Chehalis River Basin Flood Damage Reduction Project

NEPA Environmental Impact Statement

US Army Corps of Engineers®

September 18, 2020

Chehalis River Basin Flood Damage Reduction Project
Lewis County, Washington
National Environmental Policy Act Environmental Impact Statement
September 18, 2020

Responsible Agency: The lead federal agency responsible for compliance with the National Environmental Policy Act (NEPA) is the U.S. Army Corps of Engineers (Corps), Seattle District.

Abstract: The Chehalis Basin Flood Control Zone District (Applicant) is proposing to reduce the risk of flood damage along the Chehalis River mainstem by constructing and operating a flood retention facility and Airport Levee Improvements in Lewis County, Washington (proposed project). The flood retention facility would be located near the town of Pe Ell and would be operated to hold back major or greater floods in a temporary reservoir. The Airport Levee Improvements would improve the existing levee at the Chehalis-Centralia Airport to reduce the risk of flooding at this location.

The Applicant is required to obtain a Department of the Army authorization under Section 404 of the Clean Water Act (33 Code of Federal Regulations 320-332), to construct the proposed project. The Corps' decision to issue, issue with conditions, or deny a permit for activities within the Corps' jurisdiction associated with construction and operation is a federal action requiring NEPA review. This Draft Environmental Impact Statement (EIS) evaluates the effects on the natural and built environment from the proposed project. This includes two action alternatives and a No Action Alternative. The action alternatives include the proposed project, Alternative 1, and an alternative to build the flood retention facility on a smaller foundation, Alternative 2. The analysis of the natural environment includes water quantity and quality, geology, geomorphology, wetlands and other waters, aquatic species and habitats, and terrestrial species and habitats. The analysis of the built environment includes air quality, visual quality, noise and vibration, land use, recreation, cultural resources, transportation, public services and utilities, environmental health and safety, socioeconomics, and environmental justice. An initial list of mitigation measures have been identified. The Draft EIS also reviews the potential impacts in combination with past, present, and reasonably foreseeable future actions.

This document is available online at https://chehalisbasinstrategy.com/eis/nepa-process/. Comments on this Draft EIS will be accepted for 60 days after the issuance of the Notice of Availability. Comments may be submitted in the following ways:

- By mail:
  Chehalis River Basin Flood Damage Reduction Project
  c/o Anchor QEA
  6720 South Macadam Street, Suite 125
  Portland, Oregon 97219
- By email: chehalis@usace.army.mil
- Online: https://chehalisbasinstrategy.com/eis/nepa-process/
- At a public meeting verbally or in writing (dates and times provided in the Notice of Availability)

Please send requests for additional information to:

Brandon Clinton, Project Manager
U.S. Army Corps of Engineers, Seattle District
P.O. Box 3755
Seattle, Washington 98124-3755
206-316-3164
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
Applicant	Chehalis River Basin Flood Control Zone District
ASRP	Aquatic Species Restoration Plan
BMP	best management practice
CAO	Critical Areas Ordinance
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFAR	Community Flood Assistance and Resilience
CFR	Code of Federal Regulations
Chehalis Tribe	Confederated Tribes of the Chehalis Reservation
CHTR	Collection, Handling, Transport, and Release
CMC	Chehalis Municipal Code
Corps	U.S. Army Corps of Engineers
CSID	Cleanup Site ID
CSZ	Cascadia Subduction Zone
CWA	Clean Water Act
DA	Department of the Army
DNR	Department of Natural Resources
EDT	Ecosystem Diagnostic and Treatment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
Flood Authority	Chehalis River Basin Flood Authority

FRE	Flood Retention Extendable
FRFA	Flood Retention Flow Augmentation
FRMC	Flood Retention Maximum Capacity
FRO	Flood Retention Only
FTA	Federal Transit Administration
GHG	greenhouse gas
HCP	Habitat Conservation Plan
I-5	Interstate 5
LOS	level of service
LWM	large woody material
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MTCA	Model Toxics Control Act
NAAQS	National Ambient Air Quality Standards
NAIP	National Agriculture Imagery Program
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
OHWM	ordinary high water mark
OSHA	Occupational Safety and Health Act
PEIS	Programmatic Environmental Impact Statement
PM	particulate matter
PUD	Public Utility District
QIN	Quinault Indian Nation

RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RM	river mile
ROD	Record of Decision
RV	recreational vehicle
SEPA	State Environmental Policy Act
SMP	Shoreline Master Program
SR	State Route
SWCAA	Southwest Clean Air Agency
TCP	Traditional cultural properties
UGA	Urban Growth Area
UP	Union Pacific
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
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
Weyerhaeuser	Weyerhaeuser Company
WNHP	Washington Natural Heritage Program
WRIA	Water Resource Inventory Areas
WSDOT	Washington State Department of Transportation

ES EXECUTIVE SUMMARY

ES.1 Introduction

The Chehalis River Basin Flood Control Zone District (Applicant) is proposing the Chehalis River Basin Flood Damage Reduction Project (proposed project). The proposed project would reduce flood damage in the upper Chehalis River Basin. This would be achieved by temporarily storing flood waters from the Willapa Hills and improving the levee at the Chehalis-Centralia Airport (Figure ES-1). The Applicant proposes to construct a flood retention facility with a temporary reservoir near the town of Pe Ell, Lewis County, Washington. Levee improvements would be constructed around the Chehalis-Centralia Airport in the city of Chehalis, Lewis County, Washington.

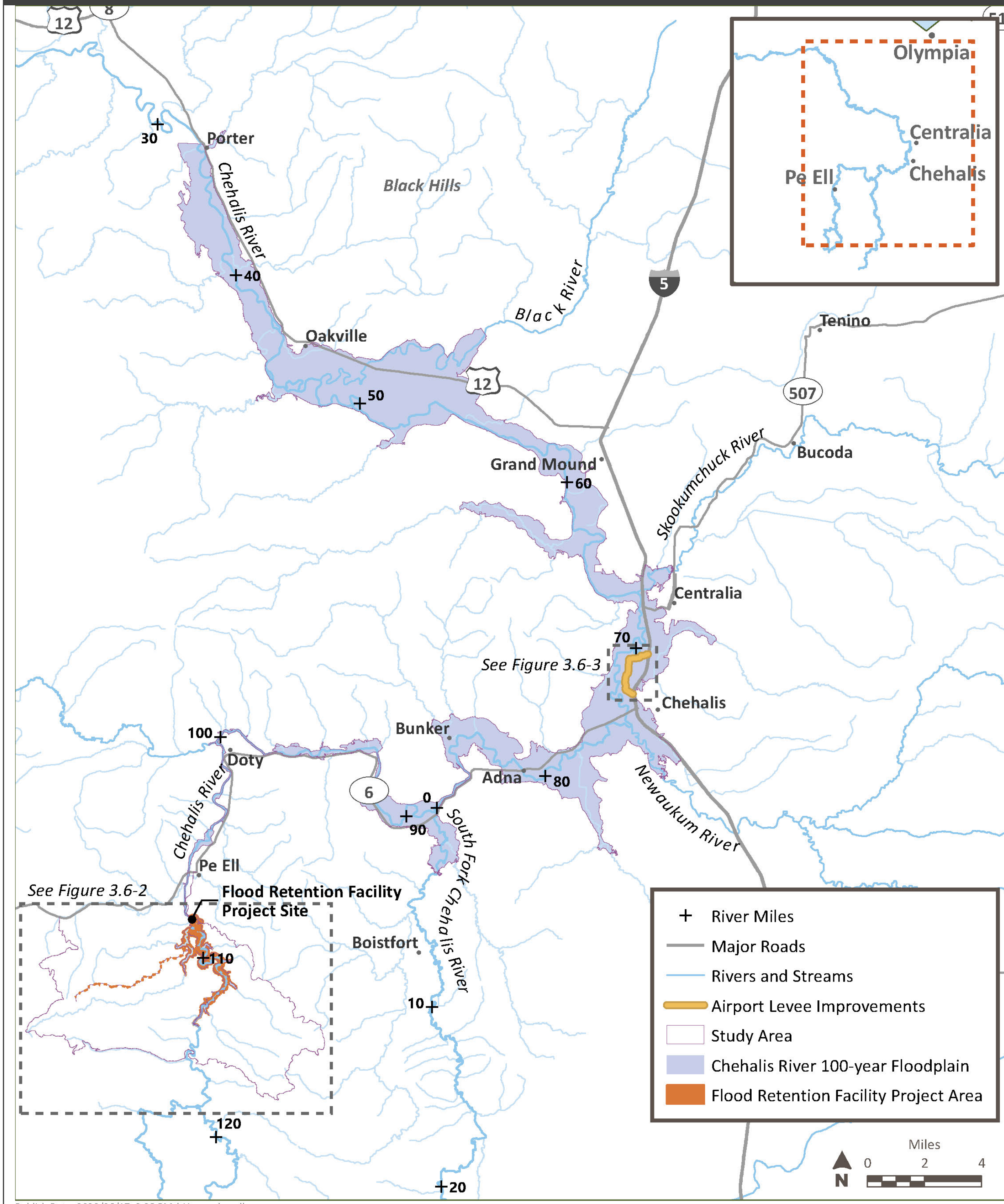
Per Section 404 of the Clean Water Act (CWA; 33 Code of Federal Regulations [CFR] 320-332), the Applicant must obtain Department of the Army (DA) authorization to construct the proposed project if it involves the discharge of dredged or fill material into waters of the United States. Waters of the United States generally include rivers, streams, lakes, marine waters, and wetlands. The U.S. Army Corps of Engineers, Seattle District (Corps) has jurisdiction over waters of the United States in the project area. The Corps will decide whether to issue, issue with conditions, or deny a permit for activities within the Corps' jurisdiction.

On January 31, 2018, the Corps determined the proposed project may have significant individual and/or cumulative impacts to the human environment. Therefore, this environmental impact statement (EIS) has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended (40 CFR 1500-1508; 33 CFR 325 Appendix B). Preparation of this Draft EIS and a future Final EIS will support the Corps' permit decision.

ES.2 Agency Coordination, Public Involvement, and Tribal Consultation

NEPA implementing regulations allow the lead agency (the Corps) to invite other federal agencies or federally recognized tribes to participate in the NEPA process as cooperating agencies. Cooperating agencies assist the lead agency by participating in the NEPA process as early as possible. They assist in developing information and preparing environmental analyses and make staff available to provide additional expertise for the analyses. The Corps invited the Quinault Indian Nation (QIN) who accepted but later withdrew as a cooperating agency. The U.S. Environmental Protection Agency (EPA) and Confederated Tribes of the Chehalis Reservation (Chehalis Tribe) were also invited to serve as cooperating agencies. EPA declined the invitation. The Chehalis Tribe did not formally respond as of the time of Draft EIS publication.

Figure ES-1
Study Area



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The Corps invited local, state, and federal agencies, Native American tribes, organizations, and members of the public to comment on the scope of the EIS during a 31-day scoping period. Ecology conducted scoping for the Washington State Environmental Protection Act EIS process at the same time. The combined scoping period began September 28, 2018, and closed October 29, 2018. The Corps received verbal and written comments at in-person scoping meetings. Comments were also received by mail and online. These comments included concerns about fish and wildlife, vegetation, climate change, tribal resources, environmental health and safety, socioeconomics, and water quality. The Corps used these comments to help identify public concerns and define the scope of the EIS. Chapter 8 of the Draft EIS describes the process of consultation and coordination in more detail.

This Draft EIS was released for review and comment from members of the public; local, state, and federal agencies, Native American tribes, organizations; and the Applicant. The document is available online at https://chehalisbasinstrategy.com/eis/nepa-process/. Comments on this Draft EIS will be accepted for a 60-day comment period beginning when the Notice of Availability was issued in the Federal Register. Comments may be submitted in the following ways:

Online:
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U.S. Mail:
Chehalis River Basin Flood Damage Reduction Project
c/o Anchor QEA
6720 South Macadam Street, Suite 125
Portland, Oregon 97219

Email:
chehalis@usace.army.mil

Online public hearings:
Dates and times provided in the Notice of Availability

ES.3 Purpose and Need

The purpose of the proposed project is to reduce the duration and level of flooding. This would in turn reduce the corresponding damage within the existing 100-year floodplain in the Chehalis/Centralia area from Adna to Grand Mound. The reduction in damage would be accomplished without causing increased flood damage in other areas. The proposed project is needed because flooding has caused major damage, substantial transportation delays, and high economic costs in the Chehalis Basin in the recent past.

ES.4 Alternatives

The Corps developed two-phase screening criteria to determine which alternatives would be evaluated in this Draft EIS. The first phase determined whether an alternative met essential criteria for flood damage reduction and did not substantially redirect negative flood impacts to other areas. The second phase determined whether alternatives were reasonably available to the Applicant. It also evaluated whether any of the alternatives would cause substantially greater impacts to the aquatic environment than other evaluated alternatives.

The Corps analyzed a total of 61 potential alternatives. The process of analysis and elimination of alternatives is described in detail in Chapter 3 and Appendix D of the EIS. Two action alternatives (Alternatives 1 and 2) and the No Action Alternative were carried forward for evaluation in the EIS.

ES.4.1 Alternative 1 (Proposed Project)

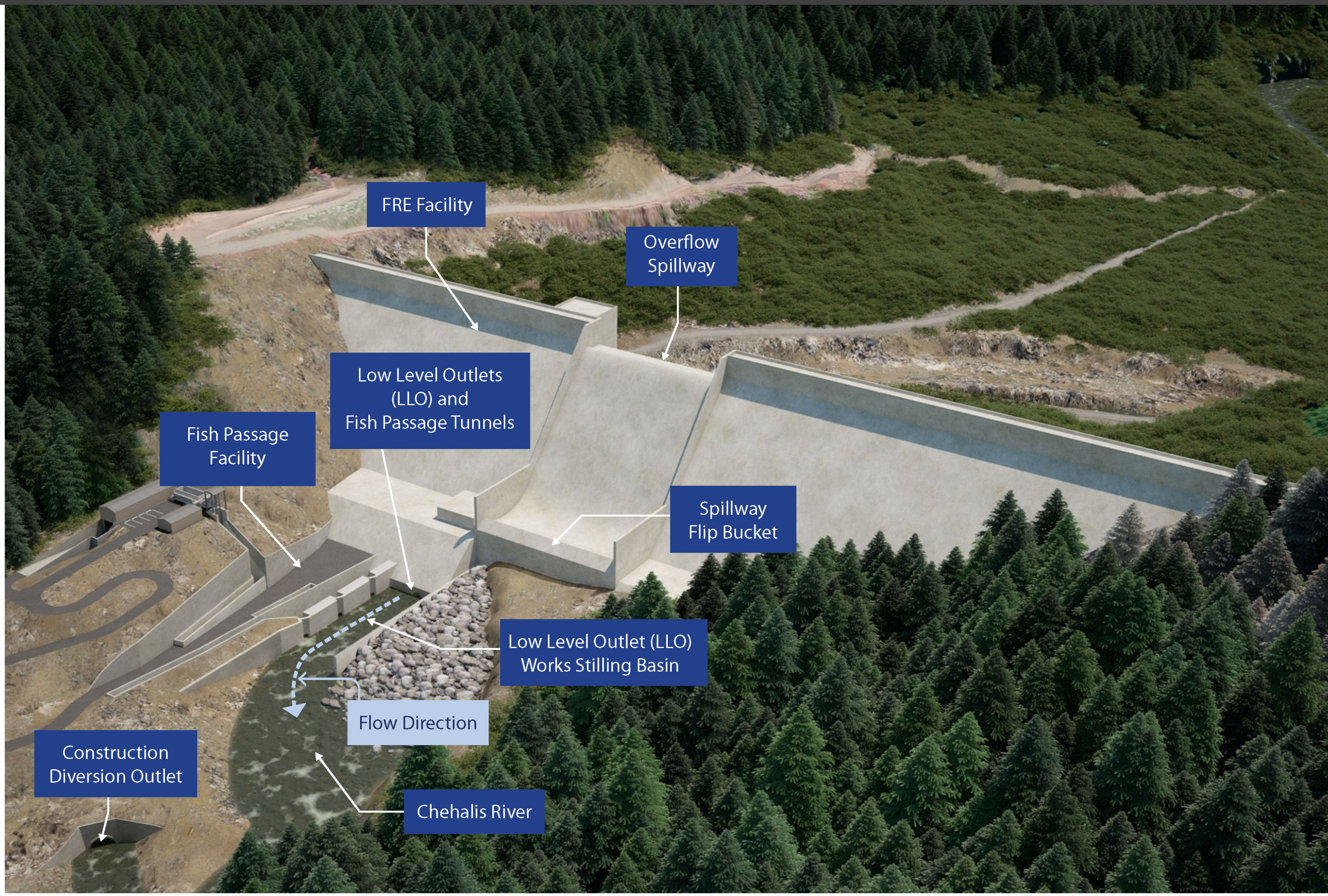
Alternative 1 is the Applicant's proposed project. Alternative 1 includes a flood retention expandable (FRE) facility (Figure ES-2) and Airport Levee Improvements.

