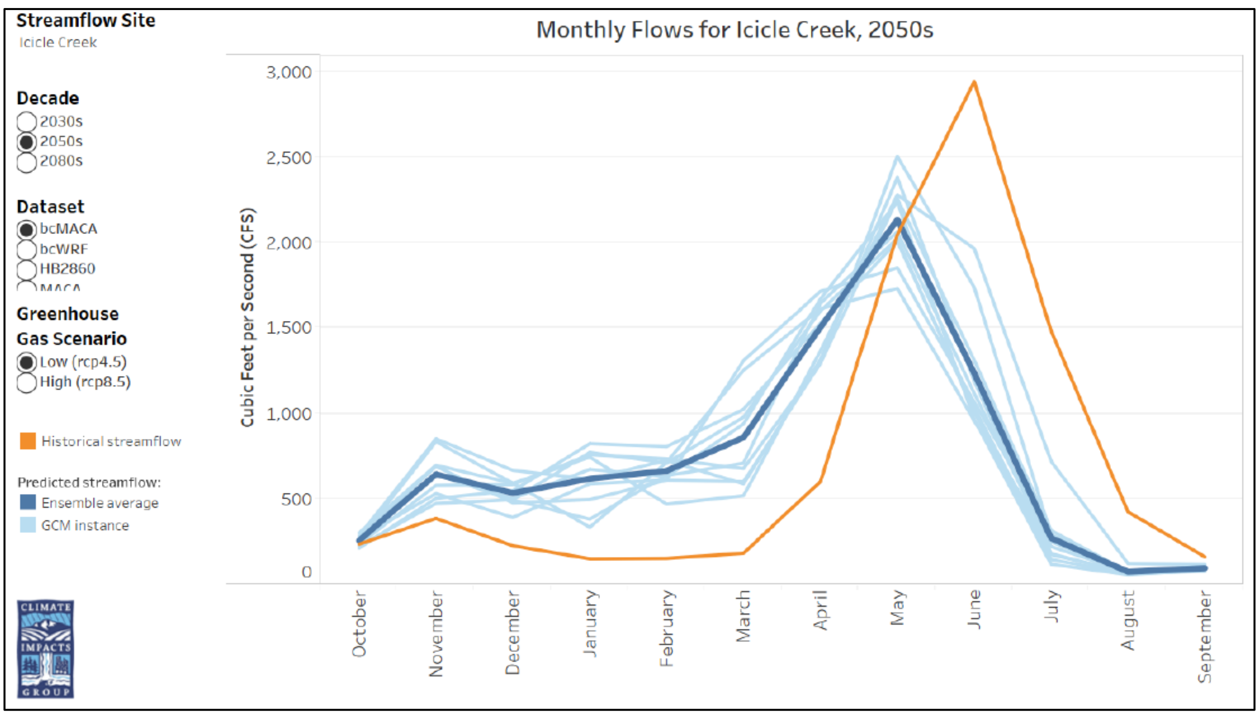


Figure 4-8. Icicle Creek Modeled 2050 Flows (Low Greenhouse Gas Emissions) (Mauger et al. 2017)



4.4 Construction Impacts

Project-related impacts during construction are described below for both surface water quantity and surface water quality, organized by alternative. Construction methods such as the helicopter access options are not specifically addressed in this chapter as they have no effect on surface water quantity or quality.

4.4.1 No Action Alternative

Surface Water Quantity and Quality

Under the No Action Alternative, no construction would occur; therefore, there would be no construction impacts on surface water quantity and quality. There would be a risk of dam failure, which could lead to additional emergency repairs. In addition, if DSO were to exercise enforcement action in accordance with WAC 173-175-620(3), impacts like those described below for construction would occur. The duration of removal activities would be substantially shorter than for construction of any of the action alternatives.

4.4.2 Impacts Common to All Action Alternatives

There is no anticipated variation in construction impacts among the action alternatives because all action alternatives require the lake level to be lowered to approximately the same elevation for approximately the same duration of time during project construction. Lake level lowering, dewatering pumping, and restriction of releases are the primary construction actions that affect water resources.

Surface Water Quantity

The primary impact on surface water quantity is that the lake and creek would have less water than usual throughout construction; however, these reductions would not be reduced in magnitude and duration to a point that would be detrimental to aquatic life, or the ability of water rights holders to make withdrawals.

Construction activities would begin in mid-June or as soon as the snow conditions allow. The work at the lake would need to be completed after the lake has been drawn down well below the existing low-level outlet pipe so that work can be completed “in the dry.” Excavation would start as soon as the lake water level was below elevation 4,661 feet. When the lake level is at 4,661 feet, the creek bed at the lake would be dry. Once the lake elevation drops below 4,650 feet, the new low-level outlet pipe would be installed. Water would exit the lake via the newly installed low-level outlet pipe throughout construction. Once the new low-level outlet pipe is installed, cofferdams would be installed, and the existing dam structure and low-level outlet pipe would be removed. Pumps would be used to dewater work areas as needed. Cofferdams would be constructed using large bulk bags, which would also be used to transport items up to the lake.

When the reservoir was actively operated to provide storage for IPID, the lake was not typically drawn down until summer, when IPID opened the gate to releases water to maintain irrigation water supply downstream. More recently, to address concerns expressed by Ecology’s DSO, IPID has left the gate open on the outlet, which has resulted in the lake being drawn down below the outlet earlier in the year and for a longer period each year. This is the proposed mode of operation during the year that the improvements are constructed. Early drawdown has resulted in up to approximately 40 cfs less streamflow being discharged to Eightmile Creek in mid- to late summer. During the year that the improvements are constructed, temporary pumping equipment and the newly constructed low-level outlet pipe may be used, if needed, to divert water from the lake through the work area, to keep the lake level low until construction is completed. This could increase streamflows in Eightmile Creek during the fall, likely on the order of 5 to 10 cfs above normal flow rates; however, the increased flow rate would depend on precipitation during the construction year and the resulting need to pump or divert water from the lake through the work area during construction. If the lake is drawn down at the beginning of construction and there is little precipitation during construction, there may be no need to pump or divert water from the lake through the work area during construction.

The expected changes in the timing and magnitude of flow into Eightmile Creek represent **less-than-significant impacts** on water quantity because these streamflow volumes and timing are within the typical range of current reservoir operation, considering the year-to-year variation in the hydrologic cycle.

Surface Water Quality

Construction activities could temporarily affect surface water quality through in-water work for the excavation and installation of the new low-level outlet pipe and the installation of the cofferdams to isolate the dam work area from Eightmile Lake and Eightmile Creek. Related disturbance of sediments would likely result in short-term, localized increases in turbidity, which could result in short-term increases in water temperature since suspended sediments absorb heat from solar radiation more efficiently than water. A temporary increase in water temperatures would result in a corresponding temporary decrease in DO levels.

Upland construction activities in areas adjacent to Eightmile Lake and Eightmile Creek also present a potential to affect surface water quality. Vegetation clearing, excavation, and fill placement for staging areas and dam construction would expose soils and temporarily increase the potential for soil mobilization and transport to surface waters in stormwater runoff, until vegetation in disturbed areas is re-established through planting after construction. The trail rerouting, road improvement work, and installation of the repeater station could also pose a risk for sediment mobilization; however, these are expected to be minimal due to the limited amount of clearing associated with each activity and the distance to a surface waterbody. Drawing down the lake earlier than normal to facilitate construction would also temporarily increase the potential for erosion and sediment mobilization along the shoreline by exposing normally submerged soils/sediments to precipitation (summer storms) earlier than normal. All activities that may mobilize sediment will be accompanied by appropriate sediment best management practices (BMPs), including installation of silt fences, coir logs, and turbidity curtains. These temporary sediment control measures would prevent significant turbidity and sediment accumulation in the lake and in the stream until the site is permanently stabilized through planting after construction.

The use of construction equipment on-site would increase the potential for pollutants (e.g., fuel, oil and grease, hydraulic fluid) to enter surface waters from accidental releases. The construction of all action alternatives would also include concrete pouring to construct a new spillway. Wet or curing concrete can raise pH in surface waters that come into contact with it. However, the concrete pours for the spillway would be performed in the dry, at low lake levels and isolated from the lake and creek by a cofferdam. Surface water contact with curing concrete is therefore not expected.

Construction would take approximately 4 months to complete starting in approximately mid-June, with the potential for water quality impacts from in-water work associated primarily with the early portion of the construction period, until the dam work area is fully isolated by the cofferdams. The potential for water quality impacts from in-water and upland construction activities would generally be similar for all three action alternatives. Alternative 2 (wide spillway without gates) would involve construction of a longer dam and require more earthwork and a larger construction footprint–including a larger staging area–than Alternatives 1 and 3, presenting a potential for a greater extent and duration of water quality impacts than the other action alternatives.

Construction activities within and adjacent to Eightmile Lake and Eightmile Creek would be performed under the regulation of federal and state permits, including a U.S. Army Corps of Engineers (Corps) Section 404 permit, an Ecology 401 Water Quality Certification, a WDFW HPA, and an NPDES Construction Stormwater Permit. Those permits would require the implementation of erosion, sediment, and pollution control measures during and after construction. The 401 Certification would include additional conditions related to water quality protection such as requirements for monitoring turbidity during in-water work to ensure that water quality standards are met at the mixing zone compliance points and that work is stopped if permitted threshold are exceeded, until problems are addressed.

After construction is completed, all supplies, construction waste, and equipment would be removed by helicopter. The area around the site disturbed by the work, temporary trail relocation, or used for construction staging would be restored. The staging area would be returned to natural looking contours. Native vegetation would be replanted in disturbed areas, following a plan approved by the Forest Service.

With appropriate construction control measures, best management practices, and monitoring programs in place as required by permits, construction-related short-term variations in stream turbidity, temperature, dissolved oxygen, and pollutant discharges are expected to be within limits allowed by water quality standards, and therefore would represent less-than-significant adverse impacts on water quality.

4.5 Operational Impacts

The section describes the long-term operational impacts associated with the project alternatives, including the No Action Alternative. Operational impacts include improvements and deficiencies to reservoir storage, control, and telemetry. Impacts that do not rise to the level of significance described in Section 4.1 are considered less-than-significant.

Table 4-8 summarizes the relevant elevations, areas, volumes, and flow rates described throughout this section for the No Action Alternative and the three action alternatives.

4.5.1 No Action Alternative

Surface Water Quantity

Under the No Action Alternative, reservoir storage would remain limited to the current active storage volume of approximately 1,151 acre-feet, roughly 540 acre-feet less than the lake’s historical maximum potential operational capacity of 1,698 acre-feet, at least in the short term while the existing dam remains functional and authorized for use. Gate operation controlling reservoir drawdown requires IPID personnel to use a come-along tool (a type of winch) to open and close the gate, making opening and closing the gate difficult. In the short term, the lake would continue to be drawn down to elevation 4,648.7 feet annually by late September, until fall precipitation begins to refill the reservoir. Due to embankment damage, storage capacity is reduced and a lower lake level has the potential to impact groundwater processes that may support hyporheic exchange into Eightmile Creek and adjacent wetlands.

Water released from the reservoir into Eightmile Creek between July and September would follow existing operational patterns (release of between 20 and 35 cfs over an approximate 6- to 8-week period), unless operational restrictions are met (e.g., flows in Icicle Creek are below the water rights that are senior in priority to the Eightmile Lake storage right). Historical release rates from Eightmile Lake are in the range of 40 to 50 cfs (Aspect 2022a). Therefore, in the short term, the No Action Alternative represents a continuation of the current practice of 30 to 50 percent reduction in maximum release rates relative to historical conditions.

Table 4-8. Summary of Operational Conditions for Eightmile Dam, by Alternative

Eightmile Lake Consideration[1]	No Action Alternative[2]	Action Alternatives		
		Narrow Spillway with Gates (Alternative 1)	Wide Spillway without Gates (Alternative 2)	Narrow Spillway without Gates (Alternative 3)
Automation	None	Automated primary spillway control gate and automated low-level outlet pipe	Automated low-level outlet pipe	Automated low-level outlet pipe
Max. Lake WSEL (feet)	4,667	4,671	4,671	4,667
Min. WSEL Without Pumping (feet)[4]	4,640	4,636	4,636	4,636
Max. Lake Area (acres)	76.6	81.4	81.4	76.6
Min. Lake Area (acres)	~41.2	38.7	38.7	38.7
Max. Lake Volume (acre-feet)	2,698	3,010	3,010	2,698
Min. Lake Volume (acre-feet)	~1,158	1,010	1,010	1,010
Active Storage Volume (acre-feet)	~1,540	2,000	2,000	1,698
When would lake be full?	Annually; Mid-May–Late July	Annually; Mid-May–Late July	Annually; Mid-May–Late July	Annually; Mid-May–Late July
When would Lake be drawn down to lowest level?	Almost Every Year; Late Sept–Early Oct	Only Drought Years; (~1 in 5 Years); Late Sep–Early Oct	Only Drought Years; (~1 in 5 Years); Late Sep–Early Oct	Only Drought Years; (~1 in 5 Years); Late Sep–Early Oct
Typical summer flow release from outlet pipe	20 to 35 cfs Jul 1- Late Aug	Estimated 20 to 40 cfs Jul 1–Late Aug	Estimated 20 to 40 cfs Jul 1–Late Aug	Estimated 20 to 40 cfs Jul 1–Late Aug
Typical 50% Exceedance Flow in Eightmile Creek[3]	23.7 cfs – July 16.2 cfs – August	Estimated 28.7 cfs – July Estimated 21.2 cfs - August	Estimated 28.7 cfs – July Estimated 21.2 cfs – August	Estimated 28.7 cfs – July Estimated 21.2 cfs – August
Summer minimum flow release from outlet pipe	0 cfs	0 cfs	0 cfs	0 cfs

1. Physical attributes of Eightmile Lake and associated operational estimates do not include climate change considerations discussed in Chapter 4.
2. No change to the existing dam or operations (same as existing conditions), until dam failure or the DSO requires removal.
3. Exceedance values were calculated from existing flow rate data at the Ecology gage 45W003 between May 2018 and June 2020. A longer record of flow rates will provide more-representative exceedance flow rates.

Eightmile Lake Consideration[1]	No Action Alternative[2]	Action Alternatives		
		Narrow Spillway with Gates (Alternative 1)	Wide Spillway without Gates (Alternative 2)	Narrow Spillway without Gates (Alternative 3)

4. This elevation represents the lowest drawdown that would occur without pumping. Under existing conditions, the lake is typically drawn down to the low-level outlet pipe invert elevation (4,648.7 feet) during the late summer. The lake level continues to drop during the late summer due to seepage through the landslide deposits that underlie the dam until precipitation begins to refill the lake. The lowest observed drawdown in recent years is estimated to be approximately 4,640 feet. Under each of the action alternatives, IPID will monitor and manage the lake WSEL and drawdown so that the lake WSEL does not fall lower than 4,636 feet, as shown in the table.

According to the Ecology's DSO, the hazard classification for the dam has been changed from "Low" to "High." Under the No Action Alternative, the dam would be left in its current condition, vulnerable to failure, which has the potential to threaten human lives and create economic hardship for the IPID. Should a dam failure occur, downstream residences, public infrastructure, and wildlife habitat may be damaged or destroyed. Uncontrolled erosion from a dam failure could cause major channel change in Eightmile Creek. If a catastrophic dam failure occurred, it would release up to 15,000 cfs of flow into Eightmile Creek during a natural high-flow event (approximately 10,000 cfs) (Anchor QEA 2018b). Additional details on the impacts of dam failure are provided in Chapter 12, *Public Safety*. Currently, DSO requires IPID to leave the low-level outlet pipe open during the winter and early spring to reduce the risk of a dam failure; IPID has currently removed all of the stop logs that allow for a maximum elevation of 4,667-feet. The long-term operation of the dam in this manner is not consistent with DSO regulations, does not meet the DSO's safety requirements for a High Hazard Dam, and ultimately may result in enforcement action by the DSO, which could include removal of the dam.

Were an enforcement action to be taken by DSO, the lake outlet elevation would likely be lowered to at least an elevation of 4,648 feet. This would likely also cause erosion and potentially a complete loss of the natural outlet of Little Eightmile Lake, which currently offers a limited amount of water storage within the Eightmile Creek System. Under either of these scenarios, the dam and low-level outlet pipe would likely no longer be operable. Lake area and volume at maximum WSEL would be substantially less than under existing conditions (particularly in the event of a catastrophic dam failure), and flows would overtop the lake outlet without passing through the low-level outlet pipe and control gate.

If the control gate and low-level outlet pipe no longer operate, flows in Eightmile Creek would generally match inflows to Eightmile Lake in a "run-of-river" manner (i.e., flows into the lake equal flows out) for much of the year, except during fall periods of initial lake refill where flows in Eightmile Creek would remain low or dry until the lake refills to the channel outlet elevation. This would mean that during the summer dry season (when inflows to the lake and streambed from snowmelt, precipitation, and groundwater are small), the flow within Eightmile Creek would be small or potentially dry in the upper reaches of the creek. Existing and historic operations practices of the dam have supplemented 20 to 35 cfs of flow to Eightmile Creek from the low-level outlet pipe during the first 6 to 8 weeks of the summer season, typically beginning July 1 of each year. These contributions of stored water to supplement streamflow would no longer be possible under an enforcement action or dam failure. Instead, flows in the creek would entirely depend on the direct inflow from the surrounding basin. Assuming no change in operation of Colchuck Lake or other water control structures on Icicle Creek, the loss of these Eightmile Lake contributions could reduce flows in Icicle Creek in July and August by up to approximately 3 to 15 percent during normal conditions and by approximately 6 to 24 percent during drought conditions. Due to climate change, summer streamflow in the study area is predicted to be further reduced by up to 75 percent in Icicle Creek and likely within its tributaries (including Eightmile Creek). This would further reduce summer flows within Eightmile and Icicle creeks if a dam failure or enforcement action were to remove the ability to adaptively manage flows from Eightmile Lake.

The loss of the ability to control stored water releases would make it more difficult to predict flows in Eightmile Creek for downstream water users and to adaptively manage releases during the summer to meet water needs. A potential massive erosion event following a dam failure has the potential to cause large-scale channel change and damage to structures throughout Eightmile Creek and lower Icicle Creek. These changes would result in **significant impacts** on lake storage and flow releases relative to existing conditions, as there would be a permanent change in releases that would be detrimental to aquatic life and reduce IPID's ability to make withdrawals. The No Action Alternative provides no benefits to the management of surface water resources within the study area.

Surface Water Quality

Under the No Action Alternative, assuming the dam continues to operate as it does currently, there would be no changes in water quality relative to existing conditions. However, two potential scenarios could result from the No Action Alternative that would affect water quality conditions in the lake and downstream: (1) the DSO requires removal of the dam due to safety concerns, or (2) the dam fails.

Removal of the existing dam could be designed and constructed in a planned way that would limit the potential for significant construction-related water quality impacts. However, as described in the *Water Quantity* section above, dam removal would lower the lake's outlet elevation, reduce lake storage, and reduce cool-water lake contributions to streamflow during summer low-flow periods downstream in Eightmile Lake and Icicle Creek. Such changes in hydrology, which could reduce flows in Icicle Creek in July and August by up to approximately 24 percent during drought conditions, could result in **significant impacts** on summer stream temperature and DO levels relative to existing conditions.

A catastrophic dam failure would ultimately result in similar long-term impacts on stream temperature and DO as the dam removal scenario described above, by reducing lake storage and contributions to downstream flows during the summer low-flow period. A catastrophic dam failure and the resultant release of stored water could also result in substantial downstream erosion, sediment transport, and flooding in Eightmile Creek and Icicle Creek to the confluence with the Wenatchee River. In addition to long-term impacts on water temperature and DO, a catastrophic dam failure would result in **significant impacts** from substantially increased turbidity from suspended sediment. Additionally, significant water quality impacts could result from mobilization of pollutants–including bacteria, nutrients, pesticides, and hazardous materials–from floodplain areas subject to sudden inundation by floodwaters.

Climate Change and Surface Water

With climate change, summer streamflow in the study area is predicted to be reduced by up to 75 percent in Icicle Creek and likely within its tributaries (including Eightmile Creek) compared to present-day flows. This will further reduce summer flows within Eightmile and Icicle creeks, and if a dam failure or enforcement action were to occur, there would be extremely limited ability to manage flows in Eightmile Creek for instream use or for downstream water users (i.e., release water stored during the wet season to supplement dry season flow rates). Given the limited ability to manage reservoir storage and outflow, the ability for IPID to adaptively operate the reservoir in response to changes in inflow timing and magnitude is limited. This represents a **significant impact** as there would be a substantial reduction in the ability to manage instream flows to support aquatic life and allow water rights holders to make withdrawals.

The No Action Alternative provides no benefits to future management for surface water resources with consideration of climate change within the study area.

4.5.2 Alternative 1: Narrow Spillway with Gates

Surface Water Quantity

Alternative 1 includes replacement of the existing dam with an earthen embankment and reinforced concrete dam structure equipped with automated control gates over the primary spillway. The gates would allow IPID to control the water level within the top 4 feet of the lake, up to a maximum elevation of 4,671.0 feet. Water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. This would allow the lake to be drawn down to a low-water surface elevation of 4,636 feet, which would allow access to stored water without pumping. IPID would release water during the late summer to maintain the water supply available for authorized diversions and instream flows in Icicle Creek. Releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream water supply and instream flow needs.

Alternative 1 provides an operational drawdown of up to 35 feet and up to 2,000 acre-feet of active storage without pumping. The restored storage volume would provide additional instream flow based on releasing up to an additional 600 acre-feet of water. Releases from the reservoir would be managed remotely by IPID and would be between 20 and 35 cfs from June through August. Release rates would be within limits of trust donation quantities and in accordance with terms of agreement; release rates would continue to vary depending on seasonal hydrology, instream flow rules, and irrigation needs. Additional storage capacity would allow IPID to release increased flow rates and/or increase the duration of flow releases (i.e., potentially release for more than 8 weeks or at maximum flow rates exceeding 35 cfs). During the winter months, additional inflow would be captured and stored within the reservoir rather than conveyed downstream. This would result in a minor reduction (less than 1 cfs on average) in wet season flow rates. Wet season flow rates are typically between 15 and 60 cfs (see Table 4-3), so a reduction in 1 cfs on average would be **less-than-significant.**

Alternative 1 would allow the lake to fill to a level that provides up to 4.8 acres more lake surface area than existing conditions (a 6 percent increase over existing conditions), and would also allow the lake to be drawn down to a level to provide a lake area of 2.5 acres less than could occur under existing conditions (a 6 percent decrease over existing conditions). Although the lake area has a potential for larger fluctuations as compared to existing conditions, the relatively small increases and decreases of 6 percent or less would not substantially alter water resources in the lake. This minor percent variation would not substantively change lake hydrology.

Alternative 1 would have **substantial benefits** to surface water resources because it provides IPID the ability to optimize reservoir operation, including water storage and downstream release for irrigation supply, and augmentation of instream flows during both drought and non-drought years. The combined total use for storage and instream flow with Eightmile Creek would remain within the limits of existing storage water right and there would not be enlargement of existing rights. There are **no significant adverse impacts** on surface water quantity for Alternative 1.

Surface Water Quality

No significant adverse impacts on water quality are expected from operations under Alternative 1. The greater potential range in maximum and minimum water surface elevations in the lake relative to existing conditions would represent relatively small changes in maximum and minimum lake surface area (a 6 percent increase/decrease). As noted in the *Water Quantity* section above, this small variation would not substantially change lake hydrology, and it would also not substantially change water quality conditions in the lake. Shoreline conditions would remain similar to existing lake levels in terms of riparian vegetation coverage (shading), nature of the adjacent bedrock and talus slopes (erosion potential), and proximity to human recreational uses (potential for exposure to camping litter, bacteria).

The greater water storage potential for Alternative 1 relative to existing conditions, and the greater flexibility for managing release rates during a wider range of conditions in both drought and non-drought years, could provide a **substantial benefit** for downstream water quality in Eightmile Creek and Icicle Creek during summer low-flow conditions. Augmenting baseline streamflows with cool water releases from the low-level outlet pipe could benefit downstream temperature and DO conditions in particular, when baseline water temperatures are highest and DO levels are lowest.

The greater storage potential of the lake under Alternative 1 provides opportunity for some additional peak flow attenuation relative to existing conditions, which could reduce excessive sediment transport and elevated turbidity levels during high-flow conditions. However, as described in the

Water Quantity section above, wet season flows rates would be reduced by less than 1 cfs on average under Alternative 1, so any benefits to turbidity levels would be minor under most conditions.

Climate Change and Surface Water

Given the increased ability to manage reservoir storage and outflow during both drought and non-drought years, implementation of Alternative 1 would improve IPID's ability to adaptively operate the reservoir in response to changes in inflow timing and magnitude as a result of climate change. The ability to release flows stored during the wet season during dry periods becomes an increasingly valuable tool to sustain flows for aquatic life in Eightmile and Icicle creeks and to manage downstream water uses in real-time. This increased adaptive capacity represents a **substantial benefit** when considering climate change.

4.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Surface Water Quantity

Alternative 2 includes replacement of the existing dam with an earthen embankment and reinforced concrete dam structure with a fixed crest elevation. The crest would be set at an elevation of 4,671.0 feet, providing a maximum storage equivalent to Alternative 1. Water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. This would allow the lake to be drawn down to a low water surface elevation of 4,636 feet without pumping. IPID would release water during the late summer to maintain the water supply available for irrigation and instream flows in Icicle Creek. Releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream water supply and instream flow needs.

As with Alternative 1, Alternative 2 would provide an operational drawdown of 35 feet and up to 2,000 acre-feet of active storage without pumping. The restored storage volume would provide additional instream flow based on releasing up to an additional 600 acre-feet of water. Changes in release rates and durations are approximately the same as Alternative 1. Changes in lake surface area would also be approximately the same as Alternative 1. The primary difference would be that the lake level would be held at 4,671 feet throughout the spring, rather than being held at 4,667 feet during late spring and then filled to 4,671 feet as summer approaches, as would be the case with Alternative 1.

Alternatives 1 and 2 have identical key water resource parameters, summarized in Table 4-8. The active storage volume, peak water level, minimum water level, and typical and minimum flow rates are the same for the two alternatives. The primary difference between the alternatives is that Alternative 1 allows for flexibility in controlling water levels to respond to storm events by raising or lowering a gate over the primary spillway. This would typically only affect the flow rates in Eightmile Creek when the gates are lowered to spill water during a storm event. Flow rates in the creek and the rate of release would otherwise be similar between the two alternatives. Alternatives 1 and 2 generally have the same influence on water resources within the study area, and the differences between the two alternatives in terms of water resources are minor.

Like Alternative 1, Alternative 2 would have **significant benefits** to surface water resources because it provides IPID the ability to optimize reservoir operation, including water storage and downstream release for irrigation supply, and augmentation of instream flows, during both drought and non-drought years. There are **no significant adverse impacts** on surface water quantity for Alternative 2.

Surface Water Quality

Similar to Alternative 1, **no significant adverse impacts** on water quality are expected from operations for Alternative 2. With the same high and low-water surface elevations, lake surface areas, and lake volumes as Alternative 1, Alternative 2 would increase lake storage potential relative to existing conditions and increase the ability to release stored water during summer low-flow periods, providing substantial benefits for temperature and DO in Eightmile Creek and Icicle Creek.

Climate Change and Surface Water

As with Alternative 1, given the increased ability to manage reservoir storage and outflow, Alternative 2 would improve IPID's ability to adaptively operate the reservoir in response to changes in inflow timing and magnitude as a result of climate change. This increased adaptive capacity represents a **substantial benefit.**

4.5.4 Alternative 3: Narrow Spillway without Gates

Surface Water Quantity

Alternative 3 includes replacement of the existing dam with an earthen embankment and reinforced concrete dam structure with a fixed crest elevation. The crest would be set at an elevation of 4,667.0 feet, equivalent to the crest height for the No Action Alternative (see Table 4-8). Water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. This would allow the lake to be drawn down to a low-water surface elevation of 4,636 feet, which would allow access to stored water without pumping. IPID would release water during the late summer to maintain the water supply available for authorized diversions and instream flows in Icicle Creek. Releases through the low-level outlet pipe would be controlled by an automated plug valve at the downstream end of the pipe. IPID would have the ability to adjust the valve remotely to release the flows needed to meet downstream water supply and instream flow needs.

This alternative provides an operational drawdown of 31 feet and up to 1,698 acre-feet of storage without pumping. The additional storage would facilitate greater potential instream flow when compared to the No Action Alternative, but less operational flexibility compared to other action alternatives. IPID would have up to 1,698 acre-feet of active storage under this alternative. The increased storage would provide additional instream flow based on releasing up to an additional 298 acre-feet of water. Releases from the reservoir would be managed remotely by IPID and would be less than 20 to 40 cfs between the months of July and August. Release rates would continue to vary depending on seasonal hydrology and irrigation needs. Additional storage capacity over the No Action Alternative would allow IPID to release slightly increased flow rates and/or slightly increase the duration of flow releases, although to a lesser degree than under Alternatives 1 and 2 (i.e., potentially release for more than 8 weeks or at maximum flow rates exceeding 40 cfs). Given the lower total storage volume, in drought years or in the future with climate change, IPID may have reduced ability to supplement instream flows or provide additional water for other uses under Alternative 3 when compared to Alternative 1 or 2.

During the winter months, additional inflow would be captured and stored within the reservoir rather than conveyed downstream. This would result in a minor reduction (less than 0.5 cfs on average) in wet season flow rates. Wet season flow rates are typically between 15 and 60 cfs (see Table 4-3), so a reduction in 0.5 cfs on average would be **less-than-significant.**

Alternative 3 would have **moderate benefits** to surface water resources because it provides IPID the ability to improve reservoir operation, including water storage and downstream release for irrigation supply, and augmentation of instream flows; benefits are to a lesser extent than Alternatives 1 and 2, and these benefits may not be able to be provided during drought years. There are **no significant adverse impacts** on surface water quantity for Alternative 3.

Surface Water Quality

Similar to Alternatives 1 and 2, **no significant adverse impacts** on water quality are expected from operations for Alternative 3.

With a greater drawdown potential and a maximum lake water level equivalent to the existing dam, Alternative 3 would improve active storage capacity, and its operations would improve the ability to manage releases of stored water for downstream uses relative to existing conditions. Alternative 3 would have a lower maximum lake water level (4 feet lower) and lower active storage capacity (302 acre-feet less) than Alternatives 1 and 2, however, and it would have less ability to supplement instream flows during drought conditions when compared to Alternatives 1 and 2. Alternative 3 is therefore considered to have **moderate benefits** to water quality through its potential to moderate downstream water temperatures and DO levels during summer low-flow periods.

Climate Change and Surface Water

Given the increased ability to manage reservoir storage and outflow relative to existing conditions, Alternative 3 would improve IPID's ability adaptively operate the reservoir in response to changes in inflow timing and magnitude as a result of climate change. This increased adaptive capacity represents a **moderate benefit**, but to a lesser degree than the benefit provided by Alternatives 1 and 2. During future drought years, Alternative 3 may not be able offer such benefits.

4.6 Avoidance, Minimization, and Mitigation Measures

4.6.1 Construction

During construction of any action alternative, standard in-water construction and demolition BMPs would be implemented in accordance with environmental regulatory permit requirements. To minimize potential impacts on water resources, construction is planned as a single construction season to limit the duration of modified flows. If construction could not be completed in one season, actions would be taken to secure the dam for overwintering. Areas that could be overtopped would be secured and stabilized (hardened) with rock. All equipment would be stored on-site or removed if feasible. The outlet pipe would be in working order, and the lake would be held at the lowest level (elevation 4,632 feet) for the winter. The relevant water quality BMPs will be implemented for all construction activities with the potential to create water quality impacts in Eightmile Lake and in Eightmile Creek, including activities associated with upland work such as road improvement, trail rerouting, and repeater station installation.

Water quality BMPs common to all action alternatives include the following:

- Cofferdams and/or other appropriate measures will be used to isolate dam and spillway construction work areas from open water in Eightmile Lake and active flows in Eightmile Creek.
- Temporary erosion and sediment control measures will be implemented to limit sediment inputs to receiving waters during and after construction.
- Cleared upland areas will be restored and replanted with appropriate native herbaceous and woody species to stabilize soils following construction.
- Spillage of concrete and releases of other construction materials into the water will be prevented through isolation of the work area and implementation of proper waste handling measures. Poured concrete will be allowed to cure prior to contact with any surface water.

- Pollution control measures will be implemented to ensure appropriate storage, handling, and use of petroleum products and other potential pollutants on-site during construction. Spill response materials will be maintained on-site during construction.
- During construction, the IPID will conform to all Ecology DSO requirements, which may include development of an Emergency Response Plan, among other requirements, and will conform to all special requirements for working in the Alpine Lakes Special Warranty Deed Area.

4.6.2 Operational

Under all action alternatives, operation of the dam will be improved relative to existing conditions, with the ability to better time and manage releases. The action alternatives will allow for greater adaptive management, including storage and water releases to reduce flooding risk, provide beneficial instream flows during drought years, and generally improve safety and reliability of operation.

4.7 Significant Unavoidable Adverse Impacts

No significant and unavoidable adverse impacts on water resources within study area would occur under Alternatives 1, 2, and 3. Under the No Action Alternative, the following significant impacts may occur:

- A catastrophic dam failure would have significant and unavoidable adverse impacts on the ability to store water in Eightmile Lake and control releases into Eightmile Creek and subsequently Icicle Creek. Uncontrolled erosion would also likely cause significant channel change within Eightmile Creek and potentially in Icicle Creek.
- Significant impacts on water quality would result from reduced storage volume with downstream impacts on instream flow, groundwater supply, and adjacent wetland process.
- Significant adverse impacts on water quality would result from such a dam failure through increased suspended sediment and turbidity levels, increased pollutant mobilization due to flooding, and increased water temperatures and decreased DO levels downstream as a result of reduced lake storage and releases during summer low-flow periods. A DSO enforcement action would also likely have similar adverse impacts on the ability to store water in Eightmile Lake and control releases into Eightmile Creek and Icicle Creek. Loss of operation of the dam would likely mean that IPID would be unable to meet early season irrigation demand and reduce their ability to manage instream flows throughout the year.
- Significant impacts on the ability to respond to climate change would result from reduced adaptive management for storage volume and regulation of discharge from the dam.

CHAPTER 5: GROUNDWATER RESOURCES

This chapter describes the groundwater resources within the area of influence of Eightmile Lake that may be affected by the project.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on groundwater resources are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key findings for Groundwater

- Natural groundwater flows through the sediments underneath the dam. The main source of the groundwater is Eightmile Lake. Groundwater discharges a short distance east of the dam to Eightmile Creek.
- There is a strong relationship between the groundwater flow and flows in Eightmile Creek. This groundwater flow is a continual source of baseflow to Eightmile Creek.
- Impacts on the groundwater flow can result from construction dewatering, but these will be localized and temporary. The resultant reduction in groundwater discharge to Eightmile Creek will be offset by the dewatering discharge to the creek.
- Impacts on groundwater flow occur seasonally as a result of lake drawdown (both naturally and through dam operations). However, resultant decreases in groundwater discharge to Eightmile Creek are only a small percent of total creek flow due to operational discharges from the dam.
- There are no unavoidable adverse impacts on groundwater resources due to any of the action alternatives.
- Under the No Action Alternative, should the dam be removed, be breached, or fail, reductions in groundwater contributions to streamflow may increase the number of days when instream flows are not met and decrease the ability of surface water rights holders to divert water from Icicle Creek.

5.1 Methodology

The study area for this chapter is the Icicle Creek Subbasin of the Wenatchee River Basin from the mouth of Icicle Creek upstream to the headwaters of Eightmile Lake, the same as the Surface Water study area. The area of the Icicle Creek Subbasin that feeds the upper reaches of Icicle Creek, above the confluence with the mouth of Eightmile Creek, is not included in the study area (see **Figure 4-1**).

The affected groundwater environment and water quality were characterized by a review of existing studies and data. Conceptual hydrogeologic analysis was used to evaluate both the operational and construction impacts from the various alternatives. In addition, in the case of the operational impacts, a spreadsheet analysis using Darcy's Law of groundwater flow was also used to estimate impacts.

For the EIS evaluation, short- and long-term (construction and operational) impacts are considered significant if they would negatively affect groundwater users or if they would result in changes of the groundwater contribution to streamflow that would reduce instream flows to levels that are detrimental to aquatic life and/or reduce the ability of water rights holders to exercise their rights.

Darcy's Law states that groundwater discharge through a porous medium is directly proportional to the hydraulic gradient (the change in water level divided by the distance over which the change occurs), hydraulic conductivity (a measure of permeability in porous media), and cross-sectional area over which the flow occurs. Darcy's Law is defined by the equation:

$$Q = KA(dh/dl)$$

where Q = discharge rate, K = hydraulic conductivity, A = cross-sectional area, dh/dl = hydraulic gradient (change in head, i.e., water level, over change in length)

Concerning groundwater quality, construction and operational impacts would be significant if water quality conditions are out of compliance with Washington State groundwater quality standards, and if the groundwater contribution to baseflow causes existing surface water background conditions to be degraded beyond variations allowed by Washington State standards for fresh waters (WAC 173-201A).

5.2 Regulatory Context

The waters of the State of Washington, including groundwater, are a public resource. Individuals and groups can be granted a right by the state, known as a water right, to use up to a defined volume of water for a defined purpose and in a specific place. Groundwater rights in Washington are governed by Chapter 90.44 RCW, which is described in more detail in Chapter 6, *Water Rights*. Groundwater rights are also subject to instream flow rules for Water Resource Inventory Area (WRIA) 45 governed by Chapter 173-545 WAC, which is also described in Chapter 6.

Groundwater is typically captured for use by wells. Wells are regulated by Chapter 18.104 RCW and Chapter 173-160 WAC. Groundwater quality is regulated by Chapter 173-200 WAC. The various statutes and regulations that apply to groundwater in the study area are listed in Table 5-1.

Table 5-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
Chapter 18.104 RCW	Water Well Construction
Chapter 90.44 RCW	Regulation of Public Groundwaters
Chapter 90.54 RCW	Water Resources Act of 1971
Chapter 173-160 WAC	Minimum Standards for Construction and Maintenance of Wells
Chapter 173-200 WAC	Water Quality Standards for Groundwaters of the State of Washington
Chapter 173-545 WAC	Instream Resources Protection Program—Wenatchee River Basin, WRIA 45

5.3 Affected Environment

Groundwater is an important resource within the study area. At Eightmile Lake, surface water infiltrates beneath the lake to become groundwater; much of this water discharges downstream of the dam, providing an important component of baseflow within Eightmile Creek. Without the groundwater contribution to Eightmile Creek below the dam, the creek would be dry or nearly dry late in the season when there is no direct discharge from the dam. In the lower part of the subbasin, near the City of Leavenworth, groundwater is a major source of potable and irrigation water, as well as providing water for the LNFH.

This section describes the general hydrogeologic setting for groundwater within the study area as well as by sub-region (i.e., Alpine Lakes, upper Icicle Creek, lower Icicle Creek). The section ends with a discussion of groundwater quality in the study area. Groundwater use is regulated by water rights, as discussed in Chapter 6.

5.3.1 Hydrogeologic Setting

As described in more detail within Chapter 7, *Geology*, bedrock geology dominates most of the study area. Unconsolidated sediments overlie the bedrock at scattered locations in the Alpine Lakes Wilderness, along Icicle Creek and its tributaries, and more extensively near the City of Leavenworth along lower Icicle Creek and the Wenatchee River. Groundwater is mainly derived from the infiltration of rainfall and snowmelt within the study area. Additionally, surface water is a major contributor to groundwater recharge in the lowest part of the subbasin—the area between the LNFH and the Wenatchee River. Infiltration can be limited where precipitation falls on bedrock, particularly in areas with steep slopes; in these areas, most precipitation runs off to become surface water. However, in areas where the surface geology is comprised of unconsolidated sediments, the amount of infiltration is greater. The amount of infiltration in these areas is largely determined by how permeable the sediments are, as well as vegetation, land use, and topography.

Groundwater flow generally follows topography, flowing from higher to lower elevations. In the upper subbasin, groundwater mainly discharges to the lakes and creeks. In the valley portion, groundwater generally flows sub-parallel to Icicle Creek before turning sub-parallel to the Wenatchee River in the downstream part of the subbasin. Here, groundwater discharges either locally to Icicle Creek or the Wenatchee River, or discharges somewhere farther downstream on the Wenatchee or Columbia rivers.

In the valley setting of the lower part of the subbasin, there is likely a high degree of hydraulic continuity between the groundwater in the unconsolidated sediments and surface waters. This is clearly demonstrated by well testing and the seasonal water level responses in wells at the LNFH (Reclamation 2010). At the hatchery, testing has demonstrated that water flowing in the Hatchery Channel actively recharges the groundwater, while drawdown is greater when the channel is dry. Conditions are expected to be similar for wells near Icicle Creek and the Wenatchee River.

The physical characteristics of the geologic units supporting aquifers primarily control the movement and occurrence of groundwater. Logs of wells completed in the bedrock aquifer generally report low yields, on the order of 1 gallon per minute (gpm), although yields of up to 15 gpm are occasionally reported (Ecology 1995). These wells typically serve single domestic households. Groundwater is more abundant in the unconsolidated-sediment aquifers, particularly where the sediments are coarse grained, with yields typically ranging from 5 to 100 gpm (Ecology 2019a). Where the unconsolidated sediments are fine grained, well yields are low to insignificant. Fine-grained units may act as barriers to groundwater flow and are referred to as confining layers. The occurrence and movement of groundwater is described further below by sub-region.

5.3.2 Groundwater Quantity

Eightmile and Other Alpine Lakes

Within the Eightmile Lake and the other alpine lake basins, groundwater is a minor component of the water budget except at some localities, such as the lower end of Eightmile Lake, where the rate of surface water infiltration is relatively high. This is because the surface geology in the Alpine Lakes Wilderness portion of the study area is dominated by metamorphic and intrusive igneous rocks (bedrock). Unconsolidated sediment deposits are limited to sporadic talus slopes, landslide deposits at Eightmile Lake, and limited alluvial deposits along Eightmile and Snow creeks. As described in the FPEIS (Ecology 2019a), "*given the prevalence of low-permeability bedrock and the steep terrain, lake hydrology is expected to be dominated by precipitation and snowmelt runoff, with groundwater recharge and discharge a relatively minor component of the water budget.*"

With the dominance of bedrock and steep topography, the amount of groundwater recharge is limited. Flow is expected to be downslope toward and discharging to the lakes, supporting lake levels. When the lakes are full due to spring runoff or storage operations, they may provide limited recharge back to the bedrock aquifer, temporarily reversing the more typical discharge relationship. Below the lakes, groundwater flow is down valley along the drainages toward Icicle Creek. Where discontinuous alluvial sediments occur along the creeks, groundwater within these sediments may provide baseflow to the creeks, particularly where the sediments are truncated by bedrock.

As described in Chapter 7, Eightmile Lake was formed when a landslide created a natural impoundment across Eightmile Creek around 11,000 years ago. The landslide deposits have a variable permeability depending on their content, but it is much higher than the surrounding bedrock and allows groundwater flow through the natural impoundment. Much of this groundwater flow through the landslide deposits appears to discharge to Eightmile Creek a short distance downstream from the lake, with groundwater seeps noted at three locations about 300, 600, and 1,200 feet east of the dam (Aspect 2019). This flow provides a large natural groundwater discharge out of Eightmile Lake. The flow rate through these deposits varies seasonally with the stage of the lake, being higher in the spring and when active reservoir storage is taking place. The flow rate of this natural groundwater discharge has not been measured; however, it is estimated to be about 5 cfs (Jantzer, pers. comm.; Aspect 2022a). An analysis by the EIS team indicates that the groundwater discharge rate could be reduced roughly by half when the lake is at its lowest levels.

Although not mapped as being dammed by a landslide deposit (Tabor et al. 2017), Colchuck Lake may also have groundwater discharge. This is postulated due to a note on the Proof of Appropriation water right form for IPID's storage right on Colchuck Lake, which states "*owing to the looseness of [the] formation at a point on the west side of the Lake … it was deemed advisable to raise the water surface of [the] reservoir to the 5 foot storage instead of 10 foot.*" Groundwater discharge out of Snow and Nada lakes would be small as they are not naturally dammed by landslide deposits.

Upper Icicle Creek Subbasin

The Icicle Creek Subbasin can be roughly divided into two parts: the areas upstream and downstream from a point roughly coincident with the LNFH diversion at RM 4.5. In the upper subbasin, the geology along Icicle Creek and its tributaries is similar to that in the Alpine Lakes area—bedrock dominated with discontinuous patches of unconsolidated alluvial and glacial deposits, and groundwater is a relatively minor part of the water budget. The creeks generally run in narrow valleys with steep walls. Because the setting is similar to the Alpine Lakes area, the groundwater occurrence and flow are similar. Most precipitation and snowmelt runs off the bedrock valley walls with limited infiltration. The unconsolidated areas may have larger amounts of infiltration, but being discontinuous, groundwater flow through the unconsolidated sediments is focused locally on the creeks. Most groundwater flow, both from the bedrock and the unconsolidated sediments, is expected to discharge to the creeks, although during periods of high creek flow, the creeks may temporarily provide groundwater recharge. The slight amount of groundwater discharge to Icicle Creek and its tributaries provides a small measure of baseflow most of the year and likely helps support late season flows in the creeks.

There are no large wells in this portion of the subbasin, and groundwater use is limited. A review of well logs at Ecology's online well log database indicates there are about 38 permit-exempt wells within the study area above the LNFH diversion on Icicle Creek (Ecology 2021f). These are mostly single-domestic wells, although the area contains several Group B[1] wells. Many of the wells are likely only used on a seasonal basis.

Lower Icicle Creek Subbasin

Near the LNFH, Icicle Creek leaves its narrow, bedrock-dominated valley and enters a broader alluvial valley with extensive unconsolidated sediments. This change in setting has a large effect on groundwater occurrence and flow. Unlike the bedrock-dominated setting of the upper subbasin, where groundwater is only a minor part of the overall water budget, in the lower subbasin, groundwater plays a significant role in the water budget. The unconsolidated sediments hold a large amount of groundwater, much of which is in hydraulic continuity with Icicle Creek and the Wenatchee River.

The surficial geology on the western valley floor is mapped as alluvial deposits, while along Icicle Creek and the eastern side of the valley floor glacial drift deposits are present (Tabor et al. 1987). The glacial deposits extend partway up the eastern valley slopes, covering sandstones and conglomerates of the Chumstick Formation. The western valley slopes are intrusive igneous and metamorphic bedrock, an extension of the bedrock from the upper subbasin. The unconsolidated sediments in the valley are generally 150 to 250 feet thick depending on location (Ecology 2019a).

Recharge from precipitation and snowmelt is much larger on the alluvial and glacial drift deposits than on the bedrock. Additional recharge occurs where Icicle Creek is above the water table, as well as seasonal leakage from unlined canals. While most of IPID's canal on the east side of the valley is lined, the Cascade Orchards Irrigation Company (COIC) canal on the western edge of the valley is unlined (Ecology 2019a). Seepage losses out of the COIC canal have been identified at about 5 percent of the total canal flow (Ecology 2019a). Additionally, the LNFH operates a man-made channel off of Icicle Creek known as the Hatchery Channel. This channel is periodically inundated with water diverted from Icicle Creek to provide recharge directly to the unconsolidated aquifers near the fish hatchery's wells (Reclamation 2010).

Both the alluvial and glacial deposits contain coarse-grained sand, gravel, and cobbles, as well as zones with finer-grained silts and clays. The coarse-grained zones without a high fine-grained content are permeable, readily transmit water, and form aquifers where saturated. The finer-grained zones restrict water flow and, where contiguous, form confining layers. Studies of the hydrogeology at the LNFH indicate that two aquifers are present: a shallow unconfined aquifer that extends over most of the valley and a more limited, deeper confined aquifer (Reclamation 2010). In the area of the hatchery, the shallow aquifer is up to 200 feet thick, although it is more typically 80 to 100 feet thick. The deep aquifer is 30 to 50 feet thick and is thought to be semi-confined because the overlying layers of silt and clay do not appear to be continuous across the valley (Reclamation 2010). Pumping tests of hatchery wells found the shallow aquifer to be very transmissive, with transmissivity values ranging between 25,000 square feet per day (ft^2/d) and 85,000 ft^2/d, while the deeper aquifer is less permeable with a calculated transmissivity of about 6,000 ft^2/d (Reclamation 2010). The fish hatchery operates a series of wells in both aquifers, with well yields up to 4,000 gpm.

Groundwater flow is influenced by the pumping of the fish hatchery wells, drawing groundwater toward the wells, and by the operation of the Hatchery Channel, recharging the aquifer. Otherwise, flow is generally northerly in a down-valley direction.

In addition to the LNFH wells, there are roughly 280 wells in the lower subbasin (based on well log records at Ecology). However, there are no other major producers of groundwater outside of the

[1] Group B public water systems have 15 or fewer connections and serve fewer than 25 people per day. All public water systems that exceed these limits are considered Group A systems. The only Group A water system in the study area is the City of Leavenworth.

hatchery within the study area.[2] Groundwater rights records indicate well yields of 10 to 50 gpm for wells with rights (see Chapter 6). Domestic and Group B wells typically have even smaller yields. While the Eightmile Dam and its operation do not directly affect groundwater in the lower subbasin, any impacts the dam may have on reducing streamflow within Icicle Creek may increase the dependence on, and potentially increase the use of, groundwater.

5.3.3 Groundwater Quality

The quality of groundwater in both the bedrock and unconsolidated aquifer is variable depending on the local geology, the quality of the surface water providing recharge to the aquifers, and the anthropogenic impacts such as agriculture and septic systems. Groundwater quality within the Upper Wenatchee River Watershed is considered to be excellent but deteriorates slightly in the Icicle Creek and Leavenworth areas (Ecology 2007a). However, the City of Leavenworth's water system plan indicates that their wellfield (just outside the study area) has excellent water quality (Varela & Associates 2018).

Groundwater quality is very good at the LNFH, being generally cold, pathogen free, and suitable for fish growth (McMillen Jacobs Associates and DJ Warren Associates 2016). A 1992 USGS study at the hatchery also found good groundwater quality (Drzymkowski and Swift 1992). However, while not particularly high for groundwater, the phosphorus concentration in the groundwater at the hatchery occasionally exceeds the hatchery's NPDES permit interim average monthly phosphorus concentration limit of 0.17 micrograms per liter (µg/L) (Hildenbrand 2019).

5.4 Construction Impacts

5.4.1 No Action Alternative

Because the No Action Alternative involves no construction, no construction-related impacts would occur.

5.4.2 All Action Alternatives

Groundwater flow is controlled by the permeability of the sediments below the water table, cross-sectional area of the sediments through which the flow occurs, and the head drive across the sediments (i.e., the change in water elevation) at the top and bottom of the flow zone. Under construction, the permeability of the sediments below the dam through which groundwater flow occurs would remain unchanged from existing conditions. However, the lake stage elevation would be modified during construction so that it will be different than that of the No Action Alternative. Consequently, groundwater flow would change during the construction from the existing condition. Impacts from construction from any of the action alternatives would be approximately the same.

Impacts on groundwater would only occur in the immediate area of the dam. Downstream, both in the bedrock-dominated portion of the basin and the lower alluvial basin, no impacts would occur due to the construction of any of the alternatives because the groundwater in the area around the lake is disconnected from groundwater downstream, and there would be no significant changes in the groundwater contribution to stream baseflow.

Some portions of the construction would have no impact on groundwater, for example, the transportation of equipment and materials. Site preparation would have only a minor impact. The removal of trees would slightly increase the amount of groundwater recharge as the trees would no longer be removing groundwater by transpiration. However, site preparation would also likely

[2] There are other large groundwater users in the region, specifically the City of Leavenworth and the Leavenworth Golf Course. However, the wellfields for both are near the Wenatchee River a short distance outside the study area.

increase runoff and, therefore, decrease groundwater recharge. Considering the small area (approximately 8,500 to 10,000 square feet) involved and that the two effects are offsetting, in total, site preparation for construction would have a minor impact on groundwater.

The only construction activities expected to have possibly significant impacts on groundwater are the early drawdown of the lake, the operation of the new outlet pipe during construction, and dewatering of work areas during construction. Normally, the lake is not fully drawn down until late summer. However, the year the dam improvements will be made, IPID will draw down Eightmile Lake early. The early drawdown of the lake would lower the lake stage, thereby decreasing the head drive controlling groundwater flow under the lake. Since essentially all of the groundwater flow at the lower end of the lake is discharged as baseflow to Eightmile Creek, the flow level in the creek will decrease. Essentially, the groundwater baseflow component of the Eightmile Creek streamflow will reach its typical late summer value much earlier in the season.

The construction sequence calls for the installation of the new outlet pipe early in the construction cycle. The outlet pipe would be operated throughout the rest of the construction period to keep lake levels low. As described, the lowering of the lake level would reduce the head drive of groundwater flowing under the lower lake area, which would reduce the groundwater baseflow component to Eightmile Lake. However, since the outlet pipe would be discharging to the creek, the direct contribution to creek flow would likely meet or exceed the reduction from groundwater baseflow resulting from the operation of the outlet pipe.

Cofferdams would be built to keep water away from the main construction zone at the dam site. Despite the cofferdams, some water may leak into the construction area, either from the lake or from groundwater, and dewatering of the construction area may be needed. Dewatering will occur by collecting any water leaking through the cofferdams at a low spot and pumping it out of the construction area, thus preventing the leaking water from pooling next to any water-sensitive construction activities (such as pouring or curing of concrete). This dewatering would remove groundwater that would have contributed to creek baseflow. However, since any dewatering will likely be discharged downhill of the construction area and return water to the creek, there would be no net decline in streamflow.

Groundwater quality is not expected to change as a result of construction or dam operations. Since activities that could result in changes in groundwater quality, such as exposure to curing cement, will occur above the groundwater level (due to the cofferdams and dewatering), water quality changes should not occur. After construction, the types of materials beneath the water table (cement, fill, and natural sediments) will be the same types of materials that are currently beneath the water table. Therefore, no changes in groundwater quality from operation of any of the alternatives are expected.

If construction is not finished in a single season, the overwintering condition of the construction site would also affect groundwater flow. In the case of overwintering, the outlet pipe would remain open, reducing the level of the lake and thereby reducing groundwater flow under the dam area and the groundwater contribution to creek flow during that time. However, since the outlet pipe will be open, the flow from the outlet pipe would likely exceed the reduction of groundwater discharge.

Although some construction activities would have possible impacts on groundwater, in all cases, the changes in groundwater will be constrained to the immediate area around the dam site and the lower lake since the groundwater near the lake is not directly connected to groundwater farther down valley. Additionally, direct discharge to the creek would increase during construction. Therefore, impacts on groundwater during construction would not be significant anywhere downstream from the dam, and changes in groundwater levels and availability would not occur outside the local area.

5.5 Operational Impacts

5.5.1 No Action Alternative

With no changes to the dam structure or operations, there are no expected impacts on groundwater from present-day conditions under the No Action Alternative. If in the future the dam is removed, breached, or there were a catastrophic failure, groundwater flow would be reduced from present-day values. This is because dam removal or failure will lower the lake level, reducing the head drive from the lake to the area down valley where the groundwater discharges to the creek. The result will be a lower level of the groundwater baseflow component of streamflow. Particularly when coupled with lower surface water contributions to streamflow possible under this scenario, the reduction in groundwater baseflow will likely be significant, increasing the number of days when instream flows set by 173-545 WAC (see Chapter 6) are not met and decreasing the ability of water rights holders to divert water from Icicle Creek. If surface water rights need to be curtailed, this could potentially increase the use of groundwater in the subbasin and result in **significant impacts** in drought years, as described below.

Reductions in streamflow due to lessening groundwater baseflow contributions would also reduce the amount of groundwater recharge to the aquifer in the alluvial valley at and below the LNFH. While not expected to rise to a level of significance in most years, the reduction in groundwater recharge in the lower portion of the subbasin could become significant in drought years, reducing the ability of groundwater uses to produce water from their wells.

5.5.2 Action Alternatives

Downstream of the dam, both in the bedrock-dominated portion of the basin and the lower alluvial basin, there are **no expected significant impacts** on groundwater due to the operations of any of the action alternatives since the groundwater at the dam and lake is not directly connected to the groundwater system down valley, and there would be no significant changes in the groundwater contribution to stream baseflow.

However, at the dam and in the area around the lower lake, each alternative would result in differing amounts of groundwater flow below the dam. As mentioned, groundwater flow is controlled by the permeability and area of the sediments through which the flow occurs, as well as the head drive between the top and bottom of the flow zone. The permeability of the sediments below the dam would remain unchanged with all action alternatives. However, the area of sediments below the dam would be different with each action alternative due to differing configurations of the concrete dam structures below ground. Further, operations of the different alternatives would result in differing maximum and minimum lake surface elevations, resulting in differing heads driving water through the permeable sediments underneath the dam.

Overall, the differences in groundwater flow would likely be relatively small. The difference in lake elevation at full storage between the alternatives is 4 feet; at low water (estimated as the outlet pipe elevation for each alternative), the difference is also 4 feet. These differences in head will create small changes in groundwater flow relative to the average creek flow. Small additional changes in groundwater flow under the dam would occur due to the amount of concrete used in the different alternatives because concrete will block/replace natural sediments, reducing the cross-sectional area of the natural sediments, which have a much larger hydraulic conductivity than the concrete. All three action alternatives would have more concrete below the water table than the No Action Alternative, reducing the cross-sectional area of the natural landslide deposits that currently exist. Alternatives 1 and 3 use the same amount of concrete, while Alternative 2 uses roughly double the amount. In total, these two effects would combine to slightly reduce the estimated amount of groundwater flow underneath the dam.

The impacts would all be local to and immediately downstream from the dam since groundwater flow from under the lake and dam discharges to Eightmile Creek a short distance downstream from the dam. Although small changes in streamflow are expected due to the various alternatives, these small changes would only create de minimis changes, at the most, to the level of groundwater farther down the valley. Further, they are unlikely to impact aquatic life or impair the ability of water rights holders to exercise their rights. The largest expected reduction in the flow of Eightmile Creek under any of the action alternatives represents less than half of one percent of the flow of Icicle Creek.

Under drought conditions, the small changes due to dam operations will become slightly more important in that the groundwater component of baseflow to Eightmile Creek will become a larger percentage of the overall creek flow. However, farther down valley, the changes in groundwater due to dam operations would still be de minimis.

Alternative 1: Narrow Spillway with Gates

Alternative 1 would result in a 4-foot higher full-storage lake elevation, a 4-foot lower lake elevation at low water, and slightly decrease the cross-sectional area of sediments below the full-storage water table (due to more concrete in the dam structure than under the No Action Alternative). These factors would cause a very small decline in the amount of groundwater discharge to Eightmile Creek east of the dam, less than 0.1 cfs, at full-storage conditions and a decline of about 0.5 cfs at low-storage conditions.[3] Based on data from the Ecology Eightmile Creek gage below the dam (Station 45W003), these declines represent about 0.2 percent of the Eightmile Creek streamflow when the lake is full and about 5 percent of the Eightmile Creek streamflow when the lake levels are low;[4] this represents less than half of one percent of the streamflow of Icicle Creek.

Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Alternative 2 would result in a 4-foot higher full-storage lake elevation, a 4-foot lower lake elevation at low water, and a modest decrease to the cross-sectional area of sediments below the full-storage water table (due to more concrete in the dam structure than under the No Action Alternative). These factors would cause a small decline in the amount of groundwater discharge to Eightmile Creek east of the dam, about 0.3 cfs, or about 0.7 percent of the Eightmile Creek streamflow, at full-storage conditions and a decline of about 0.6 cfs, or about 6 percent of the streamflow, at low-storage conditions. This represents less than half of one percent of the streamflow of Icicle Creek.

Alternative 3: Narrow Spillway without Gates

Alternative 3 would result in no change in the full-storage lake elevation from the No Action Alternative, but a 4-foot lower lake elevation at low water. It would also create a slight decrease in the cross-sectional area of sediments below the full-storage water table (due to more concrete in the dam structure than under the No Action Alternative). These factors would cause a small decline in the amount of groundwater discharge to Eightmile Creek east of the dam, about 0.3 cfs, or about 0.7 percent of the Eightmile Creek streamflow, at full-storage conditions and a decline of about 0.5 cfs, or about 5 percent of the streamflow, at low-storage conditions. This represents less than half of one percent of the streamflow of Icicle Creek.

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3 The analysis here and for the other alternatives was conducted using Darcy's Law, as described in the *Methodology* section above.

4 Ecology Station 45W003 has been sporadically active from late May 2018 to the present. The full streamflow is based on the average streamflow in June 2018 and 2019, and the low streamflow is based on the average streamflow in September 2018 and 2019. June and September data are not available for 2020, 2021, and 2022.

5.6 Avoidance, Minimization, and Mitigation Measures

The changes in groundwater flow during construction are unavoidable. However, they will be offset and effectively mitigated by the discharge of lake water to Eightmile Creek to keep the lake level low during construction.

During dam operations, the slight decline in groundwater flow under the dam and discharge to Eightmile Creek is an unavoidable impact based on the physics of groundwater flow. It cannot be avoided unless the proposed dam structures are changed. However, the slight decreases in groundwater discharge are relatively minor and not significant within the overall flow regime of Icicle Creek.

5.7 Significant Unavoidable Adverse Impacts

With construction and operation of the project, there would be no significant unavoidable adverse impacts on groundwater resources.

CHAPTER 6: WATER RIGHTS

What has Changed from the Draft EIS?

- Based on comments received on the Draft EIS, revisions to this chapter have been made to the Introduction to describe the reasonableness of alternatives, Section 6.2 to provide further detail on the multi-fill analysis and the monitoring and reporting plan, and Section 6.5 to provide more detail related to the Trust donation.
- Updates were made to Section 6.3 to provide new information related to COIC's diversionary water right, and the settlement agreement between Ecology and the City of Leavenworth.
- Minor corrections have been made for clarification. Minor typos have been corrected.
- Responses to specific comments on water rights are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key Findings for Water Rights

- There are four major entities with diversionary rights on Icicle Creek: IPID, USFWS, COIC, and the City of Leavenworth.
- IPID has a water right on Eightmile Lake authorizing the use of 25 cfs for irrigation purposes. While the certificate does not indicate a maximum annual authorized quantity, an adjudication of the right determined that the maximum annual quantity is 2,500 acre-feet, but noted that this quantity was inchoate. It has not been determined how much of this total has been perfected through actual beneficial use of water.
- The Eightmile Dam has been eroded in the past, reducing the active storage volume to 1,151 acre-feet. However, IPID reports that additional storage capacity is regularly used through multiple partial re-fillings of the reservoir.
- IPID indicates they currently require storage of 1,400 acre-feet in Eightmile Lake to provide sufficient water for irrigation use by landowners within the District.
- IPID intends to gain an authorization for the use of water for instream flow purposes through a donation to the State Trust Water Rights Program of the portion of the right above 1,400 acre-feet, with the actual quantity to be donated ascertained through the Trust Water Right Program process for donations.
- All of the action alternatives would increase single-fill active storage volume capacity in Eightmile Lake from current conditions.
- There are no significant unavoidable adverse impacts under any of the action alternatives.
- The No Action Alternative has the potential for unavoidable impacts in the form of curtailment of diversionary rights and increased numbers of days when instream flows are not met.

The purpose of this chapter is to identify and assess any potential impacts on water rights that may occur as a result of the action alternatives and No Action Alternative during construction and operation. To support this assessment, this chapter and associated appendix (Appendix B, *Water Rights*) generally describe and summarize the water rights within the study area, including the instream flows set by rule. In addition, this chapter provides background on IPID's water right at Eightmile Dam and assesses whether the action alternatives analyzed are reasonable given IPID's existing water right authorization. However, it does not make a tentative determination of the validity and extent of IPID's water right because no application has been filed to trigger a formal review of the right. Finally, it addresses potential implementation of the project, including continued water storage and releases proposed at Eightmile Lake for both ongoing irrigation water use by IPID and for streamflow augmentation within the study area as part of the Icicle Strategy.

This EIS describes action alternatives with design storage volumes that were determined to be reasonable given the review of information available on water use and storage at Eightmile Lake under IPID's existing right at the time of preparation. The purpose of the EIS process is to outline a range of possible outcomes for a proposed action. In this case, a reasonable evaluation was performed to bracket the amount of water likely available under the right to ensure that the alternatives considered and associated storage capacities were reasonable, and then to outline the range of potential outcomes that can result from those alternatives. In outlining the range of potential outcomes, consistent with WAC 197-11-080 (3)(b), the worst-case analysis within the range of outcomes was documented. As such, the analysis adequately examines a reasonable range of storage volumes and associated impacts that could occur from the proposed dam rebuild, regardless of whether a portion of the right may or may not be available as a result of Ecology's quantification of the water right for purpose of the Trust donation under RCW 90.42.080(4).

Water use in Washington State requires a water right. Water rights in Washington State follow the "first-in-time, first-in-right" doctrine, meaning whoever first uses water and establishes a water right has a senior right to water and, in times of scarcity, more junior water right holders must curtail their use if it would negatively affect the senior user's ability to use water. While the concept is simple, over the years, the administration of water rights has become quite complex due to changing law, policies, and regulations; court rulings; lack of uniform record keeping; and the realization of environmental and ecological needs for water.

This chapter describes the water rights within the Icicle Creek Subbasin up to the headwaters of Eightmile Lake. In no case can a water right holder, including IPID, legally divert or withdraw[1] more water than is authorized by their water right. Therefore, while water rights records can serve as a proxy for legal water use, they only represent an upper limit on legal water use as most water rights are not fully exercised year-to-year. Additionally, some water rights are no longer used (and thus may have been relinquished) but no action has triggered a determination of their validity and extent, so they are still listed in state records as being active. As a result, compilations of quantities from water right documents possibly over-estimate the actual total quantities of water authorized for use under rights that are actually valid.

The regulatory context behind water rights is explained, followed by descriptions of the water rights within the basin. Both surface water and groundwater rights are discussed, as are pertinent instream flow rules, which essentially establish water rights for streams, rivers, and lakes. Finally, the water rights are discussed in terms of how they would be affected by the various alternatives for the project.

IPID holds a water right on Eightmile Lake authorizing the storage and use of 25 cfs of water (with no maximum annual quantity specified on the water right certificate) for irrigation purposes. While the certificate does not indicate a maximum annual authorized quantity, an adjudication of the right

[1] When discussing water rights, a diversion involves diverting water from a surface water source, while a withdrawal involves using a well to produce groundwater. While occasionally the two terms are used interchangeably, within this document, the words "divert" and "diversion" always refer to surface water, and "withdraw" and "withdrawal" always to groundwater.

determined that the maximum annual quantity is 2,500 acre-feet.[2] However, the current active (single-fill) storage capacity is estimated at approximately 1,151 acre-feet.[3] When accounting for refilling of the lake during the summer, IPID estimates that it stores a cumulative total of approximately 1,464 to 2,228 acre-feet of water in the lake under a range of dry, wet, and average conditions (Aspect 2022a). IPID has indicated that, based on current water use and conservation practices by irrigators within the District, it needs 1,400 acre-feet of storage capacity at Eightmile Lake. Operationally, IPID indicates that any excess storage capacity above 1,400 acre-feet can be used for augmentation of instream flows.

With respect to water rights permitting for this project, since their Eightmile Lake water right authorizes the use of water for irrigation, IPID must gain authorization to also release water from storage for instream flow purposes. There are several methods to accomplish this. In this case, IPID intends to donate a portion of the right to the State Trust Water Rights Program (Trust) for instream flow purposes. In its review of the Trust water donation application, Ecology will evaluate the historical use of water under the Eightmile Lake water right to determine the quantities of water that IPID can transfer to the Trust for instream flow purposes, above what IPID can retain for irrigation purposes. After the Draft EIS was issued, IPID submitted a formal request in May 2024 to donate a portion of its water right to Trust for instream flow purposes. Following issuance of the Final EIS, Ecology will conduct its review of the quantities available for the Trust donation in accordance with the process prescribed by RCW 90.42.080(4). The results of this review will be part of a final decision on the requested Trust donation and will follow and be informed by the EIS process.

Cumulatively, the EIS team estimates there are water rights authorizing the diversion of 185.603 cfs and 68,710.8 acre-feet per year (afy) from Icicle Creek.[4] Approximately 96 percent of the diversionary rights come from four diverters: the IPID, USFWS, Cascade Orchards Irrigation Company (COIC), and the City of Leavenworth. IPID is the largest of the these, with diversionary rights totaling 117.71 cfs and an estimated annual total of 35,315 afy.[5] In addition, there are 12 groundwater rights in the

[2] The adjudication decree states that this annual quantity of 2,500 acre-feet is “inchoate.” Inchoate water rights have not yet been used, and are, therefore, not perfected. However, since the dam was completed in 1929, IPID has been storing water. Thus some, if not all, of this 2,500 acre-feet has been used and, therefore, is perfected and no longer inchoate. That said, the perfected amount has not been determined by Ecology or by a court through an adjudication of water rights.

[3] This represents the current active, physical storage capacity at the dam with the flash boards in place at the control notch and the gate closed. Following the Jack Creek Fire, and requirements by the DSO that the flash boards remain out and that the gate remains open, the actual current active storage is less than 1,151 acre-feet, and will remain so until the dam is rebuilt and safety risks are addressed.

[4] The water right quantities reported in this EIS, including the appendix to this chapter, do not represent a determination of the validity and extent of any of the rights in the basin. The estimation of total annual quantities and other parameters of water rights in the study area were based on the review and analysis of the EIS team and do not represent determinations or estimations of water right quantities by Ecology. Ecology reviewed estimated quantities to the general extent necessary to be able to identify and understand potential effects of the project on water rights in the basin and identify any potential for impacts to basin water rights. Additional information detailing the EIS team’s review of basin water rights is presented in the appendix, including methodology and assumptions. Final determinations of water right quantities can only be made by the legal determination of a court through an adjudication process.

[5] This value is believed to be a maximum and the actual total may be less. It is the sum of Qa’s listed on Table B-2 in Appendix B. Some of the Qa’s listed on that table are estimates; see the table notes for information on how the estimates were made. Additionally, the Qa for one right, with a 1912 priority date, belonging to the City of Leavenworth, is based on the continuous operation of a diversion at the full Qi rate. Concerning a different water right held by the City, Ecology disputed the City’s interpretation of the Qa that was based on the same theory. However, it appears that for the 1912-priority City right, the City’s interpretation of Qa based on continual use at the Qi was not challenged because, in decisions on subsequent water right applications, Ecology determined that an annual quantity of 1,465 afy of water was valid under Leavenworth’s water right portfolio, including the 1912-priority right.

study area with a total allowed instantaneous withdrawal of 5,402.1 gallons per minute (gpm) and a total annual quantity of 6,592.6 acre-feet. The vast majority of this is used non-consumptively by the Leavenworth National Fish Hatchery (LNFH). IPID does not have any groundwater rights.

6.1 Methodology

The study area for the water rights analysis is the Icicle Creek Subbasin of the Wenatchee River Basin, from the mouth of Icicle Creek upstream to the headwaters of Eightmile Lake. The area of the Icicle Creek Subbasin that feeds the upper reaches of Icicle Creek, above the confluence with Eightmile Creek, is not included in the study area (**Figure 4-2**).

The Water Rights Tracking System (WRTS) and Geographic Water Rights Information System (GWIS) maintained by Ecology were used to research the water rights in the area. Ecology conducted several searches of the WRTS and GWIS for the study area to identify water rights in the area (Ecology 2021a, 2021b, 2021c). The first searched for all water rights with surface water sources within the subbasin, and the second used a geographic information system (GIS) search for surface water points of diversion located within the study area. These searches and initial screening by the EIS team returned a total of 70 surface water rights records for the study area. Two similar searches were made for groundwater rights. This resulted in 82 groundwater rights records for the study area.

Most water rights records on WRTS contain one or more scanned documents. This documentation, as well as selected additional documentation (not scanned as part of WRTS), was reviewed. The review revealed location errors for points of diversion or withdrawal for some of the rights, and these rights were removed from further consideration. Records that were still in the application phase were also not considered further. The remaining records were divided by right status. Rights listed with an inactive status were removed from consideration. This final screening resulted in 45 active surface water rights and 39 active groundwater rights.[6]

For the evaluation of short-term impacts (construction), impacts on water rights are considered significant, as follows:

- Impacts are considered significant if construction would cause impairment of existing water rights due to a reduction in streamflow.

For the evaluation of long-term impacts (operational), impacts on water rights are considered significant, as follows:

- Impacts are considered significant if long-term operation of the facility would cause impairment to existing water rights due to lack of streamflow.

6.2 Regulatory Context

The waters of the State of Washington are a public resource. Individuals and groups can be granted a right by the state, known as a water right, to divert surface water or withdraw groundwater from a specific location, and use up to a defined volume of water for a defined purpose and in a specific place. Water rights in Washington are governed by Chapter 90.03 RCW for surface water and Chapter 90.44 RCW for groundwater (with certain provisions in RCW 90.03 also being applicable to groundwater use). Additionally, Chapter 90.14 RCW governs the registration of claims to water rights that were established prior to the permitting system (that was established in RCW 90.03 and RCW 90.44) and the relinquishment of water rights. Water rights in Washington State are issued and

[6] As mentioned in the introduction to this chapter, some water rights are no longer used (and thus may have been relinquished), but no action has triggered an extent and validity determination, so they are still listed in state records as being “active.” As a result, the totals listed here possibly over-estimate the actual number of current valid rights being exercised within the study area.

managed by Ecology. However, the courts have final adjudicative authority to determine the validity and extent of water rights within the state. The various statutes, regulations, and guidelines that are applicable to water rights in the study area are listed in Table 6-1 and described below.

Table 6-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
Chapter 90.03 RCW	Washington State Water Code
Chapter 90.14 RCW	Water Rights Registration, Wavier, Relinquishment
Chapter 90.22 RCW	Minimum Water Flows and Levels
Chapter 90.42 RCW	Water Resource Management
Chapter 90.44 RCW	Regulation of Public Groundwater
Chapter 90.54 RCW	Water Resources Act of 1971
Chapter 173-545 WAC	Instream Resources Protection Program—Wenatchee River Basin, WRIA 45
Chapter 508-12 WAC	Administration of Surface and Groundwater Codes
Ecology Policy 1060	The Relinquishment, Rescission, and Abandonment of Water Rights
Ecology Policy 1120	Water Resources Program Policy for Conducting Tentative Determinations of Water Rights
Ecology Policy 2030	Municipal Water Law Interpretive and Policy Statement

As described above, water rights in Washington State operate using the prior appropriation doctrine (i.e., "first-in-time, first-in-right"). In other words, an entity first using water from a certain source has the right to fully exercise their right before others may use water from, or otherwise impede, the source. Consequently, each water right is assigned a priority date based on first use (for rights that precede the water code) or the date on which an application for a water right is filed (for rights established pursuant to the water code), which establishes the seniority of the right. Based on priority dates, junior right holders (those with rights with later priority dates) are subject to interruption of their water use when there is insufficient water to meet the needs of senior right holders (those with rights that have earlier priority dates).

Water rights provide for the diversion/withdrawal and use of water within specific limitations and provisions. There are three classes of water rights: surface water rights, groundwater rights, and reservoir, i.e., storage (both above and below ground), rights. There are also three basic phases or types of water rights: claims, permits, and certificates. Claims are an official statement claiming a right for water use that predates the state's water permitting system (1917 for surface water and 1945 for groundwater). Validity of claims can only be determined and confirmed through a legal adjudication by the courts. Permits document authorization to develop a water right, but are not a final water right. Once the water system using the permitted water is fully developed and the water is put to beneficial use, the final water right, known as a water right certificate, is issued confirming that all the conditions and provisions of the permit have been met. Beneficial use is defined in RCW 90.14.031, which states "'beneficial use' shall include, but not be limited to, use for domestic water, irrigation, fish, shellfish, game and other aquatic life, municipal, recreation, industrial water, generation of electric power, and navigation."

Part of the Groundwater Code (RCW 90.44.050) exempts certain small groundwater withdrawals from the state's water right permitting process. The law is commonly known as the "groundwater permit exemption," and such wells are commonly known as "permit-exempt wells." Although such wells do not require a water right permit, they do have water rights, with a priority date established when the water is first put to beneficial use. As with all rights, permit-exempt wells are subject to water law principles, including interruption or curtailment of use when they interfere with senior rights, including previously established minimum instream flows established through water management rules (which are equivalent to water rights).

There are two types of water right applications: new applications and change applications. A new application is simply an application to obtain a new water right permit and, by itself, does not provide any legal right to use water. A change application is an application to change an existing water right claim, permit, or certificate.

The process for obtaining a new water right is prescribed in Chapter 90.03 RCW. A water right application must be submitted to Ecology, and the date Ecology receives an application sets the priority date for any permits or certificates that result from the application. As part of the application process, the applicant must make a public notice of their application, which allows the public to be informed about the proposed water use and an opportunity to make protests to Ecology concerning the water right application.

During the processing of a new application, a Report of Examination (ROE) is written in which Ecology applies a four-part test to determine if the water right can be legally permitted. The four-part test addresses: (1) whether the water is available, (2) whether the proposed use is beneficial, (3) whether it will impair the exercise of other water rights, and (4) whether it is not detrimental to the public welfare. A draft version of the ROE is posted for public review, providing an opportunity for comments from the public. When the review period ends and all comments have been addressed, Ecology issues a final version of the ROE and a decision on the application. If the four-part test is satisfied, Ecology proceeds to issue a water right permit.

The water right permit specifies (1) how much water can be used, typically both at an instantaneous rate (referred to as the “Qi” and listed in gpm for groundwater rights and cfs for surface water rights) and as an annual amount (referred to as the “Qa” and listed in afy); (2) the place the water can be used; (3) the point of diversion (for surface water) or withdrawal (for groundwater); (4) the specific type(s) of beneficial use allowed; and (5) the period of use.

Once a permittee puts the water to beneficial use, fully develops the project associated with the water right, and files a proof of appropriation form, the project is reviewed by a Certified Water Rights Examiner (CWRE) to confirm the amount of beneficial use.[7] Based on the recommendation provided by the CWRE as well as Ecology’s review and decision, Ecology issues a certificate for the water right.

Following certification, the allocated quantities of the water right must be fully utilized at least once every 5 years (unless it qualifies for one of a limited number of special exceptions, including municipal use, see Appendix B) in order not to be relinquished due to nonuse without sufficient cause. Relinquishment has a specific definition within water law. As described further in the Appendix B, RCW 90.14.130–.180 governs the relinquishment of water rights, and Ecology’s Policy 1060 covers specifically how Ecology deals with relinquishment. This an issue of potential concern

[7] WAC 173-165 established CWREs in Washington State and has an effective date in 2012. Prior to this time, review of beneficial use prior to certification was accomplished directly by Ecology.

with respect to the water right associated with the project because of uncertainty over the historical amount of water that has been stored in and released from Eightmile Lake.[8]

Change applications are processed in a similar manner to new applications, with some additional work, including reviewing the history of beneficial water use that has occurred under the underlying permit or certificate. When processing change applications, a tentative determination of the extent and validity of the right is made based on historic use. If all or a portion of the right has been relinquished for non-use, that portion of the right is not eligible for the change and is deemed to be invalid.

“Tentative determination of extent and validity” is defined by Ecology Policy 1120, as shown in Appendix B. This policy lists both when a tentative determination should be made and when it is not warranted. Tentative determinations are made as part of Ecology’s or a water conservancy board’s permitting activities. According to Policy 1120, they are required to evaluate rights that are the subject of change applications but are not warranted when a water right is donated to the State Trust Water Rights Program (described below).

With respect to water rights permitting for this project, since their Eightmile Lake water right authorizes the use of water for irrigation, IPID must gain authorization to also release water from storage in the lake for instream flow purposes. Rather than filing a change application seeking to add instream flows as a purpose of use or applying for a new secondary use permit for instream flow purposes, IPID intends to gain authorization for the new use through a donation to the Trust.

Under RCW 90.42.080(1), the holder of a water right may donate all or a portion of such right to the Trust “to assist in providing instream flows or to preserve surface water or groundwater resources on a temporary or permanent basis.” Under RCW 90.42.080(4), a water right donated into the Trust “shall not exceed the extent to which the water right was exercised during the five years before the donation nor may the total of any portion of the water right remaining with the donor plus the donated portion of the water right exceed the extent to which the water right was exercised during the five years before the donation.” Under RCW 90.42.080(10) and (11), the 5-year period shall be adjusted to include earlier years if any nonuse of water is excused under a statutory exception to relinquishment.

Following the issuance of the Draft EIS, IPID submitted a request to donate a portion of its Eightmile Lake water right to instream flow in May 2024. After the Final EIS is issued, Ecology will then evaluate historical water use under the Eightmile Lake water right for the purpose of meeting the quantification requirement in RCW 90.42.080(4) for acceptance of a donation of a portion of the water right into Trust for instream flow purposes. Through this evaluation, Ecology will ascertain the quantity of water that can be donated into Trust. Water use under the portion donated to Trust is limited to instream flow purposes and cannot be relied on for mitigation of any new out-of-stream uses. As described above, this process does not include a tentative determination of the water right as would be conducted for a water right change application. As such, a later adjudication of the water rights in the Icicle Creek Subbasin or an action triggering a tentative determination of extent and validity (such as IPID filing a water right change application) would result in a quantification of water use and annual quantity under the right. If a future quantification (through adjudication or future water right action) results in an annual quantity that is less than the maximum 2,000 acre-feet

[8] IPID conducted a multi-fill analysis (Aspect 2022a) for Eightmile Lake based on a water-balance model for a range of historical operational uses and representative wet, dry, average years. Based on this analysis and IPID’s description of historical practices, IPID estimates that while the active storage volume of the lake currently is about 1,151 acre-feet, when multi-fill events (runoff into the active storage portion of the lake after releases have started for the year) are considered, the irrigation season storage may regularly be over 1,400 acre-feet, and may exceed 2,500 acre-feet in some years. While WAC 508-12-270 specifies that only the initial reservoir filling is allowed under a water right, Ecology has ascertained that the “one-fill” requirement under WAC 508-12-270 is not applicable to the Eightmile Lake water right. This is because WAC 508-12-270 was adopted on March 23, 1960, after the water right was established with its priority date of August 2, 1926.

considered in this EIS, the physical storage volume in the lake can be reduced through modification of the siphon and intake pipe without necessitating any changes to the main dam design.

In addition, the total quantity accepted into Trust for instream flow plus the quantity retained by IPID for irrigation cannot be used in excess of the maximum active storage volume of 2,000 acre-feet that is considered in this EIS for the analysis of potential impacts described above. A monitoring and reporting plan will be required as part of the Trust donation process and will ensure that the 2,000 acre-foot limit is not exceeded on an annual basis and that the Trust donation and associated quantities are managed properly. The Ecology-approved plan will include reporting of total annual storage and release volumes for instream flows as well as IPID's irrigation uses. See Section 2.6 (Dam Operation) of the EIS for additional information on the plan and coordination that will ensure that the instream flow portion will be managed and released to improve fisheries habitat and provide benefits for aquatic resources.

Although Ecology has not conducted an evaluation of water rights quantities for IPID's Eightmile Lake right, the range of the storage volumes for the action alternatives (from up to 1,698 to 2,000 acre-feet) appears to be reasonable based on IPID's records of their historical storage and release practices at the lake and their estimated range of multi-fill volumes presented in their multi-fill analysis (Aspect 2022a). The initial design volumes of 1,698 acre-feet for Alternative 3 and 2,000 acre-feet for Alternatives 1 and 2 are maximum active storage volumes. Since IPID intends to retain 1,400 acre-feet for irrigation, this means that any reductions in quantity that result from the Trust donation process pursuant to RCW 90.42.080(4) would reduce the amount of water available for instream flow augmentation.

IPID's multi-fill analysis (Aspect 2022a) is based on a water-balance spreadsheet model using a range of historical IPID uses and practices and representative wet, dry, and average years. The methodology and spreadsheet modeling tool used are similar to the mass-balance approach used as part of the PFEIS to estimate the Eightmile Lake watershed yield (Appendix B of Ecology 2019a). The model uses a daily mass-balance to estimate change in storage at the lake over the season, which includes both inputs to the lake (precipitation and snowmelt data) and outputs from the lake (estimates of leakage out of the lake, evaporation, and a range of typical operational releases). Additionally, the model prioritized meeting senior water rights prior to multi-fill. While Ecology has not re-created the multi-fill analysis, it conducted a general review of the information and assumptions used, as well as the general methodology, and has ascertained that the analysis is reasonable and supports the design volumes for the alternatives considered.

Pursuant to the Water Resources Act of 1971 (Chapter 90.54 RCW), the state established a water resources management program and Ecology is required to retain adequate flow in streams and rivers to protect instream resources and uses, including fish, wildlife, recreation, aesthetics, water quality, and navigation. As part of the water resources management program, and of particular interest here, is Chapter 173-545 WAC, which regulates the instream resources protection program for the Wenatchee River Basin, also known as Water Resource Inventory Area (WRIA) 45. WAC 173-545 divides the basin into stream management units, including those listed in Table 6-2.

Table 6-2. WRIA 45 Stream Management Units Applicable in the Study Area

Stream Management Unit Name	Control Station Number	Affected Stream Reaches
Icicle Creek near Leavenworth	12-4585.00	Headwaters of Icicle Creek to its mouth.
Wenatchee River at Peshastin	12-4590.00	From the confluence of Derby Creek to Beaver Valley Highway, River Mile 46.2 excluding Derby and Icicle creeks.
Wenatchee River at Monitor	12-4625.00	From mouth to confluence of Derby Creek, including Derby Creek and excluding Mission Creek

Ecology is authorized to establish minimum instream flows for streams and lakes under RCW 90.22.010 and RCW 90.54.040. Minimum instream flows established by rule are considered to be the equivalent of water rights, whose priority date is either the effective date of the rule, or a date specified in the rule. Instream flows in WRIA 45 were initially established with a priority date of June 3, 1983 (WAC 173-545-050). Following recommendations of the Wenatchee watershed planning unit, WAC 173-545 was amended, and additional instream flow rules were added under WAC 173-545-060 with a priority date of November 2, 2001. For Icicle Creek, both sets of instream flows are listed in Table 6-3 and presented graphically in Appendix 1 of WAC 173-545.

Table 6-3. Instream Flows Applicable to Icicle Creek (cfs)

Month and Day	Icicle Creek at Leavenworth	
	WAC 173-545-050: 6/3/1983 Priority Date	WAC 173-545-060: 11/2/2001 Priority Date
January 1	120	267
January 15	120	267
February 1	120	267
February 15	120	566
March 1	150	518
March 15	170	518
April 1	200	650
April 15	300	650
May 1	450	650
May 15	660	650
June 1	1000	650
June 15	660	550
July 1	450	550
July 15	300	550
August 1	200	400
August 15	170	343
September 1	130	275
September 15	130	275
October 1	130	267
October 15	130	267
November 1	150	267
November 15	150	267
December 1	150	267
December 15	150	267

Note: the effective date for WAC 173-545-060 is January 12, 2008. Generally, water right permits issued after 1983 but before January 2008 are subject to the -050 flows except for the period of May 15 to June 30 when they are subject to the -060 flows. Water rights permits issued after January 2008 are subject to the -060 flows.

Thus, there are two distinct instream flows for each reach of the Wenatchee River, or its tributaries, and the flow that applies to any specific water right generally depends on the date that the water right permit was issued (see Table 6-3). For Icicle Creek near Leavenworth, the 2001 instream flows established based on watershed planning are generally higher (that is, more restrictive to water users) than the 1983 instream flows, except during the period from May 15 through June 30. WAC 173-545-050 allows for rights subject to the 1983 flows to be subject to the lower (less restrictive) WAC 173-545-060 instream flows during this period. The situation is similar for instream flows for the Wenatchee River at Peshastin and the Wenatchee River at Monitor.

Instream flows for the Wenatchee River at Peshastin and the Wenatchee River at Monitor are listed in WAC 173-545-050 and -060. Interruptible water rights in the upstream stream management units, including Icicle Creek, may also be curtailed when flows established at Monitor and Peshastin are not met at those locations.

The instream flow rules for the Wenatchee River Basin also established a reservation of water of up to 0.5 cfs for Icicle Creek, not subject to the instream flows, for certain beneficial uses, including domestic, municipal, commercial, and industrial purposes and stock water (see the Wenatchee River Watershed Instream Resources Protection Program section below).

The instream flows in both the Icicle Creek Basin and the Wenatchee River are often not met, particularly in drought years. For example, the instream flows are not met in Icicle Creek more than 90 percent of the time in late July, August, and early September and are not met over 50 percent of the time in late June through mid-late September and January through mid-March (see Chapter 4, Water Resources).

6.3 Affected Environment

As described above, water use within the Icicle Creek Subbasin is controlled by water rights. Water uses, including municipal, rural domestic, irrigation, fish propagation, power generation, and instream flows, are all defined and limited by existing water rights. The review of the water rights of the subbasin presented in this EIS does not represent an extent and validity review (see above) and does not determine whether the quantities of water listed for the rights are actually available for use. Further, maximum Qa's are not specified on some water right certificates, particularly older ones that only specify maximum Qi's. In these cases, the EIS team estimated Qa's based on other documents or records (refer to Appendix B for further information). Estimated total water rights quantities stated within may include amounts that are not valid or that may be inchoate[9] rather than perfected.

The rights described are located in the area from the headwaters of the Eightmile Lake Subbasin downstream to the confluence of Icicle Creek with the Wenatchee River; as described previously, the study area generally does not include the upper reaches of Icicle Creek (upstream of the confluence with Eightmile Creek). The discussion is based largely upon water rights records supplied by Ecology, studies of water management within the subbasin, water rights adjudication files, and the water rights summary provided in the FPEIS (Ecology 2019a).

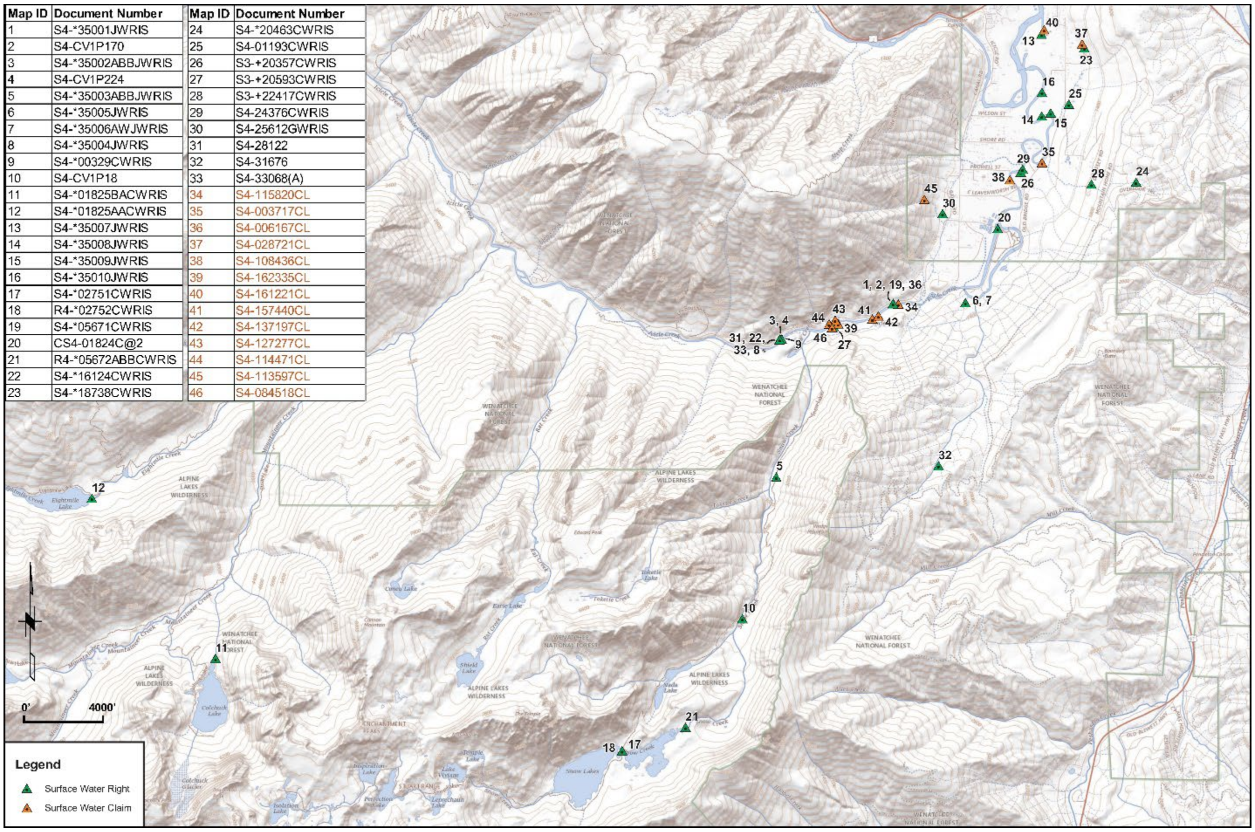
6.3.1 Surface Water Rights

Most water use in the Icicle Creek Subbasin comes from surface water rights, and these rights have more potential to be affected by the Eightmile Dam rebuild than groundwater rights. Existing surface water rights in the basin are used for irrigation, municipal supply, domestic uses, fish propagation, instream flow, and fire protection (**Figure 6-1**). There are also active surface water right applications

[9] When water rights are put to beneficial use they become "perfected." Inchoate rights are rights (or portions of rights) that have not yet been put to beneficial use, and, thus, have not been perfected.

seeking permits for the additional uses (beyond those for existing rights) of power generation and recreation-beautification.

Figure 6-1. Existing Surface Water Rights in the Basin



Map ID	Document Number	Map ID	Document Number
1	S4-*35001JWRIS	24	S4-*20463CWRIS
2	S4-CV1P170	25	S4-01193CWRIS
3	S4-*35002ABBJWRIS	26	S3-+20357CWRIS
4	S4-CV1P224	27	S3-+20593CWRIS
5	S4-*35003ABBJWRIS	28	S3-+22417CWRIS
6	S4-*35005JWRIS	29	S4-24376CWRIS
7	S4-*35006AWJWRIS	30	S4-25612GWRIS
8	S4-*35004JWRIS	31	S4-28122
9	S4-*00329CWRIS	32	S4-31676
10	S4-CV1P18	33	S4-33068(A)
11	S4-*01825BACWRIS	34	S4-115820CL
12	S4-*01825AACWRIS	35	S4-003717CL
13	S4-*35007JWRIS	36	S4-006167CL
14	S4-*35008JWRIS	37	S4-028721CL
15	S4-*35009JWRIS	38	S4-108436CL
16	S4-*35010JWRIS	39	S4-162335CL
17	S4-*02751CWRIS	40	S4-161221CL
18	R4-*02752CWRIS	41	S4-157440CL
19	S4-*05671CWRIS	42	S4-137197CL
20	CS4-01824C@2	43	S4-127277CL
21	R4-*05672ABBCWRIS	44	S4-114471CL
22	S4-*16124CWRIS	45	S4-113597CL
23	S4-*18738CWRIS	46	S4-084518CL

Source: Prepared by Robinson|Noble based on data from Ecology

Alpine Lakes Water Rights

Several water rights were established within the boundaries of the Alpine Lakes Wilderness prior to the wilderness designation in 1976. Specifically, storage rights for irrigation were established on several alpine lakes by the Icicle Irrigation District (IID, a predecessor to the IPID) and the U.S. Bureau of Reclamation (Reclamation; these are now exercised by the USFWS). The water rights were established for Eightmile, Colchuck, Nada, and Snow Lakes within the study area, and on Upper and Lower Klonaqua and Square Lakes outside the study area. Additionally, several water rights were established for water from Snow Creek within the wilderness area. These rights form an important and large component of the total water use in the subbasin. While the rights are located in the wilderness area, the stored water from these rights is used in the lower, more developed part of the subbasin.

Eightmile Lake Water Rights

Generally, the water right on Eightmile Lake tends to be exercised earlier in the season than the other Alpine Lakes rights because the lake is at a lower elevation and access there is easier earlier in the season. The rights on Eightmile Lake date back to 1926, when on August 2, the IID filed an application with the Washington Office of Supervisor of Hydraulics (a predecessor agency to Ecology) for a permit to use 25 cfs “to the extent of 2,000 acre-feet” for the beneficial use of irrigation from Eightmile Lake. The State Hydraulic Engineer approved a water right permit on January 22, 1927, and a Notice of the Beginning of Construction was filed by IID on July 26, 1927.

IID also filed a petition with the Washington State Department of Public Lands (a predecessor agency to the Washington Department of Natural Resources [WDNR]) for shore and overflow rights from Eightmile Lake. On October 26, 1927, the Department of Public Lands granted an easement right to "overflow and perpetually inundate" the "bed and shores of ... Eight Mile Lake." The same order also applied to the bed and shores of Colchuck and Klonaqua Lakes.

In 1927, IID filed a petition with the State Supervisor of Hydraulics requesting determination of the relative rights of claimants to the waters of Icicle Creek and its tributaries. This petition started the legal process that led to the 1929 general adjudication of the water rights from Icicle Creek and its tributaries in Chelan County Superior Court. On October 29, 1929, the court issued the Icicle Creek Decree (Decree). It affirmed IID's water right on Eightmile Lake (as well as Klonaqua and Colchuck Lakes), assigning the respective lands to Class 5 of the six classes in the Decree.[10] The adjudication confirmed an inchoate right at Eightmile Lake for development of a Qi of 25 cfs and a Qa of 2,500 afy (Table 6-4).[11] The Decree stated that IID's Eightmile Lake right was *"inchoate but may be perfected by compliance with provisions under which the permits were issued."* Since the maximum Qa was specified in the Decree as being inchoate, the court did not make any final determination of the Qa that is authorized under this water right.

Following the Decree, the District filed a Notice of Complete Application of Water to a Beneficial Use, Proof of Appropriation, and a Notice of Completion of Construction on August 15, 1939. These documents confirm completion of construction on October 10, 1929, with water put to use by summer of 1930. In part, the Proof of Appropriation[12] states the lake has a natural outlet, through the loose landslide materials that formed the lake, some 30 feet below the normal high water. Because of this, the dam was not constructed to the originally planned height.

A water right certificate was issued by the State Supervisor of Hydraulics on August 21, 1939, for 25 cfs, with no annual quantity stated, for the irrigation of 7,000 acres within the boundaries of the Icicle and Peshastin Irrigation Districts.

This water right, together with IPID's other Alpine Lakes storage rights, are used to supplement the natural flow in Icicle Creek to allow IPID to divert their full diversionary rights and meet mid- to late-season irrigation needs from Icicle Creek (see below) in the summer. According to the IPID Comprehensive Water Conservation Plan (Anchor QEA 2018b), currently during normal and wet years, IPID typically only draws down one of the lakes, but in dry years, multiple lakes may be drawn down. The plan states "*IPID typically releases water from Eightmile Lake first, because it is the easiest lake to access and had the highest probability of refill based on the volume of storage relative to the watershed size and annual runoff*."

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[10] In the 1929 Icicle Creek Decree, the court designated water rights into six general classes (Class 1 through Class 6) based on priority date, with Class 1 water rights having the earliest priority dates and the Class 6 water rights having the latest priority dates.

[11] Available documentation does not explain how the 2,000 acre-feet originally requested in the water right application was increased in the Decree to allow for development of up to a potential maximum of 2,500 acre-feet.

[12] The full remarks from the Proof of Appropriation form are as follows: "*Cut was made 25 feet deep in outlet channel, creosoted wood stave pipe 30 inches in diameter with standard reservoir cast iron gate installed. Gate thoroughly embedded in concrete and concrete cut-off wall placed in channel approximately 50 feet down the stream from control gate. The lake has a natural outlet channel some 30 feet below normal high water and due to difficulty in securing water tightness in formation of slide responsible for the lake dam was not constructed to height first intended, the District preferring to use pumping equipment for securing full appropriation of water during period of extreme drought.*"

Table 6-4. Alpine Lakes Water Rights

Water Right Certificate and Record No.	Person or Organization	Priority Date	Purpose of Use	Qi (cfs)	Certificated Qa (afy)	Adjudicated Qa (afy)	Source Name
01228 / S4-*01825AACWRIS	Icicle Irrigation District	08/02/1926	Irrigation	25[a]	--	2,500[a]	Eightmile Lake[b]
01229 / S4-*01825BACWRIS	Icicle Irrigation District	08/02/1926	Irrigation	50[a]	--	2,500[a]	Colchuck Lake
01591 / S4-*02751CWRIS	Icicle Irrigation District	10/29/1929	Irrigation	25		Na	Snow Creek[c]
01592 / R4-*02752CWRIS	Icicle Irrigation District	10/29/1929	Irrigation, Storage[d]	--	1,000	Na	Snow Creek[c]
01825A / R4-*05672ABBCWRIS	U.S. Bureau of Reclamation	03/26/1942	Fish Propagation	--	16,000[e]	Na	Snow Lakes, Nada Lake

[a] Set as inchoate and in Class 5 by adjudication in Icicle Creek Decree of October 28, 1929; Qi confirmed on certificate; Qa blank on certificate; perfected portion has not been determined.

[b] The Icicle Creek Decree and the certificate for this right both state the source is Eightmile Lake; the WRTS listing for this right says the source is Eightmile Creek.

[c] The WRTS and the certificates for these rights both indicated the source is Snow Creek; however, the water is stored in Snow Lakes.

[d] The WRTS indicates the purpose of use is irrigation, but the certificate states it is "storage for irrigation."

[e] Although certificated for 16,000 afy, available documentation suggests only 12,000 afy has been perfected (see Appendix B).

<u>Other Alpine Lakes Water Rights</u>

There are four other water rights on lakes within the Alpine Lakes Wilderness that are also within the study area (Table 6-4). These involve rights to water from Snow, Nada, and Colchuck Lakes. As previously mentioned, these are typically used later in the season than the Eightmile Lake right because the elevations of these lakes are approximately 250 to 750 feet higher than Eightmile Lake. The most senior of these other Alpine Lakes Wilderness rights is the IID storage right on Colchuck Lake. The right was certificated in 1939 for 50 cfs; no Qa is listed.

The IID also has two other rights in the wilderness area. They applied for these rights in 1929, and therefore the rights were not part of the adjudication. One application was for water from Snow Creek, the other application is a reservoir application to store water in Snow Lakes. The IID entered into a contract with Reclamation for Reclamation to construct the control works for Snow Lakes in return for granting Reclamation the right to use 250 acre-feet of IID's permitted 1,000 acre-feet of storage at Snow Lakes, with the remaining 750 acre-feet to be used only after the water in the District's other reservoirs is tapped.

In 1942, Reclamation applied for a right for storage of 16,000 acre-feet in Nada and Upper and Lower Snow Lakes for the purpose of fish propagation at the LNFH (at the time called the Leavenworth Hatchery Station). This right was certificated that same year.

IPID has storage rights outside the study area, but also in the Alpine Lakes Wilderness, on Klonaqua and Square Lakes for 2,500 and 2,000 acre-feet,[13] respectively. With these two rights, and the rights on Eightmile, Colchuck, Snow and Nada lakes, IPID has estimated total storage rights of up to 10,500 acre-feet.[14] However, due to the agreement with the Reclamation, only up to 10,250 acre-feet of the storage is available for IPID use.

Eightmile Creek Water Rights

The WRTS lists only one water right with Eightmile Creek as a source. However, this is IID's right to water from Eightmile Lake, and both the Icicle Creek Decree and the certificate for IID's right list the source as Eightmile Lake. Therefore, it is likely that the WRTS erroneously lists the source as Eightmile Creek.

Water Rights for Icicle Creek and Its Tributaries

Outside the wilderness area, there are rights on Icicle Creek and its tributaries. These also form an important and large component of water usage within the subbasin. These rights rely on runoff and snowmelt from all up-basin (headwater) areas rather than at specific lakes. Within the study area, Ecology records show 22 surface water rights for diversions from Icicle Creek or its tributaries (for a full listing, see the table in Appendix B). Three rights are interruptible when the flows in Icicle Creek fall below the minimum flows set in WAC 173-545. Cumulatively, the EIS team estimates that these 22 rights authorize the diversion of 185.603 cfs and 67,900.8 afy. Approximately 96 percent of the diversionary rights come from four diverters: the IPID, USFWS, COIC, and the City of Leavenworth.

Most of the rights on Icicle Creek and its tributaries have priority dates earlier than the instream flow rules set by WAC 173-545 and, therefore, are not interruptible when instream flows are not met. The City of Leavenworth's right S4-28122 is senior to the instream flow rule; however, it is interruptible when instream flows are not met due to a provision written into the permit. Two rights have priority dates later than those set for instream flows in WAC 173-545 and are partially interruptible.

[13] The certificate for Klonaqua Lake does not list a Qa; 2,500 acre-feet was described as being inchoate in the 1929 adjudication. The Qa for Square Lake is listed on the right's certificate.
[14] This total estimate may include some inchoate quantity that may have not been perfected and, thus, may not be valid. The total of perfected rights has not been determined by Ecology or a court.

IPID Diversionary Water Rights

The IPID holds three diversionary rights from Icicle and Snow Creeks for a total of 117.71 cfs. Two of these rights were issued to the IID with 1910 priority dates,[15] and another to the Peshastin Irrigation District with a 1919 priority date. All three were part of the 1929 Icicle Creek adjudication, with the earlier rights assigned as Class 2 and the more junior right as Class 5. The IPID diversion is a gravity-flow headworks, located approximately at RM 5.7 on Icicle Creek. IPID manages storage rights on Eightmile, Colchuck, and Snow lakes (discussed above), as well as on Square and Upper and Lower Klonaqua Lakes, to ensure adequate flow for their diversion. Currently during normal and wet years, IPID typically only draws down one of the lakes, but in dry years, multiple lakes may be drawn down (Anchor QEA 2018b).

None of the three rights have a listed Qa in the Icicle Creek Decree or on their certificates. However, one of the rights with a 1910 priority date, S4-*35002ABBJWRIS, has a Qa of 25,000 afy listed on WRTS. This amount appears to be based on water duty calculations presented in the Referee's Report for the adjudication (Superior Court of the State of Washington 1929). The other 1910 right has a change certificate, indicating that any Qa used by it counts against the 25,000 afy. The EIS team estimates the Qa of the 1919 right at 10,315 afy based on the Referee's Report water duty calculations, giving the IPID a total estimated Qa of 35,315 afy[16] under their rights authorizing the diversion of water from Icicle and Snow Creeks.

The IPID's Comprehensive Water Conservation Plan (Anchor QEA 2018b) includes quantity data for the rights from 2013 to 2017. The highest instantaneous diversion rates are listed as occurring during July. The full Qi was reached in 2016, and the peak summer diversion rate typically exceeds 100 cfs. The highest annual diverted total was 29,615 acre-feet in 2015. The 2016 total was only slightly less at 29,335 acre-feet.

USFWS Diversionary Water Rights

The USFWS holds a diversionary right for 42.0 cfs from Icicle Creek. The certificate for right S4-*05671CWRIS does not list a Qa. However, in 2011, the USFWS requested a change to add a point of diversion (CS4-01824C@2). During the processing of that change application, a Qa of 27,482 afy was assigned to the right. The water is non-consumptively used by the LNFH for fish propagation. The USFWS's main diversion, which is shared with COIC, is at RM 4.5. Following Ecology's 2023 water right change decision on COIC's water right, a new point of diversion downstream is being constructed and, upon completion, COIC will no longer share a diversion with LNFH. Additionally, Ecology decided that the component of COIC's Irrigation Efficiencies and Pump Exchange Project that involves the downstream change in point of diversion qualifies as a "water conservation project" under RCW 90.42.020(6) and 90.42.030. The change, authorized by a Chelan County Conservancy Board conditional decision that was affirmed by Ecology, added an alternative point of diversion at RM 2.8 to be used if the main diversion fails to provide sufficient water. The water is returned to Icicle Creek below the fish hatchery near RM 2.6. As discussed above, Reclamation has a storage right for 16,000 afy to ensure adequate flow for the USFWS diversionary right.

In addition to surface water rights, the LNFH has groundwater rights and claims totaling 6,700 gpm and 7,677 afy that are exercised through seven individual wells.

COIC Diversionary Water Rights

COIC holds several water rights to serve irrigators along Icicle Creek. In the 1929 Decree, COIC was granted adjudicated water right S4-*35001JWRIS, recognized as a Class 1 right with a 1905 priority

[15] Originally these two were a single Class 2 right for 83.33 cfs in the Icicle Creek Decree. A portion of that right was split off in a water right change in 1946, creating the two separate rights both sharing the same priority date.
[16] There has been neither a tentative determination of validity and extent by Ecology nor a court adjudication that has determined whether this entire figure is valid.

date. This adjudicated right confirmed the use of 12 cfs of water on 600 acres within the COIC service area during the irrigation season. This right went through several changes in 1940 and has not been evaluated since that time; however, a change application was filed in 2020 to move the point of diversion downstream. In August 2023, Ecology issued a decision approving the change in point of diversion and change in the place of use.

In 1939, LNFH purchased the property on which the COIC's present point of diversion is located. In 1939, LNFH and COIC entered into an agreement concerning the use of the point of diversion, associated infrastructure, and shared water use through exercise of COIC's water right. One of the key components of the agreement included the use of COIC's surplus water, assigning priority to COIC's water needs, and allowing the remaining available water each year from the original 12 cfs to be used by LNFH. This annual multi-purpose or "conjunctive" use by both COIC and LNFH each year for irrigation and fish propagation has been the normative diversion condition since 1940.

Following the 1939 agreement between COIC and LNFH, Certificate of Change S4-CV1P170 was issued in 1940 to formalize the 1939 Agreement. S4-CV1P170 changed the purpose and place of use for a total of 0.203 cfs of water from S4-*35001JWRIS. The purpose of use for 0.1 cfs was changed to fish propagation and domestic use on LNFH land. The place of use for the remaining 0.103 cfs was adjusted for COIC irrigation use. This reduced the water available for COIC irrigation from 12 cfs to 11.9 cfs. Additionally, the surplus water used by LNFH each year was formalized by Ecology in a permit that authorized changes to the place and purpose of use for the surplus water for an indefinite time period. While this permit does not have an identifier or permit number, it is included within the file in WRTS under S4-CV1P170, and Ecology interprets it as part of the same record and authorization as S4-CV1P170.

City of Leavenworth Diversionary Water Rights

The City of Leavenworth has four rights for municipal uses for a total diversion of 6.2 cfs from Icicle Creek, 3.11 cfs[17] of which is interruptible when the flows in Icicle Creek fall below the minimum flows set by WAC 173-545. The oldest right, S4-*35004JWRIS (Adj Cert No. 4), is part of Class 4 of the Icicle Creek Decree with a priority date of 1912. The next oldest, S4-*16124CWRIS (SWC 8105), has a priority date in 1960; and second newest, S4-28122, has a priority date in 1983–this is the right that is fully interruptible. The newest right, S4-33068(A), is non-additive to the earlier rights but does designate a small portion of its Qi as non-interruptible relative to instream flows. Together, the City has asserted that these rights have an estimated total annual quantity of 2,275 afy, although that amount is disputed by Ecology and is the subject of litigation and a recent November 2023 settlement agreement between Ecology and the City (discussed below). The City's diversion is at RM 5.7 across Icicle Creek from the IPID diversion.

The City also has groundwater rights for a wellfield outside the study area, near RM 27.2 of the Wenatchee River, about 0.5 mile upstream from the Icicle Creek's confluence with the Wenatchee River.

The City's current Water System Plan (Varela & Associates, Inc 2018) identified alleged errors in Ecology's previous assessments of the City's water rights and claims a higher total diversionary right than Ecology recognizes. The dispute centers around the maximum Qa authorized under surface water certificate 8105 (S4-*16124CWRIS), which does not include a Qa figure but specifies a Qi of 1.5 cfs. The City asserts that the Qa should be based on the amount of water that would be used if the Qi is diverted on a continuous basis, which is 1,085 afy, while Ecology asserts the correct Qa is 275 afy based on a "reasonable quantity" relating to actual per capita demand for water. The City filed a declaratory judgment lawsuit against Ecology in Chelan County Superior Court to challenge Ecology's Qa figure. On July 19, 2012, a summary judgment order was issued ruling in favor of Ecology. The City appealed, but the case there was suspended to allow for the City to seek additional

[17] The Qi of 3.18 cfs for S4-28122 is interruptible. However, a later permit, S4-33068(A), includes 0.07 cfs of its Qi as not subject to interruption due to instream flows even though the entire Qi on the permit is non-additive.

water through the Icicle Creek Integrated Water Resource Management Strategy.[18] The City and Ecology have entered into a settlement agreement as of November 2023, and additional information is available in the agreement (City of Leavenworth and Ecology 2023). Currently, as a result of the Superior Court's decision, the Qa for this water right officially is 275 afy, which means that the estimated combined total Qa for the City's water rights is 1,465 afy from its Icicle Creek diversion.

The City also has two rejected surface water applications and two active change applications, which are described in Appendix B.

Icicle Creek Surface Water Claims

As described in Section 6.2, *Regulatory Context*, a water right claim is an official statement claiming a right for water use that predates the state's water permitting system (1917 for surface water and 1945 for groundwater). Validity of claims can only be determined and confirmed through a general adjudication by a court. However, based on dates of first water use on the claim forms, any surface water claim with a date after 1917 is probably not valid. WRTS lists 13 surface water claims in the study area (Table 6-5).

Claims can only be filed during certain open claims registry periods prescribed by the legislature, and the claim form used depends on the particular open period. Long forms requested the claimant report the date of first water use (although not all claimants using the form filled in the date), while short forms did not ask for the first date of use or the amount being used. Therefore, many claims do not list a claimed quantity or date of first use.

Icicle Creek Water Use

While the water diverted for the LNFH is non-consumptively used for fish propagation, the water diverted by the City of Leavenworth, IPID, and COIC is used consumptively for either irrigation or municipal uses (which include domestic, commercial and irrigation uses). According to the FPEIS (Ecology 2019a), the three water purveyors serve approximately 3,250 parcels; however, the report notes that some parcels are counted twice due to dual water service (for example, outdoor water served by one of the irrigation districts and indoor water served by the City). Generally speaking, the City serves smaller parcels, most less than 0.5 acre, and the irrigation districts serve larger parcels, most larger than 1 acre (see Table B-1 in Appendix B).

Other Surface Water Rights

There are five other surface water rights in the study area outside the Alpine Lakes Wilderness with sources other than Icicle Creek and its tributaries (see table in Appendix B). These rights are all for various unnamed springs. Water from the springs may or may not be tributary to Icicle Creek; available records reviewed do not indicate where water from the springs naturally flows. In some cases it may reach Icicle Creek, in others it may be consumed by evapotranspiration prior to reaching the creek. Four of the five rights are located on hillsides east to southeast of Icicle Creek after it exits its canyon. The other is located on a hillside west of the creek. Together, these rights total 0.277 cfs and 60.7 afy.

[18] The proposed Trust donation of part of the Eightmile Lake water right will only be for instream flow benefits and will not enable the allocation of additional water to the City of Leavenworth.

Table 6-5. Surface Water Claims in Icicle Creek Subbasin

Water Right No.	Person or Organization	Claimed Date of First Use	Purpose of Use	Qi	Qa (afy)	Source Name
S4-115820CL	Willet, W C	1905[a]	Irrigation	90 gpm	16.0	Icicle Creek
S4-003717CL	Templin, H L	1905[a]	Stock Water, Irrigation	160 gpm	200.0	Icicle Creek
S4-006167CL	Cascade Orchard Irr. Co.	3/13/1911	Irrigation	0.1750 cfs[b]	0.175	Icicle Creek
S4-028721CL	Easterly, G L	May-67	Domestic General	5 gpm	nl	Unnamed spring
S4-108436CL	Hania, G E	nl	Irrigation	nl	nl	Wenatchee River and/or Icicle Creek
S4-162335CL	Sullivan, J P	nl	Domestic General	nl	nl	Icicle Creek
S4-161221CL	Parsley, B W	nl	Stock Water, Irrigation, Domestic General	nl	nl	Icicle Creek
S4-157440CL	Bires, E R	nl	Irrigation, Domestic General	nl	nl	Icicle Creek
S4-137197CL	Liggett, D L	nl	Domestic General	nl	nl	Icicle Creek
S4-127277CL	Gross, E A	nl	Domestic General	nl	nl	Icicle Creek
S4-114471CL	Schmidt, H	nl	Domestic General	nl	nl	Icicle Creek
S4-113597CL	Palmer, I M	nl	Domestic General	400 gpm	80.0	"Icicle Ridge"
S4-084518CL	Kester, H R	nl	Domestic General	nl	nl	Icicle Creek

Notes: nl – not listed on claim form

[a] These claims have dates predating the 1929 adjudication. It is unclear why these water uses, if indeed occurring after the claimed date, were not addressed in the 1929 adjudication.

[b] A study for COIC (Anchor QEA et al. 2015) indicates that 0.103 cfs of this claim may be included in change certificate SA4-CV1P170; however, documentation of this assertion is not provided. If true, the Qi for the claim should be 0.072 cfs. S4-006167CL is a statement of claim filed by COIC in 1971 for 5.627 cfs of water for the irrigation of 422 acres of COIC land. This claim specifies the shared point of diversion between LNFH and COIC. The details of this claim are redundant to adjudicated water right S4-*35001JWRIS, and the claim is not additive to S4-*35001JWRIS.

Wenatchee River Watershed Instream Resources Protection Program

As discussed above in Section 6.2, *Regulatory Context*, Ecology is required to retain adequate flow in streams and rivers to protect instream resources and uses, including fish, wildlife, recreation, aesthetics, water quality, and navigation. As part of the water resources management program, the Wenatchee River Basin Instream Flow Rule, WAC 173-545, established minimum instream flows for WRIA 45. Instream flow rules establish minimum instream flows, which are equivalent to water rights with a priority date based on the date the rules became effective. The WRIA 45 instream flow rules were initially adopted in 1983 (WAC 173-545-050) and then amended in 2008 with larger minimum flows (WAC 173-545-060). All water rights in the watershed with later priority dates are junior to the instream flow rules and are subject to interruption when flows are below the streamflow targets set in the rules (see Table 6-3).

Minimum instream flows in Icicle Creek are typically not met in average years and are often not met during drought years (see Chapter 4, Figure 4-6). This is particularly true for late July through early September when the minimum instream flows are not met in more than 90 percent of water years. Similarly, the instream flows for the Wenatchee River at Peshastin are often not met in drought years and only sometimes in average years.

WAC 173-545-090 established a water right reserve for the Icicle Creek Subbasin. The reservation was created with an Overriding Consideration of Public Interest determination, which the legislature affirmed in 2016 through enactment of a statutory provision codified at RCW 90.54.210. The reservation provides for 0.1 cfs, with an additional 0.4 cfs to "*be considered after completion of flow restoration efforts targeting habitat between the City of Leavenworth and Icicle Irrigation District's point of diversion and the U.S. Fish and Wildlife Service hatchery return. Rulemaking will be required to establish this additional reservation.*" The reservation makes water available, not subject to the minimum instream flows established under WAC 173-545-060, for the following beneficial uses: permitted and permit-exempt "*domestic purposes, irrigation associated with a residence, domestic water requirements associated with municipal, commercial, and industrial purposes, and stock water.*" All water uses under "*the reservation must implement water use efficiency and conservation practices*." Based on a review of water rights listed on WRTS by the EIS team, the only water right currently using water from the Icicle Creek Subbasin reservation, other than permit-exempt water users, appears to be the City of Leavenworth's right S4-33068(A), with 0.070 cfs allocated from the reservation.[19]

Active Surface Water Right Applications

There are nine active surface water right applications listed on WRTS. These include the two City of Leavenworth applications and the COIC application discussed above (with the COIC application since approved by Ecology in 2023 under change decision CS4-35001J@1) and in Appendix B. The other applications include one change application and five new applications.

One change application seeks to change existing right S3-+22417CWRIS from a spring source to a well source. According to the application, the change is necessary because the "spring is failing."

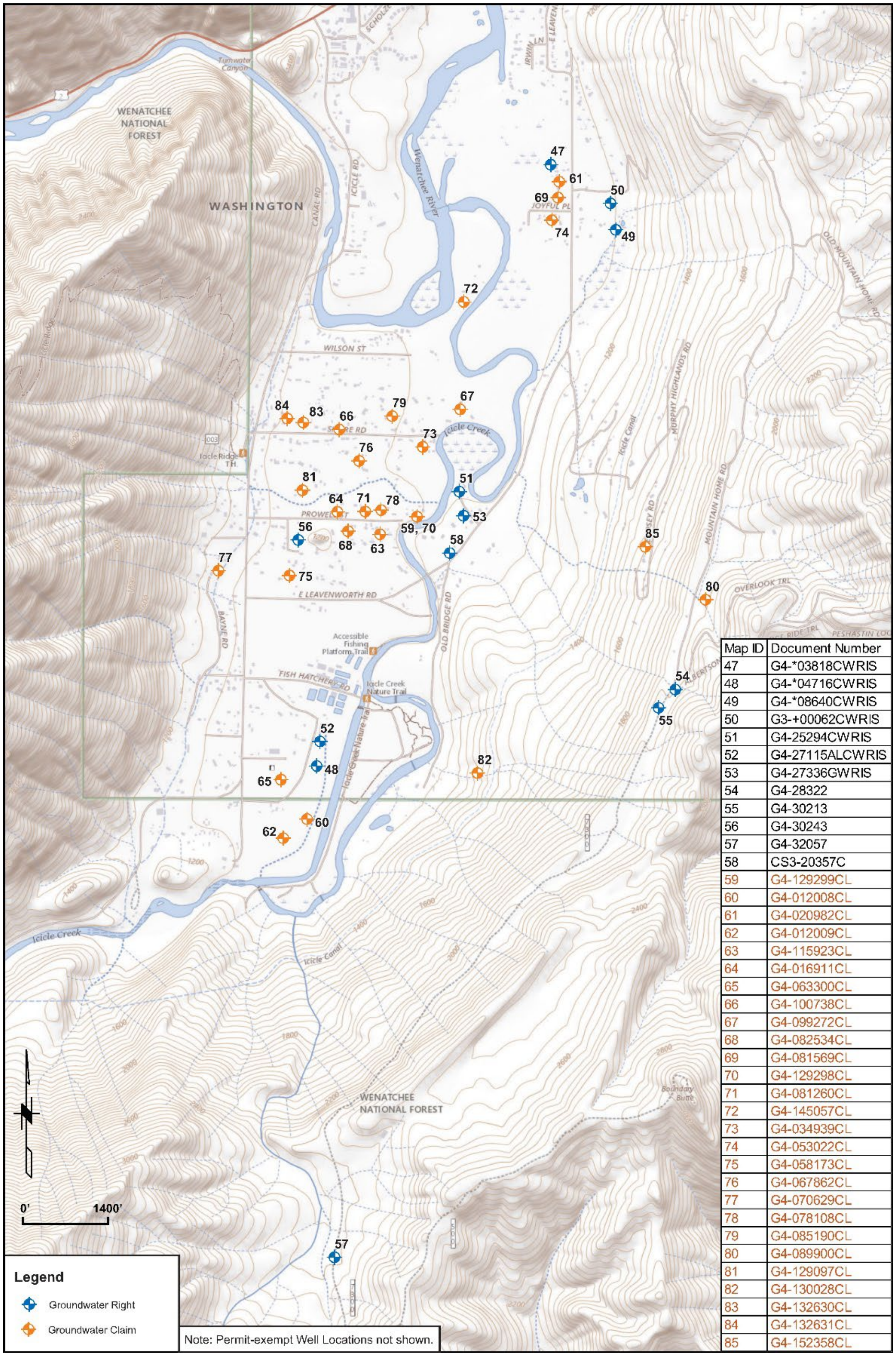
One of the new applications is for non-consumptive power generation uses on Hook Creek, a tributary to Icicle Creek. Two are related to a golf course project along a tributary to Mountain Home Creek (which is tributary to Icicle Creek). These include an application for a reservoir right and an application for irrigation. The final two are for single domestic supply from Icicle Creek, each requesting 0.02 cfs. Ecology has not issued decisions on any of these applications.

6.3.2 Groundwater Rights

While most water use in the Icicle Creek Subbasin comes from surface water rights, there are 12 groundwater rights. In addition, there are 27 groundwater claims and several hundred permit-exempt wells. Existing groundwater rights and claims in the basin are used for irrigation, fish propagation, domestic (single and multiple), fire protection, and stock water. None appear to be in the Alpine Lakes Wilderness. Most are located in the subbasin downstream of the Icicle Creek canyon (**Figure 6-2**). The City of Leavenworth also has groundwater rights; however, these are located a short distance outside of the Icicle Creek Subbasin and are not included in the totals presented here.

[19] Page 15 of the ROE for S4-33068A notes: "Prior to issuance of this decision, reserve accounting based on observed permitted and exempt uses estimated 0.006 cfs has been allocated against the Icicle Subbasin Reserve as of 2011" (Aspect 2013). As of 2023, including the allocation for S4-33068, Chelan County reports 0.090 cfs of the reservation has been allocated, leaving 0.010 cfs available (Aspect 2023).

Figure 6-2. Existing Groundwater Rights in the Basin



Map ID	Document Number
47	G4-*03818CWRIS
48	G4-*04716CWRIS
49	G4-*08640CWRIS
50	G3-+00062CWRIS
51	G4-25294CWRIS
52	G4-27115ALCWRIS
53	G4-27336GWRIS
54	G4-28322
55	G4-30213
56	G4-30243
57	G4-32057
58	CS3-20357C
59	G4-129299CL
60	G4-012008CL
61	G4-020982CL
62	G4-012009CL
63	G4-115923CL
64	G4-016911CL
65	G4-063300CL
66	G4-100738CL
67	G4-099272CL
68	G4-082534CL
69	G4-081569CL
70	G4-129298CL
71	G4-081260CL
72	G4-145057CL
73	G4-034939CL
74	G4-053022CL
75	G4-058173CL
76	G4-067862CL
77	G4-070629CL
78	G4-078108CL
79	G4-085190CL
80	G4-089900CL
81	G4-129097CL
82	G4-130028CL
83	G4-132630CL
84	G4-132631CL
85	G4-152358CL

Source: Prepared by Robinson|Noble based on data from Ecology

The 12 groundwater rights have a Qi of 5,402.1 gpm and a total annual quantity (Qa) of 6,592.6 acre-feet. However, the vast majority of these are used non-consumptively for fish propagation by the LNFH. The total annual water production from the permit-exempt wells in the study area is estimated by the EIS team to be about 102 acre-feet (as explained in Appendix B).

Because the validity of claims cannot be established without an adjudication and many claims do not list the date of first use, the total amount of valid groundwater water rights claims in the study area cannot be determined. However, the two biggest groundwater water right claims (see Table B-5 in Appendix B), may be valid based on the claimed dates of first use. These are associated with the LNFH in the amounts of 1,600 gpm and 1,300 afy.

Additional information on groundwater rights and claims in the study area is provided in Appendix B.

6.4 Construction Impacts

6.4.1 Construction Activities

Impacts related to water rights would be very similar among the action alternatives. For each alternative, active storage of water during the construction period would be minimal and IPID's storage right on Eightmile Lake would not be available. Without the storage of water in, and the release of that storage from Eightmile Lake, flows in Icicle Creek will be reduced during the construction. This has the potential to lead to curtailment of junior diversionary rights (considered a less-than-significant impact in a water-rights sense because only IPID has the right to rely on the release of their stored water) and a lesser potential for impairment of more senior rights (a significant impact).