The FRE facility would be built so its foundation could support a larger structure if the Applicant decided to increase the storage capacity in the future. Increasing storage capacity would require further environmental review.

The FRE facility would include a vertical concrete structure, an emergency spillway, a flip bucket, five gated outlets, a stilling basin, a fish passage facility, and a diversion tunnel to be used during construction. The gated outlets would be tunnels at the base of the vertical concrete structure. These gated outlets would allow water to flow through the facility during non-flood conditions. During major or greater floods, the gated outlets would close, and water would fill a temporary reservoir behind the FRE facility. The FRE facility would store up to 65,000 acre-feet of water in the temporary reservoir. After a flood, the gated outlets would open, and water from the temporary reservoir would slowly drain back into the river. When the gated outlets are partially closed, fish would be transported upstream using a trap and haul facility, which involves manually moving fish upstream. Under normal conditions, the gated outlets would stay open and the river would flow normally. Fish would be able to move upstream and downstream through the FRE facility.

The Airport Levee Improvements would include raising a part of the levee, which could require widening parts of the base, and replacing utility infrastructure.

Figure ES-2
Proposed Flood Retention Expandable Facility



ES.4.2 Alternative 2

The Flood Retention Only (FRO) facility and Airport Levee Improvement locations under Alternative 2 would be the same as under Alternative 1. The FRO facility design would also be the same as Alternative 1, except the facility would be built on a smaller foundation. The foundation for the FRO facility would be about 20 feet smaller in width than the FRE facility on the downstream (north) side. Unlike the FRE facility, the foundation would not be designed to allow for potential future expansion of flood storage capacity.

ES.4.3 No Action Alternative

Under the No Action Alternative, the Corps would not issue the requested DA permit under Section 404 of the CWA. This permit is necessary for the Applicant to construct the proposed project. The proposed project would not be constructed under the No Action Alternative. Other projects that are funded and permitted or are in the process of being constructed as of January 2019 are included in the No Action Alternative. It also includes other actions reasonably likely to occur during the EIS analysis period (2025 to 2080).

ES.5 Potential Impacts

ES.5.1 Study Area

The study area for this EIS includes the areas that would be affected by construction and operation of the action alternatives. Any differences are noted in the individual resource sections of Chapters 4 and 5. The study area includes three main areas (Figure ES-1):

- The flood retention facility project area
- The Airport Levee Improvements project area
- The Chehalis River 100-year floodplain area

The flood retention facility project area includes the site of the proposed flood retention facility and related facilities. This area extends from river mile (RM) 114 of the Chehalis River, the upstream end of the temporary reservoir, to approximately RM 108, the proposed location of the flood retention facility. It also includes upland areas that would be affected by construction, including the diversion tunnel site, construction staging and storage areas, excavation and grading areas, quarries, improved access roads, and spoil placement sites.

The Airport Levee Improvements project area includes the existing levee, areas likely to be used for construction staging, and access roads.

The Chehalis River 100-year floodplain component of the study area includes the parts of the floodplain likely to experience a reduction in flood elevation as a result of the action alternatives. This includes the 100-year floodplain from the proposed flood retention facility location at RM 108 downstream to RM 33 near Porter. The Chehalis River 100-year floodplain component of the study area does not include the Airport Levee Improvements project area.

ES.5.2 Methods

ES.5.2.1 Impact Levels

The analysis considers changes to the environment that would likely be because of the proposed project from 2030 to 2080. Impacts are changes to the existing environment that would be expected as a result of the proposed project and can be adverse or beneficial. In the EIS, adverse impacts are described as low, medium, or high. The determination is based on best professional judgment to provide a relative comparison for how impactful a change would be. Low impacts may or may not be readily noticeable while medium impacts would be. High impacts would be very noticeable and cause substantial problems for the environmental resource. Thresholds used to assess impact levels for each environmental resource are provided in Appendix E.

ES.5.2.2 Modeling

Some resource areas of the EIS relied on modeling to analyze the potential for certain impacts to occur. Modeling efforts focused on water resources, geomorphology, fish, air quality, noise, and socioeconomics. More information about the specific methods and results can be found in those sections of the Draft EIS. Models were based on the best available information but are not likely to represent a specific future outcome. This is mainly because there is much uncertainty in predicting future hydrologic conditions, such as how often and how much flooding may happen. The same modeling assumptions were made for all alternatives. This means the model results provide useful information to understand the relative impacts between Alternatives 1 and 2 and the No Action Alternative.

The modeling relied on hydrology data from the past 30 years as the best available information. Future climate conditions were not modeled in this EIS. However, it is generally accepted that precipitation patterns and air temperatures in the Chehalis Basin will differ in the future compared to the data used in modeling. If there is more precipitation in the future, it is possible that the proposed flood retention facility would operate more frequently. Impacts associated with single floods would be more frequent. Depending on how environmental resources were affected by climate variability over time, it is possible that the operational impacts of the flood retention facility would also differ.

ES.5.2.3 Flooding

Because it is not possible to predict the timing or extent of future flooding, the analysis of operational impacts generally considered two flood scenarios. These include the major flood, which would happen on average once every 7 years, and catastrophic flood, which would happen on average once every 100 years. For the purposes of the impact analysis, the EIS generally assumes that the flood retention facility would operate on average once every 7 years, which is the average predicted frequency of a major flood. However, where there were differences in predicted impacts between the scenarios, the analysis was based on the most impactful scenario. For example, the analysis of impacts to aquatic species and habitat discusses the impacts from a back-to-back flood. This is a scenario where a major flood one year would be followed by a catastrophic flood the next year.

ES.5.3 Impacts to the Natural and Built Environment

Potential impacts to the natural and built environment are summarized in Table ES-1. Chapters 4 and 5 include more detail about the impacts. The impacts are shown for the No Action Alternative and Alternative 1 construction and operation. Adverse impacts are identified as low, medium, or high. Beneficial impacts are identified, but the level of impact is not. The impacts apply to the study area unless otherwise specified. When a range of impact levels is shown, it is because there are differences depending on which part of a resource is affected. Downstream impacts refer to the Chehalis River 100-year floodplain area.

Impact Indicators

↑ = beneficial impact
↓ = low adverse impact
↓ ↓ = medium adverse impact
↓ ↓ ↓ = high adverse impact

The impacts from Alternative 2 are not included in Table ES-1 because they are very similar to Alternative 1. The construction impacts would be the same with two exceptions. The flood retention facility base would be smaller and the construction period would be shorter under Alternative 2. This means related impacts would affect a smaller area and not last as long as compared to Alternative 1. The impacts from the Airport Levee Improvements and overall operation would be the same as Alternative 1.

The main construction impacts from Alternative 1 would be from the proposed FRE facility. This is because construction would require substantial earthwork, blasting, and dewatering the Chehalis River. Activities would last for up to 5 years and result in the permanent loss of 1.23 acres of wetlands, 4.8 acres of other waters, and 11.2 acres of associated buffers. Construction would also affect aquatic species and habitat by temporarily and permanently reducing the amount and quality of aquatic habitat in this area. Salmon and lamprey would experience the highest impacts because fish passage would be reduced and access to upstream habitat would be blocked. Blasting and construction noise would also affect fish and wildlife that may be present. Pre-construction vegetation management would remove streamside trees and terrestrial habitat in the footprint of the temporary reservoir. It was assumed that other trees would not regrow. This loss would cause high impacts to water quality, fish, wildlife, and wetlands and other waters.

The main operational impacts would also come from the proposed FRE facility. The FRE facility would be operated to hold back floodwaters in the temporary reservoir when a major or greater flood was likely to happen in the Chehalis/Centralia area. This would be a beneficial impact to downstream communities that have experienced extensive flood damage in the recent past. While the temporary reservoir was holding water, there would be a loss of aquatic and terrestrial habitat in that area. This would cause high impacts to fish and wildlife in the year when the FRE facility was operating. There would also be high impacts to the natural environment over the long term. This is mainly because of reduced fish passage conditions using the trap-and-haul facility, and because of aquatic and terrestrial habitat degradation over time. The lack of major or greater flooding in the system would limit the migration of the river channel in the floodplain, and would change riverbed characteristics of the Chehalis River over time.

The Airport Levee Improvements would be able to be built in a way that would keep impacts low. Operation would be very similar to existing conditions and would result in no to low impacts.

Table ES-1
Summary of Potential Impacts

ENVIRONMENTAL RESOURCE	NO ACTION ALTERNATIVE		ALTERNATIVE 1 CONSTRUCTION		ALTERNATIVE 1 ALTERNATIVE 1 OPERATIONS	
Water Quantity and Quality	↓ to ↓↓↓	river flows, including continued flooding risk	↓	river flows	↓	river flows (↓↓ during floods)
	↓ to ↓↓↓	floodplain function, including continued flooding risk	↓ to ↓↓	floodplain function	↓	floodplain function
	↓↓↓	water quality (continued)	↓ to ↓↓↓	water quality	↓ to ↓↓↓	water quality
	↓	groundwater quantity	↓	groundwater quantity and quality	↓	groundwater recharge
	↓	available water for other users	↓	available water for other users		
			↓↓	City of Pe Ell's water supply system	↓↓	City of Pe Ell's water supply system
Geology and Geologic Hazards	↓ to ↓↓↓	soil erosion, including continued flooding risk	↓ to ↓↓	soil erosion	↓ to ↓↓↓	soil erosion
			↓↓	bedrock removal		
	↓	landslide risk	↓	landslide risk	↓ to ↓↓	landslide risk (↓↓↓ during floods)
	↓	earthquake hazard risk	↓	earthquake hazard risk	↓↓↓	earthquake causing FRE facility failure
					↓	waves or induced shaking in temporary reservoir
Geomorphology	no to ↓↓↓	sediment loading and transport, including continued flood risk	↓ to ↓↓↓	sediment loading and transport (↓↓↓ during floods)	↓ to ↓↓↓	sediment loading and transport
	no to ↓↓↓	LWM input and transport, including continued flood risk	↓ to ↓↓↓	LWM input and transport	↓↓ to ↓↓↓	LWM input and transport
	no to ↓↓↓	channel movement, including continued flood risk			no to ↓↓	channel movement
Wetlands and Other Waters	↓	wetlands	↓ to ↓↓↓	wetlands	↓ to ↓↓	wetlands
	↓	other waters	↓ to ↓↓↓	other waters	↓ to ↓↓	other waters
Aquatic Species and Habitats	no to ↓↓	habitat, including continued flood risk (small-scale ↑)	↓ to ↓↓↓	habitat	↓ to ↓↓↓	habitat
	↓↓ to ↓↓↓	coho salmon steelhead (some ↑ for coho downstream)	↓↓↓	coho salmon, spring-run and fall-run salmon, steelhead	↓↓↓	coho salmon, spring-run and fall-run salmon, steelhead
	↓ to ↓↓↓	spring-run and fall-run Chinook salmon	↓↓↓	lamprey	↓↓↓	lamprey
	↓ to ↓↓	lamprey, other native fish, mussels, and aquatic plants	↓ to ↓↓	other native fish, mussels, and aquatic plants	↓ to ↓↓	other native fish, mussels, and aquatic plants
	↓ to ↓↓↓	salmon at the Chehalis Basin scale (↑ steelhead)	↓ to ↓↓↓	salmonids at Chehalis Basin scale	↓ to ↓↓↓	salmonids at Chehalis Basin scale
	↓	marine mammals outside the study area	↓	marine mammals outside the study area	↓	marine mammals outside the study area
Terrestrial Species and Habitats	↓ to ↓↓↓	habitat, including continued flood risk (small-scale ↑)	↓↓ to ↓↓↓	habitat	↓↓ to ↓↓↓	habitat
	↓ to ↓↓↓	wildlife, including continued flood risk (small-scale ↑)	no to ↓↓↓	wildlife	no to ↓↓↓	wildlife
Air Quality	↓	criteria pollutant emissions, including continued flood risk	↓	criteria pollutant emissions	↓	criteria pollutant emissions
			↓	fugitive dust and odors	↓	fugitive dust and odors
Visual Quality	↓	visual impacts (small-scale ↑)	↓ to ↓↓	visual impacts	↓ to ↓↓	visual impacts
	↓↓↓	visual impacts from continued flood risk			↑	reduced downstream flood damage
Noise and Vibration	↓	noise	↓ to ↓↓	noise	↓	noise
Land Use	↓	land use incompatibility	↓ to ↓↓	land use incompatibility		
	↓↓↓	land use disruption from continued flood risk			↑	reduced flood damage
					↓	increased growth
Recreation	↓	disruption (small-scale ↑)	↓ to ↓↓↓	disruption	no to ↓↓↓	disruption
	↓ to ↓↓↓	disruption from continued flood risk			↑	reduced downstream flood damage

Notes: ↓= low adverse impact, ↓↓= medium adverse impact, ↓↓↓= high adverse impact, ↑= beneficial impact where the level was not identified.

			ALTERNATIVE 1			
ENVIRONMENTAL RESOURCE	**NO ACTION ALTERNATIVE**		**ALTERNATIVE 1 CONSTRUCTION**		**ALTERNATIVE 1 OPERATIONS**	
Cultural Resources	↓ to ↓↓	cultural resources	↓↓↓	cultural resources	↓↓ to ↓↓↓	cultural resources
	↓ to ↓↓↓	damage from continued flood risk			↑	reduced downstream flood damage
Transportation	↓	traffic	↓	traffic, including pedestrians, cyclists, airport use	no to ↓	traffic, including pedestrians, cyclists, and airport use
	↓	roads	↓	roads (some ↑ long-term improvements)	↓	roads (some ↑ long-term)
	↓ to ↓↓↓	traffic and damage from continued flood risk			↑	reduced downstream flood damage and traffic delays
Public Services and Utilities	↓ to ↓↓	increased demand for services, including continued flood risk	↓	increased demand for services	↓	increased demand for services
	↓ to ↓↓	infrastructure, including continued flood risk	↓↓	City of Pe Ell's water supply system	↓↓	City of Pe Ell's water supply system
	↓↓	emergency service response, including continued flood risk			↑	emergency service response from reduced flood risk
Environmental Health and Safety	↓ to ↓↓	hazardous materials exposure, including continued flood risk	↓ to ↓↓	hazardous materials exposure	no to ↓	hazardous materials exposure
	↓ to ↓↓	public worker safety risks, including continued flood risk	↓ to ↓↓	public and worker safety risks	no to ↓	public and worker safety risks
					↑	reduced downstream flood risk
Socioeconomics	↓	population and housing	↓ to ↓↓	population and housing		
	↑	income and employment	↑	income and employment	↑	income and employment, including reduced flood risk
	↑	government revenues	↑	government revenues	↑	government revenues, including reduced flood risk
	↓ to ↓↓↓	ecosystem services, including continued flood risk	↓↓ to ↓↓↓	ecosystem services	↓↓↓	ecosystem services
Environmental Justice	↓↓ to ↓↓↓	natural resource impacts, including continued flood risk	↓↓↓	natural resource impacts	↓↓↓	natural resource impacts
			↓	air/noise impacts	↑	reduced downstream flood risk

Notes: ↓= low adverse impact, ↓↓= medium adverse impact, ↓↓↓= high adverse impact, ↑= beneficial impact where the level was not identified.

ES.5.4 Cumulative Impacts

The cumulative impacts of the proposed project on each resource area analyzed in the Draft EIS are discussed in detail in Chapter 6. The proposed project would not contribute to cumulative impacts for all aspects of these resource areas. In some cases, the proposed project would result in a beneficial impact. Impacts from the proposed project would contribute to substantial adverse cumulative impacts to some portions of the study area for the following resource areas:

- Water quality and quantity
- Geology and geologic hazards
- Aquatic species and habitats
- Terrestrial species and habitats
- Cultural resources
- Socioeconomics
- Environmental justice

ES.6 Mitigation

Mitigation measures are measures used to avoid, minimize, or compensate for adverse environmental impacts from the proposed project. This includes measures proposed by the Applicant and those that may be required by the Corps. Chapter 7 of the Draft EIS identifies specific and conceptual mitigation measures. The development of mitigation will continue through the entire NEPA and permit application review process. Mitigation measures may change based on comments received on the Draft EIS.

ES.7 Next Steps

The Draft EIS was circulated for a 60-day public comment period beginning with the issuance of the Notice of Availability in the Federal Register. After the comment period, the Corps will prepare and circulate a Final EIS that will identify the alternative(s) that are considered to be environmentally preferable. The Final EIS will include a response to comments on the Draft EIS. The Corps will then prepare a Record of Decision (ROD) to document the Corps' permit decision for the proposed project, supported by the analysis in the Final EIS. The ROD will conclude the Corps' NEPA process.

1 INTRODUCTION

1.1 Proposed Project

The Chehalis River Basin Flood Control Zone District (Applicant) is proposing the Chehalis River Basin Flood Damage Reduction Project (proposed project). The proposed project would reduce flood damage in the upper Chehalis River Basin. This would be achieved by temporarily storing floodwater from the Willapa Hills and improving the levee at the Chehalis-Centralia Airport. The Applicant proposes to construct a flood retention facility with a temporary reservoir near the town of Pe Ell, Lewis County, Washington. The Applicant also proposes to implement Airport Levee Improvements around the Chehalis-Centralia Airport in the city of Chehalis, Lewis County, Washington (Figure 1.1-1).

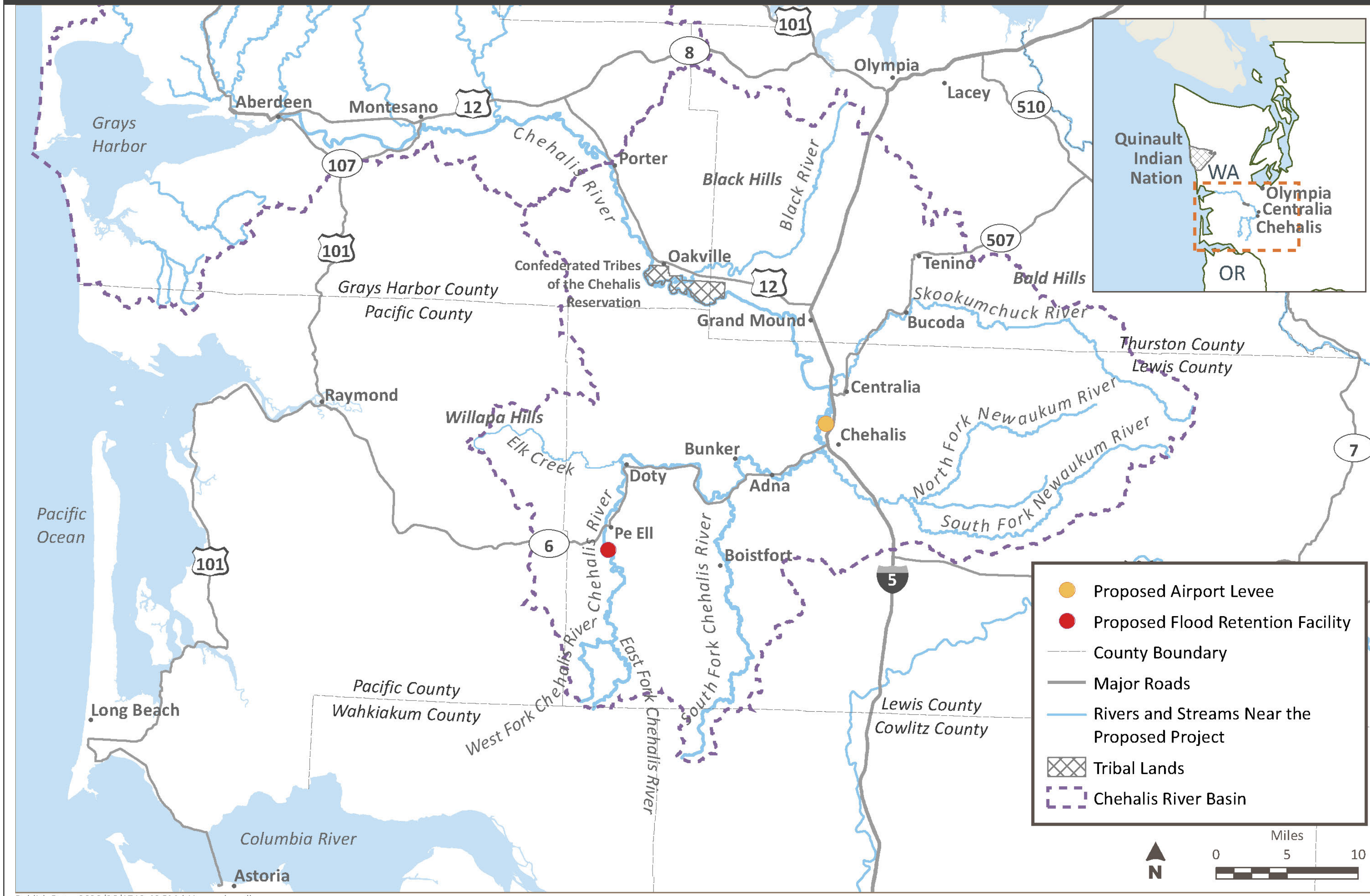
The Applicant must obtain Department of the Army (DA) authorization to construct the proposed project if it involves the discharge of dredged or fill material into waters of the United States. This is required by Section 404 of the Clean Water Act (CWA; 33 Code of Federal Regulations [CFR] 320–332). Waters of the United States generally include rivers, streams, lakes, marine waters, and wetlands. The U.S. Army Corps of Engineers, Seattle District (Corps) has jurisdiction over waters of the United States in the project area. The Corps will decide whether to issue, issue with conditions, or deny a permit for activities within the Corps' jurisdiction.

When a DA permit is requested, the Corps must review the proposal in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended (40 CFR 1500–1508; 33 CFR 325 Appendix B). An EIS must be prepared when a proposal is likely to have a significant effect on the quality of the human environment. An EIS provides a comprehensive and objective evaluation of potential environmental impacts and reasonable alternatives. It also considers mitigation measures that could avoid or minimize adverse impacts.

The Corps has determined the proposed project may have significant individual and/or cumulative impacts to the human environment (Corps 2018). Therefore, the Corps has completed this EIS in accordance with NEPA. Preparation of this Draft EIS and the future Final EIS will support the Corps' permit decision.

This Draft EIS analyzes two action alternatives (Alternatives 1 and 2) and the No Action Alternative. Alternative 1 is the Applicant's proposed project and includes the Flood Retention Expandable (FRE) Facility and Airport Levee Improvements. Alternative 2 includes the Flood Retention Only (FRO) Facility and Airport Levee Improvements. The FRO facility would be built on a smaller foundation and would not allow for potential future expansion of flood storage capacity. Alternative 2 would otherwise be the same as Alternative 1.

Figure 1.1-1
Project Vicinity Map



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1.2 Project Location

The following describes the project location for the two action alternatives. Chapter 3 of this Draft EIS describes the alternatives, including the No Action Alternative, in more detail.

1.2.1 Alternative 1 (Proposed Project): Flood Retention Expandable Facility and Airport Levee Improvements

The proposed FRE facility would be located at approximately river mile (RM) 108 on property currently owned by the Weyerhaeuser Company (Weyerhaeuser) and Panesko Tree Farm. The location is south of State Route (SR) 6 on the mainstem Chehalis River and about 1 mile south (upstream) of the town of Pe Ell, Lewis County, Washington (Figure 1.2-1).

The FRE facility would be designed and operated to hold back floodwater in a temporary reservoir. When full, the temporary reservoir would cover about 856 acres up to RM 114. The FRE facility would be built on a foundation that would allow for potential future expansion. This means that it would be possible for the Applicant to raise the height of the FRE facility later to be able to store more water. Future expansion would be considered a modification of the potentially permitted use. This would require additional environmental review under NEPA if it were ever proposed.

The Airport Levee Improvements would take place around the Chehalis-Centralia Airport in the city of Chehalis, Lewis County, Washington. The location is east of the Chehalis River and west of Interstate 5 (I-5) (Figure 1.2-2). The surrounding area is mostly privately owned and includes agricultural and rural residential uses.

The Airport Levee Improvements would improve the integrity of the existing airport levee at the Chehalis-Centralia Airport. A portion of the levee and NW Airport Road would be raised, which could require widening parts of the base and replacing utility infrastructure.

1.2.2 Alternative 2: Flood Retention Only Facility and Airport Levee Improvements

Under Alternative 2, the flood retention facility would be constructed at the same location as Alternative 1. Under Alternative 2, the proposed flood retention facility is referred to as an FRO facility. The flood retention facility would be built on a smaller foundation than Alternative 1. This is because it was assumed that it would not be designed to allow for potential future expansion of flood storage capacity. The size of the temporary reservoir would be the same as under Alternative 1 (Figure 1.2-1). The Airport Levee Improvements proposed under Alternative 2 would be the same as Alternative 1 (Figure 1.2-2).

Figure 1.2-1
Proposed Location of the Flood Retention Facility and Temporary Reservoir

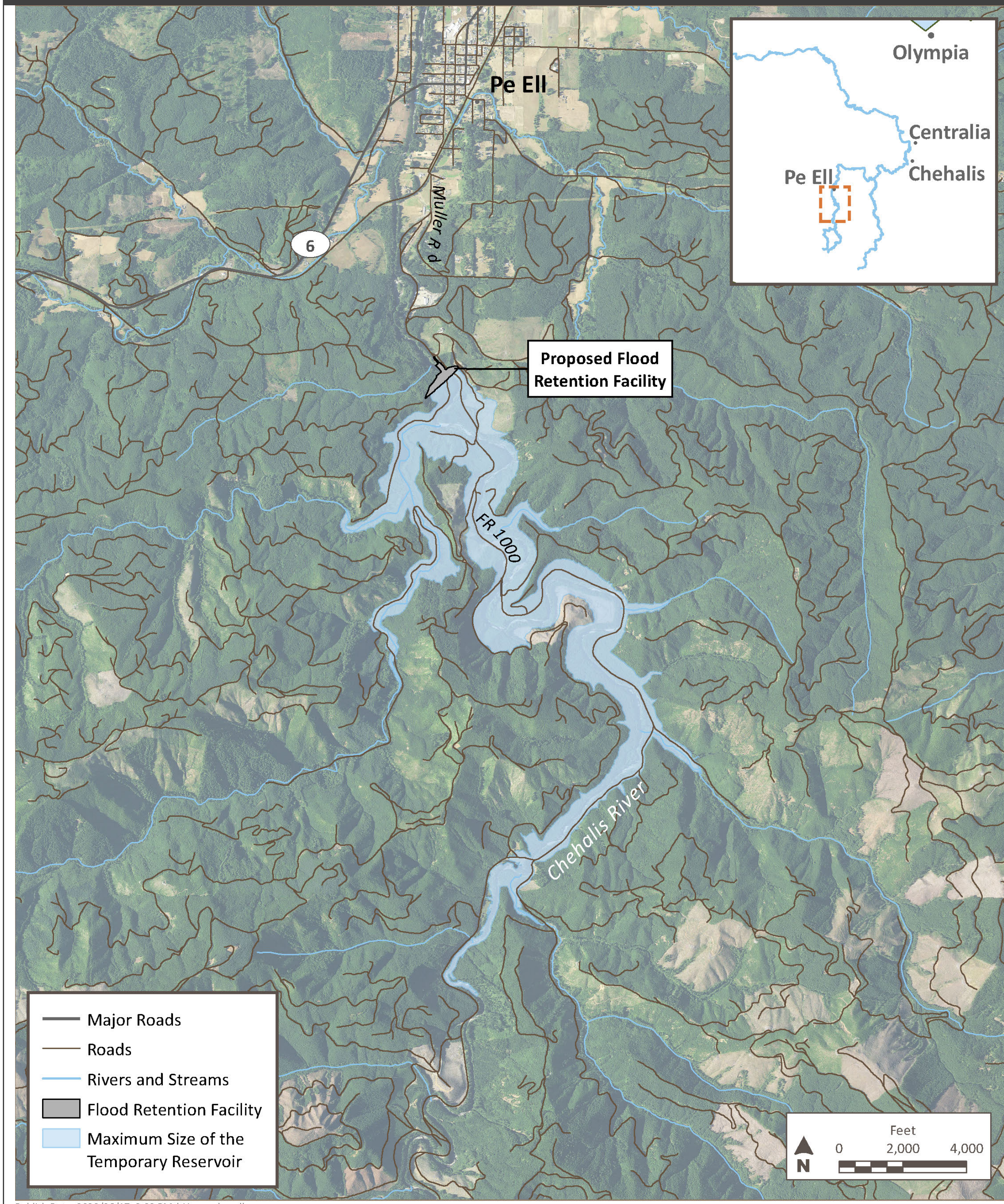

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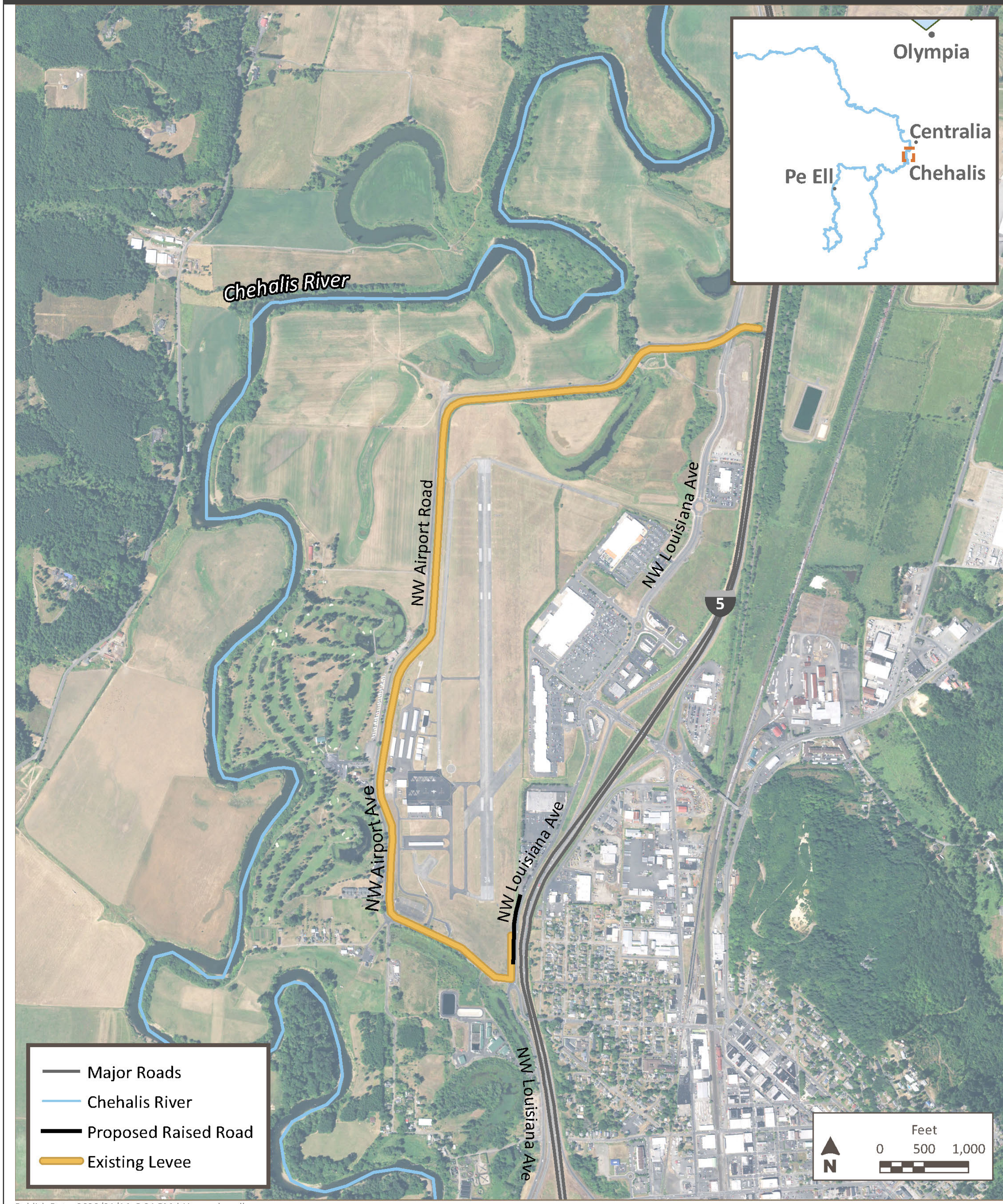
Figure 1.2-2
Proposed Airport Levee Improvements



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1.3 History and Background

1.3.1 Past Flooding and Local Regulation

Significant flooding has occurred in the Chehalis River Basin eight times in the past 60 years, causing major damage to the human environment. Damages include loss of property, adverse effects on public health and safety, and major disruptions and damage to transportation systems. This has included multiple temporary closures of I-5. Past flooding is described more fully in Chapter 2.