IPID's diversionary rights are separate from their storage rights, and even if the storage rights are not exercised, IPID can still operate their diversionary rights as long as they do not impair any senior water rights. Therefore, impacts on downstream water rights would depend on the precipitation amounts during the winter before construction as well as during the construction period. Construction is anticipated to occur during one season. If precipitation is above average, it is possible that no diversionary rights would be impacted and instream flow levels might even be met. If precipitation is below average, particularly extremely below average, diversionary rights may be affected, reducing the amount of water available for irrigation and other uses. The degree of reduction will depend on how far below average streamflow falls. Additionally, if precipitation is below average, instream flows would likely not be met.

However, even in the case of a drought, significant impacts (i.e., impairment of senior rights) are not likely. There are only 12.1 cfs of senior diversionary rights (Class 1 rights) to IPID's most senior diversionary rights of 83.3 cfs (Class 2 rights). There are an additional 5.79 cfs of rights (Classes 3 and 4) senior to IPID's Class 5 right of 34.38 cfs. Therefore, a streamflow of less than 101.19 cfs would need to occur for impairment of any rights senior to IPID's most junior right. According to the 63-year record of Icicle Creek flows at the USGS gage above Snow Creek (USGS 2022), there is less than a 5 percent chance of flows that low in Icicle Creek during any month of the irrigation season outside of September. When the contribution of Snow Creek is added, the percent chance is even smaller.

Only in the case of a very severe drought, particularly if it were preceded by another drought year that might prevent IPID from completely filling their other lake reservoirs, would significant impacts on senior water rights potentially occur.

6.5 Operational Impacts

IPID has a right to discharge up to 25 cfs of water from storage in Eightmile Lake. Although the Qa is not specified on the water right certificate, the 1929 adjudication confirmed to IPID an inchoate Qa of 2,500 acre-feet, some or all of which has since been perfected. However, damage to the dam and more recent restrictions by the DSO have reduced the storage capacity in the lake. The current active storage capacity is estimated at approximately 1,151 acre-feet (Aspect 2022a).[20] When accounting for refilling of the lake from precipitation during the irrigation season, which is when IPID actively discharges water from lake storage, Aspect (2022a) estimates that additional water is stored in the lake from partial refills, with actual quantities depending on the release period and climatic conditions for a given year.

The action alternatives would increase the physical (single-fill) active storage capacity relative to current conditions, although storage and release will still be limited by the water right. Alternatives 1 and 2 would create up to 2,000 acre-feet of active storage capacity at any one time, while Alternative 3 would have up to 1,698 acre-feet of active storage.[21] Although a refill analysis has not been conducted for the action alternatives, presumably the total season storage would be higher for each of the alternatives than their active physical storage capacities; even so, the total water use under the right may not increase. The action alternatives would increase the single-fill/active storage capacity from current conditions providing up to between 1,698 and 2,000 acre-feet of total active storage.[22] An Ecology-approved annual monitoring plan will be developed prior to storage and release of water from the rebuilt dam to ensure that the total water actively managed and stored under the right remains within the 2,000 acre-foot maximum lake volume considered for the alternatives. Under the plan, IPID will monitor and report to Ecology the total annual volume of water actively stored in the reservoir and the total annual volumes released for both instream flows (pending review and acceptance of May 2024 Trust donation) and for IPID's irrigation use. It is likely that IPID's diversionary rights could be fully exercised under all the action alternatives and that junior rights holders would not be affected under Alternatives 1 and 2. While there is some potential for impact on junior rights under Alternative 3, it is considerably less than under the No Action Alternative.

During the preparation of this EIS, IPID indicated that based on current water conservation practices, they need a minimum of 1,400 acre-feet of storage capacity at Eightmile Lake to meet needs for irrigation water (Jantzer, pers. comm. 2021). Operationally, IPID indicates that any excess storage capacity above 1,400 acre-feet can be used to support instream flows through a donation of a portion of this water right into the Trust. After the Draft EIS was issued, IPID submitted a formal request to donate a portion of its water right to Trust for instream flow purposes. Following issuance

[20] Following the Jack Creek Fire, DSO has required that the flash boards remain out of the control notch in the dam and the outlet gate remain open for safety reasons given the unsatisfactory status. This has reduced the actual physical water storage during the last few years to less than 1,151 acre-feet.

[21] The alternatives are designed for physical active storage capacities of up to 2,000 and 1,698 acre-feet. However, the amount of water that is stored cannot exceed the storage quantity authorized by the water right. The monitoring and reporting plan described above will ensure that the stored water under a rebuilt dam falls within the limits of the maximum active storage volume of the design alternatives considered and that the Trust donation is managed properly. And, if a future quantification of the right (through adjudication or future water right action) results in an annual quantity that is less than the maximum active storage capacities considered in this EIS, the physical storage volume in the lake can be reduced through modification of the siphon and intake pipe without necessitating any changes to the main dam design.

[22] As mentioned above, the EIS team estimates that IPID has total diversionary rights of up to 35,315 afy from Icicle Creek, while its total available storage rights (all tributary to Icicle Creek) are estimated to be up to 10,250 afy.

of the Final EIS, Ecology will conduct its review of the quantities available for the Trust donation in accordance with the process prescribed by RCW 90.42.080(4).

IPID allows the lake to fill during the spring runoff season, then typically starts releasing stored water in July and commonly continues releasing water into, and sometimes through, August (Aspect 2022a). Released water is supplemented by natural groundwater leakage under the dam. IPID estimates a continual 5 cfs leakage rate, which discharges to the creek a short distance downstream of the dam (Aspect 2022a). Released water travels through Eightmile Creek and into Icicle Creek.

IPID diverts water from Icicle Creek at RM 5.7 under their diversionary rights (see *IPID Diversionary Water Rights* section above, as well as Table B-2 in Appendix B). The stored water released from Eightmile Lake (along with IPID's other Alpine Lakes storage rights) supplements the natural flow of Icicle Creek to allow for IPID's exercise of their diversionary rights.[22]

In effect, utilization of the storage water right on Eightmile Lake (as well as IPID's other storage rights) allows IPID to exercise their divisionary rights to meet their irrigation water needs while keeping water in Icicle Creek. Flows in Icicle Creek at IPID's diversion are generally adequate in June to meet the IPID's full Qi (117.71 cfs) without releases from storage in Eightmile Lake's (or the IPID's other lakes). However, in dry years by the end of July, when the average mean daily discharge in Icicle Creek at the USGS gage above Snow Creek can fall below 200 cfs,[23] releases of stored water may be needed for IPID to exercise their full diversionary rights while keeping water in the creek. In August, even in normal water years, releases from storage may be necessary.

It is unlikely that any diversionary rights on Icicle Creek senior to those of the IPID would be impaired even if none of the stored water is released from Eightmile Lake (there are only rights authorizing the use of 12.1 cfs of water that are senior to IPID's most senior diversionary right). But without releases, particularly in dry years, rights junior to IPID's could potentially be curtailed if IPID does not release water from storage. Such an impact on junior water rights, however, would **not be significant** because junior rights holders are not legally entitled to the water if it is not available.

As stated, IPID submitted a request to donate a portion of its Eightmile Lake water right to the State Trust Water Rights Program for instream flow purposes for the life of the rebuilt dam and related infrastructure. Although the timeframe is technically temporary, the Trust donation for instream flow purposes is tied to the life and existence of the infrastructure for the rebuilt dam and, as such, will likely be for a long period of time (for example, the existing dam's life is reaching the 100-year mark). This also means that the quantities donated for instream flow would be used for those purposes exclusively as long as the infrastructure and project improvements are present and capable of storing water for release. Ecology will consider the request and make a determination on acceptance following issuance of the Final EIS.

If Ecology's review under RCW 90.42.080(4) and final decision on the Trust application results in less than 1,400 acre-feet (the quantity currently needed by IPID), then no water would be available for acceptance into the Trust Water Rights Program. This would not preclude IPID from making annual donations in years where it has surplus water and may not need the full 1,400 acre-feet.

However, if Ecology's review under RCW 90.42.080(4) and final decision on the Trust application results in excess of 1,400 acre-feet of water (beyond the quantity currently needed by IPID) for donation into Trust based on the extent to which the water right was exercised during the 5 years before the donation date, any water donated to Trust as part of this project will only benefit instream flow and will not be used to mitigate any new out-of-stream uses. RCW 90.42.080 authorizes Ecology to accept donations to the State Trust Water Rights Program. The donated portion of the water right will be released from storage in Eightmile Lake to augment flows in Icicle Creek in order to benefit

[23] Based on the 90 percent daily mean exceedance (see Chapter 4). Note that Icicle Creek flow levels in July include releases from Eightmile Lake since IPID usually starts releasing water from the lake during the month.

fish, with releases scheduled based on coordination with IWG members, co-conveners, and fishery co-managers. Ecology holds and has legal authority to manage all Trust water rights within the framework of the prior appropriation system. Unlike Trust water rights that Ecology acquires through means other than a donation, which it actively protects, Ecology typically does not actively manage donations to the Trust Water Rights Program. However, because of the benefit to fish in Icicle Creek, Ecology does intend to manage this donated water instream from the outlet of Eightmile Lake to the confluence of Icicle Creek with the Wenatchee River. Given the relatively senior priority date of this Eightmile Lake water right (1926, Class V), it is likely to remain instream to the confluence of Icicle Creek with the Wenatchee River.

6.5.1 No Action Alternative

Under current conditions, Eightmile Lake has about 1,151 acre-feet of active storage capacity at any one time. Without refill water during the summer, this amount of storage is not sufficient to meet IPID's stated minimum need of 1,400 acre-feet of storage to supply water for irrigation. Even accounting for the refill water volume estimated by IPID described in their refill analysis (Aspect, 2022a), the total storage could still fall short of IPID's stated need during dry years. Therefore, under the No Action Alternative, in dry years, IPID may not be able to fully exercise their diversionary rights due to lack of capacity to exercise their storage water right on Eightmile Lake. Without the release of the full storage capacity in Eightmile Lake, in all but severe drought years, IPID could still exercise their full diversionary rights. This may impact some junior water rights holders, requiring the reduction or total curtailment of their diversionary rights to meet the senior rights including IPID's. Although an impact, curtailment of a junior right is a **less-than-significant impact** from a water-rights point of view as junior rights holders are not legally entitled to the water if it is not available.

If IPID does not store and release water from Eightmile Lake, it is doubtful that any diversionary rights on Icicle Creek senior in priority to those of the IPID would be impaired, while rights junior to IPID's could potentially be curtailed, particularly in drought years. Under the No Action Alternative, in dry years, IPID may not be able to fully exercise their diversionary rights due to lack of capacity to meet their storage water right on Eightmile Lake. This may affect junior water rights holders and instream flows. Should the dam fail under the No Action Alternative, while curtailment of junior water rights may occur, **significant unavoidable impacts** will only possibly occur, in the form of impairment of rights senior to IPID's most junior right, during severe drought years.

Currently, minimum instream flows in Icicle Creek are not met on most days from late July through the end of September[24] with average flow conditions, and sometimes even during very wet years (when the streamflow has 10 percent exceedance; see Chapter 4). Under the No Action Alternative, it is likely that the flows in Icicle Creek will fall below the instream-flow rule levels more frequently as they would under the action alternatives.

Impacts would occur more often for IPID, junior water rights holders, and instream flows should the dam fail. In that case, the active storage capacity would be greatly reduced, and controlled releases during low flow periods (or, in fact, at any time) would not be possible. However, **significant impacts** (impairment of senior water rights) would only likely occur during severe drought years.

6.5.2 Alternative 1: Narrow Spillway with Gates

Alternative 1 would have an active physical storage capacity of up to 2,000 acre-feet.[21] This would be sufficient to meet IPID's stated minimum need of 1,400 acre-feet and allow up to 600 acre-feet to be used to supplement instream flows if a portion of IPID's right is accepted into the Trust. Under this alternative (assuming that 2,000 acre-feet of active storage is would be managed pursuant to the Trust donation process), it is likely that IPID would be able to exercise their full diversionary

[24] The minimum instream flows are also not met during other times of the year. However, here the focus is on the time of year when storage releases from Eightmile Lake occur.

rights. This alternative would provide the benefit of making it is less likely that junior rights would be subject to curtailment and instream flows would likely be met more often than under the No Action Alternative. Implementation of this alternative would fulfill the project purpose and need and would benefit instream flow volumes. There would be **no significant impacts** on water rights under operation of Alternative 1.

6.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Since this action alternative has the same storage characteristics as Alternative 1, the projected operational impacts would be the same. There would be **no significant impacts** on water rights under operation of Alternative 2.

6.5.4 Alternative 3: Narrow Spillway without Gates

Alternative 3 would have an active physical storage volume of up to 1,698 acre-feet.[21] This is sufficient to meet IPID's stated minimum need of 1,400 acre-feet and would still allow up to almost 300 acre-feet to be used to supplement instream flows if a portion of IPID's right is accepted into the Trust. It is likely that IPID's diversionary rights could be exercised under this alternative (assuming 1,698 acre-feet of active storage would be managed pursuant to the Trust donation). This alternative would provide the benefit that junior rights would be less subject to curtailment and instream flows would likely be met more often than under the No Action Alternative, although not to the level of Alternatives 1 or 2. Implementation of this alternative would fulfill the project purpose and would benefit to instream flow volumes, although at a lesser amount than under Alternatives 1 and 2. There would be **no significant impacts** on water rights under operation of Alternative 3.

6.6 Avoidance, Minimization, and Mitigation Measures

The loss of storage through exercise of the Eightmile Lake storage water right during the construction timeframe is unavoidable. Downstream impacts may be avoidable if construction occurs during a higher-than-average streamflow year. During some below-average years, mitigation of downstream impacts may be possible through IPID releasing water from storage on other lakes. Because some of the other lakes do not fill entirely during drought years (Jantzer, pers. comm. 2021), releases from these lakes may not be sufficient to entirely mitigate downstream impacts if construction occurs in the second of two consecutive drought years. In that case, mitigation of downstream impacts may be possible if construction is delayed, avoiding construction occurring in the year following a drought year. Regardless of the prior year's conditions, if construction occurs during an extreme drought year, downstream impacts may be unavoidable even with mitigation.

Following construction, under the action alternatives, impacts on water rights would be largely dependent on climatic conditions rather than dam operations, although significant impacts are unlikely under Alternative 3 and very unlikely under Alternatives 1 and 2. During dry years, all impacts downstream may be partially mitigated by modifying typical releases from Eightmile Lake to best meet downstream conditions (for example, releasing water later than normal). Additionally, releasing water from storage on the other lakes may also mitigate impacts.

Under the No Action Alternative, impacts on water rights will be most severe if the dam fails. In the case of a complete dam failure, potential impacts are expected to be similar to those potentially occurring during construction (as described above). Maintenance of the dam in its current state, if possible, may reduce impacts by preventing a dam failure.

6.7 Significant Unavoidable Adverse Impacts

The loss of storage through exercise of the Eightmile Lake storage water right during construction could lead to a significant unavoidable adverse impact—impairment of water rights senior to those of IPID's most junior right (except those of the COIC)— if it occurs during an extreme drought year. Impairment of the most senior rights, those of the COIC, are extremely unlikely even during the most severe droughts. However, downstream impacts, both significant and otherwise, may be avoidable if construction occurs during a higher-than-average streamflow year or during below-average years when mitigative releases from storage on other lakes are sufficient to overcome the loss of storage releases from Eightmile Lake.

During operation, there are no significant unavoidable adverse impacts under the action alternatives should the mitigation measures identified above be followed. Should the dam fail under the No Action Alternative, significant unavoidable impacts—impairment of water rights senior to those of IPID's most junior right (except those of the COIC)—would possibly occur during extreme drought years.

CHAPTER 7: GEOLOGY

For the purposes of this EIS, geology refers to the earth resources within the potential area of project disturbance.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS.
- Responses to specific comments on geology are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key Findings for Geology

- Eightmile Dam is underlain by fill with surficial cobble and boulder sized riprap material.
- Site-specific geotechnical investigations determined that the site geology is non-liquefiable under the existing conditions.
- The main construction-related impact would be from the excavation of the new core wall, embankments, and pipe trench.
- The deepest impact would be the construction of the outfall pipe structure below the core wall and dam embankment.
- The depth of the excavation, without appropriate shoring, could reduce stability of the embankment.
- Significant impacts are not expected because all permit requirements will be followed.
- Alternative 2 would result in the largest dam footprint and earthwork volume.
- There are no unavoidable adverse impacts on the study area geology due to construction of any of the action alternatives.

7.1 Methodology

The study area for geological resources includes:

- Eightmile Lake from the current maximum pool elevation of 4,667 feet up to the proposed restoration of lake capacity at the water surface elevation of 4,671 feet, the reported historic full lake elevation.
- Portions of the natural earthen embankment at the east side of the lake that could be impacted by proposed flow-control improvements and associated construction activities, including the primary and intermediate spillway, replacement of fill earthen embankment, outlet-pipe replacement, and secondary spillway.
- Eightmile Creek downstream of the natural earthen embankment and existing/proposed flow-control facilities.
- FSR 7601-116, which was most likely built during construction of the dam in the 1920s.
- The Forest Service local repeater station on Icicle Ridge.

At a broader scale, the study area covers the Alpine Lakes Wilderness; specifically, it includes the 3,822 acres of the Eightmile Creek Subbasin which feeds Eightmile Lake, as well as the Eightmile and the lower portion of Icicle Creek Subbasins downstream to the Wenatchee River Valley. The portion of the basin along the upper reaches of Icicle Creek, above the confluence with Eightmile Creek, is specifically not included in the study area because it would not be affected by project construction or operation. A small portion of Icicle Ridge is included in the study area where the proposed repeater station would be co-located with the Forest Service local repeater station on Icicle Ridge.

The information presented in this chapter is primarily derived from geologic mapping of the study area by Tabor et al. (1987) as well as the Draft Geotechnical Report for the project prepared by Aspect Consulting (Aspect 2019). The Aspect report utilized site reconnaissance, a limited geophysical survey, and a single test pit exploration at the location of the proposed primary/intermediate spillway. The geophysical survey included electrical resistivity and refraction microtremor analyses limited to an effective depth of approximately 60 feet below ground surface (bgs). The test pit was limited to a depth of 16 feet bgs, from the ground surface at approximately 4,664 feet elevation down to approximately 4,648 feet elevation. Aspect later completed two deep borings and produced a brief memorandum (Aspect 2022b).

For the evaluation of short-term impacts (construction), impacts are considered significant, as follows:

- Impacts are considered significant if construction would be unable or unlikely to comply with construction standards for geotechnical safety, resulting in potentially unsafe geotechnical conditions for workers and/or members of the public.

For the evaluation of long-term impacts (operational), impacts are considered significant, as follows:

- Impacts are considered significant if long-term operation of the facility would create unsafe geotechnical conditions, resulting in a risk of dam failure or an inability to comply with dam safety requirements for operation and maintenance.

7.2 Regulatory Context

Regulatory review for the project will be completed according to the Washington State Dam Safety Guidelines per the DSO.

7.3 Affected Environment

The study area is located on the eastern flanks of the Cascade Range in the Alpine Lakes Wilderness in central Washington, approximately 10 miles west-southwest of Leavenworth. Topographically, the project area generally consists of uplifted mountains incised into ridges and peaks, with steep-sided valleys cut by scouring glacial ice. The Eightmile Creek Subbasin is generally oriented eastward and is bounded on the north by Eightmile Mountain and on the south by a large, unnamed ridge. Eightmile Lake is a naturally occurring impoundment upgradient of the natural earthen embankment composed of landslide deposits at the east end of the lake that blocks the drainage of Eightmile Creek. The landslide deposits are identified by Tabor et al. (1987) as discussed further in Section 7.3.5 below. The lake is fed primarily by surface water runoff from the upland areas surrounding the basin.

7.3.1 Initial Dam Construction and Current Conditions

The natural earthen embankment of the lake was altered by an excavation between 1927 and 1929 at the head of the outflow creek. A man-made dam (the existing facility) was constructed within the excavated portion of the embankment with the initial intention to increase the height of the lake by approximately 10 feet, which correlates roughly to elevation 4,681 feet. During construction, it was redesigned to eliminate the additional storage and only utilize the maximum historic water elevation of 4,671 feet. The existing facility was constructed to allow the lake elevation to be lowered to regulate discharge into the creek. The dam structures included a flow-control notch with insets for "stop logs," as well as wing walls and a spillway (all constructed of stone and concrete masonry), an earthen fill embankment to backfill the excavated area and connect the structures to the natural earthen embankment, and a low-level outlet pipe with a water-control gate at the upstream end.

In 1995, DSO performed an evaluation of the dam on September 27 and summarized their findings in a letter, dated December 7 (Ecology 1995a). It is unclear what prompted the evaluation by Ecology. For the purposes of the geologic review, a few comments from Ecology's letter are summarized below:

- *"… The downstream face [of the fill earthen embankment] was oversteepened at a slope of about 1.5:1 and had also been undercut by spillway releases."*
- *"Immediately adjacent to the central rock masonry element was a rectangular slot cut through the embankment roughly 25 feet in width and 5-feet deep. Initially, it was uncertain whether this was cut [or] was an emergency overflow spillway, or if this section had been eroded out as a result of overtopping."*
- *"After viewing high water marks left from last year's flooding, which were within one foot of the crest elevation of the [fill] earthen embankment, it was clear that this section of the embankment had failed at some time in the past."*
- *"The possibility of surges in the on-going flood releases from lateral erosion of the existing breach may be construed by the owner to be a liability concern. If so, they may wish to minimize their liability posture by widening and hardening the channel now. In the judgement of the Dam Safety Section, the present dam configuration does not pose a sufficient incremental damage threat to warrant mandating a retrofit of the spillway."*

Ecology's field notes also describe "*considerable leakage through [the] bottom of [the] lake*" (Ecology 1995b).

In 2017, the Jack Creek Fire changed the runoff, erosion, and sediment conditions of the basin as described in the letter by United States Forest Service, dated February 20, 2018 (USFS 2018a). Higher runoff events occurred because of the lack of vegetation. Concerns about the increased runoff potential led to some emergency repairs to the outfall structure of the dam. These emergency repairs were conducted in May 2018 in coordination with Ecology's Dam Safety Office.

7.3.2 Forest Service Road 7601-116 (Current Conditions)

FSR 7601-116 consists of an approximately three-quarter mile section of currently closed road that extends from the Eightmile Lake Trailhead parking lot. Photos and video were provided that were taken by IPID personnel walking portions of the closed road (IPID 2021). This documentation indicates that the road has vegetation growing within the road along with vegetation overgrowing from the sides of the road. The vegetation within the road consists of small trees and shrubs. Fallen trees across the road are periodically present. Potholes were observed within the road up to approximately 1.5 foot deep. The video indicated a mound of soil within the roadway that was inferred to be deposited from a slide. Some areas of the road have been washed out from surface water flow through natural drainage channels.

7.3.3 Local Repeater Station (Current Conditions)

The local repeater station would be located on top of Icicle Ridge next to an existing Forest Service repeater station. Based on a review of recent photos of the proposed location of the repeater station, the ridge is open and rocky with scattered evergreen trees.

7.3.4 Regional Geology

In the Eightmile Creek Subbasin, the primary bedrock formations along the north valley wall are rocks of the Ingalls tectonic complex, with windows of exposed Chiwaukum Schist. The south wall of the valley is comprised of pluton tonalite—a granitic rock—associated with the Mount Stuart batholith.

The soils of the Alpine Lakes Wilderness are predominantly derived from glacial activity as well as post-glacial erosion. Glaciers eroded sediment and transported the scoured material downstream before depositing it as materials including glacial outwash, till, and ice-contact deposits (known collectively as glacial drift). Post-glacial reworking of these materials generated colluvium (deposits transported by downslope movement such as rock talus and landslides), alluvium (deposits transported by flowing water), and lacustrine (lake) sediments. Deposits overridden by glacial ice, such as glacial till, are generally denser and more consolidated than they otherwise would be, which is important for bearing capacity and stability. Colluvial deposits such as landslide deposits are the least sorted and compacted and generally present less favorable conditions for engineering. Because both glacial and colluvial deposits may be diamictic (comprised of a wide range of grain sizes ranging from clay and silt particles up to boulders), geotechnical explorations rely upon sediment source to interpret origin.

7.3.5 Site Geology

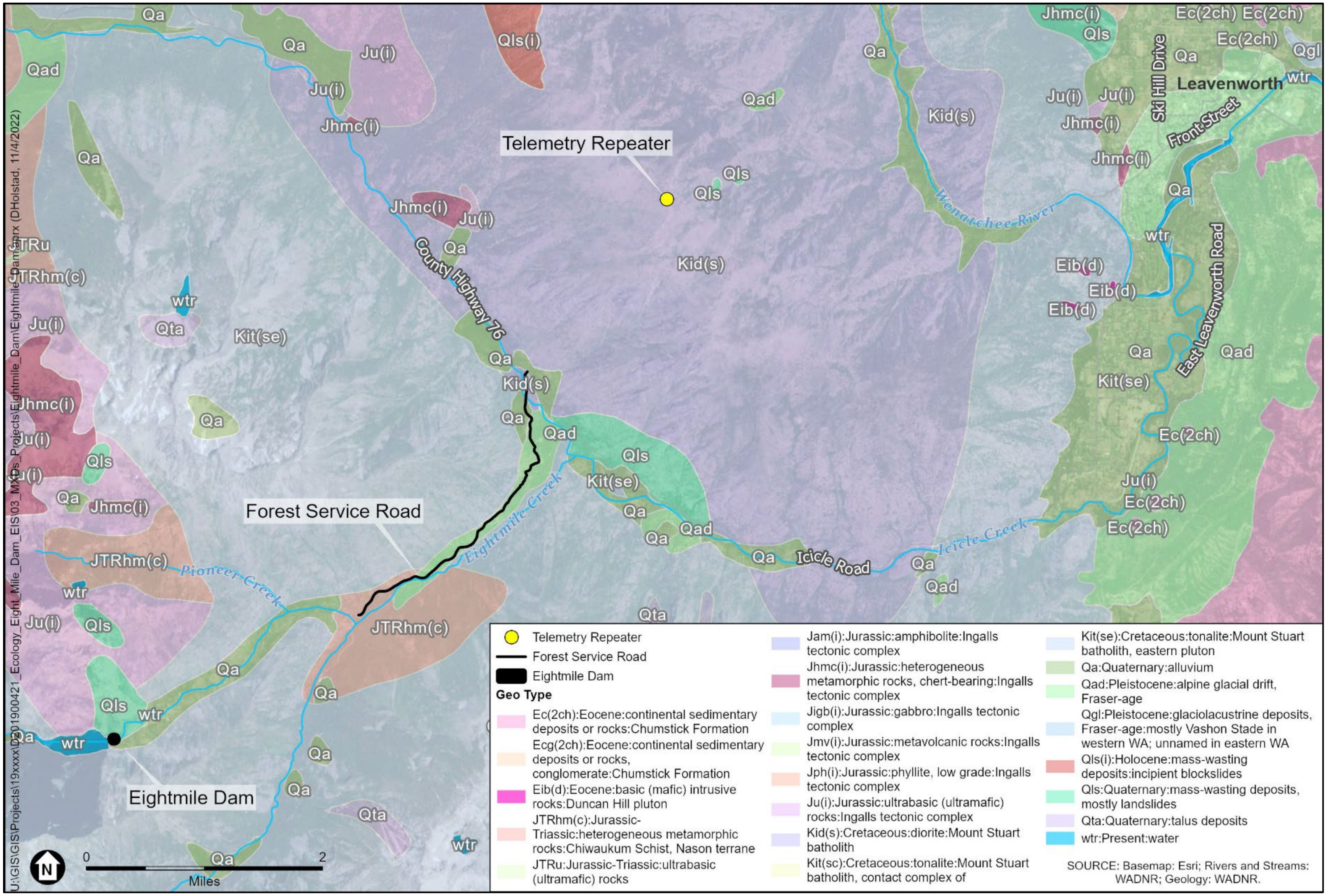
The following section summarizes the individual geologic units in the immediate site vicinity. The intent is to provide a general understanding of the site geology as context for potential impacts. A geologic map of the immediate site vicinity is included below in Figure 7-1.

Fill: Fill refers to materials placed by human activities. Fill was observed at the existing dam surface and in the explorations completed in the dam, as reported by Aspect (2019), and serves as the non-concrete composition of the dam itself. Most, if not all, of the existing fill would be removed, and partially replaced, during construction of the new dam. The existing on-site fill consists of surficial cobble and boulder-sized riprap material underlain by gravel with clay or silt and sand. The fill is derived from on-site landslide deposits and is estimated to be approximately 50 percent cobble and boulder content.

Landslide Deposits (Qls): The natural earthen embankment along the east side of Eightmile Lake that underlies the dam structure is mapped as landslide deposits originating in the bedrock upslope of the dam. These deposits would serve as foundation material for the new dam. They consist of angular gravel, cobbles, and boulders deposited from landslides originating upslope on the basin walls. When old and weathered, they are distinguished by hummocky or indistinct rolling, hilly topography.

Alluvium (Qa): This unit consists of alluvium, colluvium, fan deposits, and undifferentiated valley soil where continuous and thick enough to obscure the underlying geology. Alluvium is mapped within the valley and channel of Eightmile Creek both upgradient and downgradient of the lake and dam. It may underlie the landslide deposits at the natural embankment, although explorations have not directly observed the material at depth (Aspect 2019, 2022b).

Figure 7-1. Geologic Map of the Study Area



Glacial Till (Qgt): Glacial till was encountered when Aspect advanced deep borings (Aspect 2022b). Aspect (2022b) states that the glacial till "generally consists of very dense gravel with sand and clay."

Talus (Qta): Talus consists of non-sorted, angular, colluvial diamict ranging from gravel- to boulder-sized material; it includes small avalanche deposits as well as undifferentiated rocky Holocene glacial deposits. Talus is mapped in the upper portions of the basin. It has also been observed along much of the north and south shores of the lake, and within narrow chutes and channels along the basin walls. Along the sides of the valley floor, talus may grade and interfinger with alluvium. Talus deposits generally lack the fine sediment of landslide deposits but are derived from similar downhill slides and rockfall modes of emplacement. These deposits are not likely to be encountered during construction of the new dam, but the depositional processes forming talus would continue to occur throughout the life of the new dam, potentially impacting the shoreline at or near the dam in the future.

Tonalite Bedrock – Mount Stuart Batholith (Kit(se)): Tonalite is a felsic intrusive igneous rock that comprises the outcropping bedrock of the Eightmile Creek Subbasin upstream from the lake including Eightmile Mountain, the south shore of Eightmile Lake up to the ridge, and both the north and south sides of the Eightmile Creek Subbasin and Icicle Creek Subbasin eastward to Leavenworth. Where present, the tonalite regularly forms steep, well-exposed outcrops.

Serpentinite Bedrock—Ingalls Tectonic Complex (Ju(i), Jhmc(i)): Serpentinite is a low-grade metamorphic rock composed primarily of serpentine group minerals derived from the hydrothermal alteration of ultramafic (rich in iron and magnesium, low in silica) rocks. Although unweathered serpentinite is typically green, these rocks characteristically weather to rusty browns in outcrop and exhibit blocky jointing fractures. Ingalls Tectonic Complex outcrops on the north shore of Eightmile Lake and the area of Eightmile Creek just downstream of the lake, extending up to the ridge. The landslide deposits that dammed the valley and created the valley and created the lake originated from the Ju(i) unit (Aspect 2019).

Schist Bedrock—Chiwaukum Schist (JTRhm(c)): Schist is a foliated, regional metamorphic rock ultimately derived from clay-rich sedimentary rocks and characterized by the planar alignment of platy mica and elongate amphibole mineral groups. The Chiwaukum schist is exposed in minor portions of the valley walls on the north and south sides of the Eightmile Creek Subbasin downstream of the lake.

7.3.6 Seismicity of the Study Area

Seismic activity in the Pacific Northwest is driven by regional convergent plate tectonics. Off the coast, the Juan de Fuca (oceanic) Plate collides into and subducts (descends) under the North American (continental) Plate. The contact between these plates forms an approximately 600-mile-long fault known as the Cascadia Subduction Zone (CSZ). The resulting stresses generate three unique types of earthquakes that contribute to seismic risk in the region (CREW 2013), described below.

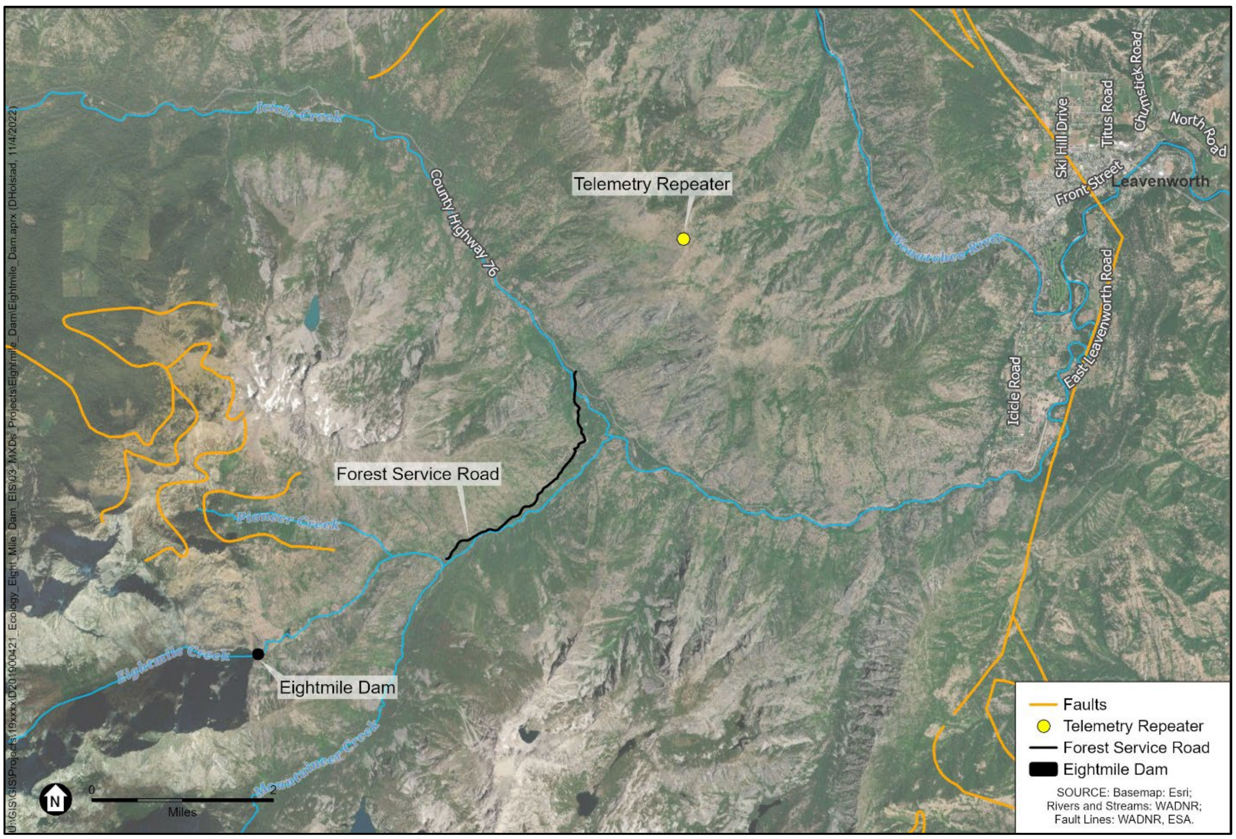
Subduction (or Megathrust) Earthquakes: Megathrust earthquakes are formed by a rupture of the contact between the plates along the CSZ. These events are capable of generating a magnitude 9 or larger earthquake. These earthquakes are relatively far from Eightmile Lake, but still pose great risk due to their extreme intensity and duration. Along the CSZ, megathrust earthquakes are understood to have a recurrence interval of roughly every 500 years. The last such event along the CSZ happened in 1700 AD, lowering the coastline several feet and generating a large tsunami across the Pacific Ocean.

Deep (or Intraslab) Earthquakes: Intraslab earthquakes are associated with stress fractures within the subducting Juan de Fuca Plate as it bends underneath the North American Plate. Because they occur at depths over 18 to 30 miles beneath the surface, the energy of these earthquakes is dissipated over large areas of ground surface, increasing their zone of influence but limiting their severity. These earthquakes concentrate underneath the Puget Sound region to the west of the study area and are closely associated with the depth of the plunging plate.

Shallow (or Crustal) Earthquakes: Stress from the predominantly compressional forces of the CSZ fractures and deforms the continental crust across the Pacific Northwest. When these near-surface crustal faults break, they generate earthquakes that affect smaller areas, but can locally be more intense than the subduction events off the coast. These faults are considered to be more likely to significantly impact the study area.

Numerous faults are present in the Cascade Range, but the majority of these faults have not exhibited evidence of displacement for millions of years and are considered seismically inactive. The WDNR Geologic Information Portal (WDNR 2022) shows the identified faults near the site (located at the tip of the arrow). A map of the faults is presented in Figure 7-2.

Figure 7-2. Mapped Faults near Eightmile Lake



The largest historical earthquake to affect the region surrounding the study area was an 1872 event with an epicenter likely located between Lake Chelan and Entiat, approximately 45 miles northeast of the study area. This earthquake had an estimated magnitude of 6.8 and has been attributed to the recently identified Spencer Canyon fault (Sherrod et al. 2015), although the exact location and magnitude of the event are unknown. All known faults with attributable Quaternary (1.6 million year ago to recent) activity are considered to be of sufficient distance from the study area to not pose a risk of fault rupture to the existing or proposed facilities. Future seismic activity in the region could be expected to be shallow earthquakes of comparable or greater magnitude than the 1872 event.

7.3.7 Conditions in the Special Warranty Deed Area

The Special Warranty Deed Area encompasses the existing facilities of Eightmile Dam and the natural earthen embankment that prehistorically created Eightmile Lake. Aspect (2019) and (2022b) describe the soil conditions as existing fill for the dam, underlain by landslide deposits, which in turn is underlain by glacial till.

Aspect (2019) describes groundwater seepage observed emanating from the creek channel at distances of approximately 300, 600, and 1,200 feet to the east and downstream of the existing dam location.

7.3.8 Conditions in the Study Area

Eightmile Lake and Shoreline: Eightmile Lake was created by a large natural earthen embankment (landslide) that blocked the drainage of Eightmile Creek. Around the shore of Eightmile Lake, small drainages feed directly into the lake as well as into Eightmile Creek, which is both the principal tributary to and distributary from the lake. Together, the lake is fed by 3,822 acres of basin, defined by Eightmile Mountain to the north, Jack Ridge to the west, and an offshoot ridge of the Stuart Range to the south.

The topography around the south shore of Eightmile Lake is strongly influenced by outcropping bedrock and forms glacially incised slopes, which can exceed 60 degrees, up to the surrounding ridges and peaks. Glacial features such as headwalls, chutes, and a sharp crest at the top of the ridge are present. The chutes descend and merge into two large talus fields. The southern lakeshore is covered with talus, is technically challenging to traverse, and is sparsely vegetated.

In contrast, the bedrock on the north shore of the lake has exhibited some mass wasting, which was likely a consequence of glacial erosion over-steepening the slopes of highly fractured bedrock. Aside from the landslide deposit at the east end of the lake, a large rockslide also abuts the west end of the lake. Ongoing rockfalls are evident farther up this chute. The northern shoreline is also littered with boulders but is vegetated with large evergreens, suggesting greater stability.

Eightmile Creek: Eightmile Creek downstream of the dam is fed by the outlet flow from Eightmile Lake. Natural groundwater seepage through the landslide deposits of the natural embankment also feed into Eightmile Creek below the dam. As the creek flows to the northeast down the Eightmile Creek Valley, it merges with its main tributaries—Pioneer Creek and Mountaineer Creek.

Icicle Creek: Eightmile Creek feeds into Icicle Creek roughly 4.5 miles east of Eightmile Lake. Icicle Creek drains the larger Icicle Creek Subbasin area. Below its confluence with Eightmile Creek, Icicle Creek wraps east around Icicle Ridge. Downstream of Icicle Ridge, the valley widens into an alluvial plain, the creek turns north into the City of Leavenworth, and flows into the Wenatchee River.

As with Eightmile Creek, the Icicle Creek channel at the base of the incised valley is filled with alluvial, colluvial, and glacial soils. As a larger valley at lower elevation, the channel flows at a shallower inclination than the more alpine Eightmile Creek channel.

Icicle Ridge: Icicle Ridge forms the northern side of the Icicle Creek Subbasin at its confluence with Eightmile Creek. It continues as the basin edge until Icicle Creek wraps around it to the east. It is a generally steeply sloping feature with exposed outcrops of bedrock.

7.4 Construction Impacts

The initial comments from the DSO and EIS team, based on Aspect's (2019) draft geotechnical report, identified the need for re-evaluation of geotechnical engineering parameters used in analyses of dam stability, seepage, and liquefaction susceptibility. The need for re-evaluation was based on concerns about the lack of deep subsurface investigations to form conclusions in Aspect's draft report (2019). The resolution of these comments and the resulting design needs could have influenced construction of the future dam. To address these, Aspect completed deeper soil borings, the analysis of which was used to form their conclusions. In Aspect's (2022b) memorandum, published following the deep borings, they concluded that:

> "*geotechnical engineering soil and rock parameters/properties presented in the Draft Report are generally conservative. Revised stability and seepage analyses using the updated soil/rock parameters using less conservative parameters will result in factor of safety (FOS) values that are equal to or greater than those in the Draft Report and meet minimum required values. Additionally, the factor of safety against soil liquefaction initiation is equal to or exceeds minimum values such that additional subsurface explorations liquefaction analysis, and/or mitigation (such as ground improvement below the dam) is not needed.*"

These conclusions imply that design needs that could influence the dam construction do not need to be undertaken.

Construction impacts would mostly be similar for all of the action alternatives, with differences only arising from differing dam footprints. Additionally, under any of the action alternatives, the new dam construction would involve the transport of equipment, materials, and personnel to the site. Several transportation options are being considered, as described in Chapter 2.

7.4.1 Transportation of Equipment and Materials

Access for helicopters to transport equipment and materials to the site will require the clearing of a staging area on the north side of the dam. The preparation of the staging area would consist of the removal of vegetation and grading to level the area. The size of the staging area varies based on the payload of the helicopter used for transport. The options being considered are either many trips with a high payload helicopter with a smaller helicopter used to fill in with items not previously transported (Option 1), or few trips with high payload helicopter then many trips with small helicopter to bring items gradually over the construction timeline (Option 2). Option 1 would require a staging area of approximately 10,000 square feet, and Option 2 would require approximately 8,500 square feet. Alternatives 1 and 3 propose the same staging area location. Alternative 2 includes a staging area that extends farther to the north due to the larger dam footprint. Under all three action alternatives, the impact on the geology of the site from establishing helicopter access remains relatively similar and is limited to the clearing and grading required to establish the staging area.

7.4.2 Construction Alternative Similarities

The initial construction activities for all action alternatives would involve the repair and improvement of FSR 7601-116, installation of temporary erosion controls, clearing and leveling of the staging area, and removal of wood and debris from the lake edge within the work area. The repair and improvement of FSR 7601-116 would involve the use of some heavy equipment to remove fallen trees and vegetation within the roadway. Some minor grading would be needed to fill in holes within the roadway, as well as to remove slide debris on the roadway and improve the washed-out areas. Permits would need to be obtained from the Forest Service, and all work would have to satisfy design and construction criteria.

Clearing of the staging area would include the removal of up to 30 trees. The removed trees would be used to help level the staging and work area. The size of the staging area varies depending on the alternative, with Alternative 2 requiring the largest area at 10,000 square feet. During this phase of construction, an approximately 150- to 300-foot-long section of the Eightmile Lake Trail would be temporarily re-routed around the active construction and staging area to ensure hiker safety near the active construction zone.

The existing outlet pipe for the lake would be removed, and excavation work to install a new outlet pipe would occur prior to further dam construction. Appropriate excavation cut angles or shoring of the trench to install the new pipe would be employed. The new outlet pipe would be the new exit point for water from the lake throughout the dam construction. In-water work would be needed to install cofferdams around the work area. Cofferdams would be constructed using large bulk bags. The bulk bags would likely be filled with on-site material. Pumps would be used as needed to dewater the work area.

Once the work area has been established, the existing dam structure would be removed. Excavation work would consist of the removal of the existing dam material and excavation for the foundation of the reinforced concrete dam structure. The excavated landslide deposits would be stockpiled and sorted for re-use as common embankment fill and as riprap armoring. During excavation, the excavated existing fill would be removed and stockpiled. Following the construction of the dam wing walls, the stockpiled sorted material would be placed to construct the embankment and backfill around the core wall.

The secondary spillway would be improved by adding armoring with both gabion baskets and riprap. The stockpiled sorted material would be used for the armoring.

All of the action alternatives would utilize automated valves and/or gates, which would require telemetry equipment to operate remotely. A local repeater station is proposed on top of Icicle Ridge, co-located with an existing Forest Service repeater station. Foundation supports would need to be installed, requiring some minor site preparation and excavation. The equipment and materials for the repeater station would be flown in by helicopter. The installation would consist of bolting down the equipment onto the foundation supports and securing with guyed wires.

The main impact on the geology of the site would be from the excavation for the new dam core wall, embankment, and pipe trench. All action alternatives would require extending the foundation for the core wall into the underlying landslide deposits, which would serve as the bearing material for the dam. This material would be stockpiled and re-used to construct the dam embankment for all action alternatives. The deepest impact of the dam would be the construction of the outfall pipe structure below the core wall and dam embankment, extending to approximately elevation 4,647 feet. The depth of the excavation could have an impact on the overall stability without appropriate shoring. The construction methods should ensure that the stability can be maintained by using trench boxes or other shoring methods during construction of the outfall pipe structure.

7.4.3 Construction Alternative Differences

The main difference in construction impacts between the alternatives consists of the difference in excavation and backfill required to create the dam footprint for each alternative. Alternative 2 requires the largest footprint and would result in more excavation and backfill activities compared to Alternatives 1 and 3, which have similar footprints. The alternatives also have slightly different outlet pipe alignments but the start and end points remain relatively similar.

In general, for all of the action alternatives, no significant impacts would occur during construction. In comparing the three action alternatives, Alternative 2 results in the largest dam footprint and the largest volume of earthwork movement and impact on geology. As previously described, this impact comes from the excavation activities required to construct the dam core wall, embankment, and pipe trench.

7.5 Operational Impacts

7.5.1 No Action Alternative

Under the No Action Alternative, DSO requires the existing low-level outlet gate to remain open during the winter and early spring to reduce the risk of a dam failure. The impact on geology is similar to that of the action alternatives (described below) and results from potential erosion at the lake edges from the fluctuating lake level. The No Action Alternative has a higher risk of dam failure, which could cause a greater impact on the site geology than the action alternatives. Dam failure would result in sudden lake drawdown, which would have a significant erosive/scour effect through the existing drainages. This could lead to slope stability issues in the sidewalls of Eightmile Creek. It would also likely release sediment farther downstream into Icicle Creek.

Regulatory enforcement by DSO in accordance with WAC 173-175-620(3) would consist of restricting the filling of the reservoir. Further regulatory enforcement, if the owner is unwilling or unable to resolve safety issues, would consist of abatement or removal of the dam. Implementation of WAC 173-175-620(3)(b) and (c) would eliminate the ability of the dam to operate.

7.5.2 Action Alternatives

Under the three action alternatives, the dam operation would allow the water levels in the lake to rise through the winter and spring until late-July each year, at which point the valve on the low-level outlet would be regulated to meet downstream needs. At the end of the irrigation season, the valve would be closed, allowing the lake to fill. Seepage through the soil under the dam would also continue to occur throughout the dam operation. The impact on the geology of the site from the dam operation would be from potential erosion at the lake edges resulting from the fluctuating lake levels. This impact would be minimal because the shore of the lake is mainly composed of talus and bedrock outcrops that are relatively resistant to erosion that may occur from lake level fluctuations.

In general, for all of the action alternatives, no significant impacts would occur during operation. All three action alternatives would result in similar fluctuating lake levels. As previously described, the lake level fluctuation would have a minimal impact on the site geology. The No Action Alternative has the highest potential for impact from continued operation as it has a higher risk of dam failure.

7.6 Avoidance, Minimization, and Mitigation Measures

The measures available to avoid, minimize, and mitigate impacts on the geology of the site are minimal for all action alternatives. All construction methods would require excavation into the underlying landslide deposits to construct a new dam embankment structure. Excavated material would be reused to construct the new dam embankment. This avoids having to dispose of the material at the site and having to source additional soil to construct the dam from elsewhere at the site. The geotechnical report (Aspect 2019) included the results of the liquefaction potential of the existing subsurface soils, and Aspect determined that an adequate factor of safety exists. Therefore, deep mitigation options are not needed with any of the alternatives. Aspect (2022b) confirmed with their deep explorations that liquefiable soils do not exist below the dam.

The existing trail would need to be temporarily rerouted around the active construction area at the dam during the construction of all action alternatives. To minimize impact, the trail could be re-routed using the shortest route possible just outside of the construction area. Impacts from the trail reroute could also be minimized by employing measures after construction to fully block the trail reroute and facilitate revegetation to the pre-construction condition.

During project construction, FSR 7601 could be improved to acceptable conditions to allow for vehicle access, provided it is permitted and constructed in accordance with Forest Service guidelines. The rehabilitation of the road for temporary use during construction could be minimized to allow access for one truck width using proper construction techniques and BMPs for controlling erosion. After project construction, FSR 7601 would be closed as per direction by the Forest Service, similar to existing conditions.

7.7 Significant Unavoidable Adverse Impacts

7.7.1 No Action Alternative

There could be significant impact from the No Action Alternative. Leaving the dam in its current condition could result in a dam failure, which would cause a significant disturbance to the geology due to erosion from the increased flow of water. The increased flow of water would scour the Eightmile Creek corridor, undercutting the hillside slopes. This undercutting of the hillside could result in landslides at various areas downslope of the dam. The disturbance area could cause issues for several miles downslope of the dam.

Regulatory enforcement by DSO in accordance with WAC 173-175-620(3) would consist of restricting the filling of the reservoir. Further regulatory enforcement, if the owner is unwilling or unable to resolve safety issues, would consist of abatement or removal of the dam. Implementation of WAC 173-175-620(3)(b) and (c) would eliminate the ability of the dam to operate. Additional geologic impacts would be minor if the elevation of the reservoir is lowered due to regulatory enforcement. Unavoidable adverse impacts could occur if further regulatory enforcement requires that the dam be abated by removal. This would require excavation cuts into existing native material to create safe slopes, and that the existing fill material be stockpiled on-site. The complete removal of the dam could cause the lake level to lower below the historic elevations. This is a result of the lower maximum lake elevation and then the continued natural infiltration.

7.7.2 Action Alternatives

Impacts from the construction and operation of the project would not cause significant unavoidable adverse impacts on geology.

CHAPTER 8: PLANTS AND ANIMALS

This section describes plants and animals in the study area, including existing wildlife and aquatic species and their habitats. The analysis focuses on protected species and their habitats.

What has Changed from the Draft EIS?

- Based on comments received on the Draft EIS, revisions were made to this chapter to clarify or address the following issues: revised information on listed species; refined information on fish distribution in the study area; clarification on potential loss of aquatic habitat in Eightmile Creek under the action alternatives; additional information on insects and benthic macroinvertebrates; additional information about groundwater impacts; and updated citations and references.
- Responses to specific comments on plants and animals are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key Findings for Fish and their Habitat

- Resident fish utilize Eightmile Lake, while anadromous and resident salmonids (including species listed under the Endangered Species Act) utilize fish habitat in the lower reaches of Eightmile Creek and the mainstem Icicle Creek.
- The Leavenworth National Fish Hatchery (LNFH) is an important component of mid-Columbia River fisheries, producing 1.2 million juvenile spring Chinook salmon and acclimating coho salmon.
- Construction of all action alternatives may result in very minor impacts on individual fish within Eightmile Lake and Eightmile Creek, but these impacts would be temporary and minimized by application of project BMPs (e.g., sediment curtains). None of the action alternatives would affect populations of fish or result in significant negative impacts on either fish species or fish habitat.
- Under existing conditions, extremely low summer streamflow conditions reduce the quantity of accessible fish habitat in Eightmile and Icicle creeks and can limit fish passage and increase water temperatures.
- Under all action alternatives, the increase in active storage capacity would potentially provide more water for summer instream flow supplementation, which would benefit fish downstream of the lake in Eightmile and Icicle creeks, including ESA-listed fish species and other anadromous salmonids that use these waterbodies. There are no significant unavoidable adverse effects from the operation of any of the action alternatives.
- Under the No Action Alternative, whether the dam were removed, breached, or fail, there is a high potential for significant unavoidable adverse impacts, including large-scale fish mortality, habitat destruction, and long-term effects on summer flows and stream temperatures. These effects would also apply to the LNFH and could reduce or eliminate production at the facility.

Key Findings for Wildlife and their Habitat

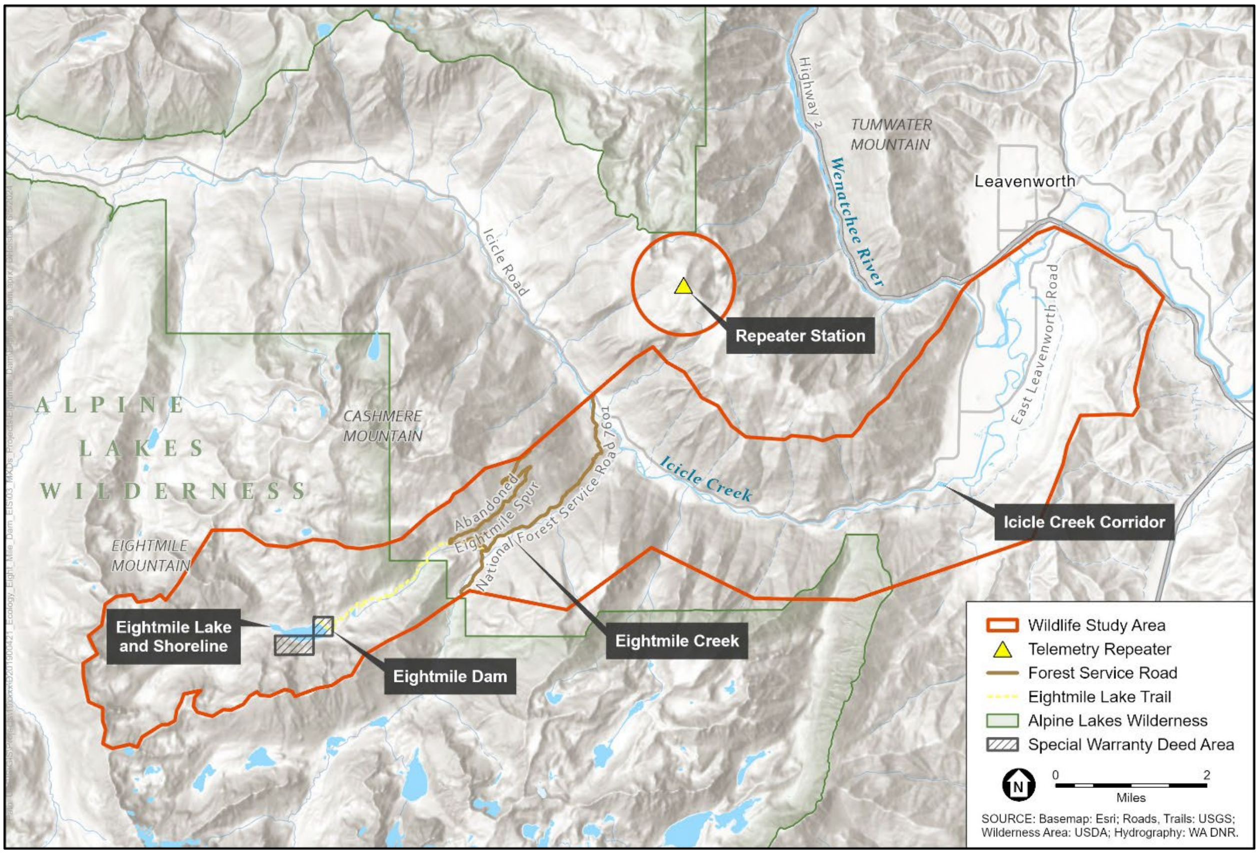
- Wetlands and other water features occur throughout the wildlife and wildlife habitat study area, including near the loading and drop-off points of the staging areas, dam site, upstream (western) end of Eightmile Lake, and shoreline of Little Eightmile Lake. Although these features would be impacted by construction and operations of all project alternatives (including the No Action Alternative), alterations would be confined to shifting the distribution and the size of these features, but would not fundamentally change their type or function.
- Of the listed species in the study area, three federally protected wildlife species and 20 Washington State-protected wildlife species were determined to have a reasonable likelihood of occurring in the study area.
- No protected plants were found to occur in the staging area or FSR 7601-116 corridor.
- Various habitats protected by the State of Washington's Priority Habitats and Species (PHS) program are mapped and occur within the plants and animals study area.
- Impacts on wildlife habitat from helicopter use would be minimal, assuming that landing zones would not need to be substantially altered from current conditions. Propwash would be strong but would not damage vegetation to the point that it is fundamentally unusable by wildlife.
- Helicopter use would disturb avian species and terrestrial mammals, including those with state and/or federal protections. Protected bat species, which may roost near the loading and unloading areas, may also be disturbed and stressed by helicopters as cargo is shuttled during construction.
- The establishment of the FSR 7601-116 road segment would require vegetation removal and road grading using heavy equipment and hand crews. These activities would cause localized noise disturbance and alter wildlife habitats along the segment. Noise would displace wildlife able to flee the area, which would likely occur prior to the associated physical habitat changes. Human presences, largely associated with the heavy equipment, would further disturb wildlife in the area. Because the road segment is currently overgrown with vegetation and not typically used, the alterations would remove wildlife habitat.
- In general, impacts from project operations would have minimal effects on plants and animals due to the similarity with pre-construction conditions, as well as the proposed mitigation actions that would return areas impacted by construction to natural conditions.

8.1 Methodology

Wildlife, aquatic species, and their habitats were evaluated by reviewing species known or expected to be found in the study area. Habitats in the study area were determined based on the available GIS data, aerial imagery, and existing studies. This analysis was supplemented with a site reconnaissance to Eightmile Lake in the summers of 2020 and 2021, and a targeted botanical survey was conducted for the proposed staging area and access road on September 30, 2021 (ESA 2021; Appendix C). No formal delineation of jurisdictional wetlands and waters of the U.S. or State of Washington was conducted as part of this EIS analysis; however, wetland and water features were specifically examined during the multiple site visits, and conditions were compared ("groundtruthed") to available mapping data, including National Wetlands Inventory (NWI), National Hydrography Dataset (NHD), and Priority Habitats and Species (PHS) datasets. Additional available data were also considered, including soil data from the Web Soil Survey, as well as various aerial and topographic maps.

The study area is based on the area where wildlife, aquatic species, and habitats could be most directly affected by the construction or operation of the project (**Figure 8-1**), which includes the project area (Eightmile Dam, access roads, and repeater station site) as well as portions of the Alpine Lakes Wilderness.

Figure 8-1. Study Area for Wildlife, Aquatic Species, and Habitats



Potential impacts include short-term impacts related to construction of the action alternatives and long-term impacts from operation of the dam under the No Action and action alternatives. Potential significant impacts are defined below; impacts that do not reach that threshold would be less-than-significant.

Criteria for Significant Construction Impacts: Impacts would be significant if construction activities would result in a large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish and wildlife species listed under the federal Endangered Species Act (ESA) (threatened or endangered) or similar effects on those species under the Washington State Code (threatened, endangered, sensitive, or candidate) (WAC 220-610-110).

Construction activities would be considered a significant impact if they eliminate, or make non-viable, a species within the study area through the loss of suitable habitat.

Criteria for Significant Operational Impacts: Impacts would be significant if operation of the dam would result in a large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish and wildlife species listed under the federal ESA or similar effects on those species under the Washington State Code (WAC 220-610-110).

Criteria for Significant Habitat Impacts During Operation: Operation of the dam would eliminate, or make non-viable, a species within the study area through the loss of suitable habitat.

8.2 Regulatory Context

The project is subject to a number of regulations at the federal, state, and local levels. Table 8-1 lists and describes the applicable regulations.

Table 8-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
Wilderness Act	The Wilderness Act created the National Wilderness Preservation System and provides the highest level of conservation protection of federal lands. The purpose of the Act is to manage wilderness areas to preserve and, where possible, to restore their wilderness character. To support the mandates of the Wilderness Act, the National Park Service established the National Park Service Management Policies (2006) and Director's Order 41 (2013), which are updated on a periodic basis.
Federal Endangered Species Act (50 CFR Part 17)	Protects species identified as endangered or threatened along with designated critical habitat required for the conservation of those species. The National Marine Fisheries Service (NMFS) has authority over most anadromous fishes, marine mammals, marine reptiles, and other marine fish species, while the United States Fish and Wildlife Service (USFWS) has authority over terrestrial wildlife and resident fish species that inhabit inland waters. Requires that federal actions (such as issuing a permit for wetland fill) do not jeopardize the continued existence of any threatened, endangered, or proposed species or result in the destruction or adverse modification of critical habitat.
Magnuson-Stevens Fishery Conservation and Management Act (MSA) - Public Law 104-297, October 11, 1996, as amended	Requires federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The EFH designation for the Pacific salmon fishery (Chinook, coho, and pink salmon) includes all those streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, except upstream of identified impassable barriers.
Fish and Wildlife Coordination Act	Requires that federal agencies consult with the USFWS, NMFS, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat.
Bald and Golden Eagle Protection Act	Protects bald and golden eagles from the unauthorized capture, purchase, or transportation of the birds, their nets, or their eggs.
Executive Order 12962 (Recreational Fisheries)	Mandates federal agencies, to the extent permitted by law and where practical, to improve the "*quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities.*"

Program, Plan, or Policy	Description
Migratory Bird Treaty Act	Protects migratory birds by prohibiting private parties (and federal agencies in certain judicial circuits) from intentionally taking, selling, or conducting other activities that would harm migratory birds, their eggs, or nests (such as the removal of an active nest or nest tree), unless the Secretary of the Interior authorizes such activities under a special permit.
Clean Water Act (33 CFR 320) Sections 401 and 404	Regulates discharges of dredged or fill materials into waters of the U.S., including wetlands and streams. Also requires any activity that may result in a discharge of a pollutant into waters of the U.S. to obtain a certification from the state that the discharge complies the applicable water standards.
Washington State Code, Endangered, threatened, and sensitive wildlife species classification (WAC 220-610-110)	Under the code, WDFW classifies species as Endangered, Threatened, or Sensitive.
State Hydraulic Code (WAC 220-660)	Regulates hydraulic projects (construction or performance of work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state) by requiring a Hydraulic Project Approval (HPA) for all such projects. The purpose of the HPA is to ensure that construction or performance of work is done in a manner that protects fish life.
Priority Habitats and Species (PHS) Program	State nonregulatory program that provides information on documented locations of fish and aquatic resources, terrestrial plants and animals, and habitats listed or defined as priority. Priority species include state endangered, threatened, sensitive, or candidate species; animal aggregations considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable (WDFW 2015). Priority habitats are habitat types or elements of habitat with unique or significant value to a diverse assemblage of species. A priority habitat may consist of a unique vegetation type (e.g., shrub-steppe) or dominant plant species, a described successional stage (e.g., old-growth forest), or a specific habitat feature (e.g., cliffs).
Washington State Shoreline Management Act	Shorelines of the state (defined in RCW 90.58.030(2)) are regulated through the Shoreline Management Act (SMA). The SMA is administered by Ecology, who delegates authority to local jurisdictions to manage their shorelines through the preparation and implementation of a Shoreline Master Program (SMP).
Fish and Wildlife Habitat Conservation Areas Overlay District Chelan County Code (CCC) 11.78	To designate and classify fish and wildlife conservation areas and to protect, restore where practical, and enhance fish and wildlife populations and their associated habitats.
Wetland Areas Overlay District (CCC 11.80)	To protect the ecological and environmental functions of wetlands and protect the public health, safety, and welfare benefits provided by wetlands by preventing the continual loss of wetlands and, where practical, enhancing or restoring wetland functions and values.

8.3 Affected Environment

8.3.1 Wildlife and Wildlife Habitat

Ecosystem Setting

The ecosystem within the study area for wildlife is composed of a diversity of habitats that support a wide array of wildlife species. The North Cascades Physiographic Province, in which the study area occurs, is a topographically mature area of great relief with very deep, glacially carved valleys with steep slopes (Franklin and Dyrness 1973). Past glacial activity has left rocky, shallow soils that readily pond water or convey it to form springs and streams, all manifesting along valley bottoms. The generally high elevation results in a relatively short growing season and cold, snowy winters. Together, these conditions create a relatively harsh environment that constrains vegetation, as well as the wildlife that resides within it, yet also drives the unique qualities of this landscape.

The study area for wildlife includes the entire length of the Eightmile Creek watershed and the portion of the Icicle Creek drainage extending from its confluence with Eightmile Creek downstream to the Wenatchee River (Figure 8-1). The study area extends vertically from the bottomlands of the various stream drainages, upslope to the surrounding ridgetops. For the purposes of this EIS, four geographic sub-areas have been identified within the study area according to their jurisdiction or the habitats present. These include the Alpine Lakes Wilderness, the Eightmile Lake and shoreline area, the Special Warranty Deed Area overlapping Eightmile Lake, and the Icicle Creek corridor, as shown on Figure 8-1. Overall, naturally occurring wildlife habitat throughout these sub-areas is moderate to high in quality and provides diverse features that support a variety of species. The exceptions are found in discrete but large areas that receive high human use. These areas include portions of the Icicle Creek corridor, Eightmile Creek drainage, and Eightmile Lake and shoreline area. Human use of these sites is generally seasonal, but becomes pronounced in the summer months where roads, parking and camping areas, and backcountry hiking trails are present. In addition to human presence, high use of backcountry sites has led to soil erosion, damage to vegetation, and long-term behavioral alterations of some wildlife species through habituation and learned association with various resources.

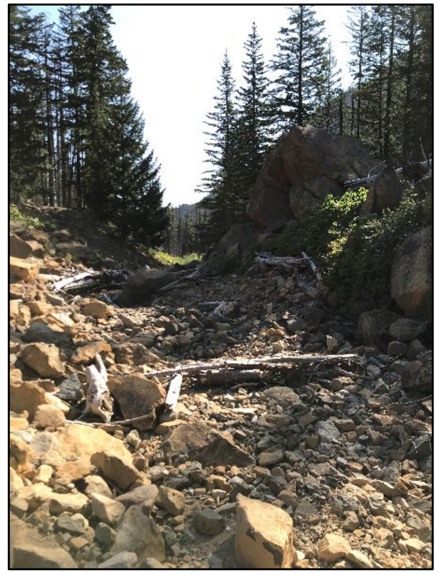
Vegetation and Protected Habitats

Environmental Science Associates conducted a vegetation survey of habitat conditions; rare, threatened, and endangered vascular plant species; and undesirable plant species on September 30, 2021 (ESA 2021; Appendix C). The survey focused on locations within the study area including the Eightmile Dam staging area, the portion of FSR 7601-116 to be improved as a part of the project, and the repeater station site. A site reconnaissance was also conducted in August 2020. As part of the survey and site reconnaissance, ecologists examined wetland and water features in the study area, and compared current on-the-ground conditions to existing mapping data sources, including the NWI, NHD, and PHS datasets (USFWS 2022; NRCS 2022; WDFW 2021c). No formal jurisdictional wetland delineation was conducted as part of this EIS analysis, but most of the study area was examined for wetland features, including hydrology, hydrophytic vegetation, and soil conditions (no test pits were excavated). The watershed for Eightmile Lake is generally confined to the ridgetops surrounding the basin in which it sits. It is bound by Jack Ridge to the west, Eightmile Mountain and ridgeline to the north, and the ridgeline separating Eightmile Lake basin and Stuart Lake basin to the south. Both the 2020 and 2021 site visits were conducted during late summer/ early fall, during seasonal low-water conditions, and observations were considered in that context.

This section summarizes the findings of the survey and site reconnaissance. Representative photos taken during the site visits are presented in Figure 8-2, illustrating the current conditions of some of the key habitat features in the study area as described below.

Figure 8-2. Representative Photos of Habitats in the Plants and Animals Study Area

Burned trees from the 2017 Jack Creek Fire



Steep, rocky shoreline along the Eightmile Creek corridor (looking downstream)

Wetland conditions at the upstream end of Eightmile Lake

Conditions along the shoreline of Little Eightmile Lake

Photos by Environmental Science Associates, 2020 and 2021.

The study area was burned by the Mt. Cashmere Wildfire in 2012 and Jack Creek Fire in 2017 (WDNR 2021; USFS 2021g), which altered vegetation by creating gaps in the forest canopy, removing vegetation, and altering soil compositions, thus allowing early seral communities to fill in these newly disturbed areas (see Figure 8-2).

Most of the study area is dominated by alpine and subalpine vegetation. The lower elevations of the study area have less drought-tolerant, more dense vegetation, while higher elevations have vegetation better adapted to a dry environment. The site around the staging area is dominated by fir trees with subcanopy vegetation dominated by Oregon boxwood (*Paxistima myrsinites*), currant (*Ribes* sp.), elderberry (*Sambucus* sp.), thimbleberry (*Rubus parviflorus*), and various grass species. The upper and lower portions of FSR 7601-116 have montane habitat with grand fir (*Abies grandis*) forest associations, but the lower portion of the road also has subalpine fir forest associations. The lower portion of FSR 7601-116 has a higher density of alders (*Alnus* spp.) with a lower density of pines than the upper portion of the road.

Previous surveys completed by Forest Service botanists had identified invasive species such as Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), and mullein (*Verbascum thapsus*) near the staging area and Eightmile Dam (Furr 2021). Common tansy (*Tanacetum vulgare*) has also been identified in the vicinity of the study area (Furr 2021). The identified populations of common tansy and Canada thistle have been treated previously with herbicide (Furr 2021). Of these populations, only mullein was observed during the September 30, 2021, survey. All undesirable species observed during the survey are listed in Table 8-2.

The Washington Department of Natural Resources, Natural Heritage Program maps Seely's catchfly (*Silene seelyi*) near the staging area and Thompson's pincushion (*Chaenactis thompsonii*) near FSR 7601-116. However, no rare, threated, or endangered plant species or habitat likely to support these species was observed during the targeted survey (ESA 2021; Appendix C).

<u>Alpine Lakes Wilderness</u>

The Alpine Lakes Wilderness intersecting the study area includes the mountain slopes extending to the ridgeline around Eightmile Lake, and the upstream portion of Eightmile Creek. This area is dominated by a mix of forest zones, subalpine meadow communities, alpine communities (Franklin and Dyrness 1973), and stream drainages including Eightmile Creek (the Eightmile Lake and shoreline are described in the section below). Alpine communities are found at the highest elevations where harsh conditions stunt or prevent tree growth. Subalpine communities, located just below alpine communities in elevation, host a greater diversity of plant species, which grow much larger and provide additional habitat structure.

Forested habitat is found at lower elevations and includes dense, somewhat mixed stands of trees including Douglas fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*) (Franklin and Dyrness 1973). A significant characteristic of this forested habitat is the condition created by the Jack Creek Fire, which severely burned much of the vegetation surrounding Eightmile Lake (U.S. Department of the Interior 2017). This intensive fire burned away large expanses of vegetation cover and killed or damaged many shrubs and trees. Although some habitats were degraded in the short term, the fire also created essential features for wildlife that will persist for some time (Fenger et al. 2006). These features include downed wood, standing-hollow snags, and stressed trees throughout the forests of the Alpine Lakes Wilderness area. These habitats provide opportunities for forage, shelter, and reproductive sites for a variety of wildlife species.

Table 8-2. Undesirable Plant Species Observed during the September 30, 2021, Vegetation Survey

Common Name	*Scientific Name*	Chelan County Noxious Weed Classification	Washington State Noxious Weed Classification	FS Region 6 Invasive Plant List
FSR 7601-116 Segment				
Bird's-foot trefoil	*Lotus corniculatus*			✓
Bull thistle	*Cirsium vulgare*		C	✓
Dandelion spp.	Genus *Taraxacum*			
Diffuse knapweed	*Centaurea diffusa*	B (non-designate selected for control)	B	✓
Orchard grass	*Dactylis glomerata*			✓
Oxeye daisy	*Leucanthemum vulgare*	C (selected for control)	Class C	✓
Red clover	*Trifolium pratense*			
Ribwort plantain	*Plantago lanceolata*			✓
Timothy grass	*Phleum pratense*			
Scentless mayweed	*Tripleurospermum inodorum*		Class C	✓
White clover	*Trifolium repens*			
Yellow salsify	*Tragopogon dubius*			
Eightmile Dam Staging Area				
Mullein	*Verbascum thapsus*			✓
Orchard grass	*Dactylis glomerata*			✓
Red sand spurrey	*Spergularia rubra*			
Yellow salsify	*Tragopogon dubius*			

Sources: Chelan County (2021a), Washington State Noxious Weed Control Board (2021), USFS (2010).

One state Priority Habitat is mapped within the portion of the study area overlapping with the Alpine Lakes Wilderness: Freshwater Wetlands – Fresh Deepwater. However, additional Priority Habitats are also present (**Table 8-3**) (WDFW 2021c). Protected habitats in this area are limited to wetlands and stream features (WDFW 2021c). The NWI maps numerous wetlands, lakes, and riverine waterbodies throughout the Alpine Lakes Wilderness (USFWS 2022). All wetlands and other waters mapped in the Alpine Lakes Wilderness area appeared to be accurately represented relative to baseline conditions (see **Figure 8-3**).

Table 8-3. WDFW Priority Habitats within the Study Area; Actual (verified present) and Mapped (not verified present) Occurrences Are Indicated

Priority Habitat Type	Alpine Lakes Wilderness	Eightmile Lake and Shoreline	Special Warranty Deed Area	Icicle Creek Corridor
Terrestrial Habitats				
Biodiversity Areas	X	X	X	X
Old-growth/Mature Forest	X		X	X
Riparian	X	X	X	M
Aquatic Habitats				
Freshwater Wetlands	M	M	M	M
Instream	X		X	X
Priority Habitat Features				
Caves	X		X	X
Cliffs	X		X	X
Snags and Logs	X	X	X	X
Talus	X		X	X

M=Habitat types mapped by WDFW PHS as occurring, X=Habitat types likely present.
Source: WDFW 2021c

Eightmile Creek Corridor

The upstream portion of the Eightmile Creek corridor provides habitat conditions that support a similar wildlife assemblage as what is present in the Alpine Lakes Wilderness forested habitat, as well as what is present in the Eightmile Lake and shoreline area (see discussion below). However, a greater diversity of plant species and vegetation communities is present in the Eightmile Creek corridor due to its lower elevation, higher precipitation, and the presence of perennially flowing water, which collectively support a small but mature riparian corridor. Common riparian trees include black cottonwood (*Populus balsamifera*) and Pacific willow (*Salix lucida*). Wildlife in the Eightmile Creek corridor, including large mammals and raptors, would tend to avoid areas of high human use such as around the roads, campgrounds, parking areas, and trails. FSR 7601 likely also functions as a potential barrier to movements of larger mammals, including deer and elk, limiting habitat quality for these species (Riley et al. 2014).

One state Priority Habitat is mapped as specifically within the portion of the study area overlapping with the Eightmile Creek corridor: Freshwater Wetlands - Fresh Deepwater. However, additional Priority Habitats are also present (Table 8-3) (WDFW 2021c). Within this portion of the study area, NWI maps Eightmile Creek as a riverine, upper perennial, unconsolidated bottom, permanently flooded (R3UBH) feature. This feature was determined to be accurately mapped during the site visits in 2020 and 2021. Based on observations during the site visits, the Eightmile Creek corridor downstream of Eightmile Dam is characterized by steep, rocky slopes and sandy soils, with very little vegetation cover (see Figures 8-2 and 8-4). A fringe of riparian trees is perched atop the steep banks, outside the rocky stream corridor, but the steep topography and substrate are not conducive to supporting a well-developed riparian corridor or riverine wetland. The area is best described as a stream corridor, with the steep slopes contributing to rapidly flowing hydrology through a channelized, rocky streambed devoid of riparian vegetation. No loamy soils are present that would support the anaerobic soil conditions associated with riverine wetlands. No Wetlands of High Conservation Value are mapped or recorded in this portion of the study area.

Figure 8-3. Wetland Habitats Mapped in the Study Area

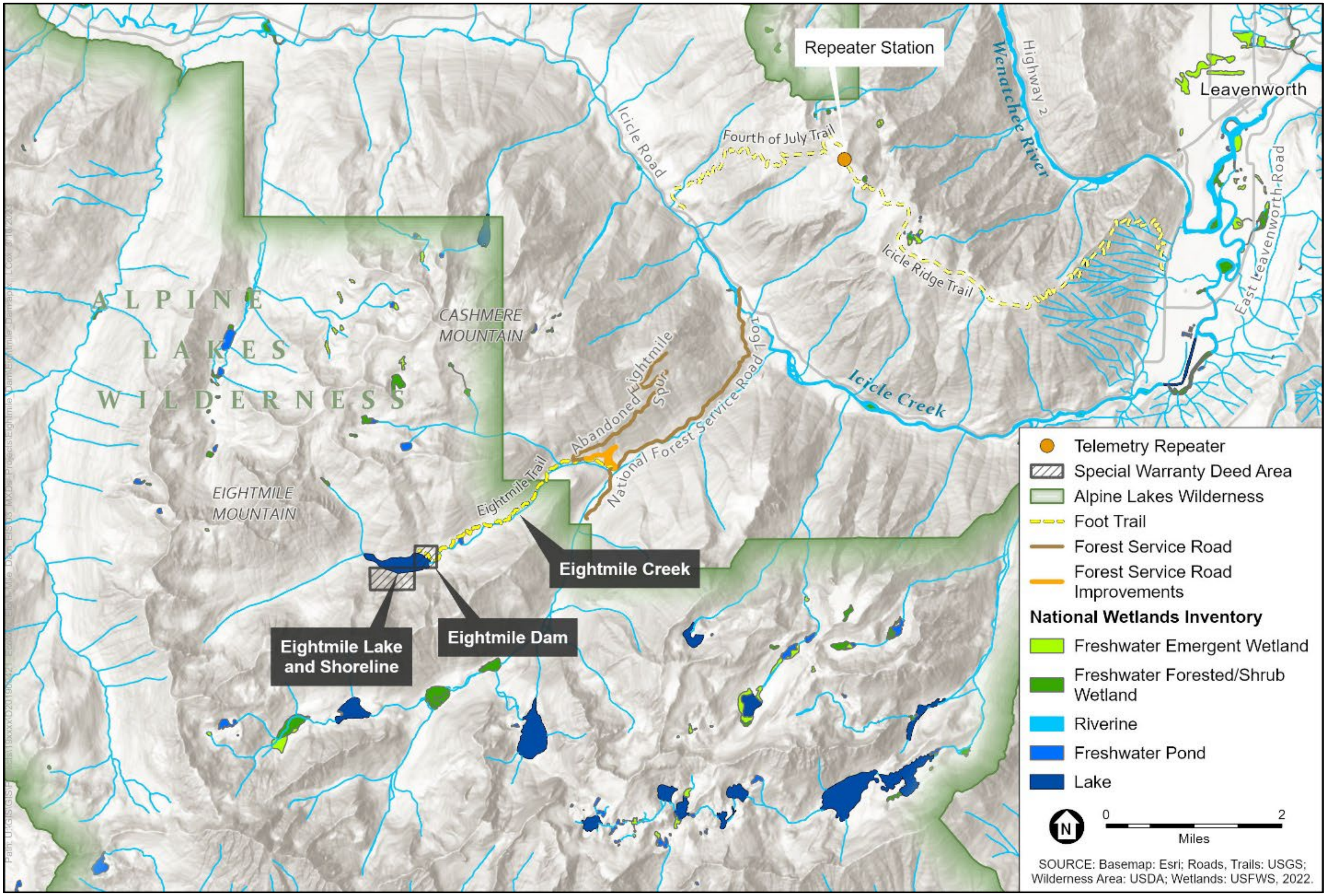
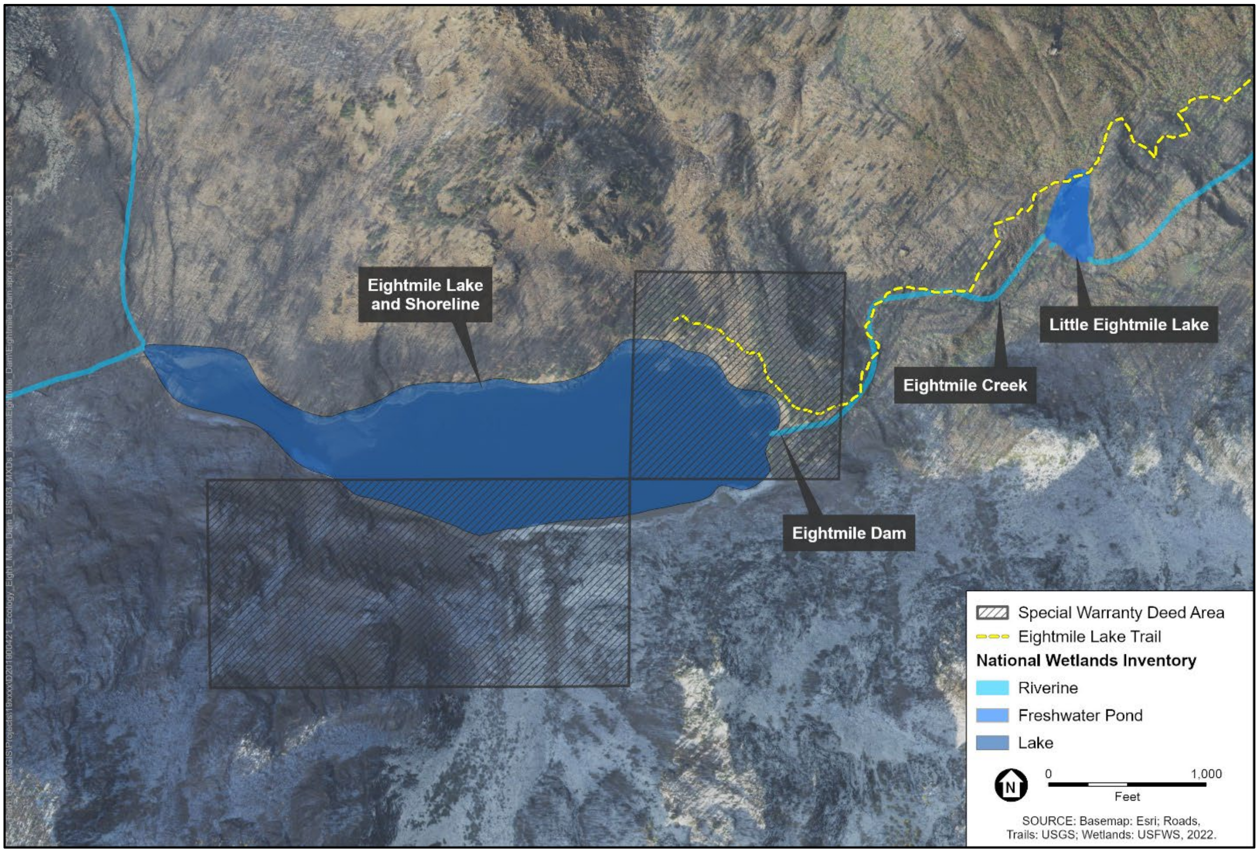


Figure 8-4. Wetland Habitats Mapped at Eightmile Lake and Downstream



Little Eightmile Lake is mapped by NWI as a palustrine, unconsolidated bottom, permanently flooded (PUBH) wetland feature (2.96-acre Freshwater Pond) (USFWS 2022). This feature was determined to be accurately mapped during site visits in 2020 and 2021. Based on the observations made, which were conducted during the late summer low-water season, the wetland area at Little Eightmile Lake is generally characterized as discrete patches of scrub-shrub wetland with limited PUBH in areas (see Figure 8-2). No Wetlands of High Conservation Value are mapped or recorded in this portion of the study area.

Eightmile Lake and Shoreline

The Eightmile Lake and shoreline area currently supports limited vegetation but provides habitat features for resident wildlife as well as for those who use it to move between adjoining habitats. Aquatic edges and limited wetlands provide habitat for several relatively common amphibian and reptile species. Many bird species use these aquatic habitats as well.

Eightmile Lake and the limited wetland habitats support a diversity of mammal species including various bats and other small mammals that depend on water or associated habitat features for foraging and breeding. Larger mammals such as deer, elk, bear, cougar, bobcat, and coyote would use the corridor to move through this area during seasonal migrations.

Because of the fluctuating water levels, Eightmile Lake has a seasonal lake fringe wetland located at the inlet that moves seasonally with changing surface water elevations. This wetland is emergent, herbaceous, and dominated by weedy wetland plants that quickly colonize the receding surface water elevation. It tends to be at its greatest size when the lake is at its lowest surface water elevation. The wetland likely supports a variety of wildlife species including amphibians and reptiles.

The NWI maps Eightmile Lake as a lacustrine, limnetic, unconsolidated bottom, permanently flooded (63.6-acre lake habitat classified as L1UBH) feature (USFWS 2022), which was determined to be accurate from field observations during the 2020 and 2021 site visits. Based on observations during the site visits, which were conducted during the late summer low-water season, the wetland area at Eightmile Lake is characterized as PUBH (see Figures 8-2 and 8-4). As described above, this wetland is emergent, herbaceous, and dominated by weedy wetland plants.

Additionally, one Priority Habitat (Freshwater Wetlands - Fresh Deepwater) occurs within this portion of the study area and overlaps with the Eightmile Lake shoreline and waterbody. All other Priority Habitats within this portion of the study area are shown in Table 8-3 (WDFW 2021c). No species are mapped by the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consulting (IPaC) as occurring within the Eightmile Lake and shoreline area (USFWS 2021b, 2024). No Wetlands of High Conservation Value are mapped or recorded in this portion of the study area.

<u>Special Warranty Deed Area</u>

The Special Warranty Deed Area overlaps with the south and northeast sides of Eightmile Lake and adjoining upland habitats. This area therefore supports the same wildlife and wildlife habitats present in the Eightmile Lake and shoreline area, as well as the burned forests of the Alpine Lakes Wilderness.

One State Priority Habitat is mapped specifically within the portion of the study area overlapping with the Special Warranty Deed Area: Freshwater Wetlands – Fresh Deepwater. This feature was determined to be accurately mapped during site visits in 2020 and 2021. However, additional Priority Habitats are also present (Table 8-3) (WDFW 2021c). No species are mapped by IPaC as occurring within the Special Warranty Deed Area (USFWS 2021b, 2024).

<u>Icicle Creek Corridor</u>

The same habitats and species found in the Eightmile Creek corridor of the Alpine Lakes Wilderness portion of the study area, described above, occur in the Icicle Creek corridor, which extends downstream to its confluence with the Wenatchee River. However, Icicle Creek has a larger, more diverse riparian zone that supports additional deciduous trees and shrubs and provides extensive instream habitat. The Icicle Creek corridor has suffered more human alterations and is more disturbed than the Eightmile Creek corridor, causing species sensitive to human activities, such as larger mammals like black bear and cougar, and raptor species, to avoid these areas. Human disturbance is greatest along Icicle Creek Road and the associated campgrounds and parking areas along the creek. The upslope areas in the Icicle Creek corridor are glacially carved slopes that provide a mix of alpine, sub-alpine, and forested habitats that are generally high quality.

Two State Priority Habitats are mapped as occurring specifically within the Icicle Creek corridor: Freshwater Wetlands – Fresh Deepwater and Riparian. However, additional Priority Habitats are also present (Table 8-3) (WDFW 2021c). Similar to the Alpine Lakes Wilderness, the NWI maps a variety of wetland and riverine resources along the Icicle Creek corridor, including Icicle Creek, which is mapped as a riverine, upper perennial, unconsolidated bottom, permanently flooded (R3UBH) feature, which is the same designation as Eightmile Creek (USFWS 2022). This mapping was determined to be accurate.

<u>Repeater Station Site</u>

The repeater station site is in the alpine habitat, up above Eightmile Lake on a ridgeline. Because of this, few large trees are present, and other plants occur only in low density. Bare ground is typical of this area. Wildlife use is limited to alpine-adapted species. No wetlands or other waters occur in this area. No wetlands or other waters have been mapped at the repeater station site.

Protected Plants and Wildlife

Aquatic and terrestrial habitats in the study area support a variety of plant and wildlife species; however, the degraded ecosystem both within and outside of the study area has reduced the vigor of some of these populations. The federal ESA protects species listed as endangered, threatened, or proposed for listing from "take," which is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. For wildlife species, these protections are implemented by the USFWS. A provision of the ESA allows for state fish and wildlife agencies to cooperate with federal agencies and implement applicable species protections. Washington maintains an active role in regulating and protecting at-risk species through their State Listed Species program and PHS program. Protected fish species are described in Section 8.3.2, *Fish and Fish Habitat*.

A review of the wildlife species listed under ESA as threatened, endangered, or proposed for listing in Chelan County identified a total of five species mapped as having potential to occur, all of which are listed as threatened (USFWS 2021a). One additional federally protected species under the Bald and Golden Eagle Protection Act (BGEPA) also has been mapped as having potential to occur. A formal PHS GIS layer was obtained from WDFW that identified a total of 27 wildlife species mapped as having potential to occur in the study area (WDFW 2020a).

Of the listed species, three federally protected wildlife species and 20 Washington State-protected wildlife species were determined to have reasonable likelihood of occurring in the study area. These species are described further in this section and are listed in Table 8-4, along with ecological and demographic information describing their likelihood of occurrence. Species determined to not have reasonable likelihood of occurring in the study area are not discussed further. No species were mapped by the USFWS IPaC tool as occurring within the Alpine Lakes Wilderness sub-area (USFWS 2021b, 2024). The targeted vegetation survey for the Eightmile Dam staging area and FSR 7601-116 did not identify any protected plant species within the Eightmile Creek corridor or Eightmile Lake and shoreline areas (ESA 2021; Appendix C).

The potential for protected plant and wildlife species to occur in the study area during at least part of the year is based on an array of characteristics including the biology of a species, demographic history, and the habitat conditions available in the study area. These characteristics were assessed during the 2020 and 2021 site visits, including the vegetation survey (ESA 2021; Appendix C). Compiling and overlaying these characteristics allows for a determination on the potential of occurrence for each protected species. Best scientific information, which is generally the most current and/or geographically applicable, is essential in assembling characteristics for this determination. Five criteria were developed and defined for this analysis that classify the potential for each species to occur in the study area. They are as follows:

- Does not occur – The species has not been recently observed in the study area, the study area is outside of the known current range of the species, no suitable habitat is found in the study area, or the species has restricted mobility or a small population size that substantially limits its dispersal ability to the study area.
- Unlikely to occur – The species has not been recently observed in the study area, the study area is outside of the species' known current range and/or suitable habitat may be absent, the species may have restricted mobility or a small population size, reducing but not preventing its dispersal potential to the study area.
- Possible to occur –The study area is within the species' known range but contains marginally suitable habitat, or suitable habitat may occur in the study area, but the species has not been reported observed despite being relatively mobile. If the species does occur within the study area, it may only be present infrequently, in small numbers, and only during short durations.

Table 8-4. Protected Wildlife Species likely to occur in the Study Area; Potential of Occurrence is included for Geographic Sub-areas

Common Name *Scientific Name*	Federal/State Listing Status	Associated Habitat Characteristics	Potential to Occur within Study Area	Potential of Occurrence in Geographic Sub-areas		
				Alpine Lakes Wilderness	Eightmile Lake and Shoreline / Special Warranty Deed Area	Icicle Creek Corridor
Invertebrate						
Giant Palouse earthworm *Driloleirus americanus*	–/SC,SP	Palouse prairies, open forest, and shrub-steppe in deep, loamy soils or gravelly and sandy soils.	Occurs. Species mapped as occurring on edge of study area. Habitat present may be marginal though little is known about this species.	U	U	O
Amphibians						
Western toad *Anaxyrus boreas*	–/SC,SP	Land dwellers found in woodlands, meadows, and mountainous wetlands. Prefer slow-moving, quiet waters, especially wetlands for breeding.	Possible to occur. While not reported in the study area, it is located within the species' current range, and habitat requirements are present at Eightmile Lake and riparian corridors.	P	P	P
Birds						
Harlequin duck *Histrionicus histrionics*	–/SP	Low to subalpine elevations within a closed forest canopy in turbulent mountain streams with midstream gravel bars or rocks.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	P	P	O
Sooty grouse *Dendragapus fuliginosus*	–/SP	Inhabit wet conifer forest from sea level to the subalpine and alpine zones where a well-developed understory of grasses, herbs, and shrubs is present.	Occurs. Sooty grouse have been observed in the study area, which is located within the species' current range.	O	O	O

Common Name ***Scientific Name***	**Federal/State Listing Status**	**Associated Habitat Characteristics**	**Potential to Occur within Study Area**	**Potential of Occurrence in Geographic Sub-areas**		
				Alpine Lakes Wilderness	**Eightmile Lake and Shoreline / Special Warranty Deed Area**	**Icicle Creek Corridor**
Northern spotted owl *Strix occidentalis caurina*	FT/SE,SP	Mid- and late-seral coniferous forests with high canopy closure, complex canopy structure, large decaying trees and/or snags, and high volume of downed wood.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	P	U	O
Flammulated owl *Otus flammeolus*	–/SC,SP	Mid-elevation, open, coniferous forests with mature ponderosa pine, Douglas fir, or mixed conifers with a thick understory.	Possible to occur. While no occurrences have been reported in the study area, it is located within the species' current summer breeding range and habitat is present.	U	U	P
Northern goshawk *Accipiter gentilis*	–/SC,SP	Mid- to high elevation, mature coniferous forests and mixed coniferous and deciduous forest, often on moderate slopes and forest edge.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	O	O	O
Golden eagle *Aquila chrysaetos*	FP/SC,SP	Steep terrain in dry open forests, shrub-steppe, canyonlands, high-elevation alpine zones, and sparingly in clear-cut areas in western Washington.	Occurs. Species mapped as occurring within the study area. Habitat requirements present throughout the study area.	O	O	O
Black-backed woodpecker *Picoides arcticus*	–/SP	Associated with boreal and montane coniferous forests, especially in areas with standing dead trees such as burns, bogs, and windfalls; less frequently in mixed forest and rarely in winter in deciduous woodland.	Occurs. Species mapped as occurring within the study area. Habitat requirements present throughout the study area.	O	O	O

Common Name *Scientific Name*	Federal/State Listing Status	Associated Habitat Characteristics	Potential to Occur within Study Area	Potential of Occurrence in Geographic Sub-areas		
				Alpine Lakes Wilderness	Eightmile Lake and Shoreline / Special Warranty Deed Area	Icicle Creek Corridor
White-headed woodpecker *Dryobates albolarvatus*	–/SC,SP	Relatively open ponderosa pine forests with both live trees and snags, at altitudes from 2,000 to 5,000 feet.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	L	P	O
Vaux's swift *Chaetura vauxi*	–/SP	Found in mature forests but also forages and migrates over open country; forages over land and water; often roosts in large flocks in hollow trees or chimneys just prior to and during migration.	Occurs. Species mapped as occurring within the study area. Habitat requirements present throughout the study area.	O	O	O
Mammals						
Gray wolf *Canis lupus*	FE/SE	Found in a diversity of habitats, including relatively flat forested areas, rolling hills, or open spaces such as river valleys and basins away from human development and disturbance. Denning occurs from May 15–June 15.	Possible to occur. No occurrences have been reported in the study area, but it is located within the species' current range and documented packs occur in surrounding areas.	P	P	P
Grizzly bear *Ursus arctos*	FT/SE	Found where food sources (salmon runs, caribou calving grounds) are concentrated. Found in a variety of habitats but generally associated with arctic and alpine tundra, and subalpine mountain forests.	Unlikely to occur. Grizzly bears in Washington are restricted to the Selkirk Mountains ecosystem in the northeastern corner of the state. The North Cascades ecosystem with high quality bear habitat is a federally designated Grizzly Bear Recovery Zone.	U	U	U

Common Name *Scientific Name*	Federal/State Listing Status	Associated Habitat Characteristics	Potential to Occur within Study Area	Potential of Occurrence in Geographic Sub-areas		
				Alpine Lakes Wilderness	Eightmile Lake and Shoreline / Special Warranty Deed Area	Icicle Creek Corridor
Wolverine *Gulo gulo luscus*	FT/SC	Generally occupy alpine and subalpine forest habitats above 4,000 feet in elevation in the remote mountainous areas of the Cascade mountain range.	Possible to occur. Populations are mapped within the Cascades, but occurrences have not been confirmed within the study area.	P	P	P
Mountain goat *Oreamnos americanus*	–/SP	Cliffs, snowfields, meadows, bare rock benches, and south-facing old-growth forest along crags and ridges.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	O	O	O
Rocky Mountain elk *Cervus canadensis nelsoni*	–/SP	Eastern slopes of the Cascade Range and shrub-steppe.	Occurs. Species have not been mapped in the study area but have been reported by several viable sources. Habitat is present, although the high elevation and limited rangeland would limit population size.	O	U	U
Rocky Mountain mule deer *Odocoileus hemionus nelson*	–/SP	Silver fir–Douglas fir, subalpine fir-mountain hemlock, and ponderosa pine shrub forests. Also utilize open bunchgrass hillsides and shrub-steppe.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	O	O	O
Big brown bat *Eptesicus fuscus*	–/SP	Forest, rangeland, and urban areas where bridges, trees (ponderosa pine and Douglas fir), snags, caves, mines, crevices in cliffs, and buildings occur.	Occurs. While no occurrences have been reported in the study area, it is located within the species' current range, and habitat characteristics important to this species occur.	L	L	O

Common Name *Scientific Name*	Federal/State Listing Status	Associated Habitat Characteristics	Potential to Occur within Study Area	Potential of Occurrence in Geographic Sub-areas		
				Alpine Lakes Wilderness	Eightmile Lake and Shoreline / Special Warranty Deed Area	Icicle Creek Corridor
California myotis *Myotis californicus*	–/SP	Deciduous and coniferous coastal and montane forests, riparian forests, dry interior forests, deserts, canyons, shrub-steppe, arid grasslands, and urban. Roosts in tree cavities, under bark, rocks, caves, mines, buildings, bridges, and shrubs.	Occurs. While no occurrences have been reported in the study area, it is located within the species' current range, and habitat requirements are present.	L	L	O
Little brown bat *Myotis lucifugus*	–/SP	Most commonly in both conifer and hardwood forests, but also inhabits open forests, forest margins, shrub-steppe, tree clumps in open habitats, cliff sites, and urban areas near water sources.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	L	L	O
Fringed myotis *Myotis thysanodes*	–/SP	Prefer drier woodlands (e.g., oak, pinyon-juniper, and ponderosa pine), but also desert scrub, dry grasslands, shrub-steppe, drier forest, moist coastal coniferous forest, and riparian forest near water sources.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	U	U	O
Yuma myotis *Myotis yumanensis*	–/SP	Moist and dry forests, riparian zones, grasslands, shrub-steppe, and deserts near rivers, streams, ponds, and lakes.	Occurs. Species mapped as occurring within the study area. Habitat requirements present.	L	L	O

Listing Status Key: FP=Federally Protected, FE=Federally Endangered, FT=Federally Threatened, SE=State Endangered, SC=State Candidate, SP=State Priority.
Potential of Occurrence Key: U=Unlikely to occur, P=Possible to occur, L=likely to occur, O=Occurs.
Source: Burke Museum 2021; Seattle Audubon 2021; NPS 2017; Innes 2011, 2013; WDFW 2015, 2016, 2021c; USFWS 2021a, b; WBWG 2021; and NatureServe 2021.

- **Likely to occur** – The study area is in the species' known current range and contains suitable habitat, and/or there are relatively recent records of the species from adjacent areas with similar habitat. Occurrence in the study area would likely correspond to supporting a portion of the life cycle of the species.
- **Occurs** – Recent records exist of the species in the study area based on USFWS, WDFW, or other reputable survey data, and suitable habitat is present. Occurrence in the study area would likely correspond to supporting a portion of the life cycle of the species.

8.3.2 Fish and Fish Habitat

The study area for fish and fish habitat includes the entire length of the Eightmile Creek watershed, including Eightmile Lake, as well as the portion of the Icicle Creek drainage extending from its confluence with Eightmile Creek downstream to the Wenatchee River (**Figure 8-1**).

Eightmile Creek Subbasin and Aquatic Habitat

Eightmile Creek (WRIA Stream Number 45.0506), itself part of the larger Icicle Creek watershed, drains a tributary area of 30 square miles and conveys surface water runoff from both Eightmile Lake and Colchuck Lake via Colchuck and Mountaineer creeks. Eightmile Creek drains into Icicle Creek at approximately RM 9, and the stream provides approximately 3 to 5 percent of the discharge to the Icicle Creek system, based on Ecology and USGS flow gage data between 2008 and 2021.

Eightmile Lake is one of the Alpine Lakes, which are characterized by naturally low productivity and provide relatively limited habitat for fish, primarily because of cold water from melting snow or glaciers, a short growing season, the lake location at the head of the watershed, and a general lack of inputs of organic material. The Alpine Lakes are relatively pristine compared to downstream habitats. The primary anthropogenic impacts on fish habitat in the Alpine Lakes are associated with dam structures to manage surface water and the introduction of sport fish.

The current high water surface elevation of Eightmile Lake is 4,667.0 feet (msl) (with stop logs in), with a corresponding surface area of 76.6 acres, as compared to a historical high of 4,671.0 feet and a surface area of 81.7 acres.

In August 2017, the Jack Creek Fire burned much of the Eightmile Basin adjacent to and upstream of Eightmile Lake, with a substantial portion of the burned area (64 percent) experiencing moderate to high soil burn severities (USFS 2021g). The rates of soil erosion and sediment delivery to Eightmile Lake and Eightmile Creek are presumed to be higher from these areas of moderate and high soil burn severity and potentially altered the hydrology of inflow to the lake and raised concerns about the condition and safety of the Eightmile Dam (USFS 2021g). Natural re-vegetation recovery should reduce runoff and erosion rates substantially, over time.

The available data indicate that for the 2019 water year, the average daily flow for Eightmile Creek was 23.1 cfs, with a low of 7.6 cfs on September 24 and a high of 102.0 cfs on May 27 and 28 (Ecology 2021e). Over the period of record (May 2018 to January 2021), the data indicate that the general low-flow period is from mid-to-late August, with low flows of approximately 10 cfs. Flows increase in the fall (October) and vary from 15 to 40 cfs over the winter months. From mid-March to mid-April, responding to snowmelt in the basin, the flows steadily increase over 1 to 2 months to a maximum of 90 to 110 cfs in mid- to late-May. Flows drop in early June and over the summer months, gradually returning to low flow conditions. Climate change will likely exacerbate summer low flows through increased droughts and potential reduction of winter/spring snowpack. It may also increase high flows due to increases in the magnitude and frequency of rain-on-snow events.

Fish habitat conditions in the Alpine Lakes Wilderness, including Eightmile Creek, are relatively intact and well-functioning compared to downstream habitats, which have been subject to greater anthropogenic disturbances. Eightmile Creek and its tributaries cross a few roads and trails in some locations, with the primary crossing being the bridge near the confluence of Icicle Creek, where Eightmile Creek passes under FSR 7601, but habitat impacts from these crossings are minimal.

Past timber harvest and forest fires have somewhat altered the vegetation and increased the exposed soils in the drainage, and large woody debris recruitment potential is below sustainable levels. Some drainages in the Eightmile Creek subbasin have been scoured to bedrock due to the effects of fire (USFS 1995, 2021g). Sediment that does reach Eightmile Creek is transported to the alluvial fan at the confluence with Icicle Creek. FSR 7601 is a major contributor of sediment to Eightmile Creek (USFS 1995).

Fish passage is blocked in several areas downstream of Eightmile Lake, including a natural falls at RM 0.5 (Andonaegui 2001). Upstream fish passage in Eightmile Creek between Eightmile Lake and the confluence with Icicle Creek is also impeded because of the steep elevation along the stream up to Little Eightmile and Eightmile lakes (Anchor QEA and Aspect Consulting 2015). In addition, the lower–middle reaches of Eightmile Creek, between Mountaineer and Pioneer creeks, is steep, averaging 17 percent slope. Two State Priority Habitats relevant to fish, Riparian and Wetlands, are mapped specifically within the Icicle Creek corridor (see Table 8-3). Riparian areas provide instream shade, recruitment of large wood, and bank stability and sediment control. Freshwater wetlands can provide off-channel habitat and refugia to some fish species.

Fish Use in Eightmile Creek Basin

Eightmile Lake is considered a “high lake,” which in Eastern Washington generally refers to those at an elevation greater than 3,500 feet. Prior to introductions of sport fish by humans in the 1930s, Eightmile Lake likely lacked suitable spawning habitat or productive conditions for rearing juveniles, and like most of the high lakes, probably contained no fish (Wydoski and Whitney 2003). Steep stream gradients downstream of Eightmile Lake preclude anadromous salmonids from entering the lake from downstream, limiting fish use of the lake to salmonids that display a resident form life history.

Eightmile Lake was periodically stocked by WDFW with cutthroat, rainbow, and lake trout, until 2005 (T. Maitland, personal communication). Eightmile Lake is one of the only alpine lakes with a naturalized population of lake trout (WDFW 2005). There is also evidence that eastern brook trout were introduced to the lake (T. Maitland, personal communication; WDFW 2021d), some of which now inhabit Icicle Creek (NWPPC 2004). Currently, the WDFW (2020b) and NWIFC (2020) salmon databases indicate documented presence of rainbow trout and eastern brook trout in the lake and mainstem of Eightmile Creek, while cutthroat trout distribution is mapped as limited to the tributaries of Eightmile Creek (see Table 8-5).

Icicle Creek Basin and Aquatic Habitat

Eightmile Creek drains to Icicle Creek, joining it at RM 9. Icicle Creek is approximately 32 miles long and located on the eastern flanks of the Cascade Mountain Range. The stream is the largest tributary to the Wenatchee River in terms of both flow and basin area, entering the Wenatchee River at RM 25.6 with a subbasin area of 213 square miles. The Wenatchee River Basin is defined as WRIA 45.

Approximately 87 percent of the Icicle Creek subbasin is in public ownership, including approximately 74 percent that consists of the Alpine Lakes Wilderness and the Wenatchee National Forest (Ringel 1997). Icicle Creek contributes approximately 20 percent of the annual average flow to the Wenatchee River (Andonaegui 2001). It is a high elevation drainage with 14 glaciers, 102 lakes, and 85 tributaries, and natural conditions (steep gradients, waterfalls, flows) limit fish access in tributaries. Most of the Icicle Creek valley has a narrow, U-shaped cross-section that reflects its history of alpine glaciation (Andonaegui 2001). Major tributaries to Icicle Creek downstream of the Alpine Lakes Wilderness include Leland, French, Eightmile, and Snow creeks.

The hydrology of Icicle Creek is typical for the area, with hydrology primarily driven by snowmelt. Flows peak in June, with a steady decline throughout the rest of the summer. Low flows typically occur in September and remain low through early October. Streamflow then begins to increase in response to fall precipitation and remains steady through winter. When snow begins melting in spring, streamflow increases until its early summer peak. For more information on streamflows, see Chapter 4, *Surface Water Resources*.

Stream habitat conditions, including floodplain connectivity and riparian habitat outside of the Alpine Lakes Wilderness, have been impacted by roads, campgrounds, timber harvest, private development, and water diversions (withdrawals) (Andonaegui 2001; Berg et al. 2002). Floodplain connectivity in Icicle Creek is limited between the LNFH and the wilderness boundary (RM 3.8–17.5) where roads and bridges confine the stream channel and riprap has been placed.

The upper watershed (upstream of RM 5.7) has higher flows than the downstream reaches, due to the lack of diversions and multiple surface water inputs. Several significant diversions are present in the lower watershed, including for the IPID, COIC, City of Leavenworth, LNFH, and numerous small local private diversions (Ecology and Chelan County 2019). See Chapter 6, *Water Rights,* for more details.

The effects of the major diversions on flow in Icicle Creek are substantial. For example, estimated flow in late summer/early fall 2016 upstream of major diversions was 203 cfs, while estimated flow below diversions was 92 cfs, a reduction of over 50 percent. Instream flow targets developed by the Icicle Work Group (IWG) were a minimum flow of 100 cfs in an average water year, and a minimum flow of 60 cfs during a dry water year (Irving 2015 in NMFS 2017). See Chapter 4, *Surface Water Resources*, and Chapter 6, *Water Rights*, for more details.

In 2020, a project was undertaken to address a fish passage barrier at the boulder field at RM 5.6 of Icicle Creek. The field, located just downstream from the IPID and City of Leavenworth diversions at RM 5.7, consisted of boulders up to 60 feet wide, resulting in a setting where at low flows, they formed impassable falls with shallow sheetflow. At this location, fish could only navigate upstream during certain higher river flows (100 to 500 cfs), which created a barrier to upstream movement of salmon, steelhead, and bull trout during most flow conditions (Dominguez et al. 2013). The project removed boulders and created a series of step pools to facilitate fish passage. This work also involved the installation of a new mechanized self-cleaning fish screen on the intake to the City Leavenworth's water diversion at RM 5.7. Ecosystem Diagnosis and Treatment modeling suggested that approximately 29 miles of mainstem habitat in Icicle Creek could be beneficial to overall salmon populations if anadromous and fluvial populations of steelhead and bull trout access the entire area on a regular basis. The project will likely have the greatest benefit to steelhead, which are much less likely than bull trout to encounter a low flow level during their migration period.

The LNFH is adjacent to Icicle Creek at RM 3.0. Since production began in 1940, the LNFH has produced several trout and salmon species, including spring and summer/fall Chinook salmon, steelhead and rainbow trout, and sockeye salmon (Muir et al. 2020). Currently, the hatchery annually produces 1.2 million juvenile spring Chinook salmon and provides acclimation facilities for coho salmon, which are Wenatchee River fish spawned on site, hatched at Columbia River hatcheries, and then returned to LNFH for acclimation and release in Icicle Creek (Skalicky et al. 2013). The LNFH rears 90,300 pounds of spring Chinook salmon annually and acclimates an additional 46,700 pounds of coho salmon in March and April. These salmon contribute to commercial, sport, and tribal in-river and ocean fisheries alike.

In addition to creating effects on flow conditions in Icicle Creek, the LNFH also includes a constructed Hatchery Channel from RM 3.9 to 2.7. Flows from Icicle Creek can be diverted into the Hatchery Channel, bypassing a 1.2-mile section of Icicle Creek known as the Historical Channel through the use of a channel spanning dam (called Structure 2). The Hatchery Channel has an inverse grade, preventing adults from swimming up the Hatchery Channel. The Historical Channel suffers from passage issues during low-flow conditions because of channel morphology (Ecology and Chelan County 2019), with limited passage for fluvial bull trout when flows drop below 200 cfs. At flows under 120 cfs, passage is limited for mid-size fish, such as steelhead, and flows below 30 to 40 cfs limit passage for juvenile salmonids.

Another structure at the LNFH is Structure 5, a channel-spanning concrete bridge capable of supporting weir pickets, located in the Historical Channel. Fish traps are employed at Structure 5 to capture spring Chinook salmon, bull trout, and steelhead, and manually move collected fish either downstream (for pre-spawned steelhead kelts) or upstream (natural-origin spring Chinook salmon). Hatchery-origin spring Chinook salmon are placed downstream or transferred to the hatchery (Ecology and Chelan County 2019; NMFS 2017).

From approximately 1940 to 2001, LNFH operations blocked fish passage during most of the year and controlled surface flows between the two channels. Since 2001, the LNFH has adaptively managed the facility to block upstream passage of LNFH-origin spring Chinook salmon during broodstock collection (approximately May through July), increase flows in the Hatchery Channel to promote smolt emigration, provide groundwater recharge to hatchery wells, aid in flood control, and perform routine maintenance of structures.

Icicle Creek Fish Use

Icicle Creek provides approximately 29 river miles of spawning and rearing habitat to native salmon and trout species, including ESA-listed Upper Columbia spring-run Chinook salmon Evolutionarily Significant Unit (ESU), listed as endangered. However, spring-run Chinook produced at the LNFH are not included in listed Upper Columbia spring-run Chinook ESU, as this stock is more closely related to lower Columbia River stocks (Muir et al. 2020).

Upper Columbia summer steelhead and bull trout, both listed as threatened under the ESA, are also present in the Leavenworth subbasin, although distribution of these species is limited, depending on flows and passage through several natural and artificial barriers (Dominguez et al. 2013). As described above, the boulder field project was undertaken in 2020 to remove fish passage barriers at RM 5.6. Available fish habitat in the lower reaches of Icicle Creek is reduced in late summer and early fall because of low instream flows.

As with other anadromous salmon in the Columbia River Basin, both the number of salmon in the Wenatchee River Basin and the extent and quality of fish habitat have substantially decreased due to anthropogenic activities. These include overfishing in the Columbia River, as well as impacts on fish habitat and fish access from logging, grazing, mining, and water withdrawals for irrigation, the majority of such impacts having occurred since 1900 (Andonaegui 2001; USFWS 1999, 2005). Major impacts on fish from hydroelectric dams have also occurred. Seven major dams impound the Columbia River downstream of the confluence with the Wenatchee River.

The project area is within the Yakama Ceded Lands, to which the Yakama Nation exercises its Treaty Reserved Rights, and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources. These tribes target non-listed spring-run Chinook salmon returning to the LNFH (with known fishing areas including the plunge pool immediately downstream of the LNFH Hatchery Channel spillway). Since the reintroduction of coho salmon to the Icicle Creek drainages, tribal subsistence fisheries for coho salmon have been opened when runs are large and surplus fish are available.

In addition to the three ESA-listed fish species in Icicle Creek, the stream also supports a number of other anadromous and resident fish (Table 8-5). Brief descriptions of the primary salmonid species in the subbasin are given below.

Table 8-5. Fish Distribution in Eightmile and Icicle Creeks

Species Group	Salmonid Species and *Scientific Name*	Listing Status	Eightmile Creek Fish Distribution	Icicle Creek Fish Distribution
Anadromous Salmonids	Spring Chinook *Oncorhynchus tshawytscha*	FE	None and no designated critical habitat.	Documented presence in lower 6 miles. Potential presence that is blocked extends upstream of confluence with Eightmile Creek. Wenatchee River at mouth of Icicle Creek is designated critical habitat.
	Summer Chinook	NL	None.	Documented spawning in lower 3 miles. Potential presence that is blocked extends upstream another 2.7 miles.
	Summer Steelhead *O. mykiss*	FT	Although no presence is documented in SWIFD (NWIFC 2024), WDFW report adult steelhead migrating over the boulder field and juvenile rearing occurring in lower Eightmile Creek (Cram pers. comm.). There is no designated critical habitat in Eightmile Creek.	NWIFC (2024) reports documented spawning in the lower 3 miles, but WDFW indicates at least one steelhead redd documented in the vicinity of the IPID diversion at approximately RM 5.7 (Cram pers. comm.). Potential presence that is blocked extends upstream another 21 miles. Lower 15.4 miles of Icicle Creek is designated critical habitat.
	Coho *O. kisutch*	NL	None.	Artificial propagation/reintroduction.
Resident Salmonids	Bull Trout *Salvelinus confluentus*	FT	Documented rearing in lower 0.6 mile of Eightmile Creek. Presumed presence extends upstream another 1.9 miles of Eightmile Creek. Documented presence in the lower 0.6 mile of Mountaineer Creek immediately upstream of the confluence with Eightmile Creek. No designated critical habitat.	Documented rearing in majority of Icicle Creek both upstream and downstream of Eightmile Creek confluence, with substantial documented spawning upstream in the headwaters. Almost entire mainstem is designated critical habitat.
	Eastern Brook Trout *S. fontinalis*	NL	Documented presence in lower 8.0 miles of creek and in Eightmile Lake.	Documented presence in entirety of Icicle Creek including downstream and upstream of confluence with Eightmile Creek.
	Lake Trout *S. namaycush*	NL	Presence in Eightmile Lake.	None.

Species Group	Salmonid Species and *Scientific Name*	Listing Status	Eightmile Creek Fish Distribution	Icicle Creek Fish Distribution
	Rainbow Trout *O. mykiss*	NL	Documented presence in lower 8.0 miles of creek and in Eightmile Lake.	Documented presence in entirety of Icicle Creek including downstream and upstream of confluence with Eightmile Creek.
	Westslope Cutthroat Trout *O. clarkii lewisi*	NL	NWIFC (2024) reports documented presence in Pioneer Creek and Mountaineer Creek tributaries, but no documented distribution in Eightmile Creek. WDFW (2024) indicates hatchery cutthroat trout have been released into Eightmile Lake as recently as 2000.	Documented presence in headwater mainstem and numerous tributaries, primarily upstream of confluence with Eightmile Creek.
	Mountain Whitefish *Prosopium williamsoni*	NL	None.	Documented presence in mainstem up to approximately 1 mile downstream of confluence with Eightmile Creek.

Listing Status Key: FT=Federally Threatened, FE = Federally Endangered, NL=Not Listed.
Source: WDFW 2020b; NWIFC 2024; Ecology and Chelan County 2019; Andonaegui 2001.

Spring-Run Chinook Salmon

In 1999, the National Marine Fisheries Service (NMFS) listed the Upper Columbia River spring-run Chinook salmon ESU as endangered. The ESU includes all naturally spawned populations of spring-run Chinook salmon (spring Chinook) in Columbia River tributaries upstream of the Rock Island Dam as well as six artificial propagation programs, but not including the spring Chinook program at the LNFH. Spring Chinook are considered a “stream-type” salmonid (spending one or more years in freshwater).

ESA-listed Wenatchee spring Chinook adult salmon (both natural-origin and hatchery-origin) may be present in Icicle Creek from May until September. Most spawners are likely hatchery-derived. Spawning surveys in Icicle Creek indicate an average number of spring Chinook salmon redds of 62 from 1989 to 2013, while in more recent years (2006 to 2013) the number of redds has decreased to 18 (Hillman et al. 2014). In 2013, Icicle Creek contained 9.2 percent of all the spring Chinook salmon redds in the Wenatchee River Basin (Hillman et al. 2014). Redd counts in the Wenatchee River Basin were 211 in 2014, 132 in 2015 (Hillman et al. 2018), and 72 in 2016 (Kondo 2017 in NMFS 2017). A small number of Chinook were observed in snorkel surveys upstream of the LNFH (USFWS 2016 in Ecology and Chelan County 2019). Subsequent to the project to improve fish passage conditions through the boulder field at RM 5.6 on the mainstem Icicle Creek, hatchery spring Chinook salmon have been upstream of the boulder field.

With the exception of the reach of Icicle Creek immediately adjacent to the Wenatchee River, the remainder of the Icicle Creek Basin is not designated as critical habitat for Upper Columbia River (UCR) Spring Chinook salmon (NMFS 2005). Although some spawning occurs in the lower Icicle Creek mainstem and in the Icicle Creek Historical Channel, this is classified as a minor spawning area with medium intrinsic potential for UCR spring Chinook salmon (UCSRB 2007).

In 2019, the LNFH released 1,248,910 juvenile spring Chinook Salmon into Icicle Creek, meeting the production goal of 1,200,000 (Muir et al. 2020). The 2019 adult return was 1,404 fish, about 27 percent of the 12-year return average. From 2008 through 2018, the average run size was 5,703 fish, with an average of 71 percent of the fish returning to the hatchery, 8 percent being taken by the sport fishery, 17 percent by tribal harvest, and the remainder (4 percent) remaining in the river. The adult fish return to the hatchery from late February to August, with the majority of returns from late April to early May.

Summer-run Steelhead

Steelhead exhibit the most complex cycle of any of the salmonid species in the region and generally spawn in the upper reaches of the watershed. UCR steelhead, listed as threatened under the ESA, are summer-run steelhead that return to freshwater between May and October, and require up to 1 year in freshwater to mature before spawning (Chapman et al. 1994). Spawning occurs between January and June. Juveniles typically reside in freshwater for 2 years before migrating to the ocean, but freshwater residence can vary from 1 to 7 years (Peven 1994 in Peven 2003). Marine residence for UCR steelhead is typically 1 year, although the proportion of 2-year ocean fish can be substantial in some years. In the Wenatchee River, spawning abundance for natural-origin UCR steelhead averaged 1,025 spawners from 2005 to 2014 (NWFSC 2015), slightly above the assigned minimum abundance threshold of 1,000. Steelhead were stocked in Icicle Creek below the hatchery in the years 1941 to 1945 and since 1978 (Carie 1995 in NMFS et al. 1998).

The USFWS Columbia River Basin Hatchery Review Team determined that ESA-listed steelhead inhabit all major tributaries of the Wenatchee River. Icicle Creek contains important habitat for ESA-listed UCR steelhead.

The vast majority of steelhead spawning in Icicle Creek occurs downstream of RM 2.8, likely indicating that the operations of the LNFH structures are not conducive to steelhead passage (Hillman et al. 2014).

Critical habitat for steelhead in Icicle Creek has been designated for the entire watershed, including all tributaries (NMFS 2005). Icicle Creek supports a major spawning aggregation for UCR steelhead. The lower Icicle Creek mainstem, from the mouth to the Historical Channel at RM 2.7, was identified as containing habitat of medium intrinsic potential for steelhead, while the upper mainstem and tributaries above LNFH were identified as containing habitat with high intrinsic potential supporting spawning, rearing, and migration.

Bull Trout

USFWS listed Columbia River bull trout as threatened under the ESA in 1998 (63 Federal Register 31647). A distinct native bull trout population exists in Icicle Creek (USFWS 2015). Two life history patterns have been present in the Icicle Creek watershed: fluvial and resident. Most bull trout in Icicle Creek are of a fluvial life history type, meaning they migrate downstream to rear in tributary rivers, the mainstem Wenatchee River, or the Columbia River (USFWS 2015; Cappellini 2001). Peak migration of adult bull trout in Icicle Creek occurs from August through September, with spawning occurring from mid-September to mid-October (USFWS 2015). Bull trout may return to spawning areas weeks to months prior to spawning. A resident form of bull trout, which do not stray far from their headwater spawning areas, also likely exists given suitable spawning habitat conditions in the headwaters. Migratory and resident bull trout spawn in the colder headwater tributaries, including the lowest reaches of Eightmile Creek (Andonaegui 2001). The potential use of Icicle Creek by migratory bull trout and their status and interaction with the resident component are currently not well understood (USFWS 2009).

Icicle Creek provides spawning and rearing habitat for bull trout; however, little information is available on the abundance and size class distribution of bull trout in Icicle Creek and its tributaries. Spawning ground surveys to enumerate bull trout redds were not conducted in the Icicle Creek watershed until 2008, when eight migratory-sized redds were found in French Creek (Nelson et al. 2009 in Nelson et al. 2011). Historically, bull trout were observed in Eightmile and French creeks (Brown 1992 in Peven 2003) and upper Icicle Creek (USFWS 2005 in NWPCC 2004). Prior to fish passage restoration at the site, migratory-sized bull trout were observed in Icicle Creek immediately upstream of the boulder field at RM 5.6 (USFWS 2011; Nelson et al. 2011; Dominquez et al. 2013). In addition, two migratory-sized bull trout x brook trout crosses have been documented in the upper reaches of Icicle Creek (Nelson et al. 2011).

USFWS conducted radio-tagging studies of seven Icicle Creek bull trout in 2009 captured and released downstream of the LNFH (Nelson et al. 2011). None of these fish moved upstream of the LNFH, and several of the fish overwintered in the Wenatchee and Columbia rivers. However, the LNFH is passable to migrating bull trout at some times of the year, as evidenced by the observation of large fluvial bull trout upstream of LNFH during the annual USFWS snorkel survey of lower Icicle Creek (USFWS 2009 in Nelson et al. 2011).

Adult fluvial bull trout returning to the base of the LNFH spillway structure may be recruits from resident fish above the structure but are more likely to be adults holding and straying from the Wenatchee River (WDFW 1997), where the water temperatures are warmer, using the cooler water in the LNFH spillway pool for thermal refuge and foraging opportunities during the summer and early fall (Nelson et al. 2011).

Summer-run Chinook Salmon

The summer Chinook run in the Upper Columbia is not listed under the ESA. This run is one of the largest naturally produced Chinook populations in the Columbia River Basin. Summer-run Chinook are considered ocean-type, as they spend less than 1 year in freshwater before migrating to the ocean as subyearlings.

Summer Chinook enter the Columbia River from late May to early July and enter the Wenatchee River beginning in late June (WDF and WWTIT 1993). Spawning begins in late September, continues through early November, and reaches a peak in early to mid-October. Fry emerge from January through April, and the fry rapidly emigrate from the mainstem Wenatchee River.

Summer Chinook have documented spawning in the lower 3 miles of Icicle Creek (WDFW 2020b; NWIFC 2020). The number of spawning summer Chinook in Icicle Creek is likely quite small when compared to the mainstem Wenatchee River near Leavenworth, where spawning densities are the highest in WRIA 45 (Peven 2003). Mixed summer/fall Chinook fingerlings were introduced to Icicle Creek in the 1940s (Peven 2003).

Westslope Cutthroat Trout

Westslope cutthroat trout are a native species that are widespread throughout Icicle Creek; although historical distribution was limited to the Lake Chelan and Methow River Basins, extensive stocking has established self-sustaining populations throughout the eastern Cascade Mountains. Cutthroat trout now found in the Wenatchee River Basin are either indigenous populations or are from past stocking and may have either a resident or a fluvial life history (Wydoski and Whitney 2003). While resident fish spend their entire life in tributary streams, migratory life forms can travel large distances as they move between adult and spawning habitat. Fluvial cutthroat spawn in tributary streams where the young rear from 1 to 4 years before migrating to a river system, where they grow to maturity, while resident fish stay in relatively proximity to where they were hatched for the duration of their life cycles. Fluvial forms may return to small tributaries for refuge during high flows.

Both life history forms spawn in tributary streams in the springtime months when water temperature is about 10°C and flows are high, and these areas are often nutrient poor. If other species are present in the lakes, Westslope cutthroat will use nearshore, littoral areas, otherwise they disperse throughout the lake (Wydoski and Whitney 2003). Introduced eastern brook trout have displaced Westslope cutthroat trout in many low gradient reaches of tributary streams, including Eightmile Creek (Griffith 1988). Westslope cutthroat are a favorite prey item of both bull trout and lake trout.

Rainbow Trout

Rainbow trout have been extensively propagated and stocked in the mid-Columbia River Basin. From 1949 to 1994, over 12 million rainbow trout from at least 15 different brood sources were stocked in the basin (Chapman et al. 1994). Because of genetic interactions with non-native steelhead, rainbow trout, and cutthroat trout, few uncontaminated indigenous native rainbow trout populations remain (Proebstel et al. 1998).

Rainbow trout are commonly observed fish species in Icicle Creek and tributaries draining the Alpine Lakes (Potter 2017, 2018; Ringel 1997; USFWS 2016, WDFW 2020b). Snorkel surveys conducted in late summer 1994 on Icicle Creek between RM 4.0 and 20.1, found that rainbow trout were the dominant species in all reaches, comprising 99 percent of all fish seen (Ringel 1997).

Genetically identical to steelhead trout, rainbow trout exhibit a non-migratory resident life history. Steelhead have a complex, plastic life history where, in some cases, steelhead offspring can take on resident rainbow life histories in subsequent generations and vice-versa. Most fish that do not emigrate downstream early in life from the coldest environments are thermally fated to a resident (rainbow trout) life history regardless of whether they were the offspring of anadromous or resident parents (Mullan et al. 1992). Hybridization between rainbow trout and Westslope cutthroat trout is common, and hybrids may occur in the Icicle Creek drainage (Ringel 1997).