The Chehalis River Basin Flood Authority (Flood Authority) is a Lewis County government agency. It was formed in 2008 through an interlocal agreement between counties, cities, towns, and federally recognized tribes with interests in the Chehalis Basin in response to the 2007 flood. The interlocal agreement now includes 13 jurisdictions: Lewis County, Grays Harbor County, Thurston County, Aberdeen, Centralia, Chehalis, Hoquiam, Montesano, Oakville, Cosmopolis, Napavine, Bucoda, and Pe Ell (CRBFA 2019). The Flood Authority proposed the establishment of a flood control zone district (authorized by the Revised Code of Washington [RCW] 86.15) to undertake and maintain flood control projects in the Chehalis Basin.

The Chehalis River Basin Flood Control Zone District is also a Lewis County government agency. It was formed on February 14, 2011, through Resolution 11-049 adopted by the Board of County Commissioners of Lewis County. The resolution established the District's jurisdiction as the area of Lewis County located within the Chehalis River Basin watershed. In this resolution, the Chehalis River Basin Flood Control Zone District adopted all powers set forth in RCW 86.15. This includes taking action to protect property and life from flood damage, acquiring property, accepting and providing funds, and controlling and removing floodwater.

1.3.2 Past Environmental Review

There are two general approaches to preparing EISs: programmatic and project-level. A Programmatic EIS (PEIS) evaluates non-project actions, like the development of plans. A PEIS is typically followed by a project-level environmental review, such as this EIS.

The Washington Department of Ecology (Ecology) completed a PEIS in June 2017 to help develop a plan to reduce flood damage and restore aquatic habitat in the Chehalis Basin. The PEIS was completed to meet the requirements of the Washington State Environmental Policy Act (SEPA). The PEIS evaluated different strategies, including a flood retention facility. After review of the PEIS, the Governor's Work Group recommended a project-level EIS be conducted to further evaluate the potential impacts of a flood retention facility (Work Group 2018).

In October 2017, the Chehalis River Basin Flood Control Zone District became the project sponsor and Applicant for the proposed project. The Applicant has since continued to look at reducing flood damage, focusing on the upper Chehalis River Basin. The Applicant submitted a permit application to the Corps proposing to reduce flood damage by constructing the FRE facility and Airport Levee Improvements.

Ecology is also conducting a separate project-level environmental review process to comply with SEPA. The SEPA Draft EIS was released for public review on February 27, 2020.

1.4 National Environmental Policy Act

NEPA requires federal agencies to analyze and consider potential environmental impacts of a proposed project as part of their decision-making process. Under NEPA, reasonable alternatives to the proposed project must be evaluated. Reasonable alternatives are those that are feasible and that accomplish the underlying project purpose and need. Input must be solicited from organizations and individuals potentially affected. Direct, indirect, and cumulative environmental impacts of the proposed project must be presented objectively. This information is considered before making a decision on whether or to not to issue the DA permit.

The Corps completed a significance determination on January 31, 2018 (Corps 2018). On September 28, 2018, the Corps published a Notice of Intent to prepare an EIS in the Federal Register (83 FR 49075–49077). Publishing the Notice of Intent started the NEPA EIS process.

1.4.1 National Environmental Policy Act Lead Agency

The proposed project would require DA authorization under Section 404 of the CWA. As the federal agency with the most significant involvement and project approval and disapproval authority, the Corps is the lead agency under NEPA, as defined in 40 CFR 1501.5. As the NEPA lead agency, the Corps is responsible for making sure federal environmental rules and regulations are followed thoroughly and objectively during the NEPA process. This Draft EIS was prepared in accordance with the Corps' procedures for implementing NEPA (33 CFR 325, Appendix B).

1.4.2 National Environmental Policy Act Cooperating Agencies

NEPA implementing regulations allow the lead agency to invite other federal agencies or federally recognized tribes to participate in the NEPA process as cooperating agencies. A federal agency or tribe may also request the lead agency to designate it as a cooperating agency. Cooperating agencies are federal agencies or tribes with jurisdiction by law or special expertise regarding a proposed project (CEQ 1999). Cooperating agencies assist the lead agency by participating in the NEPA process as early as possible, assisting in developing information and preparing environmental analyses, and making staff available to provide additional expertise for the analyses.

On May 15, 2019, the Corps and Quinault Indian Nation (QIN) signed a Cooperating Agency Agreement. The agreement confirmed the terms of cooperation between the Corps as the NEPA lead agency and the QIN as a cooperating agency. On September 22, 2019, the QIN terminated the agreement and withdrew as a cooperating agency. The U.S. Environmental Protection Agency (EPA) and Confederated Tribes of the Chehalis Reservation (Chehalis Tribe) were also invited to serve as cooperating agencies. EPA declined. The Chehalis Tribe has not formally responded as of the time of publication.

1.4.3 National Environmental Policy Act Public Scoping Process

The Corps invited local, state, and federal agencies, Native American tribes, organizations, and members of the public to comment on the scope of the EIS during a 31-day scoping period. Ecology conducted scoping for the SEPA EIS process at the same time. The combined scoping period began September 28, 2018, and closed October 29, 2018. The Corps received verbal and written comments at in-person scoping meetings. Comments were also received by mail and online. A total of 265 comments were submitted.

A number of concerns were raised through public scoping comments. Comments involved concerns about fish and wildlife, vegetation, climate change, tribal resources, environmental health and safety, socioeconomics, and water quality. The Corps established the scope of this Draft EIS based in part on comments received during the scoping period. These comments helped identify elements of the environment and potential alternatives that this Draft EIS should address. More detail on the public scoping process and the public comments received can be found in Chapter 8 of this EIS and in the *Chehalis River Basin Flood Damage Reduction NEPA EIS Scoping Summary Report* (Corps 2019).

1.4.4 National Environmental Policy Act Scope of Analysis

Under NEPA, the Corps' scope of analysis includes the activities requiring a DA permit and those portions of the entire project over which the Corps has sufficient control and responsibility. For the proposed project, the regulated activities include the discharge of fill material for the flood retention facility and Airport Levee Improvements into waters of the United States. The Corps extends the scope of analysis to other portions of a project when the environmental consequences of the entire project are essentially products of the Corps permit action. The factors considered in determining the scope of the analysis were evaluated in accordance with the Corps' NEPA implementation procedures (33 CFR 325, Appendix B, Section 7[b][2]). The Corps determined that it has sufficient control and responsibility over the proposed project to extend the scope of analysis to those portions of the project otherwise beyond the limits of Corps jurisdiction.

1.5 Document Organization

This Draft EIS is organized as follows:

- Chapter 1, Introduction, describes the project location, history and background, NEPA process, Draft EIS organization, and next steps.
- Chapter 2, Purpose and Need, describes the purpose and need for the proposed project.
- Chapter 3, Proposed Project and Alternatives, describes the proposed project, alternatives development process, alternatives evaluated in the EIS, and alternatives considered but rejected. This chapter also describes the approach to how the impacts were analyzed and compares the alternatives.

- Chapter 4, Natural Resources, presents the affected environment and environmental consequences for water resources, geology and geomorphology, wetlands and vegetation, aquatic species and habitat, and terrestrial species and habitat.
- Chapter 5, Built Environment, presents the affected environment and environmental consequences for air quality, visual quality, noise and vibration, land use, recreation, cultural resources, transportation, public services and utilities, hazardous materials, socioeconomics, and environmental justice.
- Chapter 6, Cumulative Impacts, addresses the potential for the alternatives to contribute to cumulatively substantial impacts.
- Chapter 7, Minimization and Mitigation, describes the measures proposed by the Applicant to address the potential impacts identified in Chapters 4 and 5.
- Chapter 8, Consultation and Compliance, describes how the Corps involved the public and coordinated with agencies and tribes throughout the NEPA process.
- Appendix A, Distribution List
- Appendix B, List of Preparers
- Appendix C, References Cited in the Environmental Impact Statement
- Appendix D, Selection and Description of the Alternatives
- Appendix E, Impact Levels
- Appendix F, Regulatory Context and Permits and Approvals
- Appendix G, Discipline Report for Water Quantity and Quality
- Appendix H, Discipline Report for Geology and Geologic Hazards
- Appendix I, Discipline Report for Geomorphology
- Appendix J, Discipline Report for Wetlands and Other Waters
- Appendix K, Discipline Report for Aquatic Species and Habitats
- Appendix L, Discipline Report for Terrestrial Species and Habitats
- Appendix M, Air Quality Impact Analysis
- Appendix N, Visual Quality Impact Analysis
- Appendix O, Noise Impact Analysis
- Appendix P, Socioeconomics Impact Analysis
- Appendix Q, Environmental Justice Impact Analysis

1.6 Next Steps

The Draft EIS will be circulated for a 60-day public comment period beginning with the issuance of the Notice of Availability in the Federal Register. The following is a list of next steps in the NEPA process:

1. The Corps will accept comments on the Draft EIS.
2. After the comment period on the Draft EIS has ended, the Corps will prepare and circulate a Final EIS. The Final EIS will address comments received on the Draft EIS. The Corps will identify the environmentally preferable alternative(s) in the Final EIS based on the Draft EIS analysis and comments received from agencies, tribes, and the public. The Final EIS will support the Corps' permit decision for the proposed project.
3. The Corps will prepare a Record of Decision (ROD) to document the Corps' permit decision for the proposed project and consistency with other applicable regulations, statutes, and guidance. The ROD will conclude the Corps' NEPA process.

2 PURPOSE AND NEED

This chapter describes the purpose and need for the proposed project. An EIS is required to include the underlying purpose and need to explain why the Applicant is undertaking the proposed project (40 CFR 1502.10, 1502.13). The purpose and need is also used to determine reasonable alternatives for analysis in the EIS. Chapter 3 describes the alternatives analyzed in this EIS, based on the purpose and need.

2.1 Purpose

The purpose of the proposed project is to reduce the risk of flood damage in the Chehalis/Centralia area from catastrophic flooding. The target area is the 100-year floodplain of the Chehalis River from Adna to Grand Mound (Figure 2.1-1). For the purposes of this EIS, a catastrophic flood is defined as a 100-year flood. A 100-year flood has a 1% chance of happening each year.

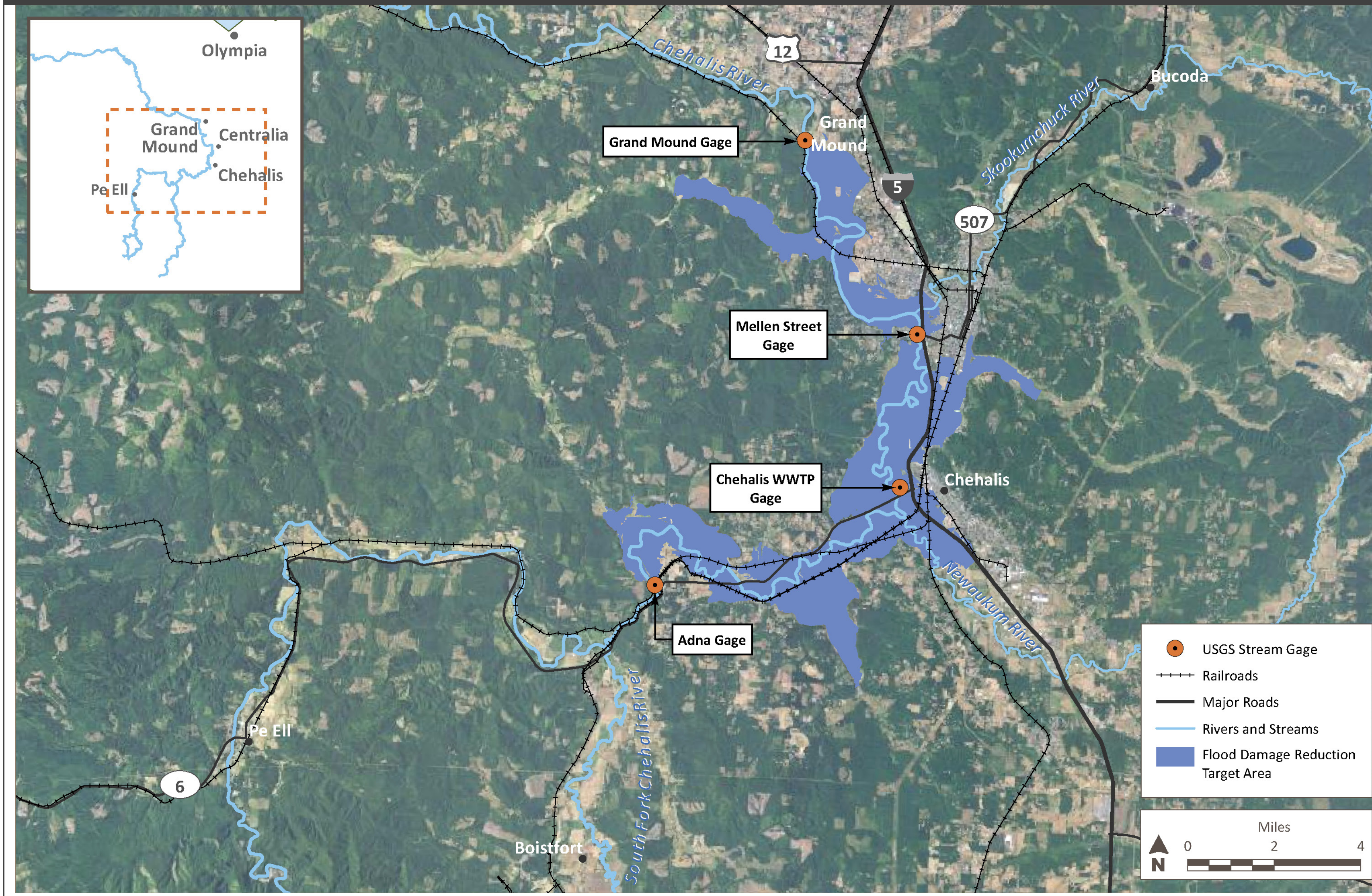
2.2 Need

Significant flooding has occurred eight times in the past 60 years. The three most recent floods, in 1996, 2007, and 2009, were the largest on record. These floods caused the losses of homes, farms, and businesses and caused extensive physical, emotional, and economic damage. Much of the flood damage occurred in the cities of Chehalis and Centralia, where there is more intensive development in the floodplain. This flooding is expected to continue.

The Applicant has determined that the proposed project is needed because flooding has caused major damage in the recent past. In the Chehalis Basin, flooding has damaged homes, businesses, and agricultural areas. It has also damaged and blocked access to critical public facilities. Some transportation facilities, like I-5 and the Chehalis-Centralia Airport, have been required to temporarily shut down. These past damages and delays have resulted in high economic costs.

If a catastrophic flood happened in the Chehalis/Centralia area, many homes and businesses would be affected. An estimated 1,261 structures, including schools, residences, and other important buildings could be damaged. Based on past flooding, damages could affect the structures and their contents, associated vehicles, and surrounding land. Flooding could also require some people to evacuate and temporarily relocate. Flooding of this scale would also disrupt local business operations. More than $90 million in Federal Emergency Management Agency (FEMA) relief funds have been distributed to communities within the Chehalis Basin since 1978 (NFIP 2015).

Figure 2.1-1
Flood Damage Reduction Target Area



Catastrophic flooding would also damage vast areas of agricultural land. Agricultural land covers approximately 41% of the Chehalis River 100-year floodplain between the proposed location of the flood retention facility and RM 33 near Porter. Agricultural uses in the Chehalis Basin consist mainly of livestock grazing, crop farming, and commercial dairy operations (CBP 2004). Silt and wood debris transported by the flood in 2007 were estimated to have affected 4,776 acres of agricultural land, with cleanup costs of over $2.3 million. Flooding has also injured and killed livestock and damaged fences and farm equipment. Approximately 1,600 commercial livestock, including 400 dairy cows, were killed in the 2007 flood in Lewis County (Ruckelshaus 2012).

Flooding in this area would impede access to public facilities and services. This would cause unsafe conditions for people and animals, including livestock. Public facilities located in the 100-year floodplain in the Chehalis-Centralia area include the Chehalis and Centralia Police Departments, the Centralia Wastewater Treatment Plant, and the Pe Ell Water Plant. Several schools and places of worship are also located within this area. Land uses and facilities are shown in Figures 2.2-1, 2.2-2, and 2.2-3.

Currently, if a catastrophic flood happened in the Chehalis-Centralia area, I-5 is predicted to be closed for 5 days. This would severely disrupt transportation and cause substantial economic loss. Figures 2.2-4, 2.2-5, and 2.2-6 show the portions of I-5 that would be flooded during a catastrophic flood without the proposed project. When I-5 is closed for more than part of a day, goods and people cannot efficiently travel through the region. This can result in substantial economic losses. The total economic damages of the 2007 flood alone were estimated at over $900 million. A third of that damage resulted from disruption and damage to the transportation system, I-5, state highways, and rail lines. The remaining economic damage included impacts to homes, businesses, and farms (Ruckelshaus 2012).

Flooding of this scale would also affect other transportation infrastructure. This would include SR 6, SR 12, and portions of the BNSF Railway, Port of Chehalis Rail Line, and Tacoma Rail Mountain Division Line. A catastrophic flood would also result in overtopping of the existing airport levee even if the flood retention facility were built. Overtopping of the levee could cause it to breach, or break away, making it ineffective for flood protection. The Airport Levee Improvements are necessary because they would improve the integrity of the levee and reduce the likelihood of a breach.

The specific areas that would be flooded and the amount of damage would depend on the extent of the flooding. However, catastrophic flooding in the Chehalis Basin has happened relatively recently and is expected to continue. Therefore, the Applicant has determined that proposed project is needed to reduce the risk of damage from catastrophic flooding in the target area.

Figure 2.2-1
Land Uses and Critical Public Facilities in the 100-Year Floodplain (Grand Mound and Centralia)

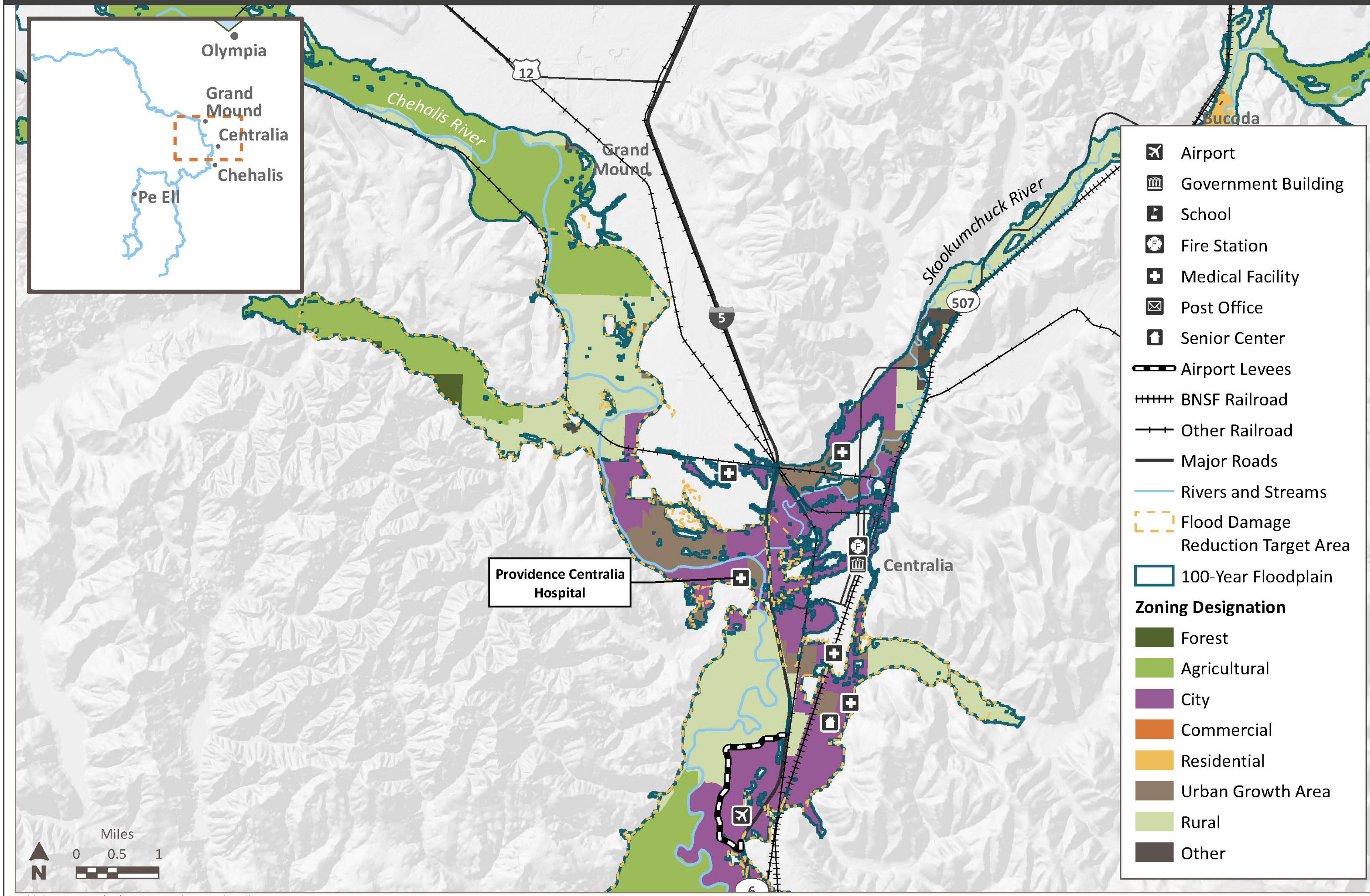


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Figure 2.2-2
Land Uses and Critical Public Facilities in the 100-Year Floodplain (Chehalis Region)

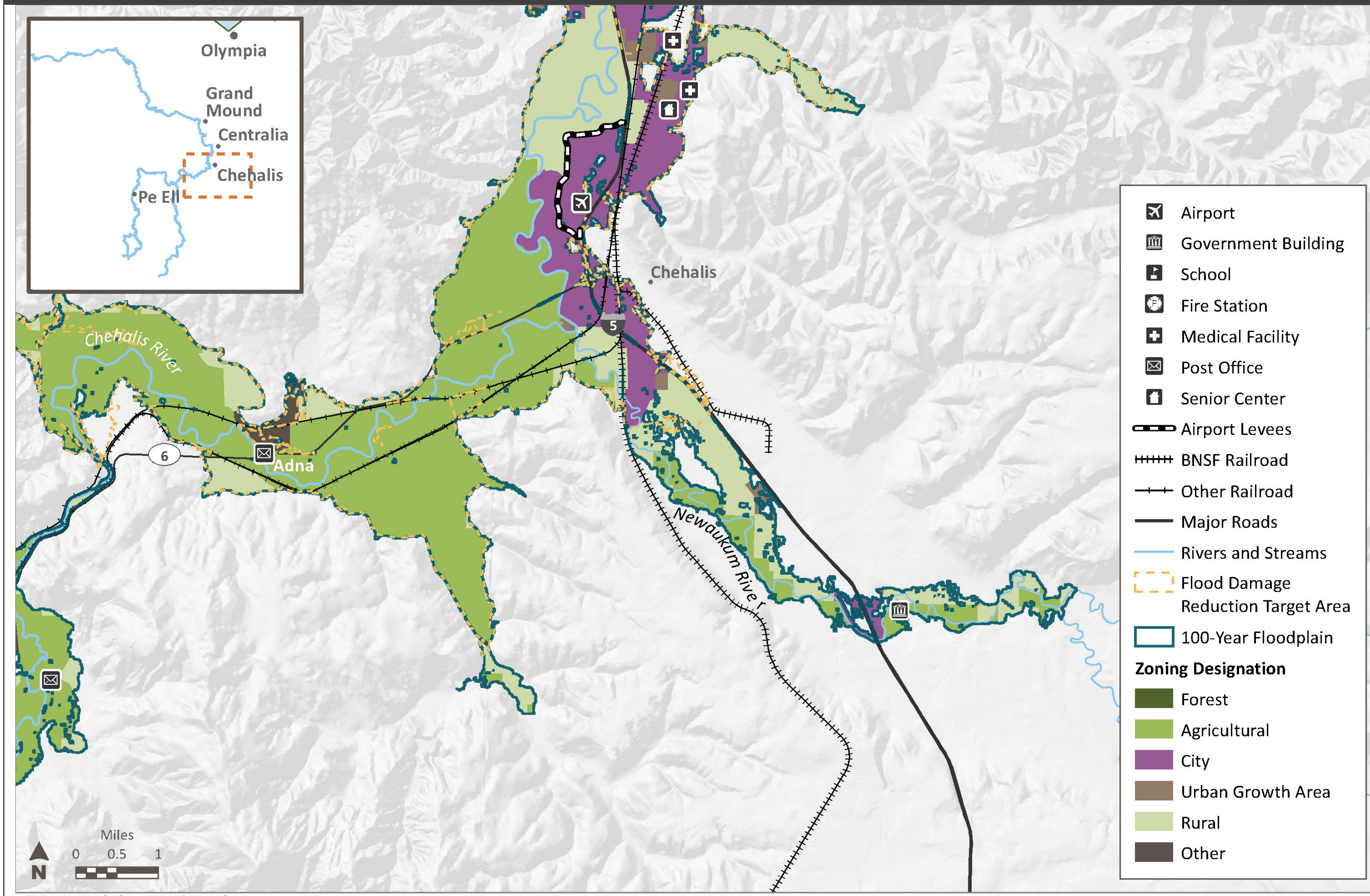

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Figure 2.2-3
Land Uses and Critical Public Facilities in the 100-Year Floodplain (Pe Ell Region)

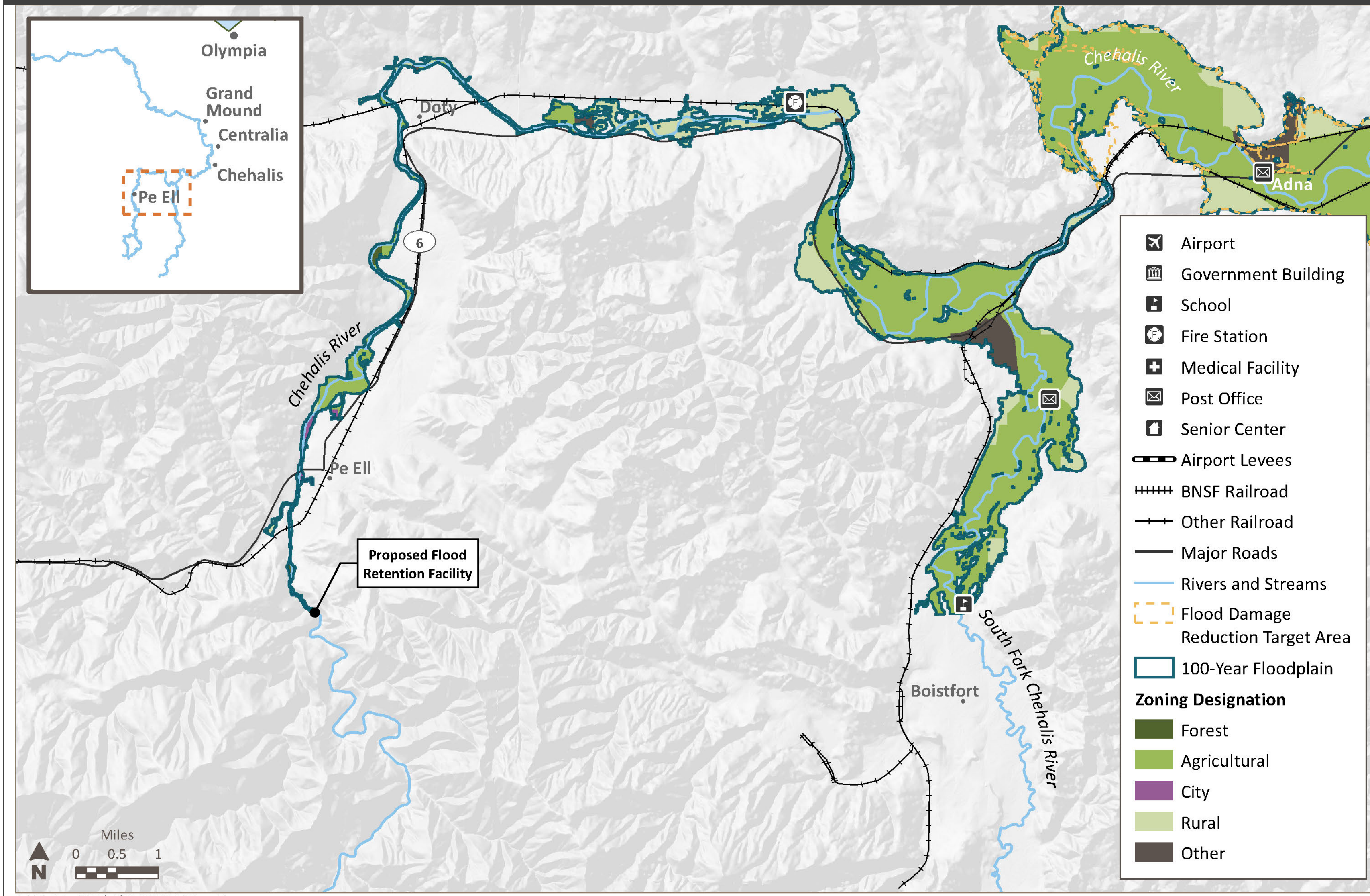

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Figure 2.2-4
Impacts to Interstate 5 in the 100-year Floodplain (Centralia Region)

Figure 2.2-5
Impacts to Interstate 5 in the 100-year Floodplain (Chehalis Region)