Rainbow trout prefer cool, well-oxygenated water but can tolerate broader temperature ranges than other salmon and trout. Growth and age at maturity vary greatly and occur between age 1 and 5 years, depending on water conditions. Rainbow trout spawn in late winter through the spring (February and June), and similar to steelhead, may spawn multiple times in their lifetime.

Other Resident and Anadromous Fish Species

Other native resident fish species observed in Icicle Creek include Pacific lamprey, longnose sucker, bridgelip sucker, mountain sucker, leopard dace, Umatilla dace, longnose dace, speckled dace, redside shiner, northern pikeminnow, and various sculpin species, as well as hatchery coho salmon and stray sockeye salmon (NWPCC 2004; USFWS 2009, 2016). In addition, Eightmile Lake contains introduced Eastern brook trout, some of which now inhabit Icicle Creek (NWPCC 2004; WDFW 2020b). Lastly, several hybrids have been observed, including hybrid bull trout and eastern brook trout (Nelson et al. 2011).

8.4 Construction Impacts

Impacts from construction activities from any of the action alternatives have the potential to affect wildlife species throughout the study area because of increased disturbance above baseline conditions typical during the summer recreation season. This is due to disturbance from the transportation of equipment and materials, in addition to construction activities at the dam. Disturbance from transporting equipment and materials would result in an impact footprint that would extend out to the limits of the study area because of the emitted noise. However, the zone of disturbance would be concentrated around the transportation activities in the travel network. Construction activities at the dam site will persist at this location throughout the duration of construction.

Construction also has the potential to affect the resident fish within the lake and in several small tributaries to Eightmile Creek downstream of the lake. As no anadromous or ESA-listed fish species are distributed in these areas, construction activities would not affect these species.

Construction impacts, and their potential for affecting wildlife, wildlife habitat, fish, and fish habitat, are described below according to specific impact source.

8.4.1 Transportation of Equipment and Materials

Helicopter

Wildlife and Wildlife Habitat

Construction Options 1 and 2 for helicopter use differ in the number of trips that large and small helicopters would fly, as well as the total number of trips made and number of days helicopters are used (Chapter 2, Table 2-2). Option 1 would require fewer trips across fewer days, and would be facilitated by a larger helicopter. Option 2 would require more trips across more days due to primarily using a smaller helicopter. Research has shown that the noise from the two proposed helicopter types is comparable (USACE 1982); therefore, it is assumed that each would have the same area of disturbance for wildlife, and only the number of trips would lead to a differential between options. Option 2 would have a larger impact on wildlife due to regular helicopter use throughout project construction, while Option 1 would require helicopter use, with accompanying potential to impact wildlife, mostly at the beginning and end of construction, with as-needed use during construction. Any impact from helicopters would be incurred along the established flight path between Eightmile Lake and in the vicinity of Bridge Creek Campground (Chapter 2, Figure 2-11).

During helicopter use, the flight corridor would be subjected to helicopter noise beyond baseline conditions as equipment and materials are transported from their loading site to the drop-off point (refer to Chapter 9, *Noise*, for further discussion). Loading and unloading activities at the loading and drop-off areas would also result in concentrated areas of disturbance. These activities would disturb most wildlife species, displacing those that have ability to flee from the area. Stress levels would likely be heightened (Runnoe 2006) and suppression of normal behaviors would likely occur to some extent. Some of the more mobile species (such as large and small mammals) may leave the study area completely, but the extent is unknown and such displacement could lead to secondary conflict with other wildlife while the displaced individuals reestablish home ranges. Individuals that remain would continue to incur stress, although those in the center of the flight path, between the loading and drop-off sites, may habituate to some extent. Most individuals surrounding the loading and drop-off sites would likely flee these areas and remain displaced throughout construction. Actual impacts would depend on species and life stage, with greater impact occurring to less mobile individuals.

Impacts on wildlife habitat from helicopter use would be minimal as landing at the dam and staging area is not anticipated, and the staging area, with the exception of removal of up to 30 trees, does not need to be substantially altered from current conditions. Propwash, which would be strong from both helicopters but particularly strong from the double-rotor Chinook, would not eliminate or damage vegetation to the point that it is fundamentally unusable by wildlife. No wetlands occur in this portion of the study area that could be affected by these construction/transportation activities. Helicopter use would have **less-than-significant impacts** on wildlife habitat and vegetation because there would only be minimal loss of habitat.

Helicopter use would disturb avian species and terrestrial mammals, including those with state and/or federal protections. Protected bat species, which may roost near the loading and unloading areas, may also be disturbed and stressed by helicopters as cargo is shuttled during construction. No work will occur during winter months when bats hibernate. Therefore, use of helicopter may have significant adverse impacts on individual bats locally if present, but would have **less-than-significant adverse impacts** on wildlife throughout the study area.

Fish and Fish Habitat

The multiple helicopter trips required for transport of construction equipment and material would not have an effect on aquatic species, including fish. Refueling of helicopters would occur in designated areas away from streams and outside of the wilderness area. **No significant adverse impacts** on fish or fish habitat would occur from helicopter use under any of the action alternatives.

Road Segment

Wildlife and Wildlife Habitat

The establishment of the road segment would require vegetation removal and road grading through the use of heavy equipment and hand-crews. These activities would cause localized noise disturbance and alter wildlife habitats along the segment. Noise would displace wildlife species able to flee the area, which would likely occur prior to the associated physical habitat changes. Human presences, largely associated with the heavy equipment, would further disturb wildlife in the area. Because the road segment is currently overgrown with vegetation and not typically used by recreationists, the alterations would remove some wildlife habitat from the study area. The significance of impact on wildlife would depend on construction timing, as greatest use by wildlife of this area occurs during the spring and summer months. This is especially the case for many bird species, which likely nest in dense thickets along the road segment. Wildlife species with minimal capacity to move from the area, including amphibians and young birds and reptiles, could be injured or killed. Road design will meet Forest Service standards and incorporate appropriate sediment and erosion control measures near stream crossings, potentially including water bars to route and disperse runoff on vegetated slopes, to minimize or eliminate stream sedimentation. No wetlands occur in this portion of the study area that could be affected by these road construction activities. Likewise, where vegetation removal or grading occurs adjacent to streams, appropriate BMPs (e.g., use of straw wattles, no side-casting, etc.) will be applied. Therefore, road reconstruction would have **less-than-significant adverse impacts** on wildlife and wildlife habitats in and around the study area.

The same protected taxa with potential to be disturbed by helicopter use would also be susceptible to disturbance from the road segment reconstruction; however, the impact area would be much smaller. Western toads, which may occur in the downslope drainages, may also be affected by sediment input, noise, and vibration.

Fish and Fish Habitat

Repair and improvement of the currently closed road segment, located downslope of Eightmile Lake and outside of the wilderness area, would involve the removal of vegetation and downed woody material on the roadway and trimming of vegetation and tree limbs immediately adjacent to the roadway. All woody material moved or cut from the roadway surface will remain on-site, adjacent to the roadway, to provide habitat functions. Minor grading may also be required, as would some minor grading/clearing to create a small landing at the road terminus to provide adequate space for unloading and vehicle turn-around. The roadway has several existing culvert crossings of small fish-bearing streams that drain to Eightmile Creek. The roadwork could increase runoff of road sediments, which in some cases could enter streams. However, road design will meet Forest Service standards and incorporate appropriate sediment and erosion control measures near stream crossings, potentially including water bars to route and disperse runoff on vegetated slopes, to minimize or eliminate stream sedimentation. Likewise, where vegetation removal or grading occurs adjacent to streams, appropriate BMPs (e.g., use of straw wattles, no side-casting, etc.) will be applied. No significant adverse impacts on fish or fish habitat would occur from repairing and improving the road under any of the action alternatives.

8.4.2 Dam Construction

Wildlife and Wildlife Habitat

Dam construction would disturb wildlife throughout the construction period in an area surrounding the east end of Eightmile Lake, and may extend out to the remaining portion of the Eightmile Lake Basin. The presence of humans and use of heavy equipment and other tools would displace wildlife from this area during construction. Similar to reconstruction of the road segment, noise and human presence would displace most mobile wildlife from the area prior to them being exposed to habitat alterations. During construction, the area may be mostly or partially unusable by taxa such as birds and large mammals, which would move to surrounding areas with less disturbance. The alterations that occur to existing wildlife habitat, such as the riparian zone around the dam, could harm species with limited mobility that are present. No wetlands occur in this portion of the study area that could be affected by these dam construction activities.

The same protected wildlife species affected by construction of the road segment would be affected by dam construction. However, the potential to affect aquatic species (amphibians) or species who rely on aquatic features for water or prey would be greater. Therefore, the dam construction could impact a few individuals in and around the dam construction; however, this would have less-than-significant adverse impacts on wildlife in the study area.

Blasting of large boulders is not expected to be necessary but is covered in this analysis as a contingency. Blasting could occur for 1 or 2 days between the hours of 11 a.m. and 3 p.m. Blasting would add a brief, high-intensity noise impact, affecting wildlife in the area. Blasting would likely surprise and displace wildlife from the area in a rapid, stressful manner. The high-intensity noise has potential to shock more mobile species, causing panic and frantic retreat that could lead to injury. The noise intensity could also directly harm less-mobile species, such as amphibians and reptiles, who are sensitive to sound and vibration. All wildlife species would be expected to be temporarily displaced from the area during blasting, if capable. Blasting, if used, would likely expand the area where wildlife would face impacts. As a result, blasting may cause significant adverse impacts on local, immobile individuals, but overall would result in less-than-significant adverse impacts on wildlife throughout the study area.

Fish and Fish Habitat

Construction would require substantial earthwork and the placement of large rock using an excavator. Blasting of very large boulders is not likely required. The use of boulder busters may be needed for breaking up smaller material. The project also requires the pouring of concrete to construct the spillways.

All alternatives would require in-water work in Eightmile Lake to construct the earthen dam and spillways, potentially affecting the resident trout species in the lake. The shoreline area where work occurs would be isolated in the lake by construction of a cofferdam consisting of bulk bags placed by an excavator. Dewatering of the isolated work area using pumps may also be necessary. Under all action alternatives, any dewatering pumps used would have WDFW-compliant screens on the intake hoses (to prevent fish impingement or entrainment). In addition, after partial drawdown of the water level behind the cofferdam, and prior to in-water excavation, qualified biologists would remove fish and aquatic life from the work area and relocate these organisms to the lake. The implementation of fish exclusion and fish removal/relocation would substantially reduce the potential of negative impacts on resident freshwater fish. Although a few individual fish would be impacted, these impacts are small and would not measurably affect the local populations of freshwater resident fish present in Eightmile Lake and are therefore considered **less-than-significant.**

The installation and removal of the cofferdam would generate short-term and localized increases in suspended sediments and turbidity in the lake. Excessive suspended sediments resulting in turbidity can have physiological and behavioral effects on fish, including clogging fish gills, avoidance, and impaired foraging (Bash et al. 2001). These activities would be regulated under the state hydraulic code (HPA) and water quality permits, which would define required BMPs (e.g., turbidity curtains), set allowable mixing zones, and set monitoring requirements. The anticipated mixing zone for Eightmile Lake is 300 feet. Alternative 2 requires construction of a longer dam than Alternatives 1 and 3, thereby necessitating a longer cofferdam to dewater the work area and resulting in more potential for suspended sediments and turbidity.

For all action alternatives, the magnitude and extent of turbidity are expected to be minor, short-term, and localized based on the use of the BMPs described above. Although some behavioral impacts on fish would likely occur, such as avoidance and temporary behavioral changes, no substantial mortality is expected to result. Deposition of sediment on the lake bed from construction-generated suspended sediment would not be substantial and would be comparable to the natural deposition from sediment in the lake. For all action alternatives, impacts from turbidity and sedimentation associated with cofferdam removal on resident fish would be **less-than-significant.**

The in-water work and associated fish removal may result in some minor mortality, injury, or behavioral disturbance in the immediate work area (individual fish could be harmed or killed and larvae of some species could be entrained). However, the vast majority of fish in the lake would be unaffected and would likely avoid the work areas of active construction due to increased turbidity.

Construction of all action alternatives would include concrete pouring to construct a new spillway. As wet or curing concrete can negatively alter the pH of freshwater systems, all concrete pours will occur in the dry behind the cofferdam, and no wet or curing concrete will come into contact with Eightmile Lake or Eightmile Creek. Furthermore, none of the action alternatives would result in a loss of aquatic habitat in Eightmile Creek or an expansion of the existing dam footprint into Eightmile Lake, so no benthic lake habitat would be lost. The spillway associated with Alternative 2 would impact approximately 2,000 square feet of lake shoreline habitat at full water surface elevation. This small increase in spillway length and associated habitat loss with all of the alternatives is expected to have a **less-than-significant** impact on fish in Eightmile Lake.

Blasting of large boulders, while not anticipated, could impact fish species by transmission of sound pressure waves through the soil/bedrock and into Eightmile Lake. In-water blasting can, in certain cases, produce sound waves that can cause fish injury or death. However, any impacts on fish and aquatic resources from blasting are expected to be minor, as no in-water blasting would occur. At most, some temporary behavioral changes to fish would occur, such as startling. These impacts would only affect resident fish present in the lake, as no anadromous or ESA-listed species are within proximity to the blasting location.

8.5 Operational Impacts

Operational impacts of the project would have short-term effects on wildlife and wildlife habitat, but would likely not persist as habitats recover from the alterations and disturbance abates to pre-project levels.

Unlike construction activities, the operational aspects of the project could affect fish and fish habitat both within Eightmile Creek, and downstream of the lake in Eightmile Creek and Icicle Creek, extending to the confluence of Icicle Creek with the Wenatchee River. Additionally, operational impacts of the project would affect both resident fish and anadromous fish, including ESA-listed fish species such as bull trout, spring Chinook salmon, and summer steelhead. Potential impacts are described below, by alternative.

8.5.1 No Action Alternative

Wildlife and Wildlife Habitat

The No Action Alternative would result in the continued operation of the Eightmile Dam, which would result in no changes to wildlife resources or habitat, including wetlands and other waters.

It is probable, however, that the dam would eventually fail, or DSO would require the removal of the dam in the future. Dam removal or failure would result in a high-water lake level of 4,648 feet, with water levels continuing to reduce as the summer season progresses. Evidence (photos, engineering drawings) indicates that a lake existed at this location prior to the original dam construction, and the dam has functioned to increase capacity. Removal of the dam–either due to failure or active removal–would therefore decrease both its capacity and surface water height and area, but would not cause the demise of the lake. The reduction in the size of Eightmile Lake would, therefore, result in **less-than-significant adverse impacts** on wildlife and wildlife habitat because the lake would persist and habitats would not be fundamentally degraded or reduced.

Dam failure would result in downstream flooding on Eightmile and Icicle creeks. This flooding would alter habitat, to some extent, including Little Eightmile Lake, wetlands, and riparian areas. Little Eightmile Lake would likely become altered because it is relatively shallow and may become scoured during a flood event, although the extent of scour would likely not change the types of aquatic and wetland habitat present. Flooding farther downstream would also result in vegetation removal, scouring, and sediment deposition, likely altering habitat along Eightmile and Icicle creeks. These alterations, however, would emulate those from natural flooding events, and the ecosystem would likely fully recover over one to two decades. Impacts from a dam failure flood event on habitat downstream of Eightmile Lake would, therefore, be **less-than-significant**.

Hydrologic changes from dam failure or removal are predicted to reduce summer streamflows by up to 75 percent, which could affect amphibians, reptiles, and other species that depend on the current flow regime from Eightmile Lake. During the summer dry season, such a reduction in flow would result in less availability of water and aquatic habitat, as well as a reduction in the quality and diversity of aquatic habitat. Together, losing substantial flow during the dry season, when many wildlife species rely on it the most, would result in significant adverse impacts on some individuals that are directly associated with these aquatic habitats. However, because of the small affected area, **less-than-significant adverse impacts** would be expected to occur to wildlife species throughout the study area.

Fish and Fish Habitat

Under the No Action Alternative, there would be no changes to fish resources or habitats, as compared to existing conditions, if the dam continues to operate. However, if the dam condition warrants enforcement actions by the DSO, dam removal may be required. Under this scenario, the lake outlet elevation would likely be lowered to an elevation of 4,648 feet. This would reduce available habitat for fish in Eightmile Lake, and would also have an effect on downstream streamflow, where reduced water storage capacity would decrease the amount of water available for summer water releases, thereby reducing flows in Icicle Creek and potentially contributing to slightly warmer water temperatures in the summer months. Salmonids are sensitive to high stream temperatures and low dissolved oxygen (DO) levels. Ecology water quality standards for the mainstem Icicle Creek for core summer salmonid habitat include a temperature of less than 16°C and DO levels more than 9.5 mg/L. Dam removal would reduce the habitat quality and quantity for both anadromous and resident salmon species that utilize Eightmile Creek and the Icicle Creek mainstem downstream of the confluence. The anadromous fish species and life stages that would likely be most affected by lower summer flows in Icicle Creek, and potential increases in stream temperature and reductions in dissolved oxygen, are spring and summer Chinook salmon and summer steelhead. In addition, those resident salmonids that utilize Icicle Creek and Eightmile Creek in the summer would also be negatively affected by low summer flows, including ESA-listed resident bull trout, rainbow trout, cutthroat trout, and mountain whitefish. The removal of the dam would also remove water storage, which would make the system more sensitive to the effects of drought, a condition that may increase in frequency and severity due to the predicted effects of climate change over time. With dam removal, flows in Icicle Creek will likely fall below the instream-flow rule levels more frequently, resulting in potential negative impacts on hatchery fish rearing and releases. The aquatic communities dependent on streamflow, including insects and benthic macroinvertebrates (which are important prey resources for fish in Eightmile and Icicle creeks) would have less available habitat due to reduced flows resulting from dam removal. Further reduction in aquatic habitat for prey production would occur due to the predicted effects of climate change over time.

In summary, dam removal would cause **significant adverse impacts** on fish and fish habitat in both Eightmile and Icicle creeks.

There is also the potential for catastrophic failure of the dam under the No Action Alternative. If such failure occurred, it would likely be during spring rain-on-snow events when streamflow is at its highest. A partial or total dam failure would have substantial negative effects, both immediately and perpetuating into the future. A catastrophic failure would quickly drain substantial water volumes from the lake, although it would not empty its volume completely, resulting in up to 1,375 acre-feet of water being suddenly released in an uncontrolled manner. The lake would be partially drained and many of the resident fish within the lake would be killed as they became entrained in the downstream flows. Partial or total dam failure could result in debris torrents that would destroy downstream infrastructure, likely including infrastructure at the LNFH; cause severe channel scour (potentially to bedrock); denude riparian areas; mobilize, transport, and ultimately deposit large volumes of sediment; cause widespread flooding; and potentially lead to debris jams and stream avulsions. A large-scale or total failure would likely result in mortality to the vast majority of the fish present in Eightmile Lake, Eightmile Creek, and in Icicle Creek downstream of the Eightmile Creek confluence, and could also have substantial negative effects in the Wenatchee River. This would include ESA-listed species such as Chinook salmon, steelhead, and bull trout, as well as other salmonids that currently use the system during springtime. Flood flows may severely damage or destroy water intakes for both IPID and the LNFH, reducing or eliminating hatchery operations. Post-dam failure, Eightmile Creek would be a free-flowing riverine system. In addition, the significant volume of water in the lake that currently serves as lacustrine habitat for resident fish would be substantially reduced, but would not cause the demise of the lake. Stream substrate conditions may also be severely altered due to erosion of deposited sediments, with the system potentially taking years or decades to equilibrate. Other long-term effects on fisheries resources, both native and hatchery stocks, would also occur with the absence of the dam related to summer flow reductions, similar to those described above for dam removal, as well as the potential release of non-native lake trout into Eightmile and Icicle creeks, potentially negatively impacting native fish survival due to predation and resource competition. Catastrophic dam failure would cause **significant adverse impacts** on fish and fish habitat in both Eightmile and Icicle creeks.

8.5.2 Alternative 1: Narrow Spillway with Gates

Wildlife and Wildlife Habitat

Operation of the project would have short-term impacts on wildlife and wildlife habitat, including wetlands and other waters, but would likely not persist as habitats recover from the alterations and disturbance abates to pre-project levels. Changes in surface water elevation and flows through the riparian corridor would support wildlife species and habitats in these areas. Revegetation and removal of invasive plant species may result in habitat enhancement above existing conditions, if executed effectively. Changes in operation of the project could influence the overall size, boundaries, vegetation composition, and type of wetlands present in the study area (especially the existing wetland at the inlet/west end of Eightmile Lake). Such changes would depend on how project operations affect lake levels and related hydrological conditions, both seasonally and over the long term. The specific changes are difficult to predict over the long term given the multiple variables, including changing snowpack levels associated with climate change. The most likely changes would include long-term shifts in vegetation composition within the wetland areas, such as the recruitment of woody vegetation. Modeling the predicted changes in wetland conditions is outside the scope of this EIS analysis. But overall, hydrological and soils conditions are expected to support the existing wetlands into the future, and the characteristics of the existing wetlands are not expected to substantially change.

Operation of Alternative 1 would result in **less-than-significant adverse impacts** on wildlife and wildlife habitat.

Fish and Fish Habitat

Alternative 1 would restore storage capacity, while adding safety features that drain the lake during extreme storm events. This alternative would not alter existing water rights or withdrawals or exceed historic use. In addition, Alternative 1 has a smaller footprint than the wide spillway alternative (Alternative 2) and also allows the lake to be drawn down to 4,636 feet during drought conditions to provide water for both downstream water supply and instream flow needs. Alternative 1 has a maximum WSEL of 4,671 feet, which would produce a lake surface area of 81.4 acres. Compared to existing conditions (and the No Action Alternative), this alternative provides a WSEL 4 feet higher, which equates to 4.8 acres more lake surface area. This elevation is similar to historical maximum WSEL with the existing dam in place. These increases in the horizontal and vertical profile of the lake under Alternative 1 would provide an increase in total maximum lake volume of 310 acre-feet and an active storage volume of approximately 460 acre-feet. Alternative 1 would cause a very small decline in the amount of groundwater discharge into Eightmile Creek, less than 0.1 cfs, at full-storage conditions and a decline of about 0.5 cfs at low-storage conditions (see Section 5.5.2). This reduction in groundwater would be offset by the potential increase in instream flow associated with the alternative. The restored storage capacity would potentially provide more water for summer instream flow supplementation, which would provide benefits to fish downstream of the lake in Eightmile and Icicle creeks, including ESA-listed fish species and other anadromous salmonids that use these waterbodies. The additional flow supplementation would consist of cooler water from below the lake surface, potentially providing lower temperatures downstream and higher dissolved oxygen levels, which also would benefit these fish species. Compared to existing conditions, where the lake is drawn down annually to the lowest level, Alternative 1 is predicted to only reach low levels during drought conditions (approximately once every 5 years). The active storage capacity provided by Alternative 1 would increase the reliability of summer instream flow supplementation to Eightmile and Icicle creeks. This would make the system more resilient to the potential for drought affecting the creeks, a condition that may increase in frequency and severity due to the predicted effects of climate change over time.

Additionally, Alternative 1 includes an automated 464-foot-long low-level outlet pipe draining the lake into Eightmile Creek. The pipe inlet in the lake under Alternative 1 would be at 4,632 feet, where the water is likely substantially cooler than the surface water temperature. The automated nature of the outlet pipe would allow IPID to remotely provide a relatively consistent source of colder water for summer instream flow supplementation and irrigation, as compared to the No Action Alternative. The resulting relatively dependable (as compared to existing conditions) summer flow augmentation would benefit those anadromous and resident salmonid species that utilize Eightmile Creek and the Icicle Creek mainstem downstream of the confluence. This includes providing more wetted aquatic habitat in the summer, as well as potential improvements to stream temperatures and increased DO levels. The increased wetted aquatic habitat in the summer applies to fish and aquatic prey resources for fish, including insects and benthic macroinvertebrates.

Furthermore, the automated spillway gates on the primary spillway, combined with the construction of intermediate spillways and a secondary spillway, would provide multiple control systems that are designed to pass all storm events, even in the most extreme storm scenarios (e.g., a 1,000,000-year storm event), while maintaining required freeboard. These systems would allow lake level regulation on a real-time basis and would not require physical access to the site to adjust lake levels, although damage to the power system or communications systems could temporarily disable these features. Overall, however, the combination of these features and the construction of a new dam would substantially reduce any risk of catastrophic dam failure, while allowing regulation of water levels in the lake that cannot occur under existing conditions.

Alternative 1 would allow the lake to fill to a level that provides 4.8 acres more lake surface area than existing conditions, and would also allow the lake to be drawn down to a level that would provide a lake area of 2.5 acres less than could occur under existing conditions. Although the lake area (and volume) has the potential for larger fluctuations as compared to existing conditions, the relatively small increases and decreases would not substantially alter lake biology, and would have a minimal effect on aquatic species within the lake. The current lake has relatively steep side slopes consisting of bedrock, talus slopes, and scattered coniferous trees. Slight alterations in the lake level will not impact the existing levels of riparian function. Similarly, ecological processes in the lake that affect fish abundance and species biodiversity (such as fish densities, nutrient and insect recruitment, sediment transport and deposition, and functioning of the lacustrine riparian zone) would not be substantially altered under Alternative 1, and no detectable changes in fish abundance, species composition, or lake water quality would occur, compared to existing conditions, resulting in **less-than-significant adverse impacts** on fish and fish habitat.

8.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Wildlife and Wildlife Habitat

Impacts on wildlife and wildlife habitat would be the same as those described above for Alternative 1: Narrow Spillway with Gates. Operation of Alternative 2 would result in **less-than-significant adverse impacts** on wildlife and wildlife habitat, including wetlands.

Fish and Fish Habitat

Alternative 2 is identical to Alternative 1 in the high and low WSELs and lake areas and volumes for these metrics. The primary differences from Alternative 1 are the design of the spillways, including spillway size, and the absence of gates to control WSELs. With an earthen embankment and reinforced concrete dam proposed under Alternative 2, the primary spillway length of 180 feet is 120 feet longer than under Alternative 1, impacting an estimated 2,000 square feet of lake shoreline habitat at full water surface elevation. The construction of Alternative 2 would require about 10,000 cubic yards of materials to be excavated from the Special Warranty Deed parcels and used to build the dam. The primary spillway would be fixed and completely passive, with the lake draining over the primary spillway when the lake fills to an elevation above 4,671 feet. Alternative 2 has only the single primary spillway, and does not include any gates or automatic equipment that would control the spillway or adjust the spillway crest elevation. As with Alternative 1, water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. The operation and configuration of the low-level outlet pipeline would be essentially the same described for Alternative 1. The fixed spillway would provide slightly less control of high-water surface elevations as compared to Alternative 1, and would require some additional disturbance to adjacent areas for construction of the larger earthen dam structure, but overall would essentially function the same and provide equivalent benefits to downstream summer flows to anadromous and ESA-listed salmonids in Eightmile and Icicle creeks. Alternative 2 would cause a very small decline in the amount of groundwater discharge into Eightmile Creek, about 0.3 cfs, at full-storage conditions and a decline of about 0.6 cfs at low-storage conditions (see Section 5.5.2). This reduction in groundwater would be offset by the potential increase in summer instream flow supplementation due to the restored active lake storage capacity of this alternative. As with Alternative 1, Alternative 2 would not result in substantive changes in the fish resources or fish habitat in Eightmile Lake, and would result in **less-than-significant adverse impacts.**

8.5.4 Alternative 3: Narrow Spillway without Gates

Wildlife and Wildlife Habitat

Impacts on wildlife and wildlife habitat, including wetlands, would generally be the same as those described above for Alternative 1: Narrow Spillway with Gates. However, should pumping be required by IPID at low-water levels, the site would be accessed by a work crew, either by foot or helicopter at times during operations when additional water is required downstream. Such an action would disturb wildlife species in the area due to noise and human presence. Species impacted include those described under dam construction (Section 8.4.2). Because the expected use of pumping would be infrequent, operation of Alternative 3 would result in **less-than-significant adverse impacts** on wildlife around the dam site during pumping activities.

Fish and Fish Habitat

Under Alternative 3, the dam type and configuration would be almost identical to that for Alternative 1, having a narrow spillway and a concrete spillway apron, but with no mechanical gates. The spillway would consist of one continuous 60-foot-wide primary spillway section with no dividing walls and would be designed to store water up to a maximum WSEL of 4,667 feet, which is 4 feet less than Alternatives 1 and 2. The maximum volume of water that could be stored for release by the dam would be less for this alternative than for the other action alternatives. The total lake volume at maximum WSEL for Alternative 3 is 1,698 acre-feet, approximately 312 acre-feet less than under Alternatives 1 and 2. Similarly, the active storage volume under Alternative 3 is 302 acre-feet less than the two other action alternatives.

In addition, under Alternative 3, pumping would be required by IPID to access additional water needed and as allowed by their water right. This would involve flying pumping equipment to the dam site, likely including the use of diesel or gasoline to power a pump or generator. The use of such equipment would result in a slight increase in the potential for spills of hazardous materials. In addition, in drought conditions and without pumping, water storage available for release to enhance downstream flows would be less than under Alternatives 1 and 2, resulting in potentially less benefit to fish habitat and water quality in downstream reaches of Eightmile and Icicle creeks. Further, Alternative 3 would cause a very small decline in the amount of groundwater discharge into Eightmile Creek, about 0.3 cfs, at full-storage conditions and a decline of about 0.5 cfs at low-storage conditions (see Section 5.5.2). The reduced water storage in this alternative compared to Alternatives 1 and 2 would reduce the potential for instream flow supplementation to offset potential groundwater reductions. However, the typical summer flow releases associated with this alternative are predicted to range from 20 to 40 cfs, which far exceeds the potential groundwater flow reductions. As with Alternatives 1 and 2, Alternative 3 would not result in substantive changes in the fish resources or fish habitat in Eightmile Lake, and would result in **less-than-significant adverse impacts**.

8.6 Avoidance, Minimization, and Mitigation Measures

During construction of any action alternative, standard in-water construction and demolition BMPs would be implemented in accordance with environmental regulatory permit requirements. Specific in-water construction periods would also be confirmed through the project permitting process to minimize potential impacts of in-water construction activities on salmonid species.

Other BMPs common to all action alternatives include the following:

- During construction, the IPID would use BMPs (for example, sediment curtains) to avoid unintentional impacts on habitat and water quality during construction.
- Cofferdams or other appropriate measures will be used to isolate work areas from open-water areas for construction of the dam and spillway.
- Cleared upland areas, including FSR 7601-116, will be restored, and the areas replanted with appropriate native herbaceous and woody species.
- Invasive species control and management will be implemented during construction and operations by following guidelines provided by the Forest Service.
- Temporary erosion and sediment control measures will be implemented to limit sediment inputs to receiving waters during and after construction.
- Spillage of concrete and releases of other construction materials into the water will be prevented through isolation of the work area and implementation of proper waste handling measures. Poured concrete will be allowed to cure prior to contact with any surface water.
- Pollution control measures will be implemented to ensure appropriate storage, handling, and use of petroleum products and other potential pollutants on-site during construction. Spill response materials will be maintained on-site during construction.
- Native vegetation will be replanted in disturbed areas, following a plan approved by the Forest Service. Vegetation management will include the removal and monitoring of noxious weeds disturbed by the project.
- Additional coordination with WDFW and the Forest Service may be necessary to ensure that construction activities comply with regulatory requirements for species and habitats covered by the ESA and MBTA.

- If blasting with explosives at the dam site is necessary, a pre-blasting survey will be performed to locate any wildlife (terrestrial and aquatic) in the area that could be impacted by such a high-intensity noise. If wildlife are found, they should be hazed from the area to prevent their injury. An option may be to ramp-up construction noise prior to the blast to disturb and eventually displace any individuals from the area in a more controlled manner that has let potential to cause injury.

8.7 Significant Unavoidable Adverse Impacts

The longer duration that helicopters are used, the more disturbance events on wildlife would be incurred. Construction activities would also disturb wildlife, but in a much smaller area than what would be affected by helicopters, which would be largely confined to surrounding each area of construction. Virtually all protected wildlife species would be negatively affected by construction, as many have potential to be present in the study area. Large mammals, birds, amphibians, and reptiles would likely incur in the most substantial negative impacts–mobile animals would be forced to flee the action areas, and less-mobile animals risk being mortally harmed if present in the construction areas. Implementing avoidance and minimization measures would somewhat reduce these impacts.

It is not expected that significant, unavoidable impacts on wildlife habitat would be incurred by any of the alternatives, as the work areas are largely sites with a history of disturbance and alterations. With invasive management and replanting of native species, impacted vegetation may be returned to conditions potentially better than under existing conditions.

Alternatives 1, 2, and 3 would not have significant and unavoidable adverse impacts on fish within, or downstream, of the project area. A catastrophic dam failure, if it were to occur under the No Action Alternative, would have large-scale significant and unavoidable adverse impacts on fish within both Eightmile Lake, extending downstream to at least the Wenatchee River, and potentially farther.

CHAPTER 9: NOISE

Noise is defined as an unwanted sound that can adversely affect humans as well as other terrestrial and aquatic species. This chapter describes existing conditions and anticipated impacts primarily from the use of helicopters and other construction equipment. Impacts of noise on wildlife and aquatic species are described in Chapter 8*, Plants and Animals*.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on noise are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key Findings for Noise

- The Special Warranty Deed preserves IPID’s right to maintain and repair the dam. In early spring, small planes fly low to inspect conditions and helicopters are used to transport personnel and equipment to maintain the dam as necessary.
- With or without the project, noise-related impacts from heavy equipment used to demolish or construct the project on recreationists in the wilderness area would be unavoidable. However, because of the limited scale and duration of the project, construction noise impacts are considered **less-than-significant**.
- Noise from helicopters transporting personnel and equipment would be audible during daytime hours along trails, lakes, and campsites in the Enchantment Permit Area zones. Maximum noise from the heavy lift helicopter would be higher than the lower payload helicopter, but the number of trips from the heavy lift helicopter would be fewer. While the noise may be considered a nuisance by some visitors, noise from helicopter flights is considered a **less-than-significant** impact due to the timing and limited duration of the project.
- Noise from the operation of heavy construction equipment and blasting with explosives (if needed) at the dam would be audible in the Eightmile / Caroline Zone. Noise from blasting would be temporary and used sporadically and is considered a **less-than-significant** impact.
- During operation, noise levels would return to existing conditions and there would be no adverse noise impacts.

9.1 Aircraft Noise and Background Information

The measurement and human perception of sound involve two basic physical characteristics: intensity and frequency. Intensity is a measure of the acoustic energy of sound vibrations, expressed in terms of sound pressure. The higher the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic is sound frequency, which is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.

The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. As a consequence, when assessing potential noise impacts on humans, sound is measured using an electronic filter that de-emphasizes the frequencies below 1,000 Hertz (Hz) and above 5,000 Hz in a manner corresponding to the human ear's decreased sensitivity to extremely low and extremely high frequencies. This method of frequency weighting is referred to as A-weighting and is expressed in units of A-weighted decibels (dBA). A-weighting follows an international standard methodology of frequency weighting and is typically applied to community noise measurements. Some representative noise sources and their corresponding A-weighted noise levels are shown in Table 9-1. As shown, the relative perceived loudness of a sound doubles for each increase of 10 dBA, although a 10-dBA change in the sound level corresponds to a factor of 10 changes in relative sound energy. Generally, single-event sound levels with differences of 2 dBA or less are not perceived to be noticeably different by most listeners.

Table 9-1. Common Sounds on the A-Weighted Decibel Scale

Sound	Sound level (dBA)	Relative loudness (approx.)*	Relative sound energy**
Rock music, with amplifier	120	64	1,000,000
Thunder, snowmobile (operator)	110	32	100,000
Boiler shop, power mower	100	16	10,000
Orchestral crescendo at 25 feet, noisy kitchen	90	8	1,000
Busy street	80	4	100
Interior of department store	70	2	10
Ordinary conversation, 3 feet away	60	1	1
Quiet automobiles at low speed	50	1/2	0.1
Average office	40	1/4	0.01
City residence	30	1/8	0.001
Quiet country residence	20	1/16	0.0001
Rustle of leaves	10	1/32	0.00001
Threshold of hearing	0	1/64	0.000001

SOURCE: U.S. Department of Housing and Urban Development 1972.

*Relative loudness refers to the perceived doubling of noise level per 10 dBA increase over levels typical of ordinary conversation.
**Relative sound energy is the sound pressure level in micro pascals (uPa) divided by the threshold of human hearing (20 uPa) in air.

9.2 Methodology

This section describes the methods used to analyze the potential for environmental noise impacts from the construction and operation of the project in the study area. The study area includes the helicopter flight path and areas of the Enchantment Permit Area, including portions of the Eightmile / Caroline and Stuart Zones, where construction noise would be audible.

The limits of acceptable change defined in the Alpine Lakes Area Land Management Plan (USFS 1984) were used to evaluate the potential for short-term and long-term impacts. The noise management standards, summarized in Section 9.3, restrict the nature and frequency of sounds experienced in wilderness areas based on the level of development. The most restrictive are defined for campsites in trailless zones where people-caused sound levels are not typically detected more than twice per day and were used as the basis to determine whether short-term and long-term impacts would be significant. Sound level changes of ± 1 dBA are not usually discernable by the human ear, even under ideal laboratory conditions. Changes between 1 and 3 dBA are detectable by some people under quiet, controlled conditions. But a change of 5 dBA or more is readily discernable to most people in outdoor environments (FTA 2018).

Short-term construction impacts are considered significant as follows:

- Impacts are considered significant if noise from construction activity is detectible (exceeding ambient levels by 5 dBA or more) in wilderness areas and campsites at night, between the hours of 10 p.m. and 7 a.m.

Long-term (operational) impacts are considered significant as follows:

- Impacts are considered significant if people-caused noise levels are detectible (i.e., exceed ambient levels by 5 dBA or more) in wilderness areas and campsites more than two times per day for more than two full construction seasons.

To determine the potential for impacts, ESA predicted environmental noise levels from helicopters and construction equipment using the Aviation Environmental Design Tool (AEDT) and the Computer Aided Noise Abatement (CadnaA) models, respectively. Project-related noise levels were calculated at five nearby lakes, where most recreationalists visit or camp. To estimate detectability, predicted noise levels were compared to typical noise levels experienced in wilderness areas during summer months. Additional details regarding helicopter noise modeling are provided in Section 9.2.1. Additional details regarding the construction equipment noise modeling are provided in Section 9.2.2.

9.2.1 Overview of Helicopter Noise Modeling

For the noise analysis, a single event noise metric was used as opposed to a time-averaged noise metric, which is generally the standard when considering aircraft noise impacts. Given how irregular the helicopter activity would be, a time-averaged noise metric would not convey the brief helicopter noise following long periods of relative low sound levels that this helicopter activity would bring. The Maximum Sound Level (or Lmax) metric was selected to identify the absolute highest noise impact that the helicopter flights to and from the dam site would cause. The Lmax metric is A-weighted as discussed above in order to calibrate the metric to the frequencies heard by the human ear.

To assess noise levels associated with the use of helicopters, the AEDT (which is the Federal Aviation Administration’s [FAA] approved model for assessing noise and emissions at civilian airports) was used. AEDT has been used for environmental review of aviation noise and emissions impacts for airport projects since 2015 and is used for 14 CFR Part 150 (Airport Noise Compatibility Planning) studies, Environmental Assessments, and Environmental Impact Statements under NEPA. AEDT was used to simulate the noise emissions from the construction-related helicopter operations.

For construction activities, helicopters would be used to transport equipment to and from the dam site. Depending on the option selected, two types of helicopters would be used: a heavy-lift helicopter (e.g., Columbia Chinook CH-47D, or similar) with a 20,000-pound payload capacity, and a small helicopter (e.g., Bell UH-1 Huey or similar) with a 5,000-pound payload. However, only one helicopter would be in operation at any one time so the operations for each helicopter were modeled and are presented separately.

The path of the helicopter flights is integral to measuring the noise along the path of the flight. The flights to the construction would begin at the "fly yard" near Icicle Creek at an elevation of 2,278 feet, and helicopters would fly along the valley generally following the path of Eightmile Creek to the construction site at an elevation of 4,675 feet. The return flights would fly back down the valley to the northeast to the fly yard. Figures 9-1 through 9-8 (presented at the end of this chapter) show the modeled flight path from the construction location to the fly yard. Due to the very short flight path and the unique difference in altitudes over such a short distance, the decision was made to model the departure and arrival at each helipad separately. AEDT assigns a standard flight profile to each aircraft type, and when modeling both helipads with this standard flight profile, the departure flight profile would result in helicopters overshooting the arrival pad and flying directly through the mountains beyond. Separating the analysis preserves the unique acoustic characteristics associated with arrival and departure flight profiles without including extra noise associated with the overshot flight path.

AEDT also requires weather data. The Cashmere-Dryden Airport has a weather station 17 miles east of the construction site that was used to approximate the weather data in the vicinity of the helicopter flights. The weather data used are the average annual values from 2011–2020 from the Integrated Surface Database (NOAA 2001). Table 9-2 gives the weather parameters used in the modeling. Given the mountains on either side of the helicopter flight path, using terrain data in the modeling was considered essential. The data were pulled from the United State Geological Survey (USGS 2021).

Table 9-2. AEDT Modeling Weather Parameters

Weather Parameter Name	Weather Parameter Value
Temperature (Fahrenheit)	48.91
Pressure(millibars)	971.37
Sea Level Pressure (millibars)	1,016.24
Relative Humidity (%)	55.72
Dew Point (Fahrenheit)	33.75
Wind Speed (knots)	5.56

Source: Prepared by ESA 2022

The results on the noise modeling are presented in Section 9.5.1, *Transportation of Equipment and Materials* of this chapter.

9.2.2 Construction Noise Modeling Overview

Construction noise from clearing, demolition, and dam construction would be audible when heavy equipment is in use. The construction assessment evaluated the potential for short-term impacts from excavator, generator, concrete mixer, and blasting (with explosives) noise. Modeled noise emissions, summarized in Table 9-3, were based on the maximum noise levels from the Federal Highway Administration (FHWA) Roadway Construction Noise Model (RCNM) (FHWA 2008).

Table 9-3. Construction Equipment Noise Emission Levels

Equipment Type	Lmax Noise Level at 50 Feet (dBA)
Excavator	85
Generator	82
Vibratory Concrete Mixer	80
Blasting	94

Source: FHWA 2008

To simulate construction noise, the CadnaA software program by DataKustik was used. CadnaA is the leading software for the calculation, presentation, assessment, and prediction of environmental noise from multiple sources, including construction equipment. The model predicts sound levels using algorithms that comply with the international standards in ISO-9613-2:1996 (ISO 1996). Effects of distance, terrain, ground surface types, and meteorological conditions are considered by the model. Using CadnaA, noise levels were predicted at the Eightmile Dam construction site and at dispersed Eightmile Lake campsites, approximately 3,000 feet west of the dam.

9.3 Regulatory Context

Soundscapes within the study area are protected by a variety of federal, state, and local plans, laws, and policies (Table 9-4). These plans and policies were reviewed to determine how the project alternatives would comply with noise regulations in the study area. Of these regulations, the Alpine Lakes Area Land Management Plan contains objective thresholds for sources of noise affecting receiving locations in wilderness zones. These standards are further summarized in the next section.

Table 9-4. Regulations and Guidelines for Noise Applicable in the Study Area

Program, Plan, or Policy	Description
Alpine Lakes Area Land Management Plan	Provides noise standards for the wilderness management areas, which include the transitional zone, semi-primitive zone, primitive zone, and trailless zone.
36 CFR § 261.18 – National Forest Wilderness	Prohibits the use of motor vehicles and motorized vehicles unless authorized by federal law or regulation. Also prohibits the landing of aircraft or dropping or picking up anything via an aircraft (including helicopter) in a wilderness area.
Noise Control Act of 1972	Authorizes federal action to address sources of noise, including motor vehicles, machinery, appliances, and other commercial products. The act authorized the EPA to issue noise emission regulations for the above sources.
Washington State Noise Control Act of 1974	Recognizing the harm that excessive noise can have on public health, safety, and well-being, the State of Washington established rules to abate and control noise pollution (RCW 70.107, Noise Control). The regulations on Maximum Environmental Noise Levels (WAC 173.60) apply to a variety of activities and facilities.
Chelan County Noise Ordinance – Chapter 7.35 Chelan County Code	Provides control of noise in a manner that promotes commerce and continues the community events, values, and traditions of Chelan County; the use, value, and enjoyment of property; sleep and repose; the health, safety, and welfare of the general public; and the quality of the environment. Sounds from construction noise during the hours of 7 a.m. to 10 p.m. are exempt from county regulations (Chelan County Code [CCC] 7.35.040).

9.3.1 Alpine Lakes Area Land Management Plan

The Alpine Lakes Area Land Management Plan was adopted in 1984 to preserve and protect the Alpine Lakes Wilderness and primitive areas. This plan sets objectives for the "Limit of Acceptable Change" to the soundscapes in four wilderness zones. Each zone represents different opportunities for visitors wishing to experience wilderness settings. Noise objectives establish standards for the intensity and frequency of detectible people-caused sounds in each zone. The plan describes the four wilderness zones as follows:

- Transition Zone – Characterized by predominantly unmodified natural environment. These zones usually are adjacent to major trailheads where the user makes the transition from motorized access to foot or horse travel and is first introduced to the wilderness. They normally extend from the wilderness boundary inward along primary travel routes up to 3 miles and 500 feet on either side of the travel route. Day use of an area often predominates or is equally mixed with destination travelers also using the interior of the wilderness. A transition zone exists 500 feet on either side of FSR 7601 and Eightmile Lake Trail and includes the area immediately surrounding the project.
- Semi-Primitive Zone – Characterized by predominantly unmodified natural environment of moderate to large size. Concentration of users is low, but there is often evidence of other area users. The zone is managed in such a way that minimum on-site controls and restrictions may be present but are subtle. Spacing of groups may be formalized to disperse use and provide low to moderate contacts with other groups or individuals. Near the project, a semi-primitive zone exists 500 feet on either side of Eightmile-Trout-Creek Trail.
- Primitive Zone – Characterized by essentially unmodified natural environment. Concentration of users is very low and evidence of other area users is minimal. The zone is managed to be essentially free from evidence of restrictions and controls. Spacing of groups is informal and dispersed to minimize contacts with other groups or individuals. Campsites in the Eightmile/Caroline and Stuart Enchantment permit areas are considered primitive zones.
- Trailless Zone – Characterized by an extensive unmodified natural environment. Natural processes and conditions are not measurably affected by the actions of users. The zone is managed to be as free as possible from the influence of human activities. Trailless zones exist in the project vicinity, more than 500 feet away from trails and campsites.

Maximum acceptable detectability values, as measured using the System for the Prediction of Acoustic Detectability (SPreAD) (Harrison et al. 1980) are provided in Table 9-5. This assessment considers any people-caused sound levels detectible if the predicted noise level exceeds ambient levels by 5 dBA or more.

Table 9-5. Wilderness Noise Management Standards

Wilderness Zone	Maximum Acceptable Detectability Levels (D’)
Transition Zone	People-caused sound rated at D'-10 are not heard on an average of more than 4 times per hour from a distance 1/4 mile within the zone.
Semi-Primitive Zone	People-caused sound rated at D'-5 between camps and are not heard on an average of more than 12 times per day by traveling groups.
Primitive Zone	People-caused sounds rated at D'-1 between camps are not heard on an average of more than 6 times per day by traveling groups.
Trailless Zone	People-caused sounds rated at D'-1 are audible between camps and not heard on an average of more than 2 times per day by traveling groups.

D’ values based on SPreAD estimation guidelines. The D’ scale represents noise levels detectable in the following conditions:

- D’-1: Wilderness / primitive areas.
- D’-5: Trail camps / semi-primitive areas.
- D’-10: Underdeveloped roadside campgrounds / semi-primitive areas.
- D’-20: Roadside campgrounds / semi modern areas.
- D’-40: Highly developed campgrounds / modern areas.

Source: USFS 1984

9.4 Affected Environment

The study area includes the Enchantment Permit Area within the Alpine Lakes Wilderness and is primarily used for recreational purposes. Transition zones exist within 500 feet of the Eightmile Lake Trail leading to and surround the dam. A semi-primitive zone exists approximately one-half mile from the dam and extends 500 feet from either side of the Eightmile-Trout-Creek Trail. Dispersed campsites in the Enchantment Permit Area are considered primitive zones. All other undeveloped areas are considered trailless zones and have very low noise levels. A telemetry repeater station would be installed in the Wenatchee National Forest near an existing Forest Service repeater station, located outside of the Alpine Wilderness (see Figure 1-2). Existing noise sources include occasional overhead air traffic and traffic on Forest Service roads in the area and at trailheads, voices, streamflows, and birds and other wildlife sounds. Ambient background noise levels in wilderness areas are typically around 45 dBA during summer months.

9.4.1 Sensitive Noise Receptors and Soundscapes in the Study Area

The Enchantment Permit Area is considered a sensitive soundscape that includes several lakes where recreationists would be considered sensitive receptors. Some of these lakes are popular destinations and are listed in Table 9-6 below.

Table 9-6. Sensitive Receptor Locations

Location Name	Latitude	Longitude	Elevation (ft)
Eightmile Lake	47.522575	-120.870633	4,880
Caroline Lake	47.540350	-120.863347	6,167
Lake Stuart	47.498167	-120.878379	5,078
Colchuck Lake	47.498366	-120.833343	5,590
Upper Snow Lake	47.458262	-120.749749	5,439

Source: Prepared by ESA 2022

The noise environment surrounding Eightmile Lake and other lakes is generally quiet as a result of the surrounding wilderness and rural land uses. Natural sounds predominate in the study area, including streamflows, bird songs, and wind. Noise-causing activities near the boundary of the wilderness areas include traffic traveling on FSR 7601 and Icicle Road.

9.5 Construction Impacts

This section analyzes short-term impacts during the project's temporary construction phase. Construction-related noise levels within the Enchantment Permit Area were evaluated from four scenarios: noise from helicopters, noise during road repairs, noise from use of heavy equipment for dam construction, and noise from blasting with explosives (if needed) at the dam. These noise-generating activities and equipment would likely be used for all alternatives, including future emergency repairs resulting from the No Action Alternative and the project's action alternatives. Such activities are permitted under the dam's Special Warranty Deed that preserves the IPID's right to maintain and repair the dam.

Noise generated from standard construction equipment that would expose people to, or generate, noise levels that would result in sustained and substantial annoyance at campsites and when most people are trying to sleep would be considered significant.

Impact equipment that would only operate during daytime hours, such as jackhammers and blasting, would expose people to, or generate, noise levels that could result in sustained and substantial annoyance and disruption of activities for receptors. Blasting with explosives is considered a contingency activity and, if necessary, based on site conditions, would only occur on one or two days.

9.5.1 Transportation of Equipment and Materials

Helicopter

The results of the noise modeling are shown below and in over eight figures, one for each modeled helicopter arriving at each helipad and departing from each helipad. Results showing noise level contours can be found in Figures 9-1 through 9-8. Noise levels are shown for the flight path and surrounding area, ranging from 50 dBA to 75 dBA.

The maximum helicopter noise was also assessed at trails and popular sites surrounding the construction site: Eightmile Lake, Carolina Lake, Lake Stuart, Colchuck Lake, and Upper Snow Lake. The latitude, longitude, and elevation of each location are given in Table 9-6. The maximum A-weighted helicopter noise was calculated at nearby trails and for each site, and these noise levels are presented in Table 9-7. Over the course of construction, helicopter use and type would vary by the option selected. Table 2-2 (in Chapter 2) presents the two construction options and lists the anticipated number of trips associated with each option. Unless an emergency transport is required, helicopter flights would only occur during daytime hours, between 7 a.m. and 7 p.m. While the noise may be considered a nuisance by some visitors, noise from helicopter flights is considered a less-than-significant impact due to the timing and limited duration of the project.

Table 9-7. Maximum Helicopter Noise at Area Sites

Site Name	Lmax Value (dBA)
Eightmile Lake Trail	116 [a]
Eightmile-Trout-Creek Trail	116 [a]
Eightmile Lake	61
Caroline Lake	51
Lake Stuart	52
Colchuck Lake	52
Upper Snow Lake	42

Notes:

a) Maximum noise level of 116 dBA predicted from fully loaded heavy-lift helicopter (e.g., Columbia Chinook CH-47D, or similar) hovering directly overhead. Actual noise levels from helicopter overflights along these trails likely 75 dBA or lower.

Source: Prepared by ESA 2022

FSR 7601-116

To reduce reliance on helicopter transport, the project proposes to partially restore and use the first 4,280 feet of FSR 7601-116. Road repairs would allow the crew to drive closer to the site and avoid 400–500 feet of elevation gain, allowing crew to carry more supplies in and out by foot and requiring fewer helicopter flights. Clearing would require approximately 16 hours for a crew of 4 members with a 305 CAT excavator. Excavator noise levels, shown in Table 9-3, generally decrease at a rate of 6 dBA per doubling of distance. The Lmax excavator noise level of 85 dBA at 50 feet attenuates to 79 dBA at 100 feet, 73 dBA at 200 feet, and down to 49 dBA at 3,200 feet. In wilderness areas with ambient noise levels of approximately 45 dBA, noise from excavator use would be detectible by most people when within 3,200 feet. Because of the short duration of the noise and sporadic use of the road, noise impacts would be considered less-than-significant.

Telemetry Repeater Station

Under existing conditions, IPID staff hike to Eightmile Lake and manually release water as necessary. Under the action alternatives, this process would be automated using telemetry equipment at Eightmile Lake and a repeater station on Icicle Ridge. While exact locations have not yet been determined, the proposed telemetry equipment would be installed on the northeast side of the dam within the Special Warranty Deed Area. The repeater station would be installed in the Okanogan-Wenatchee National Forest near an existing Forest Service repeater station and outside of the Alpine Wilderness (see Figure 1-2).

Telemetry equipment and installation materials would be flown in by helicopter and installed over the course of 1 to 3 days. Equipment at both locations would be bolted down and secured with guyed wires. Installation would not require the use of heavy construction equipment, but noise from the helicopter used during transportation would be audible in wilderness areas and to hikers in the area during that time. Because of the limited scale and duration of the equipment installation, construction noise impacts are considered less-than-significant.

9.5.2 Dam Construction

The goal for noise modeling was to ascertain the range of maximum possible noise levels likely to be experienced during construction by visitors along trails and at campsites. The maximum noise levels for equipment in Table 9-3 were modeled in CadnaA during daytime hours (7 a.m. to 10 p.m.) when construction activity would likely occur. Equipment was modeled along the lake, next to the dam, at approximately 4,700 feet elevation.

Model calculated noise levels are shown in Table 9-8. In the unlikely event that blasting with explosives is required to complete construction, cumulative noise levels due to typical construction sources and blasting are provided separately. Receiving locations for the Eightmile Lake Trail and Eightmile-Trout-Creek Trail were modeled approximately 200 feet and 2,000 feet from the construction site, respectively. Noise levels at dispersed Eightmile Lake campsites were modeled approximately 3,000 feet from the construction site. Other popular lake destinations are more than 7,200 feet from the construction site. As shown in the table, sound from dam construction activity would not be detectible at more distant lakes due to noise attenuation from distance and intervening terrain.

Maximum model predicted noise levels resulting from dam construction at the loudest point along nearby trails ranged from 42 dBA to 80 dBA. Noise levels between 21 dBA and 36 dBA were predicted at dispersed Eightmile Lake campsites approximately 3,000 feet from the construction site. Based on typical ambient wilderness noise levels and model results, construction-related noise at campsites 3,000 feet or more from the construction site would be difficult to detect. Furthermore, construction activity is not anticipated between the hours of 10 p.m. and 7 a.m., and therefore disturbance to sleep would not likely occur. Temporary noise increases due to construction would be detectible by most people using the Eightmile / Caroline Zone wilderness trails and would be viewed as a strongly negative impact by some users. However, because of the limited scale and duration of the project, construction noise impacts are considered less-than-significant.

Table 9-8. Maximum Construction Noise Levels at Area Sites (dBA)

Receiver Location	Typical Construction Noise Sources				Contingency Activity	
	Excavator	Generator	Concreate Mixer	Cumulative	Blasting	Cumulative
Construction Site	110	107	105	112	119	119
Eightmile Lake Trail	70	67	65	72	79	80
Eightmile-Trout-Creek Trail	47	44	42	49	56	57
Eightmile Lake campsites	26	23	21	29	35	36
Caroline Lake	Undetectable – Less than 15 dBA					
Lake Stuart	Undetectable – Less than 15 dBA					
Colchuck Lake	Undetectable – Less than 15 dBA					
Upper Snow Lake	Undetectable – Less than 15 dBA					

Source: Prepared by ESA 2022

9.6 Operational Impacts

This section describes any operational impacts from noise from the alternatives.

9.6.1 No Action Alternative

Currently, maintenance and inspection of the dam occurs several times per year. Helicopters are used to transport equipment and personnel as needed for maintenance. Small planes fly low and slow over the dam during the spring months to inspect the site when snow levels preclude hiking to the dam. Under the No Action Alternative, it is likely that the dam would eventually fail and require repair or replacement. During this construction, heavy equipment and materials would be flown in by helicopter, resulting in noise impacts similar to that of the action alternatives.

9.6.2 Alternative 1: Narrow Spillway with Gates

Operation of the dam does not typically generate any noise. Maintenance of the dam is currently performed with transport to the site via helicopter or personnel hiking to the site. Under this alternative, approximately 1–3 times per year, crew members would run a compressor to fill the air bladders and lift the dam gates. Gates are assumed to be low through early snowmelt and raised once during the summer. Noise from operation of the dam would be similar to existing conditions and is considered less-than-significant.

Maintenance of telemetry equipment would occur roughly once every 5 years, and would consist of one helicopter flight to the site to replace batteries. Because of the limited scale and short duration of the maintenance activities, noise impacts from telemetry equipment maintenance are considered less-than-significant.

9.6.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Gates would not be used under this alternative and, therefore, compressors would not be required. Operational impacts from Alternative 2 would be similar to or less than those described for Alternative 1, and would be less-than-significant. Noise impacts from telemetry equipment maintenance are the same as Alternative 1 and are considered less-than-significant.

9.6.4 Alternative 3: Narrow Spillway without Gates

Operational impacts from Alternative 3 would be similar to those described for Alternative 1. While a compressor would not be used to control gates, pumping may be required when water levels are low. If pumping is required at low-water levels under this alternative, additional helicopter flights may be necessary to transport equipment. Pumping would be infrequent and would likely produce noise levels similar to or less than operation of compressors under Alternative 1. Therefore, noise from operation of Alternative 3 is considered less-than-significant. Noise impacts from telemetry equipment maintenance are the same as Alternative 1 and are considered less-than-significant.

9.7 Avoidance, Minimization, and Mitigation Measures

During construction, recreationists near active construction areas would experience short-term, temporary increases in sound levels from heavy equipment use at the Eightmile Dam, near FSR 7601, and along the helicopter flight path. BMPs for mitigating construction noise and reducing detectability include:

- Require all equipment be fitted with an appropriately sized muffler.

- Require all equipment to be in good working order.
- Consider replacing typical pure-tone backup alarms with ambient sensing technology or broadband backup alarms.
- Post allowable construction hours at trailheads near construction sites.
- Use "quiet" models where available (e.g., for compressors).
- Prohibit unnecessary idling of internal combustion engines.
- As described in Chapter 3, *Wilderness Character*, and Chapter 10, *Recreational Resources*, notify the public and potential users about construction so people who find the noise incompatible with their wilderness recreation can avoid using the area.

9.8 Significant Unavoidable Adverse Impacts

It is unavoidable that recreationists in the Alpine Lakes Wilderness and using Forest Service lands will find the impacts from construction noise and helicopters to detract from their experience, and some individuals may perceive this as a strongly negative impact. Because noise would only occur during active construction and the helicopter noise would no longer be present following completion of the work, the impacts would not be significant. The project alternatives would not result in long-term significant noise impacts in the Enchantment Permit Area during operation. There would no long-term sources of noise from the project within the Enchantment Permit Area.

Figure 9-1. Southwest Helipad Arrival, CH47D
(Source: Prepared by ESA with AEDT model results)

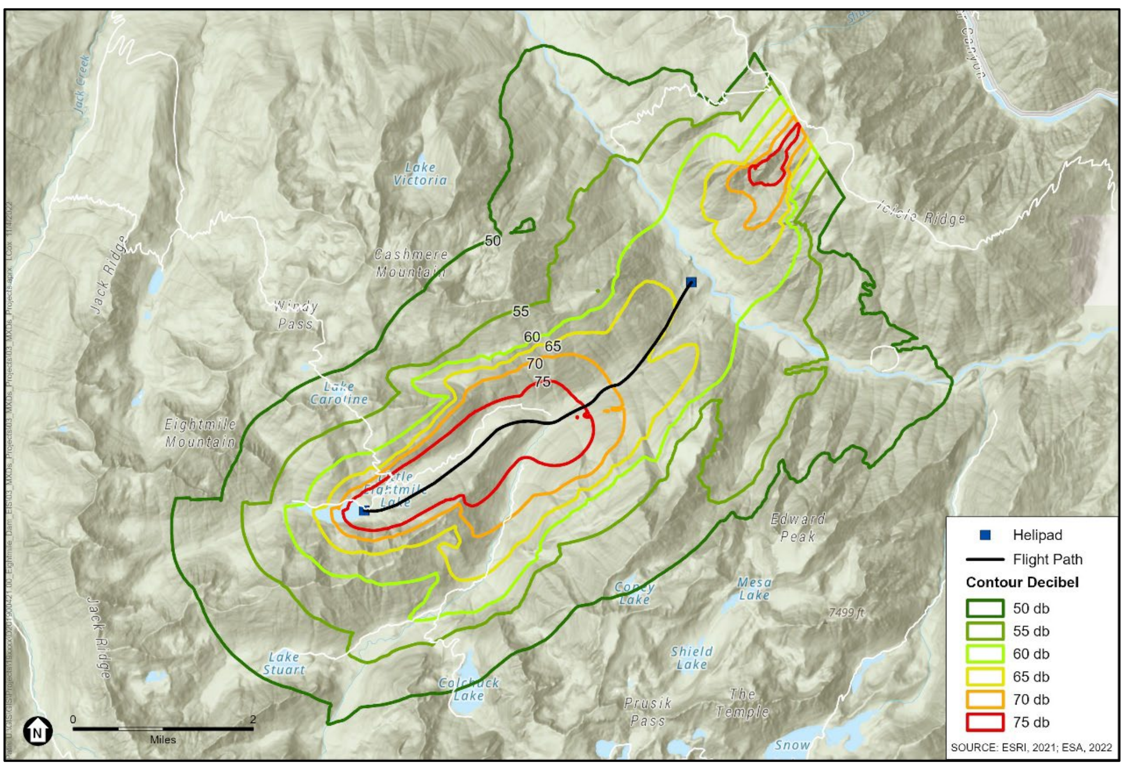


Figure 9-2. Southwest Helipad Departure, CH47D
(Source: Prepared by ESA with AEDT model results)

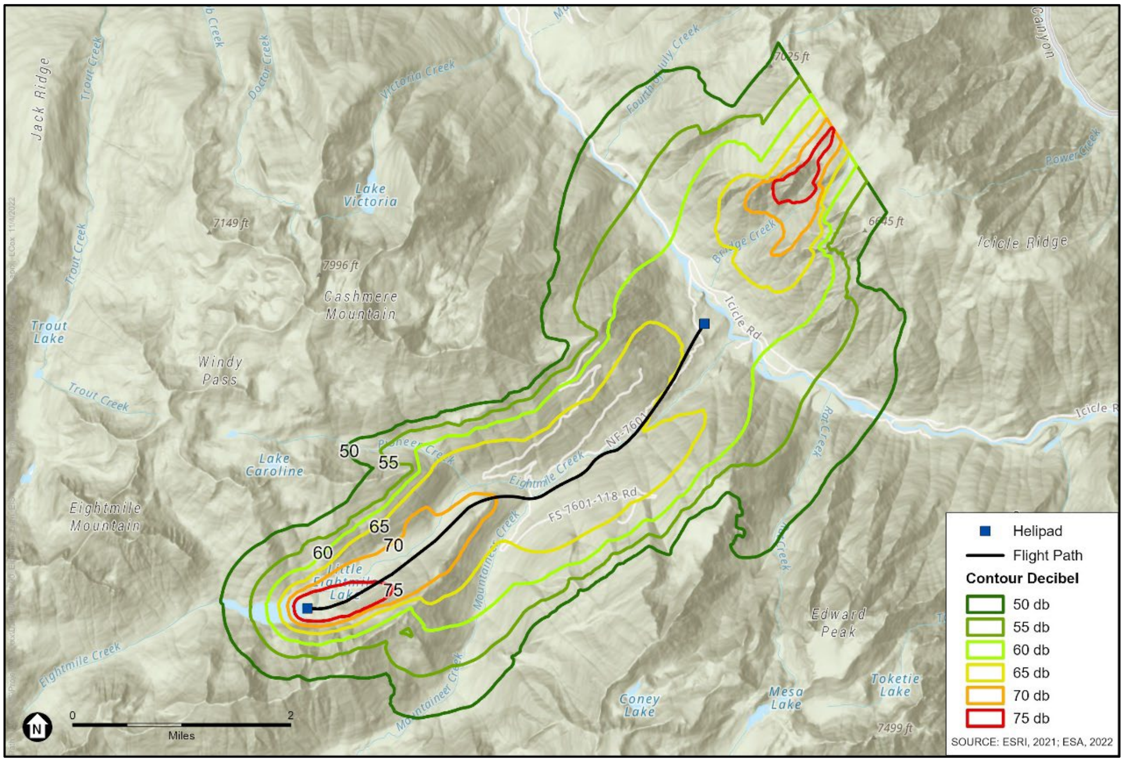


Figure 9-3. Northeast Helipad Arrival, CH47D
(Source: Prepared by ESA with AEDT model results)

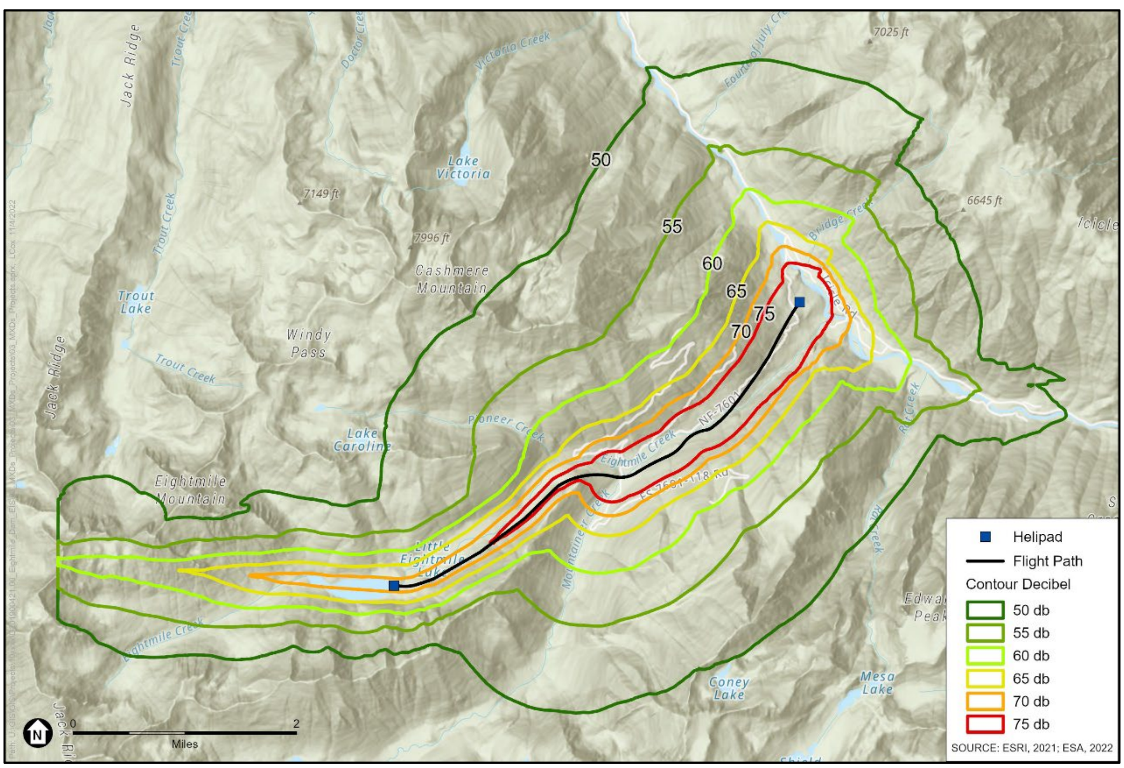


Figure 9-4. Northeast Helipad Departure, CH47D
(Source: Prepared by ESA with AEDT model results)

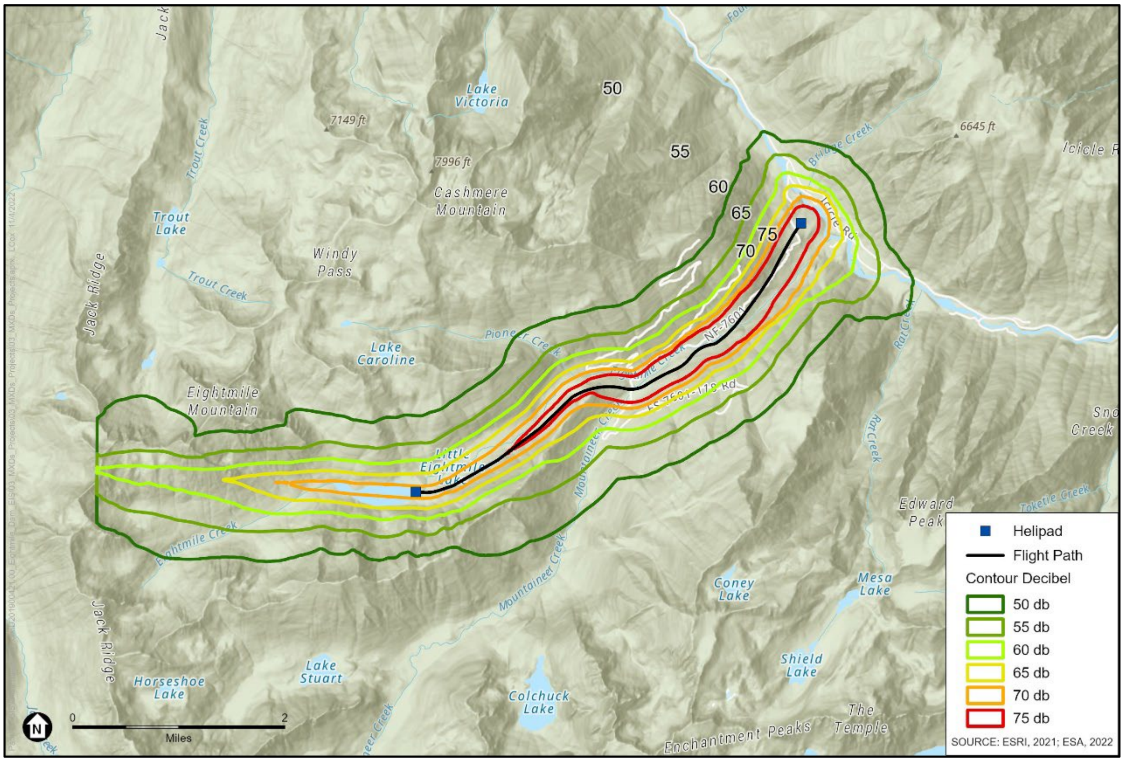


Figure 9-5. Southwest Helipad Arrival, H500
(Source: Prepared by ESA with AEDT model results)

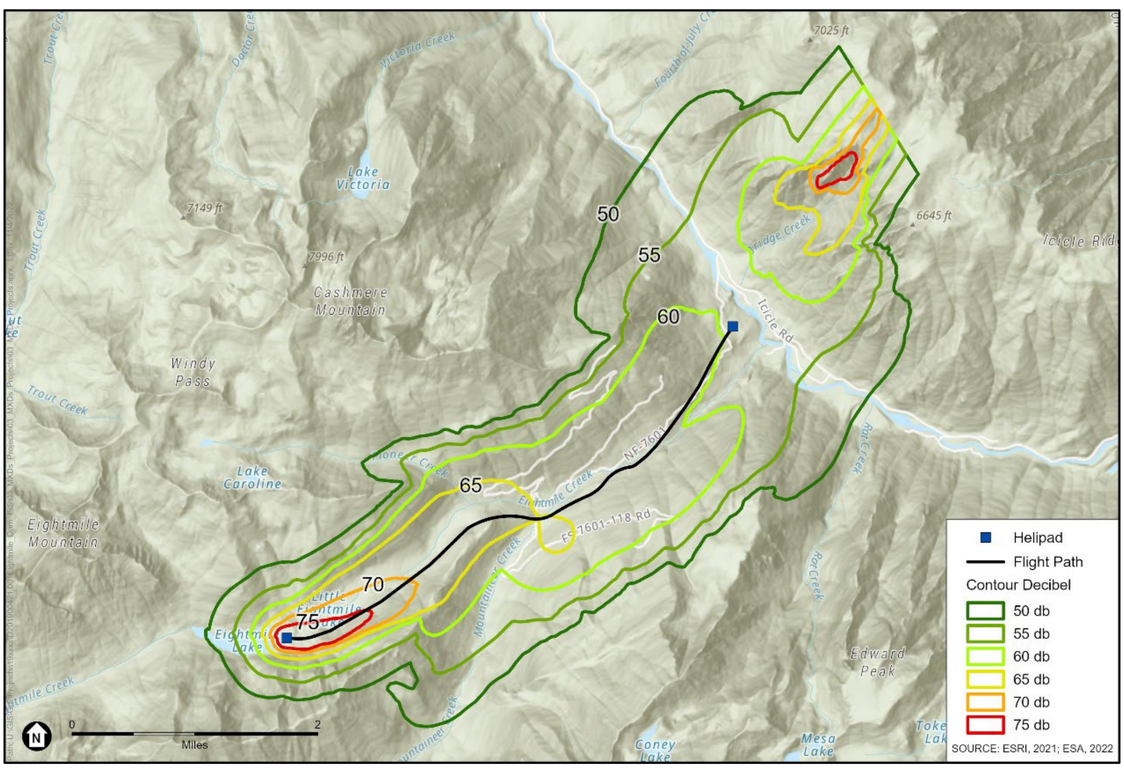


Figure 9-6. Southwest Helipad Departure, H500
(Source: Prepared by ESA with AEDT model results)

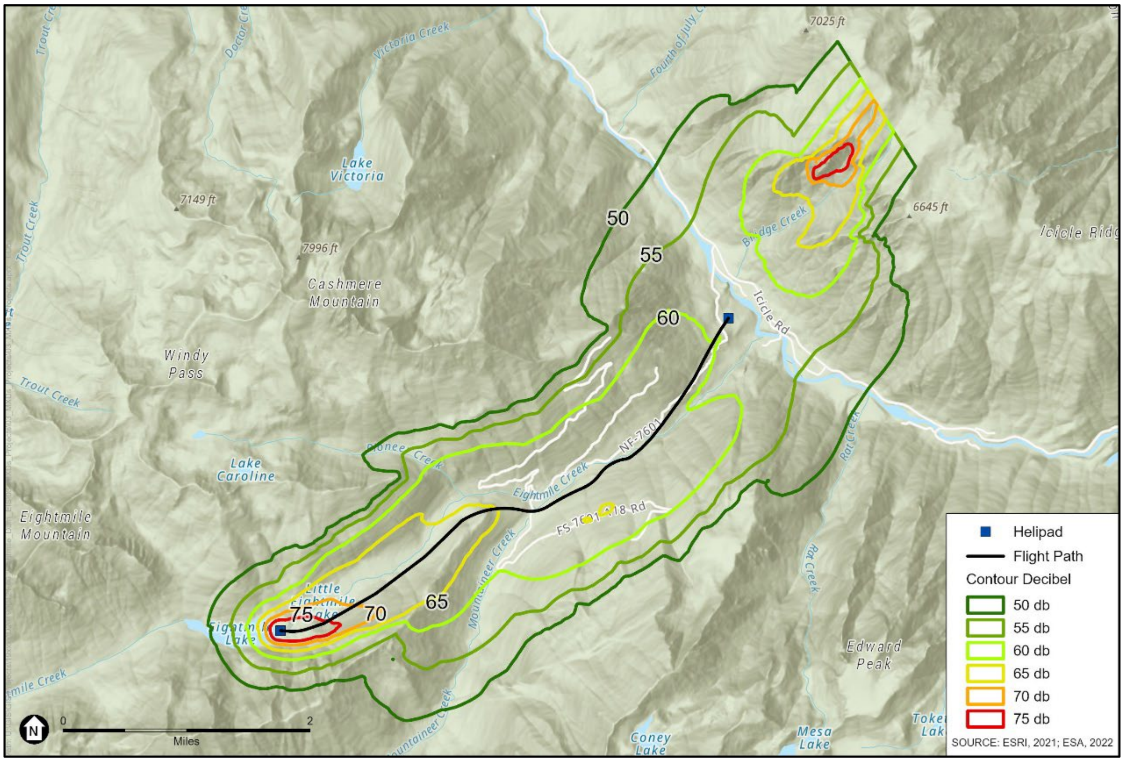


Figure 9-7. Northeast Helipad Arrival, H500
(Source: Prepared by ESA with AEDT model results)

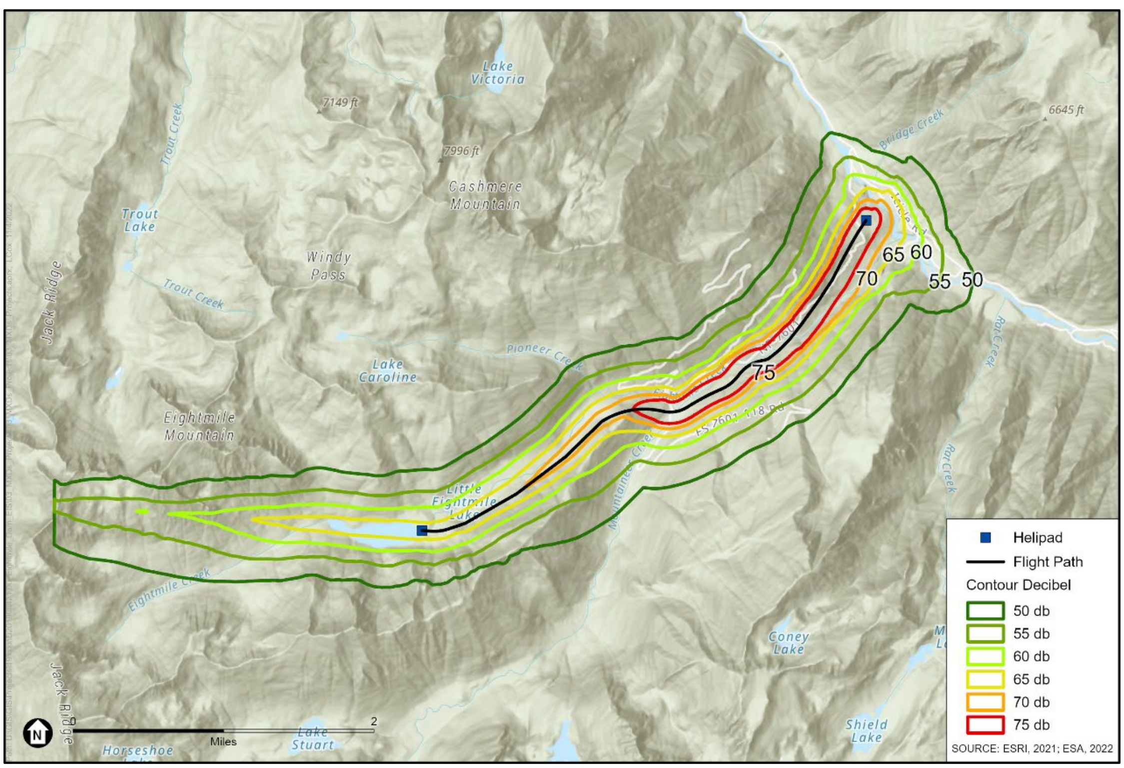
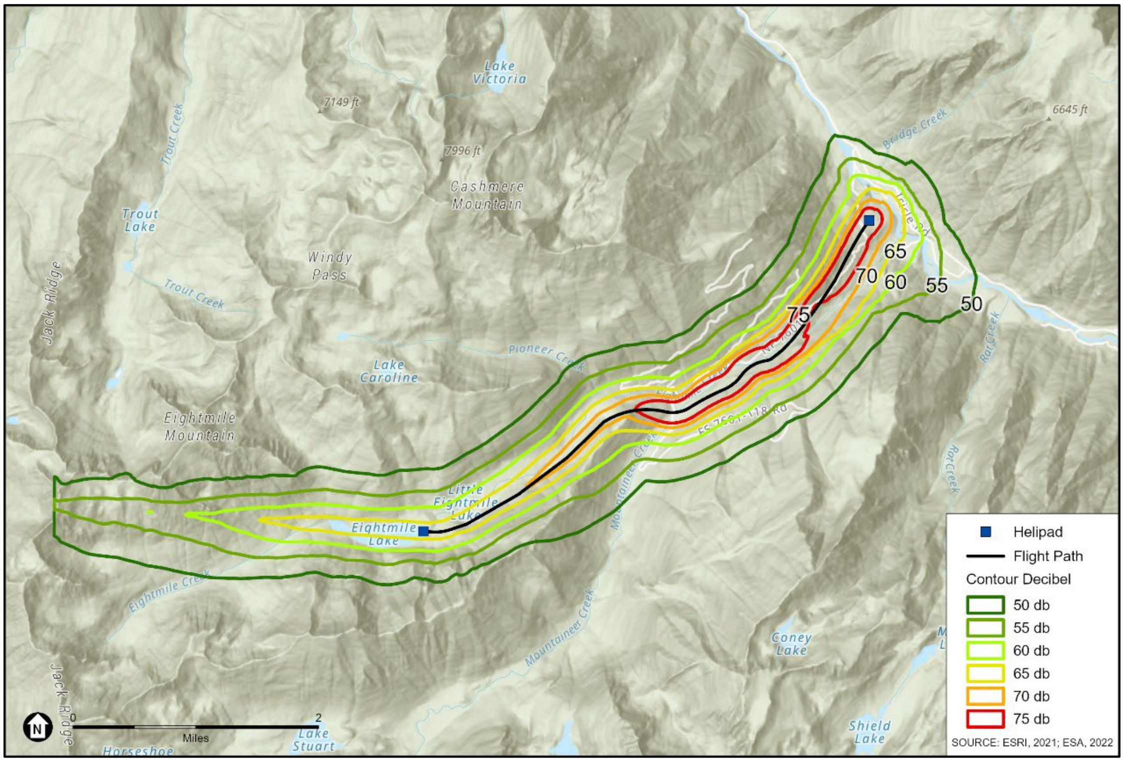


Figure 9-8. Northeast Helipad Departure, H500
(Source: Prepared by ESA with AEDT model results)



CHAPTER 10: RECREATIONAL RESOURCES

Recreation provides people with the opportunity to engage with and enjoy the natural environment. The Alpine Lakes Wilderness provides numerous opportunities for unconfined recreation as required by the Wilderness Act of 1964. Additionally, the project area is located within the Enchantment Permit Area, a popular hiking and camping destination that draws people from across Washington State and beyond.

What has Changed from the Draft EIS?

- Based on comments received on the Draft EIS, additional information was added to this chapter to clarify notification procedures. No other substantive changes have been made to this chapter. Some minor typos have been corrected.
- Responses to specific comments on recreation are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key findings for Recreation

- Recreation in the Enchantment Permit Area includes, but is not limited to, hiking, backpacking, fishing, rock climbing, and stock use.
- The Enchantment Permit Area is an increasingly popular hiking and backpacking destination.
- Permits via lottery system are required for overnight stay in the Enchantment Permit Area from May 15–October 31.
- Demand for overnight permits greatly exceeds the number of permits available.
- Primary destinations within the Eightmile /Caroline Zone are Eightmile Lake, Little Eightmile Lake, Caroline Lake, Cashmere Mountain, and Windy Pass.
- The 15- to 20-week construction period will occur during the peak summer use timeframe; however, impacts from construction noise will be temporary, with peak levels occurring for several minutes or less. Impacts are considered less-than-significant
- Dam failure under the No Action Alternative could result in significant impacts on downstream recreational opportunities and users.
- Operation of the action alternatives will result in lower lake levels during drought years, and higher lake levels during the summer months, but lake access routes, trails and camping areas are not expected to be affected. There are no significant unavoidable impacts under the action alternatives.

10.1 Methodology

This chapter describes how the rebuild and restoration of Eightmile Dam would affect recreational opportunities in the project area. The study area for the recreation analysis includes areas used for recreation directly adjacent to the dam, Eightmile Lake and shoreline, and trail, as well as areas downstream of the dam adjacent to Icicle Creek and the Wenatchee River. The study area also includes a section of Icicle Ridge adjacent to the repeater station (Figure 10-1 and Figure 10-2). The existing and potential opportunities for recreation in the study area were identified by reviewing maps, agency websites, and other information sources.

Figure 10-1. Enchantment Permit Area Zones

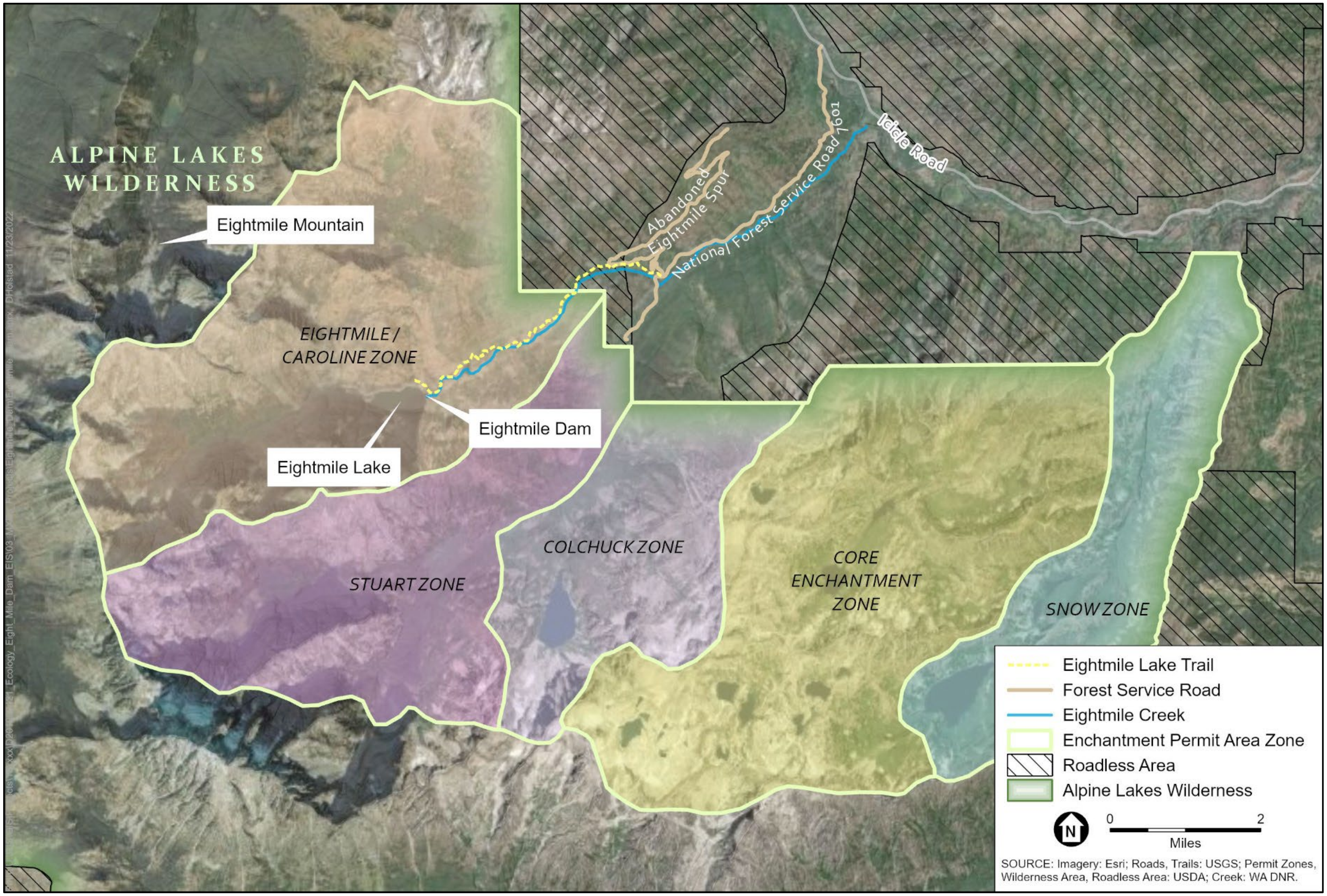
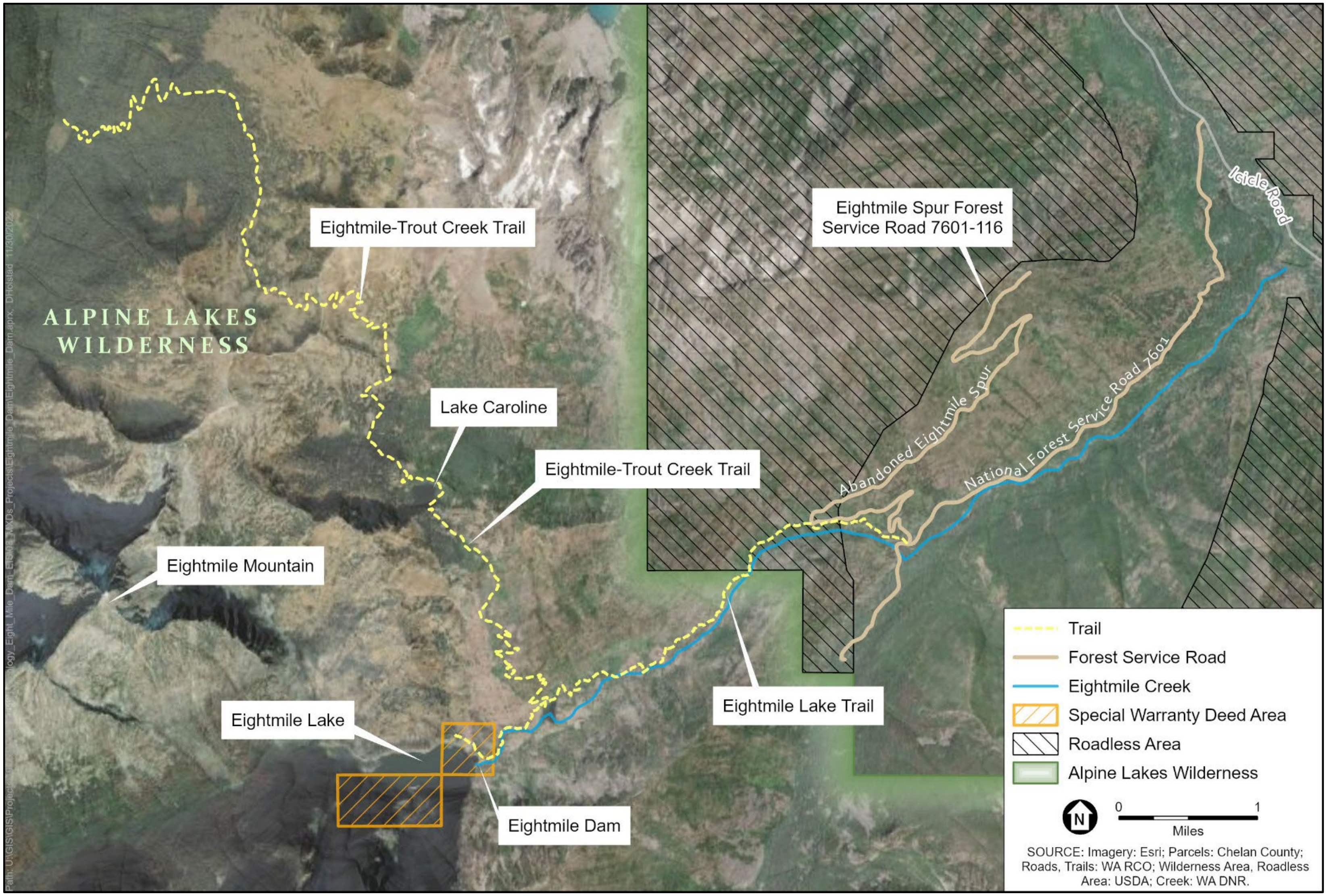


Figure 10-2. Recreation Study Area



This chapter focuses on general recreational activities, such as hiking, fishing, and camping. It does not address the wilderness designation of the area and its relationship to recreation, which is instead covered in Chapter 3, *Wilderness Character*.

For the evaluation of short-term impacts (construction), short-term impacts on recreation would be considered significant, as follows:

- Impacts are considered significant if a substantial portion of the recreational resources in the study area would be closed or become unusable due to disruption for a period greater than two full seasons or longer due to staging, construction activity, or noise that interferes with public enjoyment of the resource.

For the evaluation of long-term impacts (operational), long-term impacts on recreation would be considered significant, as follows:

- Impacts are considered significant if recreation in the Eightmile/Caroline Zone would be permanently closed or if large-scale recreational opportunities within the remainder of the study area were closed.

10.2 Regulatory Context

Recreational resources in the study area are protected by a variety of federal, state, and local plans, policies, and laws (Table 10-1). These plans and policies were reviewed to determine how well the project alternatives would conform with recreational resources in the study area. The policies reviewed generally establish and protect recreational opportunities in the Alpine Lakes Wilderness.

Table 10-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
Wilderness Act of 1964 (16 U.S.C. 1131-1136, 78 Stat. 890; Public Law 88-577)	The Wilderness Act created the National Wilderness Preservation System and provides the highest level of conservation protection of federal lands. The purpose of the act is to manage wilderness areas to preserve and, where possible, to restore their wilderness character. Wilderness areas are defined as “outstanding opportunities for solitude or a primitive unconfined type of recreation,” which refers to the following: • Solitude means having few encounters with other people and encountering no distractions from modern society. • Primitive recreation refers to traveling through wilderness without mechanization (i.e., by hiking, walking, or horseback riding). • Unconfined recreation provides the opportunity for self-discovery, exploration, and freedom from societal or managerial controls.
National Wilderness Preservation System (43 CFR Part 19)	Designates more than 111 million acres of protected wilderness areas in the United States for enjoyment of the public.
Alpine Lakes Area Management Act of 1976 (Public Law 94-357)	Established the area between Snoqualmie and Stevens Pass as the Alpine Lakes Wilderness for public outdoor recreation by present and future generations.
Alpine Lakes Area Land Management Plan 1981 (USFS 1981)	Provides recreation management objectives for the Alpine Lakes Wilderness, with a focus on providing opportunities for primitive recreation that features a natural wilderness environment, solitude, and physical and mental challenges consistent with wilderness values.

Program, Plan, or Policy	Description
	To protect wilderness resources and minimize overlap with and conflict between different types of wilderness, the plan establishes four Wilderness Use Zones (Transition, Semi-Primitive, Primitive, and Trailless). Each of zone calls for slightly different management strategies.
Alpine Lakes Wilderness regulations and restrictions	Describes regulations for recreation within the Alpine Lakes Wilderness, including, permit information, group size limitations, trail use, equipment restrictions, restoration areas, dog use and stock, camping, and fire restrictions.

10.3 Affected Environment

The study area provides opportunities for hiking, backpacking, camping, swimming, fishing, horseback riding, trail running, rock climbing, wildlife viewing, skiing, snowshoeing, and the general enjoyment of nature. Visitors from across the globe utilize the Alpine Lakes Wilderness and the Enchantment Permit Area.

10.3.1 Alpine Lakes Wilderness

Encompassing an area of approximately 414,322 acres, the Alpine Lakes Wilderness is located within the Central Cascades Mountain Range (Wilderness Connect 2022). The area offers approximately 615 miles of trails with access at 47 established trailheads. As noted on the Forest Service's website, approximately 150,000 people visit the Alpine Lakes Wilderness yearly (USFS 2021d). There are numerous opportunities for recreation, including day hiking, backpacking, horseback riding, fishing, whitewater kayaking and rafting, climbing, and various winter sports like skiing and snowshoeing. Trails in the Alpine Lakes Wilderness are managed by the U.S. Forest Service. Backpackers and climbers often access recreation opportunities and features that do not have system trail access, creating informal trail systems (USFS 1981). The maximum group size allowed within the Alpine Lakes Wilderness is 12 (combined people and stock). Permits are required for all visitors between May 15 and October 31 and are self-issued at the trailhead for all areas except the Enchantment Permit Area.

As shown in Table 10-1, the Alpine Lakes Area Land Management Plan designates Wilderness Use Zones for different areas within the Alpine Lakes Wilderness, including the Transition Zone, Semi-Primitive Zone, Primitive Zone, and Trailless Zone. The zones were established to protect the wilderness and reduce conflict between different types of recreational users and are related to trail access systems.

Transition Zones are usually adjacent to major trailheads, where wilderness visitors begin to make the transition from roadways to foot or horse travel and are first introduced to the wilderness. The *Semi-Primitive Zone* is the second zone in the progression to isolation in the wilderness. Within this zone, the concentration of users should be lower than the Transition Zone, but there is still evidence of other users within the wilderness area. Facilities in this zone are typically for the protection of natural resources and the safety of users. *Primitive Zones* should have low concentrations of users, and evidence of other users in the area should be minimal. This zone is managed to be essentially free of restrictions and controls imposed by humans, and only facilities essential for resource protection should be used and constructed of native materials. The *Trailless Zone* is intended to preserve the most extensive natural environments and should be as free as possible from human influence. No facilities should be provided in the Trailless Zone, and people are only viewed as visitors to the area (USFS 1981). The above definitions outline the desired conditions for each of the zones, but it is possible that designated zones may not always reflect such conditions.

Numerous opportunities in and near the Alpine Lakes Wilderness utilize the same roadway networks as the study area, including recreational activities off of Icicle Road, FSR 7600, and FSR 7601 (**Figures 10-2 and 10-3**). Recreational opportunities with access from Icicle Road and FSR 7600 include, but are not limited to, car camping, hiking, backpacking, fishing, kayaking, bouldering, rock climbing, and horseback riding. Some of these opportunities are located directly adjacent to the roadway, but others may require travel up Forest Service Roads, sometimes for several miles. Recreational opportunities from FSR 7601 include direct access to three of the Enchantment Permit Area zones: the Eightmile/Caroline Zone, the Stuart Zone, and the Colchuck Zone (Figure 10-1). The remaining Enchantment Permit Area zones can be accessed indirectly from FSR 7601 via the Colchuck Zone.

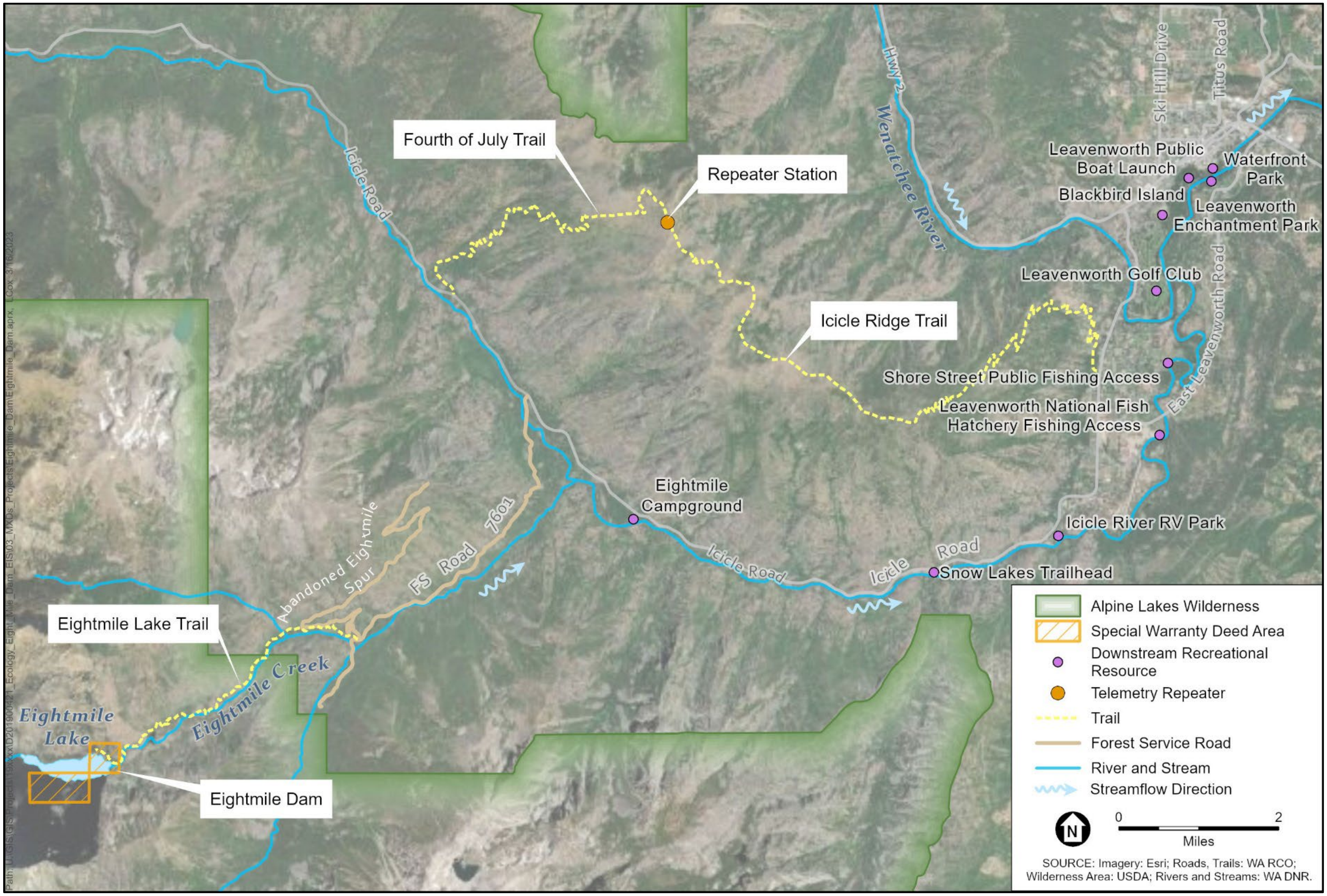
10.3.2 Enchantment Permit Area

The Alpine Lakes Enchantment Permit Area is an increasingly popular hiking and backpacking destination. The Forest Service reported that combined day and overnight use has increased from 19,678 visitors in 2009 to 58,844 in 2021, a 199 percent increase over 12 years (USFS 2017; Reed, C. personal communication, 2022). However, due to a low compliance with self-registering at trailheads and permit boxes not being full, the number of day users within the Enchantment Permit Area in 2021 is likely higher than the reported 58,844 people. Additionally, the ongoing COVID-19 pandemic has increased the use of outdoor recreation areas, including the Enchantment Permit Area. The area contains five different zones: Snow Zone, Core Enchantment Zone, Colchuck Zone, Stuart Zone, and the Eightmile/Caroline Zone (Figure 10-1). All Wilderness Use Zones are found in the Enchantment Permit Area, varying in location across the five permit zones. Transition areas within the Enchantment Permit Area Zones include the Eightmile Lake Trail (Forest Service Trail #1552), the Stuart Lakes Trail (Forest Service Trail #1599) from the trailhead to its junction with the Colchuck Lake Trail, and the Snow Lakes Trail (Forest Service Trail #1553) to the area between the lower and upper Snow Lakes. Semi- Primitive areas include the Eightmile-Trout Creek Trail from Caroline Lake to Windy Pass, the Stuart Lake Trail from its junction with Colchuck Lake Trail to Stuart Lake, and the Colchuck Lake Trail to the base of Aasgard Pass. Primitive areas include the Snow Lakes Trail from the area between upper and lower Snow Lakes to Aasgard Pass. The Trailless areas are those that do not have system trails; these areas include off-trail routes to climbing destinations like Colchuck Peak and Dragontail Peak. The majority of the Core Enchantment Zone is zoned as trailless (USFS 1981).

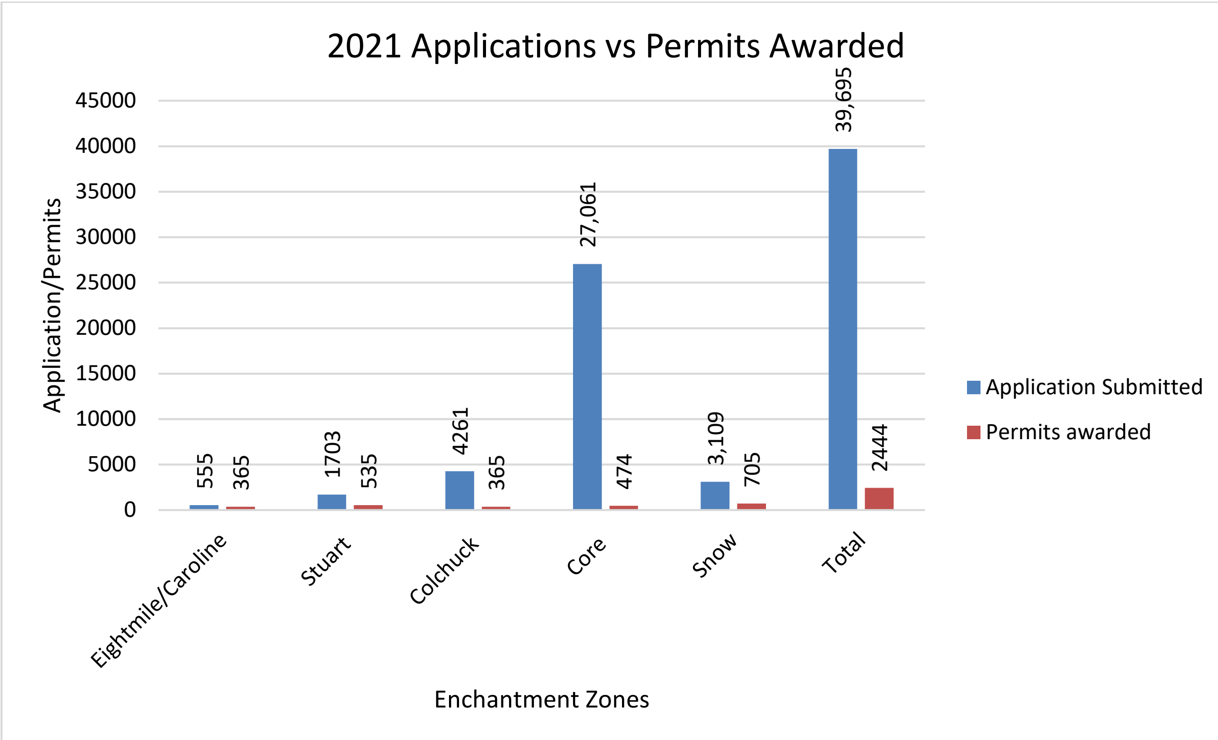
Permits are required for both day and overnight use within all permit zones, with the number of overnight (camping) users strictly limited in number and by location on any given night. Overnight use from May 15 to October 31 requires submitting a request to an online, pre-season lottery. Permits are drawn from the lottery randomly through the recreation.gov advance reservation system. An additional 25 percent of permits are held at the Wenatchee River Ranger District in Leavenworth for day-of overnight trips (i.e., walk-up lottery). However, due to the COVID-19 pandemic, the in-person walk-up lottery was suspended for 2020 through 2022, and it remains suspended until further notice. Permits that would have been issued in the walk-up lottery were placed back into the recreation.gov website every Sunday and then released for the week (USFS 2021e).

Demand for overnight permits in the Enchantment Permit Area greatly exceeds the number of permits available (**Graphs 10-1 and 10-2**). The Forest Service has made changes to the daily permit quotas and expanded the permit season in the past, due to an increasing number of observable impacts from recreation in the area (such as overflowing parking lots, increased need of toilets for human waste, and very high traveling encounters). There have also been impacts on the natural environment, including an increased number of social trails, which are informal trails created by soil compaction and erosion from foot and stock traffic, campsites, damage to vegetation, and the presence of human waste (USFS 2017). Graphs 10-1 and 10-2 and **Table 10-2** provide details on permit applications from 2018, 2019, and 2021 (USFS 2019a, 2021f).

Figure 10-3. Recreational Resources on Icicle Creek and the Wenatchee River

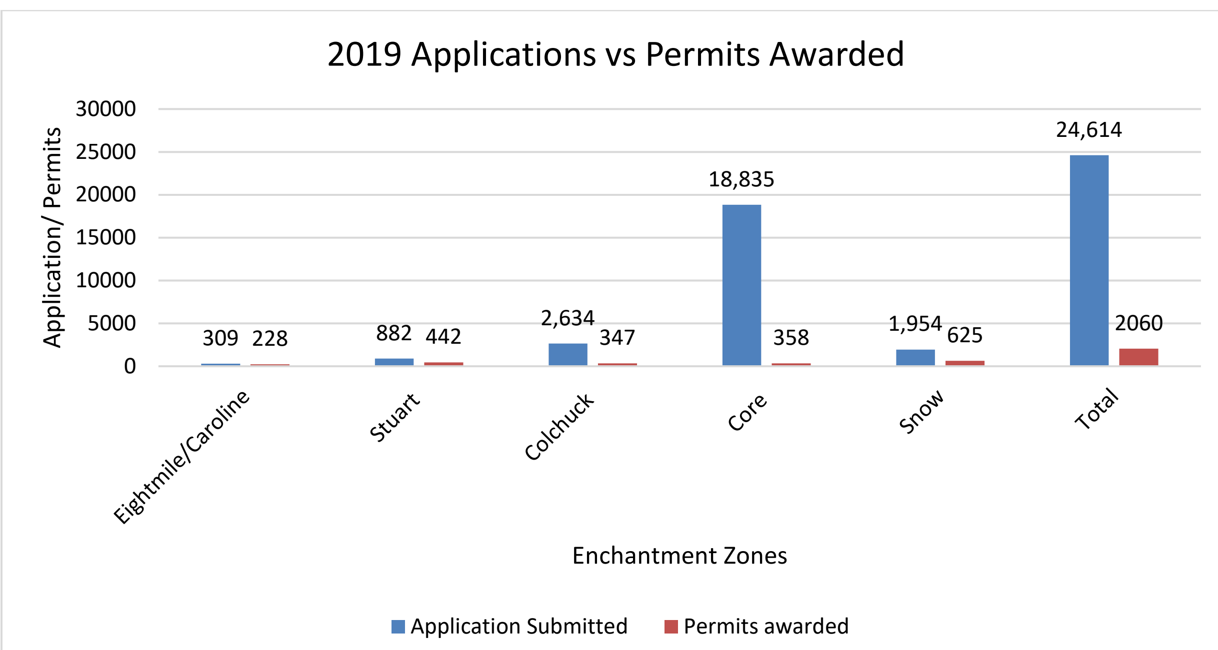


Graph 10-1. Total Applications and Permits for Overnight Use Awarded per Enchantment Permit Zones in 2021, Excluding the Walk-up Lottery



Source: USFS 2021f

Graph 10-2. Total Applications and Permits for Overnight Use Awarded per Enchantment Permit Zones in 2019, Excluding the Walk-up Lottery



Source: USFS 2019a

Although the Forest Service does not restrict the number of day users on a given day, a self-issued permit available at the trailheads is still required for day use in the Enchantment Permit Area. Table 10-3 provides the total number of day users who self-registered at the trailhead in 2019 and 2020. The Forest Service reports that day use permit compliance from the log book is on average 70 percent, so use of the area is likely higher because of individuals who do not fill out a permit (USFS 2019b, 2020).

Table 10-2. Total Applications Submitted vs. Awarded Permits for Overnight Use and Success Rates, 2019 and 2021

	2019	2021
Awarded Permits	2,060	2,444
Total Applicants	24,614	39,695
Success Rate	8.36%	6.15%
Success Rate (Core Enchantments)	1.9%	1.75%

Source: USFS 2019a and 2021f

Table 10-3. Combined Day and Overnight Use in the Enchantment Permit Area, 2019, 2020, and 2021

Year	# of day users (groups)	# of day users (individuals)	# of overnight users (groups)	# of overnight users (individuals)
2021[1]	19,988	47,971	2,613	10,873
2020[2]	12,198	31,668	3,354	12,990
2019	12,049	30,361	3,419	15,452

Source: USFS 2019a, USFS 2020, Reed (USFS) 2022
1 2021 day use numbers are likely higher than what is shown in the table because Forest Service permit boxes were not full on critical use weekends due to a low compliance rate and the trail counter being stolen at the Eightmile/Caroline Trailhead.
2 Permit compliance from the log books is on average 70 percent for day use, but that compliance is expected to be less in 2020 due to lower staffing at the trailhead to educate on the permit process.

The Forest Service has prepared a visitor use analysis report for the Enchantment Permit Area from 2007 to 2017. This document contains information regarding overnight and day use of the area, assessing group size, popularity of the area, trip length, and visitor encounters. Over the 10 years of data examined, it is clear that the Enchantment Permit Area has increased in popularity among recreational users. Day use has more than doubled, while increases in overnight use range from 70 percent to 703 percent, depending on the zone (USFS 2017).

In addition to hiking and backpacking, recreation in the Enchantment Permit Area includes fishing, rock climbing, and stock use (horseback riding). Historically, most of the high lakes were barren of fish, but WDFW stocked lakes in the Enchantment Permit Area with trout species, as described in Chapter 8, *Plants and Animals.* Stocking in the Enchantments has not occurred since the early 2000s (WDFW 2021a). Lakes are open to fishing year round, but anglers must have a valid freshwater fishing license and comply with WDFW restrictions and regulations while fishing in the Alpine Lakes Wilderness (WDFW 2021b).

The area contains the Cashmere Crags, which is rated as one of the best sites for rock climbing in the western United States. Peaks used for climbing include Bloody Tower, Cruel Thumb, Cynical Pinnacle, and Crocodile Fang. Dozens of solid granite spires also offer routes from the low class 5s to 5.11 and faces as long as 1,500 feet (USFS 2021d). These climbing routes are classified using the Yosemite Decimal System, which is a class scale from 1 to 5—1 would be equal to walking on an established flat trail, while 5 would include technical climbing requiring belayed roping and protective equipment; a fall from a class 5 route could result in serious injuries or be fatal, and a class 6 cannot be climbed. Within class 5, subcategories range from 5.1 (easy) to 5.15 (very difficult) (REI 2021). In 2019, the most popular climbing destinations as designated on self-issued permits at trailheads included Dragontail Peak, Prusik Peak, Colchuck Peak, Snow Creek Wall, Little Annapurna, and Cashmere Mountain (USFS 2019b).

Stock use such as horseback riding is permitted within some portions of the Enchantment Permit Area, including the Eightmile/Caroline Zone (year round) and the Stuart Lake Trail (in the fall between the Saturday after Labor Day until the end of the year). Stock are prohibited on the Snow Lakes and Colchuck Trails. Camping with stock in the permit area is allowed only at suitable sites and not permitted within 200 feet of water. Camping with stock is not allowed within one-half mile of Eightmile Lake, but there is a designated campsite at Upper Caroline Lake (USFS 2021c).

The Enchantment Permit Area can be accessed directly via three trailheads: Snow Lakes Trailhead, Stuart and Colchuck Lake Trailhead, and the Eightmile Lake Trailhead. As discussed above, access to the Stuart and Colchuck Lake Trailhead and the Eightmile Lake Trailhead is provided by FSR 7601, while access to the Snow Lakes Zone is off of Icicle Road. All zones of the Enchantment Permit Area, with the exception of the Eightmile/Caroline Zone, provide access to the others. Recreationalists often start in one zone, with their primary destination in another. Access to the Core Enchantment Zone requires travel through the Snow Zone or the Stuart Zone and the Colchuck Zone. Backpackers and hikers typically travel through multiple zones during their trips into the Enchantment Permit Area. The Eightmile/Caroline Zone does not provide a direct route or formal trail to access other zones. Similarly, there are no routes or formal trails that offer access to the Eightmile/Caroline Zone from other zones.

10.3.3 Eightmile/Caroline Zone

Eightmile Lake, Eightmile Creek, Eightmile Dam, and Caroline Lake are located in the Eightmile/Caroline Zone and accessed via the Eightmile Lake Trail (Forest Service Trail #1552) or Eightmile-Trout Creek Trail (Forest Service Trail #1554, also called the Caroline Lake Trail). The zone also contains routes for climbing Jack Ridge, Cashmere Mountain, and Eightmile Mountain. Primary destinations within this zone are Eightmile Lake, Little Eightmile Lake, Caroline Lake, Cashmere Mountain, and Windy Pass. Recreational opportunities within this zone include but are not limited to hiking, backpacking, fishing, rock climbing, skiing, and horseback riding.

The Forest Service reports that from 2009 to 2016, the Eightmile/Caroline Zone had a 703 percent increase of overnight visitation, the highest of any zone, while day use has remained relatively stable (USFS 2017). However, due the COVID-19 pandemic and rise in outdoor recreation, day use within the Eightmile/Caroline Zone has likely increased, as well as the demand for overnight permits. Although the Eightmile/Caroline Zone has experienced the greatest increase in overnight use, it still offers the fewest overnight permits of any zone (Table 10-4). The increase in overnight use may be because historically this zone has had the least amount of permit applications, making the chance of getting a permit in the lottery higher. In 2021, 67 percent of those who applied for a permit for the Eightmile/Caroline Zone received one.

Table 10-4. Number of Self-issued Day Use Permits for the Eightmile/Caroline Zone

Year	# of day users (groups)	# of day users (individuals)	# of overnight users (groups)	# of overnight users (individuals)
2020	1,212	3,065	394	1,516
2019	1,581	3,982	*	*

Source: USFS 2019a and USFS 2020
*represents that data were not available.

In 2020, the average maximum group size for overnight use was three people (USFS 2020). Visitor information on day use and overnight use is shown on in Table 10-4. Day use data are based on self-issued permits at the trailhead. The Forest Service estimates 70 percent compliance with day use permitting, and additional use of the area likely occurs by individuals who do not fill out a day use permit at the trailhead. During the permit season, three overnight groups are permitted to enter the Eightmile/Caroline Zone daily. There are seven campsites at Eightmile Lake and seven campsites at Caroline Lake. These campsites vary in size from individual to group sites (Moscoso, L. personal communication, 2021). Camping within the Eightmile/Caroline Zone is not confined to Eightmile and Caroline Lakes, as multiple other campsites are located within this zone.

10.3.4 Eightmile Lake and Shoreline

Recreation opportunities specific to Eightmile Lake and shoreline primarily include camping, fishing, swimming, and nature watching. Recreationists have also been known to pack in watercrafts such as kayaks and paddle boards for recreation on the lakes surface. There are seven campsites at Eightmile Lake; however, the 2017 Jack Creek Fire has limited the number of campsites available at Eightmile Lake (Moscoso, L. personal communication, 2021). During the fire, many of the campsites and trail on the northwest side of the lake were burned and are currently closed for natural restoration and resource recovery. Camping at Eightmile Lake is available at sites along the northeast side of the lake. Because of the limited number of campsites, permits for the Eightmile/Caroline Zone have been reduced since the fire (USFS 2021e).

Eightmile Lake was historically stocked with rainbow and cutthroat trout. Rainbow trout were last stocked in 2003 (10,740 trout) and 2005 (10,800 trout), and cutthroat trout were last stocked in 2000 (12,549 trout) (WDFW 2021a). Eightmile Lake is one of the only alpine lakes with a naturalized population of lake trout (WDFW 2005).

10.3.5 Icicle Creek and Icicle Creek Watershed

Whitewater kayaking occurs in Icicle Creek between the Rock Island Campground and the Leavenworth National Fish Hatchery, a distance of approximately 17.1 miles. Kayaking occurs when the streamflow is between 700 and 2,000 cfs. Difficulty in this span of Icicle Creek ranges from Class II to IV+ under normal conditions (American Whitewater 2021a). The class difficulty was determined using the International Scale of River Difficulty, which has six different classes. Class I rapids include fast-moving water with riffles and small waves. Risk to swimmers in Class I rapids is slight and self-rescue is easy. Class VI rapids are almost never attempted due to the extreme difficulty, danger, and unpredictability; rescue may be impossible (American Whitewater 2021b). In the summer when flows are low, stand-up paddle boarding and tubing are popular activities on lower Icicle Creek downstream of the Leavenworth National Fish Hatchery.

Icicle Creek supports two non-tribal fisheries: a spring-run Chinook salmon fishery (that runs from mid-May through July 31), and a resident trout fishery (that runs from the Saturday before Memorial Day through October 31) (Ecology 2019a).

WDFW manages fishing in Icicle Creek and conducts yearly creel surveys for the spring-run Chinook salmon fishery to gather data for producing estimates of harvest, angler effort, and incidental catch, as well as release of other species. This fishery is very popular and has been a mainstay for many years, drawing local and out-of-area anglers (Ecology 2019a). From 2005 to 2017, an average of 2,380 anglers fished 12,145 hours per year and caught an annual average of 502 hatchery-origin spring-run Chinook salmon in Icicle Creek and the Wenatchee River (Table 10-5; Potter et al. 2018). WDFW does not conduct creel surveys for the resident trout fishery in the creek. The Icicle Creek trout fishery is primarily made up of rainbow trout, but line sampling conducted by WDFW and anecdotal reports show there are also occasional catches of bull trout, cutthroat, and eastern brook trout (Ecology 2019a).

Table 10-5. Sport Fishery Effort for Hatchery-origin Spring-run Chinook Salmon on Icicle Creek and/or the Wenatchee River

Year	Fishery Season	Anglers	Hours Fished	Fish Harvested
2017*	June 24–July 31	197	800	41
2016	May 16–July 31	1,377	7,939	303
2015	May 20–July 31	990	5,064	433
2014	May 23–July 31	1,587	7,299	390
2013	May 18–July 31	1,979	9,644	323
2012	May 19–July 31	4,922	21,492	971
2011	May 21–July 31	5,229	25,934	873
2010	May 13–July 31	5,231	23,549	993
2009	May 22–July 31	1,530	8,235	640
2008	May 28–July 31	1,147	7,144	347
2007	May 22–July 31	1,058	7,754	115
2006	May 26–July 31	2,402	13,553	529
2005	May 28–July 31	1,108	8,131	103
Average (2005–2016)*		2,380	12,145	502

*Harvest for spring-run Chinook salmon in Icicle Creek was delayed until the Leavenworth National Fishery Hatchery acquired adequate numbers to meet broodstock goals.

The areas adjacent to Icicle Creek and the Wenatchee River, which flow into the City of Leavenworth, provide numerous opportunities for formal and informal recreation. Eightmile Campground is a popular campground located 8 miles west of Leavenworth adjacent to Icicle Creek. The campground offers 41 single sites and four double sites, with many of the sites available to reserve ahead of time. Other recreational opportunities adjacent to Icicle Creek and the Wenatchee River include access to rock climbing, bouldering, fishing, golfing, and several parks (Figure 10-3). Leavenworth and the surrounding area provide recreationalists with opportunities for hiking and backpacking in the summer as well as backcountry skiing, snowboarding, and skiing in the winter.

10.3.6 Icicle Ridge

Icicle Ridge is located to the north of Eightmile Lake and the Enchantment Permit Area. The northwestern portion of the ridge is located within Alpine Lakes Wilderness. The ridge can be accessed via Icicle Ridge Trail to the east and Fourth of July Creek Trail to the west (Figure 10-3). These trails are popular hiking destinations with opportunities for camping. The trailhead for both of these trails can be accessed from Icicle Road. The Icicle Ridge Trail continues east and provides access to the Alpine Lakes Wilderness. Within the Alpine Lakes Wilderness, Icicle Ridge and the surrounding area provide numerous opportunities for hiking, backpacking, and other recreational opportunities.

10.4 Construction Impacts

This section describes the impacts that recreationists would experience during the roughly 15– to 20-week (June to October) construction period, including noise from helicopters and construction equipment (see Chapter 9, *Noise*), increased personnel at the site, vegetation removal, and closure of the recreation area around the dam. Some recreational users come to the Enchantment Permit Area to experience the five qualities of wilderness character as outlined within the Wilderness Act. Impacts associated with the Wilderness Act are addressed in Chapter 3, *Wilderness Character.*

10.4.1 Transportation of Equipment and Materials

Helicopter Use

Option 1: Heavy-lift Helicopter with Limited Use of Small Helicopter Throughout Construction

Under this option, a heavy lift helicopter with a payload lift capacity of 20,000 pounds would be used. Option 1 would require using the heavy-lift helicopter approximately 70 to 105 trips over 3 to 5 days at the beginning of the project, and 11 trips at the end of the project.

After the initial 3 to 5 days of flights with the large helicopter, a smaller helicopter with a payload lift capacity of 5,000 pounds would be used for approximately 20 trips to the site on an as-needed basis over the course of construction to deliver food and supplies. Flights for the smaller helicopter would likely take place between the hours of 7:00 a.m. and 6:00 p.m.

Noise levels from helicopters would have the greatest impact at Eightmile Lake utilizing the larger helicopter during the initial 3- to 5-day period and at the end of construction. Noise levels from the heavy-lift helicopter would be the loudest and most disruptive at Eightmile Lake during equipment drop-off and could range as high as 115.9 dB for a period of several minutes during each drop-off. Noise impacts from the smaller helicopter would create similar impacts on recreation, but would be smaller in scale (from 75 to 78 dB) and more frequent throughout the remainder of the construction period (see Chapter 9, *Noise* for details regarding helicopter noise levels).

Noise from the helicopter would have an impact on the users of the Eightmile Lake Trail and Eightmile-Trout Creek Trail. Helicopter noise would also be audible from other parts of the Enchantment Permit Area, but is not expected to have impacts on recreation use because noise generated from the helicopter would be similar to ambient noise levels in those areas. The use of the helicopters would disrupt the natural soundscape of the project area and result in short-term impacts on recreationists. Some visitors to the area may find helicopter noise very disruptive; other visitors may not be bothered.

Helicopter noise would be temporary and limited to the 15- to 20-week construction period. Recreationists who are disturbed by helicopter noise may choose to day hike or apply for overnight permits in other zones in the Enchantment Permit Area or elsewhere. Because impacts would be temporary and other nearby recreational areas are available with similar attributes, impacts on recreation from helicopter use are considered **less-than-significant.**

Option 2: Limited Use of Heavy-lift Helicopter with Small Helicopter Use for the Majority of Materials.

This option would utilize a heavy-lift helicopter to transport the excavator, other equipment, and a portion of the supplies to the site at the beginning of the construction period. This would take approximately 20 trips over 2 days. After the initial trips with the heavy-lift helicopter, the smaller helicopter would make approximately 245 trips to deliver other supplies over the duration of the project construction. Following completion of construction, the heavy-lift helicopter would also be used for 1 to 2 days to remove equipment and any remaining materials.

Noise levels would be similar to those described under Option 1; however, noise levels from the large helicopter would occur for a shorter portion of time, approximately 4 days while it is utilized. Noise from the smaller helicopter would occur much more frequently over a longer period of time throughout the construction period. The overall impact would be the same as for Option 1.

Road Segment

Under all action alternatives, approximately 0.75 mile of the currently closed FSR 7601 would be restored from the Eightmile Lake Trailhead. The road would terminate in the Okanogan-Wenatchee National Forest outside of Alpine Lakes Wilderness. This road would allow light trucks to bring personnel and supplies closer to the project site. Reopening of the roughly 4,300 feet of road segment would not have an impact on recreation because the roadway would be located away from the trail. Hikers may see construction vehicles at the trailhead, but once on the trail would not encounter the road. Vehicle traffic on the road may be noticeable at some points along the lower portion of the trail, but limited vehicular trips are anticipated on the road. Therefore, impacts on recreation from reopening FSR 7601 and using it to transport equipment and personnel would be **less-than-significant.**

10.4.2 Dam Construction

During the 15- to 20-week construction period, access to the area directly adjacent to the dam and the staging area would be restricted, and a small portion of the trail would be temporarily relocated to direct hikers safely around the construction area. However, recreational opportunities would not be limited during construction. The Eightmile/Caroline Zone would remain open for hiking, camping, rock climbing, fishing, and horseback riding. Additionally, no campsite closures or limitations on overnight permits would occur during construction. Construction workers would stay at the site and camp within the IPID Special Warranty Deed Area (**Figure 10-2**), not in camping areas generally used by the public. The presence of construction workers in the area around Eightmile Lake could be noticeable to recreationists and could detract from the experience for some.

Construction at the lake would result in an increase of noise, dust, equipment, and people at the lake. Construction noise would be the loudest when approaching the lake on the trail and arriving at the lake; maximum noise levels adjacent to the construction area from construction equipment are anticipated to be approximately 119 dBA (as described in more detail in Chapter 9, *Noise*). Heavy equipment could typically be in use during the hours of 7 a.m. to 6 p.m. However, if heavy equipment is in use during a helicopter delivery, noise levels are predicted to be 121 dBA. Ambient background noise levels in wilderness areas are typically around 45 dBA during summer months. These access restrictions and increased noise levels are likely to disrupt some recreationist enjoyment of the area, and may cause some potential recreationists to visit other wilderness areas during this time period. This could result in noticeable increased usage on other trails.

Should blasting with explosives be needed during construction, the Eightmile Lake Trail from its junction with the Caroline Lake Trail could be closed periodically over the course of 1 or 2 days. Blasting would be scheduled for mid-week (Tuesday–Thursday) between 11 a.m. and 3 p.m. IPID would provide personnel at the trailhead and the Caroline Lake Trail junction to stop recreationists from entering the area during times of active blasting. During blasting with explosives, the Caroline Lake Trail, Eightmile Lake camping area, latrine area, and trail uphill from the Eightmile Lake camping area would remain open to recreational use. Recreationists at the camping area would be alerted by IPID prior to the start of blasting and could choose to remain at the camping area or uphill side of the trail during blasting, or leave prior to the start of any blasting.

Although IPID does perform maintenance on the dam regularly, the scale of construction activities for the dam replacement would be much larger than from maintenance activities. Construction activities would be noticeable to recreationists who are using the project area during construction, and may result in some users deciding to choose to visit other areas. Other users may find that their experience is less enjoyable due to increased noise and the presence of construction workers and equipment. However, no campsites would be closed, no other recreational opportunities would be foreclosed during construction, and construction is planned to be completed within one season. Therefore, impacts on recreation during construction would be **less-than-significant.**

Telemetry equipment would be installed on Icicle Ridge at the repeater station site, outside of the Alpine Lakes Wilderness. It is anticipated that the equipment would be brought in by a small helicopter and the installation would occur in 1 to 3 days. While the helicopter noise would be audible during this time, the short installation duration would result in **less-than-significant impacts.**

During project construction, access to the site could be limited due to the Icicle Creek Rockfall Mitigation Project, which would be under construction at the same time. This project would result in intermittent road closures for 10 weeks from August 28 to November 8, 2023. During this time, Icicle Road would be closed from 8 a.m. to 5 p.m. Monday through Friday, with a 1-hour opening from noon to 1 p.m. The road would be open on weekends from 5 p.m. on Friday until 8 a.m. on Monday. During the closures, no vehicles would be permitted to use Icicle Road, which would limit recreationists' access to the Eightmile Lake Trailhead as well as affect their ability to leave the area. The road closure, coupled with the construction at Eightmile Dam, could further diminish recreational enjoyment during construction.

10.5 Operational Impacts

This section describes the general operational impacts on recreation from the fluctuating lake levels under the project alternatives. Some recreational users come to the Enchantment Permit Area to experience the five qualities of wilderness character as outlined within the Wilderness Act. Impacts associated with the Wilderness Act are described in Chapter 3, *Wilderness Character*.

10.5.1 No Action Alternative

Under the No Action Alternative, direct recreation impacts from the operation of the project would not occur. Recreational opportunities would essentially remain the same as they currently are, in the short term. However, if the No Action Alternative is implemented, it is probable that the dam would fail or require more emergency repairs in the future, which would have impacts on recreation.

If dam failure occurs, flooding could pose a risk to the health and safety of recreationists in the areas downstream of the dam, as described in Chapter 12*, Public Safety*. Dam failure would result in an additional 15,000 cfs of water to Icicle Creek, which would flow through Eightmile Creek and the Eightmile/Caroline Zone of the Enchantment Permit Area. Further impacts on recreation from dam failure could include damage to the Eightmile Lake Trail and FSR 7601. Damage to FSR 7601, particularly where it crosses Eightmile Creek, could have impacts on access to the trailheads of the Eightmile/Caroline, Colchuck, and Stuart Zones of the Enchantment Permit Area. Dam failure could also result in impacts on or temporary closures of other recreational resources downstream on Icicle Creek and the Wenatchee River due to flooding. Potentially impacted resources on Icicle Creek and the Wenatchee River could include those facilities shown on Figure 10-3.

Additionally, if the dam remains at risk of failure, emergency repairs may be required. Repairs would likely be similar to those that occurred in 2018, which could potentially result in intermittent closures of recreation (such as trails and campsites) in the area, as well as impacts from increased noise from construction equipment and helicopters. Further emergency repairs would not bring the dam up to DSO standards and could not be guaranteed to prevent dam failure in the future.

Under the No Action Alternative, the DSO could require abatement of the dam, which would result in the lowering or removal of the dam in the future. If this were to occur, the lake level would be substantially lowered, which could make the lakeshore inaccessible in many areas currently used to access the lake, reduce locations used for informal fishing, and generally make the area less desirable for recreationists.

The No Action Alternative has the highest probability of dam failure of all the alternative considered. Due to the potential closure of the area from dam failure, impacts on recreation from the No Action Alternative are considered significant.

10.5.2 Alternative 1: Narrow Spillway with Gates

The narrow spillway with gates dam design would result in the existing trails, campsites, and lakeshore access routes remaining generally the same as existing conditions, with some seasonal fluctuations in lake water levels. Alternative 1 would result in the ability to fill the lake to 4,671 feet, roughly 4 feet higher than existing conditions. This higher water level would impact recreation by seasonally inundating some informal lake access routes and reducing the shoreline available for recreational activities and leisure by approximately 4 feet. Due to site topography, the higher water level would not inundate any recreational opportunities in the area, including the designated trail and camping areas. These impacts would be most likely to occur from late-spring to mid-summer, when recreational use in the area is high and the lake is held at its highest levels.

Alternative 1 would also result in the ability to draw the lake down to 4,636 feet, which is approximately 4 feet lower than the current low water level (Table 2-1). However, a drawdown of this level would only be utilized during drought years, which are predicted to occur roughly once every 5 years. This lower water level would create an expanded shoreline, resulting in changes in recreational areas due to topography and slope. Some areas around the lake may be more accessible, while others may be less accessible, but an overall reduction in access to recreational activities along the lake shoreline is not anticipated as a result of the lower water level.

Flows from Eightmile Creek make up a small portion of the flow contribution to Icicle Creek, so it is unlikely that additional water from lake drawdown under Alternative 1 would provide any noticeable changes to the late season flows of Icicle Creek, and would not likely change any recreational opportunities.

Recreationists at Eightmile Lake would experience visual changes due to fluctuating water levels, as described in Chapter 11, *Visual Resources*. Fluctuating water levels would also alter informal fishing opportunities around the lake, potentially making some areas less suitable for fishing and other areas more desirable, depending on the water level.

While the operation of Alternative 1 would change recreational opportunities at Eightmile Lake, some of these changes could be experienced as improvements by some recreationists, and there would be no permanent closure of recreation. Recreational opportunities would remain substantively the same, with no net loss of recreational access or facilities. Therefore, no significant adverse impacts from the operation of Alternative 1 on existing recreational activities around Eightmile Lake, including hiking, camping, and fishing, would occur.

10.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Operational impacts on recreation from Alternative 2 would be the same as those described above for Alternative 1. No significant adverse impacts on recreation would occur.

10.5.4 Alternative 3: Narrow Spillway without Gates

Under Alternative 3, the high-water level would remain at 4,667 feet. However, water levels would be lowered to 4,636 feet during drought years, which are predicted to occur roughly once every 5 years (as described for Alternative 1). Impacts from Alternative 3 would result in an expanded shoreline that may increase the size of the camping area and offer some additional space for other recreational activities along the lake, as described above for Alternative 1. Conditions at Eightmile Lake would generally be similar to current conditions with the exception of the lower water level during drought years, which is not expected to impact any recreational resources. No recreational opportunities would be closed or become unavailable, so no significant adverse impacts from the operation of Alternative 3 on existing recreational activities at Eightmile Lake, Icicle Creek, or the Wenatchee River are anticipated.

10.6 Avoidance, Minimization, and Mitigation Measures

This section describes the mitigation measures proposed that would reduce and compensate for impacts from construction and operation of the project on recreation. Measures to reduce impacts from construction include:

- To the extent possible, schedule construction activities to minimize impacts on users.
- Establish and maintain clear construction boundaries.
- Maintain detour trail around site during construction, and restore detoured trail following completion of construction.
- After construction is complete, restore trail and cleared areas to Forest Service standards, consistent with the Wilderness and Backcountry Site Restoration Guide (Therrell et al. 2006).
- Coordinate with the Forest Service to forewarn visitors of potential disruption of wilderness experience due to construction activities, including notice to people seeking reservations through the lottery and to those awarded reservations. To the extent possible, communicate information about construction timing and potential impacts prior to the annual lottery. Provide information to potential visitors via an email list as well as through communication to media and to recreation groups.
- Provide signage to alert trail users regarding construction activity, including dates and hours of helicopter use, heavy equipment operation, and blasting with explosives.
- Provide a general description of work period and work impacts, including potential areas that will be closed to the public such as the staging and construction areas, prior to the Forest Service lottery for overnight permits in the Enchantment Permit Area.
- Provide alert of construction on the Forest Service Website for Alpine Lakes Wilderness: Okanogan-Wenatchee.
- Provide notification and signage at the Leavenworth Ranger Station and suggestions of other recreational opportunities in the area.
- Providing notice, such as a press release, to organizations such as Washington Trails Association, The Mountaineers, Sierra Club, and Alpine Lake Protection Society once the schedule is known. The notice should be pre-approved by the Forest Service prior to sending.
- Measures to reduce impacts from blasting with explosives include:
    - Minimize trail closure extent and duration.
    - Use blasting mats to reduce noise and dust and prevent flyrock.
    - Limit the Eightmile Lake Trail closure to the segment from the Caroline Lakes Trail Junction westward to the minimum safe distance from the blast location.
    - Identify extent of blast safety zone on a map.
    - Identify camping areas outside of safety zone that can be used during blasting if desired.
    - Provide personnel at Eightmile Lake Trailhead, Caroline Lakes Trail junction, and upper limit of safety area on trail, on the day of blasting.

- Schedule blasting to minimize impact on trail users:
    - Schedule for midweek (Tuesday through Thursday), and non-holiday (if July 4th falls on a mid-week day).
    - Avoid full-day trail closure by scheduling blasting to occur between 11:00 a.m. and 2 hours before sunset.
- Allow trail users to use the trail in the morning before blasting or in the evening after blasting.
- Providing a general description of work period and work impacts, including potential for closure for blasting, prior to the Forest Service lottery for overnight permits in the Enchantment Permit Area (by October 1).
- Providing description of closure area and timing to Forest Service once known, at least 10 days prior to blasting.
- Posting notices at Eightmile, Caroline Lake, and Jack Creek trailheads. These notices should be pre-approved by the Forest Service prior to posting.
- Notifying occupants of campsites on Eightmile Lake the day before blasting that there will be a temporary trail closure.

Impacts from the operation of the project are not anticipated to result in any disturbances to recreation within the Enchantment Permit Area; therefore, no mitigation measures are currently proposed.

10.7 Significant Unavoidable Adverse Impacts

It is unavoidable that recreationists will find the impacts from construction to detract from their wilderness experience, and some individuals may perceive this as a strongly negative impact. Because the construction is anticipated to occur only during one recreation season (15–20 weeks), the area will be restored following construction, and the helicopter noise will no longer be present, the short-term impacts associated with construction would not be significant. The action alternatives would not result in significant impacts on recreation in the Enchantment Permit Area, during operation. There would no long-term closures of recreational areas within the Enchantment Permit Area.

Under the No Action Alternative, dam failure could occur, which would pose a risk to the health and safety of recreationists in the area downstream of the dam. Dam failure could result in inundation, temporary closures, or other impacts on the Eightmile Lake Trail, FSR 7601, and recreational resources downstream on Icicle Creek and the Wenatchee River. Due to the potential recreation closure from dam failure, impacts from the No Action Alternative are considered significant.

CHAPTER 11: VISUAL RESOURCES

Visual quality refers to how well the visual environment meets a viewer's preferences for the natural and built environment of an area. This can vary depending on the sensitivity of viewers and how much they are exposed to certain views. Impacts on views are typically identified through technical, institutional, and public considerations. Technical considerations are assessed using spatial dominance, scale and contrast, and compatibility of a project with the surrounding landscape. Institutional and public considerations are based on laws and policies that concern visual resources and public comments.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on visual resources are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS*.

Key Findings for Visual Resources:

- Eightmile Lake sits in a basin with steep mountains on all sides.
- The shoreline is lined with downed trees and sparse vegetation, consisting mostly of grasses.
- The 2017 Jack Creek Fire burned most of the trees around the lake, and the area is now dominated by snags and small groups of trees interspersed throughout the landscape.
- The current dam is small in scale relative to the size of the lake.
- The dam is most prominent when water level is low.
- Sensitive views in the project area include hikers, campers, climbers, and backcountry skiers and snowboarders.
- Construction of the dam would cause moderate adverse impacts on the visual quality of the area surrounding the dam.
- Under the No Action Alternative, dam failure could occur, which would result in a high-water level reduction of 47 percent and damage to infrastructure downstream, which would be a significant impact.
- There are no significant unavoidable impacts on visual resources under the action alternatives.

11.1 Methodology

To assess the potential for significant adverse impacts on visual quality, aerial imagery and maps of the project area and vicinity were reviewed, and one site visit was conducted (in October 2020). The Google Earth Viewshed tool was used to estimate the potential visibility of various parts of the project. The results of this analysis were used to define a study area around Eightmile Lake that includes the extent of visibility of the dam and the lake. The study area for the visual analysis includes IPID's Special Warranty Deed Area and portions of the trail and access road where visual impacts could occur (Figure 11-1). The location for the proposed telemetry repeater station on Icicle Ridge was also reviewed.

Photographs were taken from locations where project impacts would likely be most visible, including the trail leading to the lake. In addition, photos were sourced from websites such as Washington Trails Association, AllTrails, and Gaia GPS that show photographs of the study area during different seasons and from vantage points (such as adjacent ridges and trails) and reflect the visual experiences and expectations visitors have of an area.

Two key viewpoints (KVP) were selected (KVPs A and B), based on where people would have the highest potential to observe changes to the dam structure resulting from the project. KVP A is directly adjacent to the northeast portion of the existing dam spillway, and KVP B is near the camping area on the north side of the lake. (Figure 11-2). KVP C is an aerial view in the eastern portion of the lake looking west toward the dam. While KVP C is not a place a typical visitor would see the lake from, it provides a sense of what the dam looks like from the surrounding mountainsides, albeit closer to the dam than one would be on any of those vantage points. Photographs were taken at the KVP locations, then using commonly accepted protocols, visual simulations were prepared to assist in displaying the degree of impact the proposed dam replacement would have on the visual setting of the surrounding landscape.

The visual simulations were created by ESA using photos captured from field equipment, including an iPad Pro and a DJI drone. The iPad photos were taken using 35 mm-equivalent wide-angle focal lengths, while the aerial drone images were captured at 24 mm focal length. Due to the limited data signal and remoteness of the project area, photo locations were not captured with the images; therefore, locations were approximated using aerial images with reference to landscape features and vegetation. ESA developed a 3D model of existing conditions in the study area, including terrain and lake water levels. Photo locations and focal lengths were registered into a 3DS modeling program, and 3D sun and atmosphere conditions were applied based on notes taken when the photo was shot. ESA then used CAD to 3D model proposed dam structures based on design alternatives provided by Anchor QEA. Image renderings were compiled in Photoshop to create foreground screening elements (e.g., trees, structures, etc.) and subsurface lake bed textures. A selection of the visual simulation figures prepared for the project is included in this chapter to illustrate the impacts.

An analysis of the project's consistency with wilderness management regulations and guidelines can be found in Chapter 3, *Wilderness Character*. This visual analysis describes the visible physical changes expected from the project, and the degree to which they harmonize or contrast with the character of the project setting. Viewer sensitivity is discussed in Section 11.3, *Affected Environment.*

For the evaluation of short-term impacts (construction), impacts on visual resources are considered significant as follows:

- Impacts are considered significant if construction equipment and materials would be conspicuous from improved trails or camping areas and remain at the site for more than two full summer seasons, or if construction spanned more than two full summer seasons.

For the evaluation of long-term impacts (operational), impacts are considered significant as follows:

- Impacts are considered significant if the areal extent of the lake at high water were reduced by more than 10 percent, which is considered a substantial enough reduction that visitors who have seen the lake before would be aware of the reduced size and would impair the aesthetic experience of visiting the lake.
- Impacts from the dam would be considered significant if man-made objects that contrast strongly with the natural surroundings, such as mechanical or structural elements of the project, would be dominant in views from the main Eightmile Lake Trail along the northern shoreline of the lake, campsite area (KVP B), or surrounding shorelines of the lake.

Figure 11-1. Eightmile Dam Study Area for Visual Resources

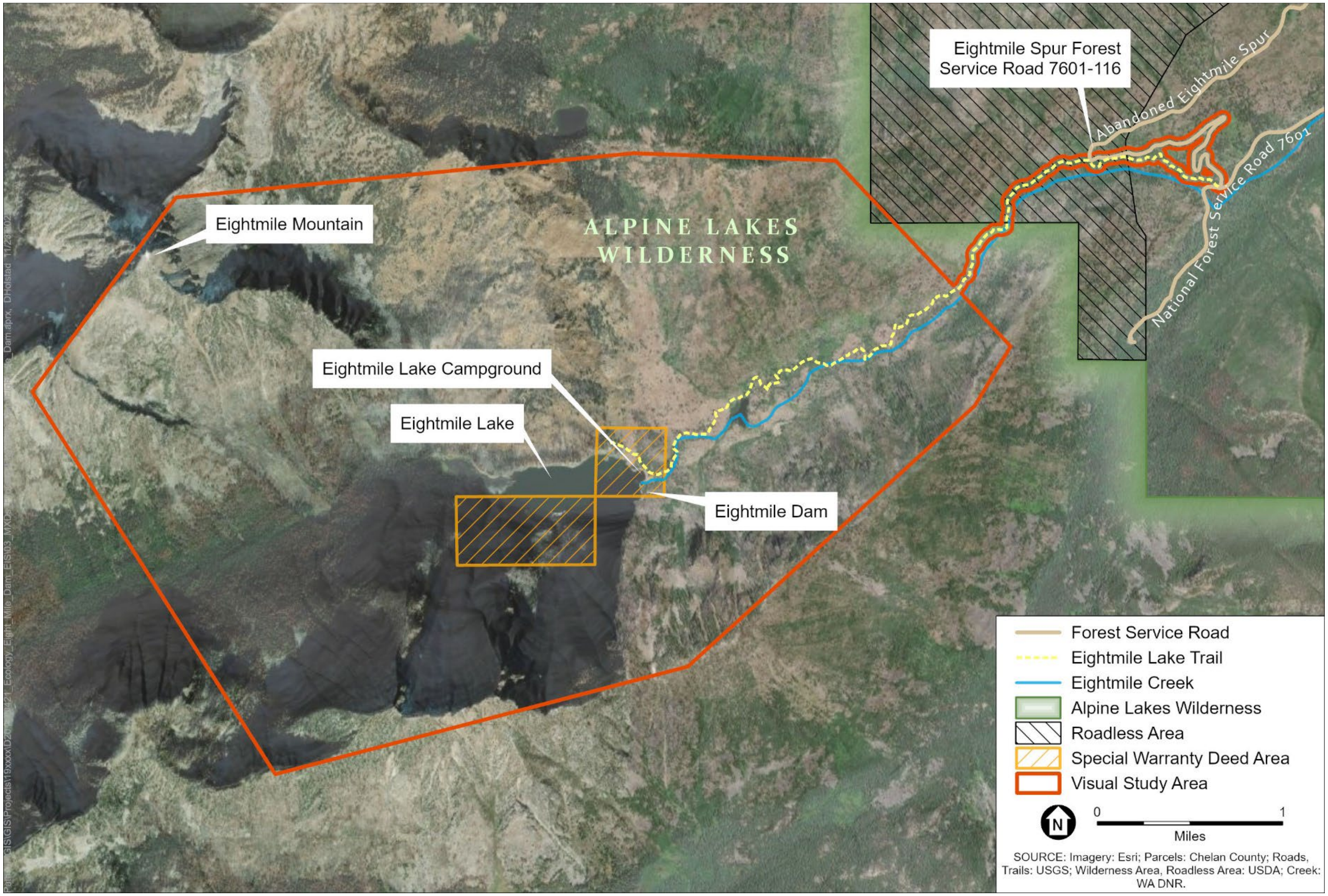
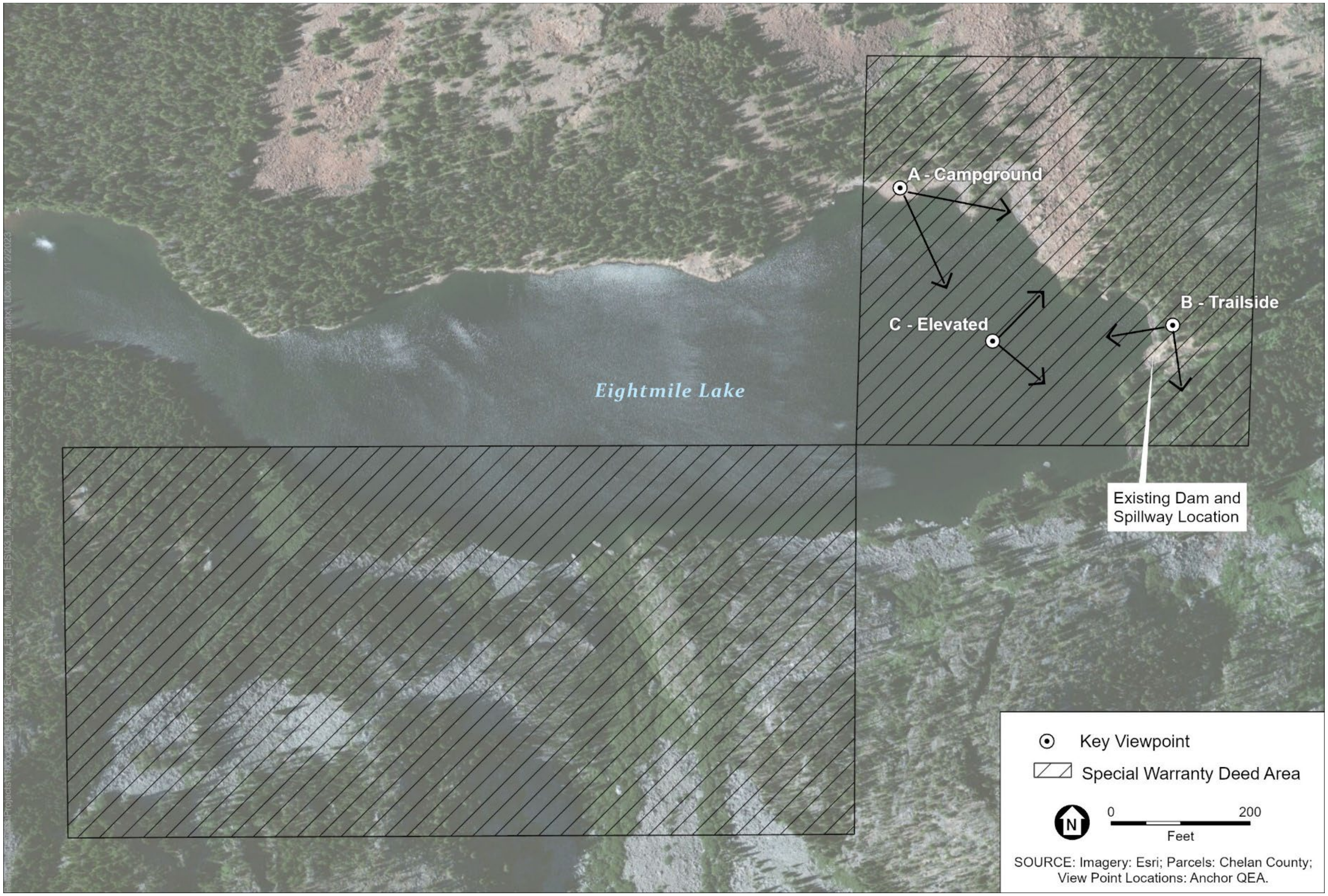


Figure 11-2. Key Viewpoint (KVP) Locations



11.2 Regulatory Context

Visual resources within the study area are protected by a variety of federal, state, and local plans, laws, and policies (Table 11-1). These plans and policies were reviewed to determine how well the project alternatives would meet viewer preferences in the study area. The policies reviewed generally promote the preservation of natural, scenic, and shoreline views.

Table 11-1. Regulations and Guidelines for Visual Resources Applicable in the Study Area

Program, Plan, or Policy	Description
Alpine Lakes Area Land Management Plan (USFS 1981)	Establishes visual quality management objectives with a goal to: *"Develop facilities and conduct management activities to create acceptable visual conditions in keeping with preservation of the wilderness character."*
Washington State Shoreline Management Act of 1971 (Chapter 90.58 RCW)	All local jurisdictions with Shorelines of the State of Washington are required to adopt a Shoreline Master Program consistent with the Shoreline Management Act, which emphasizes proper shoreline land use, protection of shoreline environmental resources, and protection of the public's right to access and use state shorelines.
Chelan County Shoreline Master (SMP) (Chelan County 2019)	Adopted on June 6, 2019, the plan provides policies protecting visual and physical access to shorelines as stated in Objective PA-1.4 of the SMP. *"Protect and enhance visual and physical access to shorelines where appropriate and in compliance with constitutional limitations."*
Chelan County Comprehensive Plan 2017–2027 (Chelan County 2017)	Developed to meet the requirements of the Growth Management Act, the Chelan County Comprehensive Plan outlines the following policies regarding visual resources: *"3.4 Consider aesthetic quality as an important element in the design and development of recreational opportunities and facilities."* *"Policy RE 2.4: Encourage the preservation and protection of unique, rare and fragile natural features, scenic vistas, unstable bluffs, and culturally significant features."* *"Policy LU 4.1: Encourage development that is compatible with the natural environment and minimizes impacts to significant natural and scenic features."*
Wenatchee National Forest Land and Resource Management Plan (Forest Plan) (USFS 1990)	Classifies visual quality within the Wenatchee National Forest according to how often areas are viewed by the public and the scenic variety of the area. The classifications range from preservation (which are areas that appear to be untouched by humans) to maximum modification (which are areas with changes in the landscape that are obvious to viewers).

The project is in the Alpine Lakes Wilderness, which is designated under the Wenatchee Forest Plan for preservation. However, the Alpine Lakes Area Land Management Plan recognizes that certain pre-existing human modifications are allowed to continue and be maintained, such as the Eightmile Dam. The Special Warranty Deed includes provisions for maintaining and operating the dam; therefore, the continued presence and operation of a dam is assumed for the affected environment.

11.3 Affected Environment

This section describes the visual character of the study area.

11.3.1 Visual Characteristics

Eightmile Lake sits in a basin with steep mountains on all sides. The study area includes the lake and surrounding areas from where it can be viewed. The study area also extends northeast along the 3.3-mile trail from the lake down to the trailhead. The lake area has no roads, few maintained trails, and very limited evidence of human presence. The lake is visible from numerous peaks and ridges surrounding it, including Eightmile Mountain, Jack Ridge, and Cashmere Mountain, which are seasonally snowcapped (Figure 11-3).

For approximately 8 months of the year (from mid-October until late May or early June), much of the study area can be covered with snow, including the lake shoreline and the dam. Snow depth, extent of cover, and duration vary from year to year. When the snow has melted away, the rocky shoreline of the lake is exposed. This analysis focuses mainly on the period of the year when snow is not present, because that is primarily when the dam would be visible and when the area has the highest level of visitors.

The shoreline is lined with downed trees and sparse vegetation, consisting mostly of grasses. Prior to the Jack Creek Fire in 2017, upland areas around the lake were forested, primarily with conifers, such as various pine species and Douglas fir (USFS 2017a). Since the fire burned most of the trees, the area is now dominated by snags and groups of living trees interspersed throughout the landscape (Figure 11-4). Although the severity of the burn has likely reduced the regenerative properties of the site, it is anticipated that a forest similar to what was present prior to the fire will return in approximately 50 years. This forest will differ, however, by providing a more diversified structure with additional habitat and aesthetic features from the remaining standing snags and downed timbers.

The dam is at the east end of the lake and controls the lake's water level. The lake is fullest during spring and early summer snowmelt. For existing conditions, the water level is held at its highest level (elevation 4,667 feet with the current dam configuration) during the summer months until additional water is needed for irrigation diversion downstream. In late summer and early fall, the water level drops to its lowest level (approximately elevation 4,640 feet, and sometimes lower due to leakage through the dam and materials below the outlet pipe). When the water level is low, more of the rocky shoreline is visible, creating peninsulas that extend into the lake and a few small rocky islands. The western end of the lake is a wetland (Figure 11-5).

The existing dam is primarily constructed of rocks and concrete and is approximately 65 feet wide. The dam has a notch in the middle that allows water to flow through when the lake level is high enough; stop logs have historically been placed within the notch to control the flow rate of water. However, IPID has removed all of the stop logs that keep the lake at an elevation of 4,661 feet (Figure 11-6).

The outlet structure is a pipeline that runs underneath the dam structure releasing water to Eightmile Creek. The pipeline is not visible from any trail on either side of the dam; the only visual indication of the outlet is the presence of water moving downstream from the dam when the lake's water level is below the spillway.

Figure 11-3. View of Eightmile Lake Looking West from Dam

Figure 11-4. View Looking West along the North Shore of Eightmile Lake during a Low-Water Period in October 2020

Figure 11-5. View from the Wetland at the West End of the Lake Looking East toward Eightmile Lake

Figure 11-6. View of the Lake Side of Eightmile Dam during a Low-Water Period

Several monitoring structures, including a solar panel, are also located near the dam and adjacent to the Eightmile Lake Trail near the campsite locations. The structures are small in scale and painted in colors that do not contrast with the surrounding landscape (Figure 11-7). The headwall and spillway of the dam are visible from much of the lake's shoreline and several locations on the Eightmile Lake Trail on the north side of the lake. However, the dam is small in scale relative to the lake, covering less than 0.25 acre including the armored embankment on the north side of the dam (Figure 11-8). The dam structure is visible from the lake's shoreline and the Eightmile Lake Trail along the north side of the lake, but only intermittently along the trail and only from distances of 500 feet or more (Figure 11-9).

The earthen embankment adjacent to the dam is approximately 100 feet in width and was eroded in 2018. Emergency repairs in 2018 included reshaping and hardening this embankment with native rock. This embankment is largely bare of vegetation and is more conspicuous than the dam itself as viewed from the trail and campsites along the lake. When the lake is at its highest, a 4-foot-high portion is visible from the lake side, and that is often partially obscured with wood debris that accumulates near the dam. Part of the maintenance at the dam includes removal and burning of woody debris that accumulates.

The dam structure is most prominent when water levels are low. Figure 11-10 is an aerial photo that shows how far the water recedes during a low-water period. (Note that this photo was taken in 2015, a relatively low water year, and before the 2018 dam repair.)

Just to the northeast of the dam is an excavator that was used to perform the emergency repairs to the dam in 2018 (Figure 11-7). The excavator is not a permanent feature. Although it contrasts sharply with the surrounding area and is intermittently visible from the shoreline near the dam and surrounding area, it would be removed regardless of whether the project is implemented. As such, this analysis does not consider the presence or removal of the excavator as part of the project effects.

The dam and lake, as well as the Eightmile Lake Trail leading to them, can also be seen from nearby ridges and peaks and routes to nearby climbing destinations. However, from these distances, the dam is very small in scale and almost invisible to the naked eye. From these distances, the more noticeable aspect is the changing lake elevation, with associated exposed shorelines.

The visual setting of the trail is similar to that of the lake, with views of surrounding peaks and intermittent views of Eightmile Creek. The trail is dominated by conifers, deciduous trees and shrubs, and snags from the Jack Creek Fire (Figure 11-11). After the snowpack melts, wildflowers are often abundant throughout the trail.

The road to be used to access the lower portion of the trail (FSR 7601-116) is outside of the boundary of the Alpine Lakes Wilderness. Currently closed and overgrown with low shrubs and grass, this road is not visible from the main trail, except at the trailhead.

The repeater station site is located above Eightmile Lake on a ridgeline with a sweeping vista of surrounding peaks and valleys in the distance (Figure 11-12). The new station will be located adjacent to an existing Forest Service repeater. Because of the elevation, few large trees are present, and other plants occur only in low density. Bare ground is typical of this area.

Figure 11-7. Excavator and Monitoring Structure with Solar Panel

Figure 11-8. View from the North Side of Eightmile Lake, Looking East toward the Dam with the Lake near High Water

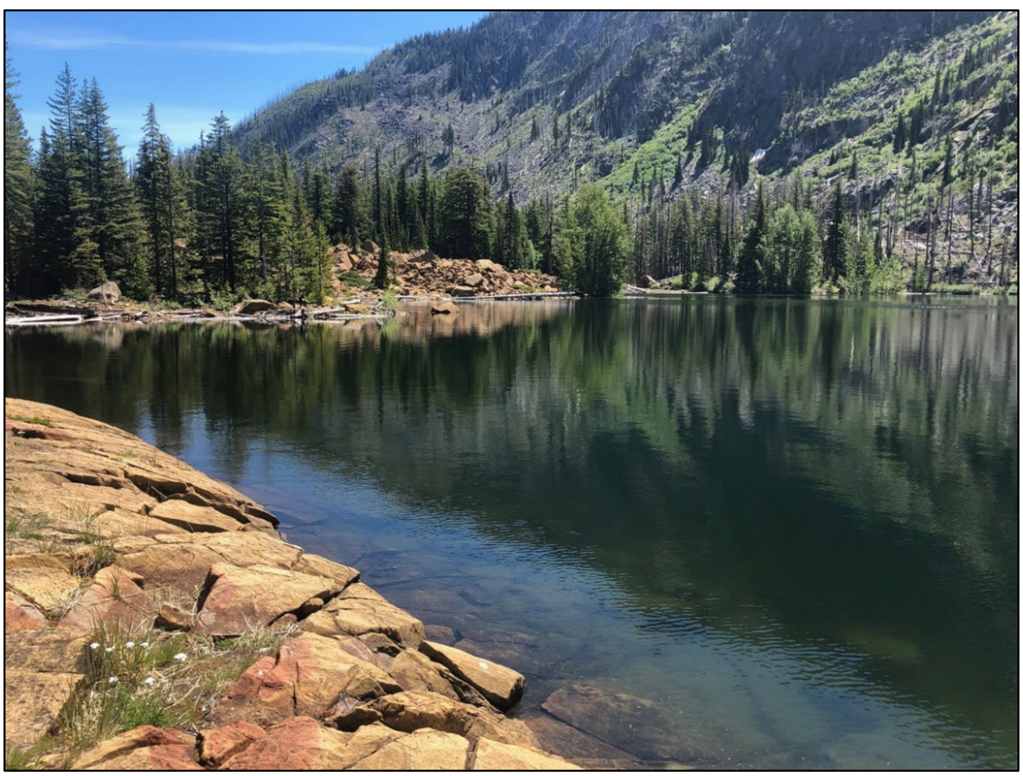


Figure 11-9. View of Eightmile Lake and Dam from Eightmile Lake Trail

Figure 11-10. Aerial View of Eightmile Lake Looking East toward Dam during Low-Water Period, September 30, 2015

Figure 11-11. Trees, Snags, and Low Brush along the Eightmile Lake Trail

Figure 11-12. Icicle Ridge Repeater Station Location

11.3.2 Viewers and Viewer Sensitivity

Because the project area is within the Alpine Lakes Wilderness, viewer sensitivity to man-made features in the area is high. Visitors come to the wilderness to experience pristine nature, and the visual experience is a large part of that. Sensitive viewers in the project area include hikers, campers, climbers, and backcountry skiers and snowboarders. Viewer prevalence would be the highest during summer, when temperatures are mild, precipitation is low, and access is easier. During the summer months, snow cover is also unlikely, making it likely the viewers would be able to see the dam and affected lakeshore.

Winter visits to the study area are much more limited due to the seasonal closure of FSR 7601 because of snow. During winter, some or all of the dam is typically obscured by snow.

Both climbers and backcountry snow sport users are typically focused on reaching the higher reaches of the study area, whereas for many summer hikers and campers, the lake is their destination, or one of their destinations in the wilderness. Therefore, hikers and campers may have slightly higher viewer sensitivity than climbers and backcountry users. However, viewers visiting at any time of year are sensitive to the presence of man-made objects because they have exerted considerable effort to reach a place that is largely free from human interference with nature.

Hiking to the lake to fish is also a popular activity (see Chapter 10, *Recreation,* for a discussion of fishing). During a site visit in July 2021, fishing was occurring off of the main trail along the eastern and northeastern shorelines of Eightmile Lake, which is the area that surrounds the dam. Assuming this is typical, recreation users visiting the lake for fishing may be more likely to experience visual impacts from changes to the dam than other trail users, who might pass the dam without noticing it.

On the same site visit in July 2021, two visitors had packed in a stand-up paddleboard and launched it from the dam area. Because of wind on the lake that day, they did not paddle long, but this suggests that a subset of visitors may also see the dam from on the lake. The extent of boat use is likely low. Views from on the lake would be similar to views from the campsites and the shoreline next to the dam.

Other portions of the study area are not as heavily trafficked as the trail and campsite area. There are no developed trails on the south side of the lake and the terrain is rugged. Several parts of the northern shoreline have brushy vegetation, making it both difficult to get to them or to see the rest of the shoreline from them. The viewers most likely to see the dam and notice any visual change from the project are those using the trail and the campsites.

11.3.3 Key Viewpoints (KVPs)

The KVPs chosen for this analysis take into account both viewer sensitivity and the characteristics of the study area that affect where the dam could be seen from.

KVP A (Figure 11-13) is adjacent to the dam. To get to this viewpoint, a viewer would need to divert from the Eightmile Lake Trail on a side trail that terminates at the dam. While this location is not frequented by all travelers on the Eightmile Lake Trail, it is the location where the effects of the project would be most pronounced during construction. In addition, it is the only location where a viewer can see the downstream side of the dam.

KVP B (Figure 11-14) is adjacent to the campsite area. This location is on a promontory rock formation that extends into the lake's north shore, affording a sweeping view of nearly the entire lake. The view of the dam at KVP B is similar to views that can be obtained from locations on the Eightmile Lake Trail, but less obstructed by vegetation and topography. The distance from the KVP to the dam is approximately 1,400 feet (approximately ¼ mile).

Figure 11-13. KVP A, Photo Facing Southwest Showing Existing Dam and East End of Lake in October 2020

Figure 11-14. KVP B, Photo Facing East Showing Existing Dam and Lake (water level below maximum high water) in October 2020

KVP C (Figure 11-15) is an aerial view of the dam. The original photo was taken by drone in June 2021. This KVP, while not in a location that a viewer can go to, provides an overview of the dam setting, somewhat akin to a view from an adjacent mountainside.

Figure 11-15. KVP C, Aerial Photo of Dam Looking East from Approximately 130 Feet above Eightmile Lake in June 2021

11.4 Construction Impacts

This section analyzes visual impacts during construction, including the use of helicopters, improving and using FSR 7601-116, and the construction of a new dam. Visual changes would include helicopter flights to and from the site, increased human construction activity, and the presence of the excavators and other construction tools, materials, and temporary worker encampment on the Special Warranty Deed land. Because the site is within a designated wilderness, all these materials and activities would strongly contrast with the existing setting.

The discussion below includes a section describing the transport of equipment and materials to the site that could be used under any action alternative, and a section describing the range of potential impacts from construction of the dam under the various alternatives.

Most of the work and staging would occur within areas near the dam that were disturbed when the dam was built or when emergency repairs were made in 2018. However, the dam is located in an area where users expect to encounter nature in a pristine state. A construction site with heavy equipment and stored construction materials will contrast strongly with these visual expectations, even if notice has been provided at the trailhead.

Aesthetic impacts from construction activity would be adverse in the short term and would occur during peak hiker usage in the area; however, these impacts would be temporary (lasting only for the anticipated duration of one construction season) and are therefore considered less-than-significant. Even if construction extended into a second season, impacts would not be considered significant.

11.4.1 Transportation of Equipment and Materials

Road Segment

A roughly three-quarter mile section of the currently closed FSR 7601-116 would be cleared from the Eightmile Lake Trailhead to allow authorized vehicles and light trucks to bring personnel and supplies closer to the site (Figure 11-1). The cleared portion of the road is within the Okanogan-Wenatchee National Forest and would terminate outside of the Alpine Lakes Wilderness. The road would not be used by the general public. The road would be approximately 10 feet wide, and improvements would include the removal of fallen trees and vegetation rooted in the roadway. No large, living trees would need to be removed. The last 100 feet of the road would be cleared to a width of 24 feet to allow parking, and the last 30 feet of the road would be cleared to a width of 30 feet to allow for vehicles to turn around. From the vehicle turnaround area at the end of the road, a trail would be cleared along an existing road grade to allow construction personnel to hike approximately 2,500 feet to a junction with the Eightmile Lake Trail that leads to the lake.

Clearing of the road would be visible to users of the Eightmile Lake Trail at the trailhead. Because of the location and contours of the road, only a short portion of the road is visible from the trailhead. The remainder of the cleared road and the trail from the staging area would be out of sight from users of the Eightmile Lake Trail, except where the trails would meet. The road would be open to personnel working on the dam for the duration of construction, which is estimated to last one season. After completion of the project, the road would remain closed to public vehicular use, and vegetation would be allowed return to the conditions prior to construction. These impacts are considered less-than-significant because the road is not in a designated wilderness, has been previously graded for a road, and would require a very limited amount of vegetation to be removed (primarily low brush and no large trees). Additionally, the road segment and parking/turnaround area would not be viewable from any existing recreational facilities, except at the trailhead and trail junction, and those areas would not contrast sharply with the existing setting.

Helicopter Use and Staging Area

Helicopters would be used to move all equipment and the majority of materials to and from the project site. Helicopters would be visible intermittently as they fly over recreational areas while delivering materials to the site. Views of the helicopters would contrast sharply with existing views of the wilderness, and would affect views throughout the study area. The number of helicopter trips and timing throughout the construction period would depend on the type and size of helicopter used, as described in Chapter 2, *Project Alternatives*.

If the larger helicopter is used (Option 1), the period of impact would be limited to 3 to 5 days at the beginning of the project, up to two flights per week during the construction process, and 2 days to remove material and equipment at the end of the project. The staging area for this option would be 15 percent larger than for Option 2 (a difference of approximately 1,300–1,800 square feet depending on the dam alternative), because the majority of materials would be brought to the site at the beginning of the project. The staging area would be located where the existing trail is, so the trail would be temporarily relocated. Approximately 20 to 30 trees would be removed for the staging area, along with brushy vegetation. Trail users would see the staging area and construction, and these views would contrast sharply with existing views.

If the smaller helicopter is used (Option 2), flights would occur daily 9 to 11 additional days over the construction period. Given the site's location in a wilderness, helicopter use under Option 2 would adversely affect more users during that season. However, because the staging area would be smaller than Option 1, up to 10 fewer trees would be removed. As a result, Option 2 may contrast less conspicuously with existing views from the trail.

Impacts on visual resources from the use of the helicopters under either option would be less-than-significant because helicopters would be used for one construction season (approximately 4 months). Even if unforeseen circumstances forced construction into a second season, helicopter use would not be considered significant under either helicopter option, because the impacts would affect a limited area and would not last more than two summer seasons. Under either option, the staging area would be small, approximately 0.25 acre, and would be restored after construction.

11.4.2 Dam Construction

Construction activities and materials would contrast the most with the visual setting when people first arrive at the lake on the rerouted trail. When approaching the lake from the trailhead, hikers would emerge from a relatively pristine forest to see a staging area with construction materials such as pipe, rebar, and concrete. The construction site would include two excavators and other construction equipment, and the worker camping area. Construction of the new dam would involve debris and vegetation removal, including up to 30 trees at the staging area and woody debris from the lake's edge. Some debris would be burned and some would be used to level the staging area. The removal of vegetation for the staging area would make the construction area more visible from the trail. The size of the staging area would vary by alternative, with Alternative 2 requiring the largest volume of materials to be stored on-site and therefore the largest staging area.

In addition, the lake would be drawn down as low as possible for the duration of the construction season, similar to the level shown in Figure 11-10. While similar low-water levels likely occurred in late summer before the dam was built, since the dam was built, the lake level has been held as high as possible until water is needed for irrigation. During construction of the project, the lake would appear as it does during the driest part of the year, but for the entire summer. The shorelines that would be exposed are generally of the same rock and sediment material as the existing shorelines; therefore, the exposed shoreline areas would not contrast with the setting. However, the reduced size of the lake would contrast sharply with the normal lake size in early to mid-summer. The reduced size of the lake would adversely affect viewers who are camping as well as those hiking past or coming to the lake on day hikes.

11.4.3 Conclusion – Construction

Construction of the dam would cause moderate adverse impacts on the visual quality of the area surrounding the dam, because viewer sensitivity to any type of construction involving heavy machinery in the wilderness would be high and the construction would be conspicuous, particularly near the dam. Lower water levels would further reduce the visual appeal of the lake. Either helicopter option would remove 30 trees and require between 5 and 16 full days of helicopter activity. However, impacts are considered less-than-significant because construction activities would be temporary, occurring over one season, with a possibility of stretching into a second season. However, if construction spanned more than two full seasons, construction impacts on the visual quality of the area would be considered significant.

11.5 Operational Impacts

This section analyzes the visual impacts from the operation of the alternatives, including impacts related to water level changes and the new dam structure at the site.

11.5.1 No Action Alternative

Under the No Action Alternative, views in the vicinity of the project would essentially remain the same, with the exception of the removal of the excavator that was used to make repairs in 2018. Under the No Action Alternative, it is probable that DSO would exercise enforcement actions in accordance with WAC 173-175-620(3). This analysis does not address any emergency repairs that might be required for a partial dam failure. The visual impacts analyzed are the worst-case impacts of either total failure or the more likely scenario of the ordered removal of the dam. Under either scenario, the primary long-term visual impact would be a permanent lowering of the lake level.

Under a DSO enforcement order, the dam structure and outlet pipe would likely be removed. This would result in the high-water level of the lake being lowered to the level of the bottom of the outlet pipe where it crosses under the dam, which is at an approximate level of 4,648 feet; however, due additional seepage through the landslide deposits that underlie the dam, the lake level would continue to drop to an approximate elevation of 4,640 feet. Figure 11-16a is a simulation (aerial view) showing what the east end of the lake would look like after dam removal. Figure 11-16b is a simulation from KVP B showing what the lake could like after dam removal. The lake's high- and low-water levels would be approximately 27 feet lower than the current water levels at the lake. The high level of the lake would be similar to the current low level, reducing the lake area by approximately 47 percent, and as the season progressed the lake would continue to reduce in size. What is currently valued as one of the most accessible lakes in the Alpine Lakes Wilderness would be substantially smaller, and would lose much of its visual appeal as a result. This would be considered a significant impact on the visual quality because the lake's area would be reduced by greater than 10 percent.

The effects of a dam failure could vary greatly depending on the size of the failure, and there could be considerable additional damage downstream. A failure could spread portions of the dam and outlet pipe downstream, which would contrast with the wilderness area but would likely be out of view from the trail and of limited extent. A failure could also cause severe scouring and loss of vegetation along the streambed both inside and outside of the wilderness, as well as the loss of structures downstream. Within the wilderness, it is assumed that this would not be restored and would be left to regenerate on its own. Visual impacts in the wilderness would not be considered significant, but some of the scenic quality of the area downstream of Eightmile Lake could be altered by the loss of vegetation. Little Eightmile Lake could be heavily altered because it is largely filled with vegetation during the growing season, and scouring could remove the lakebed sediment and possibly alter the lake outlet level. Flooding could also damage land and structures downstream of the wilderness area on Icicle Creek and the Wenatchee River. Damage to structures, roadways, and agricultural fields could temporarily impact the scenic rural character of the area, to the extent that the damage is visible from public places, or limit access to the area. Impacts could be significant if they could not be readily repaired.

Figure 11-16a. Photo Simulation of East End of Eightmile Lake with Dam Removed

Figure 11-16b. Photo Simulation of the Water Level of Eightmile Lake from KVP B with Dam Removed

11.5.2 Alternative 1: Narrow Spillway with Gates

Alternative 1 would construct a new 65-foot-wide dam with an earthen embankment and reinforced concrete structure with automated control gates on top of the primary spillway. Under Alternative 1, the lake could be filled to an elevation of 4,671 feet, which IPID reports as the historic high-water level of the lake. The dam proposed under Alternative 1 would be larger than the current dam, which is reduced from its original constructed height, with the addition of the 4-foot-high automated gates that would be raised in the spring until mid-summer. Visual impacts from the new dam would include a higher crest when the gates are raised and a more modernized looking dam in an area with limited evidence of mechanization. The dam would appear as a dominant feature when viewed from areas directly adjacent to it (KVP A) (Figures 11-17a and 11-17b). The current dam is also a dominant feature in the landscape (Figure 11-12) from KVP A. The new dam would be larger and have more strong straight lines and man-made materials that contrast with the setting. The newer concrete material would also contrast with native rock, whereas the existing dam includes some native rock and therefore contrasts less.

Similar to existing conditions from most other viewpoints, including the main Eightmile Lake Trail, campsite area (KVP B and KVP C, Figures 11-18 through 11-20), and shoreline, the dam would appear as a subordinate feature in the background of views. The dam would be the most distinct in the landscape in the initial years following construction; over time, the dam would become weathered, and vegetation would regrow in cleared areas, helping to blend the dam into the landscape. As shown in the simulations, the higher water levels would likely inundate and kill small areas of trees on each side of the dam. With time, these trees would also likely fall into the lake and either be removed from the lake or decompose.

The automated gates would be made of steel with straight edges and be a conspicuous man-made object in the wilderness area. However, once vegetation is re-established where the staging area was located, the gates would be seen mainly by people who leave the main trail and walk to the dam. From the upstream (lake) side of the dam, the gates would only be visible when they are needed to allow water to flow over them; thus, they would be obscured by flowing water. The wing walls would be visible on the sides and between the gates but would also be small in scale when viewed from Eightmile Lake Trail or other shoreline areas (Figures 11-18a and 11-18b).

This alternative would change the lake's shoreline during the summer and fall when recreational use at the lake is highest. The timing of the water level changes would remain similar to current conditions, with high-water levels present in the late spring to mid-summer, and the low-water levels beginning mid to late summer through fall. From late spring to mid-summer, the lake would be held at a water level of 4,671 feet, which would make the lake six percent (4.8 acres) larger than with the current high-water level (see Table 2-1). However, 4,671 feet is reported by IPID as the high-water level of the lake before the dam was built as well as after it was built but before it eroded (pers. comm, Jantzer, 2021). This higher water level would inundate existing portions of the shoreline, resulting in visual changes in mid-ground and background views around the lake (Figures 11-17a and 11-18b). Changes in the lake level would contrast with existing conditions where some areas would be submerged, such as the wetland at the west end of the lake and rocky, brushy areas along other shores. Some vegetation in these areas would likely die as a result of inundation. While some people would see the inundation of these areas as adversely affecting views, others would likely see the larger lake size as a visual benefit.

Because this alternative would allow more water to be stored than at present, relative to current water management, the lake would, on average, retain more water later into the summer than it does at present.

Figure 11-17a. Simulated View from KVP A of Alternative 1 with Gates in Raised Position (water level 4,671 feet)

Figure 11-17b. Simulated view from KVP A of Alternative 1 with Gates in Lowered Position (water level 4,667 feet)

Figure 11-18a. Simulated View of Alternative 1 from KVP B with Gates in Lowered Position (water level 4,667 feet)

Figure 11-18b. Simulated View of Alternative 1 from KVP B with Gates in Raised Position (water level 4,671 feet)

Figure 11-19a. View of Existing Dam from KVP C (water level approximately 4,667 feet)

Figure 11-19b. Simulated View of Alternative 1 from KVP C (water level 4,671 feet)

Figure 11-20a. Simulated View from KVP B of Alternative 1 (water at elevation 4,642 feet)

Figure 11-20b. Simulated view from KVP B of Alternative 1 – Water at Lowest Level without Pumping (elevation 4,636 feet)

Alternative 1 and all action alternatives would allow the lake to be lowered to a water level of 4,636 feet, 4 feet lower than the current dam allows without pumping. Beginning in the mid- to late summer as water is released, the lake's water level would be slowly lowered to this low-water level, resulting in a lake six percent (2.5 acres) smaller than with the current low-water level of approximately 4,640 feet (see Table 2-1). Lower water levels at the lake would expose more shoreline area, consisting of native rock and woody debris that was previously under water. These areas would be similar in appearance to low-water conditions at present, but more extensive. Water levels would be at the lowest in the late fall. The lower low-water level with this and all action alternatives would change fore- and mid-ground views from both shoreline KVPs because there would be a greater area of exposed lakebed, but this is similar to the condition that occurs with the current dam at low water (Figure 11-10). Under any of the action alternatives, mid-ground and background views would still provide views of a lake (Figure 11-20b).

Alternative 1 and all action alternatives would have small telecommunications stations to monitor and control the outlet on the dam similar to the existing condition. This installation would be similar in scale and character to existing installations and therefore would not substantially increase the degree of contrast that these installations have with the project setting.

Operational impacts from Alternative 1 would be less-than-significant because the dam and associated man-made features would not become dominant in views from the main Eightmile Lake Trail, campsite area, or surrounding shorelines, and the lake would not be reduced in size by more than 10 percent.

11.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

The dam proposed under Alternative 2 would be a more prominent feature in the landscape when compared to the existing dam, and compared to Alternatives 1 and 3. The dam would be an earthen embankment and reinforced concrete dam approximately 180 feet long, approximately three times the width of the existing spillway. Figure 11-21 shows the view from KVP A, where the entire foreground would be covered by the embankment and contrast with the existing setting. The dam would have a concrete wall that would form a straight concrete edge 180 feet long that would be visible whenever water was not going over it, which would include much of the summer recreation season. Although most of the wall would be covered with native rock, this long, straight line, along with the wing walls on the dam, would contrast with the wilderness area. The rock armoring on the downstream side of the dam would also need to be kept clear of trees, in contrast to the generally brushy and wooded shoreline around most of the lake. Although the dam would dominate views from KVP A, it would remain subordinate in views from viewpoints along the Eightmile Lake Trail and other locations along the shore (Figures 11-22 and 11-23).

This alternative would also have a higher dam crest, like Alternative 1, but it would not be retractable. The water level would remain at elevation 4,671 feet throughout the spring and mid-summer season until water is needed for irrigation. During the high-water period, the lake would be 4.8 acres larger than at present, and the wetland vegetation composition at the west end would likely be altered, including the recruitment of woody vegetation. As with Alternative 1, at the high-water level, only the wing walls would be visible from KVP B and similar viewpoints long Eightmile Lake Trail (Figure 11-22). From higher elevations, the downstream embankment would be more visible than Alternative 1, but the dam would not be a dominant feature (Figure 11-23).

Impacts from low-water levels under Alternative 2 would be similar to those described for Alternative 1, with a low-water level of 4,636 feet (Figure 11-20b). The wide spillway dam in Alternative 2 would be more apparent than Alternative 1 from KVP B at low-water levels because of the greater width of the embankment, but the embankment would be made of native rock and would not be a dominant feature from most vantage points in the study area.

Figure 11-21. Simulated View from KVP A of Alternative 2 at Maximum Water Level (4,671 feet)

Figure 11-22. Simulated View from KVP B of Alternative 2 at Maximum Water Level (4,671 feet)

Figure 11-23. Simulated View from KVP C of Alternative 2 at Maximum Water Level (4,671 feet)

As with Alternative 1, the higher water level would inundate existing portions of the shoreline, resulting in visual changes to mid-ground and background views around the lake (Figures 11-21, 11-22, and 11-23). Changes in the lake level would contrast with existing conditions where some areas would be submerged, similar to Alternative 1, but Alternative 2 would hold these high-water levels for longer. Some vegetation in these areas would die as a result of inundation. While some people would see the inundation of these areas as adversely affecting views, others would likely see the larger lake size as a visual benefit.

Like Alternative 1, Alternative 2 would allow more water to be stored than at present, and the lake would on average retain more water later into the summer than it does at present.

Operational impacts from Alternative 2 would be less-than-significant because the dam and associated man-made features would not become dominant in views from the main Eightmile Lake Trail, campsite area, or surrounding shorelines, and the lake would not be reduced in size by more than 10 percent.

11.5.4 Alternative 3: Narrow Spillway without Gates

The dam constructed under Alternative 3 would be identical to the dam proposed under Alternative 1, with the exception of the mechanical gates. Figure 11-24 shows a simulated view of the dam from KVP A. Compared to Alternative 1, Alternative 3 would contrast less with the project setting because it would have fewer angular and man-made parts that contrast with the wilderness surrounding the dam.

Figure 11-24. Simulated View from KVP A of Alternative 3 at Maximum Water Level (4,667 feet)

Under Alternative 3, the high-water level of the lake would remain the same as existing conditions at 4,667 feet, the same elevation that Alternative 1 would have when the gates were down (Figures 11-17b and 11-18a). As a result, there would be no substantial change in the size of the lake or to the vegetation around the lake from high-water levels. Lake levels would be managed similarly to the way they are at present; thus, water levels would on average be lower in the summer than they would be under Alternatives 1 and 2.

Impacts from the low-water level of Alternative 3 would be the same as those described for Alternative 1.

Operational impacts from Alternative 3 would be less-than-significant because the dam and associated man-made features would not become dominant in views from the main Eightmile Lake Trail, campsite area, or surrounding shorelines, and the lake would not be reduced in size by more than 10 percent.

11.5.5 Repeater Station (Common to All Action Alternatives)

The repeater station would be placed on a ridge in the Wenatchee National Forest outside of the Alpine Lakes Wilderness that is not accessible by an improved trail. It is relatively small in scale and would be placed in an area where similar communications equipment is currently located. Therefore, it would not contrast strongly with the existing setting. The new station will be placed next to an existing Forest Service repeater station. The impact of the repeater station would be less-than-significant because of the small size of the structure, co-location with Forest Service equipment, and the remote location.

11.6 Avoidance, Minimization, and Mitigation Measures

This section describes the mitigation measures proposed that would reduce and compensate for impacts on visual resources from the construction and operation of the project.

11.6.1 Construction

Measures to reduce impacts on visual resources from construction include:

- Minimize clearing area for staging and construction activities.
- Establish and maintain clear construction boundaries.
- Maintain detour trail around site during construction.
- After construction is complete, restore trail and cleared areas to Forest Service standards, consistent with the Wilderness and Backcountry Site Restoration Guide (Therrell et al. 2006).
- Coordinate with the Forest Service to forewarn visitors of potential disruption of wilderness experience due to construction activities, including notice to people seeking reservations through the lottery and to those awarded reservations.
- Provide signage to alert trail users regarding construction activity, including dates and hours of helicopter use, heavy equipment operation, and blasting with explosives.
- Provide a general description of work period and work impacts, including potential areas that will be closed to the public such as the staging and construction areas, prior to the Forest Service lottery for overnight permits in the Enchantment Permit Area.
- Design constructed features to match the natural environment to the extent feasible.
- Provide alert of construction on the Forest Service Website for *Alpine Lakes Wilderness: Okanogan-Wenatchee.*
- Provide notification and signage at the Leavenworth ranger station.

11.6.2 Operation

Measures to reduce impacts on visual resources from operation of the dam include:

- During design of the dam, specify materials and colors that will visually blend with the landscape around the dam, to the extent feasible.
- In the dam design, minimize the use of long, linear, and sharp rectangular edges to the extent feasible to reduce the contrast of the structure with the natural surroundings.
- Plant and allow low-growing vegetation, such as grasses and herbaceous plants, on the armored downstream face of the dam to the extent that this is compatible with safe operation of the dam.

11.7 Significant Unavoidable Adverse Impacts

It is unavoidable that some recreationists would find that impacts from construction detract from the visual quality of the study area. However, because construction is anticipated to last for one season and all disturbed areas would be restored following construction, **less-than-significant impacts** on the visual quality of the study area are anticipated during construction. During operation, the project would result in **less-than-significant impacts** on visual quality. From most viewpoints, including the main Eightmile Lake Trail, campsite area (KVP B and KVP C), shoreline, and surrounding peaks, the dam would not be a dominant feature and would blend into the background of the landscape. From KVP A, any new dam would be visible and contrast with existing conditions; however, there is an existing dam there so the changes are considered **less-than-significant**. Additionally, operation of Alternatives 1, 2, and 3 would still provide views of a lake and would not reduce the lake area by greater than 10 percent.

Under the No Action Alternative, dam failure could occur, which would result in a high-water level reduction of 47 percent and damage to infrastructure downstream. Due to the potential reduction in the water level of the lake and the contrast in views from the current condition, potential impacts from the No Action Alternative are considered **significant.**

CHAPTER 12: PUBLIC SAFETY

Public safety concerns for the project primarily consist of the potential failure of the current Eightmile Dam and the impacts a failure would have downstream. Failure of the structure could have impacts on the health and safety of people, the environment, infrastructure, livestock, and buildings downstream of the dam.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on public safety are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

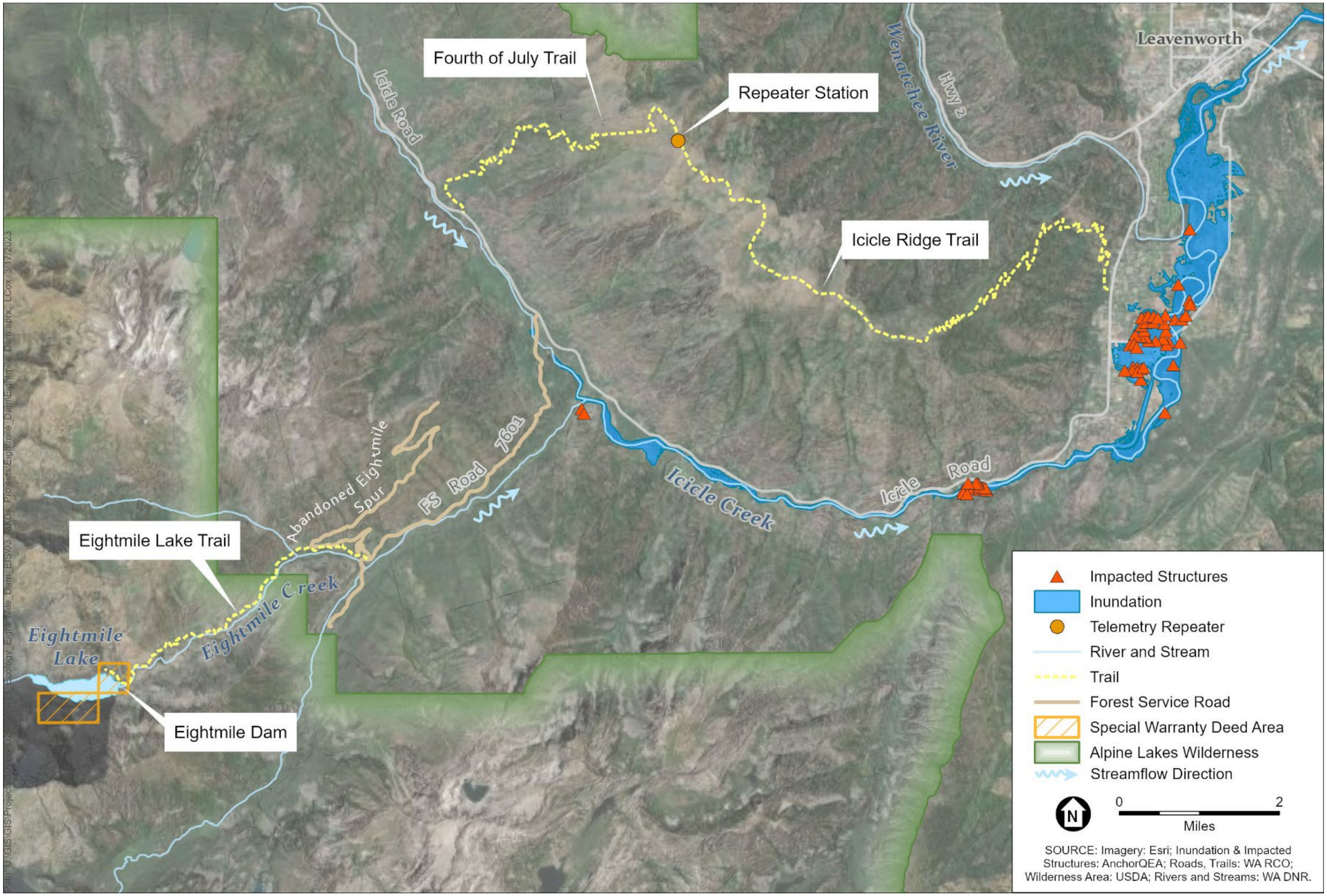
***Key Findings for Public Safety*:**

- The nearly 100-year of Eightmile Dam was classified by Ecology's DSO in 2018 as a High Hazard Dam due to potential loss of human life and property downstream if the dam were to fail.
- Increased peak runoff into Eightmile Lake caused by fire damage within the watershed, which, combined with debris piling up on the dam, could increase the risk of dam failure.
- Catastrophic failure would send an estimated additional 14,800 cfs of streamflow into Icicle Creek during a natural high flow event.
- About 150 downstream residences are at risk of being damaged or destroyed if the dam failed.
- There is a potential for loss of life downstream if the dam failed.
- There are no significant unavoidable impacts on public safety under any of the action alternatives.
- The action alternatives would substantially reduce the risk of a catastrophic dam failure and have a considerable benefit to public safety.
- The No Action Alternative would not comply with DSO safety standards, and presents the highest risk of dam failure of all alternatives. As such, it is considered a potentially significant adverse impact to public safety.

12.1 Methodology

The public safety analysis examined how construction and operation of Eightmile Dam could affect public safety. The study area for public safety encompasses the area downstream of the dam that would be affected in the event of dam failure. The downstream area extends from Eightmile Dam to the Wenatchee River and includes portions of Eightmile and Icicle creeks. The downstream study area ends where the water level from the dam failure would no longer be distinguishable from normal water levels, as determined by evaluations conducted by IPID and DSO (Anchor QEA 2019) (Figure 12-1).

Figure 12-1. Downstream Inundation Area



For the evaluation of construction impacts, impacts are considered significant as follows:

- Impacts are considered significant if construction activities would not comply with applicable federal and state safety requirements, and/or result in conditions that would negatively affect the health and safety of members of the public, including construction workers and people located downstream on Icicle Creek and the Wenatchee River.

For the evaluation of operational impacts, impacts are considered significant as follows:

- Impacts are considered significant if the dam is unable to meet DSO safety standards, and/or applicable local and state guidelines and policies, and operation of the dam puts downstream residents, structures, and recreationists at risk in the event of dam failure.

12.2 Regulatory Context

Public safety is protected by a variety of federal, state, and local plans, as well as laws and policies (Table 12-1). These plans and policies were reviewed to determine how well the project alternatives would comply with public safety in the study area. The policies reviewed generally provide guidance and regulations related to dam safety.

Table 12-1. Regulations and Guidelines Applicable in the Study Area

Program, Plan, or Policy	Description
33 U.S. Code 467f, National Dam Safety Program	Establishes and maintains a coordinated national dam safety program that is administered by the Federal Emergency Management Agency (FEMA).
Federal Guidelines for Dam Safety Risk Management (FEMA P-1025; FEMA 2015)	Provides guidance for dam safety and operation.
Dam Safety, Washington Administrative Code (WAC) 173-175	Provides comprehensive regulation and supervision of dams to reasonably secure safety of life and property. Includes oversight on the design, construction, operation, maintenance, and supervision of dams. Requires all dam designs to meet earthquake and hydrologic/hydraulic design criteria outlined in Ecology's Dam Safety Office (DSO) Guidelines. Rules are administered by Ecology's DSO.
Dam Safety Guidelines Part II – Project Planning and Approval of Construction or Modification (Ecology 1992)	Provides dam owners, operators, and design engineers with information on activities, procedures, and requirements involved in the planning, design, construction, operation, and maintenance of dams.
Water Resources Program Policy (DSO) POL 5102 (Ecology 1999a)	Existing statutes, rules, and policies regarding matters of dam safety are applicable to dams that are constructed with a potential active capacity to store 10 acre-feet or more of water as measured at the dam crest elevation.
Water Resources Program Policy (DSO) 5406 (Ecology 1999b)	Requires a surficial inspection on older dams constructed without DSO approval to assess structural integrity and safety of the facility. If the inspection indicates serious problems with the dam, the concerns must be addressed in a timely manner.
Water Resources Program Policy (DSO) 5701 (Ecology 1999c)	Requires a Dam Safety Emergency Action Plan (EAP) to be prepared and maintained, identifying appropriate procedures and agency protocols to be followed in response to emergency situations on dams where there is a potential for loss of life.

Program, Plan, or Policy	Description
Spills and Discharges into the Environment (WAC 173-303-145)	Establishes requirements for spill or discharge of dangerous waste or hazardous substances into the environment.
Washington State Water Code (Chapter 90.03 RCW)	Promotes the use of public waters in a fashion that provides for obtaining maximum net benefits from both diversionary uses and the retention of waters within streams and lakes in sufficient quantity and quality to protect instream and natural values and rights.
Occupational Health and Safety Administration Standards – 29 Code of Federal Regulations (CFR)	Promotes the mission of worker safety and health, and outlines standards for working in all types of construction environments.
Washington State Department of Labor and Industries – Safety and Health Rules (WAC 296-24)	Supports worker safety in Washington State; develops and enforces safety and health standards for construction workers in the state.

The dam safety guidelines provide guidance in the selection of appropriate design and performance goals for critical project elements (Ecology 1992). Design and performance goals for critical project elements are selected based on a design step format with eight design steps, wherein goals range from an annual exceedance probability (AEP) of 1 in 500 at Design Step 1, stepping up to 1 in 3,333 for Design Step 3 if there is the potential for the loss of one to three lives. The AEP increases (Design Step 4 at 1 in 10,000 through Design Step 8 at 1 in 1,000,000) with increasing lives, critical infrastructure at risk, and potential environmental consequences; the scheme terminates in theoretical maximum events. An initial assessment of the design step for a dam can be generally related to the downstream hazard classification. For example, using Ecology's DSO guidelines, an initial Design Step of 3 or 4 would be recommended for a significant, Hazard Class 2D dam (economic loss appreciable, 1 or 2 inhabited structures, population at risk 1 to 6 people); or a Design Step 8 would be recommended for a High, Hazard Class 1A dam (economic loss extreme, more than 100 inhabited structures, population at risk more than 300). Eightmile Dam will be designed to meet Design Step 8 at 1 in 1,000,000.

12.3 Affected Environment

12.3.1 Existing Conditions

Eightmile Dam was built nearly 100 years ago in the 1920s. Dam construction resulted in the impoundment of water from Eightmile Creek for use by the IPID. IPID reports that the high-water level established by the dam was originally 4,671 feet above sea level. However, it is unclear when the reservoir was last held at this level. Ecology's DSO regulates dams in Washington through the administration of state laws and rules to protect people and property located downstream of dams and ensure that dam safety is a priority. In 2018, the DSO gave Eightmile Dam a downstream hazard classification rating of "High Hazard" to describe the potential for loss of human life and/or property damage if the dam were to fail and release water in the reservoir into downstream areas (Appendix A). The DSO considers the dam vulnerable in the event of a large storm due to changed conditions in the watershed both above and below the dam, as well as damage to the dam itself. The Jack Creek Fire in 2017 burned a significant forested area in the watershed, creating conditions for more rapid runoff. Increased peak runoff into Eightmile Lake, which, combined with debris piling up on the dam, could increase the risk of dam failure, putting approximately 150 downstream residences at risk if the dam fails. The dam was also partially eroded more than 25 years ago, and the outlet pipe was damaged. Repairs to the dam were performed in 2018 as there was concern that further damage to the dam would occur due to a storm and increased runoff rates that follow. The dam still does not meet dam safety standards and is considered to be in unsatisfactory condition and at risk for potential failure.

12.3.2 Dam Failure

A worst-case scenario dam break analysis of an overtopping failure was performed in 2019 (Anchor QEA 2019). If catastrophic dam failure occurred, it would contribute an estimated additional 14,800 cfs of streamflow to Icicle Creek during a natural high-flow event. For comparison, peak flows have been recorded at 11,000 cfs in November 2015, 15,700 cfs in November 2006, and 19,800 in November 1995 (Anchor QEA 2019). An overtopping failure would result in downstream flooding and pose a safety risk to people who reside downstream in the Icicle Creek Area. Figure 12-1 illustrates the downstream inundation area. Modeling results concluded that the peak discharge from the dam breach would not significantly attenuate in Eightmile Creek due to the steep and confined geometry of the creek. The inundation mapping illustrates the expected flood levels in Icicle Creek and extends approximately 4 miles downstream of the confluence with the Wenatchee River (Figure 12-1). There are approximately 150 residences along Icicle Creek, many of which include structures within the area that would be flooded if the dam failed. The Icicle Island Club is a private residential community 5 miles south of Leavenworth. During a dam failure event, some of these homes and others along Icicle Creek would be at a significant risk of being severely damaged or destroyed. Flooding would not only threaten homes, but would also pose a risk to other infrastructure such as roadways and bridges, barns, and other residential developments as well as animals and livestock. Roads and bridge crossings that could be directly affected include: FSR 7601 and FSR 112, a bridge over Icicle Creek at RM 7, two bridge crossings near Icicle Island, a bridge crossing near the downstream end of the LNFH channel, and the bridge at Leavenworth Road (Anchor QEA 2019). Dam failure at Eightmile Lake could also raise water levels on the Wenatchee River and damage infrastructure if the river were already at or near flood stage.

Floodwaters could also pose a danger to any people using recreational resources downstream of the dam, such as the Eightmile/Caroline Zone in the Enchantment Permit Area or other recreational opportunities along Icicle Creek and the Wenatchee River. Hikers and other recreationists could be seriously injured or die if dam failure were to occur when hikers were present.

Floodwaters can also pose a risk to public health if they become contaminated. No known contaminated sites are located in the downstream area of the dam on Icicle Creek; however, floodwater can be contaminated in a variety of other ways, including coming into contact with chemicals stored on or above the ground, agricultural chemicals, and septic and wastewater treatment systems. These contaminated waters are health hazards if the public comes in contact with them through direct physical contact, ingestion, or open wounds (OSHA 2005). Additionally, the lower portion of Icicle Creek is identified as impaired for dichlorodiphenyldichloroethylene (4,4’-DDE) and polychlorinated biphenyls (PCBs) in Ecology’s current EPA-approved 303(d) list (Hobbs and Friese 2016); please see Chapter 4, *Surface Water,* for more information on water quality in Icicle Creek.

12.3.3 Flood Warning System

Chelan County has an emergency management department that provides training, outreach, planning, and coordination for hazard events, as well as natural hazard planning documents like the Chelan Emergency Management Plan (Chelan County 2020).

The Chelan County Department of Emergency Management sends out mass notifications via the Chelan County AlertSense system through text message, email, pager, or voicemail to alert the public about emergency and non-emergency issues. Emergency issues can relate to specific hazards with actions that require evacuation or shelter in place. Non-emergency issues can include significant police, fire responses, or transportation problems (Chelan County 2022).

12.4 Construction Impacts

Construction impacts on public safety could include potential impacts on construction workers involved in building the new dam, or members of the public who could be affected directly or indirectly during construction. Impacts could occur from the transportation of equipment and materials, and construction activities related to dam construction or the road improvements. IPID is planning to self-construct the dam using workers hired directly by IPID, and will use a helicopter contractor for helicopter transport. Impacts from these components are described below, followed by a comparison of the alternatives considered.

12.4.1 Transportation of Equipment and Materials

Helicopter

All construction methods would include the use of helicopters to transport equipment and materials. As described in Chapter 2, two helicopter options are being considered: use of only a heavy-lift helicopter (requiring fewer trips), and use of a heavy-lift helicopter combined with a smaller helicopter (requiring more trips). IPID would contract with a local licensed helicopter service with the capability of providing helicopters and certified pilots. Helicopter use in construction is a common practice and has been used by IPID for work within the IPID drainage area without an accident. However, the use of helicopters includes the risk of equipment malfunction or other types of accidents, and when helicopter accidents occur there are often casualties. The smaller helicopter option would entail relatively greater risk of an accident, as more helicopter trips would be required.

In the State of Washington, helicopters used for construction are regulated under the Department of Labor and Industries under Chapter 296-829 WAC, *Helicopters Used as Lifting Machines*. All construction use of helicopters at Eightmile Dam will be required to comply with applicable requirements for helicopter use, along with applicable requirements under the Federal Aviation Administration (FAA). The Forest Service requests to be informed of flights through their Aircraft Dispatcher at the Central Washington Interagency Communications Center to make sure the airspace is deconflicted with other potential flights. Compliance with these requirements would reduce potential construction-related risks from helicopter use to a less-than-significant level of potential impact.

Road Segment

The proposed construction includes improving a section of the previously closed FSR-7601 outside of the wilderness area to improve access to the site. Without an access road, construction workers would access the site by hiking approximately 3 miles to the construction site. Allowing use of the previously closed road to the point where it ends would shorten the hike for construction personnel by approximately 0.7 mile, and would eliminate approximately 400 feet of elevation gain from the hike. Risks to construction workers from hiking include slips, trips, and falls, as well as fatigue and heat-related illnesses during peak summer temperatures or unseasonal cold temperatures. By shortening the distance and elevation gain of the hike, these risks would be slightly reduced. The road access would provide improved access to emergency services, reducing response time if emergency services by foot are needed.

12.4.2 Dam Construction

Similar to most construction projects, the potential short-term impacts on health and safety from the construction of the dam include the risk that construction workers could have an accident while working at the site. Construction workers would camp at the site for approximately 15 to 20 weeks, with each crew staying at the site for the work week, and hiking out for the weekends. The project construction would be accelerated as much as possible to complete the construction within one season, which could increase standard risk factors associated with fatigue and other factors. The remote location creates additional safety risks for crews, including extreme weather, wildlife, and the potential for increased response time in the case of accidents. All construction activities would need to be approved by DSO, Washington Labor and Industries (L&I), and the Forest Service for those areas outside the Special Warranty Deed Area. A Dam Safety Construction Permit is required before constructing, modifying, or repairing any dam or controlling works for storage of 10 or more acre-feet of water. The application process requires approval of the construction plans and specifications, as well as a Construction Inspection Plan. The application also requires approval of a dam's Operation and Maintenance (O&M) Plan and Emergency Action Plan (EAP). An O&M Plan is required for all projects and is used to develop an O&M Manual following completion of the project. An EAP is required for those projects where a dam failure could pose a threat to life. Both plans must be approved before the project can be implemented. Ecology's DSO reviews and administers all dam permits in Washington to ensure compliance with state and federal construction and operation requirements.

While not anticipated, blasting with explosives may be needed to remove large rock deposits. If blasting occurs, construction workers and hikers in the region could be at risk if they inadvertently enter the blasting zone. Notices will be posted as far in advance of the blasting as possible, and the Eightmile Lake Trail will be closed during the brief period of blasting, which is expected to last less than one full day. IPID will have personnel on the Eightmile Lake Trail to stop hikers from entering a potentially dangerous zone should any blasting be necessary. Refer to Chapter 10, *Recreation Resources*, for additional information.

Because work would be conducted during the summer months, there may be an elevated risk of wildfire in the adjacent area, with associated risk from smoke or wildfire. Because of the remote location of the dam, the fire danger level will be carefully monitored to ensure that construction workers are not placed in danger. The construction plan approved by DSO will include provisions for fire avoidance and evacuation protocols should a wildfire occur in the area.

Construction activities at Eightmile Dam could pose a risk of starting fires in the area from the storage of fuel on-site, sparks or flames from construction equipment, camping equipment, and cigarette use associated with construction workers. Although the risk of a fire starting from construction is low because of anticipated requirements for fire avoidance, the risk cannot be completely eliminated.

Workers camping at the site would increase the potential for human waste contamination in the vicinity of the campsite, which could enter Eightmile Lake or its outlet. The campsite will be subject to waste disposal regulations that reduce but not eliminate this risk. A portable latrine will be maintained on-site and removed at the completion of construction.

With implementation and monitoring of a Health and Safety Plan, the public safety impact on construction workers would be **less-than-significant.**

During construction activities, including excavation, grading, and other non-blasting related construction activities, the construction area around the dam would remain closed to visitors. Members of the public could experience public safety impacts from construction if construction workers started a fire or spilled hazardous materials, or if hikers and/or campers were inadvertently within the construction zone during blasting with explosives. As noted above, all construction activities will require approval of detailed construction plans to avoid fires, store and use hazardous materials, and any blasting that may be required. All construction activities will be approved by Ecology's DSO and be consistent with applicable L&I requirements, which is expected to reduce the potential impacts on the public to levels that are **less-than-significant.**

12.4.3 No Action Alternative

Under the No Action Alternative, no construction would occur; however, there would be a risk of dam failure, which could lead to additional emergency repairs, which would be similar to those conducted in 2018. In addition, if DSO were to require abatement or removal of the dam, impacts similar to those described for construction would occur. Removal would likely require the use of helicopters for access. The duration of removal activities would be substantially shorter than for construction of any of the action alternatives, but construction-related risks to workers would still be present. If emergency repairs or abatement measures are required, impacts on construction workers would likely be less-than-significant.

12.4.4 Alternative 1: Narrow Spillway with Gates

Under Alternative 1, construction workers would be at risk during construction due to the potential for accidents, as described above. Workers are expected to camp at the site for approximately 15 to 20 weeks, and would work to complete the dam as quickly as possible to finish the construction in one season. As noted, this could result in an increased risk of accidents, which would require close coordination and monitoring by Ecology's construction inspectors or their designee.

Public safety impacts on the public would be as described above in Section 12.4.2, *Dam Construction*. Construction impacts on public health and safety would be less-than-significant.

12.4.5 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Because this alternative requires the longest construction time of the action alternatives, workers would be exposed to accidents, potential exposure to wildfires, wildlife encounters, and factors associated with fatigue for a longer period of time, which would slightly increase risks to their health and safety. However, this increased risk is not likely to be substantial. Construction impacts on public health and safety would be less-than-significant. Public safety impacts on the public would be as described above in Section 12.4.2, *Dam Construction*.

12.4.6 Alternative 3: Narrow Spillway without Gates

Potential public safety risks are considered to be similar to those under Alternative 1. Construction impacts on public health and safety would be less-than-significant. Public safety impacts on the public would be as described above in Section 12.4.2, *Dam Construction*.

12.5 Operational Impacts

Operational impacts are those long-term impacts that would result from implementation of the project.

12.5.1 No Action Alternative

Under the No Action Alternative, no dam improvements would be undertaken. The dam would continue in its current condition until either the dam fails, or DSO determines that abatement of the dam is required. Potential risk to residents and infrastructure downstream of Eightmile Lake from dam failure would continue, and would be expected to worsen in the future, as the structure ages and flows into Eightmile Lake increase/become more variable associated with changing climate conditions. Ecology's DSO has characterized Eightmile Dam as a 1B Hazard Dam, which is defined as having an at-risk downstream population of 31–300 people. A catastrophic dam failure could have potentially life-threatening impacts on downstream residents, structures, wildlife, and vegetation.

The No Action Alternative presents the highest risk of dam failure of all alternatives, and does not meet the safety standards of Ecology's DSO. As such, the No Action Alternative has potentially

significant adverse impacts on public safety. Potential dam failure at Eightmile Lake would be considered a **significant unavoidable adverse impact**. The No Action Alternative would not meet the project objectives as described in Chapter 1, Section 1.4.

12.5.2 Alternative 1: Narrow Spillway with Gates

The design of the new dam must follow DSO standards for safe construction and operation. This includes designing the dam to withstand a million-year storm (recurrence of once every one million years). As part of this process, DSO will review engineering design reports, and construction plans and specifications for the new dam to ensure consistency with applicable requirements. As described above under Construction, the dam permit application process requires approval of the construction plans and specifications, as well as a Construction Inspection Plan. The application also requires approval of a dam's Operation and Maintenance (O&M) Plan and Emergency Action Plan (EAP). An O&M Plan is required for all projects and is used to develop an O&M Manual following completion of the project. An EAP is required for those projects where a dam failure could pose a threat to life. Both plans must be approved before the project can be implemented.

The EAP would be updated and shared with Chelan County emergency management agencies responsible for developing community emergency response plans. The EAP will include inundation maps identifying high-water areas downstream of the dam in the event of a catastrophic structure failure. Chelan County would need to review the EAP and the inundation maps and update evacuation plans for areas downstream of the dam, to prepare in the event of a catastrophic failure of the structure.

The design, as well as proposed operation and maintenance of Alternative 1, will be approved by DSO prior to construction, and as such will comply with all applicable safety requirements and will be operated and maintained in accordance with current safety requirements. While no dam can be considered risk-free, it will substantially reduce the potential for a catastrophic dam failure. Alternative 1 would meet the project objective of complying with DSO regulations for a High Hazard Dam, and represents a considerable **benefit** to public safety.

12.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Operational impacts on public safety for Alternative 2 would be the same as those described for Alternative 1. Public safety would benefit from the restoration of the dam to be consistent with DSO design requirements. Alternative 2 would meet the project objective of complying with DSO regulations for a High Hazard Dam, and represents a considerable **benefit** to public safety.

12.5.4 Alternative 3: Narrow Spillway without Gates

Operational impacts on public safety for Alternative 3 would be the same as those discussed under Alternatives 1 and 2. Public safety would benefit from the restoration of the dam to be consistent with DSO design requirements. Alternative 3 would meet the project objective of complying with DSO regulations for a High Hazard Dam, and represents a considerable **benefit** to public safety.

12.6 Avoidance, Minimization, and Mitigation Measures

12.6.1 Construction

The following measures will be implemented to protect public safety during construction activities.

- All construction activities, including use of helicopters, construction equipment, blasting with explosives (if needed), worker safety protocols for working in remote areas, fire prevention protocols, and spill prevention measures will be in compliance with Ecology's DSO requirements, Washington L&I requirements, and general construction BMPs to promote worker and public safety.
- Construction will be monitored as required by Ecology and be conducted in accordance with the conditions of the Dam Safety Construction Permit.
- Preparation of and adherence to a Health and Safety Plan will minimize risks to construction workers.
- Construction workers would be trained for work in remote forested areas, and would be equipped with firefighting equipment, wildlife repellant, and other safety equipment as required by Ecology and L&I.
- Notice of construction will be posted at the trailhead, on the Forest Service website and at the office, recreation.gov, popular hiking websites, and other locations to ensure that the construction schedule is well publicized as far as possible in advance of construction.
- Blasting with explosives, if needed, will be publicized as far in advance as possible, at least 10 days in advance of the blasting. IPID and Ecology will coordinate with the Forest Service regarding recreation permit holders who may be restricted from accessing the Alpine Lakes Wilderness due to a potential temporary trail closure.

12.6.2 Operation

The following measures will be implemented to protect public safety during operation of the dam.

- IPID will prepare an O&M Plan to ensure that the dam is operated and maintained in accordance with all DSO requirements, which will reduce long-term risk from the facility.
- IPID's application for a dam permit will include an EAP, to be approved by Ecology with input from local emergency management officials, to outline required steps in the event of a failure. This plan is designed to reduce risks to downstream people and structures.

12.7 Significant Unavoidable Adverse Impacts

Risk to public safety is greatest associated with the No Action Alternative, which would result in Eightmile Dam remaining in its current condition and is considered by DSO to be a High Hazard Dam, exposing downstream residents and recreational users to a potentially catastrophic flood event if the dam fails. The potential failure of the dam, if it occurred, would be a **significant unavoidable adverse impact.**

Impacts resulting from Alternatives 1, 2, or 3 would not result in significant unavoidable adverse impacts on public safety. Implementation of any of the action alternatives would meet the project objective of complying with DSO regulations for a High Hazard Dam, and represents a considerable **benefit** to public safety.

CHAPTER 13: HISTORIC AND CULTURAL RESOURCES

What has Changed from the Draft EIS?

- Clarification of the tribal consultation process has been added to the introduction.
- No other substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on historic and cultural resources are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key Findings for Cultural Resources

- A cultural resources assessment, including background research and field surveys for built environment and archaeological resources, has been conducted for portions of the Area of Potential Effects (APE) not previously subject to survey actions.
- No recorded archaeological sites potentially eligible for or listed in local, state, or federal registers are within or adjacent to the project area.
- One historic-aged built environment resource, Eightmile Dam, is within the project area; the dam is recommended Not Eligible for listing in local, state, or federal registers due to its lack of critical integrity, resulting from multiple historic and modern period modifications that limit its ability to convey its association with past events, or clearly depict its original form, materials, or construction methods.
- One historic period archaeological site, FSR 7601-116, a circa 1970 double-track road prism, is within the project area and has been recommended as Not Eligible for listing in the National Register of Historic Places (NRHP).
- The area is known to have been heavily utilized by Indigenous people throughout the precontact, ethnographic, and modern periods. There are likely unrecorded archaeological sites and Traditional Cultural Properties in the study area.
- **Each of the action alternatives would result in no significant impacts** on known cultural resources.
- **The No Action Alternative would likely result in significant impacts** on cultural resources. If the dam were to fail, the resulting high-energy downstream flows would erode and scour the banks of Eightmile and Icicle creeks, which have a very high probability of containing precontact and historic period archaeological sites.
- The operation and maintenance of the facility is not likely to cause additional impacts on cultural resources due to the project being within previously disturbed areas, unlikely to contain unrecorded cultural resources.

This chapter (1) summarizes cultural resources regulations relevant to the Eightmile Dam Rebuild and Restoration Project, (2) describes the historic and cultural context of the project area, (3) describes existing cultural resources within the project area, (4) reports the results of cultural resources surveys conducted in previously unevaluated portions of the project area, and (5) evaluates potential operational and construction impacts on cultural resources for each of the project alternatives as presented in Chapter 2. Throughout the EIS process, the Confederated Tribes and Bands of the Yakama Nation and the Confederated Tribes of the Colville Reservation have been consulted on potential impacts on both cultural resources (which include archaeological sites, built environment resources, and traditional cultural properties) and tribal resources (which include natural resources and treaty rights). The Forest Service has led tribal consultation on cultural resources impacts as part of the Section 106 process. Ecology has conducted formal consultation on potential impacts on tribal resources. Consultation with the tribes will continue as the project moves through permitting and construction.

For this analysis, a cultural resource is any district, site, building, structure, or object that has been listed in, has been determined to be eligible for listing in, or may be eligible for listing in the National Register of Historic Places (NRHP) and Washington Heritage Register (WHR). Cultural resources include archaeological isolates, sites, and districts; human remains and cemeteries; historic built environment resources; and traditional cultural properties (TCPs).

The project area contains two recorded cultural resources, the Eightmile Dam and FSR 7601-116. The historic dam does not appear to be individually eligible for listing on local, state, or national historic registers, but it may contribute to a potential historic district, which encompasses the historic irrigation facilities within the Alpine Lakes Wilderness, the potential Alpine Lakes Irrigation Historic District (ALIHD). FSR 7601-116 is historic in age, having been built prior to 1970. Due to the road's current unmaintained condition, it has been recorded and evaluated as an archaeological site and has been recommended as being Not Eligible for listing in the NRHP. Full discussion of these resources will be provided in an accompanying Cultural Resources Assessment (Ostrander et al. 2023).

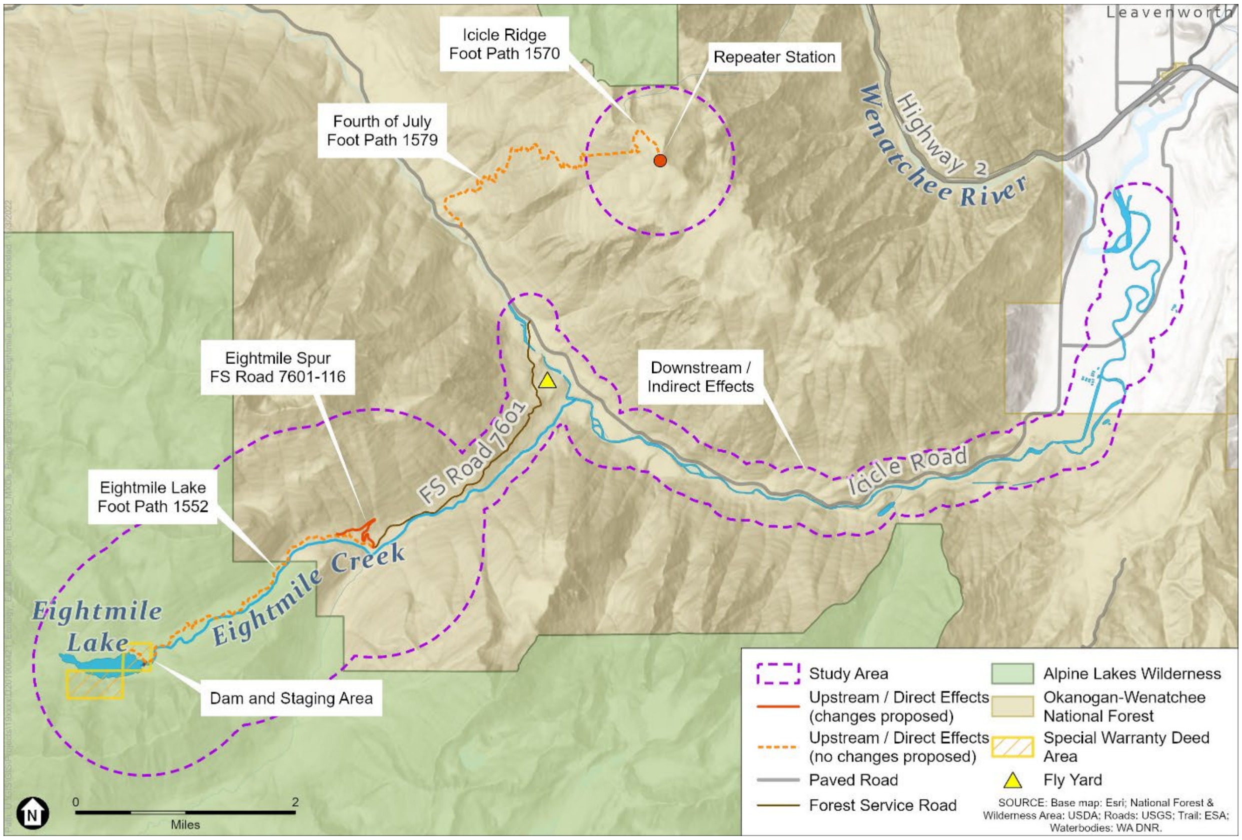
Information about existing policies and regulations is current as of the time of publication. The data on recorded cultural resources and their environmental setting were obtained from existing studies, database searches, historical maps, and historical registers. This chapter also describes current conditions and discusses Indigenous place names, and TCPs within the study area. Finally, this analysis acknowledges that tribes hold complete knowledge of their history. The following section has been prepared based on published materials by non-Native people from the 19th, 20th, and 21st centuries. These materials often do not present the full and accurate understanding of tribal history and knowledge. The authors acknowledge that these sources inherently contain deficiencies and use of them is not intended to substitute or supersede historic knowledge held within the tribes. A discussion of cultural resources significant to tribes is also presented in Chapter 14, *Tribal Resources.*

The project area is located within the Alpine Lakes Wilderness of the Okanogan-Wenatchee National Forest in Chelan County and includes Eightmile Lake and Eightmile Creek; it also includes Icicle Creek downstream to its confluence with the Wenatchee River in Leavenworth, Washington. The Alpine Lakes Wilderness is managed by the Forest Service. For this chapter, the **cultural resources study area** is based on the potential upstream (direct) and downstream (indirect) effects, as follows:

- **Upstream / Direct Effects:** Eightmile Lake perimeter, including the IPID dam; a short segment of FSR 7601-116, a segment of National Forest System Trail 1552 (Eightmile Lake Trail; non-motorized trail) between Eightmile Lake and FSR 7601-116, fly yard, the Icicle communications Repeater Station, National Forest System Trail 1579 (Fourth of July; non-motorized trail), and a segment of National Forest System Trail 1570 (Icicle Ridge; non-motorized trial).
- **Downstream / Indirect Effects**: FSR 7601, Eightmile Creek, and Icicle Creek to its confluence with the Wenatchee River.

The cultural resources study area is defined as a 1-mile buffer around the Upstream / Direct Effects area, and an approximate 0.25-mile buffer around the Downstream / Indirect Effects area, which extends from the dam structure down to where Icicle Creek reaches its confluence with the Wenatchee River, beginning 1-mile downstream of FSR 7601-116 (**Figure 13-1**). This narrower study area for Downstream / Indirect Effects was selected so that the discussion focuses on resources more directly associated within the drainages, rather than the wider landscape.

Figure 13-1. Cultural Resources Study Area for the Eightmile Dam Rebuild and Restoration Project.



13.1 Research Methodology

13.1.1 Existing Conditions

This section describes the methods used to analyze cultural resources within the cultural resources study area. A literature review and database search were conducted in December 2020 and May 2022 to identify existing and the potential for existing cultural resources and Indigenous place names, and TCPs within the study area. The Upstream / Direct Impacts area was initially partially surveyed during predesign work for this project (Anchor QEA 2018c). In October 2021, ESA completed an archaeological field surface survey along the FSR 7601-116 and repeater location (Ostrander et al. 2023); additionally, ESA documented the Eightmile Dam. An archaeological site form was completed for FSR 7601-116, and a Washington State Historic Property Inventory was completed for the Eightmile Dam (Ostrander et al. 2023).

Information about recorded and potential cultural resources and their environmental setting was obtained from existing studies, database searches, and relevant historic and archival resources. The following sources were reviewed:

- The Washington State Department of Archaeology and Historic Preservation (DAHP)'s *Washington Information System for Architectural and Archaeological Records Data*

(WISAARD) for previously completed cultural resources studies and previously recorded archaeological, ethnographic, and historic resources located within the study area.

- Digital collections of Washington State Archives.
- Digital collections of University of Washington and Western Washington University archives.
- Icicle Irrigation District consultation and archives.
- Confederate Tribes and Bands of the Yakama Nation website.
- Yakama Nation Museum and Cultural Center website.
- The Confederated Tribes of the Colville Reservation website.
- Published ethnographic studies and historic contexts.
- Contributions of ethnographic information relevant to the APE provided by the Yakama Nation (YN 2022).
- Contributions of ethnographic information relevant to the APE provided by the Confederated Tribes of the Colville Reservation.
- Archives of the Okanogan-Wenatchee National Forest.
- Other relevant online resources and historic maps.

Impacts on known cultural resources were assessed according to criteria for assessing Eligibility for the NRHP according to Section 106 of the National Historic Preservation Act (Section 106). The field survey effort to identify and assess potential Historic Properties was conducted in previously unsurveyed portions of the Upstream/Direct Effects study area, specifically the proposed repeater location and helicopter landing area on Icicle Ridge near Fourth of July Creek, and along the proposed motorized access route utilizing the path of FSR 7601-116. Finally, a field visit was made to record the current conditions of the Eightmile Dam.

> **Historic Registers**
>
> Historic Registers are official listings of historically significant resources. The Washington State Historic Preservation Office (SHPO) reviews, processes, and maintains national and state register lists for Washington sites.
>
> **National Register of Historic Places (NRHP):** Districts, sites, buildings, structures, and objects that have been identified and documented as being significant in American history, architecture, archaeology, engineering, or culture. These resources are found throughout the country and are at least 50 years old. Some exceptions are made for age and exceptional significance.
>
> **Washington Heritage Register (WHR):** The same criteria as NRHP. This is an honorary designation, and sites that are listed on the NRHP are automatically added to the WHR.
>
> Other historic registers include the Washington Heritage Barn Register and can include city and county listings. No local historic registers were identified for the Eightmile Dam Rebuild and Restoration Project.
>
> If a resource is listed in or eligible for listing in a historic register, impacts on this resource from a project must be considered and potentially mitigated depending on project activities.

13.1.2 National Register of Historic Places

This report evaluates known resources under the criteria established by the National Historic Preservation Act (NHPA) to evaluate resources for their potential eligibility to be listed in the NRHP. For a property to qualify for the National Register, it must meet one of the NRHP criteria for evaluation by being associated with an important historic context and retaining historic integrity of those features necessary to convey its significance (NPS 1997).

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess critical integrity and meet at least one of the following criteria:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of significant persons in or past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded or may be likely to yield, information important in history or prehistory.

Properties must also retain integrity. Integrity is the ability of a property to convey its significance. The seven aspects of integrity are: location, design, setting, materials, workmanship, feeling, and association. To be listed in the NRHP, a property must not only be shown to be significant under the National Register criteria, but it also must have integrity.

Historic Properties either retain integrity (that is, convey their significance) or they do not. To retain historic integrity, a property will always possess several, and usually most, of the aspects. The retention of specific aspects of integrity is paramount for a property to convey its significance. Determining which of these aspects are most important to a particular property requires knowing why, where, and when the property is significant. The evaluation of integrity is sometimes a subjective judgment, but it must always be grounded in an understanding of a property's physical features and how they relate to its significance.

13.1.3 Previous Cultural Resources Work for Eightmile Dam

A cultural resources assessment discipline report was prepared as a part of the Icicle Creek Water Resources Management Strategy PEIS in 2018 (Anchor QEA 2018c). This report related to multiple projects, one of which was repair and upgrade work for the Eightmile Dam. This project design and cultural resources assessment work was conducted in 2016, prior to flood damage and erosion at the dam caused by impacts of the 2017 Jack Creek Fire. During this work, an archeological surface survey was conducted along the accessible margins of Eightmile Lake and along the path of Eightmile Lake Trail. During this effort, Eightmile Dam was documented and recorded as an archaeological site and recommended as potentially Eligible for the NRHP as an individual listing, and as a contributing element of a potentially NRHP-eligible historic district, the Alpine Lakes Irrigation Historic District (ALIHD). The potential ALIHD was defined as including four irrigation water release systems within the Alpine Lakes Wilderness, these are located at Square Lake, Klonaqua Lake, Eightmile Lake, and Colchuck Lake.

At that time, Eightmile Dam was recorded on an archaeological site form; however, the site form was never filed with DAHP, likely as a result of the Eightmile Dam not being in ruins, but rather still functioning as a piece of historic-aged built environment infrastructure; in this state, it would be more accurately recorded as a built environment resource, rather than archaeological site. The four resources of the potential ALIHD were recommended Eligible for NRHP individually and as a district under the following criteria (Anchor QEA 2018c: 39):

- Criterion A for their association with historically significant and controversial water management in Chelan County.
- Criterion B for the unique style influenced by the extremely difficult terrain and constraints of mid-century construction methods.

- Criterion D for the potential to yield data about early 20th century engineering and construction.

No record of this determination being reviewed by DAHP has been identified during the research effort. Additionally, the recommendation under Criterion B appears to be in error. Criterion B relates to association with important persons. The text of the nomination under Criterion B in the assessment appears to more accurately describe Criterion C, which relates to association with significant materials, feats of engineering, or design. For the purposes of discussion in this EIS, the assumption is that the use of Criterion B in the original report was in error.

It should also be noted that the 2017 Jack Creek Fire and the emergency repairs to Eightmile Dam following this event have resulted in the dam being critically altered from its condition during this initial recording in 2016.

13.1.4 Impacts Methodology

Information on recorded and identified archaeological sites, historic structures, cemeteries, and TCPs within the study area was identified and compared with information on the EIS alternatives to assess potential impacts on cultural resources. To identify the potential for impacts from flood inundation, a geographic information system (GIS) map of inundation levels under the alternatives and various flood scenarios was reviewed. Other discipline reports were reviewed to identify impacts on water rights, transportation, and dam safety as they relate to impacts on cultural resources. Impacts are possible if construction or operations would result in removal, disturbance, grading, burial, erosion, contamination, or other ground-disturbing effects; changes in setting; and temporary and/or permanent exposure to noise, dust, and vibration.

Identification of Construction Impacts

Thresholds for potential significant impacts on cultural resources were defined based on the criteria used to assess adverse impacts for cultural resources listed or eligible for listing in the NRHP and the WHR. Construction impacts on archaeological resources would be an irreversible and permanent impact as these resources are non-renewable and any impact on the depositional integrity (i.e., context) of a protected archaeological resource would be significant. In the State of Washington, protected archaeological resources include all precontact archaeological sites (regardless of NRHP eligibility status) and all historic sites determined eligible for listing in the NRHP. Impacts on historic resources could also be reversible or irreversible (permanent). For example, permanent impacts could occur during construction if construction activity results in structural damage to a historic resource.

Archaeological Resources

For this analysis, significant construction impacts on archaeological resources are defined as follows:

- Significant: Archaeological resources are non-renewable, and any impact on the depositional integrity (i.e., context) of a protected archaeological resource would be considered a significant long-term impact. Any ground disturbance or modifications to the ground surface that impacts a protected archaeological site would be significant. Depending on the archaeological resource, impacts could be mitigated through resource-specific measures (e.g., minimizing the amount of disturbance, avoidance, documentation, or data recovery).

Historic Built Environment Resources

This analysis considers the potential impacts on a historic resource's integrity. Integrity is the ability of a historic resource to convey its significance. Integrity consists of seven qualities (location, design, setting, materials, workmanship, feeling, and association). For this analysis, significant construction impacts on historic resources are defined as follows:

- **Significant**: Significant construction impacts are defined in this analysis as those that are irreversible and permanently diminish the ability for a historic resource to convey its significance. For an impact to be considered significant, it must result in a decrease in the Historic Property's aspects of integrity that contribute to its ability to be listed on a register.

Identification of Operational Impacts

The project is expected to cause long-term (operational) impacts/changes/modifications to cultural resources as well as indirect impacts on cultural resources.

Archaeological Resources

For this analysis, the magnitude of long-term (operational) impacts on archaeological resources would be the same as described for construction.

Historic Built Environment Resources

For this analysis, long-term (operational) impacts on historic resources are considered significant as follows:

- **Significant**: Impacts are considered significant if they permanently diminish the integrity of a historic resource's essential physical features such that the resource is no longer able to convey its significance for which it is listed or potentially eligible for listing in a historic register.

13.2 Regulatory Context

Cultural resources within the study area are protected by several federal and state regulations, plans, and policies. Federal laws, regulations, and policies are presented in **Table 13-1**, and state laws, regulations, and policies are presented in **Table 13-2**.

Chelan County and the City of Leavenworth do not have formal Historic Preservation Programs. Preservation programs here are guided by federal and state laws and regulations.

Table 13-1. Federal Laws and Regulations Applicable in the Study Area

Regulation or Policy	Description
National Historic Preservation Act (NHPA) (Title 54 U.S.C.) Section 106 of the NHPA (36 CFR Part 800)	The NHPA was approved on October 15, 1966, for the management and preservation of historical and archaeological sites. Under this act, the NRHP, National Historic Landmarks List, State Historic Preservation Offices (SHPO), and Tribal Historic Preservation Offices (THPO) were created. Washington State's SHPO is the DAHP, which is the state agency that administers NHPA compliance in Washington. The procedures for implementing the NHPA are detailed in the Protection of Historic Places regulations. Section 106 of the NHPA requires federal agencies to consider the effects of project undertakings, project approvals, or project funding on historic properties. This process requires consultation with the relevant THPO, Native American tribes, and Native Hawaiian organizations.

Regulation or Policy	Description
Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. Chapter 32)	Enacted on November 16, 1990, NAGPRA establishes rights for lineal descendants, Native Americans and tribes, and Native Hawaiian organizations to repatriate their culturally affiliated items, including human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items and the intentional and inadvertent discovery of Native American cultural items on federal and tribal lands only.
Archaeological Resources Protection Act (ARPA) (16 U.S.C. Chapter 1B)	ARPA was enacted to strengthen the permitting procedures required for conducting archaeological fieldwork on federal and reservation lands. Includes ownership acknowledgement, preservation of objects and associated records in a “suitable” institution, and prohibits public disclosure.
Procedures for State, Tribal, and Local Government Historic Preservation Programs (36 CFR Part 61)	Federal regulation authorizing state and tribal historic preservation programs and certifies local governments to carry out the purpose of the NHPA. This is the basis for historic preservation programs and ordinances.

Table 13-2. State Regulations and Guidelines Applicable in the Study Area

Regulation or Policy	Description
State Environmental Policy Act (SEPA) (RCW 43.21C, WAC 197-11-330)	SEPA requires government decision-makers to consider the likely environmental consequences of a proposal and require mitigation measures.
Governor’s Executive Order 21-02	Washington State Governor’s Executive Order 21-02 (GEO 21-02, formerly GEO 05-05) requires agencies to consult, or delegate consultation to non-state recipients of state funds, with DAHP and affected tribes on the potential effects of projects on cultural resources proposed in state-funded construction or acquisition projects that will not undergo Section 106 review, including grant or pass-through funding that culminates in construction or land acquisitions, to determine potential effects to cultural resources. It requires that the state agency provide documentation of that consultation to DAHP.
Washington Heritage Register (Senate Bill 363; RCW 27.34.200, WAC 25-12)	Created March 19, 1971, Executive Session of the State of Washington Advisory Council on Historic Preservation and maintained by DAHP. Actions affecting resources listed on this register by any subdivision of state government or recipient of state funds must comply with SEPA and Executive Order 21-02.
Archaeological Sites and Resources (RCW 27.53)	Relates to the conservation, preservation, and protection of archaeological sites and resources.
Archaeological Site Public Disclosure Exemption (RCW 42.56.300)	Restricts the distribution of information about the location of archaeological sites to the public for the protection and preservation of those sites.
Human Remains (RCW 68.50)	Relates to the protection, management, and processes in the care of human remains.

Regulation or Policy	Description
Indian Graves and Records (RCW 27.44)	Relates to the protection, management, and processes in the care of Native American cemeteries, historic graves, and related records.
Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60)	Relates to the preservation and protection of abandoned and historic cemeteries and graves including human remains.
Archaeological Excavation and Removal Permit (WAC 25-48)	Relates to the procedures of application for and review processes of archaeological excavations and removals; permits are issued by DAHP.

13.3 Affected Environment

This section presents a broad overview of the archaeological, cultural, and historic context of the cultural resources study area and existing resources. The cultural resources study area includes the Upstream / Direct Effects, Downstream / Indirect Effects and buffer as described on page 13-2 and shown in Figure 13-1. This context is organized into three subsections—archaeological, cultural, and historic—with additional focused subsections. It is primarily based on information published in 20th and 21st century ethnographic studies, histories, maps, and online resources. Information in the cultural section is organized into two subsections based on cultural groups and bodies of ethnographic information: *Cultural Context— Wenatchapam* and *Cultural Context—Wenatchi*. The cultural contexts have been developed from two distinct bodies of knowledge. The Wenatchapam context has been adapted from contextual information provided by the Yakama Nation and is based on knowledge held by the tribe about cultural use and practice within the study area (YN 2022). This knowledge has been shared to the extent necessary to provide context, but does not represent a complete history of the area. This knowledge shared by the tribe was on an as-needed basis.

The second subsection is derived from a literature review of published in 20th and 21st century ethnographic studies, histories, maps, and online resources, and is augmented by sources provided by the Confederated Tribes of the Colville Reservation. While the Confederated Tribes of the Colville Reservation have provided information to inform this section, it should not be taken as a statement by the tribe, but rather presenting a context based on publicly available literature that has then been commented on, reviewed, and supplemented by information held by the Confederated Tribes of the Colville Reservation.

The ethnographic record can vary in spelling and interpretations. The context provided below utilizes spelling from the tribes when known. Information shared by the Yakama Nation was also incorporated into the Wenatchi context.

Archaeological Context

The study area is within the upland mountains of the region referred to by archaeologists as the South-Central Plateau culture area (Ames et al. 1998; Chatters and Pokotylo 1998:73). The South-Central Plateau culture area encompasses the Mid-Columbia River basin from the Columbia River's confluence with the Yakima to Spokane rivers and includes the Yakima and Wenatchee River drainages. It is bounded on the west by the Cascade Mountains. Use of this region during the precontact-era can also be understood through traditional knowledge and cultural practices of the region's Indigenous people.

Archaeological understanding of the South-Central Plateau is primarily based on investigations of riverine sites east of the study area where more known sites exist. The chronology of the region is broken into four periods, based on these riverine sites but also informs the use of uplands. The chronological periods and characteristics were developed in previous research and span from approximately 11,500 BC to 1720 AD (Ames et al. 1998; Ames and Marshall 1980; Boreson and Galm 1997; Chatters and Pokotylo 1998:78; Galm et al. 1981; Galm and Matsen 1985; Ray 1933; Schalk 1983). The upland mountain setting also suggests that the study area was used by Indigenous peoples on the west side of the Cascades. The Puget Sound region has been broken into five periods that are similar in characteristics to the Plateau but utilize a different chronology (Ames and Maschner 1999; Blukis Onat et al. 2001; Kidd 1964; Kopperl et al. 2016; Matson and Coupland 1995; Nelson 1990). These five periods span from approximately 14,000 calibrated years before present (BP) to 200 calibrated BP. Artifacts, features, and scientific dating provide guidance to associate a specific time period to an archaeological site. These can include a variety of lithic and bone tools such as projectile points, scrapers, flakes, hammerstones, antler wedges, needles, and bone awls. Ornamental items can include marine shell beads, soapstone pipe stems, and ochre. Processing, gathering, and food storage tools can include antler digging sticks, hopper mortar bases, weirs, and woven baskets. Seasonal and permanent campsite and village features can include evidence of pit houses, longhouses, hearths, and food storage buildings, among others.

Alpine lakes, such as Eightmile Lake, would have been attractive camp and gathering locations for both Plateau peoples as well as groups seasonally migrating between the Plateau and west side of the Cascades. The lake headwaters would have been important gathering locations for these two interconnected cultural groups. Data recovery excavations at the drainage for the Wenatchee River at Lake Wenatchee have recorded a dense material record, encountering artifacts indicative of both regions. While this excavation is approximately 20 miles north of Eightmile Lake, it provides material evidence of a long-interconnected history between cultural groups who have used seasonally available passes in the mountains to navigate a shared landscape. The known precontact-era sites within the study area have not been conclusively dated. However, known sites have produced artifact assemblages containing materials commonly associated with Plateau Period 1B sites (13,000 BP–9000/8400 BP), such as river mussel shell and hammerstones as well as side-notched projectile point types commonly associated with Period III (5900 BP–230 BP) sites. Based on the current understanding of settlement patterns in the South-Central Plateau, use of the study area would likely have been related to seasonal resource gathering and may contain associated base camps.

Cultural Context—Wenatchapam

This section has been adapted from a report prepared by the Yakama Nation and provided to Ecology on December 6, 2022 (YN 2022).

The study area is within the traditional territory of *Wenatchapam,* a signatory Band to the 1855 Treaty, and a multi-lingual group who likely used *Ichishkinsinwit* or Sahaptin as their first language. *Ichishkinsinwit* is of the land and rooted in the principles of the Creator's law *Nami Tamanwit*. This language originates from the air and water sounds created through the natural landscape and its features. This language is used in the longhouse to honor and bless the resources that sustained life. The language is interwoven into the cultural practices, the physical locations, as well as the overall understanding and connection to the land and communication with the Creator. The honoring of resources and blessings is a fundamental principle of the *Wenatchapam* people. The *Wenatchapam* people followed a practice known as, *Nami Tamanwit*, which was a practice and procedure that was distinct from that of tribes to the north and in particular those who resided in the greater Okanogan Valley and along the portions of the coastline (YN 2022).

The *Wenatchapam,* along with the *Entiatnapam, Chelanpam, and Methowpam,* are a part of the larger tribe known as the *Pisqiouse. Pisqiouse* is also shown in the ethnographic record as "Pisquouse" and "Pisquows" (Gibbs 1854; Hodge 1910:263, 932; Lahren 1998:488; Spier 1936:14). Hodge (1910: 932) notes Wenatchi as "probably a band of the Pisquows, formerly on the Wenatchee r." and were located on both the Yaka[i]ma Reservation in 1850 and with the Colville in 1910;

further Hodge translates Yaka[i]ma *winätshi* to “river issuing from a canyon.” Hodge (1910: 263) notes the *Pisquows* name may have been derived from the Yaka[i]ma word *pĭ̌sko* meaning “bend in the river” and states the “Pisquows proper or remnant of them are now on the Yakama Reservation.” Ethnographers further connect the *Pisqiouse* to the Yaka[i]ma through intermarriage (Gibbs 1854:412; Mooney 1896:736). The *Pisqiouse* travelled great distances including, but not limited to, along the Fraser River in British Columbia (YN 2022:6). The *Wenatchapam* followed a seasonal subsistence pattern from the Columbia River to the crest of the Cascade Mountains (YN 2022).

The traditional territory of the *Wenatchapam* is within the Wenatchee River drainage where other tribes may maintain some level of use. However, the use they maintained was controlled traditionally and politically by the *Wenatchapam* leaders whom elected a representative to sign the Yakama Treaty of 1855 (YN 2022).

The *Pisqiouse* were signatory to the Yakama Treaty of 1855 (12 Stat. 951) by way of *La-hoom* (*Pisqiouse/Entiatnapam*) and *Tecolekun* (*Pisqiouse/Wenatshapam*). *Tecolekun* was elected as a representative by leadership to represent the Wenatchee, Columbia, Entiat, and Chelan. He was also recognized in this capacity by both parties present at the Walla Walla council grounds[1](YN 2022).

Ichishkinsinwit provides further traditional description for *Wenatchapam* and *Pisqiouse.* The sound *Wenatcha* reflects the turbulent water that flows through the mountain, the water, and air come through a canyon (*weh*), fall (*nah*), and crash on the rocks (*tchah*). The name is used both to identify the characteristics of the river, today known as the Wenatchee, itself or to identify the *Wenatchapam* fishery, which is also known as *Speliyis Wanawish* as part of the creation story to the fishery. The suffix *pam* refers to people from the place *Wenatcha.* Specifically, its meaning is further characterized by the people that are from the water (the giver of life) that flows into the river where the water comes through a canyon and crashes on the rocks. Therefore, the *Wenatchapam* are defined by name as those from the watershed of the Wenatchee River (YN 2022). The *Pisqiouse* or *pítxkayús* is an *Ichishkinsinwit* name that means, “the people who go up into the mountains” (Oliver and Meninick 2022 as cited in YN 2022). Additionally, *“pítxkanus”* is associated with the mountains (Beavert and Hargus 2009 as cited in YN 2022).

The earliest known recorded use of the word *Wanatcha* was from the notes of the Lewis and Clark Expedition in October of 1805; maps also included the spelling *Wah na á chée* (Clark 1805). Tribal leaders, including the Great Chief *Cutsanim* who resided near the confluence of today’s Wenatchee River, provided the translation. Cutsanim or *paxat-sa-nim* relates to the five sacred figures known as part of the traditional oral story of the history of the *Shyikes* and *Wenatchapam* (YN 2022).

The *Wenatchapam* often intermarried with the *Pshwanwapam* who occupied the upper portions of the Yakima River watershed and the western shores of the Mid-Columbia. In particular, the gathering place known as Teanaway or *Teanawins* was a place where many *Pshwanwapam* and *Wanatchapam* found their significant others. This gathering place was hosted by the *Pshwanwapam* in their traditional territory. This relation is further described in oral history as it relates to the *Wáwpu* or goat people/hunters (YN 2022).

Researchers have presented this understanding, finding that the *Pisqiouse* were heavily intermarried with the Yakama as discussed above (Mooney 1896:736; Gibbs 1854:412) to the extent it was observed they “have almost lost their nationality” (Gibbs 1854:412).

The traditional use area of the *Wenatchapam* extended into the Yakima River watershed on the relationship held by *Wenatchapam* and *Pshwanwapam* who often participated in traditional use and festival events in a way that overlaps. The *Wanatchapam* maintained close ties with the neighboring

[1] See Yakima Tribe v. the United Sates (Defendant). 1963. Confederated Tribes of the Colville Reservation, et al (Intervenor). (July 29, 1963). Before the Indian Claims Commission, Docket 161. In Indian Claims Commission Decisions. Vol. 12; Part A. Native American Rights Fund. Boulder CA.

Pshwanapam through marriage and shared language (Ray 1936; Schuster 1998; Anasatsio 1972). The *Pshwanwapam* (often discussed as Yakama, Kittitas, or Upper Yakama) are the people who are from the water where the rocks fall into the river, the name and description referring to the Yakima River watershed, whose fishery was controlled and managed by the *Pshwanwapam* (YN 2022).

Traditional use or Usual and Accustomed places define a different understanding than traditional territory and span a much greater area. This distinction is important for intertribal use of an area; traditional territory refers to an area under a group's exclusive political control while traditional use area defines an area a group may have used as a guest (YN 2022). Ray (1936:21) states: "… *Thus, the hunting territory of one group might be quite open to use by another even though the bounds be highly specific. This freedom of use was the rule among many of the Salish groups. But among the Yakima [sic], for example, outsiders were required to obtain formal permission from a chief before hunting grounds might be used and even then the length of time was definitely limited*." Specific practices, ceremonies, and covenants were conducted before entering or using another tribe's land. In the case of the *Pshwanwapam* and *Wenatchapam,* they were bands of different tribes (YN 2022).

During the Yakama Wars in 1855, a Wenatchapam leader, *Sulktalthscosum* (Chief Moses), led a diverse group of followers, including some from well outside of the Wenatchapam traditional homelands (Northern Salish Tribes and Paiute). Chief Moses went against many of the established leaders at the time, and his style was considered nontraditional (YN 2022).

Chief Moses refused to recognize the Treaty with the Yakama in 1855 and petitioned the United States government for the establishment of a reservation. In 1879, the Columbia Reservation was established on his behalf (Miller 1998). Chief Moses later relinquished the Columbia Reservation and relocated to the Colville Reservation.

The Yakama Nation considers the project area to be within at least two separate TCPs, which the tribe has not been afforded the opportunity to document formally.

Cultural Context – Wenatchi

According to the Confederated Tribes of the Colville Reservation, the study area is within the traditional lands of the šnṗəšqʷáw̓šəxʷ or Wenatchi (meaning "People in the between") (Bouchard et al. 1988:135-145; CTCR 2021a). Ethnographic records also list Wenatchi known as the Wenatchee / Wenatshapam / P'Squosa people, who according to Miller (1998) speak a Columbian *nxaʔamxcin* Interior Salish language; (Bouchard et al. 1988:135-145; CTCR 2021a; Kincade et al. 1998:51; Miller 1998:253; Spier 1936:14). The šnṗəšqʷáw̓šəxʷ are considered part of the Middle Columbia River Salishan culture group, of which several distinct tribes of the Plateau Culture share similarities in subsistence patterns, structures, and other cultural practices (Miller 1998:253-270; Spier 1936). Descendants of the šnṗəšqʷáw̓šəxʷ include but are not limited to members of today's federally recognized Confederated Tribes of the Colville Reservation and the Confederated Tribes and Bands of the Yakama Nation. Indigenous peoples of this region have been using the study area and its vicinity for various levels of habitation, resource gathering, travel, and other traditional cultural practices since time immemorial.

Villages associated with šnṗəšqʷáw̓šəxʷ were located along Icicle Creek, the Wenatchee and middle Columbia rivers, along with other permanent and seasonal campsites ideal for resource gathering, hunting, and travel. The šnṗəšqʷáw̓šəxʷ village located at the mouth of Icicle Creek, within the Downstream / Indirect Effects portion of the study area, was a large trade center and included a significant fishery known for its abundance of salmon. At the height of fishing season, thousands of šnṗəšqʷáw̓šəxʷ and neighboring tribes would congregate here to share in its bounty (CTCR 2021a; Miller 1998; Ray 1936). Tribal members recall the description of Icicle Creek "running red" due to its plentiful salmon runs (Thompson 2002). This traditional fishery, also known as the Wenatshapam Fishery, or Wenatcha, or Spelyis Wanawish, as discussed above along with nearby rivers, tributaries, valleys, and mountain ranges, continue to be important resources for subsistence, teachings, and practice of traditional cultural lifeways for area tribes. The Confederated Tribes of the Colville Reservation confirmed there are named places within the project area not available for public record (personal communication, Downes 2022). Additionally, along with the fishery, published documents identified the following named place within the Upstream / Direct Effects and Downstream /Indirect Effects study areas: *Na'sik-elt* is a named used for what is known today as Icicle Creek; the original word means "narrow bottom canyon, or gorge" (Sylvester 1943, as cited in personal communication, Downes 2022). Ethnographic records can include information that may have been misinterpreted or imprecisely documented when initially recorded. It is possible that the locations known today as Eightmile Lake and Eightmile Creek, along with surrounding geographical features, may have associated place names. The Wenatchee River is named for the people that resided along its course. As discussed above, *Wenatcha* and *"Wah-na á chée"* were used in records from the Lewis and Clark Expedition in October of 1805. Additionally, Wenatchee in Yakama is "winatshi," meaning "river issuing from a canyon" (YN 2022). Archival resources indicate it was also known as "Pisquouse," "Wenatshapan[m]," and "Wah-na-a-cha" (Judge 1925:20). The villages of sċəṁáẇs (meaning "narrow in the middle") and sĭnpŭsqṓĭsoḣ were located at and near the present location of Leavenworth (Miller 1998:254 [no. 112]; Ray 1936:119, 142[no. 8]; Spier 1936:14 [no. 5]; Teit 1928). These names may refer to the same or related place, and additional unpublished named places may be present in the study area and its vicinity.

Tribes do not limit use or significance on the natural world. Animals, plants, geological, atmospheric, and astrological features play a role in traditional oral stories and cultural practices. Thousands of species have documented use. The traditional šnṗəšqʷáw̓šəxʷ diet is based on fishing, hunting, and gathering of roots, bulbs, and berries. Salmon is a dietary staple; traditionally, the First Salmon Ceremony includes several days of rites connected to the materials used to create the weirs, the river, the catch, and the processing of the salmon (Miller 1998). Other water resources include sturgeon, suckers, Pacific lamprey, trout, roe, and shellfish (Miller 1998). Seasonal camps would be set up in the mountains and foothills for hunting and gathering, with some families staying through the winter months (Miller 1998). Mountain goat, deer, elk, and other alpine game supplemented fishing resources throughout the year. Several species also hunted for use (but not for consumption) include but are not limited to coyote, mink, wolf, and land otter. A wide variety of plants serve many purposes in traditional practices; these include but are not limited to willow shoots, cedar roots, bast, tules, cattails, Oregon grape, birch, fir, cottonwood, pine, sagebrush, and hemp. One of the šnṗəšqʷáw̓šəxʷ traditional camas and root gathering places and campsites located within present-day Leavenworth has been recorded as a TCP (Leavenworth Camas Harvesting Area–45CH928). Important cultural plants for the Confederated Tribes of the Colville Reservation include but are not limited to: huckleberries, foamberry or soapberry, bitterroot, white camas, chuckluse or Canbyi's biscuitroot, Indian potatoes or lance-leaf spring-beauty, Indian carrots or yampah, cous-cous or Canby's lovage, black camas, Indian hemp or hemp dogbane, tule or hardstem bulrush, little white camas or northern biscuitroot, and Western sweet-cicely or sweet-root (CTCR 2022).