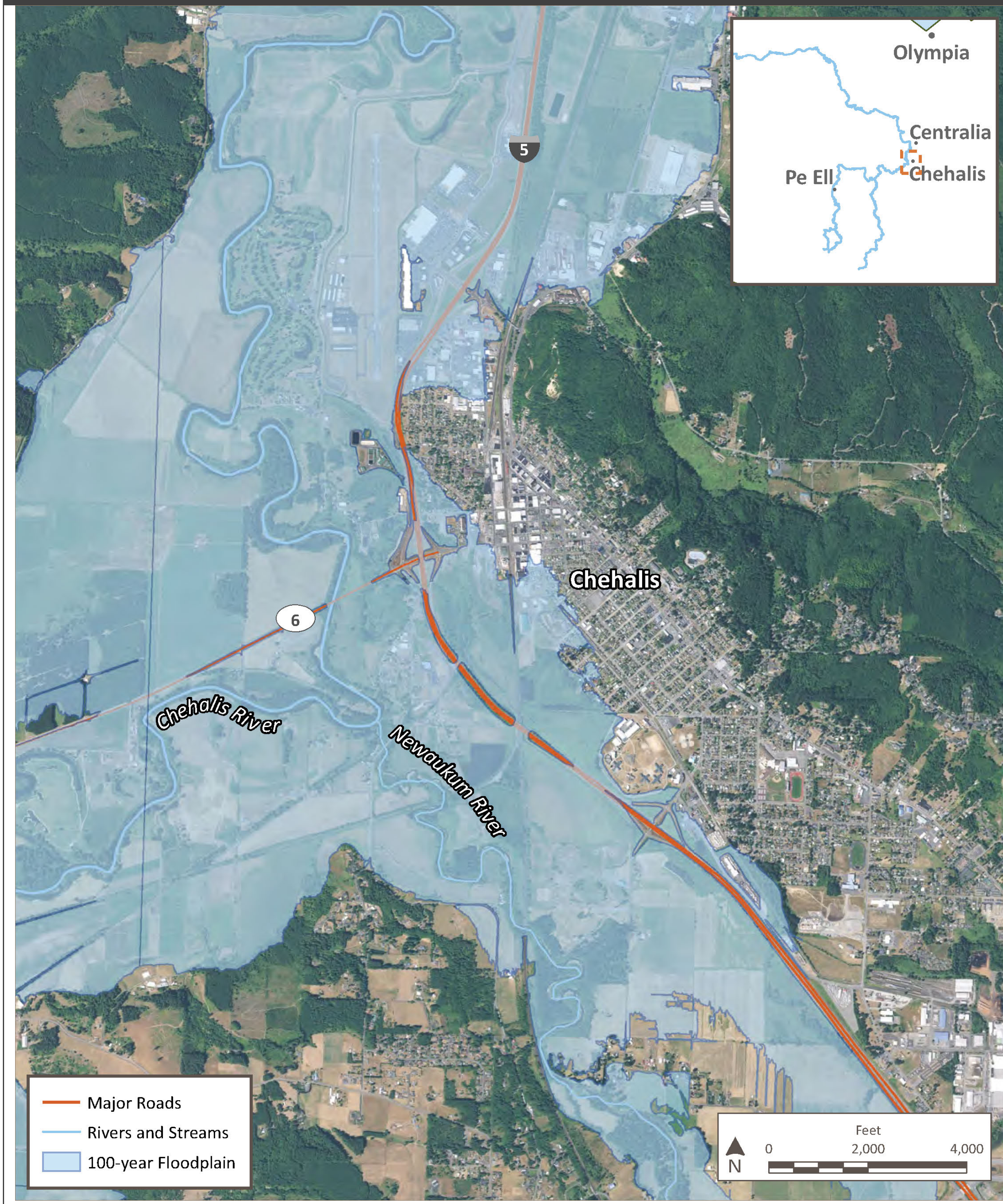
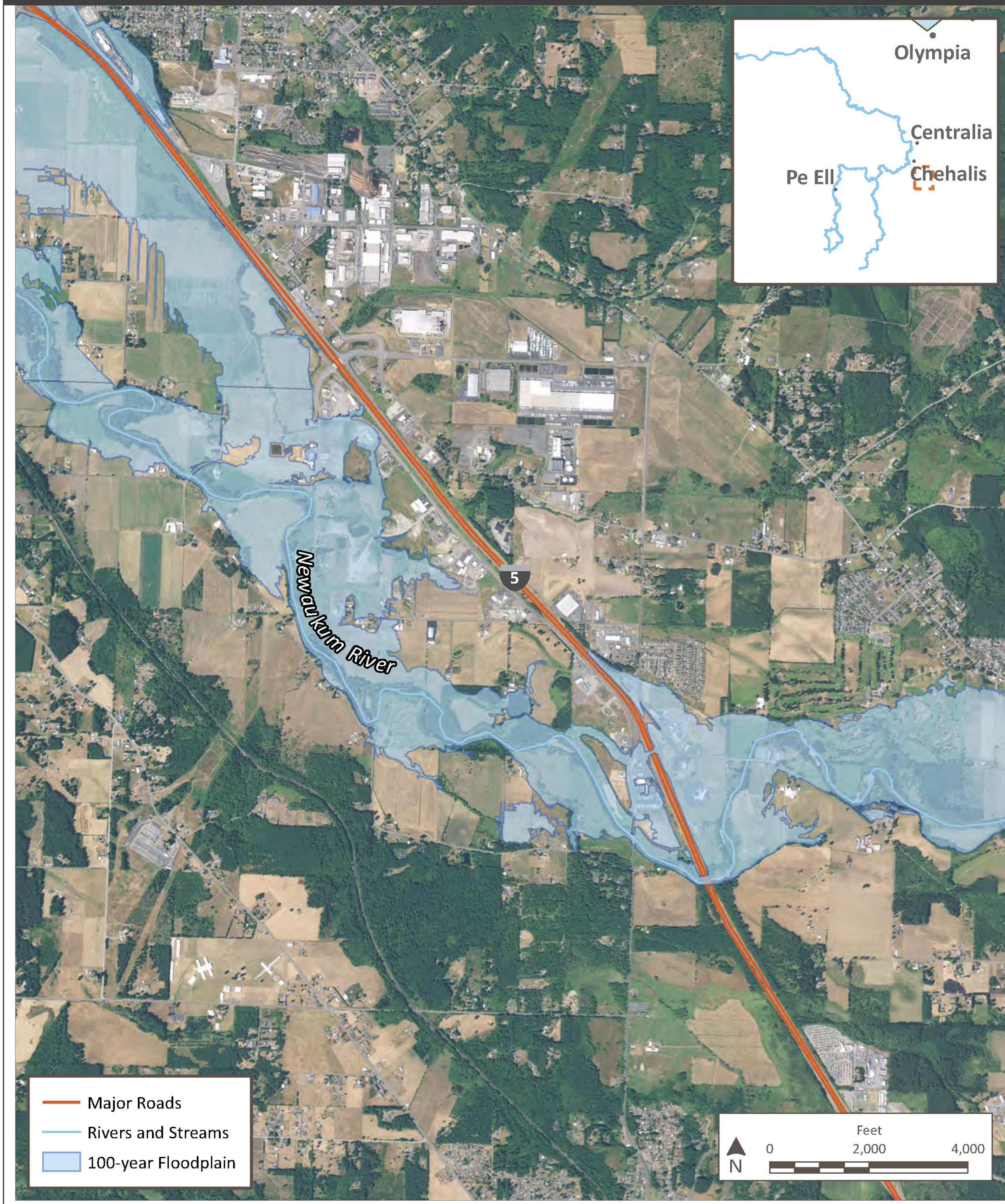


Figure 2.2-6
Impacts to Interstate 5 in the 100-year Floodplain (Southeast of Chehalis)



3 PROPOSED PROJECT AND ALTERNATIVES

This chapter describes the location and regional setting of the proposed project. It also describes the process used to develop the project alternatives and the analysis methods. This includes which alternatives are analyzed in this EIS and why other alternatives are not.

3.1 Location and Regional Setting

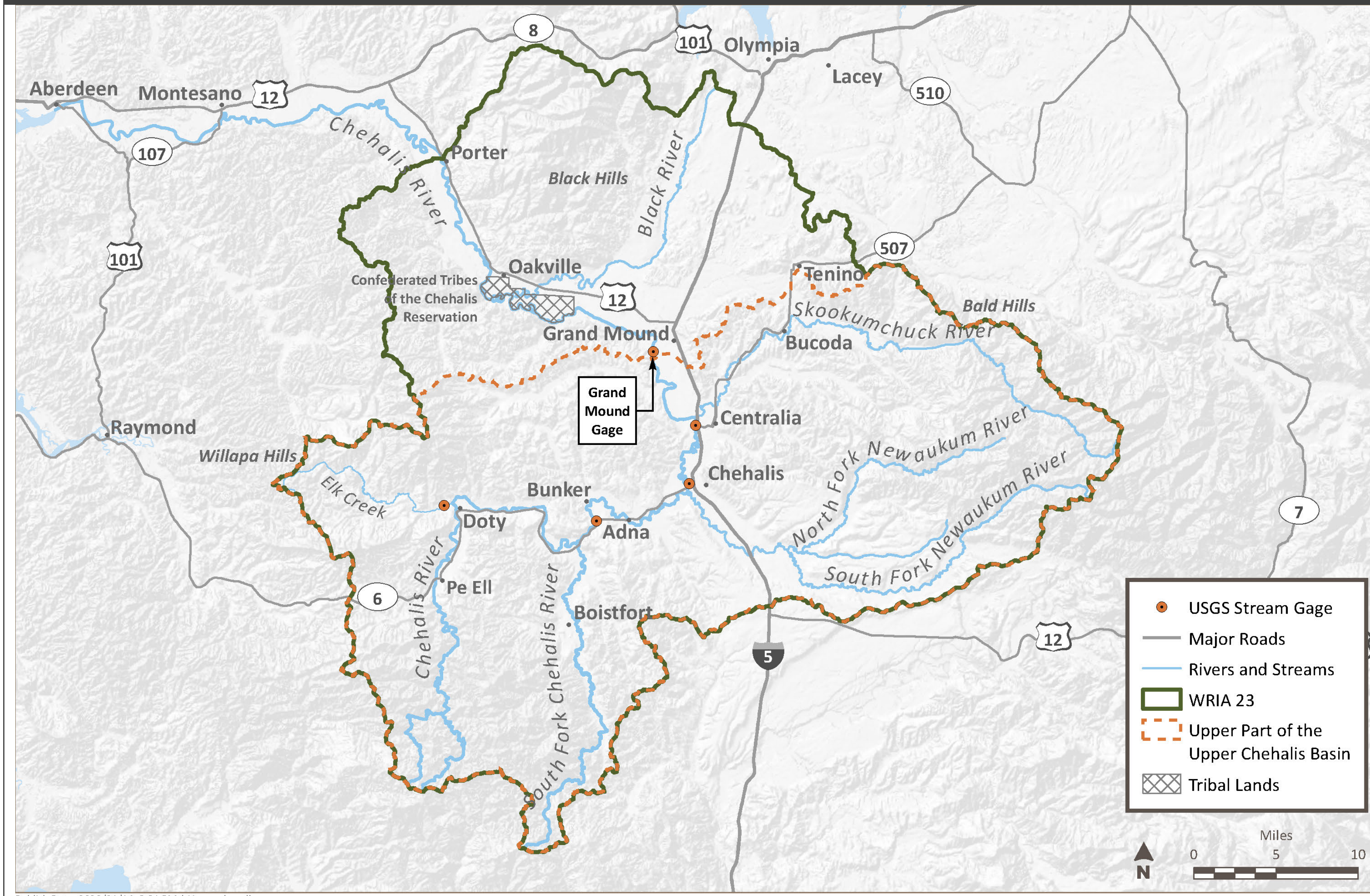
The proposed project would be located in the Chehalis Basin, which spans seven counties in southwest Washington. Most of the Chehalis Basin is located in Lewis, Thurston, and Grays Harbor counties. Smaller portions are located in Mason, Pacific, Cowlitz, and Jefferson counties. The Chehalis Basin consists of two Water Resource Inventory Areas (WRIAs): WRIAs 22 (Lower Chehalis) and 23 (Upper Chehalis). WRIAs are the major watersheds in the state of Washington, as defined by Ecology. The Chehalis River is the main river in the Chehalis Basin. It is approximately 125 miles long and drains an area of 2,700 square miles (Ruckelshaus 2012). For purposes of this NEPA EIS, the upper Chehalis Basin is defined as the area from the Grand Mound stream gage (USGS 12027500) to the upper extent of WRIA 23 (Figure 3.1-1). Major tributaries in the upper Chehalis Basin include the West Fork, East Fork, and South Fork Chehalis, Newaukum, and Skookumchuck rivers. Major tributaries downstream of the upper Chehalis Basin include the Black, Satsop, Wynoochee, Wishkah, and Hoquiam rivers. The downstream tributaries are outside of the study area for this EIS and are not discussed further.

The major population centers in the Chehalis Basin include the cities of Chehalis and Centralia in the upper Chehalis Basin, and the cities of Aberdeen and Hoquiam along Grays Harbor. The Chehalis Tribe is located where the Black River flows into the mainstem Chehalis River. The Chehalis Tribe has customarily fished, hunted, and harvested in the Chehalis Basin. The QIN's reservation is located outside of the Chehalis Basin. However, the QIN's usual and accustomed fishing grounds[1] include the entire Chehalis Basin.

The Chehalis Basin is mostly forested. Agricultural and developed lands are concentrated near the broad Chehalis River floodplain areas in the middle basin and near Grays Harbor. Agricultural uses are mostly commercial dairy, livestock, and crop farming in the low-lying areas near the Chehalis River and its tributaries. Developed lands include residential, commercial, and industrial uses centered around the Chehalis-Centralia area and the Aberdeen-Hoquiam area (CBP 2004). Major infrastructure includes I-5, U.S. Highway 12, SR 6, SR 8, and the BNSF Railway and Union Pacific Railroad lines (Figures 2.2-1, 2.2-2, and 2.2-3).

[1] Usual and accustomed fishing grounds are treaty-reserved areas where tribes traditionally fished, hunted and gathered.

Figure 3.1-1
Upper Chehalis Basin



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3.2 Alternative Screening Process

The Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (40 CFR 1502.14) require federal agencies to examine all reasonable alternatives to an applicant's proposal as part of an EIS process. When the agency determines which alternatives will be considered, they must focus on which are "reasonable" without consideration of whether the applicant supports the alternatives. Reasonable alternatives are practical or feasible from a technical, economic, and common-sense point of view. Reasonable alternatives must also accomplish the underlying purpose and need (33 CFR 325, Appendix B), which is defined in Chapter 2.

This section summarizes the Corps' process for developing and screening alternatives. The Corps conducted a two-phase review to screen alternatives for detailed evaluation in this EIS. The first phase considered whether alternatives met the Applicant's identified purpose and need for the proposed project. The second phase considered whether alternatives were reasonably available to the Applicant. This phase also removed alternatives from consideration that caused measurably greater impacts to the aquatic environment than the Applicant's proposed project. Appendix D presents additional information about the alternatives that were considered and the results of the screening.

3.2.1 Information Considered

Flooding in the Chehalis Basin has been studied since the 1930s. Many different flood damage reduction approaches have been considered. The Corps reviewed the following documents to develop a list of alternatives for screening:

- *Interim Feasibility Report and Environmental Impact Statement, Centralia, Washington, Flood Damage Reduction* (Corps 1982)
- *Centralia Flood Damage Reduction Project, Chehalis River, Washington, General Reevaluation Study* (Corps 2003)
- *Chehalis Basin Partnership Multi-Purpose Water Storage Assessment* (Tetra Tech 2003)
- *Chehalis Basin Watershed Management Plan* (CBP 2004)
- *Chehalis River Flood Water Retention Project - Phase IIB Feasibility Study* (EES Consulting 2011)
- *Chehalis Basin Flood Hazard Mitigation Alternatives Report* (Ruckelshaus 2012)
- *Elma-Porter Flood Mitigation Project – Hydraulic Modeling and Analysis Draft Memorandum* (WSE 2014)
- *Chehalis Basin Strategy Final Programmatic EIS* (Ecology 2017)
- *Chehalis River Basin Flood Damage Reduction Project Description* (Chehalis River Basin Flood Control Zone District 2018)
- *Draft Community Flood Assistance & Resilience (CFAR) Program Memorandum* (OCB 2018)
- *Chehalis Basin Strategy Restorative Flood Protection Advanced Feasibility Evaluation for the North and South Forks of the Newaukum River, Washington* (Ecology 2020)

The Corps also considered input received through the scoping process (described in Chapter 8) to develop reasonable potential alternatives. Scoping comments included recommendations for elements of the proposed project and suggestions for other structural and non-structural alternatives (Corps 2019). Many of these suggestions were considered in the alternatives screening process.

3.2.2 Phase 1 Screening Criteria

The Corps developed the following essential screening criteria based on information provided by the Applicant. An alternative was required to meet all of these criteria for achieving the project purpose to move to Phase 2 screening:

- **Geographic Area of Flood Damage Reduction**: An alternative must reduce flood damage from a 100-year flood from USGS river gage 12021800 near Adna to USGS river gage 12027500 near Grand Mound (Figure 2.1-1). This area was selected because extensive flood damage has occurred within it during past floods. Future floods in this area could adversely impact public health and safety.
- **Flood Damage Reduction Metrics**: An alternative must reduce 100-year flood elevations at each of the following locations (Figure 2.1-1). These metrics were selected because they correspond to the Applicant's proposed accepted level of flood damage reduction and a reduction in public health and safety risks and flood damages in the targeted geographic area.
  - Reduction of 1 foot at the Mellen Street gage (USGS 12025500)
  - Reduction of 4 feet at the Adna gage (USGS 12021800)
  - Reduction of 0.9 foot at the Chehalis Wastewater Treatment Plant gage (USGS 12025100)
  - Reduction of 0.8 foot at the Grand Mound gage (USGS 12027500)
- **No Substantial Increase in Redirected Negative Impacts**: An alternative cannot cause substantial changes to the 100-year floodplain that would increase flood damages in other segments of the Chehalis Basin. This criterion was selected because the Corps determined a reasonable alternative should not include measures to reduce flooding in one location that would increase flooding and result in public health and safety risks or flood-related damages elsewhere.

3.2.3 Phase 2 Screening Criteria

Phase 2 screening criteria included whether alternatives carried from Phase 1 were reasonably available to the Applicant. Phase 2 screening also evaluated whether any of the alternatives would cause substantially greater impacts to the aquatic environment relative to each other.

3.2.4 Alternatives Considered but Eliminated

The Corps independently evaluated a total of 61 potential alternatives through the screening criteria listed above. The detailed list and screening results are presented in Appendix D, Selection and

Description of Alternatives. The categories of alternatives considered include the following types of projects:

- Floodwater bypasses
- Levees and floodwalls
- Channel dredging
- Flood retention facilities on the mainstem Chehalis River and tributaries
- Actions involving reconfiguration of I-5
- Local actions such as floodproofing and land use management
- Restorative flood protection (planting and placing large wood in the floodplain and reconnecting rivers to their floodplains)
- Community flood assistance and resilience program (a program to protect individual properties)
- Bridge replacements
- Combinations of various alternatives

Of the potential alternatives, four met all the Phase 1 screening criteria. The remaining 58 met various combinations of the criteria but none also achieved the flood damage reduction metrics. As discussed in Chapter 2, under current conditions, flooding in the Chehalis-Centralia area results in large-scale physical and economic damage. This criterion is directly related to flood damage reduction in the Chehalis-Centralia area and is critical to the purpose and need of the proposed project. Therefore, alternatives that did not satisfy the flood damage reduction criterion were not carried forward for further evaluation.