Mountain pass trails ran throughout the Cascade Mountains and allowed for trade and access among the interior tribes and those west of the mountain range (CTCR 2021b; Gibbs 1877:167). These trails were also used by non-Indigenous groups as settlement in the valley increased. Surveyor records from the late 19th and early 20th centuries show trails along Eightmile and Icicle creeks as well as leading from the Wenatchee River and dotting the Cascades (USGS 1904; U.S. Surveyor General 1892, 1907, 1913, 1917, 1924).

The 1855 Treaty of Yakama, held at Walla Walla, established the Yakama Reservation (Lahren 1998:488). In addition to establishing the Yakama Reservation, the Treaty, as ratified on April 15 1859 in article 10 specified, "*a tract of land not exceeding in quantity one township situated at the forks of the Pisquouse or Wenatshapan Fishery; which reservation was to be surveyed and marked out whenever the President may direct subject to the provisions and restrictions the same as other*

Indian reservations" (as quoted in Judge 1925: 20). In a 1910 letter to the Honorable Commission of Indian Affairs, Department of the Interior, Washington D.C. John Hermilt and Louis Judge, wrote to recognize the tract thus referred to in the treaty, "*would have been located below the forks of what are now the Wenatchee and Icicle Rivers, just at or below the present town of Leavenworth, and that treaty should have made it clear that this was for the Pisquouse of Wenatchee Indians*" (Hermilt and Judge 1910 as cited Judge 1925: 22).

Boundaries were never properly surveyed or recognized for the Wenatchi Reservation, and the šnp̓əšqʷáw̓šəxʷ were encouraged to relocate to the Moses-Columbia Reservation, created under executive order and later revoked (CTCR 2021a; Lahren 1998; Mass 1983; Thompson 2002). The study area is within the area that was to have been included in the reservation land for the šnp̓əšqʷáw̓šəxʷ located at the forks of the Wenatchee and Icicle rivers (Judge 1925:22; Miller 1998; WDFW 2017). Many šnp̓əšqʷáw̓šəxʷ remained on their land, applying for homesteads, but fees and taxes forced many to relocate to the Colville Reservation (CTCR 2021a; Thompson 2002).

According to the Confederated Tribes of the Colville Reservation, they have registered Icicle Creek (nsi'qəl 't) as a TCP from Johnny Creek to the confluence with the Wenatchee River (personal communication, Downes 2022).

Historic Context

Overview

Water, logging, and mining resources within the present-day central Cascades have played a key role in the development of its surrounding valleys. Evidence of these 19th century to early 20th century activities can still be found spread throughout the Okanogan-Wenatchee National Forest and neighboring national forests as identified in the archaeological and archival record (Bruce et al. 1994; Carter 1978; Valenta 2012). Roads created to provide access to these mining activities contribute to the boundaries of the current Alpine Lakes Wilderness (Lindholdt 2019). A small settlement was established at Icicle (current Leavenworth), and eventually platted in 1893. The town was later renamed for Charles Leavenworth, an investor who purchased several tracts of land along the proposed Great Northern Railroad route through the Wenatchee Valley (Arksey 2010). The late 19th century included several individual and small cooperative irrigation efforts that coincided with the completion of the Great Northern Railroad in 1892 (Bruce et al. 1994). Irrigation districts were formed to build, manage, and improve irrigation works. These districts became municipal corporations with the capacity to issue bonds via property and water rights, condemn right-of-way, and conduct levy assessments (Dorpat and McCoy 1998). Leavenworth was incorporated in 1906.

At the turn of the 20th century, state officials recognized a need for salmon hatcheries. Recreational and subsistence fishing and trapping activities had been depleting resources in the area. Recreational campsites were in place along Icicle Creek in the early 20th century, and at least 5,000 visitors traversed the Icicle Trail in 1916 (Bruce et al. 1994). By 1938, the Bureau of Reclamation sought to build a fish hatchery along Icicle Creek with storage facilities located at the high-altitude alpine lakes. The Leavenworth National Fish Hatchery (LNFH) and its residential complex were completed in 1941 and brought with it job opportunities for the community (Bruce et al. 1994; USFWS 1997).

Alpine Lakes Wilderness

Eightmile Lake is located within the Alpine Lakes Wilderness. Interest in a protected Alpine Wilderness by conservation groups in the 1950s and 1960s led to two proposed areas: the Alpine Lakes and the Enchantments. In the 1960s, the Forest Service was expanding its road system including along Icicle Creek (Icicle Road/Forest Service [FS]-76) (Marsh 2007; USGS 1966, 1967, 1977). According to historical maps and aerial imagery, FSR 7601-116 / Eightmile Spur Road was in place by at least 1975 (USFS 1962, 1966, 1969, 1975a, 1975b). In 1964, U.S. Congress passed the Wilderness Act, which established wilderness areas administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. Trails leading to Eightmile Lake were in place by the 1960s (NETROnline 2021; USFS 1962; USGS 1967). Many early 20th century trails throughout the national forests were developed from the initial Indigenous, early settlement, and surveyor routes, with additional “trunk lines” created for fire patrols; shelters would be built along trails for workers (Bruce et al. 1994). Civilian Conservation Corps workers helped develop many of the existing trails within the central Cascades prior to World War II; a campsite at Eightmile Lake was in place by 1936 (Bruce et al. 1994). In July 1976, the Alpine Lakes Area Management Act created a 940,516-acre area in the Mt. Baker-Snoqualmie and Wenatchee National Forests (USFS 1979). The area included an Alpine Lakes Wilderness and Intended Wilderness lands and surrounding multi-use management lands (USFS 1979). U.S. Congress expanded the Alpine Lakes Wilderness by 22,000 acres in 2014 (Lindholdt 2019); the wilderness is approximately 414,322 acres. Eightmile Lake is within the Enchantment Permit Area (see Chapter 10, *Recreation*). Permit and reservation systems were established to help manage camping and trail overuse. The wilderness and intended wilderness have contributed to recreational, tourism, and economic development of the surrounding area.

Icicle Irrigation District/Eightmile Dam

The earliest cooperative irrigation companies in the Peshastin area began in the 1800s, with the Icicle Irrigation District (IID) and Peshastin Irrigation District (PID) formed in the early 1900s. Eightmile Dam was one of several water storage facilities constructed during the early part of the 20th century by the IID and PID. The IID and PID constructed their first dams at Colchuck Lake and Klonaqua Lake in the early 1920s, and the dams at Square Lake and Eightmile Lake later on. The USFWS constructed dams at Upper Snow Lake, Lower Snow Lake, and Nada Lake in the 1930s and early 1940s (Bundy 2016). The Icicle Irrigation Company (IIC) was established in 1910 to construct a series of irrigation canals to serve the agricultural needs of the surrounding community, with the Icicle Creek Canal completed in 1913. In 1918, the IID was formed, taking over management of the resources maintained by the former IIC (Spokesman-Review 1918). From 1915 into the 1930s, the IIC and later IID worked to modernize the system, removing most of the wood flume channels and replacing them with concrete cast-in-place structures (personal communication, Jantzer 2021). Construction of Eightmile Dam began in 1927 and was completed in 1929 (IID 1927a, 1929). Original design drawings detail a stone and cement mortar dam extending 35 feet deep to a concrete base, supporting a timber crib spillway and 36-inch concrete outlet pipe with a rock retaining wall in the creek channel (IID 1927b). Between the 1960s and 1970s, another series of extensive modernization projects were completed, upgrading the entire system, including replacing the original wood stave pipes. Prior to 1973, flooding resulted in 30 feet of the earthen embankment of the dam being washed away (IID 1973). During the 1990s, another large flood event resulted in runoff overtopping Eightmile Dam and washed away a 15-foot-wide portion of the earthen dam element (Polly 2018). In 2015, the outlet pipe partially collapsed as a result of deterioration of the original logs used to form the pipe. In 2018, necessary emergency repairs resulting from the 2017 Jack Creek Fire resulted in a large section of the earthen portion of the dam being removed and replaced, installation of riprap, replacement of the 13-foot-wide spillway with a 68-foot spillway to accommodate more runoff, and the removal and replacement of the original pipe and ditch (Polly 2018). A Washington State Historic Property Inventory (HPI) form, which further details the dam and its significance, has been completed by ESA for this EIS (Ostrander et al. 2023).

Existing Resources

A review of DAHP's WISAARD database identified multiple cultural resources studies completed within the study area; the majority of these have been conducted downstream of Eightmile Lake. These studies include descriptions of precontact and settlement land use of the study area and its vicinity. Surveyors have identified several cultural resources, including archaeological sites, historic-aged built environment resources, a cemetery, and a TCP.

<u>Upstream / Direct Effects / Eightmile Dam and Lake</u>

No historic register-listed built environment resources, cemeteries, or TCPs have been recorded or mapped in WISAARD within the study area (DAHP 2020, 2022). However, the Eightmile Dam is of historic age, and was recorded as an archaeological site during the preliminary assessment for this project as discussed above (Anchor QEA 2018c). The site was recommended individually Eligible, and to be part of a historic district comprising the historic-aged irrigation dams within the greater Alpine Lakes Wilderness. DAHP never reviewed the site assessment or site form, and as a result did not issue a Smithsonian trinomial (a three-part ID number given to recorded cultural resources) for Eightmile Dam, and no DAHP evaluation of the built environment resource or the eligibility recommendations from Anchor QEA (2018c) was conducted. As of the time of this EIS assessment, the resource has no existing records within the DAHP WISAARD database (DAHP 2020, 2022). For the purposes of this EIS, the dam is considered a built environment feature, not an archaeological site.

The full historic context of Eightmile Dam, its NRHP evaluation, integrity discussion, and accompanying HPI form are found in the Cultural Resources Assessment (Ostrander et al. 2023). ESA's evaluations found that the 2017 Jack Creek Fire and subsequent rebuild and modification to the dam resulted in a critical loss of integrity based on changes to the dam's form, design, and materials compared to the condition in which the dam was originally recorded.

Eightmile Dam no longer retains sufficient integrity to reflect its association with Criterion C or D, due to the significant modifications described above as part of the 2018 dam repair project, but does appear to retain sufficient integrity to reflect its associations with water management in Chelan County (Criterion A). As such, it would be considered a contributing element to the potentially NRHP-eligible ALIHD. For a property to be eligible for listing in the NRHP, it must be significant under at least one of the criteria and possess integrity. The dam is recommended Not Eligible for individual listing in the NRHP under any criteria and does not retain sufficient integrity to convey its potential significance as an individual resource. As a contributor to the ALIHD, Eightmile Dam does appear to retain sufficient integrity to reflect its associations with water management in Chelan County (Criterion A), and as such would be considered Eligible under the National Register as a contributor to the potential ALIHD. Under this listing status, continued maintenance and operation of the dam as an active irrigation property is critical to maintaining its integrity of association with irrigation activities in the local region.

Cultural Resources Surveys

One cultural resources survey, consisting of an archaeological surface survey along the existing Eightmile Lake Trail and of Eightmile Lake itself, was conducted in 2016. The survey identified the Eightmile Dam as being potentially Eligible for listing in the NRHP (Anchor QEA 2018c). A cultural resources survey was previously conducted by the Forest Service that covers the area containing the helicopter fly yard (Fink 1996a). No cultural resources were observed during this identification effort. Additionally, a cultural resources survey of the proposed road improvement along FSR 7601-116, and at the proposed repeater location and its associated non-motorized access route along the existing Fourth of July Creek Trail #1579 and Icicle Ridge Trail #1570, was conducted by ESA (Ostrander et al. 2023) as a part of this EIS assessment. A full description of that effort is included in Ostrander et al. (2023).

Archaeological Sites

At the onset of this effort, a single archaeological site, a small timber cabin with a gabled roof associated with fur trappers circa 1920s–1950s, has been recorded and mapped in WISAARD in the study area (DAHP 2022). This site was destroyed by wildfire in 1994 (Fink 1996b). ESA recorded an additional archaeological site during the archaeological survey for this EIS (Ostrander et al. 2023). The site, the circa 1970 road prism of FSR 7601-116, consists of the double-track engineered road prism along the approximately 1-mile portion of the roadway that is proposed for modification as part of this project. No other features besides the engineered prism were identified during the survey.

Historic Register-Listed Built Environment Resources

No historic register-listed built environment resources have been recorded and mapped in WISAARD within the study area (DAHP 2022). As discussed above, Eightmile Dam itself was recorded as part of the preliminary cultural resources assessment for this project as an archaeology site, and the resource was recommended as potentially Eligible for listing on the NRHP by the surveyors (Anchor QEA 2018c). This recommendation was not reviewed and commented on by DAHP, and since this recording, Eightmile Dam has been damaged and subsequently rebuilt, resulting in a change in its overall historic integrity.

Historic-Aged Built Environment Resources

No built environment resources determined eligible for listing in or listed in the NRHP have been recorded and mapped within the study area (DAHP 2022). The Eightmile Dam was built ca. 1927 and has been recorded as part of the PEIS work.

Cemeteries

No cemeteries have been recorded and mapped in WISAARD within the Upstream/Direct Effects (Eightmile Dam and Lake) portion of the study area (DAHP 2022).

Traditional Cultural Properties

No TCPs have been recorded and mapped in WISAARD within the Upstream/Direct Effects (Eightmile Dam and Lake) portion of the study area (DAHP 2022). During comment review for this EIS, the Yakama Nation indicated that two or more TCPs overlap the project area.

<u>Downstream / Indirect Effects / Icicle Creek</u>

Cultural Resource Surveys

Twenty-three cultural resources surveys were identified within the Downstream / Indirect Effects portion of the study area (DAHP 2022). Fifteen of these identified no cultural resources. The remaining eight surveys identified at least one cultural resource. One survey, conducted in 1983, noted the traditional fishery located at the confluence of Icicle Creek and the Wenatchee River; the surveyors also documented the potential of a "major seasonal use campsite," and an isolated precontact-period artifact was recorded in the vicinity of the Eightmile Creek Campground (Maas 1983). Surveys conducted in 2017 and 2018 on Icicle Creek recorded portions of the historic City of Leavenworth water system, including a water intake structure and screen house, built circa 1940s–1950s and a water control structure built ca. 1920–1960 (Lancaster 2017, 2018). A survey conducted in 1996 at the site of the LNFH recorded three debris scatters dating from the late 1800s to 1940s (Speulda 1996). A survey conducted in 2018 at a potential pump site located northeast of the confluence of Icicle Creek and the Wenatchee River recorded a scatter of debris dating from the 1930s to 1960s (Taylor and Pierson 2018).

Archaeological Sites

Twelve archaeological sites have been recorded and mapped within the Downstream / Indirect Effects portion of the study area (DAHP 2022). Nine locations are precontact sites; of these, one site has been determined Eligible for listing in the NRHP. This determined Eligible site was identified during survey work in 2018 and consists of a lithic artifact scatter, fire-modified rock, charcoal fragments, shell, and a projectile point near the confluence of Icicle Creek and the Wenatchee River (Tarman 2018a). The remaining precontact sites include one lithic scatter, two lithic isolate sites, two rock shelter sites with lithic scatters, one rock art site, and two cultural modified peeled cedar trees that contain a total of five trees whose bark was harvested for basketry and other uses (Baugh et al. 1995; Christensen et al. 1995; Duncan and Fink 1997; Krauthoefer and Steinmetz 1995, Query et al. 1995a, 1995b; Steinmetz et al. 1995a, 1995b). These sites are either not eligible for listing in the NRHP (isolate sites) or have not yet been evaluated for listing in the NRHP by DAHP (DAHP 2022). Some of the precontact sites contain lithic artifacts that have been disturbed by modern camping activity. The precontact-period archaeological sites do not have known chronological context.

Previously recorded historic-era archaeological resources are comprised of three sites. Two are related to historic-era water structures. The sites both date from the early to mid-1900s, and have been determined Not Eligible for inclusion in the NRHP (Lancaster 2017; Tarman 2018b). The third site is an historic debris scatter dating to ca. 1900s to 1960s; this site has not yet been evaluated for listing in the NRHP by DAHP (DAHP 2022).

Historic Register-Listed Built Environment Resources

Two register-listed properties have been recorded and mapped in WISAARD within the Downstream/Indirect Effects portion of the study area (DAHP 2022).

The LNFH (45CH582/ DAHP Property ID 700015), located at 12790 Fish Hatchery Road, is listed in the NRHP and the WHR. The hatchery complex was built between 1939 and 1941, and occupies 158 acres on both banks of Icicle Creek south of the confluence of Icicle Creek and the Wenatchee River (Speulda 1997).

The Colokum Dairy Farm, located at 9024 E Leavenworth Road, is listed on the Washington Heritage Barn Register. The farmhouse, barn, milkhouse, and pasteurizing building were all built in about 1920, and were listed as being in good to fair condition in 2015. The farm has not yet been evaluated for listing in the NRHP by DAHP (DAHP Property ID 585743) (DAHP 2022).

Historic-aged Built Environment Resources

Five historic-aged built environment resources have been recorded and mapped in WISAARD within the Downstream/Indirect Effects portion of the study area (DAHP 2022). Four of these resources include public works features and an RV park and have been determined Not Eligible for listing in the NRHP by DAHP (DAHP Property IDs 716087, 716099, 716426, 716428) (DAHP 2020). The remaining resource (DAHP Property ID 85445) is part of the Icicle Canal Company Irrigation System, and has not yet been evaluated for listing in the NRHP by DAHP (DAHP 2022). These resources were built between 1905 and 1969. Additionally, 22 resources have been assigned DAHP Property IDs and mapped in WISAARD within the study area. These resources have been minimally recorded based on available assessor data. No formal survey, evaluation, or determination is associated with these resources.

Cemeteries

One cemetery has been recorded and mapped in WISAARD within the Downstream/Indirect Effects portion of the study area. Mountain View Cemetery (45CH740) is a municipal cemetery of the City of Leavenworth. It occupies 7.4 acres, and is located at the intersection of Cemetery Road and Icicle

Road. One of the earliest burials belongs to Tom Nolan and dates to 1907 (Find A Grave 2020). The City of Leavenworth dedicated the plat in 1957 (DAHP 2020). The cemetery is well-maintained and in current use, and currently contains more than 1,600 memorials (Find A Grave 2020).

Traditional Cultural Properties

No TCPs have been recorded and mapped in WISAARD within the Downstream/Indirect Effects portion of the study area (DAHP 2020). However, one TCP has been recorded and mapped in WISAARD in the general vicinity, approximately 1.5 miles north of the confluence of Icicle Creek and the Wenatchee River. During comment review of this EIS, the Confederated Tribes of the Colville Reservation indicated that a TCP has been recorded by them within the study area.

Summary

Table 13-3 provides a summary of the existing cultural resources, including resources recorded by ESA for this project and resources previously recorded. The table is separated into four columns for the Direct and Indirect project and study areas.

Table 13-3. Summary of Existing Cultural Resources recorded in WISAARD in the Study Area

Resource	Upstream / Direct Effects		Downstream / Indirect Effects	
	Project Area	Study Area	Project Area	Study Area
Cultural Resources Surveys	3	None	2*	21
Archaeological Site	1	1	1	11
Historic Register Listed Properties	None	None	1	1
Historic Properties	1	None	None	27
Cemeteries	None	None	None	1
Traditional Cultural Places	None	None	None	None**

*One survey project area overlaps Icicle Creek; typically, surveys were conducted on land either adjacent to or within 0.25 mile of the creek. No surveys were identified near FSR 7601 or Eightmile Creek.
**Just beyond study area, one TCP recorded 1.5 miles north of the confluence of Icicle Creek and Wenatchee River.

As discussed previously under *Cultural Context,* village sites were identified at Leavenworth and the confluence of Icicle Creek, and several place names and names associated with the people who have traditionally utilized this area. Additional unpublished locations may be present in the study area and its vicinity.

13.3.1 Cultural Resources Survey

To identify and assess potential effects to cultural resources within the direct project area, ESA conducted a pedestrian cultural resources survey of the two portions of the direct project area that had not been previously surveyed for cultural resources: the proposed access route along FSR 7601-116, and the access route and repeater location on Icicle Ridge (see Figure 13-1). ESA also recorded the existing Eightmile Dam as a historic built environment resource on a Washington State HPI form (Ostrander et al. 2023). As part of the PEIS work, a surface archaeological survey was conducted along the Eightmile Lake Trail and the accessible margins of Eightmile Lake, including the proposed footprint of construction for the dam alternatives and the associated staging areas (Anchor QEA 2018c). This work identified the presence of the historic Eightmile Dam; no other resources were recorded. The Forest Service has previously surveyed the location of the helicopter access fly yard for cultural resources; no built environment resources, archaeological sites, or TCPs were recorded as a result of that work (Fink 1996a).

ESA's cultural resources survey effort identified the presence of the historic built environment resource, the Eightmile Dam, and recorded FSR 7601-116 as a historic-period archaeological site. No other cultural resources were identified in the Upstream/Direct Effects portion of the study area. No survey work was conducted as a part of this EIS in the Downstream/Indirect Effects portion of the study area.

FSR 7601-116 is recommended as Not Eligible for listing in the NRHP due to its lack of association with important events, persons, design features, or use of materials, and it was found to be unable to provide new important information about history. The circa 1970 road alignment lacks associated features or materials, other than its road prism and alignment, that could provide additional sources of data about its construction or use.

13.4 Construction Impacts

Construction (short-term) impacts would be related to the specific footprint of disturbance required to allow access for materials, equipment, and work crews. For access routes, this is defined as the footprint of disturbance required to improve the existing FSR 7601-116, or temporarily reroute the non-motorized trails around the construction area. The footprint of disturbance necessary for staging areas or landing pads at the construction zone is also a construction impact. The final construction impact is the footprint of disturbance necessary for the demolition of the existing dam facility, installation of the Icicle Ridge repeater station, and the construction of the selected alternative.

The No Action Alternative would not have a construction phase, and as a result would not have any short-term construction related impacts on cultural resources. The impacts for Alternative 1 (Narrow Spillway with Automated Gates), Alternative 2 (Wide Spillway without Gates), and Alternative 3 (Narrow Spillway without Gates) would be similar, and the action-specific discussions below apply to all three action alternatives.

Construction Activities

The construction activities, including demolition of the existing facility, would result in the destruction of the existing Eightmile Dam. No features or elements of the current built environment structure, other than its location and course of the spillway, would be retained. While Eightmile Dam was recommended Not Eligible for individual listing in the NRHP, it is potentially Eligible as a contributor to a potential ALIHD under Criterion A (association with water management in Chelan County). Proposed construction activities under the action alternatives would result in the removal and destruction of the currently existing dam facility. However, it would be replaced with a facility that retains the critical integrity of location and setting. Alternations from the action alternatives would not impact Eightmile Dam's continued eligibility under Criterion A, as the dam would continue to function in its historic role, and its historic association with water management in Chelan County would be unaltered. As such, project impacts would result in no significant adverse impact on historic properties.

Helicopter Access

Helicopter access would not directly or indirectly impact any recorded cultural resources. The cultural resources survey for the PEIS was conducted along the banks of Eightmile Lake (Anchor QEA 2018c). That survey did not identify any high probability areas for encountering buried cultural resources, or make recommendations for additional survey work within the area surrounding the lake. The environment surrounding Eightmile Lake is predominantly comprised of active talus slopes and seasonal channels for melt drainage. This environment is primarily erosional, rather than depositional, and is not likely to contain intact buried cultural resources. This environment is where helicopter takeoff and landing would occur at Eightmile Lake, and as a result this action is not expected to have any impact on cultural resources. Flights would originate from an existing fly yard and not result in any alterations to the site. The fly yard location was previously surveyed for cultural resources, and none were identified (Fink 1996a).

Helicopters would also likely be used to transport required materials to the repeater location on Icicle Ridge. That portion of the project area was surveyed for cultural resources and none were identified (Ostrander et al. 2023). Use of the helicopters would be associated with a temporary increase in noise in the general area. Use of helicopters is expected to have no significant impacts on known and recorded cultural resources.

Overland Motorized Access

Overland motorized access is not expected to result in a direct or indirect impact on known eligible cultural resources. Unknown or unrecorded TCPs may exist within the project area. The motorized access haul route within FSR 7601-116 is a historic-period archeological site. However, the road is recommended Not Eligible for listing in the NRHP. Furthermore, its use as a conveyance is in line with historic practice in the area. The archaeological survey along the road found that previous work done in the historic period to construct the roadway has significantly reshaped the immediate area, and no other archaeological sites or historic-aged built environment resources are recorded within this portion of the study area.

Non-motorized Wilderness Access

The use of a non-motorized wilderness access path along the route of the existing Eightmile Lake Trail or to the repeater station would not result in direct or indirect impacts on any known cultural resources. The existing Eightmile Lake Trail was surveyed for cultural resources under the PEIS (Anchor QEA 2018c). That survey did not identify any high-probability areas for encountering buried cultural resources, or make recommendations for additional survey work along the existing trail. The trail to the repeater station would be used only seldomly to access the site, as installation and maintenance would be conducted via helicopter, and as a result would not result in direct or indirect impacts on any known cultural resources. As indicated on Figure 2-13 (Chapter 2), portions of the Eightmile Lake Trail near the dam would need to be temporarily rerouted during construction. Minor vegetation and topsoil removal may be needed in some areas for the temporary trail and would result in no direct or indirect impacts on any known cultural resources.

13.5 Operational Impacts

Operational (long-term) impacts are those effects that occur as a result of the selected alternative both within the area of Upstream/Direct Effect at and around Eightmile Lake, as well as the Downstream/Indirect Effect portion of the study area. Operational (long-term impacts) on cultural resources are considered fairly consistent for all of the action alternatives. The area of direct impacts for the action alternatives contains a single archaeological site, which is recommended Not Eligible for listing on the NRHP: the historic FSR 7601-116; and a single potentially contributing built environment element (Eightmile Dam) of a potentially NRHP-eligible Historic District, the ALIHD.

The only significant impact possible as a result of long-term operation of the dam facility would be if the dam structure were to fail, and a high-energy flood inundation were sent down from Eightmile Lake into Eightmile and Icicle creeks. The event of dam failure would have significant impacts on the Downstream/Indirect Effects area of impacts. However, this failure is most likely to occur under the No Action Alternative, as the upgrades under the action alternatives greatly reduce the likelihood of this occurring.

Changes in lake level as a result of operation are not expected to impact cultural resources. No archaeological sites have been identified within or in close proximity to the lake margin. The environments are the edge of the lake are active talus slopes, bedrock exposures, or areas heavily disturbed as a result of construction or operation of the Eightmile Dam. None of these environments would be expected to be capable of burying and preserving archaeological materials.

No Action Alternative

The No Action Alternative may present a significant risk to cultural resources due to the risk of catastrophic dam failure, and resulting high-energy flooding along the Downstream/Indirect Effects portion of the study area. Catastrophic failure would likely result in a high-energy flood to flow down from Eightmile Lake into Eightmile and Icicle creeks. This flooding is a risk to recorded archaeological sites and built environment resources.

Overbank flooding also poses a risk to unrecorded archaeological sites along the waterway until Icicle Creek meets its confluence with the Wenatchee River. The near-bank environment that would be impacted by the high-energy flow in the event of a dam failure is considered very high probability for containing both precontact- and historic-period resources. The streambanks from Eightmile Lake down to Icicle Creek's confluence with the Wenatchee River have not yet been fully surveyed for cultural resources.

The portions of the Downstream/Indirect Effects portion of the study area contain both historic-period and precontact archaeological sites. One precontact campsite (45CH943) is listed on the NRHP (Tarman 2018a). Eight other precontact sites that have either been determined Not Eligible or are unevaluated for listing in the NRHP are within the Downstream/Indirect Effects study area. These sites are in close proximity to Eightmile and Icicle creeks, and each of these resources may be significantly impacted in the event of a catastrophic overbank flooding event. No recorded NRHP-eligible or listed historic period archaeological sites would be impacted.

One NRHP-listed built environment resource, the LNFH (45CH582), is within the Downstream/Indirect Effects portion of the study area and may be significantly impacted in the event of a catastrophic dam failure. The 158-acre complex, built between 1939 and 1941, is listed in the NRHP and WHR.

Overbank flooding from a catastrophic dam failure may also significantly impact historic-aged built environment resources that have not yet been evaluated for the NRHP. The Colokum Dairy Farm, approximately 0.35 mile east of the confluence of Icicle Creek and the Wenatchee River, is listed on the Washington Heritage Barn Register. The farmhouse, barn, milkhouse, and pasteurizing building were all built in about 1920, and were listed as being in good to fair condition in 2015. Additionally, a portion of the Icicle Creek Canal Company Irrigation System is within the Downstream/Indirect Effects portion of the study area.

Alternative 1: Narrow Spillway with Automated Gates

Alternative 1 is not expected to have long-term operational impacts on cultural resources. Because FSR 7601-116 is not considered Eligible to be listed in federal, state, or local historic registers, the modification and use of the historic-period road prism as part of the access infrastructure for the Eightmile Dam is not considered an impact. While the Eightmile Dam itself is potentially Eligible for listing in the NRHP as a contributor to the ALIHD, its operation in a modified form would not impact its ability to be listed in the NRHP. This is due to the dam's eligibility for the NRHP being based on its association with providing irrigation capacity to Chelan County. As such, its continued operation and use as an irrigation facility are integral to its register status. The operation of the facility would not impact any known cultural resources, and the threat to unrecorded cultural resources would be significantly lower than current conditions as the risk of failure from the dam structure and the resulting erosive flow would be mitigated. The primary risk from long-term operation would continue to be associated with erosion of streambanks due to water flow resulting in the exposure or destruction of buried archaeological materials.

Alternative 2: Wide Spillway without Gates

Alternative 2 is not expected to have long-term operational impacts on cultural resources. The impacts and analysis for this alternative are the same as Alternative 1.

Alternative 3: Narrow Spillway without Gates

Alternative 3 is not expected to have long-term operational impacts on cultural resources. The impacts and analysis for this alternative are the same as Alternative 1.

13.6 Avoidance, Minimization, and Mitigation Measures

The project would avoid and minimize impacts on cultural resources by focusing the project impacts from construction and operations within previously disturbed areas to the extent possible. The repeater location along Icicle Ridge already includes existing Forest Service facilities, and the IPID repeater would be co-located within the same area. Similarly, both the motorized and non-motorized access routes are along existing paths in the form of FSR 7601-116 and the Eightmile Lake Trail #1552. The temporarily relocated portions of trail adjacent to Eightmile Dam will be restored following construction, and access will return to the original trail. Finally, the construction and operations footprint for the action alternatives is largely within an area that has historically contained the existing Eightmile Dam and spoils from the original construction. The use of these previously disturbed areas to the greatest extent possible minimizes the risk the project will encounter currently unknown archaeological resources, or impact Native American traditional practices.

While the action alternatives will result in changes to the existing dam structure, those actions are recommended as not constituting an adverse effect, due to the dam's previous alternations and resulting loss of historic integrity. Still, the proposed changes will alter the facility further. To record the previous conditions of Eightmile Dam, a reconnaissance-level HPI form has been completed and provides documentation of the conditions and materials present circa 2020 (Ostrander et al. 2023).

While no impacts on cultural resources requiring mitigation have been identified, there is the potential that yet-unknown resources may be encountered during project construction. To mitigate for this possibility, the project would have a Cultural Resources Inadvertent Discovery Plan in place during construction. The plan would be developed between the Section 106 consulting parties and have procedures to follow in the event that potential cultural resources are identified during construction activities. Native American tribes would continue to be consulted during the design, development, and selection process and construction actions. This would be conducted through the Section 106 process, for which the Forest Service is functioning as Lead Agency.

13.7 Significant Unavoidable Adverse Impacts

There are no significant unavoidable impacts on known cultural resources. The No Action Alternative has the highest potential to cause significant impacts on known cultural resources, should the dam fail. The action alternatives would result in **no significant impacts** on cultural resources.

CHAPTER 14: TRIBAL RESOURCES

What has Changed from the Draft EIS?

- Clarification of the tribal consultation process has been added to the introduction.
- No other substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on tribal resources are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key Findings for Tribal Resources

The term "tribal resources" refers to the collective rights and access to traditional areas and times for gathering resources associated with a tribe's sovereignty since time immemorial.

- Tribal resources may also include archaeological or historic sites, elements of the built environment, and Traditional Cultural Properties (TCPs) associated with tribal use, and sites considered sacred by tribes.
- Tribal resources are related to other natural and cultural resources analyzed in this EIS, especially Plants and Animals (Chapter 8) and Cultural Resources (Chapter 13). Natural resources are inextricably linked with the lives of Indigenous peoples; all animal species have some connection to tribal members through traditional stories or practice.
- For this EIS, tribal resources were identified through review of publicly available published literature, scoping comments, and—in particular—information provided directly from the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation) and Confederated Tribes of the Colville Reservation.
- Eightmile Lake, Eightmile Creek, Icicle Creek, and the surrounding areas are part of the study area for tribal resources.
- The study area is within the Yakama Nation Treaty Territories–representing Ceded Lands of the Wenatchipum Band of Yakama Nation. The Tribe's Reserved Rights are protected by the 1855 Treaty between the United States and 14 tribes and bands of the Yakama Nation. The Treaty designated Reserved Rights at all Usual and Accustomed places within the Treaty Territory.
- A federal treaty is considered the supreme Law of the Land under the U.S. Constitution. Pursuant to its status as a sovereign nation and its Treaty-reserved authority, Yakama Nation acts as a co-manager of the resources upon the reservation, ceded lands, and Usual and Accustomed places.
- The study area is within the Traditional Use Area of the Wenatchi Band of the Confederated Tribes of the Colville Reservation. The Executive Orders that established reservations included brief statements with the intent to set aside a specific tract, including the Colville Reservation that was established by Executive Order in 1872.

This chapter summarizes the tribal resources in the study area and potential impacts that could result from the Eightmile Dam Rebuild and Restoration Project. The study area is the geographic extent of potential construction and operational impacts on tribal resources for each of the project alternatives as presented in Chapter 2. Throughout the EIS process, the Confederated Tribes and

Bands of the Yakama Nation and the Confederated Tribes of the Colville Reservation have been consulted on potential impacts on both cultural resources (which include archaeological sites, built environment resources, and traditional cultural properties) and tribal resources (which include natural resources and treaty rights). The Forest Service has led tribal consultation on cultural resources impacts as part of the Section 106 process. Ecology has conducted formal consultation on potential impacts on tribal resources. Consultation with the tribes will continue as the project moves through permitting and construction.

The full geographic extent of tribal resources that could be impacted likely extends well beyond the specific project area. The natural resources study area, which is being used to assess tribal resources with a natural resource component, includes the entire length of the Eightmile Creek watershed and the portion of the Icicle Creek drainage extending from its confluence with Eightmile Creek downstream to the Wenatchee River (Chapter 8, Figure 8-1). The study area extends vertically from the bottomlands of the various stream drainages, upslope to the surrounding ridgetops.

The project area is within the Yakama Nation Treaty Territories–representing Ceded Lands of the Wenatchipum Band of Yakama Nation. The area is also within the traditional use area of the Wenatchi Band of the Confederated Tribes of the Colville Reservation. Both tribal governments provided information resources and input during the drafting of this chapter.

The Confederated Tribes of the Colville Reservation provided additional research resources and comments on an early draft of the chapter. After reviewing the draft, the Yakama Nation provided an additional formal context on its treaty rights and history of the study area. This was done as a result of the published available sources identified during the review not providing sufficient context regarding the significance of the study area to the Yakama people (YN 2022). As a result of this significant effort on the part of the Yakama Nation, and the critical difference between this context and the published materials, the chapter presents both the Yakama Nation-provided context and the context available from archival sources when applicable.

The project area is located within the Alpine Lakes Wilderness of the Okanogan-Wenatchee National Forest in Chelan County and includes Eightmile Lake and Eightmile Creek; it also includes Icicle Creek downstream to its confluence with the Wenatchee River in Leavenworth, Washington. The Alpine Lakes Wilderness is managed by the Forest Service.

The term “tribal resources” refers to the collective rights and access to traditional areas and times for gathering resources associated with a tribe’s sovereignty since time immemorial. It also includes inherent rights or formal treaty rights associated with Usual and Accustomed territories and lands formally ceded by the Yakama Nation under the 1855 Treaty between the United States and the Yakamas (“Treaty”). The term “Usual and Accustomed” represents a different understanding than traditional territory and often spans a much greater area (YN 2022). In addition, tribal resources include areas important to traditional cultural practices and the natural and cultural resources associated with those practices, including plants, wildlife, or fish used for commercial, subsistence, or ceremonial purposes. Tribal resources may also include archaeological or historic sites, elements of the built environment, and Traditional Cultural Properties (TCPs) associated with tribal use, and sites considered sacred by tribes. Archaeological sites and historic aged built environment resources are material constructs with distinct physical attributes that are protected under local, state, and federal law. TCPs are properties associated with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community, and may have physical elements, spiritual significance, and wider cultural use practices associated with them (Ecology 2022e).These resources are often found at locations associated with tribal practice, such as important fishing, hunting, and gathering locations; however, archaeological and historic sites, as well as TCPs, are considered cultural resources and are discussed in Chapter 13, *Historic and Cultural Resources*.

14.1 Resource Description

"Tribal resources" is a term that refers broadly to the places, specific resources, and knowledge and experience of Indigenous people. This resource category directly relates to collective rights, knowledge, and access to traditional use areas and times associated with a tribe's legal and cultural sovereignty, since time immemorial (Ecology 2022e). They include the following:

- Inherent rights or formal treaty rights associated with Usual and Accustomed territories, as outlined in the Yakama Treaty on June 9, 1855, ratified in 1859.
- Areas important to traditional cultural practices and the natural and cultural resources associated with those practices, including plants, wildlife, or fish used for commercial, subsistence, and ceremonial purposes. These include areas designated by the tribes as sacred. These areas may or may not be formerly recorded.

Tribal resources were identified through review of publicly available published literature, anthropological reports, scoping comments, and information provided by tribal government. The following section has been prepared in part based on published materials by non-Native people from the 19th, 20th, and 21st centuries, as well as unpublished data provided by the Yakama Nation and published and unpublished data from the Confederated Tribes of the Colville Reservation. Separate subsections have been developed to differentiate the contextual information for the Yakama Nation and the Confederated Tribes of the Colville Reservation. The published materials from non-Native people often do not present the full and accurate understanding of tribal history and knowledge. The authors acknowledge that these sources inherently contain deficiencies, and use of them is not intended to substitute or supersede knowledge held within the tribes. Tribal communities are the best source of information about tribal resources and impacts on such resources.

Information about tribal resources is also included in Chapter 8, *Plants and Animals;* Chapter 13, *Cultural Resources*; Chapter 16, *Environmental Justice;* and CTCR (2022). Cultural resources also include non-Native American built environment and archaeological resources that would not likely be considered tribal cultural resources by the tribes; these are described in Chapter 13 and are not addressed in this tribal resources chapter.

14.1.1 Yakama Nation

The Yakama Indian Reservation was established by way of the 1855 Treaty between the United States and 14 tribes and bands including the Kah-milt-pah, Klickitat, Klinquit, Kow-was-say-ee, Li-ay-was, Oche-chotes, Palouse, Pisquose, Se-ap-cat, Shyiks, Skin-pah, Wenatshapam, Wish-ham, and Yakama ("Treaty") (YN 2022). The Treaty reserved a 1.3-million-acre Reservation "for the exclusive use and benefit" of the Yakama people.[1] The Treaty further designated Reserved Rights for Yakamas to exercise "in common with" citizens of the United States at all Usual and Accustomed places within the Treaty Territory.[2] A federal treaty is considered the supreme Law of the Land under the U.S. Constitution.[3] Pursuant to its status as a sovereign nation and its Treaty-reserved authority, Yakama Nation acts as a co-manager of the resources upon the reservation, ceded lands, and Usual and Accustomed places. This has been recognized and affirmed by federal courts,[4] for the protection of all natural and cultural resources in Yakama Nation's Treaty Territory.

[1] *See* Treaty with the Yakamas, U.S. – Yakama Nation, June 9, 1855, 12 Stat. 951, art. II, cl. 3. https://goia.wa.gov/tribal-government/treaty-yakama-1855.
[2] *See Id.* at art. III, cl. 2.
[3] *See* U.S. Const. art. VI, cl. 2. https://www.archives.gov/founding-docs/constitution-transcript#6.
[4] *See United States v. Washington*, 384 F. Supp. 312, 382 (W.D. Wash. 1974), *aff'd*, 520 F.2d 676 (9th Cir. 1975), https://cite.case.law/f-supp/384/312/; https://cite.case.law/f2d/520/676/; *see also U.S. v. State of Oregon*, 666 F. Supp. 1461 (D. Or. 1987).

The Treaty provides for both Reserved Rights, and Usufructuary Rights. Reserved Rights, as established by the Reserved Rights Doctrine, finds that the Treaty itself was not a grant of rights from the Yakama Nation to the government but a reservation of rights not granted. While Usufructuary Rights, or rights not explicitly stated in the Treaty, are those rights that are explicitly stated and are subject to specific Treaty interpretation. They are typically an action such as hunting, fishing, gathering, and so on, as explained in Article III of the Treaty, and are not the resources themselves.

Treaty-protected land rights fall into three distinct categories: Reservation Lands, Ceded Lands, and Usual and Accustomed Areas. The Yakama Nation Reservation lands are those lands set aside for the exclusive use and benefit of the Yakama Nation and its members. The Yakama Nation Ceded Lands represent a boundary of approximately 12 million acres of land in which a right of settlement was granted under provisions of the Treaty and all other rights reserved. The Yakama Nation Usual and Accustomed Places represent the traditional places utilized historically by the constituent 14 tribes and bands that comprise the Yakama Nation for fishing, hunting, and gathering.

The Yakama Nation's enrolled membership exceeds 11,000 people whose history, culture, and way of life are intertwined with the resources and places on the land. These include all natural resources used traditionally for food, tools, medicines, shelter, and so on. Protecting the land and associated water ways is critical for ensuring the Yakama Nation's Treaty-reserved resources and rights, and ultimately to the health and welfare of the Yakama people. Figure 14-1 illustrates the Ceded area and Reservation boundary of the Confederated Tribes and Bands of the Yakama Nation.

14.1.2 Confederated Tribes of the Colville Reservation

The Confederated Tribes of the Colville Reservation was established by Presidential Executive Order on April 9, 1872, which reserved acreage for the "Methow, Okanagan, Sanpoil, Nespelem, Lakes, Colville, Kalispel, Spokane, Cour d'Alene, and scattered bands of the Chelan, Entiat, and Southern Okanogan" (Lahren 1998:492). A second executive order was issued in July 1872 that relocated the reservation and returned some of the land set aside to public domain (CTCR 2021a, 2023a, 2023b; Lahren 1998:492-493). In April 1879 and March 1880, the Moses Agreement established the Columbia Reservation to set aside land for Chief Moses and his people, which included Columbia, Chelan, Entiat, and Wenatchi tribes (CTCR 2021a; Lahren 1998:492). Chief Moses signed an agreement for family heads to be assigned allotments on this reservation or they could move to the Colville Reservation (Lahren 1998:492). This reservation was returned to public domain by executive order. In 1892, the north portion of the Colville Reservation was ceded to the United States by an act of Congress (27 Stat. 62) (CTCR 2021a, 2023a). Today's Colville Reservation encompasses 1.4 million acres of land which include tribally owned lands held in federal trust status for the Confederated Tribes of the Colville Reservation, land owned by individual tribal members (which also include federal trust status), and land owned by other tribal or non- tribal entities (CTCR 2021a). Additionally, the CTCR "have 9,166 acres of off reservation management areas" (CTCR 2021a). Executive Order reservations did not contain any of the specific language found in those treaties that established reservations. The Executive Orders that established reservations included brief statements with the intent to set aside a specific tract, including the Colville Reservation that was established by Executive Order in 1872 (Lahren 1998:492). Today, the Twelve Bands that comprise the Confederated Tribes of the Colville Reservation include: Chelan, Chief Joseph Band of Nez Perce, Colville, Entiat, Lakes, Methow, Moses-Columbia, Nespelem, Okanogan, Palus, San Poil, and Wenatchi. Tribal enrollment is 9,520 members.

The traditional territories of the Colville Tribes extend across eastern Washington and into portions of British Columbia, Oregon, and Idaho. This expanse covered approximately 39 million acres as the homeland of the Lakes, Colville, Okanogan, Moses-Columbia, Wenatchi, Entiat, Chelan, Methow, Nespelem, Sanpoil, Chief Joseph Band of Nez Perce, and Palus Indians (Figure 14-2).

Figure 14-1. Ceded Area and Reservation Boundary of the Confederated Tribes and Bands of the Yakama Nation

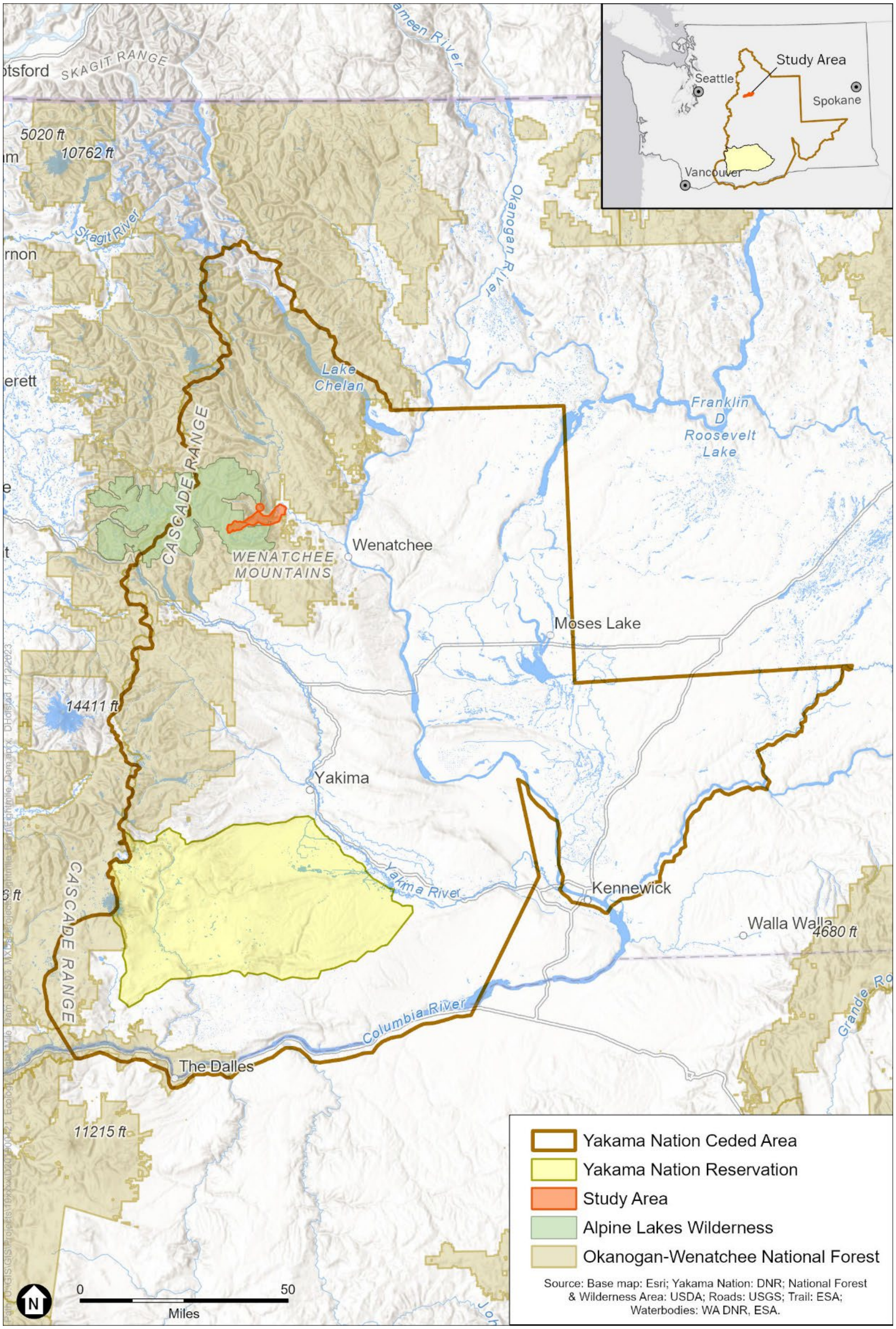
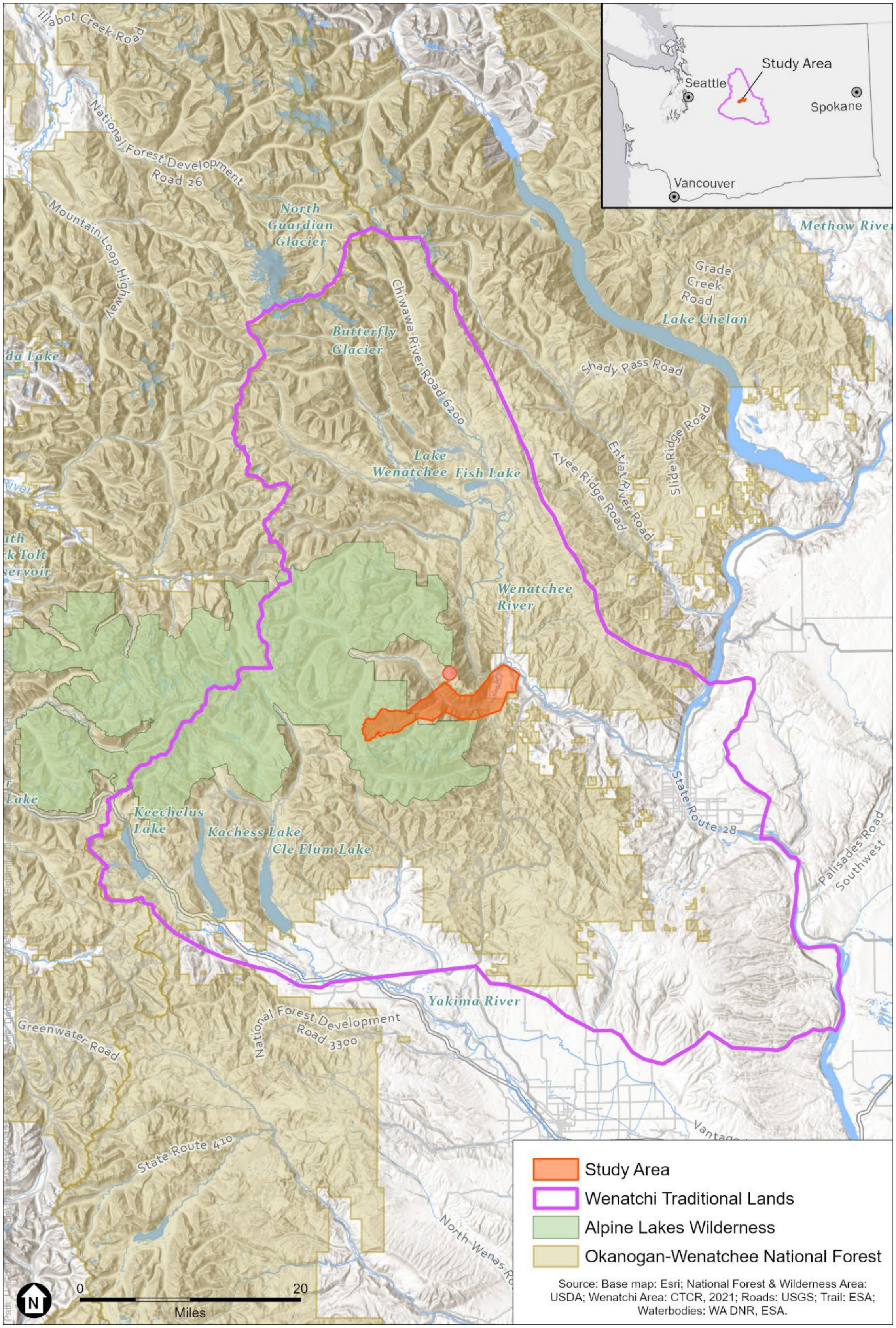


Figure 14-2. Traditional Use Areas of the Wenatchi Band of the Colville Tribes



14.1.3 Existing Conditions

This section describes the methods used to analyze tribal resources within the study area. The analysis for tribal resources references the other natural resource analyses in the EIS and considered the tribes' unique connection to and reliance on cultural and natural resources. To honor the tribes' perspective, the analysis considered all identified impacts on natural resources and cultural resources associated with tribal use or rights. This chapter includes consideration of the unique perspectives and specific impacts on the tribes when evaluating project impacts. This analysis has identified tribal resources as plants, wildlife, and areas important to traditional cultural practices and those associated with treaty rights related to Usual and Accustomed places. EIS chapters and reports, publicly available sources, and unpublished ethnographic data provided during review and consultation with the tribes were used to develop the list of resources. The following sources were reviewed:

- Unpublished ethnographic information provided by the Yakama Nation during documentation review and consultation with Ecology.
- Confederated Tribes and Bands of the Yakama Nation website.
- Yakama Nation Museum and Cultural Center website.
- Confederated Tribes of the Colville Reservation website.
- Traditional Cultural Plant Team, History/Archaeology Program, Confederation Tribes of the Colville Reservation.
- Published ethnographic studies and historic contexts.

Potential project impacts on tribal resources with a natural resource component were assessed within the study area, as per methods established in the Plants and Animals chapter (Chapter 8). In addition to this desktop assessment, ESA conducted a vegetation survey of habitat conditions; rare, threatened, and endangered vascular plant species; and invasive plant species on September 30, 2021 (Appendix C). The vegetation survey focused on locations within the study area including the Eightmile Dam staging area and the portion of FSR 7601-116 to be directly improved or modified as a part of the project (Figure 14-3).

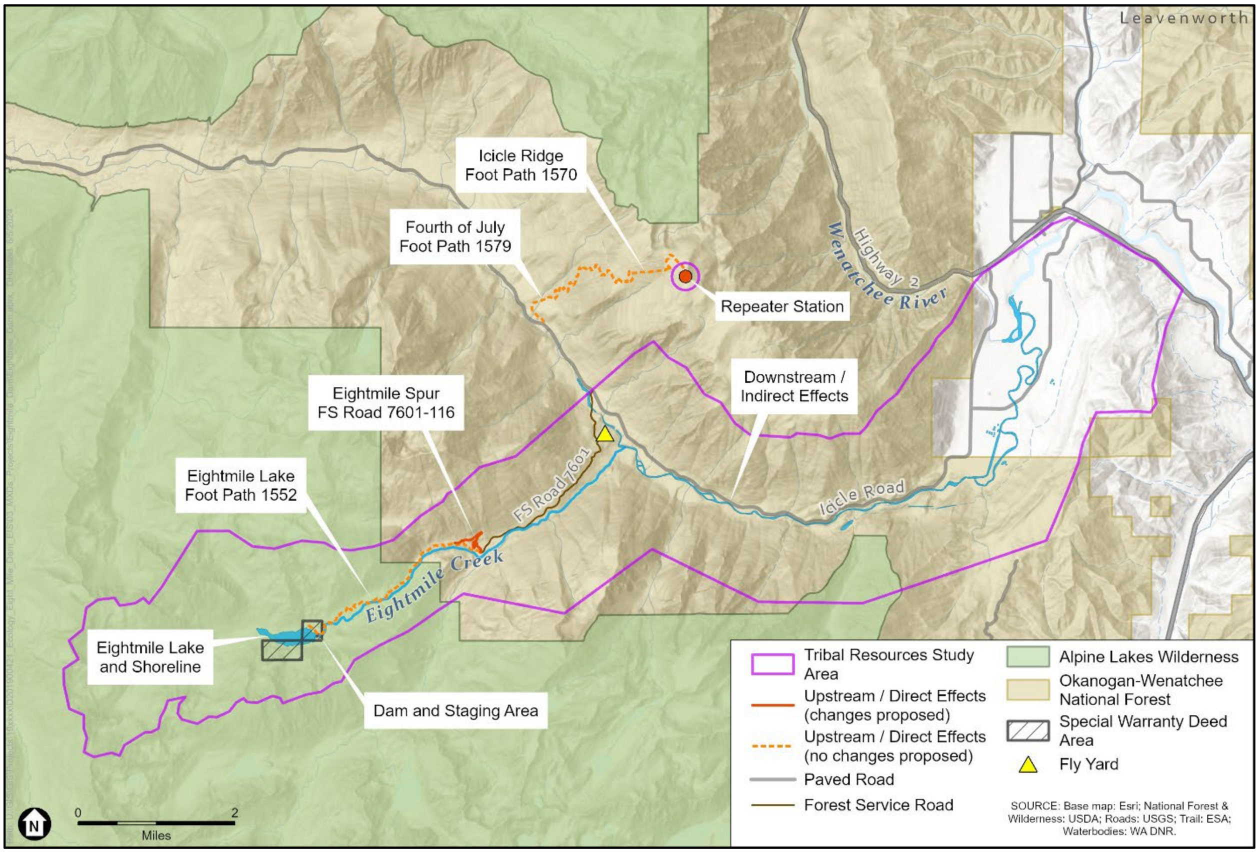
14.1.4 Impacts Methodology

The analysis of impacts on tribal resources differs in its approach when compared to the impact analysis for other natural and cultural resources. Natural resources are analyzed elsewhere in the EIS and associated reports to determine if the project would have significant impacts from a non-tribal (i.e., SEPA) perspective, and whether or not those impacts could be mitigated.

Comments from the tribes demonstrate that natural and cultural resources are highly interconnected. As a result of this connection, tribes hold a deep, inherent knowledge and understanding of the ecosystem, often referred to as Tribal Ecological Knowledge. The USFWS defines Tribal Ecological Knowledge as "*the evolving knowledge acquired by Indigenous and local peoples over hundreds or thousands of years through direct connection with and observation of the environment*" (Rinkevich et al. 2011).

The analysis for tribal resources references the other natural resource analyses in the EIS and considered the tribes' unique and powerful connection to and reliance on cultural and natural resources. To honor the tribes' perspective, the analysis considered all identified impacts on natural resources and cultural resources. This analysis includes consideration of the unique perspectives and specific impacts on the tribes and adds cultural context when evaluating project impacts.

Figure 14-3. Tribal Resources Study Area for the Eightmile Dam Rebuild and Restoration Project



This analysis has defined tribal resources as plants, wildlife, and areas important to traditional cultural practices and those associated with treaty rights related to Usual and Accustomed territories.

To identify the potential for impacts from flood inundation, a GIS map of inundation levels under the alternatives and various flood scenarios was reviewed (Figure 12-1). Other information was reviewed to identify impacts on water rights, transportation, and dam safety as they relate to impacts on tribal resources. Impacts are possible if tribal resources are permanently removed or altered, or if access to resources is temporarily (or permanently) limited during construction or operation. Potential sources of impacts include excavation, grading, burial, erosion, contamination, or other ground-disturbing effects; changes in setting; and temporary and/or permanent exposure to noise, dust, vibration, and general lack of access to Usual and Accustomed areas for hunting, fishing, and/or gathering.

Impact Identification

The analysis of impacts on tribal resources considered the following:

- Construction and operation impacts on plant and animal species used by tribal members.
- Loss of, or modifications to, habitats of species used by tribal members.
- Indirect impacts on species and habitats used by tribal members, including fragmentation of habitats and impediments to migration.

- Loss of access to a traditional hunting, fishing, or gathering area, or to an area where other traditional practices occur.
- Loss of revenue to tribal members as a result of the project.
- Interruption of spiritual practices.
- Loss of medicinal and traditional plants and foods.
- Disruption and degradation of health and mental well-being of tribal members.

Impacts on archaeological sites, built environment resources, and TCPs are analyzed in Chapter 13, *Historic and Cultural Resources*. Additionally, information on potential impacts that relate to tribal resources is also included in Chapter 8, *Plants and Animals,* and Chapter 16*, Environmental Justice.*

Identification of Construction Impacts

Thresholds for potential significant impacts on tribal resources as a result of construction were defined and established using criteria established for natural resources (Chapter 8, *Plants and Animals*).

Impacts on natural resources could be reversible or irreversible (permanent). For example, permanent impacts could occur during construction if construction activity results in permanent damage or removal of a natural resource or the permanent alteration of a culturally significant landform associated with traditional stories or practices.

For this analysis, significant construction impacts on tribal resources are defined as follows:

- Significant: Significant construction impacts are defined in this analysis as those that are irreversible and permanently diminish the ability for a tribal resource to convey its significance. For natural resources, impacts would be significant if construction activities would result in a large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish, wildlife, and plant species, or resulted in the permanent loss of access to hunting, fishing, or gathering areas.

Construction activities would be considered a significant impact if they eliminate, or make non-viable, a species within the study area through the loss of suitable habitat.

Identification of Operational Impacts

For this analysis, long-term (operational) impacts on tribal resources are considered significant as follows:

- Significant: Impacts are considered significant if they permanently diminish the integrity of essential physical features such that the resource is no longer able to convey its significance for which it is used. Impacts on natural resources would be significant if operation of the dam would result in a large-scale take (mortality, injury, or deleterious behavioral changes on more than a few individual organisms) on fish, wildlife, and plant species. Significant habitat impacts would occur if operation of the dam would eliminate, or make non-viable, a species within the study area through the loss of suitable habitat.

14.2 Regulatory Context

Tribal resources within the study area are protected by several federal, and state regulations, plans, and policies. Federal laws, regulations, and policies are presented in Table 14-1, and state laws, regulations, and policies are presented in Table 14-2.

Chelan County and the City of Leavenworth do not have formal Historic Preservation Programs. Preservation programs here are guided by federal and state laws and regulations.

Table 14-1. Federal Laws and Regulations Applicable in the Study Area

Regulation or Policy	Description
National Historic Preservation Act (NHPA) (Title 54 U.S.C.) Section 106 of the NHPA (36 CFR Part 800)	The NHPA was approved on October 15, 1966, for the management and preservation of historical and archaeological sites. Under this act, the NRHP, National Historic Landmarks List, State Historic Preservation Offices (SHPO), and Tribal Historic Preservation Offices (THPO) were created. Washington State's SHPO is the DAHP, which is the state agency that administers NHPA compliance in Washington. The procedures for implementing the NHPA are detailed in the Protection of Historic Places regulations. Section 106 of the NHPA requires federal agencies to consider the effects of project undertakings, project approvals, or project funding on historic properties. This process requires consultation with the relevant THPO, Native American tribes, and Native Hawaiian organizations.
Treaty with the Yakamas, U.S. – Yakama Nation, June 9, 1855, 12 Stat. 951, art. II, cl. 3.	The Yakama Indian Reservation was established by way of the 1855 Treaty between the United States and the Yakamas ("Treaty"). The Treaty reserved a 1.3-million-acre Reservation "for the exclusive use and benefit" of the Yakama people. The Treaty further designated Reserved Rights for Yakamas to exercise "in common with" citizens of the United States at all Usual and Accustomed places within the Treaty Territory. A federal treaty is considered the supreme Law of the Land under the U.S. Constitution. Pursuant to its status as a sovereign Native Nation and its Treaty-reserved authority, Yakama Nation acts as a co-manager of the resources upon the reservation, ceded lands, and Usual and Accustomed places.
Presidential Executive Order April 9, 1872, as amended by Executive Orders July 2, 1872, March 6, 1880, and Feb. 23, 1883	The Colville Reservation was established by executive order 1872 for the use and occupancy of the Methow, Okanogan, San Poil, Lake, Colville, Calispel, Spokane, Coeur d'Alene, and such other Indians as the Department saw fit to locate thereon. Other tribes located on the reservation were the Snake River Palouse branch of the Yakama, the Joseph band of the Nez Perce, the Moses Columbia, and the Wenatchee band of Indians. The original Colville Reservation was in existence for less than 3 months when it was exchanged for the present reservation under Executive Order of July 2, 1872. The present reservation of approximately 2,900,000 acres was divided into the North and South halves by the Act of July 1, 1892, which restored the North Half, consisting of approximately 1,500,000 acres, to the public domain. There was a group of tribes under the leadership of Chief Moses who resided during the early 1880s on the Columbia Reservation in the State of Washington. This group of tribes included: (1) the Columbia, (2) Chelan, (3) Entiat, and (4) Wenatchee. The Columbia Reservation was established by Executive Order of April 19, 1879, as amended by Executive Orders of March 6, 1880, and February 23, 1883, "for the permanent use and

Regulation or Policy	Description
	occupancy of Chief Moses and his people, and such other friendly Indians as may elect to settle thereon with his consent and that of the Secretary of the Interior." On July 7, 1883, an Agreement was made in Washington, D.C., signed by the Secretary of the Interior and the Commissioner of Indian Affairs, which contained a provision that, if the Chief Moses group of tribes and other Indians who were then residing on the Columbia Reservation would move to the Colville Reservation, the United States "will secure to Chief Moses and his people as well as to all other Indians who may go on the Colville Reservation equal rights and protection." This Agreement was ratified by the Act of Congress of July 4, 1884 (23 Stat. 76, 79-80). Subsequently, starting in or about 1886, members of the Chief Moses tribal groups were moved to the Colville Reservation. Also, during the year 1885 and later years, the Government moved to the Colville Reservation members of the Joseph Band of Nez Perce Indians and members of the Palus Tribe.
Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. Chapter 32)	Enacted on November 16, 1990, NAGPRA establishes rights for lineal descendants, Native Americans and tribes, and Native Hawaiian organizations to repatriate their culturally affiliated items, including human remains, associated and unassociated funerary objects, sacred objects, and objects of cultural patrimony. NAGPRA includes provisions for unclaimed and culturally unidentifiable Native American cultural items and the intentional and inadvertent discovery of Native American cultural items on federal and tribal lands only.
American Indian Religious Freedom Act (AIRFA) (42 U.S.C. Chapter 21 Subchapter 1 § 1996)	AIRFA was enacted to protect the rights of Native Americans to exercise their traditional religions by ensuring access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rights. The intent of AIRFA has been interpreted as ensuring that Native Americans obtain First Amendment protection, but not to grant Native Americans rights in excess of the First Amendment. Because such sites may be eligible for inclusion in the National Register, any effects that may occur, as a result of providing access to them, may trigger Section 106 review under the NHPA. As a related law, the NHPA greatly strengthens the requirements for federal agencies to ensure that tribal values are taken into account. Tribes are given greater control over patrimonial objects and are allowed to establish their own culturally specific criteria of significance.
Archaeological and historical laws and Executive Orders (EO) applicable to Natural Resources Conservation Service Department of Agriculture – assisted programs Executive Order 11593 (7 CFR § 656.2) (36 CFR 8921, 3 CFR 1971 Comp. P.154)	This EO requires that the federal government provide leadership in the protection and enhancement of the cultural environment, including preserving, restoring, and maintaining the historical and cultural environment of the nation, and that federal agencies shall administer the cultural properties under their control in a spirit of stewardship and trusteeship for future generations; initiate measures necessary to direct their policies, plans, and programs in such a way that federally owned sites, structures, and objects of historical, architectural, or archeological significance are preserved, restored, and maintained.

Regulation or Policy	Description
Indian Sacred Sites Executive Order 13007	This EO requires the federal government to accommodate access to and ceremonial use of Native American sacred sites by Native American religious practitioners and for the federal government to avoid adversely affecting the physical integrity and maintaining the confidentiality where appropriate of sacred sites on federal lands.
Consultation and Coordination with Indian Tribal Governments Executive Order 13175	This EO provides guidelines for consultation between federal agencies and Native American governments. When formulating an implementing policies that have tribal implications; self-governed Native American governments will be granted the maximum administrative discretion possible; federal agencies shall encourage Native American governments to develop policies and defer to tribes to set standards, and if establishing federal standards, consult with tribal officials as to the need for federal standards and any alternatives that would limit the scope of the federal standards or otherwise preserve the prerogatives and author of Native American tribes.
Procedures for State, Tribal, and Local Government Historic Preservation Programs (36 CFR Part 61)	Federal regulation authorizing state and tribal historic preservation programs and certifies local governments to carry out the purpose of the NHPA. This is the basis for historic preservation programs and ordinances.

Table 14-2. State Regulations and Guidelines Applicable in the Study Area

Regulation or Policy	Description
State Environmental Policy Act (SEPA) (RCW 43.21C, WAC 197-11-330)	SEPA requires government decision-makers to consider the likely environmental consequences of a proposal and require mitigation measures.
Governor's Executive Order 21-02	Washington State Governor's Executive Order 21-02 (GEO 21-02, formerly GEO 05-05) requires that agencies consult, or delegate consultation to non-state recipients of state funds, with DAHP and affected tribes on the potential effects of projects on cultural resources proposed in state-funded construction or acquisition projects that will not undergo Section 106 review, including grant or pass-through funding that culminates in construction or land acquisitions, to determine potential effects to cultural resources. It requires that the state agency provide documentation of that consultation to DAHP.
Washington Heritage Register (Senate Bill 363; RCW 27.34.200, WAC 25-12)	Created March 19, 1971, Executive Session of the State of Washington Advisory Council on Historic Preservation and maintained by DAHP. Actions affecting resources listed in this register by any subdivision of state government or recipient of state funds must comply with SEPA and Executive Order 21-02.
Human Remains (RCW 68.50)	Relates to the protection, management, and processes in the care of human remains.
Indian Graves and Records (RCW 27.44)	Relates to the protection, management, and processes in the care of Native American cemeteries, historic graves, and related records.

Regulation or Policy	Description
Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60)	Relates to the preservation and protection of abandoned and historic cemeteries and graves including human remains.
Centennial Accord Between the Federally Recognized Indian Tribes in Washington State and the State of Washington (GOIA 1989) and its implementation plan (GOIA 1999)	Ecology consults with tribes in a government-to-government relationship to protect and manage shared natural resources.

14.3 Affected Environment

This section presents a broad overview of the tribal resources and tribal context of the study area and existing resources and is organized into two subsections based on cultural groups and bodies of ethnographic information: *Cultural Context— Wenatchapam* and *Cultural Context—Wenatchi*. The cultural contexts have been developed from two distinct bodies of knowledge. The Wenatchapam context has been adapted from contextual information provided by the Yakama Nation and is based on knowledge held by the tribe about cultural use and practice within the study area. This section represents ethnographic and historic information relevant to the cultural and legal context on a portion of Yakama Nation ceded lands. This knowledge has been shared to the extent necessary to provide context, but does not represent a complete history of the area. This knowledge shared by the tribe was on an as-needed basis, only to the extent necessary to assess impacts and significance.

The second subsection is derived from a literature review of published in 20th and 21st century ethnographic studies, histories, maps, and online resources, and is augmented by sources provided by the Confederated Tribes of the Colville Reservation. While the Confederated Tribes of the Colville Reservation have provided information to inform this section, it should not be taken as a statement by the tribe, but rather presenting a context based on publicly available literature that has then been commented on, reviewed, and supplemented by information held by the Confederated Tribes of the Colville Reservation. The ethnographic record can vary in spelling and interpretations. The context provided below utilizes spelling from the tribes when known. Information shared by the Yakama Nation was also incorporated into the Wenatchi context.

These two contexts are necessary to present a more holistic understanding of the long-term tribal use of the study area and the resulting significance to the various tribal groups that have, and continue to, utilize tribal resources in the area.

14.3.1 Cultural Context—Wenatchapam

This section has been adapted from a report prepared by the Yakama Nation and provided to Ecology on December 6, 2022 (YN 2022).

The study area is within the traditional territory of *Wenatchapam,* a signatory Band to the 1855 Treaty, and a multi-lingual group who likely used *Ichishkinsinwit* or Sahaptin as their first language. *Ichishkinsinwit* is of the land and rooted in the principles of the Creator's law *Nami Tamanwit*. This language originates from the air and water sounds created through the natural landscape and its features. This language is used in the longhouse to honor and bless the resources that sustained life. The language is interwoven into the cultural practices, the physical locations, as well as the overall understanding and connection to the land and communication with the Creator. The honoring of resources and blessings is a fundamental principle of the *Wenatchapam* people. The *Wenatchapam* people followed a practice known as, *Nami Tamanwit*, which was a practice and procedure that was distinct from that of tribes to the north and in particular those who resided in the greater Okanogan Valley and along the portions of the coastline (YN 2022).

The *Wenatchapam,* along with the *Entiatnapam, Chelanpam, and Methowpam,* are a part of the larger tribe known as the *Pisqiouse. Pisqiouse* is also shown in the ethnographic record as "Pisquouse" and "Pisquows" (Gibbs 1854; Hodge 1910:263, 932; Lahren 1998:488; Spier 1936:14). Hodge (1910: 932) notes Wenatchi as "probably a band of the Pisquows, formerly on the Wenatchee r." and were located on both the Yaka[i]ma Reservation in 1850 and with the Colville in 1910; further Hodge translates Yaka[i]ma *winätshi* to "river issuing from a canyon." Hodge (1910: 263) notes the *Pisquows* name may have been derived from the Yaka[i]ma word *pǐsko* meaning "bend in the river" and states the "Pisquows proper or remnant of them are now on the Yakama Reservation." Ethnographers further connect the *Pisqiouse* to the Yaka[i]ma through intermarriage (Gibbs 1854:412; Mooney 1896:736). The *Pisqiouse* travelled great distances including, but not limited to, along the Fraser River in British Columbia (YN 2022:6). The *Wenatchapam* followed a seasonal subsistence pattern from the Columbia River to the Crest of the Cascade Mountains (YN 2022).

The traditional territory of the *Wenatchapam* is within the Wenatchee River drainage where other tribes may maintain some level of use. However, the use they maintained was controlled traditionally and politically by the *Wenatchapam* leaders who elected a representative to sign the Yakama Treaty of 1855 (YN 2022).

The *Pisqiouse* were signatory to the Yakama Treaty of 1855 (12 Stat. 951) by way of *La-hoom* (*Pisqiouse/Entiatnapam*) and *Tecolekun* (*Pisqiouse/Wenatshapam*). *Tecolekun* was elected as a representative by leadership to represent the Wenatchee, Columbia, Entiat, and Chelan. He was also recognized in this capacity by both parties present at the Walla Walla council grounds[5](YN 2022).

Ichishkinsinwit provides further traditional description for *Wenatchapam* and *Pisqiouse.* The sound *Wenatcha* reflects the turbulent water that flows through the mountain, the water, and air come through a canyon (*weh*), fall (*nah*), and crash on the rocks (*tchah*). The name is used both to identify the characteristics of the river, today known as the Wenatchee, itself or to identify the *Wenatchapam* fishery, which is also known as *Speliyis Wanawish* as part of the creation story to the fishery. The suffix *pam* refers to people from the place *Wenatcha.* Specifically, its meaning is further characterized by the people that are from the water (the giver of life) that flows into the river where the water comes through a canyon and crashes on the rocks. Therefore, the *Wenatchapam* are defined by name as those from the watershed of the Wenatchee River (YN 2022). The *Pisqiouse* or *pítxkayús* is an *Ichishkinsinwit* name that means, "the people who go up into the mountains" (Oliver and Meninick 2022 as cited in YN 2022). Additionally, *"pítxkanus"* is associated with the mountains (Beavert and Hargus 2009 as cited in YN 2022).

The earliest known recorded use of the word *Wanatcha* was from the notes of the Lewis and Clark Expedition in October of 1805; maps also included the spelling *Wah na á chée* (Clark 1805). Tribal leaders, including the Great Chief *Cutsanim* who resided near the confluence of today's Wenatchee River, provided the translation. Cutsanim or *paxat-sa-nim* relates to the five sacred figures known as part of the traditional oral story of the history of the *Shyikes* and *Wenatchapam* (YN 2022).

The *Wenatchapam* often intermarried with the *Pshwanwapam* who occupied the upper portions of the Yakima River watershed and the western shores of the Mid-Columbia. In particular, the gathering place known as Teanaway or *Teanawins* was a place where many *Pshwanwapam* and *Wanatchapam* found their significant others. This gathering place was hosted by the *Pshwanwapam* in their traditional territory. This relation is further described in oral history as it relates to the *Wáwpu* or goat people/hunters (YN 2022).

[5] See Yakima Tribe v. the United Sates July 29, 1963.

Researchers have presented this understanding, finding that the *Pisqiouse* were heavily intermarried with the Yakama as discussed above (Mooney 1896:736; Gibbs 1854:412) to the extent it was observed they "have almost lost their nationality" (Gibbs 1854:412).

The traditional use area of the *Wenatchapam* extended into the Yakima River watershed on the relationship held by *Wenatchapam* and *Pshwanwapam* who often participated in traditional use and festival events in a way that overlaps. The *Wanatshapam* maintained close ties with the neighboring *Pshwanapam* through marriage and shared language (Ray 1936; Schuster 1998; Anasatsio 1972). The *Pshwanwapam* (often discussed as Yakama, Kittitas, or Upper Yakama) are the people who are from the water where the rocks fall into the river, the name and description referring to the Yakima River watershed, whose fishery was controlled and managed by the *Pshwanwapam* (YN 2022).

Traditional use or Usual and Accustomed places define a different understanding than traditional territory and span a much greater area. This distinction is important for intertribal use of an area; traditional territory refers to an area under a group's exclusive political control while traditional use area defines an area a group may have used as a guest (YN 2022). Ray (1936:21) states: "…*Thus, the hunting territory of one group might be quite open to use by another even though the bounds be highly specific. This freedom of use was the rule among many of the Salish groups. But among the Yakima [sic], for example, outsiders were required to obtain formal permission from a chief before hunting grounds might be used and even then the length of time was definitely limited*." Specific practices, ceremonies, and covenants were conducted before entering or using another tribe's land. In the case of the *Pshwanwapam* and *Wenatchapam,* they were bands of different tribes (YN 2022).

During the Yakama Wars in 1855, a Wenatchapam leader, *Sulktalthscosum* (Chief Moses), led a diverse group of followers, including some from well outside of the Wenatchapam traditional homelands (Northern Salish Tribes and Paiute). Chief Moses went against many of the established leaders at the time, and his style was considered nontraditional (YN 2022).

Chief Moses refused to recognize the Treaty with the Yakama in 1855 and petitioned the United States government for the establishment of a reservation. In 1879, the Columbia Reservation was established on his behalf (Miller 1998). Chief Moses later relinquished the Columbia Reservation and relocated to the Colville Reservation.

The Yakama Nation considers the project area to be within at least two separate TCPs, which the tribe has not been afforded the opportunity to document formally.

14.3.2 Cultural Context – Wenatchi

According to the Confederated Tribes of the Colville Reservation, the study area is within the traditional lands of the šnṗəšqʷáw̓šəxʷ or Wenatchi (meaning "People in the between") (Bouchard et al. 1988:135-145; CTCR 2021a). Ethnographic records also list Wenatchi known as the Wenatchee / Wenatshapam / P'Squosa people, who according to Miller (1998) speak a Columbian *nxaʔamxcin* Interior Salish language; (Bouchard et al. 1988:135-145; CTCR 2021a; Kincade et al. 1998:51; Miller 1998:253; Spier 1936:14). The šnṗəšqʷáw̓šəxʷ are considered part of the Middle Columbia River Salishan culture group, of which several distinct tribes of the Plateau Culture share similarities in subsistence patterns, structures, and other cultural practices (Miller 1998:253-270; Spier 1936). Descendants of the šnṗəšqʷáw̓šəxʷ include but are not limited to members of today's federally recognized Confederated Tribes of the Colville Reservation and the Confederated Tribes and Bands of the Yakama Nation. Indigenous peoples of this region have been using the study area and its vicinity for various levels of habitation, resource gathering, travel, and other traditional cultural practices since time immemorial.

Villages associated with šnṗəšqʷáw̓šəxʷ were located along Icicle Creek, the Wenatchee and middle Columbia rivers, along with other permanent and seasonal campsites ideal for resource gathering, hunting, and travel. The šnṗəšqʷáw̓šəxʷ village located at the mouth of Icicle Creek, within the

Downstream / Indirect Effects portion of the study area, was a large trade center and included a significant fishery known for its abundance of salmon. At the height of fishing season, thousands of šnp̓əšqʷáw̓šəxʷ and neighboring tribes would congregate here to share in its bounty (CTCR 2021a; Miller 1998; Ray 1936). Tribal members recall the description of Icicle Creek "running red" due to its plentiful salmon runs (Thompson 2002). This traditional fishery, also known as the Wenatshapam Fishery, or Wenatcha, or Spelyis Wanawish, as discussed above along with nearby rivers, tributaries, valleys, and mountain ranges, continue to be important resources for subsistence, teachings, and practice of traditional cultural lifeways for area tribes. The Confederated Tribes of the Colville Reservation confirmed there are named places within the project area not available for public record (personal communication, Downes 2022). Additionally, along with the fishery, published documents identified the following named place within the Upstream / Direct Effects and Downstream /Indirect Effects study areas: *Na'sik-elt* is a named used for what is known today as Icicle Creek; the original word means "narrow bottom canyon, or gorge" (Sylvester 1943 as cited in personal communication, Downes 2022). Ethnographic records can include information that may have been misinterpreted or imprecisely documented when initially recorded. It is possible that the locations known today as Eightmile Lake and Eightmile Creek, along with surrounding geographical features, may have associated place names. The Wenatchee River is named for the people that resided along its course. As discussed above, *Wenatcha* and *"Wah-na á chée"* were used in records from the Lewis and Clark Expedition in October of 1805. Additionally, Wenatchee in Yakama is "winatshi," meaning "river issuing from a canyon" (YN 2022). Archival resources indicate it was also known as "Pisquouse," "Wenatshapan[m]," and "Wah-na-a-cha" (Judge 1925:20). The villages of sc̓əm̓áw̓s (meaning "narrow in the middle") and sĭnpŭsqṓĭsoḣ were located at and near the present location of Leavenworth (Miller 1998:254 [no. 112]; Ray 1936:119, 142[no. 8]; Spier 1936:14 [no. 5]; Teit 1928). These names may refer to the same or related place, and additional unpublished named places may be present in the study area and its vicinity.

Tribes do not limit use or significance on the natural world. Animals, plants, geological, atmospheric, and astrological features play a role in traditional oral stories and cultural practices. Thousands of species have documented use. The traditional šnp̓əšqʷáw̓šəxʷ diet is based on fishing, hunting, and gathering of roots, bulbs, and berries. Salmon is a dietary staple; traditionally, the First Salmon Ceremony includes several days of rites connected to the materials used to create the weirs, the river, the catch, and the processing of the salmon (Miller 1998). Other water resources include sturgeon, suckers, Pacific lamprey, trout, roe, and shellfish (Miller 1998). Seasonal camps would be set up in the mountains and foothills for hunting and gathering, with some families staying through the winter months (Miller 1998). Mountain goat, deer, elk, and other alpine game supplemented fishing resources throughout the year. Several species also hunted for use (but not for consumption) include but are not limited to coyote, mink, wolf, and land otter. A wide variety of plants serve many purposes in traditional practices; these include but are not limited to willow shoots, cedar roots, bast, tules, cattails, Oregon grape, birch, fir, cottonwood, pine, sagebrush, and hemp. One of the šnp̓əšqʷáw̓šəxʷ traditional camas and root gathering places and campsites located within present-day Leavenworth has been recorded as a TCP (Leavenworth Camas Harvesting Area–45CH928). Important cultural plants for the Confederated Tribes of the Colville Reservation include but are not limited to huckleberries, foamberry or soapberry, bitterroot, white camas, chuckluse or Canbyi's biscuitroot, Indian potatoes or lance-leaf spring-beauty, Indian carrots or yampah, cous-cous or Canby's lovage, black camas, Indian hemp or hemp dogbane, tule or hardstem bulrush, little white camas or northern biscuitroot, and Western sweet-cicely or sweet-root (CTCR 2022).

Mountain pass trails ran throughout the Cascade Mountains and allowed for trade and access among the interior tribes and those west of the mountain range (CTCR 2021b; Gibbs 1877:167). These trails were also used by non-Indigenous groups as settlement in the valley increased. Surveyor records from the late 19th and early 20th centuries show trails along Eightmile and Icicle creeks as well as leading from the Wenatchee River and dotting the Cascades (USGS 1904; U.S. Surveyor General 1892, 1907, 1913, 1917, 1924).

The 1855 Treaty of Yakama, held at Walla Walla, established the Yakama Reservation (Lahren 1998:488). In addition to establishing the Yakama Reservation, the Treaty, as ratified on April 15 1859 in article 10 specified, "*a tract of land not exceeding in quantity one township situated at the forks of the Pisquouse or Wenatshapan Fishery; which reservation was to be surveyed and marked out whenever the President may direct subject to the provisions and restrictions the same as other Indian reservations*" (as quoted in Judge 1925: 20). In a 1910 letter to the Honorable Commission of Indian Affairs, Department of the Interior, Washington D.C. John Hermilt and Louis Judge, wrote to recognize the tract thus referred to in the treaty, "*would have been located below the forks of what are now the Wenatchee and Icicle Rivers, just at or below the present town of Leavenworth, and that treaty should have made it clear that this was for the Pisquouse of Wenatchee Indians*" (Hermilt and Judge 1910 as cited Judge 1925: 22).

Boundaries were never properly surveyed or recognized for the Wenatchi Reservation, and the šnp̓əšqʷáw̓šəxʷ were encouraged to relocate to the Moses-Columbia Reservation, created under executive order and later revoked (CTCR 2021a; Lahren 1998; Mass 1983; Thompson 2002). The study area is within the area that was to have been included in the reservation land for the šnp̓əšqʷáw̓šəxʷ located at the forks of the Wenatchee and Icicle rivers (Judge 1925:22; Miller 1998; WDFW 2017). Many šnp̓əšqʷáw̓šəxʷ remained on their land, applying for homesteads, but fees and taxes forced many to relocate to the Colville Reservation (CTCR 2021a; Thompson 2002).

According to the Confederated Tribes of the Colville Reservation, they have registered Icicle Creek (nsi'qəl 't) as a TCP from Johnny Creek to the confluence with the Wenatchee River (personal communication, Downes 2022).

14.3.3 Existing Resources

Natural Resources Associated with Tribal Use

Natural resources are inextricably linked with the lives of Indigenous peoples. All animal species from a tick to a moose have some connection to native people through traditional stories or practice. Plant gathering is an essential subsistence and cultural activity that is documented in ethnographic literature, tribal legend and stories, and archaeological sites. Plants were historically and are currently gathered for food, medicine, and ritual uses, as well as raw material for tools, clothing, basketry and mats, and other uses. Participation by tribal members in those gathering activities is a part of cultural identity.

The site around the dam and staging area is dominated by fir trees with subcanopy vegetation dominated by Oregon boxwood, currant, elderberry, thimbleberry, and various grass species. The upper and lower portions of FSR 7601-116 have montane habitat with grand fir forest associations, but the lower portion of the road also has subalpine fir forest associations. The lower portion of FSR 7601-116 has a higher density of alders with a lower density of pines than the upper portion of the road.

Aquatic and terrestrial habitats in the study area support a variety of wildlife species; however, the degraded ecosystem both within and outside of the study area has reduced the vigor of some of these populations. Table 8-4 (Chapter 8) provides a list of protected wildlife species likely to occur in the study area.

Eightmile Lake is one of the Alpine Lakes, which are characterized by naturally low productivity and provide relatively limited habitat for fish, primarily because of cold water from melting snow or glaciers, a short growing season, the lake location at the head of the watershed, and a general lack of inputs of organic material. The Alpine Lakes are relatively pristine compared to downstream habitats. Eightmile Lake drains to Eightmile Creek, which drains to Icicle Creek. Icicle Creek provides approximately 29 river miles of spawning and rearing habitat to native salmon and trout species, including the ESA-listed Upper Columbia spring-run Chinook salmon Evolutionarily Significant Unit (ESU), listed as endangered. However, spring-run Chinook salmon produced at the LNFH are not included in the listed Upper Columbia spring-run Chinook ESU, as this stock is more closely related to lower Columbia River stocks (Muir et al. 2020).

The project area is within the Ceded Lands of the Yakama Nation and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources. These tribes target non-listed spring-run Chinook salmon returning to the LNFH (with known fishing areas including the plunge pool immediately downstream of the LNFH channel spillway). Since the reintroduction of coho salmon to the Icicle Creek drainages, tribal subsistence fisheries for coho salmon have been opened when runs are large and surplus fish are available. Additional fish present in Icicle Creek are listed in Table 8-5 in Chapter 8.

A list of culturally significant plants developed during work in nearby Okanogan County is presented in CTCR (2022). A culturally significant plant study is not available for the specific project area. Specific knowledge on significant plants and related practice is retained within the tribes, and continued consultation is required to continually assess potential impacts for this resource type.

14.4 Construction Impacts

Construction (short-term) impacts would be related to the specific footprint of disturbance required to allow access for materials, equipment, and work crews. For access routes, this is defined as the footprint of disturbance required to improve existing roads or temporarily reroute non-motorized trails. The footprint of disturbance necessary for staging areas or landing pads at the construction zone is also a construction impact and will require the removal of vegetation. The final construction impact is the footprint of disturbance necessary for the demolition of the existing dam facility, installation of the Icicle Ridge repeater station, and the construction of the selected alternative.

The No Action Alternative would not have a construction phase, and as a result would not have any short-term construction related impacts on tribal resources. The impacts for Alternative 1 (Narrow Spillway with Automated Gates), Alternative 2 (Wide Spillway without Gates), and Alternative 3 (Narrow Spillway without Gates) would be similar, and the action-specific discussions found below can be applied to all three dam alternatives.

14.4.1 Construction Activities

The construction activities, including demolition of the existing facility, would result in the destruction of the existing Eightmile Dam. No features or elements of the current built environment structure, other than its location and course of the spillway, would be retained.

Site preparation would involve site clearing, including the removal of up to 30 trees and understory vegetation, leveling of the staging area using the existing excavator on site, and removal of wood and debris from the lake edge within the work area.

Dam construction would disturb wildlife throughout the construction period in an area surrounding the east end of Eightmile Lake, and may extend out to the remaining portion of the Eightmile Lake basin. Helicopter use would disturb most wildlife species, displacing those that have ability to flee from the area. The presence of humans and use of heavy equipment and other tools would displace wildlife from this area during construction. Due to the relatively small scale of the construction, limited areas of disturbance, and limited time frame, it would have **less-than-significant adverse impacts** on wildlife and wildlife habitats in and around the study area.

All action alternatives would require in-water work in Eightmile Lake to construct the earthen dam and spillways, potentially affecting the resident trout species in the lake. The shoreline area where work occurs will be isolated in the lake by construction of a cofferdam consisting of bulk bags placed by an excavator. Dewatering the isolated work area using pumps may also be necessary. Under all action alternatives, any dewatering pumps used would have fish-friendly screens on the intake hoses (to prevent fish impingement or entrainment). The in-water work and associated fish removal may result in some minor mortality, injury, or behavioral disturbance in the immediate work area (individual fish could be harmed or killed and larvae of some species could be entrained). However, the vast majority of fish in the lake would be unaffected and would likely avoid the work areas of active construction due to increased turbidity. For all action alternatives, the magnitude and extent of turbidity as a result of construction actions are expected to be minor, short-term, and localized based on the use of the BMPs described in Chapter 8, *Plants and Animals*. Although some behavioral impacts on fish would likely occur, such as avoidance and temporary behavioral changes, no substantial mortality is expected to result. Deposition of sediment on the lake bed from construction-generated suspended sediment would not be substantial and would be comparable to the natural deposition from sediment in the lake. For all action alternatives, impacts from turbidity and sedimentation associated with dam removal on resident fish would be **less-than-significant.**

Construction of the project is not expected to affect any known TCPs associated with Indigenous peoples. Unknown or unrecorded TCPs may exist within the project area. Access would be restricted around the immediate construction area for safety reasons; however, the remainder of the lake and the wilderness would remain open. Because of the relatively small area and limited construction duration, these actions would result in **less-than-significant adverse impacts** on tribal resources and access.

14.4.2 Helicopter Access

Helicopter access would not directly or indirectly impact any known tribal resources significant to tribal communities. The environment surrounding Eightmile Lake is predominantly comprised of active talus slopes and seasonal channels for melt drainage with minimal vegetation. As noted in Chapter 2, up to 30 trees will be removed at the staging area immediately adjacent to the dam. This environment is where helicopter takeoff and landing could occur at Eightmile Lake. Because of the existing nature of the area, and the relatively small number of trees proposed for removal, this action is expected to have **less-than-significant impacts** on tribal resources.

Helicopters would also likely be used to transport required materials to the repeater location on Icicle Ridge. That portion of the project area was surveyed for cultural resources and none were identified (Ostrander et al. 2023). Helicopter use would temporarily increase noise in the general area. No activities sensitive to noise, such as hunting or spiritual practice, were identified during research or presented during tribal consultation. Use of helicopters is expected to have **no significant impacts** on tribal resources.

Impacts on wildlife habitat from helicopter use would be minimal if landing zones do not need to be substantially altered from current conditions. Propwash, which would be strong from both types of helicopters but particularly strong from the double-rotor Chinook, would not damage vegetation to the point that it is fundamentally unusable by wildlife. Helicopter use would have **less-than-significant impacts** on wildlife habitat and vegetation significant to tribes.

Helicopter use would disturb all avian species and terrestrial mammals, including those with state and/or federal protections. Protected bat species, which may roost near the loading and unloading areas, may also be disturbed and stressed by helicopters as cargo is shuttled during construction. Therefore, use of helicopter may have significant adverse impacts on individual bats locally if present, but would have **less-than-significant adverse impacts** on wildlife throughout the study area.

The multiple helicopter trips required for transport of construction equipment and material would not affect aquatic species, including fish. Refueling of helicopters would occur in designated areas away from streams and outside of the wilderness area. **No significant adverse impacts** on fish or fish habitat would occur from helicopter use under any of the action alternatives.

14.4.3 Overland Motorized Access

Overland motorized access is not expected to result in a direct or indirect impact on known TCPs associated with tribal practice. Unknown or unrecorded TCPs may exist within the project area. Use of the road segment would require vegetation removal and road grading with heavy equipment and hand crews. These activities would cause localized noise disturbance from the presence of humans and equipment, and alter wildlife habitats along the segment. Noise would displace wildlife species able to flee the area, which would likely occur prior to the associated physical habitat changes. Human presences, largely associated with the heavy equipment, would further disturb wildlife in the area. However, due to the small scale of the construction for the road segment, it would have **less-than-significant adverse impacts** on wildlife and wildlife habitats and tribal resources in and around the study area.

The roadway has several existing culvert crossings of small fish-bearing streams that drain to Eightmile Creek. The roadwork could increase runoff from road sediments, which in some cases could enter streams. However, road design will meet Forest Service standards and incorporate appropriate sediment and erosion control measures near stream crossings, potentially including water bars to route and disperse runoff on vegetated slopes, to minimize or eliminate stream sedimentation. **No significant adverse impacts** on fish or fish habitat would occur from repairing and improving the road under any action alternative.

14.4.4 Non-motorized Wilderness Access

The use of a non-motorized wilderness access path along the route of the existing Eightmile Lake Trail, 4th of July Creek Trail, and Icicle Ridge Trail would not result in direct or indirect impacts on any resources connected to tribal practice. The existing Eightmile Lake Trail was surveyed for cultural resources under the Programmatic EIS (Anchor QEA 2018c). The 4th of July Creek Trail and Icicle Ridge Trail segments needed for access to the repeater location on Icicle Ridge were surveyed as a part of this project (Ostrander et al. 2023). All trail access will generally be maintained during construction, except immediately adjacent to Eightmile Dam. The Eightmile Lake Trail may be temporarily closed for safety reasons if blasting with explosives is required (refer to Chapter 2).

14.5 Operational Impacts

Operational (long-term) impacts are those effects that would occur as a result of the selected alternative. Operational (long-term impacts) on tribal resources are considered fairly consistent for all of the action alternatives. **No impacts are anticipated for areas associated with tribal practice.** Each action alternative would have short-term effects on plants and wildlife, but would likely not persist as habitats recover from the alterations and disturbance abates to pre-project levels. Following active construction, full access to the area will be allowed for hunting, fishing, and gathering.

The only significant impact possible as a result of long-term operation of the dam facility would be if the dam structure were to fail, and a high-energy flood inundation were sent down from Eightmile Lake into Eightmile and Icicle creeks. A dam failure event would have significant impacts. However, this failure is most likely to occur under the No Action Alternative, as the upgrades under the action alternatives greatly reduce the likelihood of this occurring.

Changes in lake level would occur as a result of operation under each of the action alternatives. These seasonal changes are not expected to impact tribal resources and will not hinder access in any way. No areas associated with tribal practice have been identified within or in close proximity to the lake margin. The environments at the edge of the lake are active talus slopes, bedrock exposures, or areas heavily disturbed as a result of construction or operation of the Eightmile Dam.

Operational impacts of the project would have short-term effects on wildlife and wildlife habitat, but would likely not persist as habitats recover from the alterations and disturbance abates to pre-project levels.

Unlike construction activities, the operational aspects of the project could beneficially affect fish and fish habitat both within Eightmile Creek and downstream of the lake in Eightmile Creek and Icicle Creek, extending to the confluence of Icicle Creek with the Wenatchee River as a result of additional instream flows in those water bodies.

14.5.1 No Action Alternative

As described in Chapter 8, *Plants and Animals*, removal of the dam–either due to failure or active removal–would result in a decrease of its capacity and surface water height, but would not cause the demise of the lake. The reduction in the size of Eightmile Lake would, therefore, result in **less-than-significant adverse impacts** on wildlife and wildlife habitat because the lake would persist and habitats would not be fundamentally degraded or reduced.

The No Action Alternative may present a significant risk to tribal resources due to the risk of catastrophic dam failure and resulting high-energy flooding along the downstream portion of the study area. Catastrophic failure would likely result in a high-energy flood to flow down from Eightmile Lake into Eightmile and Icicle creeks. This flooding poses a risk to tribal resources.

Overbank flooding poses a risk to tribal resources along the waterway until Icicle Creek meets its confluence with the Wenatchee River. The near-bank environment that would be impacted by the high-energy flow in the event of a dam failure likely contains resources associated with tribal practice.

High-energy erosive flows from a dam failure may cause a short-term significant impact on tribal resources by altering the physical and natural environment where traditional practices such as resource procurement and spiritual pursuits occur. Locations within and adjacent to Eightmile and Icicle creeks are advantageous for fishing and gathering, and the alteration of the physical landscape and its resulting role in the local ecosystem could impact tribal communities by altering the viability of commercial, substance, and spiritual activities at a given location.

Dam failure would result in downstream flooding on Eightmile and Icicle creeks. This flooding would alter vegetation and habitat, to some extent, including Little Eightmile Lake, wetlands, and riparian areas. Little Eightmile Lake would likely be altered because it is relatively shallow and may become scoured during a flood event. Flooding farther downstream would also result in some vegetation removal, scouring, and sediment deposition, likely altering habitat along Eightmile and Icicle creeks. These alterations, however, would emulate those from natural flooding events, and the ecosystem would fully recover over one to two decades. Impacts from a dam failure flood event on vegetation and habitat downstream of Eightmile Lake would, therefore, be **less-than-significant**.

Hydrologic changes from dam failure or removal are predicted to reduce summer streamflows by up to 75 percent, which could affect amphibians, reptiles, and other species that depend on the current flow regime from Eightmile Lake. During the summer dry season, such a reduction in flow would result in less availability of water and aquatic habitat, as well as a reduction in the quality and diversity of aquatic habitat. Together, losing substantial flow during the dry season, when many wildlife species rely on it the most, would be expected to result in adverse impacts on some individuals that are directly associated with these aquatic habitats. However, because of the small affected area, **less-than-significant adverse impacts** would be expected to occur to wildlife species throughout the study area.

Should dam removal be required, the lake outlet elevation would likely be lowered to an elevation of 4,648 feet. This would reduce available habitat for fish in Eightmile Lake, and would also have an effect on downstream streamflow, where reduced water storage capacity would decrease the amount of water available for summer water releases. Reduced summer flows would reduce the habitat quality and quantity for all fish species that utilize Eightmile Creek and the Icicle Creek mainstem downstream of the confluence. Dam removal would be expected to cause **significant adverse impacts** on fish and fish habitat in both Eightmile and Icicle creeks.

Catastrophic failure of the dam under the No Action Alternative would also affect fish and wildlife resources. If such failure occurred, it would likely be during spring rain-on-snow events when streamflow is at its highest. A partial or total dam failure would have substantial negative effects, both immediately and perpetuating into the future. A catastrophic failure would quickly drain the lake, resulting in up to 1,375 acre-feet of water being suddenly released in an uncontrolled manner. The lake would be drained and the majority of the resident fish within the lake would likely be killed as they became entrained in the downstream flows. Partial or total dam failure could result in debris torrents that would destroy downstream infrastructure, likely including infrastructure at the LNFH; cause severe channel scour (potentially to bedrock); denude riparian areas; mobilize, transport, and ultimately deposit large volumes of sediment; cause widespread flooding; and potentially lead to debris jams and stream avulsions. A large-scale or total failure would likely result in mortality to the vast majority of the fish present in Eightmile Lake, Eightmile Creek, and in Icicle Creek downstream of the Eightmile Creek confluence, and could also have substantial negative effects in the Wenatchee River. Other long-term effects on fisheries resources would be expected to occur with the absence of the dam related to summer flow reductions, similar to those described above for dam removal. Catastrophic dam failure would cause **significant adverse impacts** on fish and fish habitat in both Eightmile and Icicle creeks, which could have direct economic impacts on any tribal members who utilize the fishery.

14.5.2 Alternative 1: Narrow Spillway with Automated Gates

The Narrow Spillway with Automated Gates alternative poses no long-term operational impacts on tribal resources. The operation of the facility would not impact any known tribal resources, and the threat to unrecorded tribal resources would be substantially lower than current conditions as the risk of failure from the dam structure and the resulting erosive flows would be mitigated. The primary risk from long-term operation would continue to be associated with the erosion of streambanks due to water flow, resulting in the degradation of habitat. Changes in surface water elevation and flows through the riparian corridor would support wildlife species and habitats in these areas. Revegetation and removal of invasive plant species may result in habitat enhancement above existing conditions, if executed effectively. Therefore, operation of Alternative 1 would result in **less-than-significant adverse impacts** on wildlife and wildlife habitat and associated tribal resources.

Alternative 1 would restore the storage capacity of Eightmile Lake, while adding safety features that drain the lake during extreme storm events. In addition, Alternative 1 has a smaller footprint than under Alternative 2 and also allows the lake to be drawn down to 4,636 feet during drought conditions to provide water for both downstream water supply and instream flow needs. Alternative 1 has a maximum WSEL of 4,671 feet, which would produce a lake surface area of 81.4 acres. Compared to existing conditions (and the No Action Alternative), this alternative provides a WSEL 4 feet higher than current conditions, which equates to 4.8 acres more lake surface area. These increases in the horizontal and vertical profile of the lake under Alternative 1 would provide an increase in total maximum lake volume of 310 acre-feet and an increase of active storage volume of approximately 460 acre-feet. This restoration of storage capacity would provide more water for both irrigation and for summer instream flow supplementation, which would provide benefits to fish downstream of the lake in Eightmile and Icicle creeks, benefiting tribal resources. The additional flow supplementation would consist of cooler water from below the lake surface, potentially providing lower temperatures downstream and higher dissolved oxygen levels, which also would benefit these fish species. Compared to existing conditions, where the lake is drawn down annually to the lowest level, Alternative 1 would only reach low levels during drought conditions (approximately once every 5 years).

Additionally, Alternative 1 includes an automated 464-foot-long low-level outlet pipe draining the lake into Eightmile Creek. The pipe inlet in the lake for Alternative 1 would be at elevation 4,636 feet, where the water is likely substantially cooler than the surface water temperature. The automated nature of the outlet pipe would allow IPID to remotely provide a relatively consistent source of colder water for summer instream flow supplementation and irrigation, as compared to the No Action Alternative. The resulting relatively dependable (as compared to existing conditions) summer flow augmentation would benefit those anadromous and resident salmonid species that utilize Eightmile Creek and the Icicle Creek mainstem downstream of the confluence. This includes providing more wetted aquatic habitat in the summer, as well as potential improvements to stream temperatures and increased dissolved oxygen levels.

Alternative 1 would allow the lake to fill to a level that provides 4.8 acres more lake surface area than existing conditions, and would also allow the lake to be drawn down to a level that provides a lake area of 2.5 acres less than could occur under existing conditions. Although the lake area (and volume) has the potential for larger fluctuations as compared to existing conditions, the relatively small increases and decreases would not substantially alter lake biology, and would have a minimal effect on aquatic species within the lake. The current lake has relatively steep side slopes consisting of bedrock, talus slopes, and scattered coniferous trees. Slight alterations in the lake level will not impact the existing levels of riparian function. Similarly, ecological processes in the lake that affect fish abundance and species biodiversity (such as fish densities, nutrient and insect recruitment, sediment transport and deposition, and functioning of the lacustrine riparian zone) would not be substantially altered under Alternative 1, and no detectable changes in fish abundance, species composition, or lake water quality would occur, compared to existing conditions, resulting in **less-than-significant adverse impacts** on fish, fish habitat, and tribal resources.

14.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

The Wide Spillway without Gates alternative poses no long-term operational impacts on tribal resources. The impacts and analysis for this alternative are largely the same as for Alternative 1. The primary differences from Alternative 1 are the design of the spillways, including spillway size, and the absence of gates to control WSEL. With the earthen embankment and reinforced concrete dam proposed under Alternative 2, the primary spillway length of 180 feet is 120 feet longer than under Alternative 1. The construction of Alternative 2 would require about 10,000 cubic yards of material to be excavated from elsewhere on the site and used to build the dam. The primary spillway would be fixed and completely passive, with the lake draining over the primary spillway when the lake fills to an elevation above 4,671 feet. Alternative 2 has only the single primary spillway, and does not include any gates or automatic equipment that would control the spillway or adjust the spillway crest elevation. As with Alternative 1, water would be released from the lake through a new 30-inch diameter low-level outlet pipe/siphon. The operation and configuration of the low-level outlet pipeline would be essentially the same as described for Alternative 1. The fixed spillway would provide slightly less control of high-water surface elevations as compared to Alternative 1, and would require some additional disturbance to adjacent areas for construction of the larger earthen dam structure, but overall would essentially function the same and provide equivalent benefits to downstream summer flows to fish in Eightmile and Icicle creeks. As with Alternative 1, Alternative 2 would not result in substantive changes in the fish resources or fish habitat in Eightmile Lake, and would be expected to result in **less-than-significant adverse impacts** on tribal resources.

14.5.4 Alternative 3: Narrow Spillway without Gates

The Narrow Spillway without Gates alternative poses no long-term operational impacts on tribal resources. The impacts and analysis for this alternative are largely the same as Alternative 1. However, the pumping required by IPID at low-water levels would require the site to be accessed by a work crew, either by foot or helicopter, at times during operations when additional water is required downstream. Such an action would disturb wildlife species in the area due to noise and human presence. Species impacted include those described under dam construction (Chapter 8, Section 8.4.2). Because the expected use of pumping would be infrequent, operation of Alternative 3 would result in less-than-significant adverse impacts on wildlife and associated tribal resources around the dam site during pumping activities.

Alternative 3 would be designed to store water up to a maximum WSEL of 4,667 feet, which is 4 feet lower than Alternatives 1 and 2. The maximum volume of water that could be stored for release by the dam would be less for this alternative than for the other action alternatives. The total lake volume at maximum WSEL for Alternative 3 is 1,698 acre-feet, approximately 312 acre-feet less than under Alternatives 1 and 2. Similarly, the active storage volume under Alternative 3 is 302 acre-feet less than the two other action alternatives.

The pumping required by this alternative would involve flying pumping equipment to the dam site, likely including the use of diesel or gasoline to power a pump or generator. The use of such equipment would slightly increase the potential for spills of hazardous materials. In addition, in drought conditions and without pumping, water storage available for release to enhance downstream flows would be less than under Alternatives 1 and 2, resulting in potentially less benefit to fish habitat, water quality, and tribal resources in downstream reaches of Eightmile and Icicle creeks.

14.6 Avoidance, Minimization, and Mitigation Measures

The project would avoid and minimize impacts on tribal resources by focusing the project impacts from construction and operations within previously disturbed areas to the extent possible. The construction and operations footprints for the dam alternatives are largely within an area that has historically contained the existing Eightmile Dam or original construction materials. The use of these previously disturbed areas minimizes the risk that the project will impact Native American traditional practices or tribal resources. Access to most of the area will be maintained during construction, with limitations only adjacent to the active dam construction area, and in the event that blasting with explosives is needed. Following construction, native vegetation will be replanted in disturbed areas, following a plan approved by the Forest Service. Vegetation management will include the removal and monitoring of noxious weeds disturbed by the project. Access to all areas will be fully restored following the completion of construction.

14.7 Significant Unavoidable Adverse Impacts

There are no significant unavoidable impacts on known tribal resources expected under the action alternatives. The No Action Alternative has the highest potential to cause significant impacts on tribal resources, should the dam fail. The action alternatives would result in no significant impacts on tribal resources, and would result in benefits to downstream summer flows to fish species in Eightmile and Icicle creeks.

CHAPTER 15: AGRICULTURE, DEVELOPMENT, AND OTHER ECONOMIC ACTIVITIES

This section describes the economic activities within the study area and evaluates how they may be affected by the project alternatives. While analysis of economics is not a SEPA requirement, Ecology has opted to include an economic analysis that focuses both on the effects in terms of regional economic productivity and values of economic activities (e.g., recreation, agriculture), as these are important factors for decision making.

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS. Some minor typos have been corrected.
- Responses to specific comments on agriculture, development, and economic activities are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

Key Findings for Agriculture, Development, and Economics

- Key drivers of the local and regional economies (including agriculture, recreation, and development) are dependent upon the natural resources in the study area, including water resources from Eightmile Lake and Icicle Creek, fish and wildlife, and the natural beauty of the environment.
- These economic activities have the potential to be negatively affected by the action alternatives and No Action Alternative to the extent that they result in the impairment or curtailment of water rights, or in the loss of life or property.
- IPID is the only entity legally entitled to water released from Eightmile Lake. Other entities with junior diversionary water rights in Icicle Creek are secondary beneficiaries of water released from Eightmile Lake but are not legally entitled to that water.
- During severe drought conditions, construction activities under all action alternatives may result in impairment of primary water rights of IPID and subsequent impacts on the agriculture sector (a significant adverse impacts) and have the potential to result in curtailment of the junior water rights of the City of Leavenworth and the LNFH (a less-than-significant impact on associated economic activities).
- If status quo operations continue under the No Action Alternative, curtailment of the junior water rights of the City of Leavenworth and LNFH and economic impacts on associated activities are possible but are not considered significant because that water is not guaranteed to those users in a given year. Any possible curtailment would be limited to low water years. Delivery of water to IPID and its agricultural customers could be significantly adversely affected in years of low water.
- Should the dam fail under the No Action Alternative, impairment of IPID's water rights and significant adverse impacts on the agriculture industry are possible during years of severe drought. Dam failure may result in other significant adverse impacts on economic activities, including threats to the safety of residents, recreationists, and tribal fisheries; loss of residential structures; loss or damage to hatchery facilities; fish kills that limit or eliminate tribal fishing opportunities; and closures of recreational areas.
- Significant adverse impacts are not anticipated under any of the action alternatives.

Agriculture, recreation, and development are key drivers of both the local and regional economies in the study area. These activities are dependent upon the natural resources in the area, including water resources from Eightmile Lake and Icicle Creek, fish and wildlife, and the natural beauty of the environment. The project alternatives affect the quantity of water that can be stored at a given time in Eightmile Lake and would be physically available from the system. IPID holds a water right on Eightmile Lake, and their agricultural customers are the primary beneficiaries of stored lake water. Other users and industries with diversionary water rights in Icicle Creek that experience secondary benefits from water released from Eightmile Lake include the City of Leavenworth and the LNFH.

15.1 Methodology

The analysis of economic activity focuses on key economic drivers within the region, as well as the economic activities dependent upon resources potentially directly or secondarily affected by the alternatives as follows:

- Agriculture
- Growth and Development
- Recreation
- Fisheries and Hatcheries

This analysis evaluates the potential effects on these economic activities due to both the operational changes at Eightmile Dam on the supply and delivery of water from Icicle Creek, and resulting from the dam construction activities. This analysis focuses on Chelan County, the site of Eightmile Dam, and the IPID service area and the City of Leavenworth's water system, both of which are reliant upon surface water from Icicle Creek. The analysis also considers neighboring Douglas County given that some portion of the potentially affected populations (e.g., farm workers) likely resides there. Together, Chelan and Douglas counties are identified by the U.S. Census as the Wenatchee Metropolitan Statistical Area (MSA). This MSA includes the population centers of Wenatchee, East Wenatchee, Cashmere, and Leavenworth, among others (see Appendix D, *Environmental Justice*, for a map of the MSA).

IPID is the only entity legally entitled to water released from Eightmile Lake. Adverse impacts resulting from the project are only considered significant if the alternative results in impairment of the water rights of senior water rights holders. Other entities with water rights in Icicle Creek are secondary beneficiaries of water released from Eightmile Lake but are not legally entitled to that water. Although the alternatives may result in impacts on these entities in the form of curtailment of their own water rights in Icicle Creek (i.e., reduced water availability), those impacts are not considered significant because that water is not guaranteed to those users under their respective water rights in a given year. Delivery of water to IPID and its agricultural customers is not likely to be affected by the operation of any of the Action Alternatives, but could be significantly adversely affected during construction and under the No Action Alternative during years of low water. For more information on water rights, see Chapter 6.

15.1.1 Threshold for Significant Adverse Impacts (Short-Term)

Short-term (i.e., construction) impacts would be considered significant under the following circumstances:

- **Agriculture**: Construction would cause impairment of existing water rights of IPID, resulting in an inability to meet the demands of existing agricultural customers.[1]
- **Recreation:** Significance determinations to recreation are made within Chapter 10, *Recreational Resources*, and this chapter does not develop separate definitions for significant impacts with respect to the value of recreation. This chapter describes the economic implications of impacts presented in Chapter 10.
- Dam failure results in loss of life or property.

This analysis also considers the potential effects on other economic activities due to curtailment of water rights to junior water rights holders resulting from the No Action Alternative or any of the action alternatives. However, these effects are not considered significant adverse impacts because only IPID has the right to rely on the release of water stored at Eightmile Lake (see Chapter 6, *Water Rights*). This analysis evaluates the potential for non-significant adverse impacts on the following activities:

- **Growth and Development**: Construction results in curtailment in delivery of water to fulfill the City of Leavenworth's existing diversionary water rights due to insufficient streamflow or increase the number of days that instream flow within Icicle Creek cannot be met, resulting in an inability to meet the demands of customers in the water service area from the interruptible portion of their water right portfolio.
- **Fisheries and Hatchery Operations**: Impacts caused by reduced water delivery would result in the closure of commercial or tribal ceremonial and subsistence fisheries or a closure of hatchery operations. Chapter 14, *Tribal Resources,* evaluates the potential impacts of the alternatives on the cultural value of tribal ceremonial and subsistence fisheries.

15.1.2 Threshold for Significant Adverse Impacts (Long-Term)

Long-term (i.e., operational) impacts would be considered significant under the following circumstances:

- **Agriculture**: Long-term operation of the new facility would cause impairment to existing water rights of IPID due to insufficient streamflow, resulting in an inability to meet the demands of existing agricultural customers.
- **Recreation**: Significance determinations to recreation are made within Chapter 10, *Recreational Resources*, and this chapter does not develop separate definitions for significant impacts with respect to the value of recreation. This chapter describes the economic implications of impacts presented in Chapter 10.
- Dam failure results in loss of life or property.

This analysis evaluates the potential for non-significant adverse impacts on the following activities:

- **Growth and Development:** Long-term operation of the replaced dam facility would curtail the delivery of water to fulfill existing diversionary water rights of the City of Leavenworth due to insufficient streamflow or increase the number of days that instream flows within Icicle Creek cannot be met, resulting in an inability to meet the demands of existing customers, or the inability to accommodate anticipated population growth and development within the planning horizon.

[1] There are no circumstances in which the Cascade Orchard Irrigation Company (COIC) senior water right would be impaired. As a result, COIC is not considered in this impact analysis.

- **Fisheries and Hatchery Operations:** Impacts would result in a reduction in the number of fish available for harvest in commercial or tribal ceremonial and subsistence fisheries or a reduction in hatchery operations. Chapter 14, *Tribal Resources,* evaluates the potential impacts of the alternatives on the cultural value of tribal ceremonial and subsistence fisheries.

15.2 Regulatory Context

Numerous programs, plans, policies, and regulations focus on water quantity, water quality, fish and wildlife, proposed land use, and practices within wilderness areas that have bearing on how these economic activities may affect, or be affected by, the project alternatives. These regulations and policies are described in greater detail in Chapters 4 (*Surface Water Resources*), 6 (*Water Rights*), and 8 (*Plants and Animals*).

In particular, Chelan County's Comprehensive Plan outlines the community's goals and policies for economic development for the next 20 years (Chelan County 2017). The County aims to accommodate and support efforts to diversify the agricultural economy, encourage the retention and growth of recreational and tourist-based industries, and encourage efforts to diversify the existing economic base to focus on long-term sustainable economic development.

Additionally, the City of Leavenworth's Comprehensive Plan specifies the City's goals and policies for economic development for the next 20 years (City of Leavenworth 2017b). The City seeks to foster a balanced, diversified, and sustainable local economy; maintain and enhance year-round opportunities for sustainable tourism; enhance commercial districts as an active and economically viable place to shop; and build upon the City's many recreational, cultural, and historical amenities.

15.3 Affected Environment

Note – this analysis was conducted using some data collected before the COVID-19 pandemic. The pandemic has likely affected the analyzed metrics.

Population growth can stimulate regional economic activity through increased spending and production. The American Community Survey (ACS; U.S. Census Bureau 2009a and 2019a) reports that the total population in the Wenatchee MSA was 118,252 in 2019, a 10.7 percent increase in population since 2009. Both counties in the MSA saw growth individually between 2009 and 2019.

Overall, Chelan and Douglas counties experienced economic growth between 2009 and 2019, including growth in gross domestic product (GDP), income, and employment. Growth in GDP in both counties outpaced GDP growth nationwide but was less than the growth experienced by the State of Washington. While per capita income in Chelan County increased more substantially than at the state and national levels, per capita income increases in Douglas County were less. The *Agriculture, Development and Other Economic Activities Discipline Report* (IEc 2023) provides more detailed information regarding recent trends in economic growth.

Before the COVID-19 pandemic, Chelan and Douglas counties experienced unemployment rates (4.9 and 5.7 percent, respectively) slightly above the Washington State rate of 4.2 percent. The pandemic led to a shrinking labor force in 2020, with the Wenatchee MSA's unemployment rate increasing from 4.9 percent in November 2019 to 6.6 percent in November 2020 (Washington ESD 2021).

In both Chelan and Douglas counties, the government sector was among the largest employers in 2019, accounting for 13 percent of total employment in Chelan County and 14 percent in Douglas County. Farms were the largest employer in 2019 in Douglas County, accounting for 14 percent of total employment. Farms accounted for 8 percent of employment in Chelan County. However, farm industry employment contracted by 9 percent (Chelan County) and 7 percent (Douglas County) between 2009 and 2019. The accommodation and food services sector experienced the highest growth in both counties over the last 10 years, reflecting the expanding view of the region as a desirable tourism destination.[2] However, the tourism sector was affected by the COVID-19 pandemic, with Chelan and Douglas counties experiencing a drop in per capita direct travel and tourism spending of approximately 19 percent from 2019 to 2020 (Eastern Washington University 2021). IEc (2023) provides a more detailed accounting of the top employment sectors in these counties, and trends in employment between 2009 and 2019.

In Chelan County, the sectors associated with the highest wages were the government and health care sectors, representing 24 percent and 20 percent, respectively, of all total wages paid. In Douglas County, the government sector represents the highest proportion of wages paid, at 31 percent. Wage growth was seen across both Chelan and Douglas counties from 2009 to 2019, with the accommodations, wholesale trade, and forestry sectors experiencing the greatest changes.

Water from Icicle Creek supports many of the key economic activities within the region, including the following:

- Orchards, fruit storage, and other agricultural operations providing employment and wages (Anchor QEA 2018b).
- Municipal and domestic use (including residences and businesses, particularly those serving tourists) (City of Leavenworth 2018).
- The Leavenworth National Fish Hatchery (LNFH), which produces spring Chinook salmon that support important recreational and tribal fisheries, and contribute to commercial fisheries in the Columbia River and Pacific Ocean (USFWS 2016).
- Recreational, commercial, and tribal ceremonial and subsistence fisheries for Chinook salmon and other species.

The remainder of this section describes the values, activity levels, and trends in economic activities dependent upon Icicle Creek water.

15.3.1 Agriculture

This section characterizes the agricultural entities that rely on water from Icicle Creek, as well as the broader agriculture industry in the region.

Agriculture Supported by Icicle Creek Water

Table B-2 of Appendix B (*Water Rights*) lists the entities with surface water rights to Icicle Creek (Anchor QEA and IPID 2021). Approximately 93 percent of the irrigation water is allocated for use by the IPID, which then delivers water to local farmers and other users of irrigation water. One other organization supplies water to farmers (COIC). The number of growers and farms supported by these water rights arrangements is unknown. IPID reports 4,314 shares in the Icicle District and 3,723 shares, although not all of these shares are necessarily dedicated to agricultural use (Anchor QEA and IPID 2021). There were 2,140 land parcels within IPID district boundaries as of 2018; individual farms may consist of multiple parcels (Anchor QEA and IPID 2021). For reference, 835 farms were recorded in Chelan County in 2017 (NASS 2017).

The total area of agricultural land irrigated with water from Icicle Creek is unknown, but estimates from IPID provide some clarity. Table 15-1 describes IPID's estimate of irrigated acres across orchards and pasture based on their 2018 Comprehensive Conservation Plan (Anchor QEA 2018b).

[2] The U.S. Census Bureau and ACS also provide data on employment by sector. However, those data do not allow us to isolate employment in the agricultural sector specifically because the defined sector includes agriculture with other industries including fishing, forestry, hunting, and mining. Additionally, they generally exclude employment in crop production. For these reasons, and for consistency and comparison with wage data, this analysis relies instead upon data from the Bureau of Economic Analysis (BEA) to characterize employment broadly in the study area.

Of a total of approximately 8,247 agricultural acres irrigated via IPID's water rights, IPID reports that 6,322 acres are under orchard crops and 1,925 acres are pasture. Additionally, COIC estimates that they irrigate approximately 400 acres (Anchor QEA and IPID 2021).[3] Together, IPID and COIC water rights from Icicle Creek irrigate up to approximately 36 percent of all irrigated agricultural acreage in Chelan County.[4]

Table 15-1. IPID Total Irrigable Acreage

Irrigation District	Orchards	Pastures	Total
Icicle Irrigation District (IID)	3,755	1,137	**4,892**
Peshastin Irrigation District (PID)	2,567	788	**3,355**
IPID Total	**6,322**	**1,925**	**8,247**

Source: Anchor QEA (2018b), Table 3-1.
Note: Estimates of total irrigable acreage provided through review of assessment rolls, aerial photography, and consultation with IPID regarding lands that are irrigated by IPID water that are not located in assessed parcel boundaries (Anchor QEA 2018b).

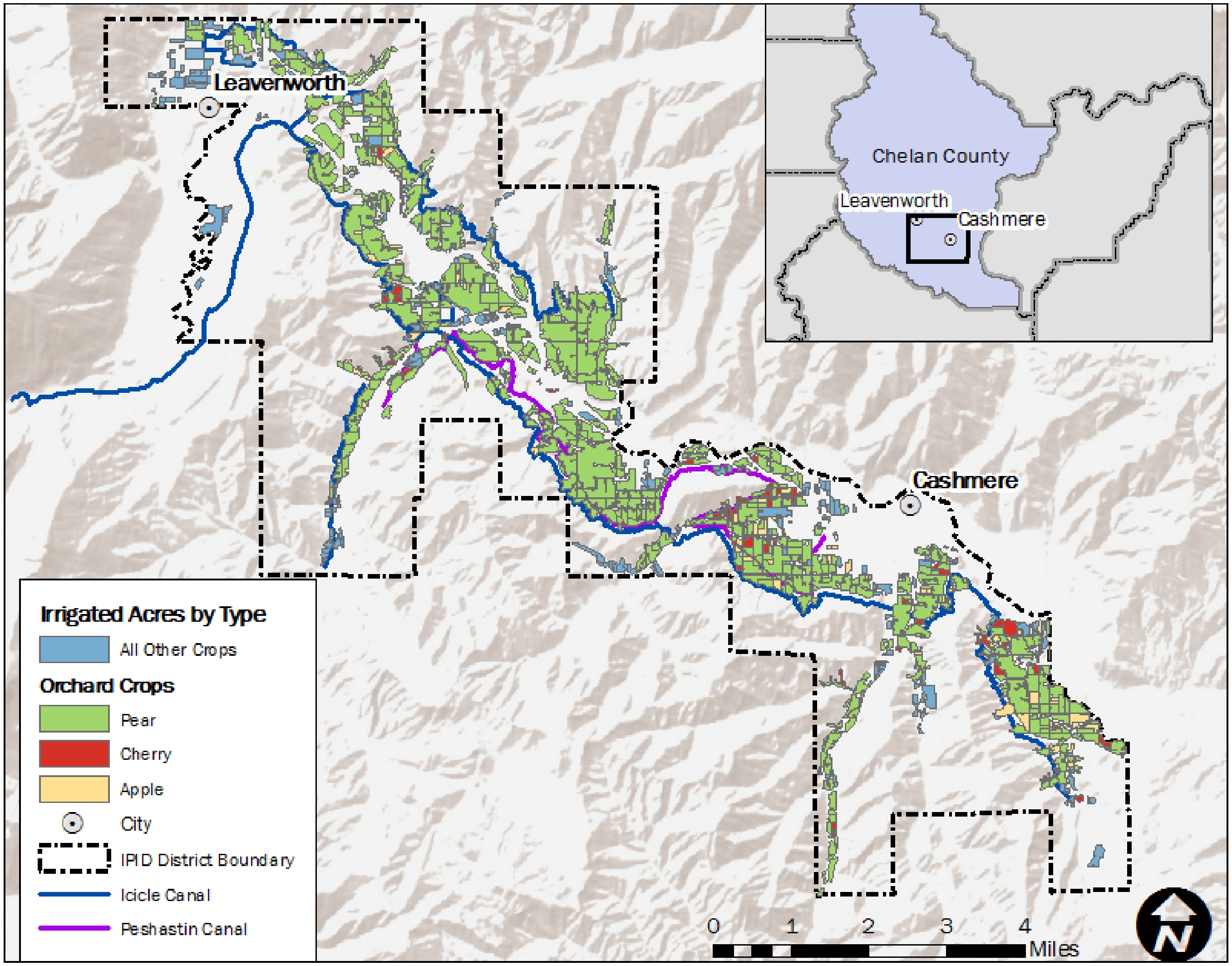
Table 15-2 identifies the major crops and crop groups grown within IPID district boundaries. Pear is the major crop in the area, representing about 83 percent of agricultural land within IPID's boundaries (WSU Extension n.d.). Other important orchard crops include apple, cherry, and pasture/hay. Figure 15-1 shows their geographic distribution and identifies the proximity of irrigated agricultural land to Icicle Creek and its tributaries. The crop mix maintained by other entities with direct or indirect water rights to Icicle Creek is likely similar to the crop mix within IPID's district boundaries. Table 15-2 also describes the contribution of acreage within IPID district boundaries to Chelan County broadly by crop. The acreage of pears grown within IPID's boundaries represents 68 percent of all acreage under pear cultivation across Chelan County. In contrast, acres of apple and cherry in IPID's boundaries represent only 5 percent and 4 percent, respectively, of all land for these same crops in Chelan County.