Of the four remaining alternatives, two were carried forward for analysis in the Draft EIS as Alternatives 1 and 2. These are described in Sections 3.4 and 3.5. The other two alternatives were eliminated in Phase 2. These alternatives included Airport Levee Improvements with a flood retention facility in the same location as the proposed project. The flood retention facility components of the eliminated alternatives were defined as follows:

- **Flood Retention Maximum Capacity (FRMC):** A flood retention facility similar to the proposed project (Alternative 1 in this EIS), but taller and capable of temporarily storing more water. The FRMC facility would be able to store up to 130,000 acre-feet of storage, which is twice the 65,000 acre-feet of storage capacity of the proposed project.
- **Flood Retention Flow Augmentation (FRFA):** A flood retention facility similar to the FRMC facility, except a portion of the larger 130,000-acre-foot reservoir would be permanent. Water would be released during the summer to increase water levels during low flows and provide colder water to the river.

The FRMC and FRFA facilities would have larger reservoirs than those associated with Alternatives 1 and 2, and would therefore result in greater impacts to the aquatic environment. The aquatic environment includes wetlands and other waters that may be protected under Section 404 of the CWA. The impacts associated with the FRFA facility would also be permanent, including permanent impacts to fish rearing habitat and spawning grounds. The CWA Section 404(b)(1) Guidelines (40 CFR 230) prohibit the Corps from authorizing a discharge into wetlands and other special aquatic sites if there is a practicable alternative that would have less adverse impacts to the aquatic ecosystem. The FRMC and FRFA facilities combined with the Airport Levee Improvements would have greater impacts than the proposed project. Therefore, these alternatives were eliminated from further consideration.

3.3 No Action Alternative

NEPA and its implementing regulations require an EIS to include a No Action Alternative (40 CFR 1502.14). A No Action Alternative describes the consequences of not implementing an action alternative and includes changes that would occur without the proposed project. This allows decision makers and the public to compare the effects of approving the proposed project with the effects that would occur if the project were not approved.

A No Action Alternative is not a baseline for evaluating the environmental effects of the proposed project or action alternatives. The baseline condition against which the proposed project is compared is defined as the existing conditions at the time the Notice of Intent was published in the Federal Register. The notice of intent for the proposed project was published on September 28, 2018.

The No Action Alternative includes projects in the upper Chehalis Basin that are funded and permitted or are in the process of being constructed as of January 2019. It also includes other actions reasonably likely to occur during the NEPA EIS analysis period (2025 to 2080). These projects are listed in Appendix D, Selection and Description of Alternatives. The upper Chehalis Basin was chosen because it represents the area that contributes flow to the Centralia-Chehalis area.

Projects included as part of the No Action Alternative include those led by the Flood Authority, local floodproofing efforts, and Washington State Department of Transportation (WSDOT) programs. Additional actions evaluated as part of the No Action Alternative include continued forecasted growth and expected changes in land use in the Chehalis Basin, managed timber harvests, including in the proposed temporary reservoir area, and planned restoration projects in the upper part of the upper Chehalis Basin.

3.4 Alternative 1: (Proposed Project) Flood Retention Expandable (FRE) and Airport Levee Improvements

Alternative 1 is the Applicant's proposed project. This includes the FRE facility and Airport Levee Improvements (Figures 1.1-1, 1.2-1, and 1.2-2). The following summarizes the proposed project, including construction and operations. A detailed description is provided in Appendix D, Selection and Description of Alternatives.

3.4.1 Flood Retention Expandable Facility

This section describes the major components, construction, and operation of the proposed FRE facility.

3.4.1.1 FRE Facility Components

The FRE facility consists of the following main components:

- FRE structure and related utilities and facilities, including those related to fish passage
- Temporary reservoir
- Access roads

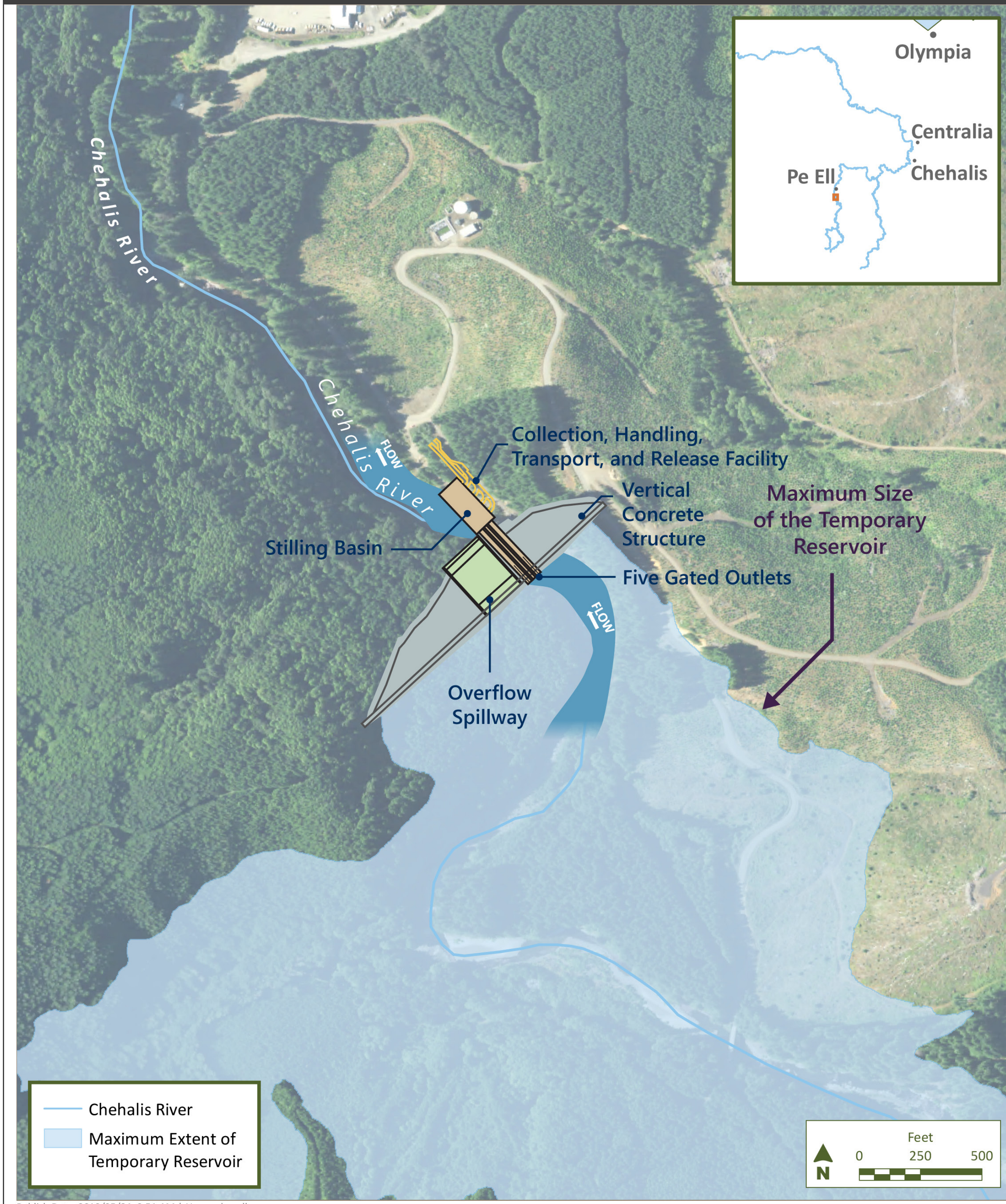
3.4.1.1.1 FRE Facility

The major elements of the FRE facility are shown in Figure 3.4-1. This includes the vertical concrete structure that would hold back floodwater. The structure would be 1,550 feet wide and approximately 270 feet high. The FRE structure would be 3 to 5 feet above the maximum height of the temporary reservoir for safety. There would also be an overflow spillway that would let water spill out if the temporary reservoir fills beyond its capacity. There would be five gated outlets in the FRE facility that would allow the river to flow through under normal conditions. During a major or greater flood when the FRE facility was operating and the temporary reservoir was holding flood water, the gates would still be kept partially open. This would allow some water to flow through during flood conditions. These gated outlets would be about 310 feet long. When the gates were open, river water would flow through to a stilling basin that would slow down the flow to reduce downstream erosion.

Fish passage through the FRE facility would depend on whether the gates were opened or partially closed. Under normal conditions, when the gates are open, fish would be able to move upstream and downstream through the five gated outlets. When the gates partially close, upstream fish passage would be provided by a Collection, Handling, Transport, and Release (CHTR) facility. The CHTR facility would be located on the east side of the river immediately downstream of the FRE facility. The CHTR would be designed to collect fish moving upstream, for transport upstream of the FRE facility. Operation of the CHTR during floods is described in Section 3.4.1.3.2.

A new power line would be installed to operate the FRE facility’s pumps, gates, instruments, and other controls. New power lines would also be installed for the CHTR facility. The new power lines would connect to existing local transmission lines and would be located along existing road alignments and areas cleared for FRE facility construction. Construction power requirements may also be provided by the new power lines.

Figure 3.4-1
FRE Facility Plan View



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3.4.1.1.2 Temporary Reservoir

When the FRE facility gates partially close, water would back up in a temporary reservoir behind the FRE facility. The FRE facility would be designed to store up to 65,000 acre-feet of water in the temporary reservoir. When full, the temporary reservoir pool would cover up to approximately 856 acres. The maximum extent of the temporary reservoir is shown in Figure 1.2-1.

3.4.1.1.3 Access Roads

When the FRE facility is operating and the temporary reservoir is holding water, up to 6 miles of the existing Forest Road (FR) 1000 would be flooded upstream of the FRE facility. This is a main access road currently used for forestry operations. When flooded, a bypass route would be used to access the temporary reservoir area and to manage forestlands outside of the temporary reservoir. The bypass route would consist of existing roads that would be improved by adding gravel and compacting it. Specific locations of the bypass route would be defined during the detailed design phase.

3.4.1.2 Construction

This section describes the major processes required for FRE facility construction, including how fish passage would be provided. The section also describes the pre-construction vegetation management plan proposed by the Applicant to prepare the temporary reservoir for operations. If the Applicant receives all necessary approvals for the proposed project, construction of the FRE facility is expected to begin in 2025. Although the Applicant has proposed a 4.5-year construction period, the analysis assumed construction could last up to 5 years through 2030.

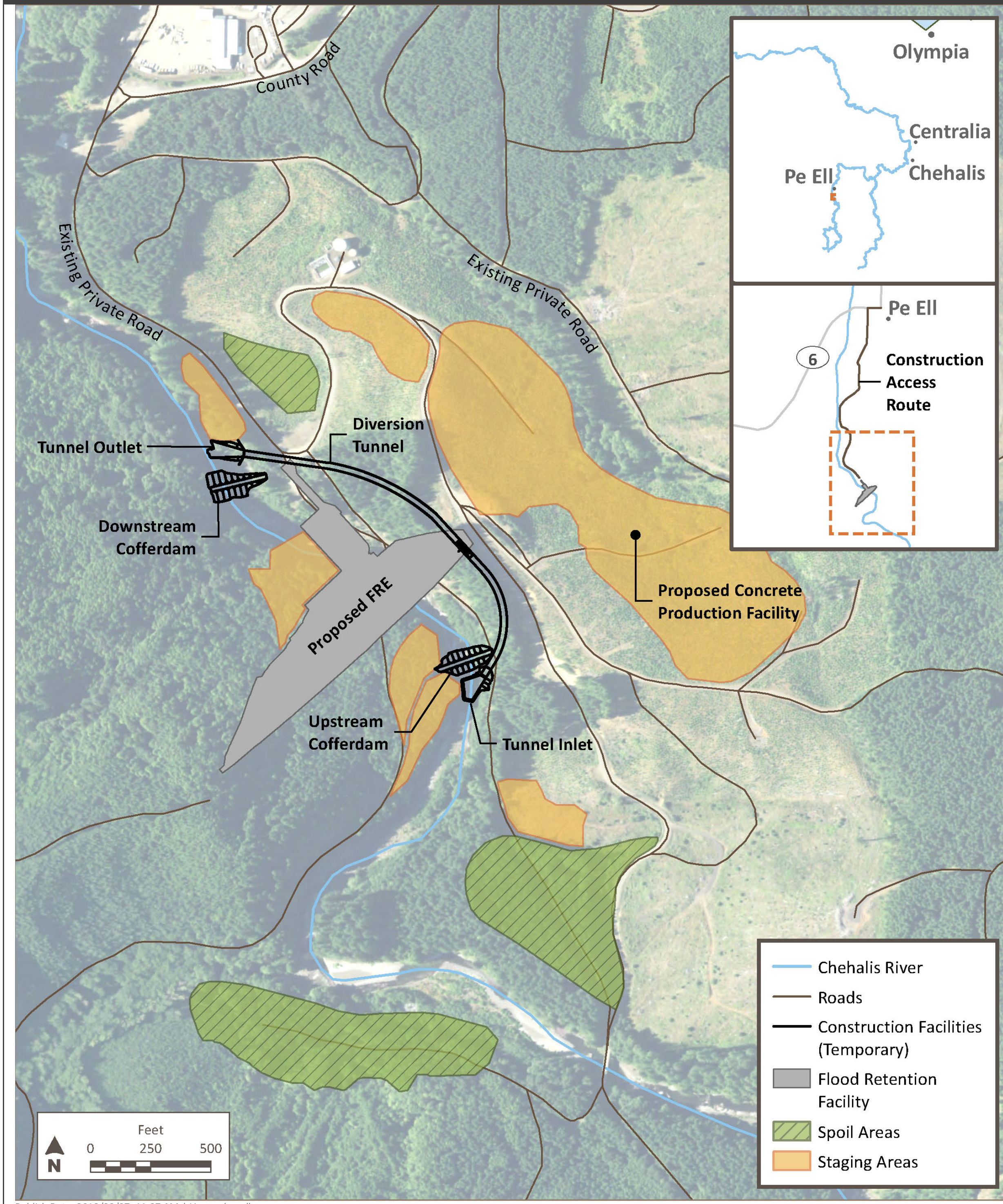
3.4.1.2.1 FRE Facility Construction

The construction site plan is shown in Figure 3.4-2. Construction would require removing vegetation from around the construction site and within the footprint of the temporary reservoir. The site would also be prepared by grading and stockpiling materials and equipment. Staging areas would be used for material storage, laydown areas, concrete production facilities, and vehicle and equipment parking. Spoil stockpile areas would be designated to store soil and rock excavated for the FRE facility foundation.

Construction of the FRE facility would require concrete aggregate. This includes materials such as sand, gravel, or crushed stone mixed with concrete to add strength. This could be mined at the site or at one of the nearby proposed quarries: North Quarry, South Quarry, or Huckleberry Ridge. Controlled excavation of rock using explosives, called blasting, would be used to break up rock. Blasting would occur up to four times per week for up to 3 years. The quarry locations are shown in Appendix D.

Quarry development would include roadwork, material storage, processing sites, and offices. Roadwork would be needed to support large earth moving equipment. Improvements may include removing the existing base materials, placing new base materials, and resurfacing the roads. The roads may also need to be widened to at least 24 feet. Work on existing culverts may also be needed.

Figure 3.4-2
Proposed FRE Facility Construction Site Plan



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A concrete production facility would also be located near the FRE facility. The production facility would be used to store and produce the materials needed to construct the FRE facility. This would provide a place to crush and screen aggregate, make concrete, and store materials such as aggregate, fly ash, and cement (Figure 3.4-2).

Construction of the FRE facility would require dewatering a section of the Chehalis River. To do this, the river would be diverted around the construction site through a 1,630-foot-long diversion tunnel about 20 feet in diameter (Figure 3.4-2). The analysis assumed that work in the flowing channel of the river would happen from July through September of each year. Once the work area is isolated from the river, work below the ordinary high water mark (OHWM) in the dry would occur year-round during the construction period. It was assumed that the river would be diverted through the diversion tunnel for up to 5 years.

Once the diversion tunnel was in place, the FRE facility structure would be built. Excavation in the riverbed would be required to get to an appropriate depth for the foundation. The diversion tunnel may remain in place once construction is complete.

Access to the construction site was assumed to be via Muller Road and FR 1000 (Figure 1.2-1). Trips to and from the construction site would include personnel, all permanent and consumable materials, and construction equipment.

3.4.1.2.2 Fish Passage During Construction

During and after construction, fish passage would be affected by the presence of the FRE facility. Table 3.4-1 summarizes how fish passage would be addressed for construction and operation. During construction, downstream fish passage would be provided by the diversion tunnel described above. Upstream fish passage would be provided by the temporary trap-and-transport facility. The fish trap would be designed to collect adult spring-run Chinook salmon (*Oncorhynchus tshawytscha*), fall-run Chinook salmon, coho salmon (*Oncorhynchus kisutch*), winter-run steelhead (*Oncorhynchus mykiss*), and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*). Resident fish and lamprey would also be collected incidental to the collection of the targeted adult salmonid species. Collected fish would be transported by truck and released back into the river at predetermined release sites upstream of the work area.