Demand for Irrigation Water

In this region, irrigation activities start between April 15 and May 1 each year, and it generally takes an individual grower between 12 and 21 days to irrigate their entire orchard with water supplied at a typical rate of 0.015 cfs (Anchor QEA 2018b). Farmers who rely on water from IPID paid $118 per share in 2017, an increase over the $110 per share per year paid between 2013 and 2016, where one share of water irrigates approximately one acre (Anchor QEA 2018b).[5]

[3] Current irrigated acreage under COIC's water right has not been determined as their water right is pending review as part of an ongoing change application.
[4] Chelan County is home to 23,819 irrigated acres of farmland (NASS 2017).
[5] All dollar values reported in this section are expressed in real 2021 dollars and were adjusted using the Bureau of Labor Statistic's "CPI Detailed Report Data" for January 2021 (BLS 2021).

Figure 15-1. Distribution of IPID Irrigated Acres by Crop Type



NOTES

1. Source: Washington State Department of Agriculture (2019) Agricultural Land Use GIS Data.
2. Source: GIS data collected by Anchor QEA as part of the field inventory for development of the IPID Comprehensive Water Conservation Plan (2018).
3. Source: ESRI World Terrain Base Map.
4. Horizontal Datum: NAD 1983 Washington State Plane North.

Table 15-2. Total Acreage by Primary Crop, IPID District and Chelan County

Primary Crop	Within IPID District	All Chelan County	Percent IPID District Relative to Chelan County
Pear	5,253	7,693	68%
Apple	311	6,141	5%
Cherry	225	6,312	4%
Other orchard crops[1]	2	114	2%
Forage/hay[2]	232	1,712	14%
All other[3]	295	2,821	10%
Total	**6,318**	**24,793[4]**	**25%**

Notes:
1. Includes peaches, nectarines, apricots, prunes, and plums.
2. Includes hay/silage and pasture.
3. Includes berries, vegetables, cereal grain, floriculture, herbs, commercial trees, turfgrass, fallow, and developed irrigated areas.
4. The total irrigated acreage calculated in this table relies upon 2019 data from the Washington Department of Agriculture. The total irrigated acreage used for calculation in footnote 3 relies upon 2017 data from the Census of Agriculture (NASS 2017). The total irrigable acreages presented in Table 15-1 are calculated using estimates from Anchor QEA (2018b). Therefore, the acreages presented across multiple sources differ from one another.

Source: Washington State Department of Agriculture (2019) Agricultural Land Use GIS Data; IPID district boundaries provided by Anchor QEA.

The water volumes presented in Chapter 6 (*Water Rights*) represent contractor estimated water right volumes and may not necessarily correspond with water demand.[6] IPID has evaluated irrigation water needs among its existing water users by considering general water requirements of currently planted crops as well as the efficiency of currently installed irrigation systems (Anchor QEA 2018b). IPID estimates that the average orchard requires 6.84 gallons per minute (gpm) per acre for efficient micro-spray systems and more than 7 gpm per acre for less-efficient systems, which are both more than the maximum 6.75 gpm IPID currently delivers to its water users during normal years. IPID explains that IPID growers have adapted to the small deficit irrigation of 6.75 gpm level of water delivery through efficiency measures (e.g., irrigating at different times of day, rotating sprinkler sets, etc.) (Anchor QEA and IPID 2021).

IPID is not seeking to increase their water rights through the rebuild of Eightmile Dam. Overall, IPID's assessment of water needs among its growers does not identify an expected increase in the demand for irrigation water beyond recent levels.

Economics of Agricultural Production

Based on Census of Agriculture sales data for Chelan County and the crop acreage from the Washington State Department of Agriculture described in Table 15-2, the average sale value for

[6] The water volumes presented in Chapter 6 do not represent a determination of the validity and extent of the rights (as further described in Chapter 6) and may not necessarily correspond with water demand.

orchard and berry crops within Chelan County is $13,000 per acre, or an approximate total sales volume of up to $90 million.[7]

Recent challenges faced by growers in the fruit tree industry include:

- High production volume but only break-even profitability conditions for pear farmers due to lackluster demand and rising production costs (Northwest FCS 2019a).
- For cherries, concerns over disease in cherry trees, leading to reductions in supply (Northwest FCS 2019b).
- Among apple growers, slight profitability, but elevated trade tensions resulting in diminishing exports (Northwest FCS 2019c). Effects from COVID-19, such as reduced number of workers in fields due to protective measures, reduced productivity and increased labor costs and labor supply bottlenecks due to border closures and reduced availability of temporary housing for a workforce largely consisting of migratory laborers (Gallardo 2020).
- Uncertainty in export markets and impacts on trade from currency fluctuations (Northwest FCS 2020a).

However, domestic demand for orchard fruits has increased. Individuals are going to the grocery store less frequently and buying more shelf-stable fruit, like apples, in larger quantities (Northwest FCS 2020a). Despite the unique obstacles due to the pandemic, apple, pear, and cherry growers in Washington State were expected to see above-normal profits during the pandemic years due mostly to strong domestic demand (Northwest FCS 2020a, 2020b, 2020c).

Employment in the Agricultural Sector

The Census of Agriculture reports that 65 percent of farms in Chelan County hire farm labor (NASS 2017). The Bureau of Economic Analysis reports about 4,800 workers under the "farm worker" classification in Chelan County (8 percent of the work force) (Bureau of Economic Analysis 2019a). These same jobs account for 5 percent of total wages (Bureau of Economic Analysis 2019b).

The agriculture industry in Chelan County is also supported by workers who reside in other counties. Data from the Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) identify about 5,600 people residing in Chelan County who report agriculture, forestry, fishing, and hunting as their primary occupation (LODES 2018). However, about 7,800 people report working in Chelan County in the aforementioned industries, suggesting a net influx of about 2,200 workers who reside outside Chelan County who work in the agriculture industry within the county (LODES 2018). In addition to commuters from nearby counties, Chelan County also relies on labor from the H-2A visa guest worker program, particularly during harvest time (EcoNorthwest 2017).

The Washington Employment Security Department (ESD) describes that the agriculture, forestry, and fishing sector (representing a broader industry than the BEA data described above) accounts for 21.4 percent of all employment in Chelan County but only provided 14.7 percent of total wage income (Washington State ESD 2021).[8] According to the Bureau of Labor Statistics, the mean hourly wage for workers in farming, fishing, and forestry across the Wenatchee MSA was $15.00 in May 2019 relative to $15.42 at the national level (BLS 2019). These data sources demonstrate that

[7] The $13,000 per acre value was applied to the 6,322 acres of orchard in the IPID service area (see Table 15-1) and approximately 400 acres supported by COIC's water rights to calculate total sales volume. The relevant per-acre sales value for the 1,925 acres of pasture in IPID's service area is less certain. Note that sales may vary significantly between years given seasonal variability in supply (e.g., resulting from weather conditions and disease outbreaks) and demand (e.g., given international trade conditions and domestic demand relative to substitute fruits).

[8] More recent data available from the Bureau of Labor Statistics and cited earlier in this section suggest that the proportion of employment and wages in the agricultural sector in the county have become more even in recent years.

agricultural workers garner relatively low wages relative to other industries in the state and in comparison to the same industry in other states. As previously mentioned, between 2009 and 2019, farm industry employment in Chelan and Douglas counties contracted by 9 percent and 7 percent, respectively. Declining employment and low wages could signal a pattern of inconsistent economic growth in the future of the Chelan and Douglas County agriculture industries.

15.3.2 Growth and Development

Water from Icicle Creek and wells in continuity with the Wenatchee River support municipal use for the City of Leavenworth (Ecology 2019a). The City of Leavenworth's water system serves businesses and residences within the city limits, as well as within adjacent areas of unincorporated Chelan County (City of Leavenworth 2018). Growth in Chelan County led to higher demand for housing within Leavenworth, as well as in the surrounding Urban Growth Area (UGA) and broader Water Service Area, shown in Figure 15-2 (City of Leavenworth 2017a). Housing development beyond the city administrative limits may connect to the City of Leavenworth's water system, meaning that the City's water budget must consider areas beyond city limits (City of Leavenworth 2018). Therefore, the main concerns regarding the water supply are as follows:

- Currently, the City's Icicle Creek water rights are composed of roughly half interruptible rights, meaning a dry year can leave the City with a shortage of municipal water.
- The City's long-term water use projections (beyond 20 years, referred to as "ultimate demands") indicate an insufficient supply to maintain expected future growth.

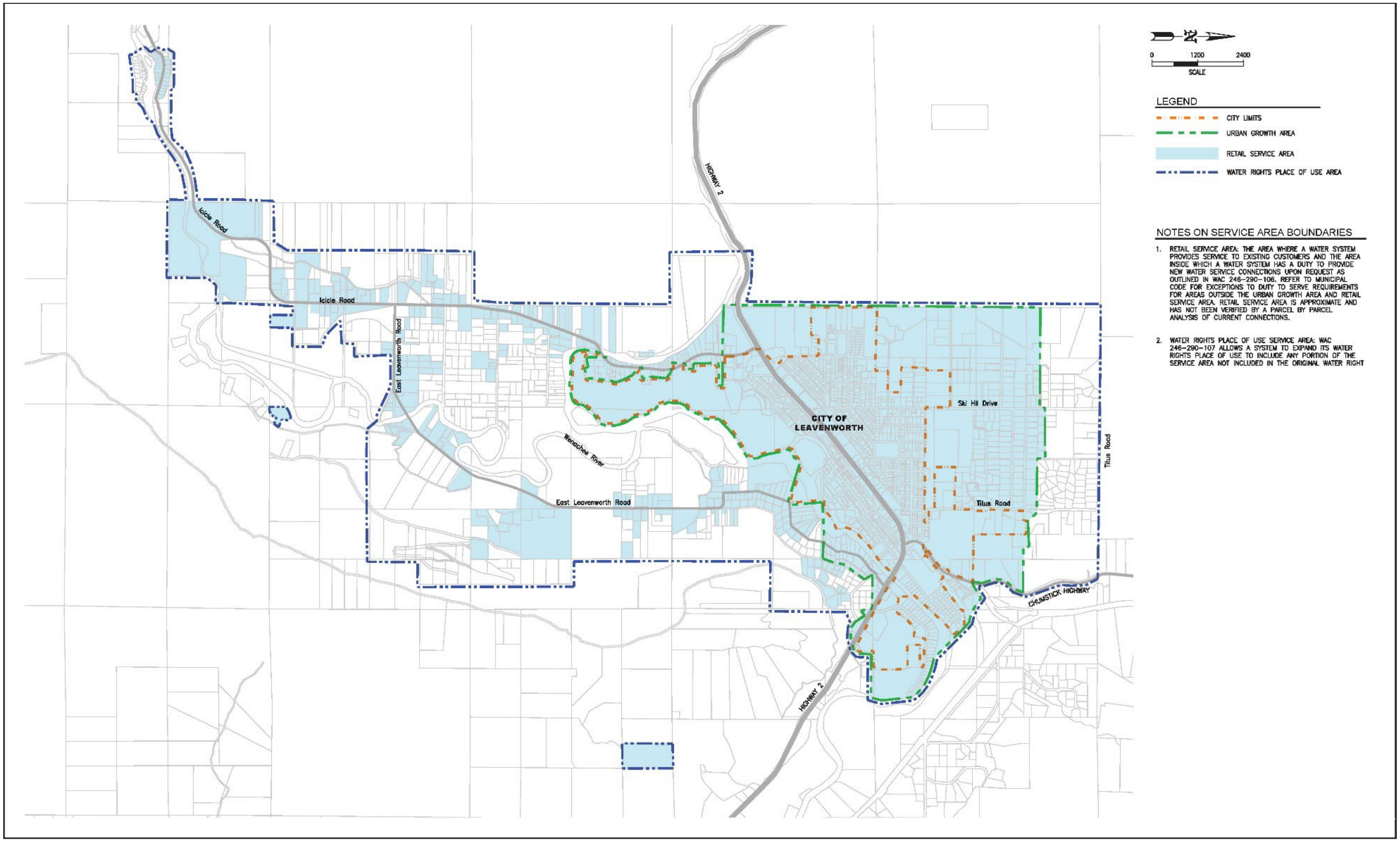
In light of these concerns, the City sought to clarify the annual quantity (Qa) of its uninterruptible water rights from Icicle Creek through a lawsuit with Ecology (City of Leavenworth v. Department of Ecology 2011), specifically seeking clarification on Surface Water Certificate 8105 (S4-*16124CWRIS). The City asserted that the Qa should be based on the amount of water that would be used if the Qi is diverted on a continuous basis, which is 1,085 afy, while Ecology asserted the correct Qa is 275 afy based on a "reasonable quantity" relating to actual per capita demand for water. The City and Ecology have entered into a settlement agreement as of November 2023 and will continue to work collaboratively with each other and other Icicle Work Group members on a non-litigious solution to meet future demands as part of the broader Icicle Strategy.

Property Values and Development Pressures

Leavenworth, and Chelan County more broadly, has become a popular tourist destination for visitors. Regional tourism has expanded in the past decade, constituting a larger portion of the local economy and placing pressures on further development to accommodate continued growth. As detailed in Table 15-3, key metrics of tourism tracked by the Economic Census all indicate positive and substantial growth between 2012 and 2017 (U.S. Census Bureau 2012, 2017; FAA 2012, 2017). Commercial assets associated with transportation, lodging, and food services contribute to the tax revenues and employment levels of the area. However, tourism decreased markedly in 2020, most likely attributed to the COVID-19 pandemic (Eastern Washington University 2021).

Chelan County, and cities including Leavenworth, Plain, and Lake Wenatchee, have become increasingly popular sites for recreational and retirement properties (Chelan County 2017). The median home value in 2019 (reported in 2021$) for owner-occupied housing units in Chelan County was $299,700, while the median home price in Leavenworth was $363,800 (U.S. Census Bureau 2019b). The corresponding values from 2009 reveal significant price increases in the past decade, with the Chelan County median home price rising by 9 percent and Leavenworth city median home prices rising by 16 percent between 2009 and 2019 (U.S. Census Bureau 2009b). More recently, home prices have increased even further, with Chelan County median home prices rising to $552,000, and Leavenworth city home prices rising to $629,500 between June 2021 and June 2022 (Rocket Homes 2022a, 2022b).

Figure 15-2. Map of Leavenworth, the Urban Growth Area, and Water Service Area



Source: City of Leavenworth (2018a)

Table 15-3. Tourism Metrics for Chelan County

Metric	2012	2017	Absolute Change	% Change
Chelan County Accommodation Revenues ($1,000)	$88,073	$118,508	$30,435	+35%
Chelan County Accommodation Employment	1,039	1,247	208	+20%
Chelan County Food and Drink Revenues ($1,000)	$136,554	$190,514	$53,960	+40%
Chelan County Food and Drink Employment	2,325	2,942	617	+27%
Wenatchee Airport Annual Passengers	51,347	60,335	8,988	+18%

Note: All dollar values reported in this section are expressed in real 2021 dollars and were adjusted using the Bureau of Labor Statistic's "CPI Detailed Report Data" for January 2021.
Source: U.S. Census Bureau (2012 & 2017); FAA (2012 & 2017)

In 2019, the U.S. Census Bureau (2019b) reported a total of 37,693 housing units across Chelan County and 1,422 housing units in the City of Leavenworth, further broken down in IEc (2023). Compared to 2009, Chelan County saw an increase in housing units of 14 percent, while the City of Leavenworth saw an increase of 9 percent.

Leavenworth's status as a tourism and recreation destination has increased the proportion of second homes within the area, resulting in roughly 15 percent of the housing market being homes being used for seasonal, recreational, or occasional visits and 11 percent being vacant for any other reason (U.S. Census Bureau 2019b).

The lack of available housing has driven up the average home price over the past decade within Chelan County and Leavenworth, as described previously and further detailed in IEc (2023). This trend ultimately excludes low- and middle-income residents looking to become homeowners or seeking a long-term rental. The County expects the population of the city and the Leavenworth UGA, shown in Figure 15-2, to grow by approximately 200 people from 2017 to 2037, requiring another 91 dwellings. They anticipate that this need can be met with existing land use and development plans within the existing UGA (Chelan County 2017). The growth and development goals regarding the housing supply are designed to align with the city's current and expected population. As mentioned previously, however, the City must also factor in housing development occurring within the Water Service Area but outside the City's jurisdiction to develop an accurate water budget. This results in slightly higher growth projections that estimate an annual population increase of around 0.47 percent (City of Leavenworth 2018).

An updated analysis from the 2020 Housing Needs Assessment indicates that the City is on track to meet its 20-year planning targets in the near term (City of Leavenworth 2020). Development outside city limits also falls beyond the purview of City administrators, meaning the rate of future development within the Water Service Area is not necessarily within Leavenworth's purview, and initial population projections could underestimate the future population growth of the city if greater housing availability draws more new residents than anticipated. However, City officials have consistently built strategies for manageable growth into their water, sewage, transportation, and other public systems plans that are expected to handle reasonable deviations in expected population growth.

Development Along Icicle Creek

About 5 miles south of the Leavenworth downtown area, 50 private lots sit along Icicle Creek, forming a small community known as the Icicle Island Club. The homes were built after Eightmile Dam's original construction in the 1930s (Chelan County Assessor 2022). The houses are not significantly above the highest water level of the creek, meaning that failure of Eightmile Dam would put most or all the houses at significant risk of being severely damaged or destroyed. Employing market values calculated by the Chelan County Tax Assessor's Office in January 2021, the homes have a median value of about $448,000, a mean value of about $485,000 (ranging from $70,000 to $1.89 million), and a total market value of about $24.3 million.

Municipal Water Demand

Since 1989, the City of Leavenworth water usage has averaged around 800 to 1,200 afy, with a subtle downward trend largely attributed to efficiency improvements (City of Leavenworth 2018). These ranges are significantly below the current level of water rights claimed by the City (Chapter 6, *Water Rights*). The City of Leavenworth's existing and pending water rights are served by both surface water from Icicle Creek and groundwater from wells along the Wenatchee River. The City of Leavenworth reports that the existing needs for water within the city limits are being met by existing water rights (City of Leavenworth 2021). However, development in the UGA that lies in unincorporated Chelan County has resulted in new and increasing demands for water. Although this area lies outside of the jurisdiction of the City of Leavenworth, the City has committed to providing water to meet these demands through its own water system (City of Leavenworth 2018).

The 2018 Leavenworth Water System Plan indicates that it will "*oversize some of the water system infrastructure improvements…to meet ultimate demands*." The plan expects to incorporate significant capacity overhauls in the next 20 years to keep up with anticipated increased water usage.

A primary component in the calculation of "ultimate demands" (i.e., beyond 20 years) centers on the Leavenworth area's status as a tourism hub, with annual increases in expected water usage outpacing expected population growth due to the high demands on both the residential and commercial infrastructure from seasonal visitors. This water use projection "*equates to an increase of approximately 24 percent over the next 10 years and 55 percent over the next 20 years*" (City of Leavenworth 2018). Existing and future infrastructure is expected to serve the current and future developments, but currently relies on or is expected to heavily rely on Icicle Creek, in addition to groundwater sources.

The City's current continuous and interruptible rights can meet demand in the current and 20-year time horizons, but not the ultimate time horizon.[9] To cover this gap, the City is currently involved in the aforementioned litigation with Ecology regarding the annual quantity of surface water certificate 8105 (S4-*16124CWRIS) (City of Leavenworth 2018; see Chapter 6, *Water Rights*). Concurrently, both Ecology and the City are also working on alternate new water supply options for the City as part of the larger Icicle Strategy.

15.3.3 Recreation

As described in Section 10.3 of Chapter 10, the project area provides numerous opportunities for solitude or primitive, unconfined recreation. This is a popular destination for hiking and camping, fishing, horseback riding, swimming, skiing/snowshoeing, and nature watching that draws people from across Washington State and beyond. Recreational visitation to the Eightmile/Caroline Zone (see Figure 10-1) in 2019 and 2020 is presented in Table 10-4 (Chapter 10). Day use visitation

[9] As of 2017, the City uses roughly 983 afy, with demand expected to increase to 1,519 afy in 20 years and 2,903 afy in the ultimate demand time horizon (City of Leavenworth 2018). The City currently holds rights to 2,275.95 afy, although this quantity is under ongoing dispute and litigation.

ranged from 4,379 to 5,689 users (USFS 2019b, 2020).[10] Overnight use totaled 1,516 users in 2020, while the information for 2019 is unavailable (USFS 2019b, 2020). Recreational visitation produces economic activity and benefits, measured in terms of expenditures and value to recreationists themselves. As visitors travel to and from recreation sites, they spend money in local communities on food, gas, lodging, and other trip-related expenses, contributing to the regional economy by supporting jobs and income for residents. The economic value of recreation is the difference between the maximum amount a recreationist would be willing to pay to participate in a recreational activity and the actual cost of participating in that activity, referred to as consumer surplus or net economic value. Put simply, this is a recreationist's value of a trip after all expenses have been paid. Additional description regarding recreational value is provided in IEc (2023).

The sections below present the estimated expenditures, regional economic contributions, and net economic value associated with recreation in the Eightmile/Caroline Zone, where the project is located.

Recreational Expenditures and Regional Economic Contributions

The Forest Service estimates recreational expenditures and the associated regional economic contributions at the National Forest level.[11] Estimates are not available at a more specific geographic scale, such as the Eightmile/Caroline Zone. The most recent report available for the Okanogan-Wenatchee National Forest, which contains the Alpine Lakes Wilderness, is from 2016 (USFS 2016a). Total recreational visitation to in 2016 was 1.34 million visits, which generated $98.8 million in expenditures (Table 1 in USFS 2016a; 2021 dollars).[12,13] These expenditures supported 1,080 jobs and $46.3 million in labor income (Tables 2 and 3 in USFS 2016a; 2021 dollars).[14] Approximately 84 percent of the expenditures and associated jobs and labor income contributions were supported by non-local recreational visitors, while the remaining portion was supported by local visitors (USFS 2016a; White 2017).

Non-local visitors bring new money into the regional economy and spend more per visit because they come from a greater distance. Local recreationists spend less per visit, and the standard assumption is that the money they spend would be spent on something else in the local economy if not for recreation. Both local and non-local visitation effects are included by the Forest Service to estimate regional economic contributions.[15] The methods used by the Forest Service to estimate visitation, expenditures, and regional economic contributions are described in multiple reports (e.g., English et al. 2020; White 2017; Horsch et al. 2017).

As recreational expenditures and regional economic contributions are not available for the Eightmile/Caroline Zone, this analysis relies on approximations based on the percentage of visitation to the Okanogan-Wenatchee National Forest that occurs in the Eightmile/Caroline Zone (about 0.6 percent).[16] This results in an annual contribution of $610,000 in expenditures, 6.7 jobs, and $286,000 in labor income (Table 15-4). As expenditure patterns and local economic effects vary

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[10] Day use is estimated by the Forest Service using self-issued permits at the trailhead. The Forest Service estimates 70 percent compliance with day use permitting. The numbers in Table 10-4 were adjusted to reflect this compliance rate and estimate total day use.
[11] Reports by National Forest are available online at: https://www.fs.fed.us/emc/economics/at-a-glance/jobs-income.shtml.
[12] All dollars in this section have been adjusted to 2021 dollars using the Consumer Price Index (CPI; BLS 2021).
[13] Detailed visitation estimates by National Forest can be downloaded from https://www.fs.usda.gov/about-agency/nvum/.
[14] These job and income effects include direct contributions that come from recreational expenditures and secondary contributions that result from ripples of economic activity stimulated by the direct economic activity (USFS 2016a). Total contributions are the sum of direct and secondary contributions. Job estimates represent the average annual sum of portions of jobs, including part time, full time, seasonal, and temporary.
[15] An economic impact analysis would exclude expenditures by local visitors. The Forest Service tends to focus on economic contributions rather than economic impacts (Horsch et al. 2017).
[16] 2016 visitation data for the Eightmile/Caroline Zone were from USFS (2017b).

throughout the Okanogan-Wenatchee National Forest, these annual estimates reflect approximate contributions.

Table 15-4. Okanogan-Wenatchee National Forest and Eightmile/Caroline Zone Annual Recreational Visitation, Expenditures, and Regional Economic Contributions (2021 Dollars)

Metric	Okanogan-Wenatchee National Forest	Eightmile/Caroline Zone
Visits	1.34 million	8,267
Expenditures	$98.8 million	$610,000
Jobs	1,080.0	6.7
Labor Income	$46.3 million	$286,000

Sources: USFS 2016a, 2017b.

Net Economic Value

The net economic value of recreation in the Eightmile/Caroline Zone is estimated in two steps. First, annual recreational visits are converted to annual recreational visitor days to account for the fact that some visits last longer than one day. Second, annual visitor days are scaled by a net economic value per day to estimate the annual net economic value.

The number of days per visit varies by recreational activity. The distribution of activities for the Eightmile/Caroline Zone is adapted from information for the Wenatchee National Forest, the most specific information available, which are presented in detail in IEc (2023) based on USFS (2016b). These data show that 19.9 percent of visits are for hiking/walking, 11.5 percent for viewing natural features, 9.8 percent for hunting, and smaller percentage for other activities. The estimated days per visit are reported for Forest Service Region 6 (Pacific Northwest), the most specific information available (Rosenberger et al. 2017), which range from 1.0 to 2.8 depending on the activity (see IEc 2023). The overall average days per visit, weighted by activity type, is 1.40. To be consistent with the information presented in IEc (2023), recreation visitor days for the Eightmile/Caroline Zone are calculated for 2016, which is 11,608 days. Repeating the exercise for 2020 visitation yields 8,277 recreation visitor days.

The average net economic value per day is also reported for Forest Service Region 6 (Pacific Northwest), the most specific information available (Rosenberger et al. 2017), which ranges from $36.13 to $118.72 depending on the activity (IEc 2023).[17] The overall average value per day, weighted by activity type, is $68.49. Multiplying recreation days by net economic value per day yields an annual net economic value of recreation in the Eightmile/Caroline Zone of $795,000 in 2016 and $567,000 in 2020.

15.3.4 Fisheries and Hatchery Operations

Water supply to support fish propagation at the LNFH includes water from Icicle Creek, Snow Lake, and Nada Lake, and from seven wells (USFWS 2016). Certificate 1824[18] specifically provides an instantaneous withdrawal right to 42 cfs from Icicle Creek through the hatchery's diversion dam and intake at RM 4.5. Chapter 8, *Plants and Animals*, describes the fish resources of the study area,

[17] Rosenberger et al. (2017) uses meta-regression analysis to develop average per person user day values by primary activity and Forest Service region (see Table 3 in that report). The regression specified the value per person day as a function of region, activity, resource type, and other factors. The estimated coefficients were used to predict average value estimates by activity and region.

[18] This certificate is referred to as CS4-01824C@2 in Chapter 6 (*Water Rights*).

including those populations that are supported by hatchery production at the LNFH. Fish from this system support recreational, commercial, and tribal fisheries both immediately in the vicinity, as well as (in the case of anadromous fish) farther downstream into the Wenatchee and Columbia rivers, and in the Pacific Ocean. Commercial and recreational fisheries for these fish resources, as well as the operation of the hatchery itself, contribute to the economy of the region. As described in Chapter 14, *Tribal Resources*, ceremonial and subsistence harvest by the Yakama Nation and Confederated Tribes of the Colville Reservation is critically important to the culture of those tribes. The recreational fisheries in the study area are described in Chapter 10, and their economic contribution to the regional economy is discussed in Section 15.3.3. This section focuses on the commercial fisheries supported by fish from the study area, the economic contribution of the hatchery to the regional economy, and the tribal cultural importance of these fish resources.

Economic Value and Contributions of Hatchery Operations and Icicle Creek Fish

The anadromous fish returning to Icicle Creek consist primarily of returns of spring Chinook produced by the LNFH (Ecology 2019a).[19] LNFH-produced fish contribute to recreational fisheries in Icicle Creek and other nearby freshwater areas, as well as in the Columbia River and Pacific Ocean (further addressed in Section 15.3.3), and to important tribal ceremonial and subsistence fisheries in Icicle Creek (described later in this section).[20] Tribal and non-tribal commercial fisheries target these fish within the Columbia River, while they also contribute to non-tribal commercial fisheries in the Pacific Ocean (USFWS 2016).[21] Table 15-5 reports the estimated average annual harvest and ex-vessel value or sport angler spending of harvest of LNFH-produced spring Chinook salmon in commercial and recreational fisheries. Fish produced at LNFH provide $22,570 in tribal and non-tribal commercial ex-vessel value annually, and support 0.5 job and $25,152 in personal income in the fishing industry (2021$) (USFWS 2016).[22] LNFH-produced fish targeted in recreational fisheries also contributed $637,906 in sport angler spending and $463,636 in personal income, as well as 12.2 jobs. The hatchery program for coho salmon at the LNFH, run cooperatively by USFWS and the Yakama Nation, also provides economic benefits to the region, but data on the distribution and economic impacts of that harvest are not available (USFWS 2016).

The operation of the hatchery itself also contributes to the economy of the region through spending on goods and services. The USFWS estimates that the spring Chinook and steelhead production hatchery operations provide 30.9 jobs and $2.5 million in personal income annually. These benefits are mostly concentrated within the City of Leavenworth, where the LNFH is located, and in Wenatchee, which offers a greater variety of goods and services to residents and businesses (USFWS 2016).

[19] In addition to the spring Chinook salmon production that is the cornerstone of the hatchery's operation, the LNFH supports the Yakama Nation's coho restoration program. Fish produced by this program contribute to a variety of commercial, recreational, and ceremonial and subsistence fisheries in the Columbia River and Pacific Ocean (Yakama Nation 2017). The Tribe's Mid-Columbia Coho Master Plan anticipates a dramatic reduction in coho salmon production and releases to Icicle Creek over the next 5 to 10 years (Yakama Nation 2017).

[20] In addition to the value derived from commercial fisheries targeting fish produced by the LNFH, and from hatchery operations and maintenance, hatchery surplus fish are provided directly to Columbia River tribes and local food banks. USFWS estimates that approximately 2,000 spring Chinook salmon and steelhead are provided as a free source of protein annually (USFWS 2016).

[21] Tribes participating in commercial fisheries for these fish include the Yakama Nation, the Warm Springs Tribe, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation (USFWS 2016).

[22] "Ex-vessel" value refers to the price per pound of commercial landings at initial purchase multiplied by the pounds landed (NOAA 2022).

Table 15-5. Estimated Distribution of Anadromous Fish Produced by the LNFH and Associated Economic Impacts (2021 Dollars)

Fishery	Number of Fish Harvested	Ex-Vessel Value/Sport Angler Spending	Jobs	Personal Income
Sport (Icicle Creek/Freshwater Vicinity)	587	$307,780	6.2	$223,452
Tribal Ceremonial and Subsistence	1,982	N/A	N/A	N/A
Hatchery Surplus	1,947	N/A	N/A	N/A
Tribal Commercial (Columbia River)	187	$8,534	0.3	$13,699
Non-Tribal Commercial (Columbia River)	191	$13,587	0.2	$10,330
Sport (Columbia River)	631	$330,126	6	$240,183
Non-Tribal Commercial (Pacific Ocean)	8	$449	0	$1,123
Total	**5,533**	**$660,476**	**12.7**	**$488,788**

Source: USFWS (2016)

Tribal Ceremonial and Subsistence Fisheries

The fishery known as "Wenatchapam" is a place of great historical and present-day importance to the Yakama Nation and Confederated Tribes of the Colville Reservation. The Wenatchapam salmon fishery occurs annually between May and July (Chelan County 2016). It is centered around the confluence of Icicle Creek and the Wenatchee River, in the vicinity of the LNFH. After a legal dispute between the Yakama Nation and the Confederated Tribes of the Colville Reservation, the 9th District Court found in 2010 that "*We…construe the 1855 Treaty and the 1894 Agreement as conferring on the parties similar non-exclusive fishing rights at Wenatchapam that they share "in common with" non-treaty and non-agreement fishermen*" (*U.S. v. Tribes of Colville Indian*, 606 F.3d 698 (9th Cir. 2010)).

The project area is within the Yakama Ceded Lands, to which the Yakama Nation exercises its Treaty Reserved Rights, and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources. These tribes target non-listed spring-run Chinook salmon returning to the LNFH. Since the reintroduction of coho salmon to the Icicle Creek drainages, tribal subsistence fisheries for coho salmon have been opened when runs are large and surplus fish are available. The smolts produced by the LNFH account for the vast majority of returning adult spring Chinook salmon harvested in the fishery (USFWS 2016). The USFWS (2016) estimates that the tribes collectively harvest approximately 2,000 spring Chinook annually on average for ceremonial and subsistence use. Fish from this hatchery also provide a limited contribution (approximately 200 fish annually) to tribal commercial fisheries in the Columbia River (see Table 15-5 above).

In addition to harvest of the spring Chinook produced by the USFWS at the LNFH, the Yakama Nation conducts a Mid-Columbia Coho Restoration Program aiming to re-establish naturally spawning coho populations in the area to sustainable levels.[23] This program is distributed across several hatchery facilities, including the LNFH. Since the reintroduction of coho to the upper Wenatchee River and Icicle Creek, both the Yakama Nation and the Confederated Tribes of the Colville Reservation have participated in ceremonial and subsistence fisheries when run size supports a fishery (Ecology 2019a). Tribal members may also harvest resident fish such as whitefish, sucker, and pikeminnow, and other non-native species year-round unless otherwise restricted (Ecology 2019a).

[23] Specifically, the program goal is *"to re-establish naturally spawning coho populations in mid-Columbia tributaries to biologically sustainable levels which provide significant harvest in most years"* (Yakama Nation 2017).

15.3.5 Summary

Agriculture, development, recreation, and fisheries and hatchery production are the primary economic activities that rely upon water from Eightmile Lake and Icicle Creek and the related natural resources that may be affected, either directly or indirectly, by the project alternatives. Water supply from Eightmile Lake is important to the substantial agricultural activities in the region. Led by the production of fruit including pears and apples, production costs can exceed revenues in certain years. Although the water supply currently available to the City of Leavenworth and the growth areas outside of the city limits is sufficient to meet current demand, it is not expected to meet the demands anticipated under long-term population growth projections, and may limit development in the future. Recreation and tourism are regional economic drivers, with tourists and recreationists drawn to the natural beauty of the area. Water from Eightmile Lake eventually flows into Icicle Creek via Eightmile Creek, supporting a fishery of great cultural and subsistence importance to the Yakama Nation and the Confederated Tribes of the Colville Reservation. Icicle Creek water also provides a substantial portion of the water needed for fish production at the LNFH, with fish production supporting both tribal ceremonial and subsistence, as well as recreational fishing.

15.4 Construction Impacts

This section evaluates the extent to which the short-term construction period for the action alternatives affects agriculture and other economic activities, focusing on both the transportation of equipment and materials, and the implementation of the construction activities. As described in Section 15.1.1, significant adverse impacts would only occur to the extent that construction activities result in impairment of senior water rights.

Agriculture

The dam construction will require a drawdown of Eightmile Lake to well below the current low-level outlet in order for construction work to be performed “in the dry.” As described in Chapter 6 (Water Rights), active storage in the lake would be reduced and the IPID’s storage right would be unavailable during the construction period. Effects on delivery of water to rights holders would therefore largely depend on the prevailing precipitation rates and the ability of IPID to utilize their full diversionary right without access to their storage right. During average precipitation conditions, there may be no impacts at all on diversionary water rights in the form of impairment of senior rights (a significant adverse impact) or curtailment of junior rights. Even if climatic conditions result in below-average rainfall during mid to late summer and into early fall, impairment of IPID’s water rights, and significant adverse impacts on their agricultural customers, are unlikely. However, in the case of a very severe drought, there is the potential that IPID would not be able to fulfill the water needs of all of their agricultural customers, resulting in significant adverse impacts on the agriculture industry.

Growth and Development

As described previously, the City of Leavenworth is not legally entitled to water released by IPID from Eightmile Lake but does receive secondary benefits from released water. Dam construction would involve the temporary lowering of lake water levels below the existing low-level outlet. As described in Chapter 6, *Water Rights*, active storage in the lake would be reduced for the duration of the construction process, which would cause downstream flow quantities to be more reliant on prevailing precipitation rates and could lead to the curtailment of junior diversionary water rights, including those of the City of Leavenworth. If climatic conditions result in below-average rainfall, there is the potential that the City of Leavenworth would not have access to the amount of water they typically receive from Icicle Creek to fulfill their water supply obligations to residents and businesses, potentially forcing the City to rely upon alternative water sources in the short term (e.g., groundwater). The potential for this outcome would be even greater during severe drought conditions. However, these effects are limited to the relatively short time period surrounding construction and could potentially be mitigated through reliance on the City's groundwater rights. Thus, construction is unlikely to have any impact on the City's growth and development.

Recreation

The transportation of equipment and materials is **not anticipated to have a significant impact** on recreation in the area (Chapter 10, *Recreational Resources*). There may be higher noise levels associated with helicopter use in the Eightmile Lake and Caroline Lake Trail areas (Chapter 9, *Noise*), which may affect the experience of some recreationists and reduce the value they experience for those trips. Some recreationists may find the noise levels disruptive enough that they choose to spend their time and overnight in other areas of the Enchantment Permit Area or elsewhere. In other parts of the Enchantment Permit Area, noise levels are unlikely to exceed regular ambient noise levels (Chapter 9, *Noise*). Altogether, some visitors may experience reduced value for trips taken to the area. However, as the impacts of transportation of equipment and materials by helicopter would be temporary, and recreational options with similar attributes are readily available in the area, the transportation of equipment and materials is unlikely to result in changes in recreational visitation and spending in the region.

Reopening of FSR-7601 to accommodate transportation of equipment would not have any effect on recreation other than the visibility of construction equipment at the trailhead and some audible road noise at the beginning of the trail during what are expected to be very limited trips to transport equipment along the road. Thus, **impacts on recreation would be less-than-significant** (Chapter 10, *Recreational Resources*). The minor disruptions associated with the visibility of construction equipment and road noise may reduce the value some recreationists hold for their visits to the area, but are not likely to result in reduced recreational visitation or spending in the region more broadly.

Although the Eightmile/Caroline Zone would remain open for recreational activities throughout the dam construction process, construction would lead to some short-term disruptions to recreation in the Eightmile Lake and Caroline Lake Trail areas, mainly consisting of higher noise levels and more frequent visibility of construction equipment and workers. However, as no recreational areas would be closed and construction is not expected to extend beyond a single season, **impacts on recreation due to construction would be less-than-significant** (Chapter 10, *Recreational Resources*).

The annual net economic value of recreation in the Eightmile/Caroline Zone was $567,000 in 2020, while the regional economic contribution of recreation in the zone included $610,000 in expenditures, 6.7 jobs, and $286,000 in labor income (2021 dollars). The impacts of construction described above may detract from some recreationists' experience, with some experiencing disruptions substantial enough to result in their electing to use other areas. This, in turn, could result in increased congestion in other areas, detracting from recreationists' experience in those areas. Altogether, in the event that recreationists still elect to travel to the immediate area, they may experience some reduction in value held for their trips. To the extent that the construction activities deter recreationists from traveling to the region at all, the previously described net economic value and regional economic contributions would be lost.

Fisheries and Hatchery Operations

Equipment transportation would not significantly impact fish or fish habitat within Eightmile Lake, Eightmile Creek, or Icicle Creek (Chapter 8, *Plants and Animals*). Thus, commercial and tribal ceremonial and subsistence fisheries would not experience any meaningful change in the number of fish available for harvest. Although there may be higher noise levels in the area due to helicopter use, which may affect tribal community members fishing at Icicle Creek, noise levels along Icicle Creek are unlikely to consistently exceed or significantly disrupt regular ambient noise levels in the area (Chapter 9, *Noise*). Therefore, the transportation of equipment and materials would **not result in**

significant adverse impacts on tribal communities reliant on the aquatic resources of Icicle Creek, or to commercial fisheries farther downstream.

As described previously, LNFH does not have any legal right to water released from Eightmile Lake, but does receive secondary benefits from these releases that could be affected by construction. Dam construction would involve the temporary lowering of lake water levels below the existing low-level outlet. As described in Chapter 6, *Water Rights*, active storage in the lake would be reduced during construction, resulting in downstream flow quantities being more reliant on precipitation rates. If below-average rainfall occurs during the construction season, there is the potential for curtailment of junior diversionary water rights, and LNFH may not receive delivery of its entire water right, potentially resulting in a temporary reduction in operations. If the reduction in available water results in the complete closure of LNFH operations, dam construction has the potential to cause effects on hatchery operations and their economic contributions to the local economy, but the contributions from the dam construction **are not considered significant**.

Dam construction would result in higher levels of noise in the vicinity of Eightmile Lake (Chapter 9, *Noise*), visibility of construction activities and personnel in the area (Chapter 11, *Visual Resources*, and Chapter 10, *Recreational Resources*), and some minimal disruption to fish in the lake from increased turbidity and fish removal/relocation (Chapter 8, *Plants and Animals*). Construction activities are generally limited to the immediate surroundings of Eightmile Lake. As tribal communities primarily fish on Icicle Creek, heightened noise levels at the lake are unlikely to significantly affect their activities. No impacts are identified for fish populations in Icicle Creek; therefore, dam construction **would not result in significant adverse impacts** on downstream fishing opportunities in Icicle Creek for tribal communities, or for commercial fisheries farther downstream.

15.5 Operational Impacts

This section describes the operational impacts on agriculture and other economic activities from the fluctuating lake levels, changes in instream flow, and water delivery under the project alternatives. As described previously, impacts are only considered significant if the alternative results in the impairment of senior water rights.

15.5.1 No Action Alternative

Agriculture

The current conditions associated with the No Action Alternative reflect lake elevation levels that do not meet IPID's stated water storage needs, making IPID heavily dependent on favorable hydrological conditions to meet their expected water needs (Chapter 6, *Water Rights*). Under the No Action Alternative, assuming the dam remains intact and current operations continue, IPID could likely still exercise their full diversionary water right (potentially requiring increased reliance on storage rights in other alpine lakes) and meet all agricultural customer demands during years of average or even slightly below-average precipitation conditions (Chapter 6, *Water Rights)*. Should precipitation rates fall significantly below what is needed to meet the stated water needs of IPID, as during a severe drought year, impairment of IPID water rights is possible, and IPID's agricultural customers would likely need to find an alternative water source to maintain their current agricultural output or risk water shortages that would threaten their crop production and expected revenues. Therefore, the agriculture industry may experience **significant adverse impacts** under the No Action Alternative in years of severe drought.

In the event of a dam failure, senior water rights holders, including IPID, could experience significant adverse impacts due to the reduction in available irrigation water to support the agriculture industry during severe drought conditions (Chapter 6, *Water Rights*). In the immediate aftermath, the dam failure and ensuing flood wave could cause significant damage to structures associated with the IPID and COIC water intake facilities downstream (Anchor QEA 2019).[24] Following the immediate effects of downstream flooding, the dam and outlet pipe infrastructure would be destroyed, meaning that controlled releases of stored water in the future would not be possible without significant construction. The inability to control releases of stored lake water would exacerbate IPID's dependence on the prevailing precipitation rates, and during years of severe drought, even with releases of stored water from other alpine lakes, impairment of senior water rights is possible (Chapter 6, *Water Rights)*. The effects of a dam failure would therefore have **significant adverse impacts** on the availability of irrigation water, which would jeopardize the agriculture industry's ability to sufficiently and consistently irrigate cropland and generate revenues.

Growth and Development

The City of Leavenworth receives secondary benefits from water stored and released from Eightmile Lake, but is not legally entitled to this water. Assuming the dam remains intact and current operations continue, the No Action Alternative may affect water supply supporting the growth and development of the City of Leavenworth due to curtailment of their junior water rights. Continuation of the status quo under the No Action Alternative would mean lake storage levels that, during dry years, could fall below what is required to meet IPID's demand. Consequently, junior water rights holders, including the City of Leavenworth, may receive less water, particularly in dry years. The City of Leavenworth currently relies in part on water from Icicle Creek to provide municipal services to its residents and businesses. Curtailment of delivery of water to fulfill these diversionary water rights would result in adverse impacts on the City's ability to maintain its current population and level of economic productivity, let alone fulfill previous expectations regarding population growth and economic development. However, these impacts **are not considered significant.**

Failure of the dam under the No Action Alternative would result in **significant adverse impacts** on downstream infrastructure (Chapter 12, *Public Safety*). Dam failure could also affect the delivery of Icicle Creek water to the City of Leavenworth, which may force the City to reevaluate its projected rates of economic development and expansion unless an alternative water supply is secured. These impacts would not be considered significant, as they represent a curtailment of junior water rights and a reduction in delivery of water to which the City is not legally entitled.

According to Anchor QEA's 2019 Dam Break Analysis, a total of at least 60 residential and public buildings could face partial or complete inundation due to the resulting flood wave (see Chapter 12, *Public Safety*). The 50 residential buildings facing the threat of partial or total inundation, primarily including residences belonging to the Icicle Island Club, have a total market value of approximately $24.3 million (Chelan County 2021b). Overall, an estimated 130 to 150 residences and lots sit along Icicle Creek, approximately 50 of which support structures vulnerable to flooding, according to Chapter 12, *Public Safety*. Flood waters could also directly affect roads and bridge crossings, including FSR 7601 and FSR 112, a bridge over Icicle Creek at RM 7, two bridge crossings near Icicle Island, a bridge crossing near the downstream end of the LNFH channel, and the bridge at Leavenworth Road (Anchor QEA 2019).

Beyond the impacts on buildings and transportation infrastructure, a complete dam failure would likewise inhibit the ability to control future releases of water, making flow predictions highly uncertain. In combination with the lowered lake water elevation associated with a dam failure, the City of Leavenworth would likely experience impacts based on the reduced amount of water received as a secondary benefit of water released from Eightmile Lake, although these impacts would not be considered significant. The City has based their current growth projections in part on their current diversionary water rights in Icicle Creek, which benefit secondarily from water released from

[24] COIC has historically shared the water intake facility associated with the LNFH, although plans to relocate the COIC intake facility downstream are currently in process. It is unclear whether the new location is operational and would avoid flood-induced damages associated with a catastrophic dam failure (Bureau of Reclamation 2020).

Eightmile Lake. If that water is not available, it would hinder the City's ability to provide water to future residents and businesses that the City hopes to attract. Further economic development opportunities would therefore require an alternative water source to maintain similar levels of expected growth.

Recreation

Under the No Action Alternative, recreational opportunities are unlikely to change so long as dam operations continue. In the long term, emergency repairs or dam failure are likely, which would result in **significant adverse impacts** on recreation (Chapter 10, *Recreational Resources*). Flooding in the case of dam failure would endanger the safety of recreationists (Chapter 12, *Public Safety*). Emergency repairs would likely result in intermittent closures of recreational areas and increased levels of construction and noise. Both dam failure and disruptions due to emergency repairs could result in reduction in values held by individuals for trips to the Eightmile/Caroline Zone. If such disruptions result in recreationists deciding to travel to other regions instead, the net economic value of trips to the area, and regional economic contributions of that recreational activity could be lost.

Fisheries and Hatchery Operations

Under the No Action Alternative, current operations would continue, resulting in some limited impacts on the water supply provided via a secondary benefit from Eightmile Lake storage and releases supporting LNFH's diversionary water rights (Chapter 6, *Water Rights*). Lake levels would continue to fall short of what is required to ensure that all existing water rights are fulfilled, and availability of water to rights holders, including LNFH, would continue to be highly dependent on hydrological conditions and above-average precipitation. During low-precipitation years, curtailment of junior water rights such as those held by LNFH are possible, and LNFH may not have access to sufficient water to support existing levels of production. Reduced operational capacity at LNFH during dry years could result in reductions in the contribution of the hatchery to the local economy. However, these **impacts are not considered significant.** Dam failure under the No Action Alternative could result in the destruction of or significant damage to hatchery facilities (Chapter 12, *Public Safety*), resulting in closure of the hatchery and **significant adverse impacts** on both hatchery operations and tribal ceremonial and subsistence fisheries.

Continued operation of the dam under status quo conditions would not affect fish resources or habitats (Chapter 8, *Plants and Animals*). Thus, commercial and tribal ceremonial and subsistence fisheries are unlikely to be affected. However, dam failure is a likely outcome of the No Action Alternative (see Chapter 2, *Alternatives*). As described in Chapter 8 (*Plants and Animals*), dam failure would kill the majority of fish in Eightmile Lake, Eightmile Creek, and Icicle Creek. This outcome would result in **significant adverse impacts** on the Yakama Nation and Confederated Tribes of the Colville Reservation members who exercise fishing rights in Icicle Creek. Because Icicle Creek fish comprise a very small proportion of commercial fisheries in the Columbia River and Pacific Ocean, commercial fisheries **would not experience significant adverse impacts**.

15.5.2 Alternative 1: Narrow Spillway with Gates

Agriculture

Alternative 1 would restore the active storage capacity within Eightmile Lake and allow for controlled releases of water, making more water available for supporting diversionary water rights and instream flows (Chapter 6, *Water Rights*). Under this alternative, IPID would likely be able to meet demand for irrigation water and retain the ability to control releases of stored water within the limits of their water rights. The improvements in lake water storage quantity and controlled release capability due to the reduction in dependence on uncertain precipitation rates to fulfill water needs under

Alternative 1 would result in benefits to the agriculture industry. Alternative 1 would **not result in significant adverse impacts** on the agriculture industry.

Growth and Development

Alternative 1 involves replacement of the existing dam with upgraded infrastructure that would ultimately restore the lake water elevation back to historical conditions and allow for controlled releases of water, which provides a secondary benefit to junior water rights holders, including the City of Leavenworth (Chapter 6, *Water Rights*). This upgrade has the potential to reduce the impacts of drought conditions on entities with junior diversionary water rights that benefit secondarily from releases of Eightmile Lake water, including the City of Leavenworth, and on instream flows. Because a considerable portion of the Icicle Creek water rights belonging to the City of Leavenworth consists of interruptible rights, drought conditions could directly affect the City's growth and development by limiting the delivery of water during those times. Therefore, reductions to the risk of drought conditions lowering instream flow may provide secondary benefits to the growth and development of the City of Leavenworth. Alternative 1 would **not result in significant adverse impacts** on growth and development in the City of Leavenworth.

Recreation

Alternative 1 would not meaningfully alter existing recreational features around Eightmile Lake (i.e., trails, campsites, and lake access) (Chapter 10, *Recreational Resources*). Alternative 1 may lead to minor changes in recreational opportunities affecting shoreline and informal lake access trail availability depending on water levels, drought years, and the possibility of both lake drawdowns and restored water level elevation. Impacts would differ depending on conditions, and given varying potential lake levels, could mean improved fishing access and larger campsites, or reductions in those attributes. Altogether, however, differences from existing conditions would be minor, and Alternative 1 would **not result in significant adverse impacts** on recreation (Chapter 10, *Recreational Resources*). Recreationists would experience very limited changes in their experience under Alternative 1, and thus Alternative 1 would not change the value recreationists hold for trips to the area, or to result in any change in recreational spending in the region.

Fisheries and Hatchery Operations

Alternative 1 has the potential to result in secondary benefits by reducing the impacts of drought conditions on entities with junior diversionary water rights, including the LNFH, and the rate of instream flow due to upgraded infrastructure that would ultimately restore the lake water elevation and allow for controlled releases of water (Chapter 6, *Water Rights*). Increased reliability of water availability for the LNFH may have beneficial effects on hatchery production and operations, and on the hatchery's contribution to the local economy. Increases in instream flow may benefit survival of hatchery-produced fish (Chapter 8, *Plants and Animals*). Thus, tribal ceremonial and subsistence fisheries may see beneficial effects of Alternative 1. Because of the relatively minor contribution of Icicle Creek fish to commercial fisheries in the Columbia River and Pacific Ocean, commercial fisheries are unlikely to be affected, or may experience minor beneficial effects, under this alternative. Alternative 1 would **not result in significant adverse impacts** on fisheries or hatchery operations.

15.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Agriculture

This alternative involves the same storage characteristics as Alternative 1. Accordingly, operational impacts would be the same. Alternative 2 would result in benefits to the agriculture industry due to improvements in lake water storage quantity and controlled release capability resulting from the reduction in dependence on uncertain precipitation rates to fulfill water needs. Alternative 2 would **not result in significant adverse impacts** on the agriculture industry.

Growth and Development

Alternative 2 consists of similar outcomes as Alternative 1 with respect to restored water elevation in Eightmile Lake and enhanced control over water release that would provide secondary benefits for junior diversionary water rights holders, including the City of Leavenworth, and enhanced instream flow, particularly during drought conditions. As such, the benefits to the growth and development of the City of Leavenworth would be the same between Alternatives 1 and 2. Reductions to the risk of drought conditions resulting in curtailment of delivery of water to Leavenworth would provide benefits to the growth and development of the City of Leavenworth. Alternative 2 would **not result in significant adverse impacts** on growth and development in the City of Leavenworth.

Recreation

The operational impacts of Alternative 2 on recreation and recreational values are the same as the effects of Alternative 1. Alternative 2 would **not result in significant adverse impacts** on recreation (Chapter 10, *Recreational Resources*). As with Alternative 1, Alternative 2 would not change the recreational experience to an extent that changes the value of trips to the area, or changes visitation and spending in the region more broadly.

Fisheries and Hatchery Operations

This alternative involves the same benefits to LNFH in the form of increased reliability of water availability due to the secondary benefits provided by Eightmile Lake water storage and release, as well as to fish in the form of increased instream flow, as Alternative 1. The expected beneficial impacts on hatchery operations and the economic contribution of the hatchery to the local economy, and to tribal ceremonial and subsistence fisheries, would be the same. Commercial fisheries are similarly unlikely to be affected. Alternative 2 would **not result in significant adverse impacts** on fisheries or hatchery operations.

15.5.4 Alternative 3: Narrow Spillway without Gates

Agriculture

Alternative 3 involves storage characteristics below that of Alternatives 1 and 2, but above those associated with the No Action Alternative. As such, IPID would likely be able to meet their diversionary rights under this alternative, although not to the same extent as under Alternatives 1 and 2. The agriculture industry would experience benefits from the improvements in lake water storage quantity and controlled release capability since the dependence on uncertain precipitation rates to fulfill water needs would be significantly reduced, although the magnitude of benefit would be slightly less than that of the first two action alternatives. Alternative 3 would **not result in significant adverse impacts** on the agriculture industry.

Growth and Development

Alternative 3 consists of similar actions as Alternatives 1 and 2, although with not fully restored projected water elevation in Eightmile Lake. This alternative still includes the ability for IPID to regulate stored water release and instream flow during drought conditions, resulting in secondary benefits to junior water rights holders like the City of Leavenworth. Ultimately, this alternative may provide benefits to the growth and development of the City of Leavenworth via reductions in drought-induced water delivery interruptions compared to the No Action Alternative, albeit at a smaller scale than Alternatives 1 and 2. Alternative 3 would **not result in significant adverse impacts** on growth and development in the City of Leavenworth.

Recreation

The operational impacts of Alternative 3 on recreation are generally the same as the effects of Alternative 1 and 2. Under Alternative 3, water levels would be lowered in drought years, creating an expanded shoreline and additional camping and recreational opportunities. This alternative would **not result in significant adverse impacts** on recreation (Chapter 10, *Recreational Resources*). Given the minimal change that recreationists would experience as a result of Alternative 3, it would not change the value recreationists hold for trips to the area, or result in any change in recreational spending in the region.

Fisheries and Hatchery Operations

The outcomes from this alternative are similar to Alternatives 1 and 2, resulting in benefits to LNFH operations and economic contribution, and to tribal ceremonial and subsistence fisheries, compared with the No Action Alternative. Beneficial effects of Alternative 3 on water availability and instream flow are slightly reduced from those resulting from Alternatives 1 and 2. Alternative 3 would **not result in significant adverse impacts** on commercial or tribal ceremonial and subsistence fisheries, nor to hatchery operations.

15.6 Avoidance, Minimization, and Mitigation Measures

The agriculture industry may experience significant adverse impacts in the short term only if construction occurs during years of extremely low water due to interruptions in water delivery during construction and impairment of IPID's senior water right. Impacts on the agriculture industry and growth and development in Leavenworth are tied to the potential impacts of the alternatives on the ability for their diversionary water rights to be fulfilled. Measures to avoid, minimize, or mitigate impacts on water delivery will reduce impacts on agriculture and to the City of Leavenworth. As described in Chapter 6, *Water Rights*, these include:

- Ideally, construction occurring during a year with higher-than-average precipitation and streamflow.
- During dry years, modifying lake releases from other alpine lakes with storage water rights to meet downstream conditions (e.g., changing the timing of releases).

In addition to these mitigation opportunities, other measures may more directly address the impacts on agriculture and growth and development experienced as a result of reduced water supplies, including identifying alternate sources of water for use during the construction period and in years with below-average precipitation.

Chapter 10, *Recreational Resources*, describes methods for avoiding, minimizing, and mitigating for the potential less-than-significant short-term impacts on recreationists, which would also offset potential impacts on the value of recreation in the region. These opportunities generally include providing early and frequent notifications to recreationists of the construction activities in the area. As no long-term impacts on recreation are anticipated as a result of the action alternatives, no mitigation measures are identified.

Less-than-significant impacts on hatchery operations and tribal ceremonial and subsistence fisheries are anticipated if the reduction in available water during dam construction results in the complete closure of LNFH operations. Opportunities for mitigation or minimization of these outcomes include increasing the amount of available water to the hatchery from other sources, including groundwater.

15.7 Significant Unavoidable Adverse Impacts

The potential for significant unavoidable adverse impacts on agriculture is tied to the potential impacts on water delivery to fulfill IPID's existing senior diversionary water rights. With respect to water delivery, there are **no significant unavoidable adverse impacts under the action alternatives.** Under the No Action Alternative, if the dam were to fail, significant unavoidable impacts may occur in the form of impairment of water delivery to fulfill existing senior diversionary rights.

The potential for significant unavoidable adverse impacts on the value of recreation in the region is driven by the potential impacts on recreation. As described in Chapter 10, *Recreational Resources*, construction activities may detract from recreationists' wilderness experience, and some individuals may experience a substantial or total loss of value for this experience as a result. This impact may be an unavoidable outcome of construction activities. However, these impacts would be experienced only temporarily.

Under the dam failure scenario of the No Action Alternative, threats to safety and loss of recreational opportunities may result in unavoidable **significant adverse impacts.** Dam failure would pose a risk to the health and safety of downstream recreationists, and could result in inundation, temporary closures, or other impacts on the Eightmile Lake Trail, FSR 7601, and recreational resources downstream on Icicle Creek and the Wenatchee River.

Dam failure under the No Action Alternative could result in destruction of or significant damage to the LNFH (Chapter 12, *Public Safety*), substantially affecting the economic contribution of the hatchery to the local economy. This outcome would be a **significant unavoidable adverse impact.**

CHAPTER 16: ENVIRONMENTAL JUSTICE

The U.S. Environmental Protection Agency (EPA) defines environmental justice as "*the 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*" (EPA 2021).

What has Changed from the Draft EIS?

- No substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS.
- No comments were received on the Draft EIS about environmental justice issues.

Key Findings for Environmental Justice

- The study area includes communities of color, low-income communities, and overburdened communities. These communities are located primarily near Wenatchee and East Wenatchee, along Lake Chelan, south of Chelan, and north of Cashmere. None are directly adjacent to the project site. The study area also includes tribal populations that rely on resources potentially affected by the project alternatives.
- Sixty of the 84 Census block groups within the environmental justice study area are identified as a community of color, a low-income community, and/or an overburdened community. Together, the population of these block groups account for 64.8 percent of the total population of Chelan and Douglas counties.
- Neither the transportation of equipment and materials nor dam construction is expected to result in significant adverse impacts on communities of color, low-income communities, overburdened communities, or tribal populations.
- If the dam continues operating in its present condition, significant adverse impacts on communities of color, low-income communities, overburdened communities, and tribal populations are not anticipated. However, dam failure under the No Action Alternative would result in significant adverse impacts on these communities and populations. Steep declines in fish populations would significantly adversely affect tribal populations who exercise fishing rights in Icicle Creek, while damage to the LNFH could adversely affect tribal members employed by the hatchery. Reduced water availability for IPID would also significantly adversely affect members of low-income communities and communities of color working in the agriculture industry.
- The action alternatives would not result in changes in water delivery or fish resources. Therefore, the action alternatives would not result in significant adverse impacts on any of these identified communities and populations.

Building upon this definition, the Washington State law on Environmental Justice (Chapter 70A.02 RCW) defines environmental justice as:

> *The 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, rules and policies. Environmental justice includes addressing disproportionate environmental and health impacts in all laws, rules, and policies with environmental impacts by prioritizing vulnerable populations and overburdened*

communities, the equitable distribution of resources and benefits, and eliminating harm. (RCW 70A.02.010(8)).

This chapter identifies people with low-incomes, people of color, and communities that are overburdened with respect to environmental health disparities, as well as potentially affected tribal populations with unique connections to potentially affected resources, within the study area.[1,2] It also addresses all significant anticipated impacts and evaluates the potential that identified populations may be disproportionately affected.

16.1 Methodology

The environmental justice analysis considers the extent to which people of color, low-income communities, and overburdened communities, as well as potentially affected tribal populations, may be disproportionately adversely or beneficially affected by the alternatives. The environmental justice analysis relies on the findings of the impact analyses described in the previous chapters of this EIS to identify the potential for impacts on vulnerable communities and evaluates whether impacts on the vulnerable communities are disproportionate relative to the impacts on other affected communities.

The environmental justice analysis involves the following general steps:

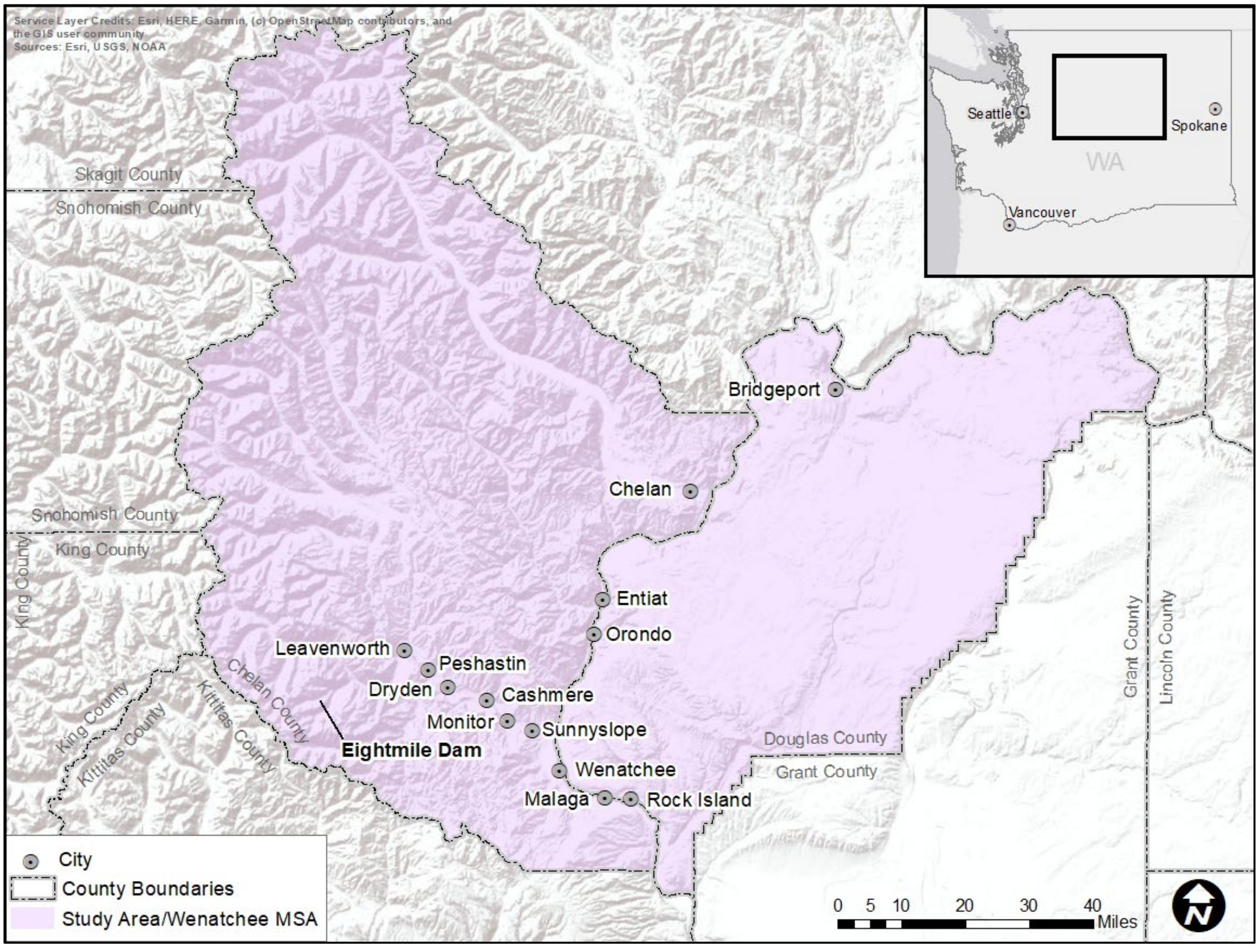
1. Identify and describe: (i) the relative presence of people of color and low-income communities at the Census block group level across the study area;[3] (ii) presence of communities at the Census tract level that the state describes as having demographic and other characteristics that identify it as overburdened;[4] and (iii) tribal populations with unique connections to the potentially affected resources.
2. Identify whether the impacts of the alternatives as described in the Construction and Operations Impacts sections of the EIS may affect the communities identified in the first step.
3. Evaluate the nature and relative intensity of impacts of the alternatives that would be experienced by the general population and compare with the anticipated impacts on the identified communities.
4. Identify and describe impacts that may disproportionately affect the vulnerable communities identified in this analysis.

This analysis identifies communities of color, low-income communities, and overburdened communities across the Wenatchee Metropolitan Statistical Area (MSA), which includes all of Chelan and Douglas counties (Figure 16-1). This geographic region encompasses the area over which individuals and communities may experience the impacts to the affected activities and resources (e.g., water, fish, agriculture). For example, the affected communities may be employed in affected industries, rely on the affected environmental resources for food or recreation, or hold cultural value for potentially affected resources. While this study area is broad and includes areas somewhat distant from the dam site, the major population centers within the MSA are relatively close to the

[1] This analysis collectively considers race, color, and national origin under the umbrella of "communities of color."
[2] The scope of this analysis with respect to tribal populations includes those individual tribal members that may experience impacts resulting from the project alternatives due to their use of affected resources.
[3] A Census block group is a subdivision of a Census tract and is the smallest geographical unit for which the Census publishes sample data.
[4] These include the communities identified in the State of Washington's Environmental Health Disparities mapping tool as characterized by environmental health disparities. Factors considered include environmental exposures, environmental effects, sensitive populations, and socioeconomic factors (DOH 2021).

dam site. Most of the communities that may be affected by the project are within Chelan County. However, the analysis includes Douglas County, as a substantial portion of the largest proximal population center (Wenatchee/East Wenatchee) lies in Douglas County.

Figure 16-1. Study Area for Environmental Justice Analysis



Source: WDNR 2022.

This analysis identifies short-term (construction) impacts on environmental justice as significant if they meet any of the following conditions:

- The effects of the alternative include impairment of senior water rights that reduce the delivery of water to communities of color, low-income communities, overburdened communities, or tribal populations;
- The effects of the alternative include impairment of senior water rights that reduce the delivery of water to industries that employ members of communities of color, low-income communities, overburdened communities, or tribal populations;
- The effects of the alternative on fish populations could result in the temporary closure of tribal fisheries, limiting or eliminating the ability for affected tribes to exercise their fishing rights; or
- Communities of color and low-income communities, overburdened communities, or tribal populations are affected by flooding.

This analysis identifies long-term (operational) impacts on environmental justice as significant if they meet any of the following conditions:

- The effects of the alternative include impairment of senior water rights that results in a persistent reduction in the delivery of water to communities of color, low-income communities, overburdened communities, or tribal populations;
- The effects of the alternative include impairment of senior water rights that results in a long-term reduction in the delivery of water to the agriculture industry, which is reliant upon individuals that are members of communities of color, low-income communities, overburdened communities, or to the LNFH, which employs members of tribal populations; or
- The effects of the alternative on fish populations result in persistent closures of tribal fisheries, limiting or eliminating the ability for affected tribes to exercise their fishing rights.

16.2 Regulatory Context

Regulations, programs, policies, and guidance that identify methods for determining environmental justice impacts of proposed actions are detailed in Appendix D; they include directives from Executive Orders (i.e., Executive Order 12898), the Council on Environmental Quality (CEQ), the Interagency Working Group on Environmental Justice & NEPA Committee (IWGEJ), and Washington State's Environmental Justice Task Force. The State of Washington does not require environmental justice analyses of significant regulatory actions until July 1, 2023 (70A.02 RCW), and the federal guidance and policies regarding environmental justice are not required for this SEPA analysis. However, absent specific existing requirements for consideration of environmental justice within SEPA, this analysis relies on these federal policies and guidelines, recent state legislation on Environmental Justice (Chapter 70A.02 RCW), as well as the State of Washington's Environmental Justice Task Force's report (Environmental Justice Task Force 2020), to evaluate the potential environmental justice effects of the alternatives.

16.3 Affected Environment

This section uses demographic data to identify the existence of communities of color, low-income communities, and overburdened communities within the study area. It is based on the most recent socioeconomic statistics currently available from the U.S. Census American Community Survey (ACS) 5-year estimates from 2015 to 2019, as well as data compiled in the Washington State Department of Health's Environmental Health Disparities (EHD) Map (United States Census 2020; DOH 2021). In addition to communities of color, low-income communities, and overburdened communities, this analysis identifies tribal populations with special interest in potentially affected resources.

16.3.1 Communities of Color

People of color are defined in this analysis as all people who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. This analysis considers two criteria for identifying communities of color:

1) Whether the population of color in any Census block group within the study area exceeds 50 percent, which would identify the presence of a community of color (i.e., the "50 percent analysis"); and

2) Whether the population of color in any remaining block group is greater than 10 percent higher than the "reference community," which in this case is the broader relevant county.[5]

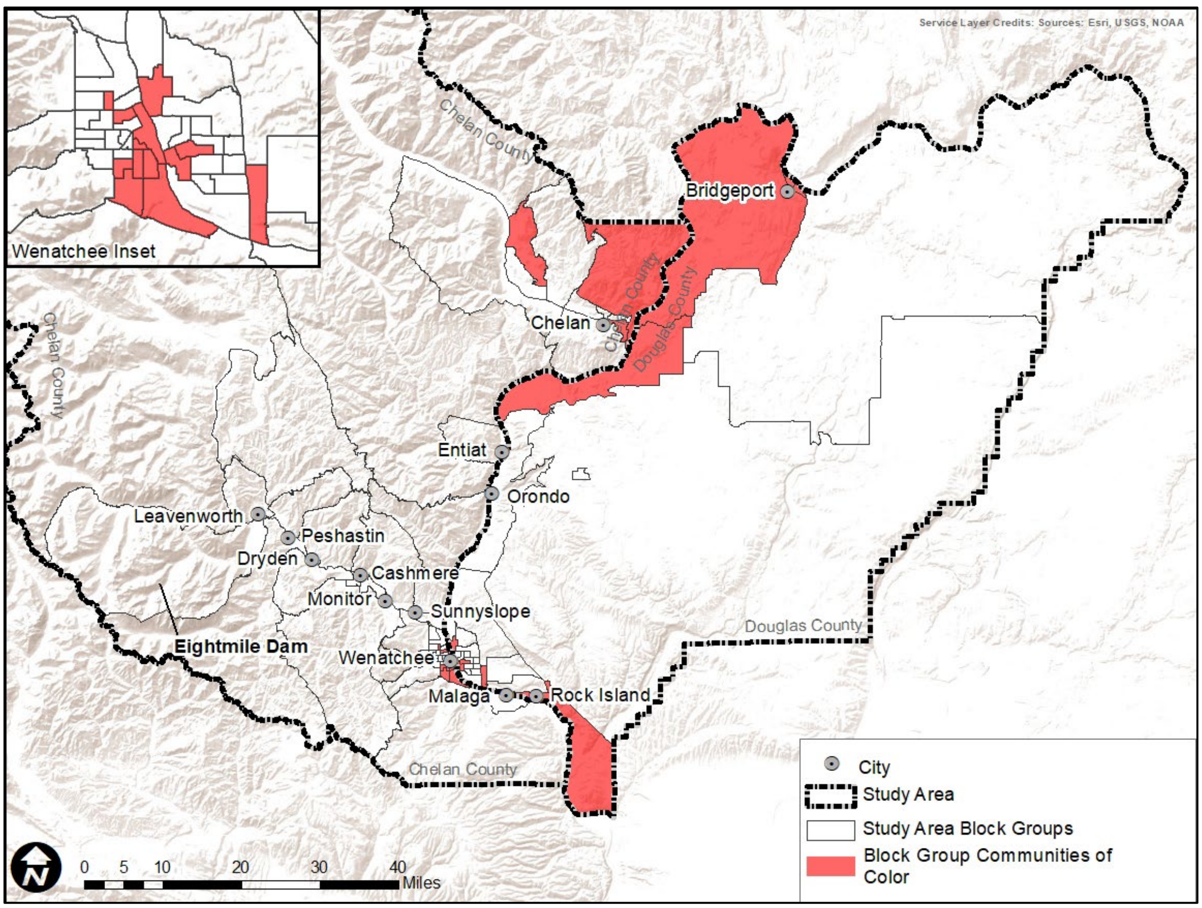
The communities that meet either of these thresholds are identified as "communities of color."

The percentages of people of color in Chelan and Douglas counties are 32 and 36 percent, respectively (see Table 16-1). The population of color within these counties is slightly higher than the statewide proportion of 31 percent. Accordingly, the thresholds to identify communities of color in Chelan and Douglas counties, respectively, are 42 and 46 percent.

Twenty-one of the 84 Census block groups within the study area are identified as communities of color. These community block groups account for 24.7 percent of the total population of Chelan and Douglas counties. The populations of color in the study area are predominantly Hispanic/Latino or "other."

This analysis identifies communities of color in the study area based on Census block group level data from the ACS 2015–2019 5-year estimates (U.S. Census 2020). The detailed results of this analysis are presented in Appendix D. The "50 percent analysis" identifies 20 block groups as communities of color. Figure 16-2 maps these block groups identified as communities of color.

Figure 16-2. Map Identifying Locations of Communities of Color within the Study Area



Sources: WDNR 2022, U.S. Census 2020.

[5] The CEQ guidance identifies areas of minority populations as being where "*minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis*" (CEQ 1997). The federal IWGEJ provides additional guidance for defining "meaningfully greater" in identifying environmental justice communities (NEPA Committee and IWGEJ 2016). IWGEJ references 10 to 20 percent thresholds as examples; this analysis uses a 10 percent threshold.

Table 16-1. Populations of Color in Census Area

Census Area	Total Population[1]	Total People of Color	Percentage of People of Color	Racial Groups Breakdown							Hispanic/ Latino Origin – Any Race
				White (Hispanic or Non-Hispanic)	Black/ African American	American Indian and Alaska Native	Asian	Native Hawaiian and other Pacific Islander	Other	Two or More Races	
Chelan County	76,229	24,413	32%	80%	1%	1%	1%	0%	13%	4%	28%
Douglas County	42,023	15,062	36%	69%	0%	1%	1%	0%	25%	3%	32%
Washington State	7,404,107	2,330,162	31%	75%	4%	1%	9%	1%	4%	6%	13%

Note:
1/ Total population refers to an estimated value based on census responses and may therefore differ across metrics.
2/ Percentages sum to 100 percent across racial groups; Hispanic/Latino category is not included in this breakdown because of overlap between Hispanic/Latino category and multiple racial categories.
Source: U.S. Census 2020.

The population of color across the MSA is predominantly Hispanic/Latino and does not include many individuals identifying as Black/African American, Asian, or Native Hawaiian/Other Pacific Islander. The populations of color are largely centered around the City of Wenatchee and East Wenatchee. In Chelan County, the communities of color generally include between 50 and 65 percent (in one case as high as 92 percent) of the population identifying as Hispanic/Latino at the block group level, and relatively large populations of color exist in and around the town of Chelan. In Douglas County, the statistics are generally similar. In addition to communities around East Wenatchee, there are block groups with relatively large populations of color near the towns of Bridgeport and Rocky Butte, in other communities moving south along the Columbia River, and in the area south of Rock Island. The population of color of the MSA includes a substantial proportion of individuals who identify their race as “other” or “two or more races,” and two block groups with relatively high proportions of the population that identify as American Indian or Alaska Native.

16.3.2 Low-Income Communities

Data from the U.S. Census Bureau ACS 5-year estimates (2015–2019) inform the assessment of low-income communities across the study area at the Census block group level. For this analysis, a block group is considered to contain a “low-income community” if the proportion of individuals living at or below twice the poverty level is greater than the proportion for the state.[6] The federal poverty level for an individual in 2020 was $12,760 (ASPE 2021). Thus, individuals with an income of less than $25,520 (two times the poverty level) are considered low-income. The threshold for identifying “low-income communities” for this analysis is the state-level low-income percentage of 26 percent (Table 16-2). Of the 84 block groups within the Wenatchee MSA study area for this analysis, 58 have low-income proportions above the established threshold (see Appendix D for the detailed results of this analysis). Figure 16-3 depicts the locations of identified low-income communities graphically.

Table 16-2. Low-Income Populations in the Study Area

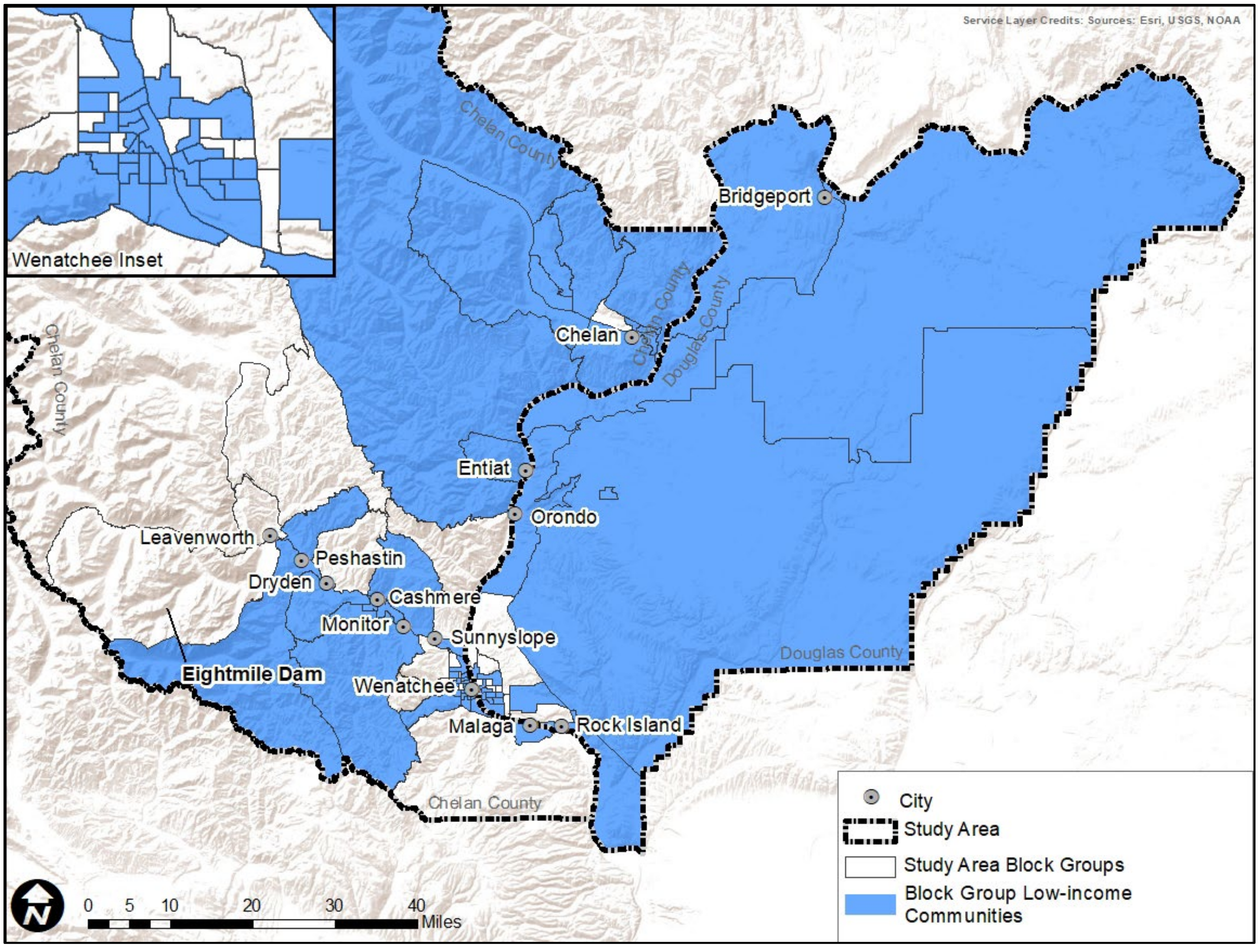
Census Area	Total Population[1]	Total Low-Income	Low-Income Percentage
Chelan County	75,073	24,638	33%
Douglas County	41,862	14,084	34%
Washington State	7,266,810	1,860,917	26%

Note:
1/ Total population refers to an estimated value based on census responses and may therefore differ across metrics.
Source: U.S. Census 2020.

Of the 58 low-income communities, 19 are also identified as communities of color. The identified low-income communities cover a broader geographic area as compared with the communities of color. Low-income communities are in many of the same locations as the identified communities of color. Additionally, low-income block groups are located along the entirety of Lake Chelan (northwest of the town of Chelan), south of the town of Chelan, in the area to the north of Cashmere, and south of the City of Leavenworth and Eightmile Lake.

[6] The methodology for the low-income analysis is derived from the SEPA analysis conducted by Ecology for the Chehalis River Basin Flood Damage Reduction Project (Ecology 2020).

Figure 16-3. Map Identifying Locations of Low-Income Communities within the Study Area



Sources: WDNR 2022, U.S. Census 2020.

16.3.3 Overburdened Communities

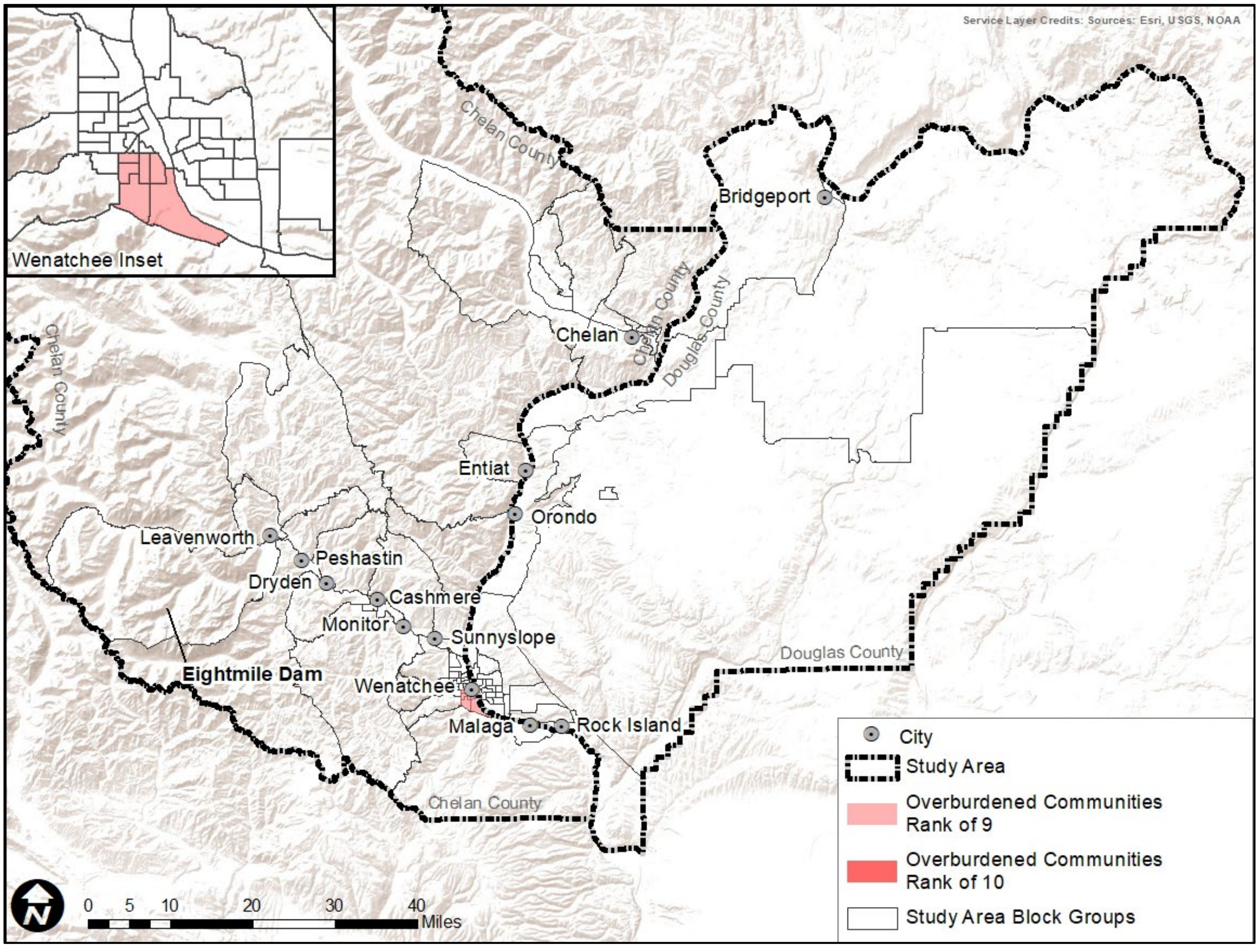
RCW 70A.02 directs agencies to use cumulative environmental health impact analysis, such as the Washington State DOH EHD Map, to consider the effects of a proposed action on overburdened communities. This analysis uses the Census tract-level data and overall environmental health disparities rankings from the EHD Map to identify additional overburdened communities that are experiencing environmental health disparities. The EHD Map compares communities across the state and provides descriptive information and context for the pollution measures, proximity to hazardous sites, and social vulnerabilities that may characterize certain communities within the study area. The map contains 19 indicators split across four themes as follows (descriptions of each theme can be found in Appendix D): (1) Environmental Exposures, (2) Environmental Effects, (3) Sensitive Populations, and (4) Socioeconomic Factors.

Each indicator is ranked using a set of 10 equally distributed deciles.[7] The average ranking across all indicators under each theme constitutes the overall theme ranking (University of Washington Department of Environmental & Occupational Health Sciences 2019). Based on the Environmental

[7] For example, a ranking of 9 for "unemployment" means that approximately 10 percent of other Census tracts also experienced that level of unemployment (ranked as "9"), while 10 percent of Census tracts had higher unemployment (ranked as "10"), and 80 percent had lower unemployment (tracts ranked 1 through 8).

Justice Task Force's suggested interpretation of overall ranks, this analysis considers any community identified as having an overall environmental health disparities rank of 9 or 10 as "overburdened." Figure 16-4 identifies communities (by Census tract) identified as rank 9 or 10 with respect to environmental health disparities.

Figure 16-4. Communities Ranked 9 or 10 by the DOH Environmental Health Disparities Map in the Study Area



Sources: WDNR 2022; U.S. Census 2020; DOH 2021.

To evaluate the environmental health disparities rankings, the analysis considers whether any areas that were not identified specifically as communities of color or low-income communities are identified as overburdened using this approach.[8] The results, presented in detail in Appendix D, indicate that all of the Census block groups that were identified as overburdened according to the EHD rankings were also otherwise identified as low-income or communities of color. The six overburdened block groups are located in Chelan County, in the City of Wenatchee.

[8] Because both Census tracts and block groups are used to identify communities of color, low-income communities, and overburdened communities, the analysis assumes that the tract-level environmental health disparity ranking applies to all block groups within that tract; this approach may over-estimate the block groups that may be overburdened.

16.3.4 Potentially Affected Tribal Populations

Tribal populations may be uniquely affected by the alternatives due to their connections to the potentially affected resources.[9] The project area is within the Yakama Ceded Lands, to which the Yakama Nation exercises its Treaty Reserved Rights, and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources. Although no federally designated Indian reservations overlap with or are in close proximity to the project area, the fish resources in the area, and in Icicle Creek specifically, as well as the wildlife and vegetation in the project area are of great importance to the Yakama Nation and the Confederated Tribes of the Colville Reservation (USFWS 2016; Corps et al. 1995). Both tribes have expressed their rights to fish in Icicle Creek. This activity is described in greater detail in Chapter 14 (*Tribal Resources*) and Chapter 15 (*Agriculture and Economics*). While the previously described Census data identify the relative presence of American Indian populations, detailed information defining where the specifically affected tribal populations reside (i.e., members of the Yakama Nation and Confederated Tribes of the Colville Reservation) is not available. Some portion of the tribal members live on the tribes' respective reservations (i.e., outside of the study area), while others may live within the MSA, or in other locations. Within the MSA, as described in Appendix D, the analysis identifies two block groups with relatively high proportions of the population that identify as American Indian or Alaska Native, as compared to the statewide proportion of one percent for this population. These include one area in East Wenatchee where 12 percent of the population describes themselves as Native American or Alaska Native, and another directly across the Columbia River in Wenatchee where 18 percent of the population describes themselves as such. To the extent that fish resources are affected by the alternatives, the Yakama and Colville Reservation tribal members participating in these fisheries may be uniquely affected.

Additionally, the Yakama Nation cooperatively runs the hatchery program for coho salmon at the LNFH (USFWS 2016). Alternatives that affect operations of the LNFH have the potential to impact the tribal populations who are employed there.

16.3.5 Summary of Affected Environment

Of the 84 total block groups in Chelan and Douglas counties:

- 21 are Communities of Color: These block groups have percentages of populations of color ranging between 47 percent and 92 percent. The communities are predominantly Hispanic/Latino or "other."
- 58 are Low-Income Communities: These block groups have percentages of low-income populations ranging from 26 percent to 79 percent of the total block population.
- 6 are Overburdened Communities: These block groups are part of a census tract that is identified as rank 9 or 10 with respect to overall environmental health disparities identified by the State of Washington (DOH 2021). Of these, all are also identified as a community of color or low-income community.

Overall, 60 of the 84 total block groups in the study area are identified as a community of color, low-income community, and/or overburdened community (i.e., at least one of the three categories above). Together, the population of these block groups account for 64.8 percent of the total population of the two counties.

People of color comprise a proportion of the population in both Chelan and Douglas counties that is higher than the state average, with individuals identifying as Hispanic or Latino being the largest

[9] Section 16.3.1 describes the communities of color within the study area that may be affected by the alternatives, which include populations identifying as American Indian or Alaska Native.

group of color within the study area. The cities of Wenatchee and East Wenatchee have higher percentage of people of color, and in the northwestern part of Douglas County near the town of Chelan, all of which are fairly distant from the project area. Low-income communities are distributed throughout the study area, particularly around Wenatchee, East Wenatchee, Cashmere, and well north of the project area around the town of Chelan. In Chelan County, the overburdened communities are limited to areas within the City of Wenatchee. In addition to these communities that live within the study area and that may be affected by the alternatives, members of the Yakama Nation and Confederated Tribes of the Colville Reservation exercise fishing rights within Icicle Creek and may be uniquely affected by the alternatives to the extent that they result in impacts on fish populations in the creek.

16.4 Construction Impacts

The following section identifies the potential short-term impacts associated with construction, which apply across all of the action alternatives.

16.4.1 Transportation of Equipment and Materials

Helicopter Use

Option 1: Heavy-lift Helicopter with Limited Use of Small Helicopter Throughout Construction

As described in Chapter 7 (*Plants and Animals*), the heavy-lift helicopter with limited use of a small helicopter throughout construction option is unlikely to affect fish and other aquatic resources in the study area. As described in Chapter 9 (*Noise*), helicopter activity in the Eightmile Lake area has the potential to generate increased noise levels along Icicle Creek. However, as described in Chapter 14 (*Tribal Resources*), the use of helicopters is expected to have **no significant adverse impacts** on tribal traditional cultural practices and populations, which would include tribal fishing on Icicle Creek. No other impacts on low-income communities, communities of color, or other overburdened communities are expected.

Helicopter use would occur outside of the Census tracts identified as low-income, communities of color, or overburdened communities, so these communities are unlikely to be affected by helicopter use.

Option 2: Limited Use of Heavy-lift Helicopter with Small Helicopter Use for the Majority of Materials.

Like Option 1, Option 2 would not affect aquatic resources in the study area (Chapter 7, *Plants and Animals*), and tribal populations reliant upon fishing in Icicle Creek would not be significantly adversely impacted by helicopter use (Chapter 14, *Tribal Resources*). **No significant adverse impacts** on low-income, overburdened, or communities of color, or tribal populations are expected in the area.

Road Segment

Under all action alternatives, repair and replacement of the roadway would not affect fish or aquatic resources so long as BMPs are employed for all activities, as described in Chapter 7 (*Plants and Animals*). Therefore, **no significant adverse impacts** are expected for tribal populations reliant on aquatic resources. No other impacts on low-income, communities of color, or overburdened communities due to roadway repair activities are expected.

16.4.2 Dam Construction

Dam construction would result in higher levels of noise in the vicinity of Eightmile Lake (Chapter 9, *Noise*), visibility of construction activities and personnel in the area (Chapter 11, *Visual Resources,* and Chapter 10, *Recreation*), and some minimal disruption to fish in the lake from increased turbidity and fish removal/relocation (Chapter 7, *Plants and Animals*). However, as described in Chapter 14 (*Tribal Resources*), construction activities would not affect any traditional cultural practices, which include tribal fishing activities on Icicle Creek. Therefore, dam construction **would not result in significant adverse impacts** on tribal populations. No other impacts on low-income, communities of color, or overburdened communities as a result of dam construction are expected.

16.5 Operational Impacts

This section describes the potential long-term environmental justice impacts of the project alternatives from dam operations following the construction phase on communities of color, low-income, and overburdened communities. This section also considers whether the impacts may be disproportionately borne by tribal populations.

16.5.1 No Action Alternative

Under the No Action Alternative, some impacts on communities of color and tribal populations may occur if the dam continues to operate without failing. Dam failure under the No Action Alternative may result in **significant adverse impacts** on communities of color and tribal populations.

Status Quo Operations

Under a scenario in which the dam continues to operate in its present condition, as described in Chapter 6 (*Water Rights*), IPID would not have consistent access to adequate water storage during dry years, which may affect the agriculture industry and employees, many of whom are members of nearby communities of color and low-income communities. Other water rights holders, such as the City of Leavenworth and LNFH, are not legally entitled to water stored and released from Eightmile Creek but do receive secondary benefits from that water. These junior water rights holders would also likely fall short of adequate water access, which could affect residents who rely on water from the City or tribal populations employed by the hatchery. However, as described in Chapter 6 (*Water Rights*), status quo operations are not expected to have significant adverse impacts on water rights. Status quo operations are not expected to have any effect on fish resources (Chapter 7, *Plants and Animals*). Therefore, status quo operations under the No Action Alternative are **not expected to have significant adverse impacts** on communities of color, low-income communities, overburdened communities, or tribal populations.

Dam Failure

Dam failure is a likely outcome of the No Action Alternative (see Chapter 2, *Alternatives*). In the event of dam failure, as described in Chapter 7 (*Plants and Animals*), most of the lake would drain, killing most fish in Eightmile Lake, Eightmile Creek, and Icicle Creek. Dam failure may also severely damage or destroy water intakes at LNFH, reducing or eliminating hatchery operations (Chapter 7, *Plants and Animals*). This outcome would result in **significant adverse impacts** on members of the Yakama Nation and Confederated Tribes of the Colville Reservation who exercise fishing rights in Icicle Creek, or who are employed by the hatchery. In the long term, summer flow reductions would significantly adversely affect fish populations (see Chapter 7, *Plants and Animals*), leading to **significant adverse impacts** on tribal populations that exercise fishing rights in Icicle Creek.

In the event of dam failure, IPID's water rights may also be adversely affected, as the active storage capacity in Eightmile Lake would be further reduced, leading to lower levels of access to water for IPID and IPID's customers. Although IPID will likely be able to exercise their complete diversionary water rights during years of average precipitation, **significant adverse impacts** in the form of impaired water rights may occur during years of severe drought. Other junior water rights holders, including the City of Leavenworth and the LNFH, may also experience curtailment of diversionary water rights following dam failure; however, these effects are not considered significant (Chapter 6, *Water*

Rights). Reduced water availability for fish propagation at the fish hatchery under this scenario could lead to additional adverse impacts on tribal populations reliant on aquatic resources, as well as those employed by the hatchery. However, because LNFH is not legally entitled to the water from Eightmile Lake, these effects are not considered significant. Although no low-income, overburdened, tribal populations, or communities of color would be affected by reduced delivery of water to Leavenworth, reduced water delivery to IPID and its customers could negatively affect the agriculture industry, which may result in **significant adverse impacts** on low-income communities or communities of color employed within that industry during years of severe drought.

Dam failure would flood areas downstream of the dam, which could threaten residences and infrastructure (Chapter 12, *Public Safety*). However, no Census block groups that meet the threshold definition of being low-income, overburdened, or communities of color are within the projected flood zone. These communities would thus not disproportionately bear the impacts of flooding under the No Action Alternative.

Overall, **significant adverse impacts** on tribal populations with fishing rights in Icicle Creek would be expected in the event of dam failure under the No Action Alternative, and closure of the hatchery following damage due to flooding could **significantly adversely affect** tribal members employed by the hatchery. The No Action Alternative may also have **significant adverse effects** on low-income communities and communities of color employed by the agriculture industry.

16.5.2 Alternative 1: Narrow Spillway with Gates

As described in Chapter 7 (*Plants and Animals*), the replacement of Eightmile Dam would bolster instream flow, providing dependable flows of water and improving habitat for anadromous and resident salmonid species in Eightmile and Icicle creeks. These benefits to fish populations would likely benefit tribal populations who rely on fish from Icicle Creek for subsistence use, as well as provide benefits related to the cultural significance of fishing as an activity for tribal populations in the area.

Under Alternative 1, water levels in Eightmile Lake may fluctuate seasonally. However, the seasonal filling and drawdown of the lake are unlikely to lead to corresponding fluctuations in the waters of Eightmile Creek and Icicle Creek. Therefore, fishing opportunities for tribal populations in those areas are unlikely to be affected under Alternative 1.

Alternative 1 would not change the quantity of water provided to the City of Leavenworth, LNFH, or the IPID. The agriculture industry is unlikely to face any changes in water availability under this alternative. Therefore, members of low-income communities or communities of color working in the agricultural sector are unlikely to be affected. The LNFH is similarly unlikely to experience reduced water delivery that would affect operations, and Alternative 1 is thus unlikely to affect tribal populations employed by the hatchery.

No significant adverse impacts from the operation of Alternative 1 on low-income communities, communities of color, overburdened, or tribal populations in the Eightmile Lake area are expected.

16.5.3 Alternative 2: Wide Spillway without Gates (Preferred Alternative)

Operational impacts on low-income communities, communities of color, overburdened, or tribal populations under Alternative 2 would be the same as those described above for Alternative 1. Alternative 2 is very similar to Alternative 1, resulting in sufficient delivery of water to fulfill the existing water rights of IPID, the City of Leavenworth, and the LNFH, and providing the same level of benefits to downstream summer flows in Eightmile and Icicle creeks.

Under Alternative 2, the replacement of Eightmile Dam would bolster instream flow, providing dependable flows of water and improving habitat for anadromous and resident salmonid species in

Eightmile and Icicle creeks. These benefits to fish populations would likely benefit tribal populations who rely on fish from Icicle Creek for subsistence use, as well as provide benefits related to the cultural significance of fishing as an activity for tribal populations in the area.

Under Alternative 2, water levels in Eightmile Lake may fluctuate seasonally. However, the seasonal filling and drawdown of the lake are unlikely to lead to corresponding fluctuations in the waters of Eightmile Creek and Icicle Creek. Therefore, fishing opportunities for tribal populations in those areas are unlikely to be affected under Alternative 2.

Alternative 2 would not change the quantity of water provided to the City of Leavenworth or the IPID. The agriculture industry is unlikely to face any changes in water availability under this alternative. Therefore, members of low-income communities or communities of color working in the agricultural sector are unlikely to be affected. The LNFH is similarly unlikely to experience reduced water delivery that would affect operations, and Alternative 2 is thus unlikely to affect tribal populations employed by the hatchery.

No significant adverse impacts on low-income, communities of color, overburdened, or tribal populations are anticipated under Alternative 2.

16.5.4 Alternative 3: Narrow Spillway without Gates

Operational impacts on low-income, communities of color, overburdened, or tribal populations under Alternative 3 differ slightly from the impacts of Alternatives 1 and 2. As described in Chapter 6 (*Water Rights*), under Alternative 3, IPID expects to be able to meet their minimum need and be able to supplement instream flows, and it is less likely that junior water rights would experience curtailment of water delivery than under the No Action Alternative. The reduced storage volume compared to Alternatives 1 and 2, however, may provide lower levels of flexibility for water storage and release to bolster downstream flows. Fewer benefits are expected for fish habitats and downstream water quality under Alternative 3, which may result in fewer benefits to tribal populations reliant on fishery resources from Icicle Creek. Although Alternative 3 may result in fewer benefits than Alternatives 1 and 2, **no significant adverse impacts** on low-income communities, communities of color, overburdened, or tribal populations are expected.

16.6 Avoidance, Minimization, and Mitigation Measures

This environmental justice analysis does not identify significant adverse impacts on communities of color, or low-income, overburdened, or tribal populations, except in the following cases:

- The No Action Alternative (under dam failure) would result in **significant adverse impacts** on the Yakama Nation and Confederated Tribes of the Colville Reservation members who exercise fishing rights in Icicle Creek.
- The No Action Alternative (under dam failure) may also **have significant adverse effects** on low-income communities and communities of color employed by the agriculture industry, and tribal populations employed by the LNFH.

Opportunities for avoidance, minimization, and mitigation of impacts on low-income communities, communities of color, or overburdened and tribal populations derive directly from offsetting the impacts on those resources that drive potential impacts on these communities. Potential impacts on these communities are primarily related to impacts from the following resources:

- Water rights.
- Terrestrial and aquatic species and habitats.

As such, all mitigation opportunities identified within those resource-specific chapters would serve to offset the potential impacts on these communities.

16.7 Significant Unavoidable Adverse Impacts

The potential for significant unavoidable adverse impacts on low-income communities, communities of color, and overburdened and tribal populations results from unavoidable adverse impacts on the resources from which impacts on those communities derive. For those resources, dam failure under the No Action Alternative would result in unavoidable adverse impacts, including curtailment of diversionary water rights, increase in days where instream flows are not met, and loss of aquatic resources and habitats. These unavoidable adverse impacts would result in corresponding unavoidable adverse impacts on tribal populations that exercise fishing rights in Icicle Creek. To the extent that the agriculture industry is adversely affected by impairment of IPID’s water rights during years of severe drought, there may also be unavoidable adverse impacts on low-income communities and communities of color that are employed by that industry.

CHAPTER 17: CUMULATIVE IMPACTS

This chapter evaluates and summarizes the potential cumulative impacts of the project alternatives. Cumulative impacts are impacts that could result from the incremental consequences of an action (in this case, the project alternatives) when added to other reasonably foreseeable future actions. When impacts of an action are viewed individually, they may appear minor, but when considered collectively (cumulatively) with the impacts of other actions (especially over a period of time), the impacts can be more significant. The purpose of the cumulative impacts analysis is to ensure that decision-makers consider the full range of consequences for the proposed project, including the project's incremental contribution to cumulative impacts on the environment. The analysis includes only the elements of the environment for which cumulative impacts could occur from the reasonably foreseeable projects identified: Alpine Lakes Wilderness, Water Rights, Plants and Animals, and Recreation.

What has Changed from the Draft EIS?

- Project completion dates for reasonably foreseeable projects have been updated, and some minor typos have been corrected. No other substantive changes have been made to this chapter of the Final EIS based on comments received on the Draft EIS.
- Responses to specific comments on cumulative impacts are included in Volume 2, Appendix F, *Responses to Comments on the Draft EIS.*

17.1 Regulatory Context

SEPA directs lead agencies to consider the direct, indirect, and cumulative impacts of proposed actions.

17.1.1 Methods

This analysis provides a broad assessment of potential cumulative impacts related to implementing the project. Past, present, and reasonably foreseeable future actions near the project site were identified and reviewed. The cumulative impact analysis used the following approach:

- Identification of geographic boundaries (i.e., the study area). The preceding chapters of this EIS describe the potential impacts of the project on elements of the environment. As described in those chapters, the study areas are the areas where the project has the potential to affect elements of the environment. In general, the study areas include the project site and surrounding areas. The cumulative impact assessment uses the same study area for each element of the environment, as the study areas represent the area where the project, in combination with other past, present, or reasonably foreseeable future actions, could result in cumulative impacts.
- Identification of reasonably foreseeable future projects and actions within the geographic and time-based boundaries. These projects were identified by reviewing existing adopted plans and funded programs for land managers in the area, including the Forest Service, IPID, and the Icicle Work Group.
- Analysis of the potentially additive or cumulative impacts of these reasonably foreseeable future projects and actions together with the direct and indirect impacts of the project.

17.1.2 Reasonably Foreseeable Future Projects

Reasonably foreseeable projects in the vicinity of the project that are known or are projected to occur during approximately the same time frame as the proposed project and are anticipated to result in a change in baseline conditions were considered in this cumulative impact analysis and are summarized below. If any of these projects were constructed at the same time as the Eightmile Dam construction, there is a potential for a cumulative impact related to construction traffic, noise, and dust in the construction vicinity, but the impact would only be during construction and temporary for the duration of the construction activity.

None of the activities described below are functionally related or interconnected to this project (i.e., one could proceed without the other). Each of the projects would be required to conduct separate, project-specific environmental review, as appropriate. Construction of the Eightmile Dam Rebuild and Restoration Project would include coordination with other projects to reduce the potential cumulative construction impacts to the extent possible. IPID, the Forest Service, and Chelan County will continue discussions and provide updates on their respective projects and timeframes. Mitigation measures for each project would also decrease the potential for cumulative impacts.

There are no cumulative construction-related impacts associated with the No Action Alternative for any element of the environment. Potential cumulative impacts would be the same for Alternatives 1, 2, and 3, as described below. Only those environmental elements with potential cumulative impacts are described.

Table 17-1. Reasonably Foreseeable Projects

Project / Sponsor	Description
Icicle Creek Rockfall Mitigation Project Forest Service, FHWA	The Forest Service and the Federal Highway Administration (FHWA) are partnering on a project to mitigate hazardous rockfalls along FSR 7600. Road closures will likely occur beginning in fall 2025 for an estimated 10-week period. During this time, scaling of the steep slopes adjacent to FSR 7600 will occur to reduce the potential for future rockfalls. A segment of FSR 7600 is expected to be fully closed during the 10-week construction period from 8:00 am to 5:00 pm on weekdays, with a 1-hour opening between 12:00 pm and 1:00 pm, potentially limiting access for workers and some supplies. The road will be open on weekends. Excavated material from the slopes will transported to the Forest Service fly yard for placement.
Alpine Lake Automation, Modernization, and Optimization Project Icicle Work Group, IPID, USFWS, Ecology	Currently, water releases from the Alpine Lakes are manually controlled by IPID and USFWS staff hiking into the lakes to periodically manage release from existing infrastructure. In drought years, water is released from all of the lakes to meet IPID and LNFH demand. In non-drought years, partial release occurs, which results in water remaining in the lakes (subject to additional drawdown periods for maintenance). Automation at Colchuck, Klonaqua, Square, Snow, and Eightmile Lake dams would allow for additional release from the lakes in non-drought years in a manner that maximizes efficiency in an optimized manner. Releases could be fine-tuned in a manner that meets irrigation and LNFH needs, while also providing instream flow benefits. Automation efforts are still in the planning stages so construction efforts at each dam are not likely to overlap, but longer term flow benefits would be likely.
Leavenworth National Fish Hatchery Surface Water Intake Fish Screens and Fish Passage Projects	The projects propose to rehabilitate, replace, and modernize the LNFH intake and delivery system on Icicle Creek by constructing new intake headworks, installing compliant fish screens, building a roughened channel and fishway that conforms to fish passage guidelines, and replacing/lining the surface water conveyance pipeline to the hatchery. Upgrades to the LNFH have been underway since 2021, with Phase I (intake, fish screens and roughened

Project / Sponsor	Description
LNFH, U.S. Bureau of Reclamation, Icicle Work Group	channel) completed in 2023, and Phase II (pipeline rehabilitation to the hatchery) planned for 2026. The projects will help decrease fish mortality in Icicle Creek and ensure safe, efficient, and reliable delivery of LNFH's full surface water rights from Icicle Creek.
Cascade Orchards Irrigation Company (COIC) Irrigation Efficiencies and Pump Exchange Project COIC, Icicle Work Group	This project consists of replacing the existing COIC system with a pressurized delivery system, relocating the point of diversion to a location near the confluence of the Wenatchee River and Icicle Creek, and intake facilities at that location. Implementation would result in increased instream flows in Icicle Creek.
Enchantment Toilet Maintenance Forest Service	Motorized transport, including helicopter, is prohibited in the Wilderness with limited exceptions. The Forest Service has approved the use of helicopters for servicing six vault toilets in the Alpine Lakes Wilderness, which results in approximately 13 trips annually.
Smart Water Meters City of Leavenworth, Icicle Work Group	The City of Leavenworth has installed smart water meters so each account holder can access and analyze water usage against weather data to promote water conservation.
Lower Icicle Riparian Improvement and Sediment Reduction Project Icicle Work Group	Several riparian improvement and sediment reduction projects are being designed. Upcoming projects may include riparian planting, side channel restoration, engineered log jams.
Tribal Fishery Adaptive Management Icicle Work Group	Projects to develop and implement actions that protect and improve the Yakama Nation and Confederated Tribes of the Colville Reservation tribal fishery on Icicle Creek (adding power to restrooms, installing fish cleaning station, exploring additional fishing locations, evaluating stream channel conditions); includes evaluating sediment dynamics in plunge pool.
IPID Water Conservation Measures IPID	District-funded piping and canal lining work to improve water conservation. This work is ongoing, and construction typically occurs in the canal during non-irrigation time, when water is not flowing.

17.2 Cumulative Impact Evaluation

This cumulative impact analysis is prepared in accordance with SEPA (RCW 43-21C), the SEPA Rules (WAC 197-11-060 and 197-11-792), and the SEPA Handbook (Ecology 2018b). The analysis focuses on the projects that may intersect in place and time with the Eightmile Dam project. Only the elements of the environment that would potentially experience cumulative impacts are described below.

17.2.1 Alpine Lakes Wilderness

Eightmile dam construction is also likely to overlap with toilet maintenance in the Enchantments, contributing to additional helicopter noise. Because the number of flights associated with the toilet maintenance is low and the timeframe for dam construction disturbance is short (limited to one to two seasons). As a result, **no significant cumulative impacts** on the Alpine Lakes Wilderness are expected to occur from the additional helicopter noise.

17.2.2 Water Resources

As described in Chapter 1, the Eightmile Dam Rebuild and Restoration Project is one of several early actions to be implemented as part of the Icicle Creek Water Resource Management Strategy (Icicle

Strategy). The Guiding Principles of the Icicle Strategy are intended to provide a comprehensive program of integrated long-term water resource management and habitat restoration actions to achieve reliable water supplies and improve instream flows in the Icicle Creek Subbasin (see Chapter 1 for additional detail). The Icicle Strategy uses best available science to identify and support water management solutions that lead to implementation of high-priority water resource projects within the Icicle Creek Subbasin. The Icicle Strategy is a comprehensive water resource management plan designed to balance and meet out-of-stream and instream water demand and resolve habitat and fisheries issues in the Icicle Creek Subbasin. Implementation of the Eightmile Dam Rebuild and Restoration Project will result in cumulative benefits to the water resources and instream flow volumes in Icicle Creek in conjunction with the implementation of the Alpine Lake Automation, Modernization, and Optimization Project, the Leavenworth National Fish Hatchery Surface Water Intake Fish Screens and Fish Passage Projects, the COIC Irrigation Efficiencies and Pump Exchange Project, the Smart Meter Project in Leavenworth, and the IPID Water Conservation Measures.

The No Action Alternative could result in long-term cumulative impacts on water resource management in the area, by reducing the options available for long-term instream water management. Should Eightmile Dam have a catastrophic failure, these impacts would be intensified.

17.2.3 Plants and Animals

As described for the Alpine Lakes Wilderness, the Rockfall Mitigation project would potentially occur during the same construction time frame as the Eightmile Dam project. Additional construction noise has the potential to further impact wildlife in the vicinity as a result of the additional construction and disruption, and may result in some wildlife mortality due to increased construction traffic. Implementation of the Eightmile Dam Rebuild and Restoration Project will result in cumulative benefits to the water resources in Icicle Creek in conjunction with the implementation of the Alpine Lake Automation, Modernization, and Optimization Project, and the Leavenworth National Fish Hatchery Surface Water Intake Fish Screens and Fish Passage Projects and the COIC Irrigation Efficiencies and Pump Exchange Project, the Lower Icicle Riparian Improvement and Sediment Reduction project. The combination of these projects will result in cumulative benefits to instream flow volumes and fish habitat in Icicle Creek and downstream.

17.2.4 Recreation

The Icicle Creek Rockfall Mitigation Project could be ongoing during the construction period for the dam. During this time, public access to and from the Eightmile Lake Trailhead and project area would be limited due to road closures and construction activities. FSR 7600 is proposed to be closed from 8:00 am to 5:00 pm Monday through Friday, with a 1-hour opening from noon to 1:00 pm each day. The road would be open on weekends from 5:00 pm on Friday until 8:00 am on Monday to allow access for recreationists. These closures are proposed to take place for approximately 10 weeks during summer/fall 2025. Access to trailheads above the road closure will be limited, and the timing of the daily closures may result in temporary delays for recreationists to and from the area. The road closure, coupled with the construction and helicopter flights to and from Eightmile Dam, could further diminish recreational enjoyment during construction due to added noise and difficulties with access. Eightmile dam construction is also likely to overlap with toilet maintenance in the Enchantments, contributing to additional helicopter noise.

While some wilderness users may feel their experience is curtailed or is greatly diminished, the timeframe for disturbance is short (limited to one to two seasons for dam construction). As a result, **no significant cumulative impacts** on recreation are expected to occur from the concurrent construction activities and additional helicopter noise. Refer to Chapter 10, *Recreational Resources*, for further discussion.

17.2.5 Tribal Resources

As previously noted, the Guiding Principles of the Icicle Strategy are intended to provide a comprehensive program of integrated long-term water resource management and habitat restoration actions to achieve reliable water supplies and improve instream flows in the Icicle Creek Subbasin (see Chapter 1 for additional detail). Projects conducted as part of the Tribal Fishery Adaptive Management are intended to develop and implement actions that protect and improve the tribal fishery on Icicle Creek. Implementation of the Eightmile Dam project will improve instream flows, which will benefit tribal fisheries in Icicle Creek.

CHAPTER 18: REFERENCES

American Whitewater. 2021a. River List. URL: https://www.americanwhitewater.org/content/River/search.

American Whitewater. 2021b. Safety Code of American Whitewater.

Ames, Kenneth M., and Alan G. Marshall. 1980. Villages, Demography and Subsistence Intensification on the Southern Columbia Plateau. North American Archaeologist 2(1):25–52. Farmingdale, New York.

Ames, Kenneth M., and Herbert G. Maschner. 1999. Peoples of the Northwest Coast: Their Archaeology and Prehistory. Thames & Hudson, New York.

Ames, Kenneth M., Don E. Dumond, Jerry R. Galm, and Rick Minor. 1998. Prehistory of the Southern Plateau. In Plateau, edited by Deward E. Walker, Jr., pp. 103–119. Handbook of North American Indians, Vol. 12, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Anastasio, A. 1972. The Southern Plateau An Ecological Analysis of Intergroup Relations*. Northwest Anthropological Research Notes*. University of Idaho.

Anchor QEA. 2018a. *Eightmile Lake Storage Restoration Feasibility Study*. Prepared for Icicle and Peshastin Irrigation Districts and Chelan County Natural Resources Department. April 2018.

Anchor QEA. 2018b. Icicle and Peshastin Irrigation Districts Comprehensive Water Conservation Plan. Prepared for the Icicle and Peshastin Irrigation Districts under the direction of Trout Unlimited.

Anchor QEA. 2018c. Icicle Creek Water Resources Management Strategy Cultural Resources Discipline Report. Prepared for Chelan County Natural Resources Department and Washington State Department of Ecology, Wenatchee by Anchor QEA, Wenatchee. On file, Environmental Science Associates, Seattle.

Anchor QEA. 2019. Hydrologic and Hydraulic Analyses Report – Eightmile Lake Storage Restoration Project. Prepared for Icicle and Peshastin Irrigation Districts. July 2019.

Anchor QEA and Aspect Consulting, LCC. 2015. Appraisal Study: Eightmile Lake Storage Restoration. Prepared for Chelan County Natural Resources Department, March 2015.

Anchor QEA and IPID (Icicle- Peshastin Irrigation District). 2021. Email conversation on February 12, 2021, and February 16, 2021, between Anchor QEA, IPID, Industrial Economics, and ESA discussing IPID's Comprehensive Water Conservation Plan.

Anchor QEA, Aspect Consulting, and Washington Water Trust. 2015. Alternatives Evaluations Study – Public Release Version Cascade Orchards Irrigation Company. URL: https://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/current-project/COIC%20Alternatives%20Analysis%202015.pdf.

Andonaegui, C. 2001. Salmon, Steelhead, and Bull Trout Habitat Limiting Factors For the Wenatchee Subbasin (Water Resource Inventory Area 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum drainages). Prepared for the Washington State Conservation Commission. Olympia, WA.

Arksey, Laura. 2010. Leavenworth – Thumbnail History. HistoryLink.org Essay 9475. URL: https://www.historylink.org/file/9475.

ASPE (Office of the Assistant Secretary for Planning and Evaluation). 2021. Poverty Guidelines. U.S. Department of Health and Human Services. URL: https://aspe.hhs.gov/system/files/aspe-files/107166/2020-percentage-poverty-tool.pdf, accessed February 23, 2021.

Aspect (Aspect Consulting, LCC). 2013. Wenatchee Reserve Accounting, Memorandum to Chelan County Natural Resources Department.

Aspect (Aspect Consulting, LCC). 2019. *Draft Geotechnical Report – Eightmile Lake Storage Restoration Project*. Prepared for Anchor QEA and Icicle Peshastin Irrigation Districts. Project no. 180151. July 17, 2019, draft.

Aspect (Aspect Consulting, LCC). 2022a. Eightmile Lake Multi-Fill Analysis. Prepared for Halverson NW Law Group. May 2022.

Aspect (Aspect Consulting, LCC). 2022b. *Eightmile Lake Restoration – Geotechnical Engineering Progress Memorandum*. Project No. 180151. January 10, 2022.

Aspect (Aspect Consulting, LCC). 2023. *Icicle Strategy Instream Flow Rule Amendment Memo*. To: Mike Kaputa, Director, Chelan County Natural Resources Department. From: Dan Haller, PE, CWRE. Project No. 120045-028-04. Aspect Consulting, LLC, Yakima, WA. May 9, 2023.

Aspect Consulting and Anchor QEA LLC. 2015. Appraisal Study - Eightmile Lake Storage Restoration. Report prepared for Chelan County and Icicle-Peshastin Irrigation Districts. URL: https://www.iciclenetwork.com/sites/default/files/2017-11/Appraisal%20-%20Eightmile%20Lake%20Storage%20%28March%202015%29_0.pdf.

Bash, J., C.H. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington, Seattle, WA, November 2001. 72 pp.

Berg, L., D. Lowman, and Yakama Nation Consultants. 2002. Wenatchee Subbasin summary. Draft report prepared for the Northwest Power Planning Council. 115p.

Baugh, J., T. Krauthoefer, J. Query, and B. Reed. 1995. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS1580. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Beavert, V., and S. Hargus. 2009. *Ichíishkin Sínwit Yakama/Yakima Sahaptin* Dictionary. University of Washington Press, Seattle. As cited in YN 2022.

Beavert, V., and S. Hargus. 2009. *Ichíishkin Sínwit Yakama/Yakima Sahaptin* Dictionary. University of Washington Press, Seattle. As cited in YN 2022.

BLS (Bureau of Labor Statistics). 2019. Occupational Employment and Wages in Wenatchee – May 2019. Western Information Office. URL: https://www.bls.gov/regions/west/news-release/occupationalemploymentandwages_wenatchee.htm. Accessed February 23, 2021.

BLS (Bureau of Labor Statistics). 2021. Consumer Price Index. URL: https://www.bls.gov/cpi/tables/supplemental-files/historical-cpi-u-202101.pdf. Accessed February 12, 2021.

Blukis Onat, Astrida R., Maury E. Morgenstein, Philippe D. LeTourneau, Robert P. Stone, Jerre Kosta, and Paula Johnson. 2001. Archaeological Investigations at stuwe'yuq – Site 45KI464, Tolt River, King County, WA. Prepared for Seattle Public Utilities by BOAS, Inc., Seattle. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Boreson, Keo, and Jerry R. Galm. 1997. Archeological Investigations at the Stemilt Creek Village Site (45CH302), Chelan County, Washington. Eastern Washington University Reports in Archaeology and History. Cheney.

Bouchard, Randy, Dorothy Kennedy, and Mark Cox. 1988. Ethnography and Ethnohistory of the National Forest Lands Proposed for Exchange to Plum Creek Timber Company I-90 Land Exchange Project. Prepared for The U.S. Forest Service, Wenatchee and Plum Creek Timber Company, Seattle, by British Columbia Indian language Project Victoria, British Columbia, Canada. On file, Environmental Science Associates, Seattle.

Bruce, Robin, Susan Carter, Stephen Emerson, Mark Garris, Craig Holstine, Charles T. Luttrell, and Chris McCarthy-Ryan. 1994. An Historical Overview of the Wenatchee National Forest, Washington. Craig Holstine, editor. Prepared for the Wenatchee National Forest, Wenatchee by Archaeological and Historical Services, Eastern Washington University, Cheney, Washington. On file, Environmental Science Associates, Seattle.

Bundy, Barbara. 2016. Washington State Archaeological Site Inventory Form: Eightmile Lake Water Release System, Temp ID ICS-1. In Appendix A of Icicle Creek Water Resource Management Strategy Cultural Resources Discipline Report. Prepared for Chelan County Natural Resources Department and Washington State Department of Ecology by Anchor QEA (May 2018). On file, Environmental Science Associates, Seattle, Washington.

Bureau of Economic Analysis. 2019a. Total Full-Time and Part-Time Employment by NAICS Industry, 2009 and 2019. URL: https://apps.bea.gov/iTable/iTable.cfm?reqid=70&step=1&acrdn=5.

Bureau of Economic Analysis. 2019b. Compensation of Employees by NAICS Industry, 2009 and 2019 – CAEMP25N. URL: https://apps.bea.gov/iTable/iTable.cfm? reqid=70&step=1&acrdn=5.

Bureau of Reclamation. 2020. Leavenworth National Fish Hatchery Surface Water Intake Fish Screens and Fish Passage Project Environmental Impact Statement. Page 3. U.S. Department of the Interior. URL: https://www.usbr.gov/pn/programs/leavenworth/swisp/pdf/waterre.pdf. November 2020.

Burke Museum. 2021. Collections & Research; Biology. Accessed: 4 February 2021. URL: https://www.burkemuseum.org/collections-and-research/biology/herpetology.

Capellini, M.M.J. 2001, Movements of bull trout (*Salvelinus confluentus*), spring Chinook (*Oncorhynchus tshawytcscha*), and steelhead (*O. mykiss*) in Icicle Creek, Washington, July 7, 2001.

Carter, Susan. 1978. Archaeological Reconnaissance Wenatchee Group of the Selected Alpine Lakes Wilderness Exchange Lands. Prepared by Mt. Baker-Snoqualmie National Forest. On file, Washington State Department of Archaeology and Historic Preservation, Olympia, Washington.

CEQ (Council on Environmental Quality). 1997. Environmental Justice: Guidance Under the National Environmental Policy Act. Accessed at: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf, February 23, 2021.

Chapman, D., C. Peven, T. Hillman, A., Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants Inc., Boise, Idaho.

Chatters, James C., and David L. Pokotylo. 1998. Prehistory: Introduction. In Plateau, edited by Deward E. Walker, Jr., pp. 73–80. Handbook of North American Indians, Vol. 12, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Chelan County. 2016. Icicle Strategy: Tribal Fisheries Preservation and Enhancement Project. URL: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/TribalFisheries_final_reduced.pdf.

Chelan County. 2017. *Chelan County Comprehensive Plan 2017-2037.* Accessed February 11, 2021. URL: https://www.co.chelan.wa.us/community-development/pages/comprehensive-plan-2017-2037.

Chelan County. 2019. *Chelan County Shoreline Master Program.* Accessed February 11, 2021. URL: https://www.co.chelan.wa.us/community-development/pages/shoreline-master-program.

Chelan County. 2020. Chelan County Comprehensive Emergency Management Plan. June 2020. URL: https://www.co.chelan.wa.us/files/emergency-management/Documents/Chelan%20County%20Comprehensive%20Emergency%20Management%20Plan%202023.pdf.

Chelan County. 2021a. Chelan County Noxious Weed List. Accessed: September 27, 2021 from URL: https://www.co.chelan.wa.us/files/noxious-weed/documents/2021%20Chelan%20County%20Weed%20List.pdf.

Chelan County. 2021b. Chelan County Parcel Search. URL: https://maps.co.chelan.wa.us/GIS/.

Chelan County. 2022. Chelan Citizen Notification System. URL: https://public.alertsense.com/signup/?regionid=1184.

Chelan County Assessor. 2022. 30008 Icicle Island Club for Year 2022 – 2023. URL: https://pacs.co.chelan.wa.us/PropertyAccess/Property.aspx?cid=91&year=2022&prop_id=30008.

Chelan County Natural Resources. 2020. Chelan County Climate Resilience Strategy. https://www.co.chelan.wa.us/files/natural-resources/documents/FINAL%20Chelan%20Climate%20Resiliency%20Strategy%202020(1).pdf.

Christensen, B. S. Steinmetz, J. Baugh, and T. Krauthoefer. 1995. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS1572. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

CIG (Climate Impacts Group). 2009. The Washington Climate Change Impacts Assessment. Climate Impacts Group, University of Washington, Seattle. URL: https://cig.uw.edu/wp-content/uploads/sites/2/2020/12/wacciareport681-3.pdf.

City of Leavenworth v. Department of Ecology. 2011. Chelan County Superior Court Case No. 09-2-00748-3.

City of Leavenworth. 2017a. Leavenworth Housing Needs Assessment. March.

City of Leavenworth. 2017b. City of Leavenworth Comprehensive Plan. June.

City of Leavenworth. 2018. City of Leavenworth Water System Plan. February.

City of Leavenworth. 2020. Leavenworth Housing Needs Assessment. February.

City of Leavenworth. 2021. Telephone conversation on February 26, 2021, between Industrial Economics, the City of Leavenworth City Administrator discussing water use and needs in Leavenworth.

City of Leavenworth and Ecology (Washington State Department of Ecology). 2023. Settlement Agreement. Signed by Carl Florea, Andrea Fischer, G. Thomas Tebb, and Alan Reichman. November 2023.

Clark, William. 1805. Journals of the Lewis and Clark Expedition. URL: https://lewisandclarkjournals.unl.edu/item/lc.jrn.1805-10-18#ln23101805.

Corps (U.S. Army Corps of Engineers), Reclamation (Bureau of Reclamation), and Bonneville (Bonneville Power Administration). 1995. Columbia River System Operation Review/Final Environmental Impact Statement. Portland, OR.

Cram, J. 2024. pers. comm. Email from Jeremy Cram, WDFW Salmon Recovery Policy Lead, to Nathan White, WDFW. Summarized in email from Nathan White dated June 10, 2024.

CREW (Cascadia Region Earthquake Workgroup). 2013. *Cascadia Subduction Zone Earthquakes: A Magnitude 9.0 Earthquake Scenario, Update*. URL: http://crew.org/sites/default/files/cascadia_subduction_scenario_2013.pdf.

CTCR (Confederated Tribes of the Colville Reservation). 2021a. A Brief History. URL: https://colvilletribes.maps.arcgis.com/apps/MapJournal/index.html?appid=ac4721130e424df786eb06dbbb4a5880.

CTCR (Confederated Tribes of the Colville Reservation). 2021b. Facts. URL: https://www.cct-hsy.com/facts.

CTCR (Confederated Tribes of the Colville Reservation). 2022. Eightmile Dam Traditional Plants, including Top TC Plants. Information provided by Guy Moura, Manager/Tribal Historic Preservation Officer, History/Archaeology Program, Confederated Tribes of the Colville Reservation. Email dated August 22, 2022.

CTCR (Confederated Tribes of the Colville Reservation). 2023a. Department of Fish and Wildlife. Fish History. URL: https://www.cct-fnw.com/ct-fish-history.

CTCR (Confederated Tribes of the Colville Reservation). 2023b. Proclamation. URL: https://www.cct-cbc.com/proclamation.

DAHP (Department of Archaeology and Historic Preservation). 2020, 2022. Washington Information System for Architectural and Archaeological Records Data (WISAARD). Secure database. URL: http://www.dahp.wa.gov/.

Dethier, D.P., P. Heller, and S. Safioles. 1979. Reconnaissance Data on Lakes in the Alpine Lakes Wilderness Area, Washington. U.S. Geological Survey Open-File Report 79-1465. Prepared in cooperation with the U.S. Forest Service and the Washington Department of Fish and Game.

Dion N.P., G.C. Bortleson, J.B. McConnell, and L.M. Nelson. 1976. Reconnaissance on Lakes in Washington. Volume 5. Chelan, Ferry, Kittitas, Klickitat, Okanagan, and Yakima Counties. Prepared in cooperation with United States Geological Survey.

DOH (Washington State Department of Health). 2021. "Washington Environmental Health Disparities Map." Accessed at: https://fortress.wa.gov/doh/wtn/WTNIBL/, March 3, 2021

Dominguez, L., P. Powers, E.S. Toth, and S. Blanton. 2013. Icicle Creek Boulder Field Fish Passage Assessment. Prepared for Trout Unlimited-Washington Water Project. Wenatchee, WA.

Dorpat, Paul, and Genevieve McCoy. 1998. Building Washington: A History of Washington State Public Works. Tartu Publications, Seattle.

Downes, M. Personal Communication. 2022. Personal communication by email with Melissa Downes, Office of Columbia River, Washington State Department of Ecology with Lisa Adolfson, Regional Business Group Director Water Group, Environmental Science Associates, on September 30, 2022.

Drzymkowski, R.E., and C.H. Swift. 1992. Water Quantity and Quality Data, September-October 1991, for Source Water to the Leavenworth National Fish Hatchery, Washington. US Geological Survey Open-file Report 92-93.

Duncan, Bonita, and Ann Fink. 1997. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS01571. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Eastern Washington University. 2021. Institute for Public Policy and Economic Analysis. "Chelan-Douglas Trends – Culture & Leisure." URL: http://chelandouglastrends.com/graph.cfm?cat_id=1&sub_cat_id=2&ind_id=1. Accessed November 20, 2021.

Ecology (Washington State Department of Ecology (Ecology). 1999c. Water Resources Program Policy 5701, Emergency Response Procedures by Dam Safety Office. URL: https://appswr.ecology.wa.gov/docs/WaterRights/wrwebpdf/pol5701.pdf.

Ecology (Washington State Department of Ecology), 1993. *Dam Safety Guidelines Part IV: Dam Design and Construction*. Publication No. 92-55D. July 1993.

Ecology (Washington State Department of Ecology). 1992. Dam Safety Guidelines Part 2 – Project Planning and Approval of Dam Construction and Modification. Publication number 92-55b. Dam Safety Office. July 1992 (Revised 2008).

Ecology (Washington State Department of Ecology). 1995a. *Reconnaissance Inspection of Eightmile Lake Dam*, Dam Safety Section, December 7, 1995.

Ecology (Washington State Department of Ecology). 1995b. *Eightmile [Field Notes]*, Dam Safety Section, September 25, 1995.

Ecology (Washington State Department of Ecology). 1999a. Water Resources Program Policy 5102, Applicability of Dam Safety Policies and Procedures. Dam Safety Office. URL: https://appswr.ecology.wa.gov/docs/WaterRights/wrwebpdf/pol5102.pdf.

Ecology (Washington State Department of Ecology). 1999b. Water Resources Program Policy 5406, Older Dams Which Were Constructed Many Years Ago Without DSO Approval of Plans and Specifications. Dam Safety Office. URL: https://appswr.ecology.wa.gov/docs/WaterRights/wrwebpdf/pol5406.pdf.

Ecology (Washington State Department of Ecology). 2007a. *Groundwater Data Summary for the Wenatchee River Watershed Total Maximum Daily Load Study*. URL: https://apps.ecology.wa.gov/publications/documents/0503018.pdf.

Ecology (Washington State Department of Ecology). 2007b. Wenatchee River Watershed Temperature Total Maximum Daily Load. Water Quality Improvement Report. July 2007. Publication No. 07-10-045.

Ecology (Washington State Department of Ecology). 2009. Wenatchee River Watershed Dissolved Oxygen and pH Total Maximum Daily Load. Water Quality Improvement Report. Revised August 2009. Publication No. 08-10-062.

Ecology (Washington State Department of Ecology). 2012. Municipal Water Law Interpretive and Policy Statement. Policy 2030. URL: https://appswr.ecology.wa.gov/docs/WaterRights/wrwebpdf/pol2030.pdf.

Ecology (Washington State Department of Ecology). 2018a. EPA-approved 2018 Water Quality Assessment. Approved by EPA on August 26, 2022. Accessed at https://ecology.wa.gov/Water-Shorelines/Water-quality/Water-improvement/Assessment-of-state-waters-303d.

Ecology (Washington State Department of Ecology). 2018b. State Environmental Policy Act (SEPA) Handbook. 2018 Updates. URL: https://ecology.wa.gov/DOE/files/4c/4c9fec2b-5e6f-44b5-bf13-b253e72a4ea1.pdf.

Ecology (Washington State Department of Ecology). 2019a. Icicle Strategy - Icicle Creek Water Resource Management Strategy, Final Programmatic Environmental Impact Statement. Publication # 18-12-016. January 2019. URL: https://www.co.chelan.wa.us/natural-resources/pages/environmental-review.

Ecology (Washington State Department of Ecology). 2019b. *Plan Review of Eightmile Lake Dam*, Office of Dam Safety letter, October 7, 2019.

Ecology (Washington State Department of Ecology). 2020. State Environmental Policy Act Draft Environmental Impact Statement - Proposed Chehalis River Basin Flood Damage Reduction Project. Publication No.: 20-06-002. Shorelines and Environmental Assistance Program. February 2020.

Ecology (Washington State Department of Ecology). 2021a. Water Rights Search. Accessed April 8, 2021 and June 30, 2022, from URL: https://secureaccess.wa.gov/ecy/waterrighttrackingsystem/WaterRights/WaterRightSearch.aspx.

Ecology (Washington State Department of Ecology). 2021b. Map Search of Washington State Well Report Viewer. Accessed April 8, 2021, from URL: https://appswr.ecology.wa.gov/wellconstruction/map/WCLSWebMap/WellConstructionMapSearch.aspx.

Ecology (Washington State Department of Ecology). 2021c. Geographic Water Information System (GWIS). Accessed January 20, 2021, from URL: https://fortress.wa.gov/ecy/gispublic/DataDownload/wr/GWIS_Data/.

Ecology (Washington State Department of Ecology). 2021d. Scoping Summary Report, Ecology Publication No. 21-12-008, URL: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-supply-projects-EW/Icicle-Creek-strategy/Eightmile-Dam.

Ecology (Washington State Department of Ecology). 2021e. Ecology Flow Monitoring Data Network Online Data for Station ID# 45W003 - Eightmile Creek Below Dam. URL: https://fortress.wa.gov/ecy/eap/flows/station.asp?sta=45W003#block2. Accessed January 2020.

Ecology (Washington State Department of Ecology). 2021f. Map Search of Washington State Well Report Viewer. Retrieved April 8, 2021, from https://appswr.ecology.wa.gov/wellconstruction/map/WCLSWebMap/WellConstructionMapSearch.aspx.

Ecology (Washington State Department of Ecology). 2022a. River & Stream Monitoring Program. Data from URL: https://apps.ecology.wa.gov/continuousflowandwq/.

Ecology (Washington State Department of Ecology). 2022b. Environmental Information Management Database. Data from URL: https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database.

Ecology (Washington State Department of Ecology). 2022c. Water Quality Atlas. URL: https://apps.ecology.wa.gov/waterqualityatlas/wqa/map.

Ecology (Washington State Department of Ecology). 2022d. Chapter 173-201A WAC (Natural Conditions), from Ecology's website. URL: https://ecology.wa.gov/Regulations-Permits/Laws-rules-rulemaking/Rulemaking/WAC-173-201A-Natural-Conditions.

Ecology (Washington State Department of Ecology). 2022e. Proposed Goldendale Energy Storage Project State Environmental Policy Act Draft Environmental Impact Statement. Ecology Publication No. 22-06-006. June 2022.

Ecology (Washington State Department of Ecology). 2022f. Station 45W003 Stream Flow Data. Retrieved July 6, 2022, from https://apps.ecology.wa.gov/continuousflowandwq/StationDetails?sta=45W003.

Ecology (Washington State Department of Ecology) and Chelan County. 2019. Final Programmatic Environmental Impact Statement (FPEIS) for the Icicle Creek Water Resource Management Strategy (Icicle Strategy). February 2019.

EcoNorthwest. 2017. Economic Contributions of Washington H-2A Workers. Prepared for WAFLA. URL: https://www.wafla.org/resources/Documents/Press%20Releases/2017/Econ.%20Contrib.%20of%20WA%20H-2A%20Workers%205-2017.pdf.

English, D.B.K., E.M. White, J.M. Bowker, and S.A. Winter. 2020. A Review of the Forest Service's National Visitor Use Monitoring (NVUM) Program. *Agricultural and Resource Economics Review:* 49 (1), 64–90.

Environmental Justice Task Force. 2020. Report to the Washington State Governor and Legislature: Recommendations for Prioritizing EJ in Washington State Government. Fall. Accessed at https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/EJTF%20Report_FINAL(1).pdf, February 23, 2021.

EPA (U.S. Environmental Protection Agency). 2021. "Environmental Justice." Accessed at https://www.epa.gov/environmentaljustice. March 1, 2021.

EPA (U.S. Environmental Protection Agency). 2022. Washington NPDES Permit. URL: https://www.epa.gov/npdes-permits/washington-npdes-permits.

ESA (Environmental Science Associates). 2021. Vegetation Survey for the Eightmile Dam Staging Area and FS Road 7601-116. Technical Memorandum. November 24, 2021.

ESRI. 2020. Light Gray Canvas Map. URL: https://services.arcgisonline.com/ArcGIS/rest/services/Canvas/World_Light_Gray_Base/MapServer. Accessed July 2022.

Executive Order 12898. Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. February 11, 1994.

FAA (Federal Aviation Administration). 2012. Enplanements at All Commercial Service Airports (by Rank). URL: https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/previous_years/.

FAA (Federal Aviation Administration). 2017. Enplanements at All Commercial Service Airports (by Rank). URL: https://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/previous_years/.

FEMA (Federal Emergency Management Agency). 2015. Federal Guidelines for Dam Safety Risk Management. FEMA P-1025. January 2015. URL: https://www.fema.gov/sites/default/files/2020-08/fema_dam-safety_risk-management_P-1025.pdf.

Fenger, M., T. Manning, J. Cooper, S. Guy, and P. Bradford. 2006. Wildlife & Trees in British Columbia. Lone Pine Publishing. Vancouver, British Columbia. August 15, 2006. 336 pg.

FHWA (Federal Highway Administration). 2008. Roadway Construction Noise Model (RCNM) version 1.1. December 8, 2008.

Find A Grave. 2020. Mountain View Cemetery, Leavenworth, WA. URL: https://www.findagrave.com/cemetery/76956/mountain-view-cemetery. Accessed 14 December 2020.

Fink, Ann. 1996a. Cultural Resources Survey Report for the Eightmile Recovery Project, Report# R1996061707001. On file, Okanogan Wenatchee National Forest, Wenatchee.

Fink, Ann. 1996b. U.S. Forest Service Cultural Resources Site Update: 45WF388. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Franklin, J.F., and C.T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington*. Gen. Tech. Rep. PNW-8. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station.

FTA (Federal Transit Administration). 2018. Transit Noise and Vibration Impact Assessment. September 2018.

Furr, Kathryn. 2021. Conversation with Brigitte Ranne, Botanist. Email message to Lisa Adolfson and Jeff Barna, ESA. August 31, 2021.

Gallardo, R.K. 2020. COVID-19 and the Washington Apple Industry. Washington State University, IMPACT Center. URL: http://ses.wsu.edu/wp-content/uploads/2020/04/IMPACT_Tree-Fruit-Covid.pdf.

Galm, Jerry R., and Ruth A. Masten (editors). 1985. Avey's Orchard: Archaeological Investigations of a late Prehistoric Columbia River Community. Eastern Washington University, Archaeological and Historical Services Reports in Archaeology and History 100-142. Cheney.

Galm, Jerry R., Glenn D. Hartmann, Ruth A. Masten, and Garry O. Stephenson. 1981. A Cultural Resource Overview of Bonneville Power Administration's Mid-Columbia Project. Central Washington. Archaeological and Historical Services, Eastern Washington University. Reports in Archaeology and History 100-116. Cheney.

Gibbs, George. 1854. Report of Mr. George Gibbs to Captain McClellan on the Indian Tribes of the Territory of Washington. In Reports of Explorations and Surveys, To Ascertain the Most Practical and Economical Route for a Railroad from the Mississippi river to the Pacific Ocean 1853-4, Volume 1. Washington 1855, pp. 402–436. Beverly Tucker, Printer, Washington.

Gibbs, George. 1877. Tribes of Western Washington and Northwestern Oregon. In Contributions to North American Ethnology, Vol. 1, Part II, pp. 8-42 and 157-241. Department of the Interior, U.S. Geographical and Geological Survey of the Rocky Mountain Region, J.W. Powell, Geologist in Charge. Government Printing Office, Washington, D.C.

GOIA (Governor's Office of Indian Affairs). 1989. Centennial Accord Between the Federally Recognized Indian Tribes in Washington State and the State of Washington. URL: https://goia.wa.gov/relations/centennial-accord. Accessed October 2021.

GOIA (Governor's Office of Indian Affairs). 1999. Centennial Accord Between the Federally Recognized Indian Tribes in Washington State and the State of Washington. Government-to-Government Implementation Guidelines. URL: https://goia.wa.gov/relations/millennium-agreement/implementation-guidelines.

Griffith, J. S. 1988. Review of competition between cutthroat trout and other salmonids. American Fisheries Society Symposium 4. 4:134-140.

Harrison, Robin T., Roger N. Clark, and George H. Stankey. 1980. Predicting Impact of Noise on Recreationists. US Forest Service, Equipment Development Center, San Dimas, CA. April 1980. Accessed from URL: https://www.fs.fed.us/eng/pubs/pdfimage/80231202.pdf.

Hermilt, John, and Louise Judge. 1910. Letter to the Honorable Commissioner of Indian Affairs, Department of the Interior dated July 3, 1910. In Wenatchee Indians Ask Justice, in *The Washington Historical Quarterly* Vol XVI pp. 20–28, 1925, Edmond S. Meany, managing editor, The Washington University State Historical Society, University Stations, Seattle, WA.

Hildenbrand, J.F. 2019. *Leavenworth National Fish Hatchery, Leavenworth, Washington, Phosphorus Study*. Prepared by Robinson Noble, Inc. for the U.S. Fish and Wildlife Service.

Hillman, T., and coauthors. 2014. Monitoring and Evaluation of the Chelan and Grant County PUDs Hatchery Programs: 2013 Annual Report. June 1, 2014. Report to the HCP and PRCC Hatchery Committees, Wenatchee, Washington. 625p.

Hillman, T., M. Miller, M. Johnson, M. Hughes, C. Moran, J. Williams, M. Tonseth, C. Willard, S. Hopkins, B. Ishida, C. Kamphaus, T. Pearsons, and P. Graf. 2018. Monitoring and evaluation of the Chelan and Grant County PUDs hatchery programs: 2017 annual report. Report to the HCP and PRCC Hatchery Committees, Wenatchee and Ephrata, WA.

Hobbs, W., and M. Friese. 2016. Wenatchee River PCB and DDT Source Assessment. Washington State Dept. of Ecology. Olympia, WA. Publication No. 16-03-029. URL: https://fortress.wa.gov/ecy/publications/summarypages/1603029.html.

Hodge, F. 1910. Handbook of American Indians North of Mexico, Part 2. Smithsonian Institute Bureau of American Ethnology. Government Printing Office, Washington, D.C.

Horsch, E., C. Leggett, C. Smith, and R. Unsworth. 2017. Estimating the Economic Benefits of Recreational Visitation to Federally-Managed Lands. Final Report. September. Prepared for the U.S. Department of the Interior Office of Policy Analysis.

IEc (Industrial Economics, Incorporated). 2022. Discipline Report: Agriculture, Development and Other Economic Activities. Draft Report. prepared for Washington State Department of Ecology. Prepared by IEc, Cambridge, MA.

IID (Icicle Irrigation District). 1927a. Notice of Beginning of Construction to State Supervisor of Hydraulics. July 22, 1927. On file, Icicle Irrigation District, Cashmere, Washington.

IID (Icicle Irrigation District). 1927b. Eight Mile Lake Outlet Dam: Cross Section of Dam, Profile of Dam, Cross Section of Spillway, Profile of Spillway. On file, Icicle Irrigation District, Cashmere, Washington.

IID (Icicle Irrigation District). 1929. Notice of Completion of Construction to State Supervisor of Hydraulics. October 10, 1929. On file, Icicle Irrigation District, Cashmere, Washington.

IID (Icicle Irrigation District). 1973. Meeting Minutes from May 31, 1973, Directors Meeting. On file, Icicle Irrigation District, Cashmere, Washington.

Innes, Robin J. 2011. Oreamnos americanus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Accessed: 11 February 2021. URL: www.fs.fed.us/database/feis/animals/mammal/oram/all.html.

Innes, Robin J. 2013. Odocoileus hemionus. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). URL: www.fs.fed.us/database/feis/animals/mammal/odhe/all.html.

IPID (Icicle and Peshastin Irrigation Districts). 2021. *Photos and Videos from IPID personnel showing FSR 7601-116*, August 11, 2021.

ISO (International Organization for Standardization). 1996. 9613-2:1996. Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation.

Jantzer, Anthony. 2020. Personal communication. Statement by Tony Jantzer, IPID, to Environmental Science Associates and Robinson Noble on October 21, 2020.

Jantzer, Anthony. 2021. Personal email communication between Tony Jantzer (Secretary and Manager, Icicle & Peshastin Irrigation Districts) with Chanda R. Schneider (ESA Cultural Resources). January 5, 2021.

Judge, Louis. 1925. Wenatchee Indians Ask Justice. In The Washington Historical Quarterly Vol XVI pp. 20–28, Edmond S. Meany, managing editor, The Washington University State Historical Society, University Stations, Seattle, WA.

Kidd, Robert. 1964. A Synthesis of Western Washington Prehistory from the Perspective of Three Occupation Sites. Unpublished Master's Thesis. Department of Anthropology University of Washington, Seattle.

Kincade, Dale M. William W. Elmendorf. Bruce Rigsby, and Haruo Aoki. 1998. Languages. In Plateau, edited by Deward E. Walker Jr., pp. 49–72, Handbook of North American Indians Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Kopperl, Robert, Charles Hodges, Christian Miss, Johonna Shea, and Alecia Spooner. 2016. Archaeology of King County, Washington: A Context Statement for Native American Archaeological Resources. Prepared by SWCA Environmental Consultants, Seattle. Prepared for the King County Historic Preservation Program, Seattle.

Krauthoefer, Tracie, and Shawn Steinmetz. 1995. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS01573. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Lahren, Sylvester L. Jr. 1998. Reservations and Reserves. In Plateau, edited by Deward E. Walker Jr., pp. 484–498, Handbook of North American Indians Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Lancaster, Kim J. 2017. State of Washington Archaeological Site Inventory Form: 45CH00935. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Lancaster, Kim J. 2018. Trout Unlimited Icicle Boulder Field IPID COL Project, Chelan County, WA. Prepared for Trout Unlimited Washington Water Project by Cascadia Conservation District, Wenatchee, WA. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Landres, Peter, Chris Barns, Steve Boutcher, Tim Devine, Peter Dratch, Adrienne Lindholm, Linda Merigliano, Nancy Roeper, and Emily Simpson. 2015. *Keeping it wild 2: an updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System*. Gen. Tech. Rep. RMRS-GTR-340. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Lindholdt, Paul. 2019. Alpine Lakes Wilderness. historyLink.org Essay 20940. URL: https://www.historylink.org/File/20940.

LODES (Longitudinal Employer-Household Dynamics [LEHD] Origin-Destination Employment Statistics). 2018. URL: https://onthemap.ces.census.gov/. Accessed on February 8, 2021.

Maitland, T. Personal Communication. 2021. Personal communication by email with Travis Maitland, District 7 Fish Biologist, Washington Department of Fish and Wildlife with Pete Lawson, Fisheries Biologist, Environmental Science Associates, on January 29, 2021, and February 1, 2021.

Marsh, Kevin R. 2007. Drawing Lines in the Forest: Creating Wilderness Areas in the Pacific Northwest. University of Washington Press, Seattle and London.

Mass, Johnathan. 1983. Cultural Resources Reconnaissance of the Proposed Icicle Creek Hydropower Development near Leavenworth, Chelan County, Washington. Prepared for and by the U.S. Army Corps of Engineers, Seattle District. On file, Washington State Department if Archaeology and Historic Preservation, Olympia, Washington.

Matson, R. G., and Gary Coupland. 1995. The Prehistory of the Northwest Coast. Academic Press, San Diego.

Mauger, G.S., S.Y. Lee, and J.S. Won. 2017. Changing Streamflow in Icicle, Peshastin, and Mission Creeks. Climate Impacts Group, University of Washington, Seattle. URL: https://data.cig.uw.edu/picea/mauger/2017_03_IcicleCreekWG/pub/TechReport_IWG_ChelanCounty_20170510_FINAL.pdf.

McMillen Jacobs Associates and DJ Warren Associates. 2016. *Leavenworth Fisheries Complex Planning Report*. URL: https://www.fws.gov/leavenworthfisheriescomplex/pdfs/LFC%20Planning%20Report%20-Volume%201.pdf.

Miller, Jay. 1998. Middle Columbia River Salishans. In Plateau, edited by Deward E. Walker, Jr., pp. 253–270, Handbook of North American Indians Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Mooney, J. 1896. The Ghost Dance Region and the Sioux Outbreak of 1890. University of Nebraska Press, Lincoln.

Mooney, J. 1896. The Ghost Dance Region and the Sioux Outbreak of 1890. University of Nebraska Press, Lincoln.

Moscoso, L. (USFS). Email from Leslie Moscoso, District Recreation Program Manager, U.S. Forest Service, Okanogan-Wenatchee National Forest, Wenatchee River Ranger District, to Lisa Adolfson, ESA, Seattle, WA. March 8, 2021.

Mote, P., A. Hamlet, M. Clark, and D. Lettenmaier. 2005. Declining Mountain Snowpack in Western North America. Bulletin of the American Meteorological Society. 86:1.

Muir, H., M. Maxey, T. Becker, and M. Cooper 2020. Monitoring and Evaluation of the Leavenworth National Fish Hatchery Spring Chinook Salmon Program, 2019. U.S. Fish and Wildlife Service, Leavenworth WA.

Mullan, J.W., K.R. Williams, G. Rhodus, T.W. Hillman, and J.D. McIntyre. 1992. Production and habitat of salmonids in Mid-Columbia River tributaries. Monograph 1, U.S. Fish and Wildlife Service, Leavenworth, WA.

NASS (National Agricultural Statistics Service). 2017. Census of Agriculture, Chelan County, Washington Profile. United States Department of Agriculture. URL: https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Washington/cp53007.pdf.

National Park Service. 2013. Director's Order #41: Wilderness Stewardship. Effective date: May 13, 2013. URL: https://www.nps.gov/policy/DOrders/DO_41.pdf.

National Park Service. 2016. Management Policies 2006. URL: https://www.nps.gov/subjects/policy/upload/MP_2006.pdf.

NatureServe. 2021. Explorer online guide. Accessed: 10 February 2021. URL: https://explorer.natureserve.org/.

Nelson, Charles M. 1990. Prehistory of the Puget Sound Region in Northwest Coast. In Northwest Coast, edited by Wayne Suttles, pp. 481–484. Handbook of North American Indians, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Nelson, M.C, A. Johnsen, and R.D. Nelle. 2011. Seasonal movements of adult fluvial bull trout and redd surveys in Icicle Creek, 2009 Annual Report. U.S. Fish and Wildlife Service, Leavenworth Washington.

NEPA Committee and IWGEJ (Federal Interagency Working Group on Environmental Justice). 2016. Promising Practices for EJ Methodologies in NEPA Reviews. EPA 300B16001. March 2016. Accessed at https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf, February 23, 2021.

NETROnline.2021. 1963, 1998, 2006, 2009, 2011, 2013, 2013, 2015, 2017 Aerial Coverage. URL: www.HistoricAerials.com.

NMFS (National Marine Fisheries Service). 2005. Endangered and threatened species; designation of critical habitat for 13 evolutionarily significant units of Pacific salmon (*Oncorhynchus* spp.) and steelhead (O. mykiss) in Washington, Oregon, and Idaho; Final Rule. September 2, 2005. Federal Register 70(170):52630–52858.

NMFS (National Marine Fisheries Service). 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation - Leavenworth National Fish Hatchery Spring Chinook Salmon Program (Reinitiation 2016). NMFS Consultation Number: WCR-2017-7345. September 2017.

NOAA (National Oceanic and Atmospheric Administration). 2001. Global Surface Hourly Integrated Dataset for 2011—2020 at Cashmere-Dryden Airport. NEI (National Centers for Environmental Information). Accessed October 2021.

Northwest FCS (Northwest Farm Credit Services). 2019a. Market Snapshot: Pears. Released March 31, 2019.

Northwest FCS (Northwest Farm Credit Services). 2019b. Market Snapshot: Cherries. Released December 31, 2019.

Northwest FCS (Northwest Farm Credit Services). 2019c. Market Snapshot: Apples. Released June 30, 2019.

Northwest FCS (Northwest Farm Credit Services). 2020a. Market Snapshot: Apples: Released December 31, 2020.

Northwest FCS (Northwest Farm Credit Services). 2020b. Market Snapshot: Pears: Released December 31, 2020.

Northwest FCS (Northwest Farm Credit Services). 2020c. Market Snapshot: Cherries: Released September 30, 2020.

NPS (National Park Service). 1997. How to Apply the National Register Criteria for Evaluation. National Register Bulletin No. 15, U.S. Department of Interior, National Park Service Cultural Resources. Government Printing Office, Washington, D.C.

NPS (National Park Service). 2017. North Cascades National Park: Mountain Goats. Accessed: 11 February 2021. URL: https://www.nps.gov/noca/learn/nature/mountain-goats.htm.

NRCS (USDA Natural Resources Conservation Service). 2022. Web Soil Survey (WSS). Accessed: 12 December 2022. URL: https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

NWFSC (Northwest Fisheries Science Center). 2015. Status Review Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest. December 21, 2015.

NWIFC (Northwest Indian Fisheries Commission). 2020. Statewide integrated fish distribution web map. URL: https://geo.nwifc.org/swifd/. Accessed: December 2020.

NWIFC (Northwest Indian Fisheries Commission). 2024. Statewide integrated fish distribution web map. URL: https://geo.nwifc.org/swifd/. Accessed: June 2024.

NWPCC (Northwest Power and Conservation Council). 2004. Wenatchee Subbasin Plan, Prepared by Chelan County and the Yakama Nation for the NPCC, May 28, 2004.

Oliver, N., and J. Meninick. 2022. Governmental Introductory Presentation prepared in partnership with Yakama Nation Fisheries, Yakama Nation Cultural Resources, and the Yakama Nation Office of Legal Counsel: Cultural Resource Section: The Pisqiouse. For further information see Keenan et al. (2022) on file with Yakama Nation Office of Legal Counsel. As cited in YN 2022.

OpenStreetMap. 2019. OpenStreetMap North America, online at http://download.geofabrik.de/north-america.html. Accessed July 2022.

OSHA (Occupational Safety and Health Administration). 2005. Fact Sheets on Natural Disaster Recovery: Flood Cleanup. Accessed October 12, 2022, from URL: https://www.osha.gov/sites/default/files/publications/OSHA3471.pdf.

Ostrander, Tom, Kathy Cleveland, Chanda Schneider, and Katie Wilson. 2023. DRAFT Eightmile Dam Rebuild and Restoration Project, Chelan County, Washington, Cultural Resources Assessment. On file, ESA, Seattle.

Peven, C. 2003. Population Structure, Status and Life Histories of Upper Columbia Steelhead, Spring and Summer/fall Chinook, Sockeye, Coho Salmon, Bull Trout, Westslope Cutthroat Trout, Non-migratory Rainbow Trout, Pacific Lamprey, and Sturgeon. Prepared by Peven Consulting, Inc.

Polly, Kris. 2018. Tony Jantzer of Icicle and Peshastin Irrigation Districts. Interview with Irrigation Leader Magazine, May 2018. URL: http://irrigationleadermagazine.com/tony-jantzer-of-icicle-and-peshastin-irrigation-districts/.

Potter, H. 2016. Memo: Assessing Fish Passage at Leavenworth National Fish Hatchery using DIDSON Sonar. U.S. Fish and Wildlife Service, Leavenworth, Washington.

Potter, H. 2017. Memo: Snorkel survey results for adult spring Chinook Salmon and Bull Trout in Icicle Creek, 2017. U.S. Fish and Wildlife Service, Leavenworth, Washington.

Potter, H. 2018. Memo: Snorkel survey results for adult spring Chinook Salmon and Bull Trout in Icicle Creek, 2018. U.S. Fish and Wildlife Service, Leavenworth, Washington.

Potter, H., J. Bednarek, T. Becker, M. Cooper, and T. Collier. 2018. Leavenworth National Fish Hatchery Annual Report, 2017. U.S. Fish and Wildlife Service, Leavenworth WA.

Proebstel, D.S., R.J. Behnke, and S.M. Noble. 1998. Identification of salmonid fishes from tributary streams and lake of the mid-Columbia Basin. 171 pp.

Query, J., J. Baugh, and S. Steinmetz. 1995b. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS01570. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Query, Juliane, J. Baugh, and S. Steinmetz. 1995a. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS01569. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Ray, Verne F. 1933. The Sanpoil and Nespelem: Salishan Peoples of Northeastern Washington. University of Washington Publications in Anthropology, Vol 5. Seattle. University of Washington Press.

Ray, Verne F. 1936. Native Villages and Groupings of the Columbia Basin. Pacific Northwest Quarterly 27(2):99–152.

Reclamation (U.S. Bureau of Reclamation). 2010. *Groundwater Conditions at the Leavenworth National Fish Hatchery, Leavenworth, Washington*. URL: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/Icicle_Studies/140-218%20LNFH%20groundwater%20report%20(Feb%202010)%20(2).pdf.

Reed, C. (USFS). Email from Carly Reed, Wilderness & Climbing Program Manager/Outfitter & Guide Enchantments Permit Administrator, Forest Service, Wenatchee River Ranger District to Madeline Remmen, ESA, Seattle, WA, April 27, 2022.

REI (Recreational Equipment Inc.). 2021. Climbing and Bouldering. Accessed February 19, 2021. URL: https://www.rei.com/learn/expert-advice/climbing-bouldering-rating.html.

Riley S., Brown J., Sikich J., Schoonmaker C., Boydston E. 2014. Wildlife Friendly Roads: The Impacts of Roads on Wildlife in Urban Areas and Potential Remedies. In: McCleery R., Moorman C., Peterson M. (eds) Urban Wildlife conservation. Springer, Boston, MA. https://doi.org/10.1007/978-1-4899-7500-3_15.

Ringel, B.K. 1997. Analysis of Fish Populations in Icicle Creek, Trout Creek, Jack Creek, Peshastin Creek, Ingalls Creek, and Negro Creek, Washington - 1994 and 1995. Prepared by the Mid-Columbia River Fishery Resource Office. Leavenworth, Washington. September 1997.

Rinkevich, S., K. Greenwood, and C. Leonetti. 2011. Traditional Ecological Knowledge for Application by Service Scientists Fact Sheet. U.S. Fish and Wildlife Service, Native American Program. URL: https://portal.azoah.com/oedf/documents/17-001-WQAB/SCAT-17-USFWS.TEK-fact-sheet.2011.BATES.pdf.

Rocket Homes. 2022a. Chelan County Housing Market Report. URL: https://www.rockethomes.com/real-estate-trends/wa/chelan-county. Accessed: July 5, 2022.

Rocket Homes. 2022b. Leavenworth Housing Market Report. URL: https://www.rockethomes.com/real-estate-trends/wa/leavenworth. Accessed: July 5, 2022.

Rosenberger, R.S., E.M. White, J.D. Kline, and C. Cvitanovich. 2017. Recreation Economic Values for Estimating Outdoor Recreation Economic Benefits From the National Forest System. Gen. Tech. Rep. PNW-GTR-957. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Runnoe, V. 2006. Helicopter Use in Wildlife Management. Press Release. Idaho Department of Fish and Game. March 27, 2006. URL: https://idfg.idaho.gov/press/helicopter-use-wildlife-management.

Schalk, Randall F. 1983. Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, near Lyons Ferry, Washington. Washington State University, Laboratory of Archaeology and History, Pullman.

Schuster, Helen H. 1998. Yakima and Neighboring Groups. In Plateau, edited by Deward E. Walker, Jr., pp. 327–351, Handbook of North American Indians Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.

Seattle Audubon. 2021. BirdWeb. Seattle Audubon Society for Birds and Nature. Accessed: 4 February 2021. URL: http://www.birdweb.org/BIRDWEB/birds.

Sherrod, B.L., R.J. Blakely, and C.S. Weaver. 2015. *LIDAR helps identify source of 1872 Earthquake near Chelan, Washington*; Abstract, American Geophysical Union Fall Meeting, San Francisco, California, December 2015.

Skalicky, J.J., D. Hines, D. Anglin, and N. Jones. 2013. Icicle Creek Instream Flow and Fish Habitat Analysis for the Leavenworth National Fish Hatchery. U.S. Fish and Wildlife Service, Columbia River Fisheries Program Office, Vancouver, WA.

Speulda, Lou Ann. 1996. Historic Properties Identification Report of the Salmon Carcass Disposal Pits for the Leavenworth National Fish Hatchery, Chelan County, WA. Prepared by U.S. Fish and Wildlife Service, Sherwood, OR. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Speulda, Lou Ann. 1997. State of Washington Historic Property Inventory Form: Leavenworth National Fish Hatchery. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Spier, Leslie. 1936. Tribal Distribution in Washington. American Anthropological Association General Series in Anthropology No. 3. George Banta, Menasha, Wisconsin.

Spokesman-Review, 1918. Transfer Canal System: Private Company's Assets Taken over by District. September 6, 1918.

Steinmetz, S., B. Christensen, and B. Reed. 1995a.Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS1574. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Steinmetz, S., B. Christensen, and B. Reed. 1995b. Cultural Resource Site Report, Region 6, U.S. Forest Service: 45FS01584. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Superior Court of the State of Washington. 1929. No. 8252 Report of Referee, in the matter of the determination of the rights of the use of the waters of Icicle Creek and its tributaries in Chelan County, Washington. Signed by R.K. Tiffany, State Supervisor of Hydraulics. April 18, 1929.

Sylvester A.H. 1943.Place-Naming in the Northwest. American Speech, 18 (4): 241-252. As cited in personal communication Downes 2022.

Tabor, R.W., R.B. Waitte, V.A. Fizzell, D.A. Swanson, G.R. Byerly, and R.D. Bentley. 2017. *Geologic Map of the Wenatchee 1:100,000 Quadrangle, Central Washington*. U.S. Geological Survey, Miscellaneous Investigations Series Map I-1311. URL: https://pubs.usgs.gov/imap/i1311/.

Tabor, R.W., V.A. Fizzell, Jr., J.T. Whetten, R.B. Waitt, D.A. Swanson, G.R. Byerly, D.B. Booth, M.J. Hetherington, and R.E. Zartman. 1987. *Geologic Map of the Chelan 30-minute by 60-minute Quadrangle, Washington*. U.S. Geological Survey, Miscellaneous Investigations Series Map I-1661. URL: https://pubs.usgs.gov/imap/i1661/.

Tarman, Sylvia. 2018a. State of Washington Archaeological Site Inventory Form: 45CH00943. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Tarman, Sylvia. 2018b. State of Washington Archaeological Site Inventory Form: 45CH00944. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Taylor, Amanda, and F. Scott Pierson. 2018. Archaeological Survey for Leavenworth and Lower Wenatchee Reach Potential Pump Test Pit Locations, Chelan County, WA. Prepared for Yakama Nation Fisheries by Willamette Cultural Resources Associates, Ltd., Seattle, WA. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Teit, James H. 1928. The Middle Columbia Salish. University of Washington Publications in Anthropology 2(4):83-128. Franz Boas, editor. University of Washington Press, Seattle.

Therrell, Lisa, David Cole, Victor Claassen, Chris Ryan, and Mary Ann Davies. 2006. *Wilderness and Backcountry Site Restoration Guide.* USDA Forest Service Technology and Development Program, Missoula, MT. September 2006.

Thompson, Rustin. 2002. False Promises, The Lost Land of the Wenatchi, Newly Updated posted 2019. Documentary. URL: https://www.cct-hsy.com/wenatchi-indians/.

U.S. Census Bureau. 2009a. Race and Population, 2005-2009 American Community Survey 5-year estimates. Retrieved from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 15.0 [dataset]. Minneapolis, MN: IPUMS. 2020. URL: http://doi.org/10.18128/D050.V15.0.

U.S. Census Bureau. 2009b. Selected housing characteristics, 2005-2009 American Community Survey 5-year estimates. Retrieved from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 15.0 [dataset]. Minneapolis, MN: IPUMS. 2020. URL: http://doi.org/10.18128/D050.V15.0.

U.S. Census Bureau. 2012. Accommodation and Food Services: Summary Statistics for the U.S., States, and Selected Geographies: 2012. URL: https://data.census.gov/cedsci/table?q=ec1272&g=0500000US53007&n=N0300.00&tid=ECNBASIC2012.EC1272A1&hidePreview=true.

U.S. Census Bureau. 2017. Accommodation and Food Services: Summary Statistics for the U.S., States, and Selected Geographies: 2017. URL: https://data.census.gov/cedsci/table?q=EC1772BASIC%3A%20Accommodation%20and%20Food%20Services%3A%20Summary%20Statistics%20for%20the%20U.S.,%20States,%20and%20Selected%20Geographies%3A%202017&g=0500000US53007&n=N0300.00&tid=ECNBASIC2017.EC1772BASIC&hidePreview=true.

U.S. Census Bureau. 2019a. Race and Population, 2015-2019 American Community Survey 5-year estimates. Retrieved from Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 15.0 [dataset]. Minneapolis, MN: IPUMS. 2020. URL: http://doi.org/10.18128/D050.V15.0.

U.S. Census Bureau. 2019b. Selected housing characteristics, 2015-2019 American Community Survey 5-year estimates. URL: https://data.census.gov/cedsci/table?t=Vacancy&g=1600000US5338845&y=2019&tid=ACSDP5Y2019.DP04&hidePreview=false.

U.S. Census Bureau. 2020. American Community Survey (ACS) 2015–2019 5-Year Data Release. Accessed at https://www.census.gov/newsroom/press-kits/2020/acs-5-year.html, March 2, 2021.

U.S. Department of Housing and Urban Development. 1972. Aircraft Noise Impact—Planning Guidelines for Local Agencies.

U.S. Department of the Interior. 2017. Interactive Viewer - Monitoring Trends in Burn Severity. Accessed: 17 February 2021. URL: https://www.mtbs.gov/viewer/index.html.

U.S. Surveyor General. 1892. Township 24 North, Range 17 East. URL: https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t240n170e_001.jpg.

U.S. Surveyor General. 1907. Township 24 North, Range 17 East. URL: https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t240n170e_002.jpg.

U.S. Surveyor General. 1913. Township 23 North, Range 16 East. URL: https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t230n160e_001.jpg.

U.S. Surveyor General. 1917. Township 24 North, Range 16 East. URL: https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t240n160e_001.jpg.

U.S. Surveyor General. 1924. Township 23 North, Range 16 East. URL: https://www.blm.gov/or/landrecords/survey/yPlatView1_2.php?path=PWA&name=t230n160e_002.jpg.

UCSRB (Upper Columbia Salmon Recovery Board). 2007. Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan. 352p.

University of Washington Department of Environmental & Occupational Health Sciences. 2019. Washington Environmental Health Disparities Map: technical report. Seattle.

USACE (United States Army Corps of Engineers). 1982. Operational Noise Data for UH-60A and CH-47C Army Helicopters. Integrated Installation Noise Contour System. Construction Engineering Research Laboratory. Technical Report N-131. June 1982. URL: http://www.chinook-helicopter.com/Technical_Reports/Operational_Noise_Data_for_UH-60A_and_CH-47C_Army_Helicopters.pdf.

USFS (U.S. Department of Agriculture Forest Service). 1962. Wenatchee National Forest. Map on file, University of Washington, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1966. Wenatchee National Forest. Map on file, University of Washington, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1969. Wenatchee National Forest, Trail Bike Trips. Map on file, University of Washington, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1975a. Aerial Image. Line 36001. 53037 1575 140. On file, University of Washington, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1975b. Aerial Image. Line 35004. 53037 1575 103. On file, University of Washington, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1979. Alpine Lakes Area Acquisitions, Final Environmental Impact Statement. Wenatchee, Colville, and Mt Baker-Snoqualmie National Forests, Pacific Northwest Region. On file, Environmental Science Associates, Seattle.

USFS (U.S. Department of Agriculture Forest Service). 1981. *Alpine Lakes Area Land Management Plan*. Selected Alternative from the Final Environmental Impact Statement.

USFS (U.S. Department of Agriculture Forest Service). 1984. Alpine Lakes Area Land Management Plan.

USFS (U.S. Department of Agriculture Forest Service). 1990. *Land and Resource Management Plan.* Wenatchee National Forest. Accessed at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_053595.pdf.

USFS (U.S. Department of Agriculture Forest Service). 2010. List of Invasive Plants on National Forests in the PNW Region. Accessed September 27, 2021, from URL: https://www.fs.usda.gov/detail/r6/forest-grasslandhealth/invasivespecies/?cid=stelprdb5302157.

USFS (U.S. Department of Agriculture Forest Service). 2016a. Jobs and Income. Economic Contributions in 2016 at a Glance. Okanogan-Wenatchee National Forest. URL: https://www.fs.fed.us/emc/economics/contributions/documents/at-a-glance/published/pacificnorthwest/AtaGlance-OkanoganWenatchee.pdf. Accessed February 18, 2021.

USFS (U.S. Department of Agriculture Forest Service). 2016b. NVUM Results Application. Wenatchee National Forest, 2016, Activity Participation. URL: https://www.fs.usda.gov/about-agency/nvum/. Accessed February 19, 2021.

USFS (U.S. Department of Agriculture Forest Service). 2017a. *Post-Fire BAER Assessment Burned Area Emergency Response (BAER) Information Brief, Jack Creek Fire 2500-8 Summary*. URL: http://centralwashingtonfirerecovery.info/2017/wildfire-reports/jack-creek-fire/.

USFS (U.S. Department of Agriculture Forest Service). 2017b. *Enchantment Permit Area Visitor Use Data Analysis 2007-2017*. Prepared by Gabrielle Snider, Recreation Planner, Forest Service Washington Office, Business Operations, Enterprise Program for Wenatchee River Ranger District, Okanogan Wenatchee National Forests.

USFS (U.S. Department of Agriculture Forest Service). 2018a. Letter from Michael Williams, Forest Supervisor, to Joe Witczak, Ecology. February 20, 2018.

USFS (U.S. Department of Agriculture Forest Service). 2018b. Letter from Michael Williams, Forest Supervisor, Anthony Jantzer, Manager, Icicle Peshastin Irrigation District. March 30, 2018.

USFS (U.S. Department of Agriculture Forest Service). 2019a. Enchantment Permit Lottery Statistics. URL: https://www.fs.usda.gov/detail/okawen/passes-permits/recreation/?cid=fsbdev3_053607.

USFS (U.S. Department of Agriculture Forest Service). 2019b. Enchantments 2019 Use Numbers. Emailed from Leslie Moscoso, USFS to Lisa Adolfson, ESA on February 2, 2021.

USFS (U.S. Department of Agriculture Forest Service). 2020. 2020 Enchantments Use Summary. Emailed from Leslie Moscoso, USFS to Lisa Adolfson, ESA on February 2, 2021.

USFS (U.S. Department of Agriculture Forest Service). 2021a. *Alpine Lakes Wilderness Character Narrative*. May 2021.

USFS (U.S. Department of Agriculture Forest Service). 2021b. *Okanogan-Wenatchee National Forest Wilderness Regulations*. Accessed February 11, 2021. URL: https://www.fs.usda.gov/detail/okawen/specialplaces/?cid=stelprdb5405234.

USFS (U.S. Department of Agriculture Forest Service). 2021c. *Okanogan-Wenatchee National Forest Enchantment Permit Area Rules and Regulations.* Accessed February 11, 2021. URL: https://www.fs.usda.gov/detail/okawen/passes-permits/recreation/?cid=stelprdb5405903.

USFS (U.S. Department of Agriculture Forest Service). 2021d. Okanogan-Wenatchee Nation Forest Alpine Lakes Wilderness: Okanogan-Wilderness. Accessed on February 11, 2021. URL: Okanogan-Wenatchee National Forest - Alpine Lakes Wilderness: Okanogan-Wenatchee (usda.gov).

USFS (U.S. Department of Agriculture Forest Service). 2021e. Okanogan-Wenatchee National Forest Enchantment Area Wilderness Permits. Accessed February 11, 2021. URL: https://www.fs.usda.gov/detail/okawen/passes-permits/recreation/?cid=fsbdev3_053607.

USFS (U.S. Department of Agriculture Forest Service). 2021f. Enchantments Permit Lottery Statistics by Zone. Accesses April 6, 2022. URL: https://www.fs.usda.gov/detail/okawen/passes-permits/recreation/?cid=fsbdev3_053607.

USFS (U.S. Department of Agriculture Forest Service). 2021g. Jack Creek Fire (2500-8) Soil Burned Area Emergency Response Information Brief Summary and Jack Creek Fire Severity Map. URL: http://centralwashingtonfirerecovery.info/2017/wildfire-reports/jack-creek-fire/. Accessed January 30, 2021.

USFS (U.S. Department of Agriculture Forest Service). 2021h. Alpine Lakes Wilderness Web Site, Accessed: 1 February 2021. URL: http://www.wilderness.net/index.cfm?fuse=NWPS&sec=wildView&WID=8.

USFS (U.S. Department of Agriculture Forest Service). 2022. *Enchantment Permit Area* (webpage). Accessed June 7, 2022. URL: https://www.recreation.gov/permits/233273.

USFS (U.S. Department of Agriculture Forest Service). n.d. Alpine Lakes Wilderness Area regulations and restrictions.

USFWS (U.S. Department of Fish and Wildlife). 1997. National Register of Historic Places Registration Form: Leavenworth National Fish Hatchery 45CH582. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

USFWS (U.S. Fish and Wildlife Service). 2016. Leavenworth Fisheries Complex: Planning Report. Prepared by McMillen Jacobs Associates and DJ Warren Associates. August.

USFWS (United States Fish and Wildlife Service). 1999. Endangered and threatened wildlife and plants; determination of threatened status for bull trout in the coterminous United States. Final rule November 1, 1999. Federal Register 64(210):58910–58933.

USFWS (United States Fish and Wildlife Service). 2005. Endangered and threatened wildlife and plants; Designation of critical habitat for the Klamath River and Columbia River Populations of Bull Trout (Salvelinus confluentus). Final Rule. Federal Register 69(193):56211–56311.

USFWS (United States Fish and Wildlife Service). 2011. Biological Assessment for the Operation and Maintenance of Leavenworth National Fish Hatchery. Prepared by the USFWS, Leavenworth Fisheries Complex, Leavenworth, Washington.

USFWS (United States Fish and Wildlife Service). 2015. Recovery Plan for the Coterminous United States Population of Bull Trout (*Salvelinus confluentus*). Portland, Oregon. xii + 179 pages.

USFWS (United States Fish and Wildlife Service). 2016. Memo: Assessing Fish Passage at Leavenworth National Fish Hatchery using DIDSON Sonar. Assessing Fish Passage at Leavenworth National Fish Hatchery using DIDSON Sonar, Memorandum from Hayley Potter to interested parties, May 5, 2016. Leavenworth, Washington

USFWS (United States Fish and Wildlife Service). 2021a. Endangered Species Act, Species County Report. Listed Species believed to or known to occur in Chelan, Washington. Accessed: 4 February 2021. URL: https://www.fws.gov/endangered/?ref=topbar.

USFWS (United States Fish and Wildlife Service). 2021b. Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) tool. Accessed: January 2021. URL: https://ecos.fws.gov/ipac/.

USFWS (United States Fish and Wildlife Service). 2022. National Wetlands Inventory. Accessed August 8, 2022, from URL: https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/.

USFWS (United States Fish and Wildlife Service). 2024. Environmental Conservation Online System (ECOS) Information for Planning and Consultation (IPaC) tool. Accessed: May 2024. URL: https://ecos.fws.gov/ipac/.

USGS (U.S Geological Survey). 2021. The StreamStats program for Washington, URL: http://water.usgs.gov/osw/streamstats/washington.html. Accessed July 2022.

USGS (U.S. Geological Survey). 1904. *Chiwaukum, WA.* 30' Series Quadrangle. U.S. Geological Survey, Reston, Virginia.

USGS (U.S. Geological Survey). 1966. Leavenworth, WA. 15' Series Quadrangle. U.S. Geological Survey, Reston, Virginia.

USGS (U.S. Geological Survey). 1967. Chiwaukum Mts, WA. 15' Series Quadrangle. U.S. Geological Survey, Reston, Virginia.

USGS (U.S. Geological Survey). 1977. Chelan, WA. Intermediate Series Quadrangle. U.S. Geological Survey, Reston, Virginia.

USGS (U.S. Geological Survey). 2021. Terrain data from the USGS National Map website. Accessed December 2021 from URL: https://apps.nationalmap.gov/downloader/.

USGS (U.S. Geological Survey). 2022. USGS Gage 12458500 Icicle Creek Near Leavenworth, WA Stream Site. Accessed June 28, 2022, from URL: https://nwis.waterdata.usgs.gov/wa/nwis/inventory/?site_no=12458500&agency_cd=USGS.

USGS (U.S. Geological Survey) and NSHM (National Seismic Hazard Mapping Project). 2021 (accessed). Quaternary Fault and Fold Database for the United States. Web application. Accessed March 2, 2021. URL: https://www.usgs.gov/natural-hazards/earthquake-hazards/faults.

Valenta, Jared. 2012. The Identification and Historic Context of Mining Archaeology of the Wenatchee Mountains within the Alpine Lakes Wilderness. Thesis presented to Central Washington University. On file, Washington State Department of Archaeology and Historic Preservation, Olympia, Washington.

Varela & Associates, Inc. 2018. City of Leavenworth Water System Plan. URL: https://cityofleavenworth.com/col-assets/uploads/2018/02/14-10-01-Leavenworth-WSP-final-2018.pdf.

Washington State Department of Agriculture. 2019. Agricultural Land Use GIS Data. URL: https://agr.wa.gov/departments/land-and-water/natural-resources/agricultural-land-use.

Washington State ESD (Employment Security Department). 2021. Chelan and Douglas County profiles. URL: https://esd.wa.gov/labormarketinfo/county-profiles/chelan-douglas#labor, November 22, 2021.

Washington State Noxious Weed Control Board. 2021. Washington State Noxious Weed List. Accessed: September 27, 2021, from URL: https://www.nwcb.wa.gov/pdfs/2021-State-Weed-List_Common_Name-8.5x11.pdf.

WBWG (Western Bat Working Group). 2021. Species Info. Accessed: 10 February 2021. URL: http://wbwg.org/western-bat-species/.

WDF (Washington Department of Fisheries) and WWTIT (Western Washington Treaty Indian Tribes). 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Internal Report to Washington Department of Fisheries and Wildlife, Olympia, WA, 212 p. plus 5 regional volumes.

WDFW (Washington Department of Fish and Wildlife). 1997. Washington State salmonid stock inventory: Bull trout/Dolly Varden.

WDFW (Washington Department of Fish and Wildlife). 2005. Management of Washington's High Lakes. December 2005.

WDFW (Washington Department of Fish and Wildlife). 2015. State Wildlife Action Plan Update: Appendix A-1 Species of Greatest Conservation Need Fact Sheet. URL: https://wdfw.wa.gov/sites/default/files/publications/01742/10_A1_Mammals.pdf.

WDFW (Washington Department of Fish and Wildlife). 2016. Washington State Mule Deer Management Plan, Wildlife Program, Washington Department of Fish and Wildlife, Olympia, WA, USA. 144 p.

WDFW (Washington Department of Fish and Wildlife). 2017. Tribal Ceded Areas in Washington State. Washington Department of Fish and Wildlife Interpretation Map. URL: https://wdfw.wa.gov/sites/default/files/201812/tribal_ceded_areas_in_washington_state.pdf.

WDFW (Washington Department of Fish and Wildlife). 2020a. Priority Habitats and Species Report and GIS Package. Olympia, Washington. Received on 15 December 2020.

WDFW (Washington Department of Fish and Wildlife). 2020b. SalmonScape fish database and mapping application. URL: http://wdfw.wa.gov/mapping/salmonscape/index.html Accessed December 2020.

WDFW (Washington Department of Fish and Wildlife). 2021a. Eightmile Fish Stocking Information. Accessed February 11, 2021. URL: High lakes | Washington Department of Fish & Wildlife.

WDFW (Washington Department of Fish and Wildlife). 2021b. Fishing regulations. Accessed February 12, 2021. URL: https://wdfw.wa.gov/fishing/regulations.

WDFW (Washington Department of Fish and Wildlife). 2021c. Species and Habitats; Species in Washington. Accessed: 4 February 2021. URL: https://wdfw.wa.gov/species-habitats/species.

WDFW (Washington Department of Fish and Wildlife). 2021d. WDFW Stocking History Records for Eightmile Lake (Chelan County) - 1933 to 2005.

WDFW (Washington Department of Fish and Wildlife). 2024. High Lakes: Eightmile. Fish stocking information. Available at: https://wdfw.wa.gov/fishing/locations/high-lakes/eightmile#trout-plants.

WDNR (Washington Department of Natural Resources). 2020. DNR Hydrography – Watercourses – Forest Practices Regulation. Washington Geospatial Open Data Portal. URL: https://data-wadnr.opendata.arcgis.com/datasets/816586b10c6c4954883b236f9fff208f/explore?location=47.191238%2C-120.754300%2C7.68. Accessed July 2022.

WDNR (Washington Department of Natural Resources). 2021. WDNR GIS Open Data: Washington Large Fires 1973-2020. URL: https://data-wadnr.opendata.arcgis.com/. Accessed: 27 September 2021.

WDNR (Washington Department of Natural Resources). 2022. *Washington Geologic Information Portal.* URL: https://geologyportal.dnr.wa.gov/.

White, E. 2017. Spending Patterns of Outdoor Recreation Visitors to National Forests - DRAFT. Gen. Tech. Rep. PNW-GTR. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Wilderness Connect. 2022. Alpine Lakes Wilderness. URL: https://wilderness.net/visit-wilderness/?ID=8#atdModal. Accessed December 8, 2022.

WSDOT (Washington State Department of Transportation). 2017. Guidance for NEPA and SEPA Project-Level Climate Change Evaluations. WSDOT Environmental Services Office.

WSU Extension (Washington State University Extension). nd. Tree Fruit Overview. URL: https://extension.wsu.edu/chelan-douglas/agriculture/treefruit/horticulture/tree_fruit_overview/. Accessed February 22, 2021.

Wydoski R.S., and R.R. Whitney. 2003. Inland Fishes of Washington. University of Washington Press, Seattle, Washington.

Yakama Nation. 2017. Mid-Columbia Coho Restoration Master Plan. February.

Yakama Treaty. June 9, 1855, 12 Stat., 951. Ratified Mar. 8, 1859. Proclaimed Apr. 18, 1859. https://www.yakama.com/about/treaty/.

Yakima Tribe v. the United Sates (Defendant) 1963. Confederated Tribes of the Colville Reservation, et al. (Intervenor). (July 29, 1963). Before the Indian Claims Commission, Docket 161. In Indian Claims Commission Decisions. Vol. 12; Part A. Native American Rights Fund. Boulder CA.

YN (Confederated Tribes and Bands of the Yakama Nation). 2022. Report to address ongoing concerns in ethnographic, historic, and contextual reporting standards related to the Eightmile Dam EIS. Prepared by Noah Oliver based on information obtained from tribal members and the Yakama Nation Atlas. Submitted to the Washington State Department of Ecology. December 1, 2022, Document Draft.

CHAPTER 19: LIST OF PREPARERS

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CHAPTER 20: DISTRIBUTION LIST

The following table provides a list of the tribes; federal, state, and local agencies; and organizations who have received notice of availability of the Final EIS. In addition, notice has been sent to everyone who has provided comments during scoping or on the Draft EIS, as well as the property owners along Icicle Creek. The total list of recipients of the notification is more than 7,000.

Type	Name
Tribes	Confederated Tribes and Bands of the Yakama Nation
	Confederated Tribes of the Colville Reservation
Federal Agencies	United States Forest Service
	U.S. Fish and Wildlife Service – Leavenworth Fisheries Complex
	National Oceanic and Atmospheric Association – National Marine Fisheries Service
	United States Army Corps of Engineers
	United States Bureau of Reclamation - Yakima Office
State Agencies	Washington Department of Archaeology and Historic Preservation (DAHP)
	Washington Department of Fish and Wildlife (WDFW) Region 2
	Washington Department of Agriculture
	Washington Department of Commerce
	Washington Department of Corrections
	Washington Department of Ecology - SEPA Register
	Washington Department of Ecology – Office of Columbia River
	Washington Department of Ecology – Central Region Office
	Washington Department of Ecology – Southwest Regional Office, Shoreline
	Washington Department of Fish and Wildlife
	Washington Department of Health
	Washington Department of Natural Resources
	Washington Department of Social and Health Services
	Washington Department of Transportation - North Central Region
	Washington Department of Transportation
	Energy Facility Site Evaluation Council (EFSEC)
	Parks and Recreation Commission
	Puget Sound Partnership
	Puget Sound Regional Council
	Washington Governor Policy Advisor

Type	Name
Local Agencies	Chelan County
	Chelan County Natural Resources
	Chelan County Commissioner
	City of Leavenworth
	City of Cashmere
Organizations	Alpine Lakes Foundation
	Alpine Lakes Protection Society
	American Rivers
	Cascade Orchard Irrigation Company
	Cascadia Conservation District
	Center for Environmental Law and Policy
	Friends of Leavenworth
	Friends of the Enchantments
	Icicle Creek Watershed Council
	Icicle Fund
	Overlake Fly Fishing Club
	Sierra Club
	The Mountaineers
	The Wilderness Society
	Trout Unlimited
	Washington Trails Association
	Washington Wild
	Wilderness Watch
	Wise Use Movement
	Icicle & Peshastin Irrigation Districts
	Peshastin Irrigation District

Appendix A: DSO Letter re: Eightmile Dam

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

March 23, 2018

Anthony D. Jantzer
Icicle & Peshastin Irrigation District
5594 Westcott
PO Box 371
Cashmere, WA 98815-0371

Re: Eightmile Lake Dam DSO File: No. CH45-0228

Dear Mr. Jantzer:

Thank you for your continued coordination with the Department of Ecology's Dam Safety Office (DSO) regarding Eightmile Lake Dam. Given the Icicle & Peshastin Irrigation District's (District) March 13, 2018, declaration of an emergency at the dam, Ecology submits this letter containing directives regarding further actions that need to be taken by the District in response.

As you are aware, the 90-year-old dam is in deteriorating condition and the August 2017 Jack Creek Fire has created additional concerns of increased peak runoff into Eightmile Lake. To assist in addressing this situation, the District must submit a written incident report to the Dam Safety Office no later than April 6, 2018.

The report should identify the District's efforts to safely manage this situation and include, at a minimum, the information and requirements in the following five areas:

1. Drawdown: The District has currently removed all the stop logs that leave the lake at an elevation of 4661 feet. This provides some capacity to manage rain and snow runoff. The DSO supports the District's decision to further increase the lake's capacity to accommodate additional runoff by repairing the outlet pipe. According to the District, correcting that condition will allow the lake level to be lowered an additional 12 feet to an elevation of 4649 feet. This repair work should occur as soon as the weather and site conditions allow access for staff and equipment. On behalf of the District, you indicated that this work is expected to be done in May 2018, by walking an excavator up to the site. The report should also assess the option of airlifting the excavator into place along with pumps and siphons to draw down the lake, should repair of the low-level outlet be unsuccessful. The excavator should be sized to repair the outlet, as well as perform other earth moving tasks, if needed, to allow passage of inflow such as lowering a portion of the dam crest. Please provide the DSO with 14 days advance notice of the repair work

and the opportunity to oversee the work. The lake level shall be maintained at the lowest elevation feasible until we agree otherwise.

2. Hydrology and Hydraulic Analysis: The District must retain the services of a qualified professional engineering consultant to conduct a detailed analysis of a dam breach, downstream breach hydraulics, and the design-storm watershed hydrology. The purpose will be to:
    - fully characterize and map the breach flood's downstream inundation, Persons at Risk (PAR) and inundated infrastructure,
    - calculate the Design Storm and model the watershed hydrology to produce a hydrograph of the reservoir's Inflow Design Flood (IDF),
    - determine the reservoir's minimum Design Freeboard, and,
    - determine if the current combined overflow outlet works are capable of passing the peak of the IDF, while maintaining the design freeboard.

    This analysis must consider the existing, as-is dam geometry (i.e. the full hydraulic height of the embankment: minimum crest to the low-level conduit inlet invert), embankment and foundation materials, and changed conditions on the dam's watershed as a result of the Jack Creek Wildfire. This work will provide a more realistic and accurate estimate of potential impacts from a potential dam breach. DSO staff are available to assist your engineer in scoping out this analysis and identifying applicable guidance. The District must submit an engineering report summarizing the analysis and findings to the DSO on or before April 27, 2018.

3. Emergency Action Plan: The District submitted a draft Emergency Action Plan (EAP) to the DSO on March 21, 2018. The District must share the draft EAP with the U.S. Forest Service and Chelan County Emergency Management and incorporate any input received from those offices. The EAP is based, in part, on DSO's March 14, 2018, preliminary estimates of the homes that could be impacted by a potential dam breach. The District should be prepared to modify the EAP with the more detailed hydrology and hydraulics analysis required above and any further comment DSO may provide on the draft EAP.

4. Site Access and Monitoring: We understand that access is very limited, given the dam's location in the Alpine Lakes Wilderness Area, and due to the lack of roads and extreme winter weather. On behalf of the District, you communicated that your staff occasionally access the dam site via small plane flyovers, helicopter insertions, and hikes. The incident report should identify the frequency and method of monitoring the site on a regular basis to assess reservoir volume, embankment condition, debris blockage of the outlet works, and changes to the watershed (i.e. snow cover, surface soil permeability, and vegetation cover). We ask that the District inform the DSO of any future opportunities to visit and view the site with your staff. In addition to reporting emergency events as specified in the EAP, the District should immediately notify the DSO of any significant, non-emergency changes or events related to the site that could affect the timing or methods of your response to this situation.

5. Weather Tracking: The District must describe how weather patterns and forecasts will be tracked to provide maximum advance warning of weather conditions that could result in unusually large runoff into the lake. The EAP should identify how the District will respond to forecasted extreme precipitation events. The District should also evaluate the feasibility of immediately employing remote monitoring of weather at the dam site, Eightmile Lake levels and the flow in Eightmile Creek to support an advance warning.

Based on the DSO's preliminary analysis of homes that could be impacted by a potential failure, the DSO has changed the hazard classification of the dam from "Low" to "High". Under the Low Hazard Classification, an EAP was not required, nor were regular inspections of the dam. The High Hazard Classification now means an EAP is required, as well as a detailed inspection every five years. The DSO will conduct the first detailed inspection this summer. We will also initiate annual billings to cover our periodic inspection costs, as provided under the Dam Safety Regulations in Chapter 173-175 Washington Administrative Code (WAC). We will coordinate that inspection with the District in advance.

District actions identified in this letter to respond to the situation are considered operation and maintenance. Therefore, the District is not required to obtain a permit from DSO, nor pay any dam permitting fees. However, this does not relieve the District from obtaining permits and approvals, if any, from other local, state and/or federal agencies for its operation and maintenance activities. Future actions to rebuild or modify the dam, and/or its appurtenant structures, will require the DSO's review and written approval through the dam safety permitting process. Those future actions may also trigger the need for the District to obtain permits and approvals required by other local, state and/or federal agencies.

If you have questions about preparing the incident report or compliance with the dam safety regulations, which are set forth in the WAC 173-175, please contact the engineer assigned to this project, Guy Hoyle-Dodson at (360) 407-6451.

Thank you for your ongoing cooperation.

Sincerely,

Joe Witczak, P.E.
Dam Safety Manager
Water Resources Program

cc: Guy Hoyle-Dodson, Ecology
Mike Williams, U.S. Forest Service
Kent Sisson, Chelan County Emergency Management

Certified: [91 7199 9991 7037 2237 8746]

Appendix B: Water Rights

APPENDIX B: WATER RIGHTS

This appendix provides additional information concerning the water rights in the study area.

Additional Explanation of Methodology

As described in Chapter 6 of the EIS, the Water Rights Tracking System (WRTS) maintained by Ecology was used to research the water rights in the area. Ecology made several searches of the study area to identify the water rights in the area.

The first search looked for surface water rights with sources listed in WRTS[1] as being 1 of the 28 various surface waterbodies in the Icicle Creek Subbasin, including Icicle Creek, Snow Creek, Eightmile Creek, Mountaineer Creek, Eightmile Lake, Snow Lakes, Colchuck Lake, among others. The records returned by this search were then sorted by Township, Range, and Section, and records with locations outside the Icicle Creek Subbasin were removed. This resulted in a total of 56 surface water rights.

A second search was also made for surface water rights; this one used a GIS search of points of diversion, as mapped in Ecology's Geographic Water Information System (GWIS),[2] located within the study area. Duplicates from the first search were identified and then deleted. This second search identified 14 additional rights, giving a total of 70 surface water rights records for the study area.

Two similar searches were made for groundwater rights. This resulted in 82 groundwater rights records for the study area.

Most water rights records on WRTS contain one or more scanned documents, including applications, permits, certificates, reports of examination (ROEs), supporting documents, and maps, etc. All scanned documents for the identified surface water and groundwater rights were downloaded and indexed by water right number. Additional documentation (not scanned as part of WRTS) for selected rights was made available from public records requests to Ecology.

As described in Chapter 6, some rights were removed from further consideration due to location errors, rights still in the application phase, and rights with an inactive status. This resulted in the number of records being reduced to 45 surface water rights and 39 groundwater rights.

The water right quantities reported in this document do not represent a determination of the validity and extent of any of the rights in the basin. The estimation of total annual quantities and other parameters of water rights in the study area were based on the review and analysis of the EIS team and their subcontractors and do not represent determinations or estimations of water right quantities by Ecology. Ecology reviewed estimated quantities to the general extent necessary to be

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[1] According to the WRTS database, "Water Right Data, Application Data, Claim Data, and Document Images released from the Department of Ecology are provided on an 'AS IS' basis, without warranty of any kind. The data and/or image(s) may not be accurate, complete, legible, or otherwise reliable. Ecology disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties or fitness for a particular purpose. In no event will Ecology be liable to you or to any third party for any direct, indirect, incidental, consequential, special or exemplary damages or loss resulting from any use or misuse of these data and/or images. The user of this information assumes the entire risk that the data and/or images may be inaccurate, incomplete, illegible, or otherwise unreliable."

[2] According to the GWIS database, "the Data is provided 'as is' without warranty of any kind. The entire risk as to the results and performance of the Data is assumed by you. Should the Data prove defective, you assume the entire cost of all necessary servicing, repair, or correction. Further, the Washington State Department of Ecology does not warrant, guarantee, or make any representations regarding the use of, or results from the use of the Data in terms of correctness, accuracy, reliability, currentness, or otherwise; and you rely on the Data and results solely at your own risk."

able to identify and understand potential effects of the proposal on water rights in the basin and identify any potential for impacts to basin water rights. Additional information detailing the EIS team's review of basin water rights is presented herein and in Chapter 6, including methodologies and assumptions used. Final determinations of water right quantities can only be made by the legal determination of a court through an adjudication process.

Additional Discussion of Regulatory Context

Though frequently and informally known as water right applications, for a new water right, the proper name is Application for a New Water Right Permit, and for the change of a water right, the proper name is Application for a Change/Transfer of a Water Right. As described in Chapter 6, during the processing of a new water right application, Ecology applies a four-part test to determine if the water right can be legally permitted. When processing the application, Ecology will prepare an ROE, which describes how the four-part test applies to the proposed right. If the four-part test is satisfied, Ecology approves the application and issues a water right permit.

Water right permits specify how much water can be used, the place of use, the point of diversion (for surface water) or withdrawal (for groundwater), the specific type(s) of beneficial use allowed (such as irrigation, fish propagation, domestic use, etc.), and the period of use. Permits also typically contain a number of provisions that must be followed when putting the water to use. Examples of provisions include requirements to meter and report water usage, maintenance of an efficient water delivery system, and operation of a plan to prevent or mitigate impairment to senior water rights holders or instream flows. The permit sets a development schedule, setting the date by which the water project must be started and completed, and the date by which the water use is to be fully perfected (put to beneficial use).

Once a permittee puts their water to beneficial use and the project associated with the water right is fully developed, the project is reviewed to confirm the amount of beneficial use and Ecology issues a certificate for the water right. Following certification, the allocated quantity of the water right must be fully utilized at least once every 5 years (unless it qualifies for one of a limited number of special exceptions, including the exemption for water rights that qualify as being for "municipal water supply purposes") to remain fully valid.

Change applications are processed in a similar manner to new applications with one additional step. When preparing the ROE for a change application, Ecology must investigate the history of beneficial water use resulting from the underlying permit or certificate to determine if any portion or all of the originally authorized instantaneous or annual quantity (Qi or Qa) has been relinquished or abandoned due to nonuse without sufficient cause. Relinquishment and abandonment have specific definitions within water law as described below.

RCW 90.14.130–.180 governs the relinquishment of water rights, and Ecology's Policy 1060, *The Relinquishment, Rescission, and Abandonment of Water Rights*, defines water right relinquishment, abandonment, and rescission. The policy gives the following definitions:

- *"'Abandonment' is nonuse of a water right combined with an intent to abandon the water right. This is based on a common law doctrine for extinguishment of water rights that are unused, rather than a doctrine that was created by statute."*
- *"'Relinquishment' occurs when a water right has reverted to the state because of nonuse for five or more successive years after 1967 without sufficient cause that excuses the nonuse. There can be full or partial relinquishment of a water right. The law relating to relinquishment was created by statute."*

- *"'Rescission' is an administrative procedure to revoke a certificate of a water right or change certificate, where the quantity of water that was perfected through actual beneficial use of water is not in agreement with the maximum quantity specified in the state-issued certificate of water right."*

In a footnote to Policy 1060, it also notes that abandonment was defined by the courts in *Cornelius v. Washington Department of Ecology* as "*abandonment is the intentional relinquishment of a water right.*"

Certificates and claims are subject to relinquishment, but not permits, although permits may be subject to cancellation if their development schedules are not met without an authorized extension. Permits are not subject to relinquishment because the total water right allocation is not set until the right is perfected. That is, the quantity provided for in a permit may need to be reduced to the amount actually put to beneficial use once the right undergoes final certification. Policy 1060 states *"rights documented by permits become subject to relinquishment on the date they are certificated; meaning that five years of consecutive nonuse without sufficient cause through an exception … may be evaluated starting on the date that the certificate is issued."*

As noted in the definition for relinquishment, certain sufficient causes excuse the nonuse of a water right. These are listed in RCW 90.14.140 and described in Policy 1060. The statute was originally enacted in 1967, but over the years since then, the legislature has added additional sufficient cause exceptions. Ecology interprets that these additional causes became valid from the date the amended statute became effective; therefore, the new causes are not retroactively applied.

Sufficient causes, with their effective year, to preclude relinquishment include, but are not limited to:

- Water unavailability due to drought or other causes, 1967.
- Various irrigation issues, including temporary reductions due to weather conditions and reductions due to crop rotation, 2001.
- Waiting for a final determination of a change application if the water user is unable to legally use the water without the approval of the change application, 2012.
- Standby or reserve water rights, for example, water rights used only in times of drought, 1967.
- Municipal water rights, 1967.
- Trust water rights, 2001.

Involuntary relinquishment of a water right can only occur in three ways: through an administrative relinquishment order issued by Ecology, through a decision on a water right change application, and through a general water rights adjudication. RCW 90.14.130 authorizes Ecology to issue relinquishment orders, which involve a involves a multi-step process of documenting non-use and allowing the water right holder to prove that water was actually used or show cause for the non-use by demonstrating qualification for a relinquishment exception, as described in Policy 1060. When a court conducts a water right adjudication, it makes determinations of extent and validity for all water rights involved in the adjudication.

In processing change applications, Ecology or a conservancy board investigates the historical use of the water right and makes a tentative determination of the extent and validity of the right. If they find that all or a portion of the right has been relinquished for non-use, that portion of the right is not eligible for the change and is deemed to be invalid.

"Tentative determination of extent and validity" is defined by Ecology Policy 1120, *Water Resources Program Policy for Conducting Tentative Determinations of Water Rights*. It is defined as *"a determination of the extent and validity of an existing water right established pursuant to either chapter 90.03 RCW or 90.44 RCW, or claimed pursuant to chapter 90.14 RCW. Such determinations are tentative, as final determinations of the extent and validity of existing water rights can only be made by Superior Court through a general adjudication of water rights."* The policy further describes it as *"a water conservancy board's or the department of Ecology's finding of the amount of water perfected and beneficially used under a water right that has not been abandoned or relinquished due to non-use. In a proposal to change or transfer a water use, a tentative determination may include a decision as to the portion of the water right that is eligible for change, for instance, in some cases only consumptively used water may be eligible for change. A tentative determination is conducted for all uses associated with the entire certificate, permit,*[3] *or claim. In situations where forfeiture of water is not an issue, a simplified tentative determination may be needed*."

Policy 1120 lists both when a tentative determination should be made and when it is not warranted. Tentative determinations are made as part of Ecology's or a water conservancy board's permitting activities. According to Policy 1120, they are required:

- When evaluating uses of an existing surface water or groundwater right that is the subject of an application for change or transfer.
- When evaluating water use appurtenant to existing and proposed places of use under a new or change application.
- When evaluating water uses that are potentially impaired under a new or change application.
- When evaluating existing water uses associated with water rights pursuant to RCW 90.14.130 or other regulatory statutes that results in a departmental order.

There are several instances where tentative determinations are not warranted according to Policy 1120, including when a water right is donated to the Trust Water Rights Program (Trust) and when a right is acquired as a result of a water conservation project pursuant to Chapter 90.42 RCW. However, RCW 90.42 does contain other requirements for determining the extent and validity of trust water right acquisitions.

Additional Discussion of Other Alpine Lakes Water Rights

There are four other water rights on lakes within the Alpine Lakes Wilderness Area that are also within the study area. These are on Snow, Nada, and Colchuck Lakes. The most senior of these is the IID storage right on Colchuck Lake that is also a Class 5 right in the 1929 adjudication. Like its Eightmile Lake right, the IID applied for this right in 1926. The application was for 50 cfs and 2,500 acre-feet per year (afy), and those amounts were confirmed, but determined to be inchoate, in the adjudication The right was certificated on August 21, 1939 for 50 cfs; no Qa is listed.

The IID has two other rights in the wilderness area, both of which were applied for in 1929. Consequently, these rights were not part of the adjudication. One application was for using water from Snow Creek, although the application states there will be no diversion from the stream, rather water will be stored in Snow Lakes for supplementing Snow Creek flow during the summer. The other

[3] While a permit is eligible for a determination of extent and validity, it is not eligible for relinquishment per RCW 90.14.150 and RCW 90.14.180.

application is a reservoir application to store water in Snow Lakes.[4] Rather than completing the construction of the dam themselves, the IID entered into a contract with Reclamation stipulating that Reclamation would build a tunnel between Nada Lake and Upper and Lower Snow Lakes and control works at Upper and Lower Snow Lakes. In return, IID would grant Reclamation the right to use 250 acre-feet of its permitted 1,000 acre-feet of storage in Snow Lakes, with the remaining 750 acre-feet to be used only after the water in the District's other reservoirs has been tapped. According to records in the water right file for IID's Snow Lakes rights, Reclamation completed its development work at Snow Lakes in 1939. Subsequently, during the irrigation season in 1940, the IID used water from Snow Creek including some water stored in Snow Lakes. In 1941, they filed a Notice of Completion of Construction, and the two rights were certificated later that year.

In 1942, Reclamation applied for storage of 16,000 acre-feet in Nada and Upper and Lower Snow Lakes for the purpose of fish propagation at the Leavenworth National Fish Hatchery (LNFH; at the time called the Leavenworth Hatchery Station). This right was certificated that same year. The Reclamation-IID contract states that the storage volume of Upper and Lower Snow Lakes is 12,000 acre-feet, of which 750 acre-feet is dedicated to the IID. Based on that document, it is questionable whether 16,000 acre-feet of storage provided in the Reclamation water right was ever fully developed. The Proof of Appropriation document, which might answer this question for the Reclamation right, is missing from the water rights file in WRTS. The right is used to ensure an adequate flow of cool water in Icicle Creek to meet required LNFH flows under the USFWS diversionary right on Icicle Creek (USFWS 2009).

Additional Discussion of City of Leavenworth Diversionary Water Rights

The City of Leavenworth has diversionary rights that authorize an estimated combined total annual quantity of 1,465 afy. However, this figure is the subject of ongoing litigation.

The City conducted a water rights assessment in 2008. According to the City's current Water System Plan (Varela & Associates, Inc. 2018), this assessment identified alleged errors in Ecology's previous assessments of the City's water rights. The Water System Plan states:

> *"The City sought to clarify the scope and quantity of its water rights in the 2008 Amendment of the 2002 Water System Plan. That amendment was neither accepted nor rejected by DOH due a to [sic] disagreement between the City and Ecology. The City filed a declaratory judgment lawsuit to resolve those errors and determine [the] existing quantity of the City's water rights, City of Leavenworth v. Dep't of Ecology, Chelan County Superior Court cause number 09-2-00748-3. On July 19, 2012, Chelan County Superior Court Judge Lesley A. Allan entered a final Order on Parties' Cross-Motions (final order), which contained the superior court's rulings in the case…*
>
> *The City appealed the final order to the Washington Court of Appeals, Division III, (Case No. 312364). The appeal is currently subject to a March 11, 2013 Order Staying Further Proceedings, to allow the City and Ecology time to settle the appeal through replacement of the disputed water rights from another source in the Icicle Creek basin. The City and Ecology are actively participating in efforts with the Icicle Working Group to identify and fund projects that will result in water*

[4] The application actually asks to dam Snow Creek, but later documents in the water right file indicate the proposed dam is on Snow Lakes.

savings that can be transferred to the City for this purpose.[5] *Until a final resolution of the appeal, the City's water right dispute with Ecology is unresolved. The City has not revised its water right self-assessment pending resolution of the appeal, but is voluntarily complying with the conditions contained in the final order until the appeal is resolved."*

As discussed in Chapter 6, the City asserted the Qa assigned to surface water certificate 8105 (S4-*16124CWRIS), which does not include a Qa figure, is 1,085 afy, while Ecology asserted the Qa is 275 afy. The City and Ecology recently entered into a settlement agreement in November 2023 (*City of Leavenworth v. Department of Ecology)*. Currently, the Qa for this water right is considered to be 275 afy as shown in Table B-2, and the estimated combined total Qa for the City's water rights is 1,465 afy. The parties agree to continue to seek water supply solutions. See *City of Leavenworth v. Department of Ecology* for additional information.

The City also has two rejected surface water applications and two active change applications. Change application CS4-ADJ35P4 seeks to correct the point of diversion for right S4-*35004JWRIS, which is incorrectly listed. The other is a seasonal change application (CS4-35004J@1) which seeks to temporarily change the point of diversion for S4-*35004JWRIS from the existing diversion on Icicle Creek to the City's wellfield near the Wenatchee River during construction of a new fish screening structure.

Additional Discussion of Icicle Creek Water Use

Water diverted by the City of Leavenworth, IPID, and COIC is used consumptively for either irrigation or municipal uses (which includes domestic, commercial, and irrigation uses), with specific purposes of use authorized described on respective water rights held by these entities. According to the PEIS (Ecology 2019), the three water purveyors serve approximately 3,250 parcels. Generally speaking, the City serves smaller parcels, most less than half an acre, and the irrigation districts serve larger parcels, most larger than 1 acre (Table B-1).

Table B-1. Number and Size of Parcels Served by Water Purveyors

Parcel Size	Number of Parcels Served		
	City of Leavenworth	IPID	COIC
0.00–0.10	108	0	0
0.11–0.25	552	128	0
0.26–0.50	270	234	12
0.51–1.00	150	361	65
1.01–2.00	122	353	118
2.01–3.50	36	135	19
>3.50	41	508	41
Total	**1,279**	**1,719**	**255**

Data from PEIS (Ecology 2019)

[5] The proposed Trust donation of part of the Eightmile Lake water right will only be for instream flow benefits and will not be used to provide additional water to the City.

Additional Discussion of Other Surface Water Rights

Within the study area, Ecology records show 22 surface water rights for diversions from Icicle Creek or its tributaries (see Table B-2). For some of the rights, the Qa is not listed on the right's certificate. In those cases, the Qa listed on WRTS was used for Table B-2, or if the Qa was also blank on WRTS, the value was estimated as described in the table notes. In several cases the Qa is estimated based on the water duty calculation from the Referee's Report of the Icicle Creek Decree (Superior Court of the State of Washington 1929). The Referee's report calculates a water duty for a 5-month irrigation season as 1 acre-foot for each irrigated acre except for irrigated lands in with Cascade Orchard Tracts for which the duty is 1.2 acre-feet per irrigated acre.

Table B-2. Icicle and Snow Creek Water Rights

Water Right No.	Person or Organization	Priority Date	Purpose of Use	Additive		Source Name
				Qi (cfs)	Qa (afy)[a]	
S4-*35001JWRIS	Cascade Orchards Inc	1905 (Class 1)	Irrigation	11.9[b]	*2,064.5*[c]	Icicle Creek
S4-CV1P170	Cascade Orchard Inc	1905 (Class 1)	Irrigation, fish propagation, domestic multiple [d]	0.203[d]	0	Icicle Creek
S4-*35002ABBJWRIS	Icicle Irrigation District	04/01/1910 (Class 2)	Irrigation	81.5775[e]	*25,000*[f]	Icicle Creek
S4-CV1P224	Icicle Irrigation District	04/01/1910 (Class 2)	Irrigation	1.7525[e]	0	Icicle Creek
S4-*35003ABBJWRIS	Snow Creek Water Users Inc	10/14/1910 (Class 3)	Irrigation	4.0	*450*[g]	Snow Creek
S4-*35005JWRIS	Fromm, S J	1912 (Class 4)	Irrigation	0.1	*30* [h]	Mountain Home Creek
S4-*35006AWJWRIS	Fromm, S J	1912 (Class 4)	Irrigation	0.17[j]	*50* [i, j]	Mountain Home and Turner Creeks
S4-*35004JWRIS	City of Leavenworth	1912 (Class 4)	Municipal	1.52	*1,100*[k]	Icicle Creek
S4-*00329CWRIS	Peshastin Irrigation District	10/27/1919 (Class 5)	Irrigation	34.38	*10,315*[l]	Icicle Creek
S4-CV1P18[m]	Snow Creek Water Company	01/03/1922[m]	Irrigation	—	—	Snow Creek
S4-*35007JWRIS	Simons, R E	Class 6 (10/28/1929)[n]	Irrigation	0.17	*50* [i]	Icicle Creek
S4-*35008JWRIS	Briskey, O	Class 6 (10/28/1929)[n]	Irrigation	1.0	*300* [o]	Icicle Creek

Water Right No.	Person or Organization	Priority Date	Purpose of Use	Additive		Source Name
				Qi (cfs)	Qa (afy)[a]	
S4-*35009JWRIS	Fromm, S J	Class 6 (10/28/1929)[n]	Irrigation	0.08	*25* [p]	Icicle Creek
S4-*35010JWRIS	Fromm, S J	Class 6 (10/28/1929)[n]	Irrigation	1.0	*300* [o]	Icicle Creek
CS4-01824C@2	USFWS Leavenworth Fisheries Complex	03/26/1942[q]	Fish Propagation	42.0	27,482[q]	Icicle Creek
S4-*16124CWRIS	City of Leavenworth	06/20/1960	Municipal	1.5	*275*[r]	Icicle Creek
S3-+20357CWRIS	Beemer, T A	07/25/1972	Irrigation	—[s]	—[s]	Icicle Creek
S3-+20593CWRIS	Elmore, H C	10/31/1972	Domestic Multiple	0.02	2	Icicle Creek
S4-24376CWRIS	Falzon, D	08/03/1976	Irrigation	0.05	10	Icicle Creek
S4-28122	City of Leavenworth	01/28/1983[t]	Municipal	3.18	90[t]	Icicle Creek
S4-31676[u]	Johnson, Robert	1/29/1993	Fish Propagation, Irrigation, Domestic Multiple, Fire Protection	1.0	357.3[v]	Mountain Home Creek
S4-33068(A)[u]	City of Leavenworth	06/08/2012	Municipal	—[w]	—[w]	Icicle Creek

a. Quantities in *italics* are estimates; see other table notes for details.

b. Qi set by adjudication as 12.0 cfs in Icicle Creek Decree; certificate confirms 12.0 cfs; however, WRTS lists as 11.9 cfs reflecting change certificate S4-CV1P170.

c. Qa not listed on decree, nor on certificate. WRTS lists Qa as 2,064.5 afy. It is unclear how this quantity was derived as it does not meet the formula established by the Referee's Report (600 acres for 5 months with 1.2 acre-feet per month, or 3,600 acre-feet total), and the quantity listed on the WTRS may be incorrect.

d. In 1939 LNFH and COIC entered into an agreement concerning the use of the point of diversion, associated infrastructure, and shared water use through exercise of COIC's water right S4-*35001JWRIS. Following the 1939 agreement between COIC and LNFH, Certificate of Change S4-CV1P170 was issued in 1940 to formalize the 1939 Agreement. S4-CV1P170 changed the purpose and place of use for a total of 0.203 cfs of water from S4-*35001JWRIS. The purpose of use for 0.1 cfs was changed to fish propagation and domestic use on LNFH land. The place of use for the remaining 0.103 cfs was adjusted for COIC irrigation use within their service area. This reduced the water available for COIC irrigation from 12 cfs to 11.9 cfs. Additionally, the surplus water used by LNFH each year was formalized by Ecology in a permit in 1940, that was issued to authorize the changes to the water right that were approved. The permit authorized changes to the place and purpose of use for the surplus water for an indefinite time period. While this permit does not have an identifier or permit number, it is included within the file in WRTS under S4-CV1P170 and Ecology interprets it as part of the same record and authorization as S4-CV1P170. S4-006167CL is a statement of claim filed by COIC in 1971 for 5.627 cfs of water for the irrigation of 422 acres of COIC land (see Table 6-5 in Chapter 6). This claim specifies the shared point of diversion between LNFH and COIC. The details of this claim are redundant to adjudicated water right S4-*35001JWRIS, and the claim is not additive to S4-*35001JWRIS.

e. Qi set by adjudication as 83.33 cfs in Icicle Creek Decree; certificate confirms 83.33 cfs; however, WRTS lists as 81.5775 cfs reflecting Qi moved by change certificate S4-CV1P224.

f. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (5,000 acres for 5 months with 1 acre-foot per month, 25,000 acre-feet in total).
g. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (90 acres for 5 months with 1 acre-foot per month, 450 acre-feet in total).
h. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (6 acres for 5 months with 1 acre-foot per month, 30 acre-feet in total).
i. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (10 acres for 5 months with 1 acre-foot per month, 50 acre-feet in total).
j. WRTS lists the Qi and Qa as "supplemental" (non-additive) for this right, but that is not reflected on the certificate and no other documents are available from WRTS. Based on the certificate, we assume it is additive and WRTS is incorrect.
k. Qa is not listed on either the Icicle Creek Decree nor the certificate. If one presumes Qa is equal to constant application of Qi, the Qa would be 1,101 afy. The City's water system plan (Varela & Associates, Inc. 2018) lists the annual quantity for this right as 1,100 afy.
l. Qa is not listed on either the Icicle Creek Decree, the certificate, nor WRTS. The Qa listed here is an estimate based on applying the water duty calculations in the Referee's Report. The amount listed her was derived by application of the water duty calculations in the Referee's Report (2063 acres for 5 months with 1 acre-foot per month, 10,315 acre-feet in total).
m. No documents are available on WRTS for this right, which is listed as a Certificate of Change without a Qi or Qa. As a change certificate, it likely is a change in point of diversion or place of use for S4-*35003ABBJWRIS, so any Qi or Qa would be non-additive to that right. The priority date is listed in WRTS as 1/3/1922. However, it is a change from S4-*35003ABBJWRIS, the priority date potentially should be 10/14/1910, the same as S4-*35003ABBJWRIS.
n. The Icicle Creek Decree lists the lands pertinent to these rights as being in Class 6 but does not establish a priority date. The certificates for the rights list the priority date as "not given." WRTS lists the priority dates as 01/01/1901. However, we learned that January 1, 1901 is typically the default date added to WRTS when the priority date field is left blank (pers. comm., Ingrid Ekstrom, Washington Department of Ecology). As Class 6, their priority dates should be after the Class 5 rights. Consequently, we estimate the priority dates for the rights is the date of the Icicle Creek Decree.
o. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (60 acres for 5 months with 1 acre-foot per month, 300 acre-feet in total).
p. Icicle Creek Decree and certificate do not list a Qa. The amount listed on WRTS was apparently derived by application of the water duty calculations in the Referee's Report (5 acres for 5 months with 1 acre-foot per month, 25 acre-feet in total).
q. This water right change allowed an additional point of withdrawal for right S4-*05671CWRIS. No Qa was listed on the certificate for S4-*05671CWRIS. Qa was assigned as part of the processing of the water right change.
r. The estimated Qa is based on the application requesting 1,085.95 afy; the certificate not listing a Qa, but only a Qi of 1.5 cfs, which if applied continuously is 1,086.7 afy; and the City's water system plan which argues for a Qa equal to the full instantaneous quantity. However, in a later water rights action, Ecology assigned a Qa of 275 afy on this right. The matter was litigated in *City of Leavenworth v. Department of Ecology*, and parties entered into a settlement agreement in November 2023, but continue to seek water supply solutions. The Qa is considered to be 275 afy (see Chapter 6).
s. The Qi, 0.075 cfs, and Qa, 29.4 afy, were originally additive. However, the right was changed in 1995 to change the point of diversion from Icicle Creek to a well adjacent to the Creek under Change authorization no. CS3-20357C and the Qi and Qa for that groundwater right are additive, leaving the surface water right as non-additive. It is listed on WRTS as "supplemental" (non-additive).
t. While the priority date for this right is earlier than the priority date for the Icicle Creek instream flow rule, the right is interruptible when the flow rule is not met due to a provision on the right's permit and the ROE was issued following the effective date of the instream flow rule. Additionally, the permit for this right allocates a Qa of 636 afy, of which 546 afy is non-additive. Further, the primary/additive 90 afy is not in addition to any primary/additive 90 afy granted by the permit for groundwater right G4-29958. This right is the subject of the on-going litigation discussed above and the quantities may change subject to the final results of that litigation.
u. WRTS lists this right as being in permit stage, but the permit document is not available online. Qi and Qa amounts are from the ROE.
v. According to the ROE, the total Qa is 381 afy, of which the amount for multiple domestic, 23.7 afy, is an alternative non-additive source to G4-32057.
w. The ROE approves non-additive Qa of 702 afy and non-additive Qi of 1.17 cfs, of which, 0.070 cfs is debited to the Icicle Subbasin Reserve. The non-additive quantities are non-additive to groundwater quantities from the City's wellfield near the Wenatchee River, outside of the Icicle Creek subbasin.

There are five other surface water rights in the study area with sources other than Icicle Creek and its tributaries. These rights are all for various unnamed springs, as listed below.

Table B-3. Other Surface Water Rights

Water Right No.	Person or Organization	Priority Date	Purpose of Use	Additive		Source Name
				Qi (cfs)	Qa (afy)	
S4-*18738CWRIS	Easterly, G L	10/7/1964	Domestic Single, Irrigation	0.05[a]	10.0[a]	unnamed spring
S4-*20463CWRIS	Knaake, E J	8/23/1967	Domestic Single	0.01	2.0	unnamed spring
S4-01193CWRIS	Hendrickson, R L	5/17/1971	Stock Water, Irrigation	0.15	28.5	unnamed spring
S3-+22417CWRIS	Dempsey, L C	1/24/1974	Domestic Multiple	0.007	3.6	unnamed spring
S4-25612GWRIS	Ritter, D W	11/16/1977	Stock Water, Irrigation	0.06	16.6[b]	unnamed spring

a. These are the values given on WRTS and are the same as in the permit. However, the certificate is written for a Qi of 0.02 cfs and a Qa of 5 afy. It is unclear why the permit values are used in WRTS.
b. The certificate lists the total Qa as 16.4 afy while the WRTS lists 16.6 afy. However, the total given on the certificate is possibly an error, as the certificate also states there should be 0.2 afy for stock water and 16.4 afy for irrigation.

Additional Discussion of Groundwater Rights

Groundwater Certificates and Permits

The 12 water rights have a total allowed instantaneous withdrawal (Qi) of 5,402.1 gpm and a total annual quantity (Qa) of 6,592.6 acre-feet. However, the vast majority of this is used non-consumptively for fish propagation by the LNFH. The USFWS has rights to 5,100 gpm and 6,377 afy of non-consumptive use. The groundwater rights are summarized on Table 4.7.

Table B-4. Groundwater Water Rights

Water Right No.	Person or Organization	Priority Date	Purpose of Use	Additive	
				Qi (gpm)	Qa (afy)
G4-*03818CWRIS	Wilson, W D	12/14/1954	Irrigation	50	33.0
G4-*04716CWRIS	USFWS	10/16/1957	Fish Propagation	1,200	1,120.0
G4-*08640CWRIS	Conwell, B L	04/04/1967	Irrigation	44	28.0
G3-+00062CWRIS	Coffman, K E	07/06/1971	Domestic Single, Irrigation	27	17.0
CS3-20357C	Beemer, W A	07/25/1972[a]	Irrigation	33.6	29.4
G4-25294CWRIS	Blanchard, H	06/03/1977	Domestic Single, Irrigation	40	18.0
G4-27115ALCWRIS	USFWS	10/20/1980	Fish Propagation	3,900	5,257.0
G4-27336GWRIS	Dahlgreen, A E	02/26/1981	Domestic Single, Irrigation	12.5	12.6
G4-28322	Adams, S	10/24/1983	Domestic Single, Irrigation	25	24.1
G4-30213	Jensen, B	03/19/1990	Domestic Single, Irrigation, Frost Protection	10	1.0
G4-30243	Nelson, CW	04/23/1990	Domestic Single	10	1.0
G4-32057	Johnson, R K	04/22/1994	Domestic Multiple, Irrigation	50[a]	51.5[b]

a. This right is a change on S3-+20357CWRIS from a diversion on Icicle Creek to a well. WTRS lists the priority date as July 5, 1994, which is the date the change application was made. However, the priority date for the surface water right is July 25, 1972.

b. The permit indicates 50 gpm additive for multiple domestic and 50 gpm non-additive for irrigation, but the combined withdrawal for domestic and irrigation uses cannot exceed 50 gpm. Also consumptive multiple domestic use shall not exceed 0.01 cfs (7.24 acre-feet) in September. Multiple domestic authorization is primary to an alternate, non-additive source under S4-31676. Quantities authorized for irrigation are subject to interruption when instream flows are not met.

USFWS Groundwater Rights

The LNFH has two groundwater rights (Table B-4) and two water right claims (Table B-5). The rights total 5,100 gpm and 6,377 afy, while the claims add 1,600 gpm and 1,300 afy. Groundwater is used to supplement water quantities and modify temperatures of the hatchery's surface water supply. Reportedly, the hatchery requires between 1,060 and 6,590 gpm of groundwater, with the highest needs in June and December, to supplement their surface water source (Reclamation 2010). However, recently the LNFH has been limited to a peak production of about 3,200 gpm and 2,600 afy due to well inefficiencies, drawdown interference, and low water levels (Aspect 2016). The hatchery produces groundwater from a wellfield consisting of seven production wells scattered across their property.

Table B-5. Groundwater Water Claims

Water Right No.	Person or Organization	Claimed Date of First Use	Purpose of Use	Qi	Qa (afy)
G4-129299CL	Stroup, R H	05/1939	Domestic General	3 gpm	2.0
G4-012008CL	USFWS	08/1939	Fish Propagation	700 gpm	570.0
G4-020982CL	Nigbor, E V	01/1940	Stockwater, Irrigation	0.07 cfs	4.0
G4-012009CL	USFWS	06/1940	Fish Propagation	900 gpm	730.0
G4-115923CL	Gregory, H L	05/15/1944	Domestic General	nl	nl
G4-016911CL	King, V R	03/15/1948	Domestic General, Irrigation	160 gpm	62.0
G4-063300CL	Marson, K M	08/1954	Domestic General	100 gpm	nl
G4-100738CL	Holcombe, A M	02/1955	Domestic General	3 gpm	2.0
G4-099272CL	Titus, D	04/1968	Domestic General	3 gpm	2.0
G4-082534CL	Horton, VL	05/01/1973	Domestic General	10 gpm	2.0
G4-081569CL	Fliegel Jr, J J	09/1973	Domestic General	10 gpm	2.0
G4-129298CL	Stroup, R R	10/1973	Domestic General	3 gpm	2.0
G4-081260CL	Wicks, G	04/1974	Domestic General	10 gpm	1.0
G4-145057CL	Gibb, L	05/01/1975	Irrigation, Domestic General	310 gpm	124.0
G4-034939CL	Chamberlin, B M	nl	Domestic General	nl	nl
G4-053022CL	Ranahan, H J	nl	Domestic General	nl	nl
G4-058173CL	Woods, E A	nl	Domestic General	nl	nl
G4-067862CL	Silhavy, C F	nl	Domestic General	nl	nl
G4-070629CL	Norris, B	nl	Domestic General, Stockwater	nl	nl
G4-078108CL	Foster, C M	nl	Domestic General	nl	nl
G4-085190CL	Marson, K G Sr	nl	Domestic General	nl	nl
G4-089900CL	Parish, J W	nl	Domestic General, Irrigation	nl	nl
G4-129097CL	Weinhold, M R	nl	Domestic General	nl	nl
G4-130028CL	Smith, R L Jr	nl	Domestic General, Stockwater, Irrigation	nl	nl
G4-132630CL	Carlson, A N	nl	Domestic General, Irrigation	nl	nl
G4-132631CL	Carlson, A N	nl	Irrigation, Domestic General	nl	nl
G4-152358CL	Dempsey, L C	nl	Stockwater, Irrigation, Domestic General	nl	nl

nl – not listed on claim form

Permit-Exempt Wells

Permit-exempt wells are exempt from the requirement to obtain water right permits, but they still have water rights and are subject to water law principles, including interruption of use when interfering with senior rights, including previously established instream flow rules. It is difficult to determine the number of permit-exempt wells in the Icicle Creek Subbasin. However, based on a review of well logs in Ecology's online well log database conducted by the EIS team in 2021, there appear to be about 38 permit-exempt wells within the study area above the LNFH diversion on Icicle Creek and about 255 permit-exempt wells below. Most of these wells support single-domestic usage, but many likely support Group B water systems, which can have up to six Equivalent Residential Units (ERUs). A review of the Washington State Department of Health Source Water Assessment Program online mapping application indicates there are 17 Group B systems in the study area.

The wells in the upper portion of the basin and on the hillsides above the valley in the lower basin are mostly completed in bedrock, while those on the valley floor in the lower portion of the basin are completed in unconsolidated sediments. The amount of water produced by permit-exempt wells in the Icicle Creek subbasin is unknown. However, an estimate can be made based on projected water demand per ERU from the City of Leavenworth's water system plan. The water system plan projects annual demand per ERU at 98,250 gallons (Varela & Associates, Inc. 2018), which is equivalent to about 0.3 acre-feet. Assuming each Group B system has a single well, the Group B systems average 4 ERUs, and the non-Group B wells each represent a single ERU, the estimated 288 permit-exempt well logs in the study area represent about 340 ERUs. Further, assuming the water demand for ERUs on permit-exempt wells is approximately equal to the water demand in the City of Leavenworth, the total annual water production from the permit-exempt wells in the study area is about 102 acre-feet.

Groundwater Claims

Groundwater claims are an official statement claiming a water right for water use that predates the State's Groundwater Code of 1945. Validity of claims can only be determined and confirmed through a legal adjudication by the court. However, any groundwater claim with a date of first use after 1945 is probably not valid. WRTS lists 27 groundwater claims in the study area (Table B-5).

As described above, claims can only be filed during certain open periods allowed by the legislature, and the form used depends on the particular open period. Long forms requested the claimant report the date of first water use (although not all claimants using the form filled in the date), while short forms did not ask for the first date of use or the amount being used. Therefore, many claims do not list a claimed quantity or date of first use.

Active Groundwater Right Applications

There are seven active groundwater right applications within the study area. These include five change applications and two new applications.

One of the new applications is for a current permit-exempt well where, according to a note in the documentation on WRTS, the applicant understands they do not need a permit but wants to obtain one anyway.

The other new application is for a property that currently has a surface water right, S3-+22417CWRIS. The same applicant also has one of the change applications, which seeks to move the authorized quantity to the same well as the new application.

The four other change applications all belong to the USFWS. The USFWS change application seeks to add additional points of withdrawal for the LNFH's existing groundwater rights.

References

Anchor QEA, Aspect Consulting, and Washington Water Trust. 2015. Alternatives Evaluations Study – Public Release Version Cascade Orchards Irrigation Company. URL: https://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/current-project/COIC%20Alternatives%20Analysis%202015.pdf.

Aspect. 2016. Leavenworth National Fish Hatchery Water Supply Action Plan. Memorandum to Steve Croci, Leavenworth National Fish Hatchery. URL: https://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/current-project/LNFH/LNFH%20Action%20Plan.pdf.

Chelan County Superior Court, State of Washington vs. Icicle Irrigation District, No. 8252 Report of Referee, 1929.

Ecology (Washington State Department of Ecology). 2019. Icicle Strategy - Icicle Creek Water Resource Management Strategy, Final Programmatic Environmental Impact Statement. Publication # 18-12-016. January 2019. URL: https://www.co.chelan.wa.us/natural-resources/pages/environmental-review.

Reclamation (U.S. Bureau of Reclamation). 2010. Groundwater Conditions at the Leavenworth National Fish Hatchery, Leavenworth, Washington. URL: http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/Icicle_Studies/140-218%20LNFH%20groundwater%20report%20(Feb%202010)%20(2).pdf.

Superior Court of the State of Washington. 1929. No. 8252 Report of Referee, in the matter of the determination of the rights of the use of the waters of Icicle Creek and its tributaries in Chelan County, Washington. Signed by R.K. Tiffany, State Supervisor of Hydraulics. April 18, 1929.

USFWS (U.S. Fish and Wildlife Service). 2009. Leavenworth National Fish Hatchery, Proposed Flow Management Operations for 2009 – 2014.

Varela & Associates, Inc. 2018. City of Leavenworth Water System Plan. Available at: URL: https://cityofleavenworth.com/col-assets/uploads/2018/02/14-10-01-Leavenworth-WSP-final-2018.pdf.

Appendix C: Plant Survey Memo

ESA

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memorandum

date	November 24, 2021
project	Eightmile Dam Rebuild and Restoration Project
to	Brigitte Ranne, U.S. Forest Service
from	Sierra McComas, Environmental Science Associates
subject	Vegetation Survey for the Eightmile Dam Staging Area and FS Road 7601-116

INTRODUCTION

On behalf of the U.S. Forest Service (FS), Environmental Science Associates (ESA) conducted a survey of habitat conditions, rare, threatened, and endangered (RTE) vascular plant species, and undesirable plant species for the Eightmile Dam Rebuild and Restoration Project (Project). The survey focused on two study area locations in Chelan County, including the Eightmile Dam Staging Area and a portion of FS Road 7601-116 to be improved as part of project operations (**Appendix A, Figure 1**). The Staging Area is located in Township 24 North, Range 16 East, Section 34 and the segment of FS Road 7601-116 spans Township 24 North, Range 16 East, Sections 26 and 27.

ESA Environmental Scientists, Sierra McComas and Hannah Smiley, surveyed the Staging Area and the defined segment of FS Road 7601-116 on September 30, 2021. The weather on the day of the survey included intermittent rain, wind, and partially cloudy skies. The Fish Lake weather station is located approximately 10 miles east of Eightmile Lake at a similar elevation as the study areas. On September 30, the station recorded a maximum temperature of 50 degrees, a minimum temperature of 37 degrees Fahrenheit, average temperature of 43.5 degrees, and 0.70 inch of precipitation. No snow was reported nor had accumulated on the ground at the time of the survey.

SURVEY METHODS

ESA field staff recorded vegetation types and surveyed for populations of target RTE and undesirable plant species within the study areas determined by the planned extent of the Eightmile Dam Staging Area and roadbed of the FS Road 7601-116 segment. All surveys were conducted simultaneously.

Because of the time constraints concerning construction and permitting, the study areas were surveyed outside of the peak bloom period for many of the target species. As a result, the ESA field surveyors identified potentially suitable habitat for target species that may be present but not in bloom. Additionally, in the absence of diagnostic blooming features, remaining senesced inflorescence and vegetation were utilized to identify species found on site.

The survey methodology consisted of the following steps: (1) determine survey locations; (2) gather preliminary habitat data and develop target lists of plant species reasonably likely to occur in the Project vicinity; (3) conduct field surveys; and (4) compile mapping and data for reporting. These steps are described in further detail in subsequent discussion.

Study Areas

The extents of the two study areas were determined based on communications between the Icicle and Peshastin Irrigation Districts (IPID), FS, and ESA concerning access to Eightmile Dam (Jantzer 2021a, 2021b). From these communications, the following two study areas were derived:

Staging Area Study Area

- The entirety of the proposed 0.14 acre Staging Area (**Appendix A, Figure 2**) and a 10-foot buffer surrounding the area.

FS Road 7601-116 Segment Study Area

- The full 24-foot width of the roadbed for the first 4,280 feet of FS Road 7601-116 (which will be cleared for a 10-foot width roadbed) (**Appendix A, Figure 3**) extending north from the intersection of FS Road 7601 with the following additional areas:
  - The last 100 feet (to be cleared the full 24 feet for parking) was surveyed 10 feet on both sides of the 24-foot wide roadbed.
  - The last 30 feet (to be widened to 30 feet for a turnaround) was surveyed 15 feet from the roadbed edge on both sides of the road.
  - The entirety of the debris pile at the end of the road (that will be used to widen the road) was surveyed.

Pre-field Data Collection and Development of Plant Species Lists

Preliminary habitat data and lists of RTE and undesirable vascular plant species with potential to occur in the study areas were gathered prior to fieldwork as part of the survey methodology and are described below.

Staging Area Preliminary Habitat Data

- Elevation: Approximately 5,150 feet above mean sea level (MSL).
- Natural Resources Conservation Service (NRCS) soil type: soda very bouldery sandy loam, 30 to 60 percent slopes (NRCS 2021).
  - Ecological site: east mountain slopes forest subalpine fir.
  - Vegetative classification: subalpine fir/Cascade azalea.
- U.S. Environmental Protection Agency (EPA) Ecoregion 77c: The North Cascades Subalpine/Alpine ecoregion is characterized by high mountain peaks, bare rock, glaciers, many tarns, plentiful precipitation, and sediment-laden glacial meltwater streams (EPA n.d.). Subalpine meadows occur around the taller peaks; their flora and fauna are adapted to the prevailing subarctic climate (EPA n.d.).
- Located within the Alpine Lakes Wilderness Area.

FS Road 7601-116 Segment Preliminary Habitat Data

- Elevation: Begins at approximately 3,250 feet above MSL and extends to approximately 3,800 feet above MSL.
- NRCS soil and vegetation types:
  - Icicle very bouldery sandy loam, 3 to 30 percent slopes.
  - Icicle very bouldery sandy loam, 30 to 75 percent slopes.
  - Icicle-chumstick-rock outcrop complex, 45 to 90 percent slopes.
  - Vegetative classification: grand fir/cascade Oregon grape/pinegrass.
  - Ecological site: cool frigid xeric ashy slopes (grand fir cool dry grass).
- EPA Ecoregion 77g: The glaciated Wenatchee/Chelan Highlands ecoregion is characterized by mountains and ridges, tarns, U-shaped valleys, and dissected high-gradient streams. Leeward climatic

conditions prevail (EPA n.d). Douglas-fir, grand fir, and subalpine fir are common; lodgepole pine and Engelmann spruce also occur (EPA n.d.).

- Located 0.31 mile northeast of the nearest portion of the Alpine Lakes Wilderness Area.

RTE Plant Target Species List

The target list of RTE plant species included vascular plant species that are federally threatened or endangered under the Endangered Species Act and rare plant species identified by the Washington Natural Heritage Program (WNHP). A target list of 17 species was generated from the following sources:

- WNHP records of rare plant species documented as occurring within 10 miles of the study areas (**Table 2)** (WDNR 2021b).
- 2019 Forest Service Region 6 Regional Forester Special Status Species: Okanogan-Wenatchee National Forest Federally Threatened, Endangered, or Proposed Species (**Table 2**) (**Appendix B)** (Forest Service 2019).

Undesirable Plant Target Species List

The target list of noxious weed species was generated from the following sources:

- 2021 Chelan County Noxious Weed List (**Appendix C**) (Chelan County 2021).
- 2021 Washington State Noxious Weed List (**Appendix D**) (Washington State Noxious Weed Control Board 2021).
- 2010 Forest Service Region 6 Invasive Plant List (**Appendix E**) (Forest Service 2010).

Prior to the start of surveys, the field team reviewed data relating to the plant species identified on the RTE and undesirable plant species target lists. For RTE species, the Burke Herbarium Image Collection (Burke Herbarium 2021) and the Online Field Guide to the Rare Plants of Washington (WNHP 2021) were reviewed to gain familiarity with seasonal morphological characteristics of target RTE plant species and the habitat requirements of each. Geographic information system (GIS) data regarding the location of RTE plant populations within the study area, provided by WNHP, was also reviewed. For undesirable species, the Washington State Noxious Weed Control Board invasive species plant profiles were reviewed prior to field work commencing.

Methods for Habitat Conditions Survey

While simultaneously conducting walking surveys for RTE and undesirable plants, ESA field staff mapped and recorded habitat conditions observed within and directly adjacent to the study areas. Field staff also photo-documented habitats and related species. Indicators used to identify habitat types included:

- Dominant species
- Soils
- Vegetative structure
- Geomorphology

Field staff used navigation system software (GNSS) Bluetooth receivers paired with tablet computers to record any relevant habitat data in real time and at resource-grade accuracy.

Methods for RTE Plant Survey

ESA field staff conducted meandering walking surveys of the study areas to determine RTE plant presence and/or the presence of potentially suitable habitat. Indicators used to identify potential habitat for sensitive plants included:

- The area is relatively undisturbed with <20 percent cover of non-native/invasive species.
- At least three associated species are present.

- Vegetative characteristics of the possible target plant indicate a likely match.
- Soil, geomorphology, and aspect meet the requirements of identified sensitive plant habitats.

Field staff used GNSS Bluetooth receivers paired with tablet computers to record any relevant sensitive species data in real time and at resource-grade accuracy.

Methods for Undesirable Plant Survey

ESA field staff conducted meandering walking surveys of the study areas to identify undesirable plant species. Where undesirable plants were observed, field staff estimated the extent of the population and used GNSS Bluetooth receivers paired with tablet computers to record noxious weed data in real time and at resource-grade accuracy. Field staff also photographed representative populations of target species. As ecological integrity is important in and around Wilderness Areas, other incidental observations of non-native species whose vegetation or inflorescence had not yet fully senesced were also recorded when observed.

HABITAT CONDITIONS SURVEY RESULTS

Based on the results of the surveys, there are similarities in the botanical species observed within both study areas. However, differences in elevation, soil type, geomorphic conditions, and aspect have created unique vegetation communities within these areas. In 2012, both study areas were scorched in the Cashmere wildfire (WDNR 2021a). The wildfire contributed to the landscape composition by creating gaps in the canopy, removing vegetation and altering soil compositions, thus allowing new communities of trees, shrubs, and forbs to grow in the newly created open areas. The physical characteristics differentiating the two study areas are described in the following discussion.

The Staging Area covers a relatively small patch of habitat and consists of one subalpine vegetation community. However, the FS Road 7601-116 study area stretches approximately 0.85 mile with an elevation change of approximately 550 feet. Within this range, the vegetation communities vary slightly with a less drought-tolerant, more dense habitat occurring at the lower elevations, and a sparser, drier habitat occurring at the higher elevations. Both the Staging Area and lower segment of FS Road 7601-116 occur in or near a topographical basin or drainage. The upper portion of FS Road 7601-116 is located on a south-facing slope. The plant communities and habitat types of the study areas are summarized in **Table 1**.

Table 1. Vegetation Communities Surrounding the Study Areas

Vegetation Community	Associated Species	Observed Conditions and Species	Photograph
Staging Area			
Subalpine habitat with subalpine fir forest associations	Subalpine fir forests in this region are associated with the following species seen in the vicinity of the study area: subalpine fir (*A. lasiocarpa*), Pacific silver fir (*Abies amabilis*), Engelmann spruce (*Picea engelmannii*), mountain hemlock (*Tsuga mertensiana*), lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii)*, grand fir (*Abies grandis*), quaking aspen (*Populus tremuloides*), common juniper (*Juniperus communis*), serviceberry (*Amelanchier alnifolia*), thimbleberry (*Rubus parviflorus*), white hawkweed (*Hieracium albiflorum*), aster (*Aster* spp.), and common yarrow (*Achillea millefolium*).	The Staging Area was set back from the lakeshore via distance and elevation. Fir trees with lower story vegetation were present. Species observed within and surrounding the area included: Douglas-fir, subalpine fir, silver fir, Engelmann spruce, mountain hemlock, black cottonwood (*Populus balsamifera*), quaking aspen, common juniper, Oregon boxwood (*Paxistima myrsinites*), currant (*Ribes* sp.), elderberry (*Sambucus sp.*), thimbleberry, mullein (*Verbascum thapsus*), milk vetch (*Astragalus* sp.), white hawkweed, common yarrow, aster, various clumping and non-clumping grasses, yellow salsify (*Tragopogon dubius*), red sand spurrey (*Spergularia rubra*), and blackcap raspberry (*Rubus leucodermis*).	
Upper Elevation Portion of FS Road 7601-116 Segment			
Montane highland habitat with grand fir forest associations	Highland forested habitat is found at lower elevations than subalpine communities. Some species commonly associated with grand fir forest zones in the eastern Cascades included: grand fir, western hemlock (*Tsuga heterophylla*), mountain hemlock, Douglas-fir, ponderosa pine (*Pinus ponderosa*), lodgepole pine, Oregon boxwood, willow (*Salix* spp.), rose (*Rosa* spp.), common snowberry (*Symphoricarpos albus*), snowbrush (*Ceanothus velutinus*), serviceberry, blue elderberry (*Sambucus cerulea*), fragrant bedstraw (*Galium triflorum*), white hawkweed, and lupine (*Lupinus* spp.). In some areas, western hemlock and western red cedar (*Thuja plicata*) are also present.	This segment of road was open with a mat of pine needles in most areas. Slopes below and above the study area were mostly vegetated, with some boulder outcrops. Species observed within and surrounding the area included: lodgepole pine, ponderosa pine, grand fir, black cottonwood, willow spp., snowbrush, manzanita (*Arctostaphylos* spp.), ocean spray (*Holodiscus discolor*), blue elderberry, Oregon grape (*Berberis aquifolium*), Oregon boxwood, serviceberry, Wood's rose (*Rosa woodsii*), blackcap raspberry, thimbleberry, common yarrow, fireweed (*Chamaenerion angustifolium*), aster spp., bracken fern (*Pteridium aquilinum*), diffuse knapweed (*Centaurea diffusa*), clumping and non-clumping grasses, spreading dogbane (*Apocynum androsaemifolium*), broadleaf lupine (*Lupinus latifolius*), and pearly everlasting (*Anaphalis margaritacea*).	
Lower Elevation Portion of FS Road 7601-116 Segment			
Montane highland habitat with grand fir forest associations and low elevation subalpine fir forest species present	In addition to the grand fir forest associations listed above, this area also included species associated with lower elevation subalpine fir forests located in ravines and more moist habitats. Some species associated with this type of habitat include: Rocky Mountain maple (*Acer glabrum*), white hawkweed, serviceberry, aster spp., red baneberry (*Actaea rubra*), thimbleberry, and fragrant bedstraw.	This area was characterized by an adjacent seasonal drainage, a higher density of cedar and alder trees, and a lower density of pine trees than the upper portion of FS Road 7601-116. Species observed within and surrounding the area included: Douglas-fir, lodgepole pine, grand fir, western red cedar, black cottonwood, willow spp., alder spp., Rocky Mountain maple, snowbrush, blue elderberry, ocean spray, Oregon grape, serviceberry, thimbleberry, orange honeysuckle (*Lonicera ciliosa*), various grasses, spreading dogbane, common yarrow, fragrant bedstraw, fireweed, broadleaf lupine, bracken fern, pearly everlasting, horsetail (*Equisetum* sp.), and red baneberry.	

Sources: EPA (2021), Franklin and Dyrness (1973).

RTE PLANT SURVEY RESULTS

Neither of the study areas provide quality potential habitat for any known rare, sensitive, or Endangered Species Act-listed botanical species. Both study areas occupy disturbed sites, which diminishes the suitability of the habitats to support such RTE species. The FS Road 7601-116 segment has been previously excavated and used for transportation and access, while the Staging Area is in a location that receives disturbance from recreational use of the area by hikers and previous repairs to the Eightmile Dam.

Table 2 lists all WDNR Natural Heritage Program rare species mapped within 10 miles of the study areas, as well as Endangered Species Act-listed species with known occurrences in the Okanagan-Wenatchee National Forest, the associated habitats in which these RTE species are found, and the presence of the species in relation to the study areas. Rare species mapped by the WDNR Natural Heritage Program in the immediate vicinities of the study areas include Seely's catchfly (*Silene seelyi*) near the Staging Area and Thompson's pincushion (*Chaenactis thompsonii*) near FS Road 7601-116. Neither of these species, or quality habitat for any other RTE species, was observed within the study areas during the field surveys.

Table 2. Target List of RTE Plant Species and Observed Likelihood of Occurrence

Common Name	Scientific Name	Listing Status*	Associated Habitat Characteristics	Likelihood of Occurrence in Study Areas
Endangered Species Act-Listed Species				
Showy stickseed	*Hackelia venusta*	FE G1 N1	Found in dry, loose granitic sand and crevices in granite or talus between elevations 1,500 and 7,400 feet above MSL. This species is restricted to sites with low vegetative cover from unstable slopes (ranging between 25 and 70 degree slopes) and periodic fires.	**No occurrence.** No unstable slopes of granite and/or talus occur within either of the study areas.
Ute ladies'-tresses	*Spiranthes diluvaulis*	FT G2G3 N2	Grows in a variety of habitats but is usually associated with moist environments, including alkaline wetlands, moist meadows, floodplains, flooded river terraces, sub-irrigated or spring-fed abandoned stream channels and valleys, lakeshores, irrigation canals, berms, levees, or irrigated meadows. It is found in elevation ranges between 720 and 1,830 feet above MSL.	**No occurrence.** The study areas are above the elevational range of this species.
Wenatchee Mountains checker-mallow	*Sidalcea oregana* var. *calva*	FE G5 N1	Grows in moist meadows with surface water or saturated soil into early summer. It also grows in open Douglas-fir or ponderosa pine coniferous stands and along edges of shrub and hardwood thickets. Associated species include: quaking aspen, snowberry, serviceberry, and Wenatchee larkspur. Fire historically played a role in maintaining habitat for this species, and it is generally found in elevations between 1,900 and 3,200 feet above MSL.	**No occurrence.** While there are some areas with moist soils and associated species along the FS Road segment, the study area is above the identified elevation range of this species.
Rare Species				
Brewer's cliffbrake	*Pallaea breweri*	G5 S2	Grows in open, rocky alpine habitats in crevices, ledges, and bases of cliffs, rock outcrops and rocky slides at elevations between 4,700 and 6,700 feet above MSL. Associated species include: Brandegee's desert-parsely (*Lomatium brandegei*), Columbian lewisia (*Lewisia columbiana*), spreading phlox (*Phlox diffusa*), cliff beardtongue (*Penestemon rupicola*), saxifrage (*Saxifrage bronchialis*), and Leiberg's fleabane (*Erigeron leibergii*).	**No occurrence.** While Brandegee's desert-parsley and a rockslide area occur within the FS Road segment, the entirety of the road segment is well below the elevation range this species is found within.
Canadian single-spike sedge	*Carex scirpoidea*	G5T5 S2	Found in moist alpine meadows, stream banks, and open rocky slopes above timberlines at elevations of 4,800 to 7,600 feet above MSL. It prefers moist habitats with thin, rocky soils, rock outcrops, and talus slopes.	**No occurrence.** The Staging Area is within the elevational range that this species is found. However, the Staging Area is below the timberline, is not moist, and no sedges were observed within the vicinity.

Common Name	Scientific Name	Listing Status*	Associated Habitat Characteristics	Likelihood of Occurrence in Study Areas
False mountain willow	*Salix pseudomonticola*	G4G5 S1	Habitats include wet meadows, stream banks, lake edges, hummocks in calcareous peat fens, thickets, and floodplains in montane to subalpine sites at elevations between 2,950 and 5,500 feet above MSL. Associated species include subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), resin birch (*Betula glandulosa*), Maccall's willow (*Salix maccalliana*), alderleaf buckthorn (*Rhamnus alnifolia*), sedges (*Carex lasiocarpa, C. cusickii, C. utricularia*), cotton-grass (*Eriophorum* spp.), and mosses (*Sphagnum* spp.).	**Unlikely to occur.** This species was not observed within either of the study areas, and no perennial streams occur within either study area. The Staging Area is set back enough from the lake shore that the habitat would not support this species.
Mountain lousewort	*Pedicularis pulchella*	G3 S3	Uncommonly found in Washington and grows in gravel fields and slopes at or above timberline.	**No occurrence.** The study areas are below the timberline.
Rone's biscuitroot	*Lomatium roneorum*	G1 S1	Endemic to Chelan County where it grows on open, rocky, steep slopes (45% slope recorded for population in Chelan County) in ponderosa pine forest openings.	**No occurrence.** There are no steep slopes within either study area.
Ross' avens	*Geum rossii* var. *depressum*	G5T1 S1	Found in high-elevation rocky areas, including talus slopes, cliffs, and rock crevices at elevations between 6,700 and 8,400 feet above MSL.	**No occurrence.** The study areas are below the elevational range of this species.
Salish fleabane	*Erigeron salishii*	G3 S2	Habitat includes dry, rocky, or scree slopes and ridgetops with granite, rock, talus, sand, and loess soils in alpine zones at elevations between 6,600 and 9,000 feet above MSL.	**No occurrence.** The study areas are below the elevational range of this species.
Seely's catchfly	*Silene seelyi*	G2G3 S2S3	Grows in shaded crevices in ultramafic, granitic, or basaltic cliffs and rock outcrops and occasionally among boulders in talus at elevations between 1,120 and 6,300 feet above MSL. It prefers a canopy cover typically less than 30% and a slope of 15–20%. Associated species included: alumroot (*Heuchera cylindrica*), Chelan penstemon (*Penstemon pruinosus*), field chickweed (*Cerastium arvense*), northern hollyfern (*Polystichum lonchitis*), and Wallace's selaginella (*Selaginella wallacei*).	**Unlikely to occur.** Potential habitat occurs upslope and downslope of some portions of the FS Road segment. Alumroot was observed on several rocky outcrops outside of the roadbed. No associated species were observed at the Staging Area and rocky areas were disturbed.
Smoky Mountain sedge	*Carex proposita*	G4 S2	Often grows on talus or granite near or above the timberline at elevations between 4,500 and 7,700 feet above MSL. Found on open, dry, rocky slopes and ridges and in dry meadows near lakes and streams. Associated species include subalpine fir (*Abies lasiocarpa*), subalpine larch (*Larix lyallii*), whitebark pine (*Pinus albicaulis*), sedges (*Carex nardina, C. breweri, C. phaeocephala*), alpine pussy-toes (*Antennaria alpina*), spreading phlox (*Phlox diffusa*), black crowberry (*Empetrum nigrum*), and alpine fescue (*Festuca brachyphylla* spp. *brachyphylla*).	**No occurrence.** The Staging Area falls within the known elevation range of this species, but is below the timberline and contains no talus or granite open habitat.
Strawberry saxifrage	*Saxifragopsis fragariodes*	G3 S1	Habitat includes cracks and crevices on cliffs and rock outcrops at elevations between 1,440 and 4,300 feet above MSL. Associated species include: ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), oceanspray (*Holodiscus discolor*), mock orange (*Philadelphus lewisii*), snowbrush ceanothus (*Ceanothus veluntinus*), serviceberry (*Amelanchier alnifolia*), bitterbrush (*Purshia tridentata*), snowberry (*Symphoricarpos albus*), field chickweed (*Cerastium arvense*), Tweedy's Lewisia (*Lewisia tweedyi*), beardtongue (*Penestemon* spp.), and balsamroot (*Balsamorhiza sagittata*).	**No occurrence.** While some of the species associated with this plant are present within and surrounding the FS Road segment, and it falls within the appropriate elevation zone, there are no cliffs or rock outcrops within the boundaries of either study area.
Taylor's stickseed	*Hackelia taylorii*	G2 G2	Found on steep, unstable, sparsely vegetated subalpine to alpine sandy-gravely talus slopes derived from Mount Stuart batholith.	**No occurrence.** There are no steep, unstable slopes or soils derived from Mount Stuart batholith within either study area.
Thompson's chaenactis	*Chaenactis thompsonii*	G2G3 S2S3	Grows on dry, rocky slopes and ridges at elevations between 2,900 and 7,000 feet above MSL. It typically grows in serpentine soils high in magnesium and low in	**Unlikely to occur.** Yarrow and lupine were found in moderate densities throughout the

Common Name	Scientific Name	Listing Status*	Associated Habitat Characteristics	Likelihood of Occurrence in Study Areas
			calcium along moderate to steep slopes with variable aspects. Surrounding vegetation is generally sparse and xerophytic, and associated species include: bluegrass (*Poa* spp.), wheatgrass (*Agopyron* spp.), buckwheat (*Erigonum* spp.), snow-dwarf primrose (*Douglasia nivalis*), yarrow (*Achillea millefolium*), and lupine (*Lupinus* spp.).	roadbed. The lack of rocky outcrops and steep slopes in the roadbed indicates the plant will not likely be found in the study area, but may be found just upslope or downslope.
Wenatchee larkspur	*Delphinium viridescens*	G2 S2	Found in moist meadows, seasonally wet openings in aspen groves and hardwood thickets, springs, seeps, and riparian areas between the elevations of 1,240 and 5,700 feet above MSL. All habitats include surface water or saturated upper soil profiles into early summer and silt loam or clay loam soils.	**No occurrence.** There are no areas within either study area that appear to be saturated into the summer. Culverts divert seasonal water flows under and away from the study areas.
Whited's fuzzytongue penestemon	*Penstemon eriantherus* var. *whitedii*	G4T2 S2	Habitat includes west-facing slopes of small canyons, ridgetops, and dry rocky places in the foothills of the Cascades and in the Columbia Basin between the elevations of 500 and 4,000 feet above MSL. Associated species include antelope bitterbrush (*Purshia tridentata*), rabbitbrush (*Ericameria nauseosa*), big sagebrush (*Artemisia tridentata*), purple sage (*Salvia dorrii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and cheatgrass (*Bromus tectorum*).	**No occurrence.** None of the associated species were observed in either study area, and both study areas are located above the foothills of the greater region.

Sources: Forest Service (2019), Burke Museum (2021), NatureServe (2021), WNHP (2021), and WDNR (2021b)
* Conservation Status Rank Categories: Global (G) Conservation Status Rankings: Infraspecific Taxon Rank (T); National (N); Subnational (S)
Conservation Status Rank Levels: 1 = Critically Imperiled; 2 = Imperiled; 3 = Vulnerable; 4 = Apparently Secure; 5 = Secure
Endangered Species Act Listings: FE = Federally Endangered, FT=Federally Threatened

UNDESIREABLE PLANT SURVEY RESULTS

Washington State and Chelan County classify weeds on a ranked scale from A to C. No Class A weeds were identified within the study areas; however, several Class B and C species were mapped within the study areas. Class B weeds are species that are widespread in some parts of Washington State but are limited or absent in other areas. Some populations of Class B weeds require control, depending on whether the species is a local priority. Class C weeds are often widespread species that are not required for control. However, Chelan County does require landowners to control certain Class C weeds due to their threat to agriculture and/or natural resources (Chelan County 2021).

During the survey, the locations of Washington State and Chelan County classified weeds were recorded and mapped using geographic information system (GIS) software. Non-classified weeds were mapped only if the occurrence of the species was small or concentrated in one particular area. Unclassified non-native and invasive species that were widespread throughout the study areas were not mapped in GIS and covered one percent or less of the total surveyed areas. See **Appendix A, Figures 2 and 3** for mapped locations of undesirable plant species.

Previous surveys completed by FS botanists have identified Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), and mullein (*Verbascum thapsus*) near the Staging Area and Eightmile Dam (Furr 2021). Common tansy (*Tanacetum vulgare*) has also been identified in the vicinity of the study areas (Furr 2021). The identified populations of common tansy and Canada thistle have been treated previously with herbicide (Furr 2021). Of these populations, only mullein was observed during the September 30, 2021 survey. All undesirable species observed are listed in **Table 3**.

Table 3. Undesirable Plant Species Identified

Common Name	Scientific Name	Chelan County Noxious Weed Classification	Washington State Noxious Weed Classification	FS Region 6 Invasive Plant List
FS Road 7601-116 Segment				
Bird's-foot trefoil	*Lotus corniculatus*			✓
Bull thistle	*Cirsium vulgare*		C	✓
Dandelion spp.	Genus *Taraxacum*			
Diffuse knapweed	*Centaurea diffusa*	B (non-designate selected for control)	B	✓
Orchard grass	*Dactylis glomerata*			✓
Oxeye daisy	*Leucanthemum vulgare*	C (selected for control)	Class C	✓
Red clover	*Trifolium pratense*			
Ribwort plantain	*Plantago lanceolata*			✓
Timothy grass	*Phleum pratense*			
Scentless mayweed	*Tripleurospermum inodorum*		Class C	✓
White clover	*Trifolium repens*			
Yellow salsify	*Tragopogon dubius*			
Eightmile Dam Staging Area				
Mullein	*Verbascum thapsus*			✓
Orchard grass	*Dactylis glomerata*			✓
Red sand spurrey	*Spergularia rubra*			
Yellow salsify	*Tragopogon dubius*			

Sources: Chelan County (2021), Washington State Noxious Weed Control Board (2021), Forest Service (2010).

CONCLUSIONS

Although the study areas are disturbed by historic fire and human use, the Eightmile Dam Staging Area and the surveyed portion of FS Road 7601-116 both host botanical species that are representative of the larger ecoregions they fall within. The Staging Area is located in North Cascades subalpine habitat, while the FS Road 7601-116 segment is located in Wenatchee/Chelan Highlands montane forest habitat. Additionally, the FS Road 7601-116 segment has experienced greater human disturbance than the Staging Area, which is reflected in the variety of non-native species present.

Neither study area presents suitable habitat for rare or listed botanical species. While no sensitive or rare species were observed within the study areas during the survey, there is the possibility that such species could be present in locations outside of or adjacent to the study areas. Future work within the study areas should emphasize the importance of maintaining distance from bordering rock outcrops, wet areas where water flows through culverts, and the drainage/seasonal stream at the end of the FS Road 7601-116 segment.

Both study areas are occupied by various non-native and invasive weedy species. Diffuse knapweed and oxeye daisy are two newly identified classified weeds within the FS Road 7601-116 segment that require removal as mandated by Chelan County. Various other previously unrecorded non-native and invasive species were identified within the study areas as well. The ecological integrity of the landscapes may benefit from future actions to contain or remove the presence of such species.

REFERENCES

Burke Museum. 2021. Burke Herbarium Image Collection: Vascular Plants, Macrofungi, & Lichenized Fungi of Washington. Collections & Research; Biology. Available: https://biology.burke.washington.edu /herbarium/imagecollection.php. Accessed: 27 September 2021.

Chelan County. 2021. Chelan County Noxious Weed List. URL: https://www.co.chelan.wa.us/files/noxious-weed/documents/2021%20Chelan%20County%20Weed%20List.pdf. Accessed: 27 September 2021.

EPA (U.S. Environmental Protection Agency). n.d. Ecoregions of Western Washington and Oregon. URL: http://ecologicalregions.info/data/reg10/ORWAFront90.pdf. Accessed: September 2021.

EPA (U.S. Environmental Protection Agency). 2021. Level III and IV Ecoregions by State. URL: https://www.epa.gov/eco-research/level-iii-and-iv-ecoregions-state. Accessed: September 2021.

Forest Service (U.S. Forest Service). 2010. List of Invasive Plants on National Forests in the PNW Region. URL: https://www.fs.usda.gov/detail/r6/forest-grasslandhealth/invasivespecies/? cid=stelprdb5302157. Accessed: 27 September 2021.

Forest Service (U.S. Forest Service). 2019. Region 6 Regional Forester Special Status Species List. URL: https://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/. Accessed: 27 September 2021.

Franklin, J.F., and C.T. Dyrness. 1973. Natural Vegetation of Oregon and Washington, United States Department of Agriculture, Forest Service, General Technical Report PNW-8.

Furr, Kathryn. 2021. Conversation with Brigitte Ranne, Botanist. Email message to Lisa Adolfson and Jeff Barna, ESA. Sent: August 31st, 2021.

Jantzer, A. 2021a. Memorandum to Erick Walker on the Subject of “Rehab and use of Eight Mile Spur Forest Service 7601-116 Road”. Sent: August 11, 2021.

Jantzer, A. 2021b. Memorandum to Lisa Adolfson on the Subject of “Eight Mile Lake Staging Area and Road Rehab”. Sent: August 12, 2021.

NatureServe. 2021. NatureServe Explorer. URL: https://explorer.natureserve.org/. Accessed: 27 September 2021.

NRCS (U.S. Department of Agriculture Natural Resources Conservation Service). 2021. Web Soil Survey. URL: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed: 27 September 2021.

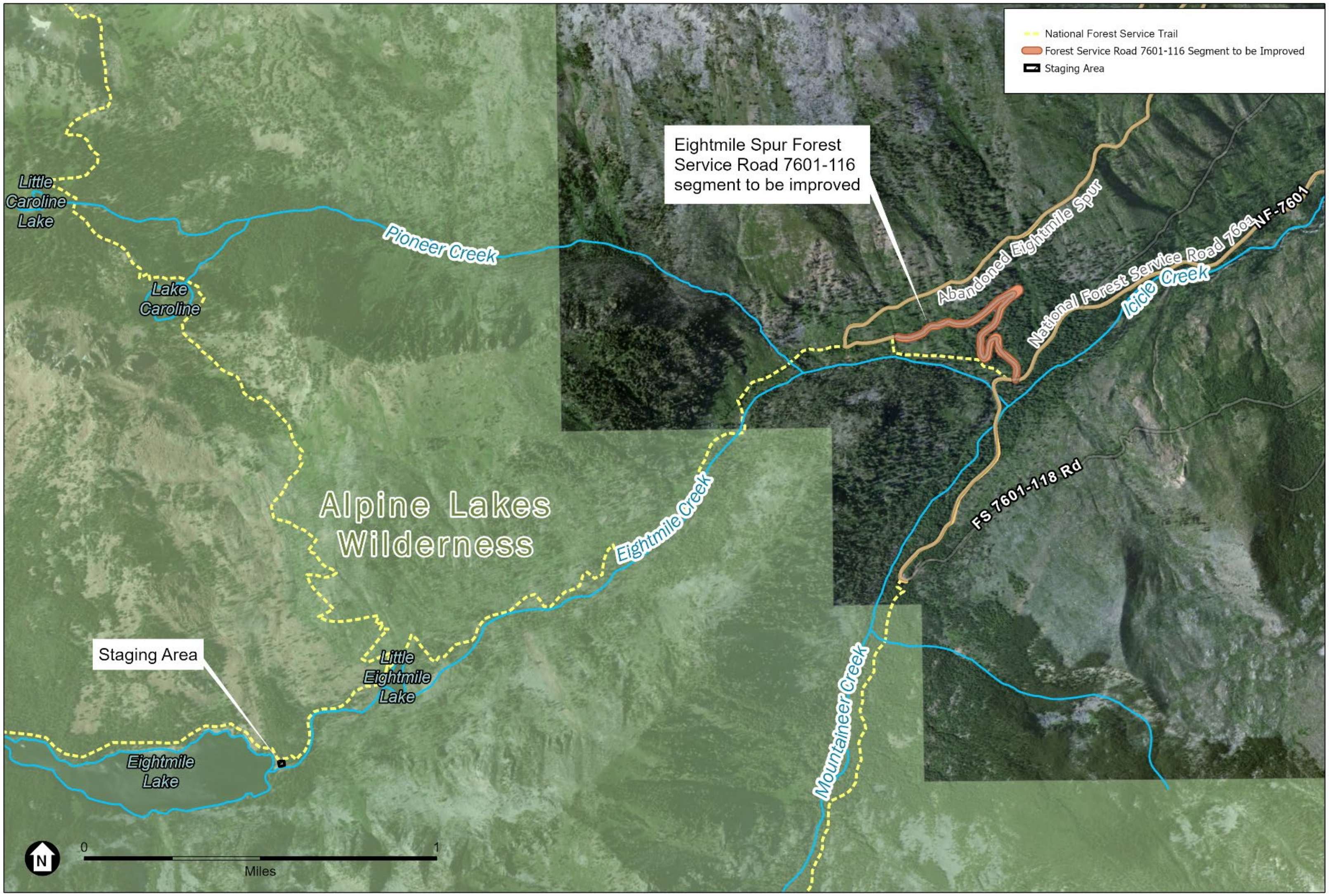
Washington State Noxious Weed Control Board. 2021. Washington State Noxious Weed List. URL: https://www.nwcb.wa.gov/pdfs/2021-State-Weed-List_Common_Name-8.5x11.pdf. Accessed: 27 September 2021.

WDNR (Washington Department of Natural Resources). 2021a. WDNR GIS Open Data: Washington Large Fires 1973-2020. URL: https://data-wadnr.opendata.arcgis.com/. Accessed: 27 September 2021.

WDNR (Washington Department of Natural Resources). 2021b. WDNR GIS Open Data: Washington Natural Heritage Program Element Occurrences. URL: https://data-wadnr.opendata.arcgis.com/. Accessed: 27 September 2021.

WNHP (Washington Natural Heritage Program). 2021. Online Field Guide to the Rare Plants of Washington. URL: https://fieldguide.mt.gov/wa. Accessed: 27 September 2021.

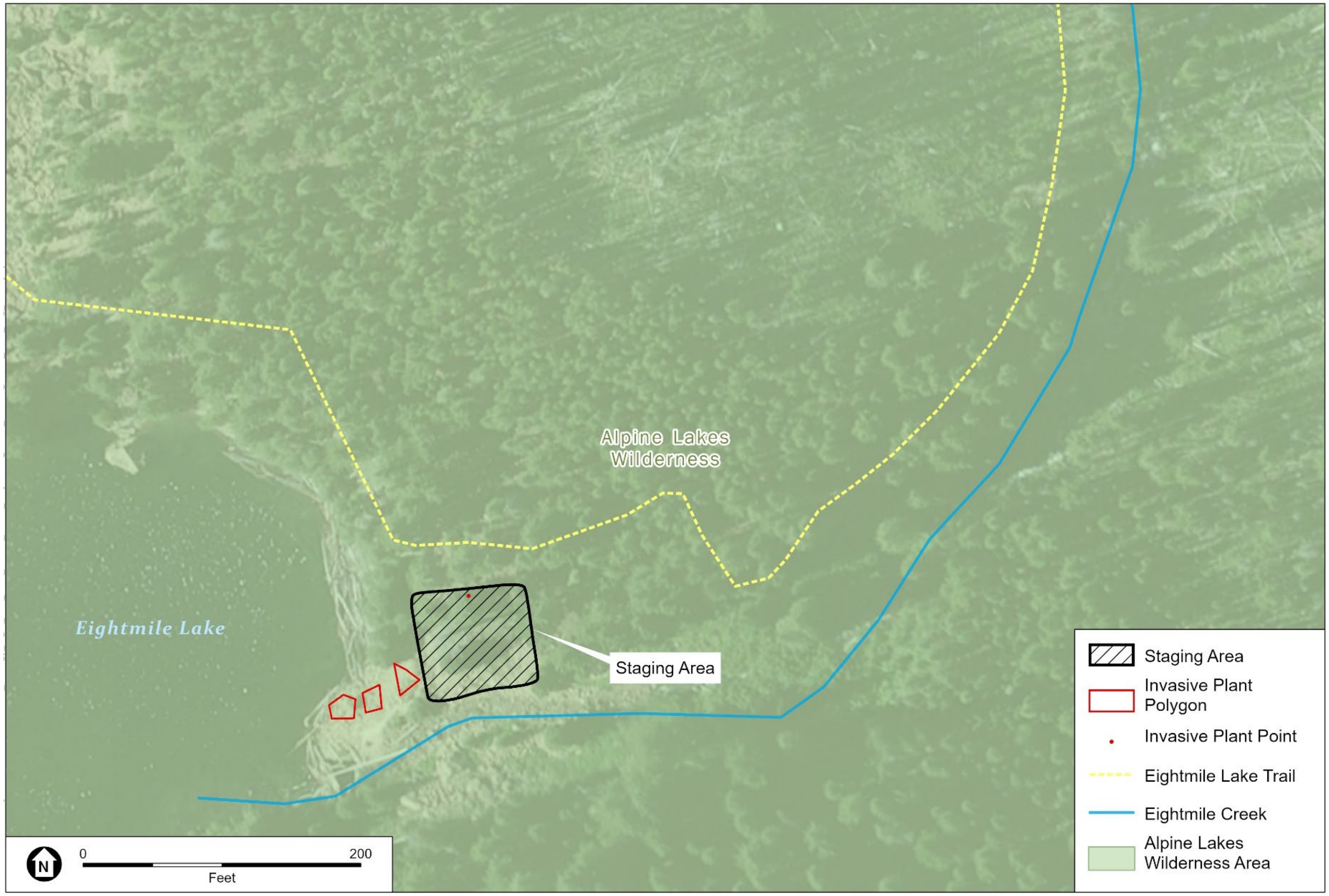
Appendix A
Study Area Figures



SOURCE: Imagery: ESRI; Parcels: Chelan County; Trail: USGS; Creek: WA DNR

Eightmile Dam Rebuild and Restoration Project

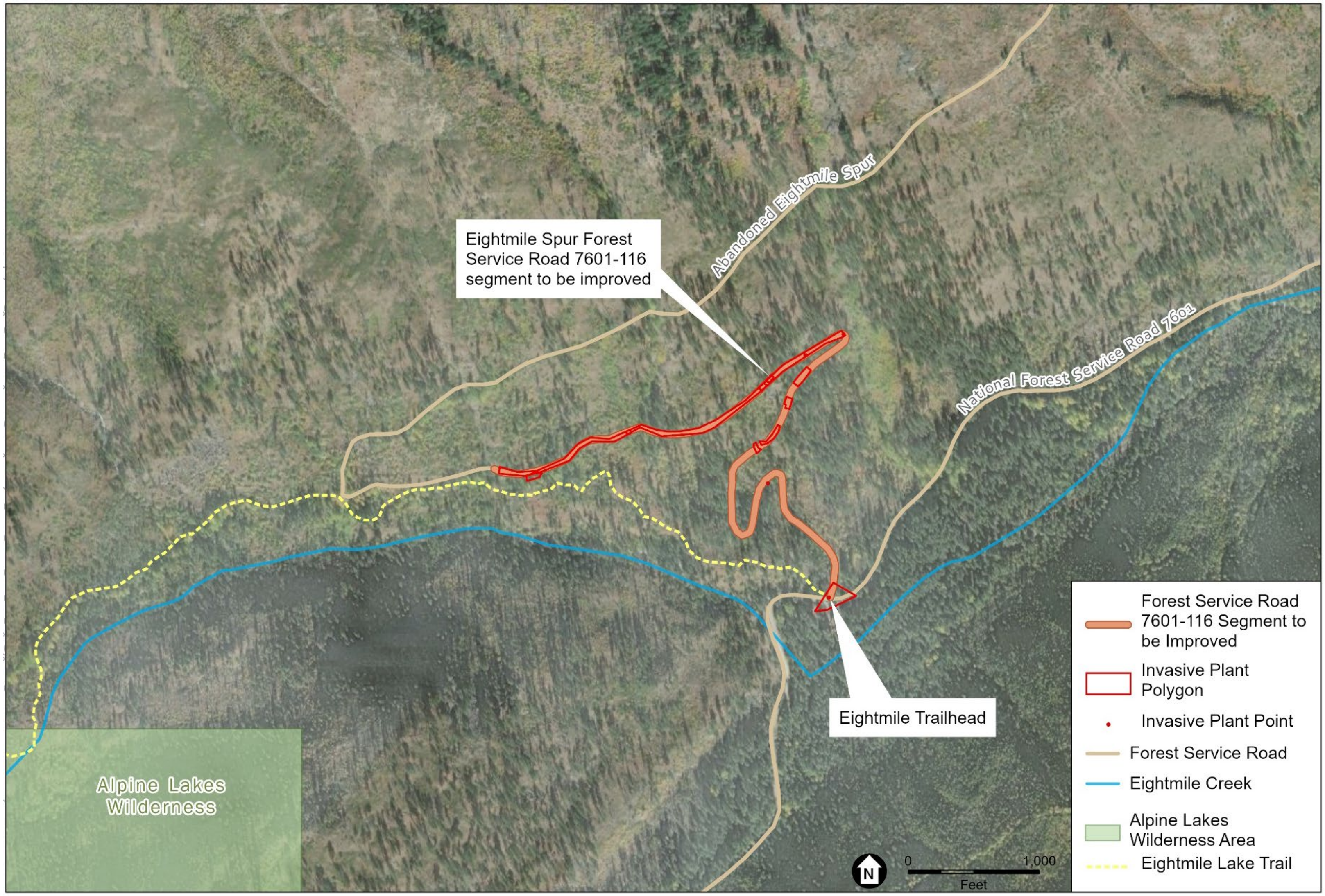
Figure 1
Study Area Context Map



SOURCE: Imagery: ESRI; Parcels: Chelan County; Trail: USGS; Creek: WA DNR

Eightmile Dam Rebuild and Restoration Project

Figure 2
Staging Area



SOURCE: Imagery: ESRI; Parcels: Chelan County; Trail: USGS; Creek: WA DNR

Eightmile Dam Rebuild and Restoration Project

Figure 3

Forest Service Road 7601-116 Segment to be Improved

Appendix B

2019 U.S. Forest Service Region 6 Regional Forester Special Status Species: Okanogan-Wenatchee National Forest Federally Threatened, Endangered or Proposed Species

FINAL Region 6 Regional Forester Special Status Species List, February 25, 2019
This worksheet Includes Federally Threatened, Endangered or Proposed Species.

Name and ESU/DPS		T&E INFORMATION				RANK AND STATUS INFORMATION						
Scientific Name	Common Name	Federal Status	Date Listed	Critical Habitat	Recovery Plan	Global Rank	National Rank	Sub-species Rank	ORBIC State Rank	ORBIC List	WNHP WDFW State Status	WNHP State Rank
Hackelia venusta	Showy stickseed	FE	2002	None	Final 2007; draft amendment 2019	G1	N1				SE	S1
Howellia aquatilis	Water howellia	FT	1994	None	Draft 1996	G3	N3		S1	1	ST	S2
Sidalcea oregana var. calva	Wenatchee Mountains checker-mallow	FE	1999	Designated 2001	Final 2004	G5	N1	T1			SE	S1?
Spiranthes diluvialis	Ute ladies'-tresses	FT	1992	None	Draft 1995	G2G3	N2				SE	S1

Appendix C
2021 Chelan County Noxious Weed List with Present Species Highlighted

2021 Chelan County Noxious Weed List

The following noxious weeds have been adopted from the Washington State Noxious Weed List contained in chapter 16-750 WAC for 2021

Class A Weeds: Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. **Eradication of all Class A weeds is required by law**.

Class A - Eradication Required

Common Name	**Scientific Name**
common crupina	*Crupina vulgaris*
cordgrass, common	*Spartina anglica*
cordgrass, dense-flowered	*Spartina densiflora*
cordgrass, saltmeadow	*Spartina patens*
cordgrass, smooth	*Spartina alterniflora*
dyer's woad	*Isatis tinctoria*
eggleaf spurge	*Euphorbia oblongata*
false brome	*Brachypodium sylvaticum*
floating primrose-willow	*Ludwigia peploides*
flowering rush	*Butomus umbellatus*
French broom	*Genista monspessulana*
garlic mustard	*Alliaria petiolata*
giant hogweed	*Heracleum mantegazzianum*
goatsrue	*Galega officinalis*
hydrilla	*Hydrilla verticillata*
Johnsongrass	*Sorghum halepense*
knapweed, bighead	*Centaurea macrocephala*
knapweed, Vochin	*Centaurea nigrescens*
kudzu	*Pueraria montana var. lobata*
meadow clary	*Salvia pratensis*
oriental clematis	*Clematis orientalis*
purple starthistle	*Centaurea calcitrapa*
reed sweetgrass	*Glyceria maxima*
ricefield bulrush	*Schoenoplectus mucronatus*
sage, clary	*Salvia sclarea*
sage, Mediterranean	*Salvia aethiopis*
silverleaf nightshade	*Solanum elaeagnifolium*
small-flowered jewelweed	*Impatiens parviflora*
South American spongeplant	*Limnobium laevigatum*
Spanish broom	*Spartium junceum*
Syrian beancaper	*Zygophyllum fabago*
Texas blueweed	*Helianthus ciliaris*
thistle, Italian	*Carduus pycnocephalus*
thistle, milk	*Silybum marianum*
thistle, Turkish	*Carduus cinereus*
thistle, slenderflower	*Carduus tenuiflorus*
variable-leaf milfoil	*Myriophyllum heterophyllum*

wild four-o'clock	*Mirabilis nyctaginea*
Class B Designated - Control Required for Chelan County	
blueweed	*Echium vulgare*
Brazilian elodea	*Egeria densa*
bugloss, annual	*Lycopsis arvensis*
bugloss, common	*Anchusa officinalis*
camelthorn	*Alhagi maurorum*
common fennel, (except bulbing fennel)	*Foeniculum vulgare (except F. vulgare var. azoricum)*
common reed (nonnative genotypes only)	*Phragmites australis*
Eurasian watermilfoil	*Myriophyllum spicatum*
European coltsfoot	*Tussilago farfara*
fanwort	*Cabomba caroliniana*
gorse	*Ulex europaeus*
grass-leaved arrowhead	*Sagittaria graminea*
hairy willowherb	*Epilobium hirsutum*
hawkweed oxtongue	*Picris hieracioides*
hawkweed, orange	*Hieracium aurantiacum*
hawkweeds: All nonnative species and hybrids of the meadow subgenus	*Hieracium, subgenus Pilosella*
hawkweeds: All nonnative species and hybrids of the wall subgenus	*Hieracium, subgenus Hieracium*
herb-Robert	*Geranium robertianum*
hoary alyssum	*Berteroa incana*
houndstongue	*Cynoglossum officinale*
indigobush	*Amorpha fruticosa*
knapweed, black	*Centaurea nigra*
knapweed, brown	*Centaurea jacea*
knapweed, meadow	*Centaurea × gerstlaueri*
knotweed, Bohemian	*Fallopia × bohemica*
knotweed, giant	*Fallopia sachalinensis*
knotweed, Himalayan	*Persicaria wallichii*
knotweed, Japanese	*Fallopia japonica*
lesser celandine	*Ficaria verna*
loosestrife, garden	*Lysimachia vulgaris*
loosestrife, purple	*Lythrum salicaria*
loosestrife, wand	*Lythrum virgatum*
Malta starthistle	*Centaurea melitensis*
parrotfeather	*Myriophyllum aquaticum*
perennial pepperweed	*Lepidium latifolium*
poison hemlock	*Conium maculatum*
policeman's helmet	*Impatiens glandulifera*
Ravenna grass	*Tripidium ravennae*
rush skeletonweed	*Chondrilla juncea*
saltcedar	*Tamarix ramosissima*
Scotch broom	*Cytisus scoparius*
shiny geranium	*Geranium lucidum*
spurge flax	*Thymelaea passerina*
spurge laurel	*Daphne laureola*

spurge, leafy	*Euphorbia virgata*
spurge, myrtle	*Euphorbia myrsinites*
tansy ragwort	*Jacobaea vulgaris*
thistle, musk	*Carduus nutans*
thistle, plumeless	*Carduus acanthoides*
thistle, Scotch	*Onopordum acanthium*
velvetleaf	*Abutilon theophrasti*
water primrose	*Ludwigia hexapetala*
white bryony	*Bryonia alba*
wild chervil	*Anthriscus sylvestris*
yellow archangel	*Lamiastrum galeobdolon*
yellow floatingheart	*Nymphoides peltata*
yellow nutsedge	*Cyperus esculentus*
yellow starthistle	*Centaurea solstitialis*
Class B and C Selected - Control Required for Chelan County	
*Class B non-designate selected for control in Chelan County	
**Class C selected for control in Chelan County	
Babysbreath**	*Gypsophila paniculata*
Canada thistle**	*Cirsium arvense*
Common St. Johnswort **	*Hypericum perforatum*
Dalmation toadflax*	*Linaria dalmatica*
Kochia*	*Bassia scoparia++*
Oxeye daisy**	*Leucanthemum vulgare*
Medusahead grass**	*Taeniatherum caput-medusae*
Puncturevine*	*Tribulus terrestris*
Russian knapweed*	*Rhaponticum repens++*
Spotted knapweed*	*Centaurea stoebe*
Ventenata grass**	*Ventenata dubia*
knapweed, diffuse*	*Centaurea diffusa*
hoary cress**	*Lepidium draba*

Appendix D
2021 Washington State Noxious Weed List with Present Species Highlighted

Class C Weeds

absinth wormwood	*Artemisia absinthium*
Austrian fieldcress	*Rorippa austriaca*
babysbreath	*Gypsophila paniculata*
black henbane	*Hyoscyamus niger*
blackgrass	*Alopecurus myosuroides*
buffalobur	*Solanum rostratum*
cereal rye	*Secale cereale*
common barberry	*Berberis vulgaris*
common catsear	*Hypochaeris radicata*
common groundsel	*Senecio vulgaris*
common St. Johnswort	*Hypericum perforatum*
common tansy	*Tanacetum vulgare*
common teasel	*Dipsacus fullonum*
curlyleaf pondweed	*Potamogeton crispus*
English hawthorn	*Crataegus monogyna*
English ivy - four cultivars only	*Hedera helix* 'Baltica', 'Pittsburgh', and 'Star', and *H. hibernica 'Hibernica'*
Eurasian watermilfoil hybrid	*Myriophyllum spicatum* x *Myriophyllum sibiricum*
evergreen blackberry	*Rubus laciniatus*
field bindweed	*Convolvulus arvensis*
fragrant waterlily	*Nymphaea odorata*
hairy whitetop	*Lepidium appelianum*
Himalayan blackberry	*Rubus bifrons* (*Rubus armeniacus*)
hoary cress	*Lepidium draba*
Italian arum	*Arum italicum*
Japanese eelgrass	*Nanozostera japonica*
jubata grass	*Cortaderia jubata*
jointed goatgrass	*Aegilops cylindrica*
lawnweed	*Soliva sessilis*
longspine sandbur	*Cenchrus longispinus*
medusahead	*Taeniatherum caput-medusae*
nonnative cattail species and hybrids (reminder, does not include the native common cattail, *Typha latifolia*)	*Typha* species
old man's beard	*Clematis vitalba*
oxeye daisy	*Leucanthemum vulgare*
Pampas grass	*Cortaderia selloana*
perennial sowthistle	*Sonchus arvensis*
reed canarygrass	*Phalaris arundinacea*

Class C Weeds continued

Russian olive	*Elaeagnus angustifolia*
scentless mayweed	*Tripleurospermum inodorum*
smoothseed alfalfa dodder	*Cuscuta approximata*
spikeweed	*Centromadia pungens*
spiny cocklebur	*Xanthium spinosum*
spotted jewelweed	*Impatiens capensis*
Swainsonpea	*Sphaerophysa salsula*
thistle, bull	*Cirsium vulgare*
thistle, Canada	*Cirsium arvense*
tree-of-heaven	*Ailanthus altissima*
ventenata	*Ventenata dubia*
white cockle	*Silene latifolia*
wild carrot (except where commercially grown)	*Daucus carota*
yellow flag iris	*Iris pseudacorus*
yellow toadflax	*Linaria vulgaris*

To learn more about noxious weeds and noxious weed control in Washington State, please contact:

WA State Noxious Weed Control Board
P.O. Box 42560
Olympia, WA 98504-2560
(360) 725-5764

Email: noxiousweeds@agr.wa.gov
Website: http://www.nwcb.wa.gov

Or

WA State Department of Agriculture
(509) 249-6973

Or

Your County Noxious Weed Control Board

Please help protect Washington's economy and environment from noxious weeds!

Cover photo of Turkish thistle by Mark Porter, Oregon Department of Agriculture

2021 Washington State Noxious Weed List

Turkish thistle, *Carduus cinereus*, is a new Class A noxious weed for 2021. This annual thistle is found close to Washington in northeastern Oregon and the adjacent area in Idaho. Eradication is required of Turkish thistle when found in Washington.

List arranged alphabetically by:

COMMON NAME

Washington State Noxious Weed Control Board

Class A Weeds: Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. **Eradication of all Class A plants is required by law.**

Class B Weeds: Non-native species presently limited to portions of the State. Species are **designated** for required control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal. Please contact your County Noxious Weed Control Board to learn which species are designated for control in your area.

Class C Weeds: Noxious weeds that are typically widespread in WA or are of special interest to the state's agricultural industry. The Class C status allows county weed boards to require control if locally desired, or they may choose to provide education or technical consultation.

Class A Weeds
Eradication is required

common crupina	*Crupina vulgaris*
cordgrass, common	*Spartina anglica*
cordgrass, dense-flowered	*Spartina densiflora*
cordgrass, saltmeadow	*Spartina patens*
cordgrass, smooth	*Spartina alterniflora*
dyer's woad	*Isatis tinctoria*
eggleaf spurge	*Euphorbia oblongata*
false brome	*Brachypodium sylvaticum*
floating primrose-willow	*Ludwigia peploides*
flowering rush	*Butomus umbellatus*
French broom	*Genista monspessulana*
garlic mustard	*Alliaria petiolata*
giant hogweed	*Heracleum mantegazzianum*
goatsrue	*Galega officinalis*
hydrilla	*Hydrilla verticillata*
Johnsongrass	*Sorghum halepense*
knapweed, bighead	*Centaurea macrocephala*
knapweed, Vochin	*Centaurea nigrescens*
kudzu	*Pueraria montana* var. *lobata*
meadow clary	*Salvia pratensis*
oriental clematis	*Clematis orientalis*
purple starthistle	*Centaurea calcitrapa*
reed sweetgrass	*Glyceria maxima*
ricefield bulrush	*Schoenoplectus mucronatus*
sage, clary	*Salvia sclarea*
sage, Mediterranean	*Salvia aethiopis*
silverleaf nightshade	*Solanum elaeagnifolium*
small-flowered jewelweed	*Impatiens parviflora*
South American spongeplant	*Limnobium laevigatum*
Spanish broom	*Spartium junceum*
Syrian beancaper	*Zygophyllum fabago*
Texas blueweed	*Helianthus ciliaris*
thistle, Italian	*Carduus pycnocephalus*
thistle, milk	*Silybum marianum*
thistle, slenderflower	*Carduus tenuiflorus*
thistle, Turkish	*Carduus cinereus*
variable-leaf milfoil	*Myriophyllum heterophyllum*
wild four-o'clock	*Mirabilis nyctaginea*

Class B Weeds

blueweed	*Echium vulgare*
Brazilian elodea	*Egeria densa*
bugloss, annual	*Lycopsis arvensis*
bugloss, common	*Anchusa officinalis*
butterfly bush	*Buddleja davidii*
camelthorn	*Alhagi maurorum*
common fennel, (except bulbing fennel)	*Foeniculum vulgare* except *F. vulgare var. azoricum)*
common reed (nonnative genotypes only)	*Phragmites australis*
Dalmatian toadflax	*Linaria dalmatica* ssp. *dalmatica*
Eurasian watermilfoil	*Myriophyllum spicatum*
European coltsfoot	*Tussilago farfara*
fanwort	*Cabomba caroliniana*
gorse	*Ulex europaeus*
grass-leaved arrowhead	*Sagittaria graminea*
hairy willowherb	*Epilobium hirsutum*
hawkweed oxtongue	*Picris hieracioides*
hawkweed, orange	*Hieracium aurantiacum*
hawkweeds: All nonnative species and hybrids of the meadow subgenus	*Hieracium*, subgenus *Pilosella*
hawkweeds: All nonnative species and hybrids of the wall subgenus	*Hieracium*, subgenus *Hieracium*
herb-Robert	*Geranium robertianum*
hoary alyssum	*Berteroa incana*
houndstongue	*Cynoglossum officinale*
indigobush	*Amorpha fruticosa*
knapweed, black	*Centaurea nigra*
knapweed, brown	*Centaurea jacea*
knapweed, diffuse	*Centaurea diffusa*
knapweed, meadow	*Centaurea × gerstlaueri*
knapweed, Russian	*Rhaponticum repens*
knapweed, spotted	*Centaurea stoebe*
knotweed, Bohemian	*Fallopia × bohemica*
knotweed, giant	*Fallopia sachalinensis*
knotweed, Himalayan	*Persicaria wallichii*
knotweed, Japanese	*Fallopia japonica*
kochia	*Bassia scoparia*
lesser celandine	*Ficaria verna*
loosestrife, garden	*Lysimachia vulgaris*
loosestrife, purple	*Lythrum salicaria*
loosestrife, wand	*Lythrum virgatum*
Malta starthistle	*Centaurea melitensis*
parrotfeather	*Myriophyllum aquaticum*
perennial pepperweed	*Lepidium latifolium*
poison hemlock	*Conium maculatum*
policeman's helmet	*Impatiens glandulifera*
puncturevine	*Tribulus terrestris*
Ravenna grass	*Tripidium ravennae*
rush skeletonweed	*Chondrilla juncea*
saltcedar	*Tamarix ramosissima*
Scotch broom	*Cytisus scoparius*
shiny geranium	*Geranium lucidum*
spurge flax	*Thymelaea passerina*
spurge laurel	*Daphne laureola*
spurge, leafy	*Euphorbia virgata*
spurge, myrtle	*Euphorbia myrsinites*
sulfur cinquefoil	*Potentilla recta*
tansy ragwort	*Jacobaea vulgaris*
thistle, musk	*Carduus nutans*
thistle, plumeless	*Carduus acanthoides*
thistle, Scotch	*Onopordum acanthium*
velvetleaf	*Abutilon theophrasti*
water primrose	*Ludwigia hexapetala*
white bryony	*Bryonia alba*
wild chervil	*Anthriscus sylvestris*
yellow archangel	*Lamiastrum galeobdolon*
yellow floating heart	*Nymphoides peltata*
yellow nutsedge	*Cyperus esculentus*
yellow starthistle	*Centaurea solstitialis*

Appendix E
2010 U.S. Forest Service Region 6 Invasive Plant List with Present Species Highlighted

ESA

R6 Invasive Plant List 2010

NAME	ACC SCIENTIFIC NAME	COMMON NAME	FAMILY
R6 Invasive Plant Species	Acaena novae-zelandiae	biddy-biddy	Rosaceae
R6 Invasive Plant Species	Centaurea diffusa	diffuse knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea stoebe ssp. micranthos	spotted knapweed	Asteraceae
R6 Invasive Plant Species	Acaena novae-zelandiae	biddy-biddy	Rosaceae
R6 Invasive Plant Species	Acaena novae-zelandiae	biddy-biddy	Rosaceae
R6 Invasive Plant Species	Acer platanoides	Norway maple	Aceraceae
R6 Invasive Plant Species	Acer platanoides	Norway maple	Aceraceae
R6 Invasive Plant Species	Polygonum polystachyum	cultivated knotweed	Polygonaceae
R6 Invasive Plant Species	Acroptilon repens	hardheads	Asteraceae
R6 Invasive Plant Species	Acaena novae-zelandiae	biddy-biddy	Rosaceae
R6 Invasive Plant Species	Aegilops cylindrica	jointed goatgrass	Poaceae
R6 Invasive Plant Species	Aegilops cylindrica	jointed goatgrass	Poaceae
R6 Invasive Plant Species	Aegopodium podagraria	bishop's goutweed	Apiaceae
R6 Invasive Plant Species	Aegopodium podagraria	bishop's goutweed	Apiaceae
R6 Invasive Plant Species	Aegilops triuncialis	barbed goatgrass	Poaceae
R6 Invasive Plant Species	Aegilops cylindrica	jointed goatgrass	Poaceae
R6 Invasive Plant Species	Aegilops triuncialis	barbed goatgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Ailanthus altissima	tree of heaven	Simaroubaceae
R6 Invasive Plant Species	Ailanthus altissima	tree of heaven	Simaroubaceae
R6 Invasive Plant Species	Alopecurus myosuroides	slender meadow foxtail	Poaceae
R6 Invasive Plant Species	Alliaria petiolata	garlic mustard	Brassicaceae
R6 Invasive Plant Species	Alyssum murale	yellowtuft	Brassicaceae
R6 Invasive Plant Species	Alopecurus myosuroides	slender meadow foxtail	Poaceae
R6 Invasive Plant Species	Alliaria petiolata	garlic mustard	Brassicaceae
R6 Invasive Plant Species	Alliaria petiolata	garlic mustard	Brassicaceae
R6 Invasive Plant Species	Ammophila arenaria	European beachgrass	Poaceae
R6 Invasive Plant Species	Anchusa arvensis	small bugloss	Boraginaceae
R6 Invasive Plant Species	Anthemis cotula	stinking chamomile	Asteraceae
R6 Invasive Plant Species	Egeria densa	Brazilian waterweed	Hydrocharitaceae
R6 Invasive Plant Species	Bromus matritensis	compact brome	Poaceae
R6 Invasive Plant Species	Bromus matritensis	compact brome	Poaceae
R6 Invasive Plant Species	Anchusa officinalis	common bugloss	Boraginaceae
R6 Invasive Plant Species	Anchusa officinalis	common bugloss	Boraginaceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Bromus tectorum	cheatgrass	Poaceae
R6 Invasive Plant Species	Artemisia absinthium	absinthium	Asteraceae
R6 Invasive Plant Species	Artemisia absinthium	absinthium	Asteraceae
R6 Invasive Plant Species	Arundo donax	giant reed	Poaceae
R6 Invasive Plant Species	Arctium minus	lesser burdock	Asteraceae
R6 Invasive Plant Species	Ventenata dubia	North Africa grass	Poaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Borago officinalis	common borage	Boraginaceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Bromus hordeaceus	soft brome	Poaceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Bromus matritensis	compact brome	Poaceae

R6 Invasive Plant Species	Bromus matritensis	compact brome	Poaceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Bromus matritensis	compact brome	Poaceae
R6 Invasive Plant Species	Brassica rapa	field mustard	Brassicaceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Brachypodium sylvaticum	slender false brome	Poaceae
R6 Invasive Plant Species	Bromus tectorum	cheatgrass	Poaceae
R6 Invasive Plant Species	Bromus tectorum	cheatgrass	Poaceae
R6 Invasive Plant Species	Bromus tectorum	cheatgrass	Poaceae
R6 Invasive Plant Species	Bromus tectorum	cheatgrass	Poaceae
R6 Invasive Plant Species	Bromus diandrus ssp. rigidus	ripgut brome	Poaceae
R6 Invasive Plant Species	Buddleja davidii	orange eye butterflybush	Buddlejaceae
R6 Invasive Plant Species	Carduus acanthoides	spiny plumeless thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cardaria draba	whitetop	Brassicaceae
R6 Invasive Plant Species	Cirsium vulgare	bull thistle	Asteraceae
R6 Invasive Plant Species	Lepidium latifolium	broadleaved pepperweed	Brassicaceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
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R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus nutans	nodding plumeless thistle	Asteraceae
R6 Invasive Plant Species	Cardaria pubescens	hairy whitetop	Brassicaceae
R6 Invasive Plant Species	Cardaria pubescens	hairy whitetop	Brassicaceae
R6 Invasive Plant Species	Carduus pycnocephalus	Italian plumeless thistle	Asteraceae
R6 Invasive Plant Species	Carduus tenuiflorus	winged plumeless thistle	Asteraceae
R6 Invasive Plant Species	Cirsium vulgare	bull thistle	Asteraceae
R6 Invasive Plant Species	Centaurea stoebe ssp. micranthos	spotted knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea cyanus	garden cornflower	Asteraceae
R6 Invasive Plant Species	Centaurea debeauxii	meadow knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea diffusa	diffuse knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea jacea	brownray knapweed	Asteraceae
R6 Invasive Plant Species	Prunus laurocerasus	cherry laurel	Rosaceae
R6 Invasive Plant Species	Centaurea stoebe ssp. micranthos	spotted knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea melitensis	Maltese star-thistle	Asteraceae
R6 Invasive Plant Species	Centaurea moncktonii	meadow knapweed	Asteraceae
R6 Invasive Plant Species	Acroptilon repens	hardheads	Asteraceae
R6 Invasive Plant Species	Centaurea nigrescens	Tyrol knapweed	Asteraceae
R6 Invasive Plant Species	Acroptilon repens	hardheads	Asteraceae
R6 Invasive Plant Species	Centaurea solstitialis	yellow star-thistle	Asteraceae
R6 Invasive Plant Species	Centaurea virgata ssp. squarrosa	squarrose knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea stoebe ssp. micranthos	spotted knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea virgata ssp. squarrosa	squarrose knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea virgata ssp. squarrosa	squarrose knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea virgata ssp. squarrosa	squarrose knapweed	Asteraceae
R6 Invasive Plant Species	Centaurea virgata ssp. squarrosa	squarrose knapweed	Asteraceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Chondrilla juncea	rush skeletonweed	Asteraceae
R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae
R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae

R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae
R6 Invasive Plant Species	Tanacetum parthenium	feverfew	Asteraceae
R6 Invasive Plant Species	Tanacetum vulgare	common tansy	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cichorium intybus	chicory	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cichorium intybus	chicory	Asteraceae
R6 Invasive Plant Species	Cichorium intybus	chicory	Asteraceae
R6 Invasive Plant Species	Cirsium vulgare	bull thistle	Asteraceae
R6 Invasive Plant Species	Cirsium vulgare	bull thistle	Asteraceae
R6 Invasive Plant Species	Cirsium ochrocentrum	yellowspine thistle	Asteraceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Cirsium undulatum	wavyleaf thistle	Asteraceae
R6 Invasive Plant Species	Cirsium vulgare	bull thistle	Asteraceae
R6 Invasive Plant Species	Clematis vitalba	evergreen clematis	Ranunculaceae
R6 Invasive Plant Species	Convolvulus arvensis	field bindweed	Convolvulaceae
R6 Invasive Plant Species	Convolvulus arvensis	field bindweed	Convolvulaceae
R6 Invasive Plant Species	Convolvulus arvensis	field bindweed	Convolvulaceae
R6 Invasive Plant Species	Conium maculatum	poison hemlock	Apiaceae
R6 Invasive Plant Species	Cortaderia	pampas grass	Poaceae
R6 Invasive Plant Species	Calystegia sepium ssp. sepium	hedge false bindweed	Convolvulaceae
R6 Invasive Plant Species	Crupina vulgaris	common crupina	Asteraceae
R6 Invasive Plant Species	Aegilops cylindrica	jointed goatgrass	Poaceae
R6 Invasive Plant Species	Cyperus esculentus	yellow nutsedge	Cyperaceae
R6 Invasive Plant Species	Genista monspessulana	French broom	Fabaceae
R6 Invasive Plant Species	Cynoglossum officinale	gypsyflower	Boraginaceae
R6 Invasive Plant Species	Cytisus scoparius	Scotch broom	Fabaceae
R6 Invasive Plant Species	Cytisus striatus	striated broom	Fabaceae
R6 Invasive Plant Species	Daucus carota	Queen Anne's lace	Apiaceae
R6 Invasive Plant Species	Dactylis glomerata	orchardgrass	Poaceae
R6 Invasive Plant Species	Daphne laureola	spurgelaurel	Thymelaeaceae
R6 Invasive Plant Species	Dianthus armeria	Deptford pink	Caryophyllaceae
R6 Invasive Plant Species	Dianthus armeria	Deptford pink	Caryophyllaceae
R6 Invasive Plant Species	Dipsacus fullonum	Fuller's teasel	Dipsacaceae
R6 Invasive Plant Species	Dipsacus fullonum	Fuller's teasel	Dipsacaceae
R6 Invasive Plant Species	Dipsacus fullonum	Fuller's teasel	Dipsacaceae
R6 Invasive Plant Species	Dipsacus laciniatus	cutleaf teasel	Dipsacaceae
R6 Invasive Plant Species	Digitalis purpurea	purple foxglove	Scrophulariaceae
R6 Invasive Plant Species	Digitalis purpurea	purple foxglove	Scrophulariaceae
R6 Invasive Plant Species	Dipsacus fullonum	Fuller's teasel	Dipsacaceae
R6 Invasive Plant Species	Echium vulgare	common viper's bugloss	Boraginaceae
R6 Invasive Plant Species	Egeria densa	Brazilian waterweed	Hydrocharitaceae
R6 Invasive Plant Species	Taeniatherum caput-medusae	medusahead	Poaceae
R6 Invasive Plant Species	Elaphoglossum decoratum	showy tonguefern	Dryopteridaceae
R6 Invasive Plant Species	Egeria densa	Brazilian waterweed	Hydrocharitaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Myriophyllum aquaticum	parrot feather watermilfoil	Haloragaceae

R6 Invasive Plant Species	Alliaria petiolata	garlic mustard	Brassicaceae
R6 Invasive Plant Species	Sisymbrium officinale	hedgemustard	Brassicaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphorbia esula	leafy spurge	Euphorbiaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia stricta	drug eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia stricta	drug eyebright	Scrophulariaceae
R6 Invasive Plant Species	Euphrasia nemorosa	common eyebright	Scrophulariaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum sachalinense	giant knotweed	Polygonaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Brachypodium sylvaticum	slender false brome	Poaceae
R6 Invasive Plant Species	Foeniculum vulgare	sweet fennel	Apiaceae
R6 Invasive Plant Species	Foeniculum vulgare	sweet fennel	Apiaceae
R6 Invasive Plant Species	Geranium columbinum	longstalk cranesbill	Geraniaceae
R6 Invasive Plant Species	Genista monspessulana	French broom	Fabaceae
R6 Invasive Plant Species	Geranium robertianum	Robert geranium	Geraniaceae
R6 Invasive Plant Species	Gypsophila paniculata	baby's breath	Caryophyllaceae
R6 Invasive Plant Species	Gypsophila paniculata	baby's breath	Caryophyllaceae
R6 Invasive Plant Species	Hedera helix	English ivy	Araliaceae
R6 Invasive Plant Species	Hedera hibernica	Atlantic Ivy	Araliaceae
R6 Invasive Plant Species	Hedera hibernica	Atlantic Ivy	Araliaceae
R6 Invasive Plant Species	Heracleum mantegazzianum	giant hogweed	Apiaceae
R6 Invasive Plant Species	Hieracium lachenalii	common hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium aurantiacum	orange hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium caespitosum	meadow hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium lachenalii	common hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium pilosella	mouseear hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium caespitosum	meadow hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium sabaudum	New England hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium laevigatum	smooth hawkweed	Asteraceae
R6 Invasive Plant Species	Hieracium lachenalii	common hawkweed	Asteraceae
R6 Invasive Plant Species	Hyoscyamus niger	black henbane	Solanaceae
R6 Invasive Plant Species	Hypericum perforatum	common St. Johnswort	Clusiaceae
R6 Invasive Plant Species	Cardaria pubescens	hairy whitetop	Brassicaceae
R6 Invasive Plant Species	Hypochaeris radicata	hairy catsear	Asteraceae

R6 Invasive Plant Species	Hydrilla verticillata	waterthyme	Hydrocharitaceae
R6 Invasive Plant Species	Ilex aquifolium	English holly	Aquifoliaceae
R6 Invasive Plant Species	Iris pseudacorus	paleyellow iris	Iridaceae
R6 Invasive Plant Species	Isatis tinctoria	Dyer's woad	Brassicaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Bassia scoparia	burningbush	Chenopodiaceae
R6 Invasive Plant Species	Lamiastrum galeobdolon	yellow archangel	Lamiaceae
R6 Invasive Plant Species	Lamiastrum galeobdolon	yellow archangel	Lamiaceae
R6 Invasive Plant Species	Lathyrus latifolius	perennial pea	Fabaceae
R6 Invasive Plant Species	Lathyrus latifolius	perennial pea	Fabaceae
R6 Invasive Plant Species	Arctium minus	lesser burdock	Asteraceae
R6 Invasive Plant Species	Mycelis muralis	wall-lettuce	Asteraceae
R6 Invasive Plant Species	Prunus laurocerasus	cherry laurel	Rosaceae
R6 Invasive Plant Species	Lactuca serriola	prickly lettuce	Asteraceae
R6 Invasive Plant Species	Lactuca serriola	prickly lettuce	Asteraceae
R6 Invasive Plant Species	Lathyrus sylvestris	flat pea	Fabaceae
R6 Invasive Plant Species	Centaurea cyanus	garden cornflower	Asteraceae
R6 Invasive Plant Species	Cardaria draba	whitetop	Brassicaceae
R6 Invasive Plant Species	Cardaria draba	whitetop	Brassicaceae
R6 Invasive Plant Species	Lepidium latifolium	broadleaved pepperweed	Brassicaceae
R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae
R6 Invasive Plant Species	Centaurea solstitialis	yellow star-thistle	Asteraceae
R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae
R6 Invasive Plant Species	Leucanthemum vulgare	oxeye daisy	Asteraceae
R6 Invasive Plant Species	Linaria dalmatica	Dalmatian toadflax	Scrophulariaceae
R6 Invasive Plant Species	Linaria vulgaris	butter and eggs	Scrophulariaceae
R6 Invasive Plant Species	Ligustrum vulgare	European privet	Oleaceae
R6 Invasive Plant Species	Linaria vulgaris	butter and eggs	Scrophulariaceae
R6 Invasive Plant Species	Lotus corniculatus	bird's-foot trefoil	Fabaceae
R6 Invasive Plant Species	Lotus corniculatus	bird's-foot trefoil	Fabaceae
R6 Invasive Plant Species	Lotus pedunculatus	big trefoil	Fabaceae
R6 Invasive Plant Species	Lonicera etrusca	Etruscan honeysuckle	Caprifoliaceae
R6 Invasive Plant Species	Lotus pedunculatus	big trefoil	Fabaceae
R6 Invasive Plant Species	Lotus pedunculatus	big trefoil	Fabaceae
R6 Invasive Plant Species	Lotus pedunculatus	big trefoil	Fabaceae
R6 Invasive Plant Species	Anchusa arvensis	small bugloss	Boraginaceae
R6 Invasive Plant Species	Lythrum salicaria	purple loosestrife	Lythraceae
R6 Invasive Plant Species	Saponaria officinalis	bouncingbet	Caryophyllaceae
R6 Invasive Plant Species	Lythrum salicaria	purple loosestrife	Lythraceae
R6 Invasive Plant Species	Lythrum salicaria	purple loosestrife	Lythraceae
R6 Invasive Plant Species	Lythrum salicaria	purple loosestrife	Lythraceae
R6 Invasive Plant Species	Lysimachia vulgaris	garden yellow loosestrife	Primulaceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Tanacetum parthenium	feverfew	Asteraceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae

R6 Invasive Plant Species	Marrubium vulgare	horehound	Lamiaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Melilotus officinalis	yellow sweetclover	Fabaceae
R6 Invasive Plant Species	Myriophyllum aquaticum	parrot feather watermilfoil	Haloragaceae
R6 Invasive Plant Species	Myriophyllum aquaticum	parrot feather watermilfoil	Haloragaceae
R6 Invasive Plant Species	Mycelis muralis	wall-lettuce	Asteraceae
R6 Invasive Plant Species	Myriophyllum aquaticum	parrot feather watermilfoil	Haloragaceae
R6 Invasive Plant Species	Myriophyllum spicatum	Eurasian watermilfoil	Haloragaceae
R6 Invasive Plant Species	Onopordum acanthium	Scotch cottonthistle	Asteraceae
R6 Invasive Plant Species	Onopordum acanthium	Scotch cottonthistle	Asteraceae
R6 Invasive Plant Species	Phalaris arundinacea	reed canarygrass	Poaceae
R6 Invasive Plant Species	Phalaris arundinacea	reed canarygrass	Poaceae
R6 Invasive Plant Species	Phalaris arundinacea	reed canarygrass	Poaceae
R6 Invasive Plant Species	Phalaris arundinacea	reed canarygrass	Poaceae
R6 Invasive Plant Species	Egeria densa	Brazilian waterweed	Hydrocharitaceae
R6 Invasive Plant Species	Plantago lanceolata	narrowleaf plantain	Plantaginaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Plantago lanceolata	narrowleaf plantain	Plantaginaceae
R6 Invasive Plant Species	Plantago lanceolata	narrowleaf plantain	Plantaginaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum arenastrum	oval-leaf knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum arenastrum	oval-leaf knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum arenastrum	oval-leaf knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum bohemicum	Bohemian knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum arenastrum	oval-leaf knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum polystachyum	cultivated knotweed	Polygonaceae
R6 Invasive Plant Species	Potentilla recta	sulphur cinquefoil	Rosaceae
R6 Invasive Plant Species	Potentilla recta	sulphur cinquefoil	Rosaceae
R6 Invasive Plant Species	Potentilla recta	sulphur cinquefoil	Rosaceae
R6 Invasive Plant Species	Potentilla recta	sulphur cinquefoil	Rosaceae
R6 Invasive Plant Species	Polygonum sachalinense	giant knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Prunus laurocerasus	cherry laurel	Rosaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Ranunculus repens	creeping buttercup	Ranunculaceae
R6 Invasive Plant Species	Polygonum cuspidatum	Japanese knotweed	Polygonaceae
R6 Invasive Plant Species	Polygonum sachalinense	giant knotweed	Polygonaceae
R6 Invasive Plant Species	Robinia pseudoacacia	black locust	Fabaceae
R6 Invasive Plant Species	Rubus armeniacus	Himalayan blackberry	Rosaceae
R6 Invasive Plant Species	Rubus armeniacus	Himalayan blackberry	Rosaceae
R6 Invasive Plant Species	Rubus laciniatus	cutleaf blackberry	Rosaceae

R6 Invasive Plant Species	Rubus armeniacus	Himalayan blackberry	Rosaceae
R6 Invasive Plant Species	Salvia aethiopis	Mediterranean sage	Lamiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola kali	Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Saponaria officinalis	bouncingbet	Caryophyllaceae
R6 Invasive Plant Species	Saponaria officinalis	bouncingbet	Caryophyllaceae
R6 Invasive Plant Species	Sasa palmata	broadleaf bamboo	Poaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Salvia sclarea	Europe sage	Lamiaceae
R6 Invasive Plant Species	Cytisus scoparius	Scotch broom	Fabaceae
R6 Invasive Plant Species	Salvia sclarea	Europe sage	Lamiaceae
R6 Invasive Plant Species	Salsola tragus	prickly Russian thistle	Chenopodiaceae
R6 Invasive Plant Species	Schoenoplectus mucronatus	bog bulrush	Cyperaceae
R6 Invasive Plant Species	Cirsium arvense	Canada thistle	Asteraceae
R6 Invasive Plant Species	Secale cereale	cereal rye	Poaceae
R6 Invasive Plant Species	Senecio jacobaea	stinking willie	Asteraceae
R6 Invasive Plant Species	Secale cereale	cereal rye	Poaceae
R6 Invasive Plant Species	Secale cereale	cereal rye	Poaceae
R6 Invasive Plant Species	Senecio sylvaticus	woodland ragwort	Asteraceae
R6 Invasive Plant Species	Alliaria petiolata	garlic mustard	Brassicaceae
R6 Invasive Plant Species	Sisymbrium officinale	hedgemustard	Brassicaceae
R6 Invasive Plant Species	Sisymbrium officinale	hedgemustard	Brassicaceae
R6 Invasive Plant Species	Sonchus arvensis	field sowthistle	Asteraceae
R6 Invasive Plant Species	Sonchus asper	spiny sowthistle	Asteraceae
R6 Invasive Plant Species	Sonchus asper	spiny sowthistle	Asteraceae
R6 Invasive Plant Species	Soliva sessilis	field burrweed	Asteraceae
R6 Invasive Plant Species	Solanum dulcamara	climbing nightshade	Solanaceae
R6 Invasive Plant Species	Solanum elaeagnifolium	silverleaf nightshade	Solanaceae
R6 Invasive Plant Species	Soliva sessilis	field burrweed	Asteraceae
R6 Invasive Plant Species	Soliva sessilis	field burrweed	Asteraceae
R6 Invasive Plant Species	Spartium junceum	Spanish broom	Fabaceae
R6 Invasive Plant Species	Convolvulus arvensis	field bindweed	Convolvulaceae
R6 Invasive Plant Species	Symphytum officinale	common comfrey	Boraginaceae
R6 Invasive Plant Species	Taeniatherum caput-medusae	medusahead	Poaceae
R6 Invasive Plant Species	Tanacetum vulgare	common tansy	Asteraceae
R6 Invasive Plant Species	Taeniatherum caput-medusae	medusahead	Poaceae
R6 Invasive Plant Species	Taeniatherum caput-medusae	medusahead	Poaceae
R6 Invasive Plant Species	Tanacetum parthenium	feverfew	Asteraceae
R6 Invasive Plant Species	Tamarix ramosissima	saltcedar	Tamaricaceae
R6 Invasive Plant Species	Tanacetum vulgare	common tansy	Asteraceae
R6 Invasive Plant Species	Tanacetum vulgare	common tansy	Asteraceae
R6 Invasive Plant Species	Genista monspessulana	French broom	Fabaceae
R6 Invasive Plant Species	Secale cereale	cereal rye	Poaceae
R6 Invasive Plant Species	Aegilops cylindrica	jointed goatgrass	Poaceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Tripleurospermum maritima	false mayweed	Asteraceae
R6 Invasive Plant Species	Tripleurospermum maritima ssp. mar	false mayweed	Asteraceae
R6 Invasive Plant Species	Aegilops triuncialis	barbed goatgrass	Poaceae
R6 Invasive Plant Species	Tripleurospermum perforata	scentless false mayweed	Asteraceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae

R6 Invasive Plant Species	Tribulus terrestris	puncturevine	Zygophyllaceae
R6 Invasive Plant Species	Aegilops triuncialis	barbed goatgrass	Poaceae
R6 Invasive Plant Species	Elymus repens	quackgrass	Poaceae
R6 Invasive Plant Species	Ulex europaeus	common gorse	Fabaceae
R6 Invasive Plant Species	Urtica dioica	stinging nettle	Urticaceae
R6 Invasive Plant Species	Ventenata dubia	North Africa grass	Poaceae
R6 Invasive Plant Species	Ventenata dubia	North Africa grass	Poaceae
R6 Invasive Plant Species	Verbascum thapsus	common mullein	Scrophulariaceae
R6 Invasive Plant Species	Vinca major	bigleaf periwinkle	Apocynaceae
R6 Invasive Plant Species	Vinca major	bigleaf periwinkle	Apocynaceae
R6 Invasive Plant Species	Vinca minor	common periwinkle	Apocynaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae
R6 Invasive Plant Species	Vulpia myuros	rat-tail fescue	Poaceae

Appendix D: Environmental Justice Data

APPENDIX D: ENVIRONMENTAL JUSTICE DATA

The U.S. Environmental Protection Agency (EPA) defines “environmental justice” as “*the 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* (EPA 2021). Building upon this definition, the Washington state law on Environmental Justice (Chapter 70A.02 RCW) defines environmental justice as:

> *The 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, rules, and policies. Environmental justice includes addressing disproportionate environmental and health impacts in all laws, rules, and policies with environmental impacts by prioritizing vulnerable populations and overburdened communities, the equitable distribution of resources and benefits, and eliminating harm.*

This appendix identifies people with low-income, people of color, and other communities that are overburdened with respect to environmental health disparities, as well as the tribal populations with unique connections to potentially affected resources, within the study area.[1,2] Additionally, it addresses all significant anticipated impacts and evaluates the potential that identified groups may be disproportionately affected.

Methodology

The environmental justice analysis considers the extent to which people of color, low-income communities, and overburdened communities, as well as potentially affected tribal populations, may be disproportionately adversely or beneficially affected by the alternatives. The environmental justice analysis relies on the findings of the impact analyses described in the previous chapters of this EIS to identify the potential for impacts on vulnerable communities (including low-income individuals, people of color, and tribal communities), and evaluates whether impacts on the vulnerable communities are disproportionate relative to the impacts on other affected communities.

The environmental justice analysis involves the following general steps:

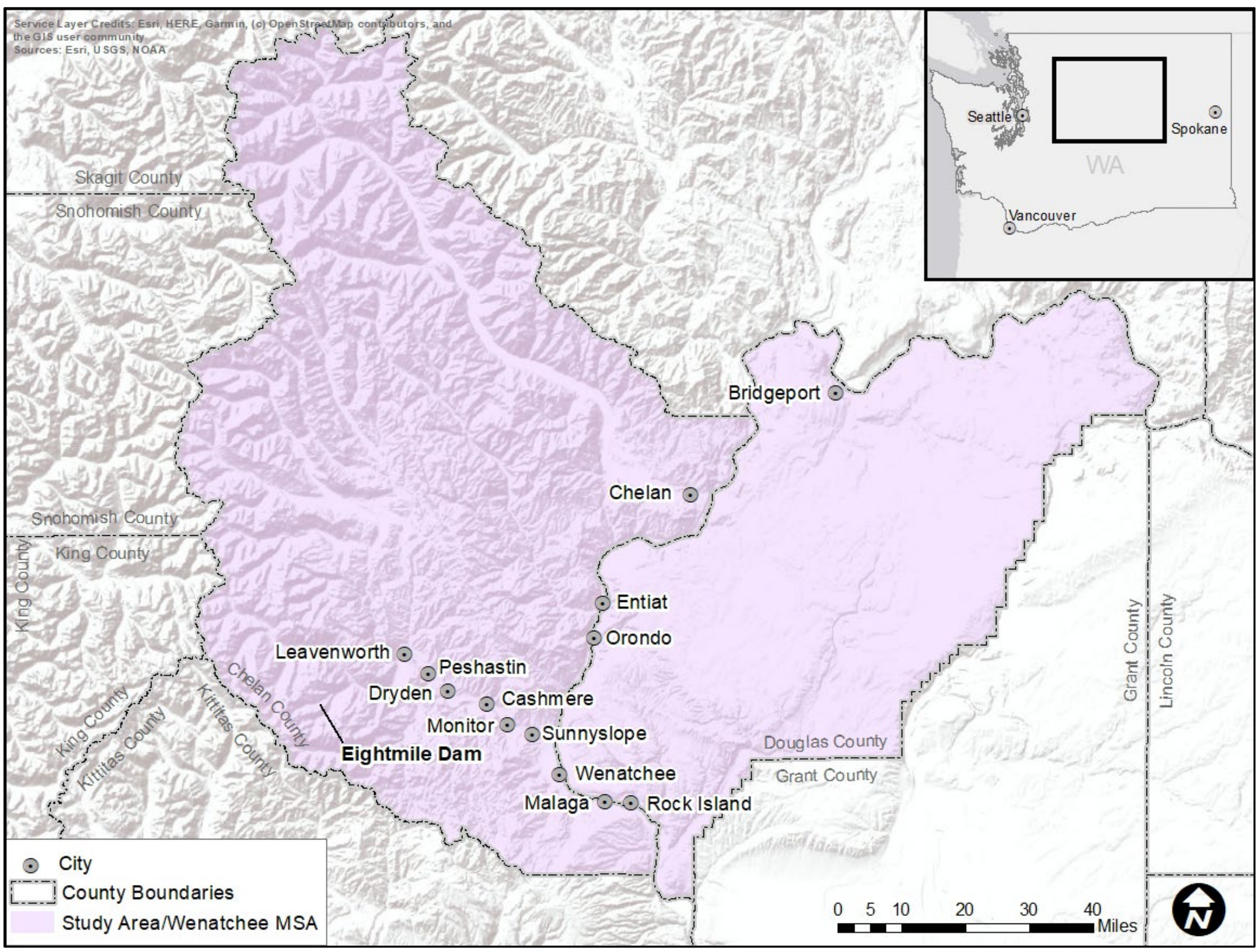
1. Identify and describe relative presence of people of color and low-income communities at the Census block group level across the study area. A Census block group is a subdivision of a Census tract and is the smallest geographical unit for which the Census publishes sample data.
2. Identify and describe presence of communities at the Census tract level that the state describes as having demographic and other characteristics that identify it as overburdened.[3]
3. Identify tribal populations with unique connections to the potentially affected resources.
4. Identify whether the impacts of the alternatives as described in the Impacts sections of the EIS may affect the communities identified in the first three steps.

[1] This analysis collectively considers race, color, and national origin under the umbrella of “communities of color.”
[2] The scope of this analysis with respect to tribal populations includes those individual tribal members that may experience impacts resulting from the alternatives due to their use of affected resources.
[3] These include the communities identified in the State of Washington’s Environmental Health Disparities mapping tool as characterized by environmental health disparities. Factors considered include environmental exposures, environmental effects, sensitive populations, and socioeconomic factors (DOH 2021).

5. Evaluate the nature and relative intensity of impacts of the alternatives that would be experienced by the general population and compare with the anticipated impacts on the identified communities.
6. Identify and describe impacts that may disproportionately affect the vulnerable communities identified in this analysis.

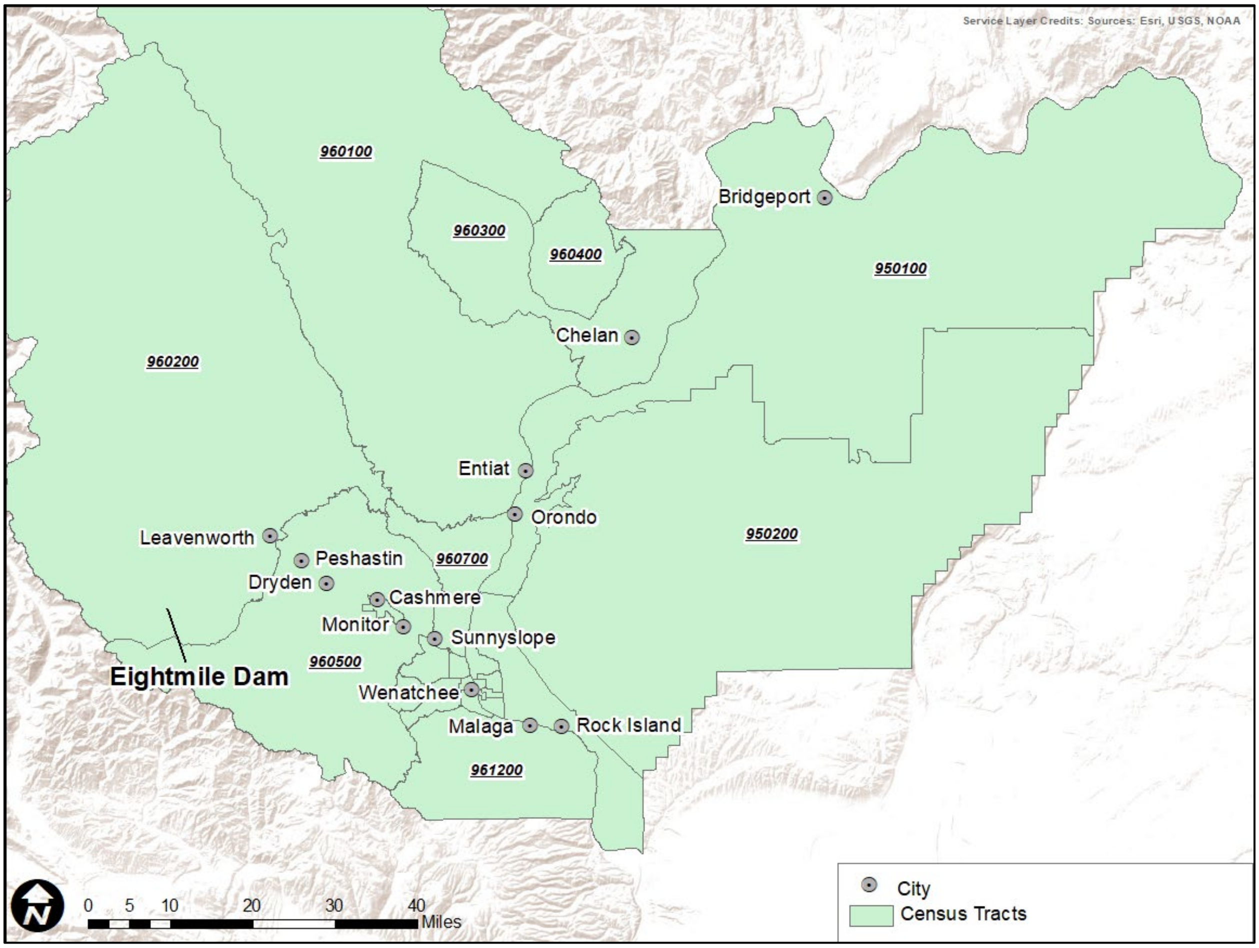
This analysis identifies communities of color, low-income communities, and overburdened communities across the Wenatchee Metropolitan Statistical Area (MSA), which includes all of Chelan and Douglas counties (Figure D-1). Figure D-2 and Figure D-3 identify the relevant census tracts for this analysis. This geographic region encompasses the area over which individuals and communities may experience the impacts to the affected activities and resources (e.g., water, fish, agriculture). For example, the affected communities may be employed in affected industries, rely upon the affected environmental resources for food or recreation, or hold cultural value for potentially affected resources. While this study area is broad and includes areas somewhat distant from the dam site, the major population centers within the MSA are relatively close to the dam site. The majority of communities that may be affected by the action are likely within Chelan County. However, the analysis includes Douglas County as a significant portion of the largest proximal population center (Wenatchee/East Wenatchee) lies in Douglas County.

Figure D-1. Study Area for Environmental Justice Analysis



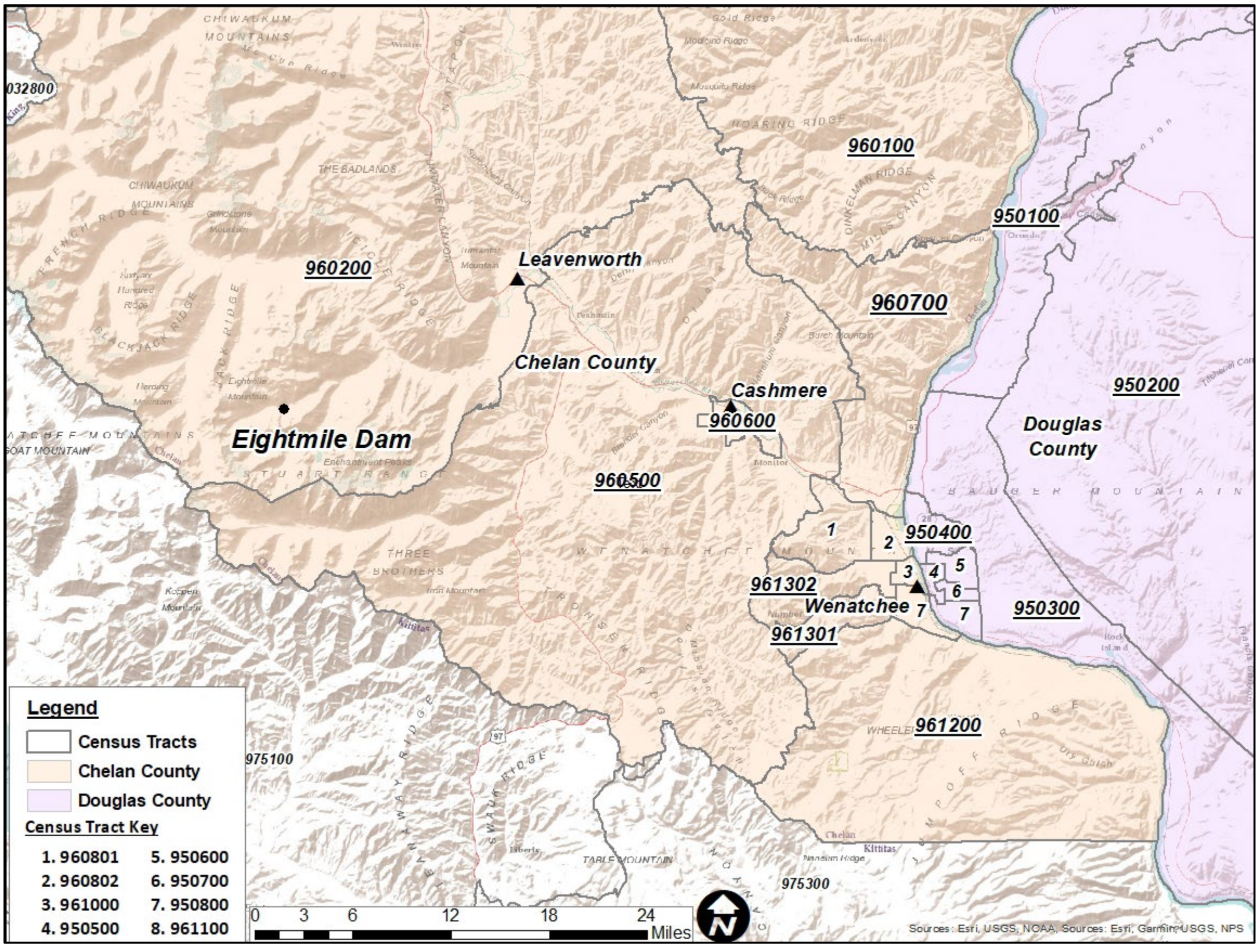
Sources: DNR 2022; United States Census 2020.

Figure D-2. Census Tracts within Study Area for Environmental Justice Analysis



Sources: DNR 2022; United States Census 2020.

Figure D-3. Census Tracts within Urban Areas of Study Area for Environmental Justice Analysis



Sources: DNR 2022; United States Census 2020.

Regulatory Context

Regulations, programs, policies, and guidance that identify methods for determining environmental justice impacts of proposed actions are described in Table D-1. The State of Washington does not require environmental justice analyses of significant regulatory actions until July 1, 2023 (70A.02 RCW), and the federal guidance and policies regarding environmental justice are not required for this SEPA analysis. However, absent specific existing requirements for consideration of environmental justice within SEPA, this analysis relies on these federal policies and guidelines, recent state legislation on Environmental Justice (Chapter 70A.02 RCW), as well as the State of Washington's Environmental Justice Task Force's report, to evaluate the potential environmental justice effects of the alternatives.

Table D-1. Regulations and Guidelines Related to Environmental Justice

Program, Plan, or Policy	Description
Executive Order 12898. Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994)	E.O. 12898 requires that federal agencies identify and address disproportionately high and adverse effects of its programs, policies, and activities on minority and low-income populations.
Council on Environmental Quality (CEQ) Environmental Justice: Guidance Under the National Environmental Policy Act (1997)	Guidance from the CEQ on how federal agencies can most effectively identify and address environmental justice concerns within National Environmental Policy Act (NEPA) analyses.
Promising Practices for EJ Methodologies in NEPA Reviews: Report of the Federal Interagency Working Group on Environmental Justice & NEPA Committee (2016)	A report of the Federal Interagency Working Group on Environmental Justice (IWGEJ), which was established to improve consideration of environmental justice issues in the NEPA process across all relevant federal agencies. This report specifically compiles methodologies and best practices used by Federal agencies relative to environmental justice within NEPA. The recommendations and methodologies presented do not reflect formal agency guidance.
Environmental Justice Task Force Recommendations for Prioritizing EJ in Washington State Government: Report to the Washington State Governor and Legislature	In 2019, the Washington State Legislature, through a proviso in its 2019–2021 operating budget, created the Environmental Justice Task Force. The Task Force was charged with developing a report that included, among other charges: • Model policies that prioritize highly impacted communities and vulnerable populations for the purpose of reducing environmental health disparities and advancing a healthy environment for all residents; and • Guidance for using the Washington Environmental Health Disparity Map to identify communities that are highly impacted by EJ issues with current demographic data (Environmental Justice Task Force 2020). The Task Force published its Final Report in October 2020.
Washington State Law on Environmental Justice RCW 70A.02	RCW 70A.02 implements the recommendations of the Environmental Justice Task Force with the goal of reducing and eliminating the disparities in how low-income communities and communities of color experience environmental health impacts. It requires that specific state agencies: • Incorporate environmental justice into their strategic plans. • Conduct environmental justice assessment when considering significant actions. • Develop a framework for consultation with tribal governments. • Create and adopt a community engagement plan to identify how it will facilitate participation of potentially affecting communities in agency decision-making.

Affected Environment

This section uses demographic data to identify the existence of communities of color, low-income communities, and overburdened communities within the study area. It is based on the most recent socioeconomic statistics currently available from the U.S. Census American Community Survey (ACS) 5-year estimates from 2015 to 2019, as well as data compiled in the Washington State Department of Health's Environmental Disparities (EHD) Map (United States Census 2021; DOH 2021). In addition to communities of color, low-income communities, and overburdened communities, this analysis also identifies tribal populations with special interest in potentially affected resources.

Communities of Color

People of color are defined in this analysis as all people who list their racial status as a race other than white alone and/or list their ethnicity as Hispanic or Latino. The CEQ guidance identifies areas of "minority communities" as being where "*minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis*" (CEQ 1997). The Federal Interagency Working Group on Environmental Justice (IWGEJ) provides additional guidance for defining "meaningfully greater" in identifying environmental justice communities (NEPA Committee and IWGEJ 2017). This analysis considers two criteria for identifying communities of color. It first considers whether the population of color in any Census block group within the study area exceeds 50 percent, which would identify the presence of a community of color (i.e., the "50 percent analysis"). It then evaluates whether the population of color in any remaining block group is greater than 10 percent higher than the "reference community," which in this case is the broader relevant county. The communities that meet either of these thresholds are identified as "communities of color."

The percentages of people of color in Chelan and Douglas counties are 32 and 36 percent, respectively (Table D-2). The population of color within these counties is slightly higher than the state-wide proportion of 31 percent. Accordingly, the thresholds to identify communities of color in Chelan and Douglas counties, respectively, are 42 and 46 percent.

This analysis identifies communities of color in the study area based on Census block group level data. Race and ethnicity characteristics are based on the ACS 2015–2019 5-year estimates (Table D-2). The "50 percent analysis" identifies 18 block groups as communities of color. Table D-2 also describes the percentages of people of color in block groups within the study area and identifies three additional block groups with populations of color greater than 10 percent above the threshold for the associated county.

Of the 84 block groups considered, 21 have percentages of people of color above the established thresholds. These block groups account for 24.7 percent of the total population of Chelan and Douglas counties. The populations of color in the study area are predominantly Hispanic/Latino or "other." Figure D-4 maps these block groups identified as communities of color.

The population of color across the MSA is predominantly Hispanic/Latino. In Chelan County, the populations of communities of color generally include between 50 and 65 percent (in one case as high as 92 percent) of the population identifying as Hispanic/Latino at the block group level. In Douglas County, the statistics are generally similar. The population of color of the MSA also includes a substantial proportion of individuals who identify their race as "other" or "two or more races," and two block groups with relatively high proportions of the population that identify as American Indian or Alaska Native. The population of color of the MSA does not include many individuals identifying as Black/African American, Asian, or Native Hawaiian/Other Pacific Islander.

Table D-2. Populations of Color in Study Area Block Groups

Census Area		Total Population[1]	Total People of Color	Percentage of People of Color	Racial Groups Breakdown: White (Hispanic or Non-Hispanic)	Black/ African American	American Indian and Alaska Native	Asian	Native Hawaiian and other Pacific Islander	Other	Two or More Races	Hispanic/ Latino Origin – Any Race
Chelan County		76,229	24,413	**32%**	80%	1%	1%	1%	0%	13%	4%	28%
Douglas County		42,023	15,062	**36%**	69%	0%	1%	1%	0%	25%	3%	32%
Washington State		7,404,107	2,330,162	**31%**	75%	4%	1%	9%	1%	4%	6%	13%
Tract	**Block Group**	**Total Population[1]**	**Total People of Color**	**Percentage of People of Color**	**White (Hispanic or Non-Hispanic)**	**Black/ African American**	**American Indian and Alaska Native**	**Asian**	**Native Hawaiian and Other Pacific Islander**	**Other**	**Two or More Races**	**Hispanic/Latino Origin-Any Race**
Chelan County (Percentage of People of Color Threshold 42%)												
960300	6	709	461	**65%**	68%	0%	0%	0%	0%	32%	0%	65%
960300	7	1,103	514	**47%**	93%	0%	0%	0%	0%	7%	0%	47%
960400	2	1,470	954	**65%**	63%	0%	0%	0%	0%	20%	16%	63%
960802	5	1,449	765	**53%**	70%	0%	0%	0%	0%	19%	12%	53%
961000	1	770	417	**54%**	95%	0%	0%	0%	0%	0%	5%	51%
961000	2	774	605	**78%**	31%	0%	18%	2%	0%	28%	21%	58%
961000	6	1,081	620	**57%**	68%	0%	0%	0%	0%	13%	19%	47%
961100	1	1,131	554	**49%**	61%	3%	0%	0%	0%	32%	4%	45%
961100	2	2,444	1,391	**57%**	48%	0%	0%	0%	0%	47%	5%	54%
961100	3	2,562	1,908	**74%**	72%	0%	0%	0%	0%	28%	0%	74%
961100	4	1,978	1,054	**53%**	54%	9%	4%	0%	0%	29%	4%	36%
961100	5	2,201	2,034	**92%**	41%	0%	0%	0%	0%	59%	0%	92%
Douglas County (Percentage of People of Color Threshold 46%)												
950100	2	878	623	**71%**	29%	0%	0%	0%	0%	71%	0%	71%
950100	3	1,328	1,182	**89%**	22%	0%	2%	0%	0%	71%	4%	86%

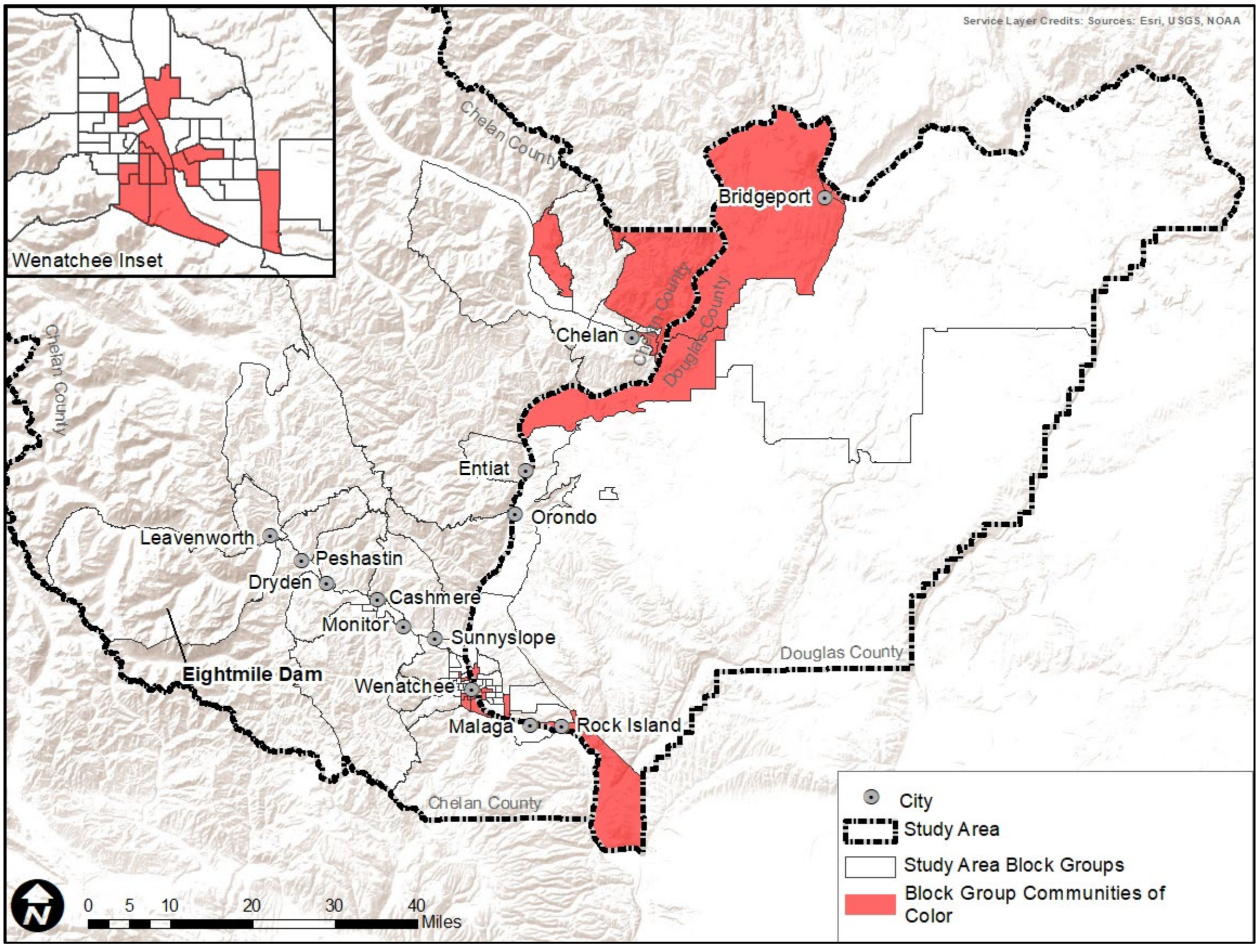
Tract	Block Group	Total Population[1]	Total People of Color	Percentage of People of Color	White (Hispanic or Non-Hispanic)	Black/ African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Other	Two or More Races	Hispanic/Latino Origin-Any Race
950100	4	1,247	1,109	**89%**	13%	0%	1%	0%	0%	77%	9%	88%
950100	5	1,271	822	**65%**	43%	0%	0%	1%	0%	49%	7%	57%
950300	2	1,110	632	**57%**	43%	0%	3%	3%	0%	50%	0%	52%
950300	5	1,425	743	**52%**	64%	0%	0%	0%	0%	32%	3%	49%
950400	3	2,005	1,057	**53%**	53%	0%	1%	1%	1%	44%	0%	49%
950500	3	492	229	**47%**	53%	0%	12%	0%	0%	16%	18%	24%
950700	1	1,828	962	**53%**	56%	0%	2%	0%	0%	38%	5%	49%

Note:

1/ Total population refers to an estimated value based on Census responses and may therefore differ across metrics.
2/ Percentages sum to 100 percent across racial groups; Hispanic/Latino category is not included in this breakdown because of overlap between Hispanic/Latino category and multiple racial categories.

Source: United States Census 2020.

Figure D-4. Map Identifying Locations of Communities of Color within the Study Area



Sources: DNR 2022; United States Census 2020.

The populations of color are largely centered around the City of Wenatchee and East Wenatchee. In Chelan County, they also include Census block groups with relatively large populations of color in and around the town of Chelan. In Douglas County, in addition to communities around East Wenatchee, there are block groups with relatively large populations of color near the towns of Bridgeport and Rocky Butte, as well as in other communities moving south along the Columbia River, and in the area south of Rock Island. The population of color of the MSA includes a substantial proportion of individuals who identify their race as “other” or “two or more races,” and two block groups with relatively high proportions of the population that identify as American Indian or Alaska Native.

Low-Income Communities

Data from the U.S. Census Bureau ACS 5-year estimates (2015–2019) inform the assessment of low-income communities across the study area at the Census block group level. For this analysis, low-income is defined as income less than 200% of the poverty level. The federal poverty level for an individual in 2020 was $12,760 (ASPE 2021). Thus, individuals with an income of less than $25,520 (two times the poverty level) are considered low-income.

For this analysis, a block group is considered to contain a “low-income community” if the proportion of individuals living at or below twice the poverty level is greater than the proportion for the State. The low-income percentage for Washington is 26 percent. This value establishes the threshold for identifying "low-income communities" for this analysis. Of the 84 block groups within the Wenatchee MSA study area for this analysis, 58 have low-income proportions above the established threshold (Table D-3). Figure D-5 depicts the locations of identified low-income communities graphically.

Of the 58 "low-income communities," 19 are also identified as "communities of color." The identified low-income communities cover a broader geographic area as compared with the block groups with communities of color. In addition to low-income areas in many of the same locations as the identified communities of color, low-income block groups are located along the entirety of Lake Chelan (northwest of the town of Chelan), south of the town of Chelan, in the area to the north of Cashmere, and south of the City of Leavenworth and Eightmile Lake.

Table D-3. Low-Income Populations in Study Area Block Groups

Census Area		Total Population[1]	Total Low-Income	Low-Income Percentage
Chelan County		75,073	24,638	33%
Douglas County		41,862	14,084	34%
Washington State		**7,266,810**	**1,860,917**	**26%**
Tract	**Block Group**	**Total Population[1]**	**Total Low-Income**	**Low-Income Percentage**
Chelan County				
960100	1	1192	362	31%
960100	2	998	270	27%
960300	1	514	218	42%
960300	3	1498	550	37%
960300	4	842	494	59%
960300	5	717	258	36%
960300	6	709	195	28%
960300	7	1103	512	46%
960400	1	576	200	35%
960400	2	1470	465	32%
960400	3	1173	597	51%
960500	1	905	289	32%
960500	3	1444	621	43%
960500	4	1757	557	32%
960500	5	1271	434	34%
960500	6	2060	543	27%
960600	2	1229	310	28%
960600	3	1486	409	29%
960700	2	1118	358	32%
960802	1	2107	1241	59%
960802	2	888	262	30%
960802	4	1503	437	29%
961000	1	770	290	38%
961000	2	774	391	51%
961000	3	557	262	47%

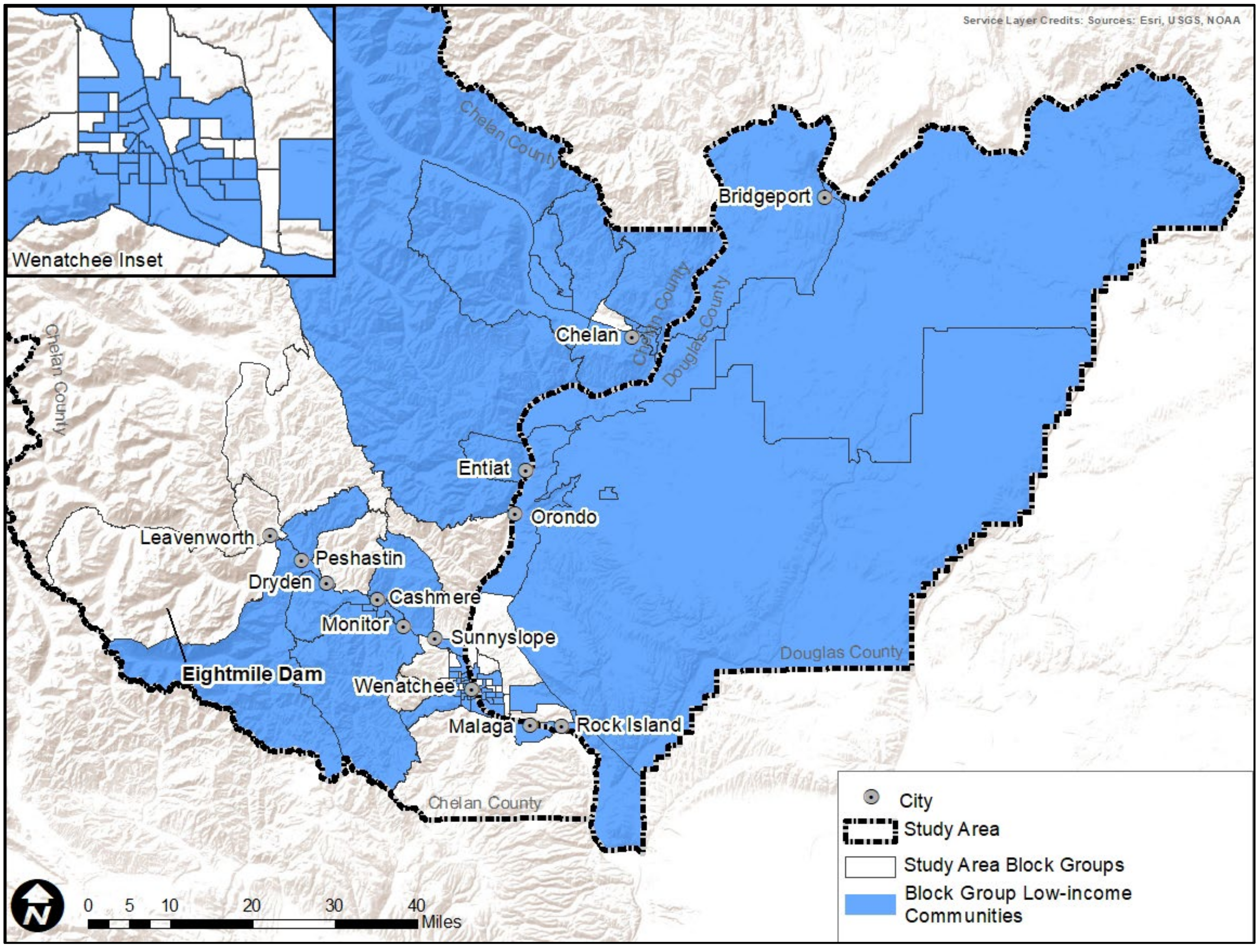
961000	4	541	188	35%
961000	6	1081	628	58%
961000	7	657	300	46%
961100	1	1131	447	40%
961100	2	2356	959	41%
961100	3	2562	1505	59%
Tract	Block Group	Total Population[1]	Total Low-Income	Low-Income Percentage
961100	4	1978	983	50%
961100	5	2078	1252	60%
961100	6	553	152	27%
961200		1972	591	30%
961302	1	1883	661	35%
961302	3	891	269	31%
961302	6	1590	604	38%
Douglas County				
950100	1	942	289	31%
950100	2	878	399	45%
950100	3	1328	700	53%
950100	4	1247	991	79%
950100	5	1271	681	54%
950100	6	625	197	32%
950200	1	1553	409	26%
950200	2	1513	444	30%
950300	3	1415	608	43%
950300	5	1409	525	37%
950400	3	2005	1103	55%
950500	2	1310	473	36%
950500	3	492	290	59%
950600	1	1311	568	43%
950700	1	1828	989	54%
950700	2	1364	619	45%
950700	3	1369	391	29%
950800	1	1614	783	49%
950800	2	1960	592	30%
950800	3	2205	659	31%

Note:

1/ Total population refers to an estimated value based on Census responses and may therefore differ across metrics.

Source: United States Census 2020.

Figure D-5. Map Identifying Locations of Low-Income Communities within the Study Area



Sources: DNR 2022; United States Census 2020.

Overburdened Communities

RCW 70A.02 directs agencies to use cumulative environmental health impact analysis, such as the Washington State Department of Health (DOH) Environmental Disparities (EHD) Map to consider the effects of a proposed action on overburdened communities. This analysis uses the Census-tract level data and overall environmental health disparities rankings from the EHD Map to identify additional overburdened communities that are experiencing environmental health disparities. The EHD map compares communities across the state and provides descriptive information and context for the pollution measures, proximity to hazardous sites, and social vulnerabilities that may characterize certain communities within the study area. The map contains 19 indicators split across four themes as follows: (i) Environmental Exposures; (ii) Environmental Effects; (iii) Sensitive Populations; and (iv) Socioeconomic Factors.

- *Environmental Exposures*: Emissions and concentrations of PM2.5 and ozone, proximity to heavy traffic roadways, and toxic releases from facilities.

- *Environmental Effects:* Risk of exposure to lead, and proximity to hazardous waste sites, Superfund sites, and Risk Management Plan facilities. *Sensitive Populations:* Death from cardiovascular disease, low birth weight.
- *Socioeconomic Factors:* Limited English-speaking abilities; no high school diploma; poverty; people of color; transportation expense; unaffordable housing; and unemployed (DOH 2021).

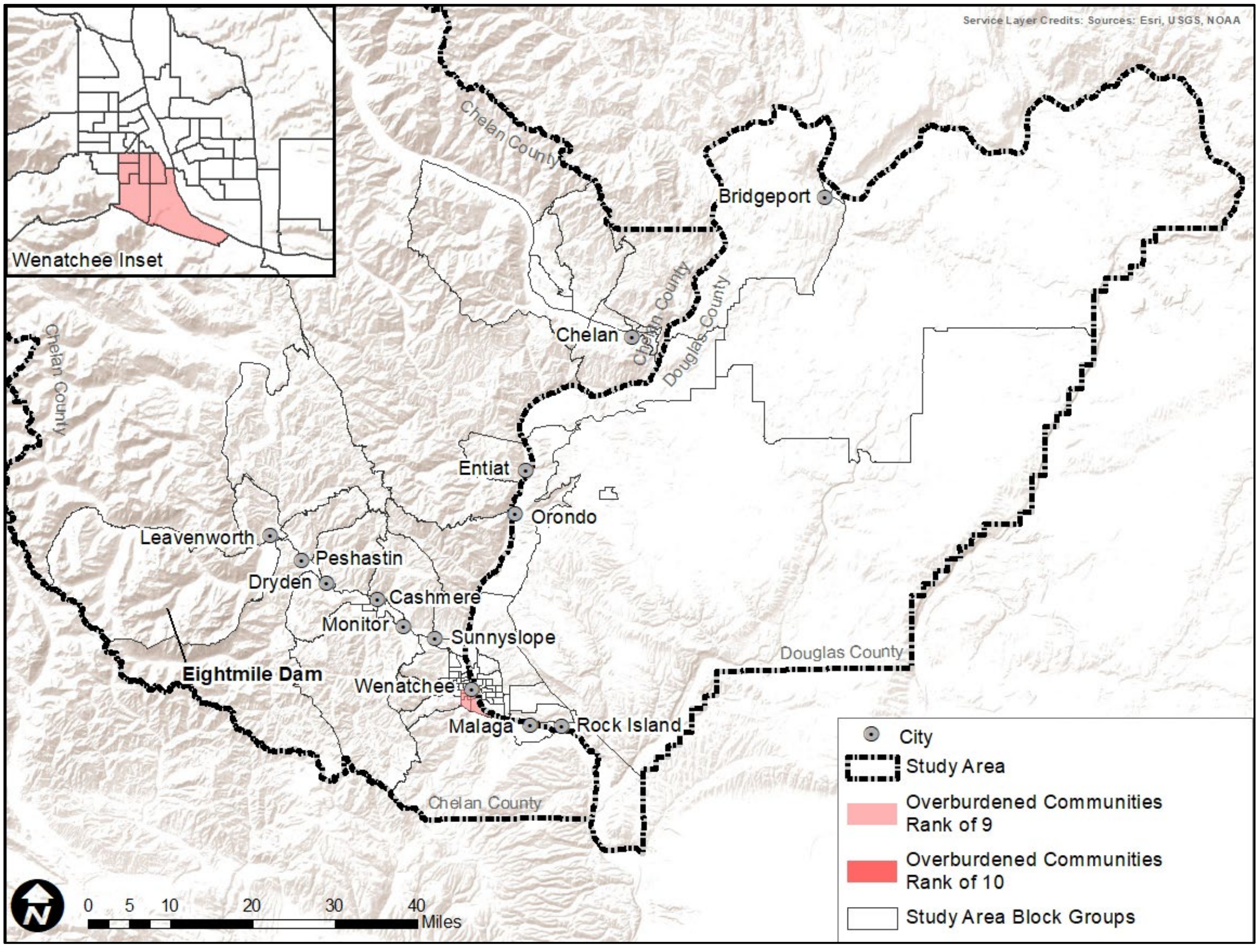
Each indicator is ranked using deciles (a set of 10 equally distributed subsections). For example, a ranking of 9 for "environmental exposures" means that approximately 10 percent of other Census tracts also experienced that level of environmental exposures (ranked as "9"), while 10 percent of Census tracts had higher environmental exposures (ranked as "10"), and 80 percent had lower exposures (tracts ranked 1 through 8). The average ranking across all indicators under each theme constitutes the overall theme ranking (University of Washington Department of Environmental & Occupational Health Sciences 2019).

The Environmental Justice Task Force suggests identifying "highly impacted" communities as those with an overall rank of 9 or 10 (although the recommendations specifically note that these ranks should not be used as a way to label an area as "an EJ community") (Environmental Justice Task Force 2020). Building from this guidance, this analysis considers any community identified as having an overall environmental health disparities rank of 9 or 10 as "overburdened." Figure D-6 identifies those communities (by Census tract) that are identified as rank 9 or 10 with respect to environmental health disparities.

To evaluate the environmental health disparities rankings, the analysis considers whether any areas that were not identified specifically as communities of color or low-income communities are identified as overburdened using this approach. Because both Census tracts and block groups are used to identify communities of color, low-income communities, and overburdened communities, the analysis assumes that the tract-level environmental health disparity ranking applies to all block groups within that tract; this approach may over-estimate the block groups that may be overburdened.

These results indicate that all of the Census block groups that were identified as overburdened were also otherwise identified as low-income communities or communities of color. The six "overburdened" block groups are located in Chelan County, in the city of Wenatchee.

Figure D-6. Communities Ranked 9 or 10 by the DOH Environmental Health Disparities Map in the Study Area



Sources: DNR 2022; United States Census 2020; DOH 2021.

Potentially Affected Tribal Populations

Tribal populations may be uniquely affected by the alternatives due to their connections to the potentially affected resources. The project area is within the Yakama Ceded Lands, to which the Yakama Nation exercises its Treaty Reserved Rights, and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources. These tribes target non-listed spring-run Chinook salmon returning to the Leavenworth National Fish Hatchery (LNFH). Since the reintroduction of coho salmon to the Icicle Creek drainages, tribal subsistence fisheries for coho salmon have been opened when runs are large and surplus fish are available. While the previously described Census data identify relative presence of American Indian populations, detailed information defining where the specifically affected tribal populations reside (i.e., members of the Yakama Nation and Confederated Tribes of the Colville Reservation) is not available. It is likely that some portion of the tribal members may live on the tribes' respective reservations (i.e., outside of the study area), while others may live within the MSA, or in other locations. Within the MSA, as described above, the analysis identifies two block groups with relatively high proportions of the population that identify as American Indian or Alaska Native, as compared to the statewide proportion of 1 percent for this population. These include one area in East Wenatchee where 12 percent of the population describes themselves as Native American or Alaska Native, and another directly across the Columbia River in Wenatchee where 18 percent of the population describes themselves as such. To the extent that fish resources are affected by the alternatives, the Yakama and Colville tribal members participating in these fisheries may be uniquely affected.

Additionally, the Yakama Nation cooperatively runs the hatchery program for coho salmon at the LNFH (USFWS 2016). Alternatives that affect operations of the LNFH have the potential to impact the tribal populations that are employed there.

Summary

Of the 84 total block groups in Chelan and Douglas Counties:

- 21 Communities of Color: These block groups have percentages of populations of color ranging between 47 percent and 92 percent. The communities are predominantly Hispanic/Latino or “other.”
- 58 Low-Income Communities: These block groups have percentages of low-income populations ranging from 26 percent to 79 percent of the total block population.
- 6 Overburdened Communities: These block groups are part of a Census tract that is identified as rank 9 or 10 with respect to overall environmental health disparities identified by the State of Washington (DOH 2021). Of these, all are also identified as a community of color or low-income community.

Overall, 60 of the 84 total block groups in the study area are identified as a community of color, low-income community, and/or overburdened community (i.e., at least one of the three categories above). Together, the population of these block groups account for 64.8 percent of the total population of the two counties.

People of color comprise a proportion of the population in both Chelan and Douglas counties that is higher than the state average, with individuals identifying as Hispanic or Latino being the largest group of color within the study area. The cities of Wenatchee and East Wenatchee have higher percentages of people of color, and in the northwestern part of Douglas County near the town of Chelan, all of which are fairly distant from the project area. Low-income communities are distributed throughout the project area, particularly around Wenatchee, East Wenatchee, Cashmere, and well north of the project area around the town of Chelan. In Chelan County, the overburdened communities are limited to areas within the City of Wenatchee. In addition to these communities that live within the study area and which may be affected by the alternatives, the project area is within the Yakama Ceded Lands, to which the Yakama Nation exercises its Treaty Reserved Rights, and traditional use area of the Confederated Tribes of the Colville Reservation for hunting, fishing, and gathering resources, and tribal members may be uniquely affected by the alternatives to the extent that they result in impacts to fish populations in the Creek.

References

ASPE (Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services). 2021. Poverty Guidelines. Accessed at https://aspe.hhs.gov/system/files/aspe-files/107166/2020-percentage-poverty-tool.pdf, February 23, 2021.

CEQ (Council on Environmental Quality), 1997. Environmental Justice: Guidance Under the National Environmental Policy Act. Accessed at: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf, February 23, 2021.

Chelan County. 2016. Icicle Strategy: Tribal Fisheries Preservation and Enhancement Project. April. Accessed at http://www.co.chelan.wa.us/files/natural-resources/documents/Planning/icicle_work_group/SEPA%20Open%20House/Handouts/TribalFisheries_final_reduced.pdf, February 22, 2021.

DNR (Washington State Department of Natural Resources). Washington Geospatial Open Data Portal. https://geo.wa.gov/. Accessed 19 Aug. 2022.

DOH (Washington State Department of Health). 2021. "Washington Environmental Health Disparities Map." Accessed at: https://fortress.wa.gov/doh/wtn/WTNIBL/, March 3, 2021.

Environmental Justice Task Force. 2020. Report to the Washington State Governor and Legislature: Recommendations for Prioritizing EJ in Washington State Government. Fall. Accessed at https://healthequity.wa.gov/Portals/9/Doc/Publications/Reports/EJTF%20Report_FINAL(1).pdf, February 23, 2021.

EPA (U.S. Environmental Protection Agency). 2021. "Environmental Justice." Accessed at https://www.epa.gov/environmentaljustice, March 1, 2021.

Executive Oder 12898. Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. February 11, 1994.

NEPA Committee and IWGEJ (Federal Interagency Working Group on Environmental Justice), 2016. Promising Practices for EJ Methodologies in NEPA Reviews. EPA 300B16001. March 2016. Accessed at https://www.epa.gov/sites/production/files/2016-08/documents/nepa_promising_practices_document_2016.pdf, February 23, 2021.

United States Census. 2020. American Community Survey (ACS) 2015-2019 5-Year Data Release. Accessed at https://www.census.gov/newsroom/press-kits/2020/acs-5-year.html, March 2, 2021.

University of Washington Department of Environmental & Occupational Health Sciences. 2019. Washington Environmental Health Disparities Map: technical report. Seattle.

USFWS (U.S. Fish and Wildlife Service). 2016. Leavenworth Fisheries Complex: Planning Report. Prepared by McMillen Jacobs Associates and DJ Warren Associates. August.

Appendix E: Special Warranty Deed

OR 44205 (W)
Wenatchee #139

64267
REAL ESTATE EXCISE TAX
EXEMPT
Chelan County Treasurer
Robert H. May
By ____ Deputy

SPECIAL WARRANTY DEED

ICICLE IRRIGATION DISTRICT, a municipal corporation organized and existing under the laws of the State of Washington and fully authorized to do business in the State of Washington, hereinafter called Grantor, for and in consideration of National Forest System land under the provisions of the General Exchange Act of March 20, 1922 (42 Stat. 465, as amended; 16 U.S.C. 485, 486); the Alpine Lakes Area Management Act of July 12, 1976 (90 Stat. 906; 16 U.S.C. 1132), the Federal Land Policy and Management Act of October 21, 1976 (90 Stat. 2755; 43 U.S.C. 1715, 1716, 1717); and the Weeks Law Act of March 1, 1911 (36 Stat., 961, as amended; 16 U.S.C. 516), which is of equal value to the land herein conveyed, the receipt of which is hereby acknowledged, hereby grants, bargains, sells, conveys and confirms to the UNITED STATES OF AMERICA, Grantee, and its assigns, all interest in the following described real property, including minerals, in the County of Chelan, State of Washington, except for those encumbrances specifically set forth:

9005170061

Willamette Meridian, Chelan County, Washington

T. 23 N., R. 16 E.,
sec. 5, lots 1 and 2;
sec. 15, lots 1 and 2.

FEE 13.00
FILED FOR RECORD
PIONEER TITLE COMPANY
90 MAY 17 PM 2 55
Deed
BOOK 929 PAGE 085-91
KENNETH C. HOUSDEN
CHELAN COUNTY AUDITOR
WENATCHEE, WASH.

T. 24 N., R. 14 E.,
sec. 3, lots 17 thru 25, inclusive.

T. 24 N., R. 16 E.,
sec. 33, lot 1.

T. 24 N., R. 17 E.,
sec. 27, Part of the NW1/4SW1/4 described as follows:
BEGINNING at an aluminum monument, set on the southerly edge of the Icicle River Road right-of-way as recorded under Auditor's No. 692951 and 617768, and common with point "A" as described in the City of Leavenworth deed, recorded under Auditor's No. 698355, from said POINT OF BEGINNING the west 1/4 corner of said section 27 bears N. 37° 18' 55" W., 718.59 feet.
THENCE S. 54° 01' 45" E., 292.95 feet along line A-E of said City of Leavenworth property to a rebar with aluminum cap;
THENCE S. 29° 00' 59" E., 108.50 feet to an "X" on a boulder 2 feet x 4 feet x 3 feet lying on the north bank of the Icicle River;
THENCE S. 16° 26' 32" W., 40.00 feet to the center of the Icicle River;
THENCE N. 73° 33' 28" W., 400.00 feet along the north bank of the Icicle River;

THENCE N. 16° 26' 32" E., 40.00 feet to a rebar with aluminum cap located on the north bank of said Icicle River;
THENCE N. 28° 07' 10" W., 199.96 feet to a rebar with aluminum cap located on the southerly edge of said Icicle River Road right-of-way;
THENCE S. 82° 28' 37" E., 137.81 feet along the southerly edge of said right-of-way;
THENCE along the southerly edge of said right-of-way following a curve to the left having a radius length of 613.00 feet along an arc length of 51.77 feet to the POINT OF BEGINNING, as shown in that certain record of survey recorded on January 11, 1983, as Auditor's File No. 8301120006 in Book 14 of Surveys, at Page 80.

Containing 362.83 acres, more or less.

EXCEPTING AND RESERVING to the Grantor, its successors and assigns, a nonexclusive, perpetual easement across, through, along and upon the property described herein for the purposes of maintenance, repair, operation, modification, upgrading and replacement of all facilities presently located in or upon the property described herein, together with a nonexclusive right of ingress to and egress from all such facilities for all such purposes, in accordance with the Rules and Regulations of the Secretary of Agriculture, 36 CFR 251.17 and 251.18, attached hereto and made a part hereof, in such manner as not unreasonably to interfere with its use by the United States, its authorized users or assigns, or cause substantial injury thereto.

The Grantor may exercise the rights hereunder by any means reasonable for the purposes described, including but not limited to the use of motorized transportation and equipment, or aircraft. These rights include the right to regulate water level of all facilities located upon the property described herein. In performing maintenance, repair, operation, modification, upgrading and replacement of facilities located in or upon the property described herein, the Grantor will not without the prior written consent of the Forest Service, which consent shall not unreasonably be withheld, materially increase the size or scope of the facilities.

The United States of America shall charge no fee for the exercise of the rights reserved or granted hereunder, nor shall it require any further permission for the Grantor to exercise the rights granted or reserved herein.

Said easements shall be perpetual unless the Grantor, its successors and assigns, abandons such facilities. The United States of America acknowledges that the interests in real property, improvements to real property and water rights referred to in this Warranty Deed are used by the Grantor on an "as-needed" basis to supplement the water supply of the Grantor.

Termination of this easement will be according to terms and conditions set out in the "Easement Termination Agreement" dated December 27, 1989 and recorded on May 9 , 1990, as Auditor's File No. 9005090031 in records of Chelan County, Washington. (Affects all parcels.)

OR 44205(W)

FURTHER EXCEPTING AND RESERVING to the Grantor, its successors and assigns, the right to overflow and inundate the bed and shore of Colchuck, Eight Mile and Klonaqua Lakes and further excepting and reserving to the Grantor all other water rights in favor of the Icicle Irrigation District, in accordance with the Rules and Regulations of the Secretary of Agriculture, 36 CFR 251.19, attached hereto and made a part hereof, including, but not limited to, the following:

1. Rights granted by Commissioners of Public Lands, under that certain Application No. 12855 dated October 26, 1927, and recorded April 14, 1928, in volume 172 of Deeds, page 131 in the records of Chelan County, Washington, as Auditor's File No. 165072. (Affects secs. 5 and 15, T.23 N., R.16 E.; sec. 3, T.24 N., R.14 E., and sec. 33, T.24 N., R.16 E., W.M.).

2. Water rights granted under Certificate of Water Right to use the waters of Klonaqua Lake for the purposes of irrigation under Appropriation Permit No. 827, entered of record in Volume 3, at Page 1227, on August 21, 1939.

3. Water rights granted under Certificate of Water Right to use the waters of Eight Mile Lake for the purposes of irrigation under Appropriation Permit No. 828, entered of record in Volume 3, at Page 1228, on August 21, 1939.

4. Water rights granted under Certificate of Water Right to use the waters of Colchuck Lake for the purposes of irrigation under Appropriation Permit No. 829, entered of record in Volume 3, at Page 1229, on August 21, 1939.

5. Water rights granted in Icicle Creek and Snow Creek, a tributary of Icicle Creek, as noted in that certain Certificate of Water Rights for 83.33 second feet issued to Icicle Irrigation District on September 18, 1934, and recorded in Volume F, Page 2 of Water Right Certificates at Olympia, Washington. (Also affects intakes located in the SW1/4SW1/4 sec. 27, T. 24 N., R. 17 E., W.M.)

SUBJECT TO:

1. Easements for water pipeline and use incidental thereto over and across the eastern portion of NW1/4SW1/4 sec. 27, T. 24 N., R. 17 E., W.M., granted to the City of Leavenworth, a municipal corporation. Recorded February 25, 1964, under Auditor's No. 617729 in volume 657, page 54, and March 19, 1970, under Auditor's No. 698355 in volume 697, page 603, Chelan County.

2. Shifting or change in the course of the ICICLE RIVER and rights of the State of Washington in and to that portion of said premises, if any, lying in the bed or former bed of the Icicle River, if it is navigable. Affects NW1/4SW1/4 sec. 27, T. 24 N., R. 17 E., W.M.

OR 44205(W)

The acquiring agency is the Forest Service, U.S. Department of Agriculture.

The Grantor for itself and for its successors in interest does by these presents expressly limit the covenants of the deed to those herein expressed, and excludes all covenants arising or to arise by statutory or other implication, and does hereby covenant that against all persons whomsoever lawfully claiming or to claim by, through or under said Grantor and not otherwise, Grantor will forever warrant and defend the said described real estate.

Dated this 17th day of May, 1990.

ICICLE IRRIGATION DISTRICT

By Lyman B. Bardin
Lyman B. Bardin
President, Board of Directors

ATTEST:

By Kent A. Christensen
Kent A. Christensen, Director

By Monroe Mashburn
Monroe Mashburn
Title Secretary/Manager

By Ralph F. Kimmerly
Ralph F. Kimmerly , Director

ACKNOWLEDGMENT

STATE OF Washington)
)ss
County of)

On this 17th day of May, 1990, before me the undersigned, a Notary Public in and for said State, personally appeared Lyman B. Bardin, Kent Christensen, Ralph F. Kimmerly, and Monroe Mashburn, known to me to be the Directors and Secretary/Manager, respectively, of the ICICLE IRRIGATION DISTRICT, the municipal corporation that executed the within and foregoing instrument, and acknowledged to me that such corporation executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal the day year first above written.

(SEAL)

Terence M. McCauly
Notary Public for the State of Washington
Residing at Leavenworth
My Commission Expires May 1, 1991

BOOK 929 PAGE 088

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE GOVERNING THE GRANTOR'S RIGHT TO OCCUPY AND USE LANDS CONVEYED TO THE UNITED STATES

Code of Federal Regulations - Title 36 - Chapter II - Section 251.17

Except as otherwise provided in paragraph (h) of this section, in conveyances of lands to the United States under authorized programs of the Forest Service, where owners reserve the right to occupy and use the land for the purposes of residence, agriculture, industry, or commerce, said reservations shall be subject to the following conditions, rules and regulations which shall be expressed in and made a part of the deed of conveyance to the United States and such reservations shall be exercised thereunder and in obedience thereto:

(a) Except when provided otherwise by statute, the reservation so created shall not be assigned, used, or occupied by anyone other than the grantor without the consent of the United States.

(b) All reasonable precautions shall be taken by the grantor and all persons acting for or claiming under him to prevent and suppress forest fires upon or threatening the premises or other adjacent lands of the United States, and any persons failing to comply with this requirement shall be responsible for any damages sustained by the United States by reason thereof.

(c) The premises shall not be used or permitted to be used without the written consent of the United States, for any purpose or purposes other than those specified in the instrument creating the reservation.

(d) The grantor and all persons acting for or claiming under him shall maintain the premises and all buildings and structures thereon in proper repair and sanitation and shall comply with the National Forest laws and regulations and the laws and lawful orders of the State in which the premises are located.

(e) Except when provided otherwise by statute, the reservation shall terminate (1) upon the expiration of the period named in the deed; (2) upon failure for a period of more than one calendar year to use and occupy the premises for the purposes named in the deed; (3) by use and occupancy for unlawful purposes or for purposes other than those specified in the deed; and (4) by voluntary written relinquishment by the owner.

(f) Upon the termination of the reservation the owners of personal property remaining on the premises shall remove same within a period of three months, and all such property not so removed shall become the property of the United States except that when such removal is prevented by conditions beyond the control of the owners the period shall be extended in writing by the Forest Service to allow a reasonable time for said removal, but in no event longer than one year.

(g) The said reservation shall be subject to rights-of-way for the use of the United States or its permittees, upon, across, or through the said land, as may hereafter be required for the erection, construction, maintenance, and operation of public utility systems over all or parts thereof, or for the construction and maintenance of any improvements necessary for the good administration and protection of the National Forests, and shall be subject to the right of officials or employees of the Forest Service to inspect the premises, or any part thereof, at all reasonable times and as often as deemed necessary in the performance of official duties in respect to the premises.

(h) The conditions, rules and regulations set forth in paragraphs (a) through (g) of this section shall not apply to reservations contained in conveyances of lands to the United States under the act of March 3, 1925, as amended (43 Stat. 1133, 64 Stat. 82; 16 U.S.C. 555).

All regulations heretofore issued by the Secretary of Agriculture to govern the exercise of occupancy and use rights reserved in conveyances of lands to the United States under authorized programs of the Forest Service shall continue to be effective in the cases to which they are applicable, but are hereby superseded as to occupancy and use rights hereafter reserved in conveyances under such programs.

(36 Stat. 961, as amended, 16 U.S.C. 513–518, 42 Stat. 465, as amended, 16 U.S.C. 485, 486, and 50 Stat. 525, as amended, 7 U.S.C. 1011, and 70 Stat. 1034, 7 U.S.C. 428a, 78 Stat. 890, 16 U.S.C. 1131–1136; 79 Stat. 843, 16 U.S.C. 460p—460p-5; 79 Stat. 1295, 16 U.S.C. 460q—460q-9; 80 Stat. 190, 16 U.S.C. 460r—460r-5; 82 Stat. 904, 16 U.S.C. 460v—460v-8; 82 Stat. 919, 16 U.S.C. 1241–1249 and 82 Stat. 906, 16 U.S.C. 1271–1287)

Done at Washington, D.C., this 30th day of December 1970.

T. K. COWDEN,
Assistant Secretary of Agriculture.

(F.R. Doc. 71-132; Filed, Jan. 5, 1971; 8:49 a.m.)

United States Department of Agriculture
Forest Service

CONDITIONS, RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE GOVERNING EXERCISE OF RIGHTS-OF-WAY RESERVED IN CONVEYANCES TO THE UNITED STATES OF AMERICA

Code of Federal Regulations - Title 36 - Chapter II - Section 251.18

This section governs the use, occupancy & operation of rights-of-way reserved by a grantor of lands to the U.S.

(a) Brush and refuse resulting from the exercise of the right-of-way reservation shall be disposed of to the satisfaction of the Forest Officer in in charge.

(b) Timber cut an destroyed in the exercise of the right-of-way reservation shall be paid for at the rates to be prescribed by the Forest Officer in charge, which rates shall be the usual stumpage prices charged in the locality in sales of National Forest timber of the same kind or species; for injury to timber, second growth, and reproduction, the amount of actual damage shall be ascertained by the Forest Supervisor according to the rules applicable in such cases.

(c) All improvements built or maintained upon the right-of-way shall be kept in an orderly, safe and sanitary condition. Failure to maintain such conditions shall be cause for the termination of the reservation after 30 days' notice in writing to the occupant or user that unsatisfactory conditions exist and that the Department intends to terminate all rights under the reservation unless such conditions are forthwith corrected to the satisfaction of the Regional Forester.

(d) Upon the abandonment of a reserved right-of-way, either by formal release, by termination, or by non-use for a period of 1 calendar year, all improvements thereon not the property of the United States shall be removed therefrom within 3 months from the date of the abandonment; otherwise, such improvements shall vest in and become the property of the United States.

(e) All reasonable precautions to prevent and suppress forest fires shall be taken by the grantor and all persons acting for or claiming under him; suitable crossings shall be constructed by grantor and/or said persons where the reserved right-of-way intersects existing roads and trails; borrow pits shall not be opened outside of the immediate graded section except under a special-use permit from the Forest Supervisor.

(f) Officers of the Forest Service shall have free ingress and egress on and over the reserved rights-of-way for all purposes necessary and incidental to the protection and administration of the National Forest.

(36 Stat. 962, as amended; 16 U.S.C. 518)

United States Department of Agriculture
Forest Service

CONDITIONS, RULES AND REGULATIONS OF THE SECRETARY OF AGRICULTURE GOVERNING EXERCISE OF WATER RIGHTS RESERVED BY THE GRANTOR OF LANDS CONVEYED TO THE UNITED STATES

Code of Federal Regulations - Title 36 - Chapter II - Section 251.19

This section governs the exercise of water and related rights reserved by the grantor of land conveyed to the United States under the provisions of the act of March 1, 1911 (36 Stat. 961).

(a) All reasonable precautions shall be taken by the grantor and all persons acting for or claiming under him to prevent and suppress forest fires upon or threatening the premises or other adjacent lands of the United States, and any person failing to comply with this requirement shall be responsible for any damages sustained by the United States by reason thereof.

(b) All slash and debris resulting from the cutting and removal of timber shall be disposed of as directed by the Forest Officer in charge.

(c) Flowage and reservoir areas shall be cleared of timber and debris, in a manner satisfactory to the Forest Supervisor, or in accordance with a special agreement approved by him. Timber cut and destroyed in the exercise of the reserved rights shall be paid for at rates to be prescribed by the Forest Officer in charge, which rate shall be the usual stumpage price charged in the locality.

(d) The water surface created shall be open to the Forest Service and its permittees when such use does not interfere with the original purpose of the development.

(e) The water surface shall be open to fishing by the public in accordance with State laws when such use does not interfere with the original purpose of the development.

(f) Plans for dams and supplemental structures, impounding or controlling more than 10 acre-feet of water or with a head in excess of 6 feet, shall be approved by the Regional Engineer of the Forest Service before construction shall begin.

(36 Stat. 962, as amended, 16 U.S.C. 518)

EXHIBIT 10J-5 (Rev. 7/26/88)