Table 3.4-1
Fish Passage Through the FRE Facility During Construction and Operation

TIME PERIOD	DOWNSTREAM FISH PASSAGE	UPSTREAM FISH PASSAGE
FRE Facility Construction	Diversion tunnel	Temporary trap-and-transport
FRE Facility Operation (normal conditions)	FRE facility gated outlets	FRE facility gated outlets
FRE Facility Operation (during major or greater flood)	None for up to 32 days (during a catastrophic flood)	CHTR facility

3.4.1.2.3 Pre-Construction Vegetation Management Plan

Prior to construction, the Applicant proposes to remove vegetation from 405 acres of the FRE facility site. It is also assumed that the Applicant would remove select trees and other vegetation within the temporary reservoir area before operations begin in 2030. Within the temporary reservoir footprint, it was assumed the Applicant would remove all trees from the areas that have a 5% chance of being flooded in a year (20-year flood). Trees in the area of the temporary reservoir that have a 1% chance of being flooded in a year (100-year flood) would be left in place. In total, it was assumed that approximately 485 acres of vegetation may need to be removed.

3.4.1.3 Operation

This section describes when and how the FRE facility would be operated to hold back floodwater. It also describes fish passage and vegetation management during FRE facility operation. Additional operational details provided by the Applicant are described in the Operations Plans (Anchor QEA 2017; CBS 2017; HDR 2018).

3.4.1.3.1 FRE Facility Operation

FRE facility operation would happen when a major or greater flood is predicted. During all other times, the river would be allowed to flow through the FRE facility structure. This section describes when and how the FRE facility would begin to hold back floodwater in the temporary reservoir. It also describes when the gates would reopen and how the temporary reservoir would drain to return to free-flowing conditions. Finally, it describes wood management during operation.

The FRE facility would begin to hold back floodwaters when flood forecasts predict a major or greater flood. The temporary reservoir would begin to fill approximately 48 hours before the predicted flow rate reached 38,800 cubic feet per second (cfs) at the Grand Mound gage (USGS 12027500). At that time, river flow through the FRE facility would be reduced to 300 cfs by partially closing the gates. This is a naturally occurring winter low flow rate on the Chehalis River. The outflow rate would be adjusted based on observed flows and revised predictions. The size of the temporary reservoir pool would depend on how much precipitation fell during a major or greater flood. The FRE facility would be operated to keep river outflow at a reduced rate until the peak flood passed the Grand Mound gage. The peak flood levels in this area typically last for 2 to 3 days.

After the flood risk passed, the drawdown process would begin. The gates would open more fully, and the temporary reservoir would begin to drain. The length of this drawdown process would depend on the amount of rain and flows into the mainstem from downstream tributaries. If the temporary reservoir was full to its maximum capacity, it is estimated that it would take up to 32 days for the temporary reservoir pool to completely empty. The Applicant proposes to slowly release water to a maximum outflow of 5,000 to 6,500 cfs. The flow through the gates would be managed to reduce the risk of erosion downstream and within the footprint of the temporary reservoir. Drawdown would continue until the temporary reservoir is emptied. At this point, the Chehalis River would return to a free-flowing state.

When the temporary reservoir is holding water, debris from surrounding tributaries and hillsides may enter it. Large woody material (LWM) could affect the FRE facility by blocking the gated outlets and preventing efficient drawdown. Upstream of the FRE facility, an anchored log boom would capture LWM floating on the surface of the temporary reservoir. At the FRE facility, steel bar racks would protect the gated outlets from LWM that could not pass through to downstream areas. LWM trapped by the racks would be removed, sorted, and either reused or disposed. During drawdown, boats would be used to move large debris to an existing log sorting yard upstream of the FRE facility. When all necessary debris had been removed, and temporary reservoir elevation reaches 500 feet, drawdown rates would increase. Wood that is suitable for habitat projects in the Chehalis Basin would be sorted and trucked out of the temporary reservoir area. The remainder of the debris would be hauled off site and disposed of at an approved facility.

3.4.1.3.2 Fish Passage During Operations

Fish would not be able to pass through the FRE facility while it operates. To address this issue, the Applicant proposes to provide upstream fish passage through the CHTR facility. No downstream passage would be provided. This means downstream passage could be blocked for up to 32 days in the event of a catastrophic flood. Fish passage during operations is summarized in Table 3.4-1.

Operation of the CHTR facility would begin immediately prior to the closure of the gates. The Applicant proposed to design the CHTR facility for upstream fish passage. Fish would be collected in the CHTR facility and released into the river at pre-selected release sites determined by fisheries biologists. The CHTR would continue to operate until the last remaining water in the temporary reservoir is released. Fish passage is discussed in greater detail in Section 4.5.

3.4.1.3.3 Vegetation Management During Operations

Vegetation management would be required in the footprint of the temporary reservoir to ensure that the FRE facility could be safely operated. Routine maintenance would involve periodic removal of larger trees below elevation 584 feet, which corresponds to the average pool elevation during a 20-year flood. This would happen about every 7 to 10 years to keep larger trees from growing in areas that would be flooded when the temporary reservoir is full.

The Applicant proposes to develop a vegetation management plan that focuses on maximizing the amount of beneficial shading for aquatic resources, reducing potential LWM accumulation at the FRE facility, and vegetating areas to minimize erosion. In addition, the Applicant would focus on maintenance of flood-tolerant vegetation.

3.4.2 Airport Levee Improvements

This section describes the major components, construction, and operation of the Airport Levee Improvements.

3.4.2.1 Components of the Airport Levee Improvements

The Applicant proposes the following improvements at the Chehalis-Centralia Airport (Figure 1.2-2):

- Modifying the airport levee by adding 4 to 7 feet to the height of the existing 9,511-foot-long levee with earthen materials or floodwalls
- Raising 810 feet of NW Louisiana Avenue along the southern extent of the airport to a height equal to the raised levee height to protect against flooding
- Replacing utility infrastructure

At this stage in the design, it is uncertain whether it would be necessary to widen parts of the existing levee base. This analysis assumed that widening would be needed.

3.4.2.2 Construction

The Applicant proposed to construct the Airport Levee Improvements over 10 to 12 months. Construction would likely take place in the following general sequence:

- Mobilization, 1 month
- Erosion control, clearing, and grubbing, 1 month
- Removal of structures or obstructions, 1 month
- Material placement and compaction, 6 to 8 months
- Trimming, cleanup, and sod placement, 1 month

Earthwork would include removing existing retaining walls, removing the gravel surface currently on top of the levee, and excavating to place hydraulic structures such as culverts. Only existing sources would be evaluated for acceptable fill material, which would be brought in from off site. Work trucks would use NW Airport Road to haul materials to and from the site, and the top of the levee would be used for site access.

3.4.2.3 Operation

Regular maintenance of the levee would include mowing and vegetation management. Annual inspections would evaluate the overall levee condition, identify deficiencies, and recommend maintenance actions.

3.5 Alternative 2: Flood Retention Only (FRO) and Airport Levee Improvements

The FRO facility and Airport Levee Improvement locations under Alternative 2 would be the same as under Alternative 1.

3.5.1 Components

The Alternative 2 flood retention facility would be the same as Alternative 1, except the facility would be built on a smaller foundation. The foundation would be about 20 feet smaller in width on the downstream (north) side. Unlike the FRE facility, the foundation would not be designed to allow for future expansion of flood storage capacity. The Airport Levee Improvements would be the same as described in Alternative 1 (Section 3.4.2.1).

3.5.2 Construction

Construction of the FRO facility would involve the same construction methods, in-water work activities, and fish passage elements as the FRE facility described for Alternative 1. However, the duration of construction and the amount of materials required would be less. It was assumed that construction of the FRO facility would be about 9 months shorter than the FRE facility. Construction of the Airport Levee Improvements would be the same as described in Alternative 1 (Section 3.4.2.2).

3.5.3 Operation

Alternative 2 operations would be the same as Alternative 1, as described in Sections 3.4.1.3 and 3.4.2.3.

3.6 Analysis Methods

This section describes the approach to the impact analysis. This includes a discussion of the study area and the methods for how impacts were evaluated and described.

3.6.1 Study Area

The study area for this EIS includes the areas that would be affected by construction and operation of the action alternatives:

- The Chehalis River 100-year floodplain area (Figure 3.6-1)
- The flood retention facility project area (Figure 3.6-2)
- The Airport Levee Improvements project area (Figure 3.6-3)

The study area is the same for most environmental resources addressed in Chapters 4 and 5. However, some natural resources would not be affected by Airport Levee Improvements. Therefore, that project area is not part of the study area for those environmental resources. For some built resources, the study area was expanded to account for impacts that would be farther reaching. Any differences in study area are noted in the individual sections of Chapters 4 and 5.

Figure 3.6-1
Study Area: Chehalis River 100-Year Floodplain Area

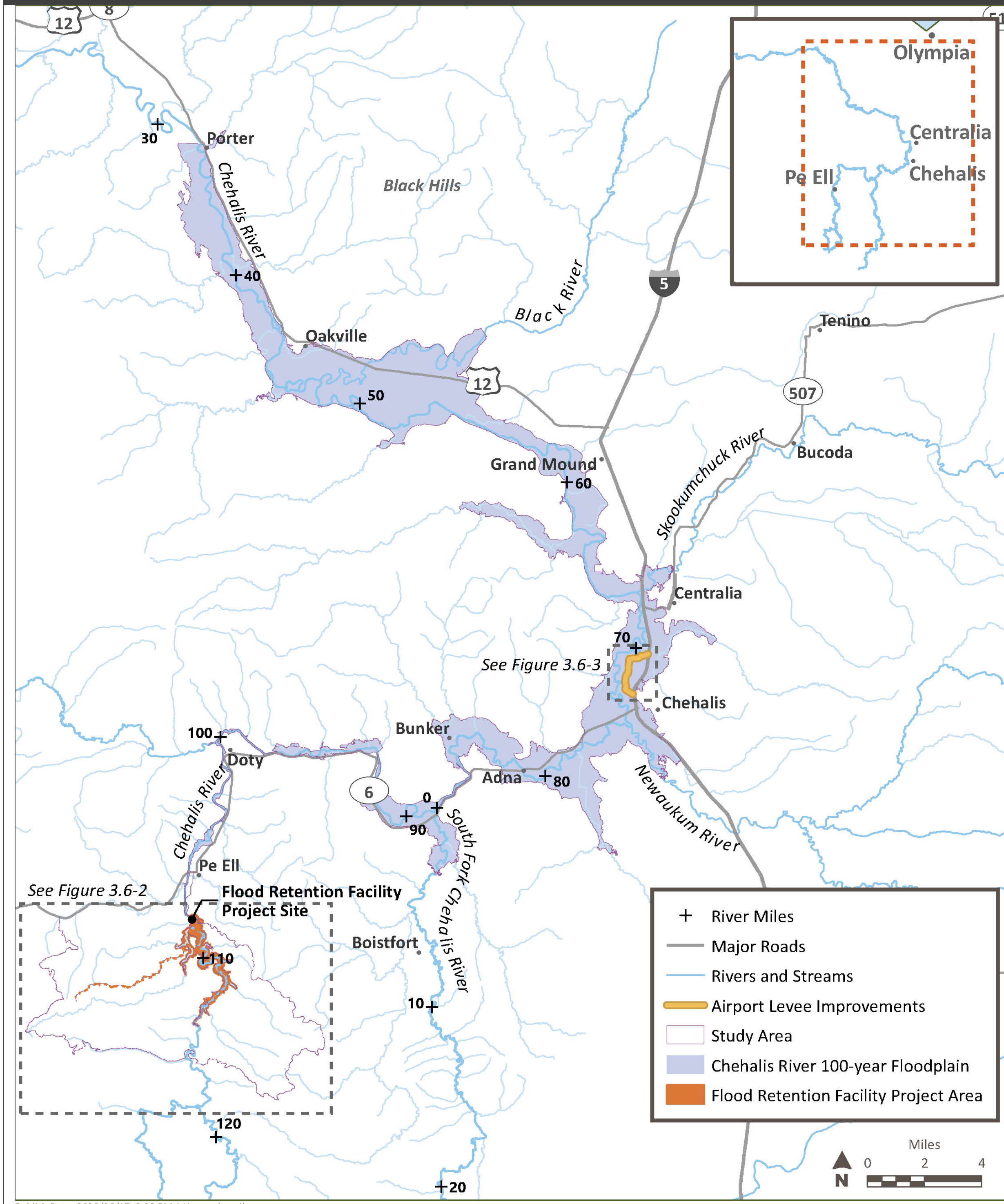

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Figure 3.6-2
Study Area: Flood Retention Facility Project Area

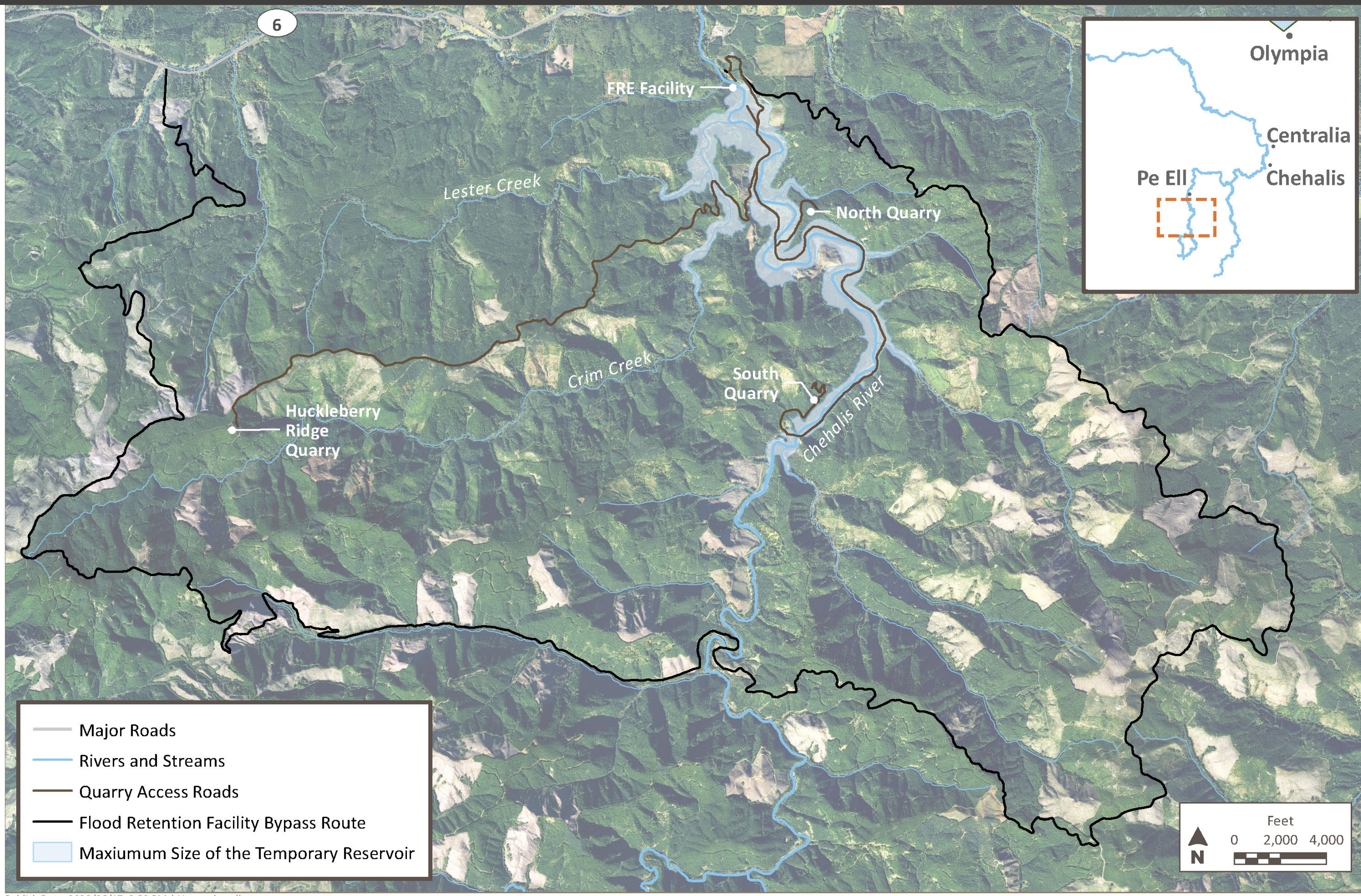

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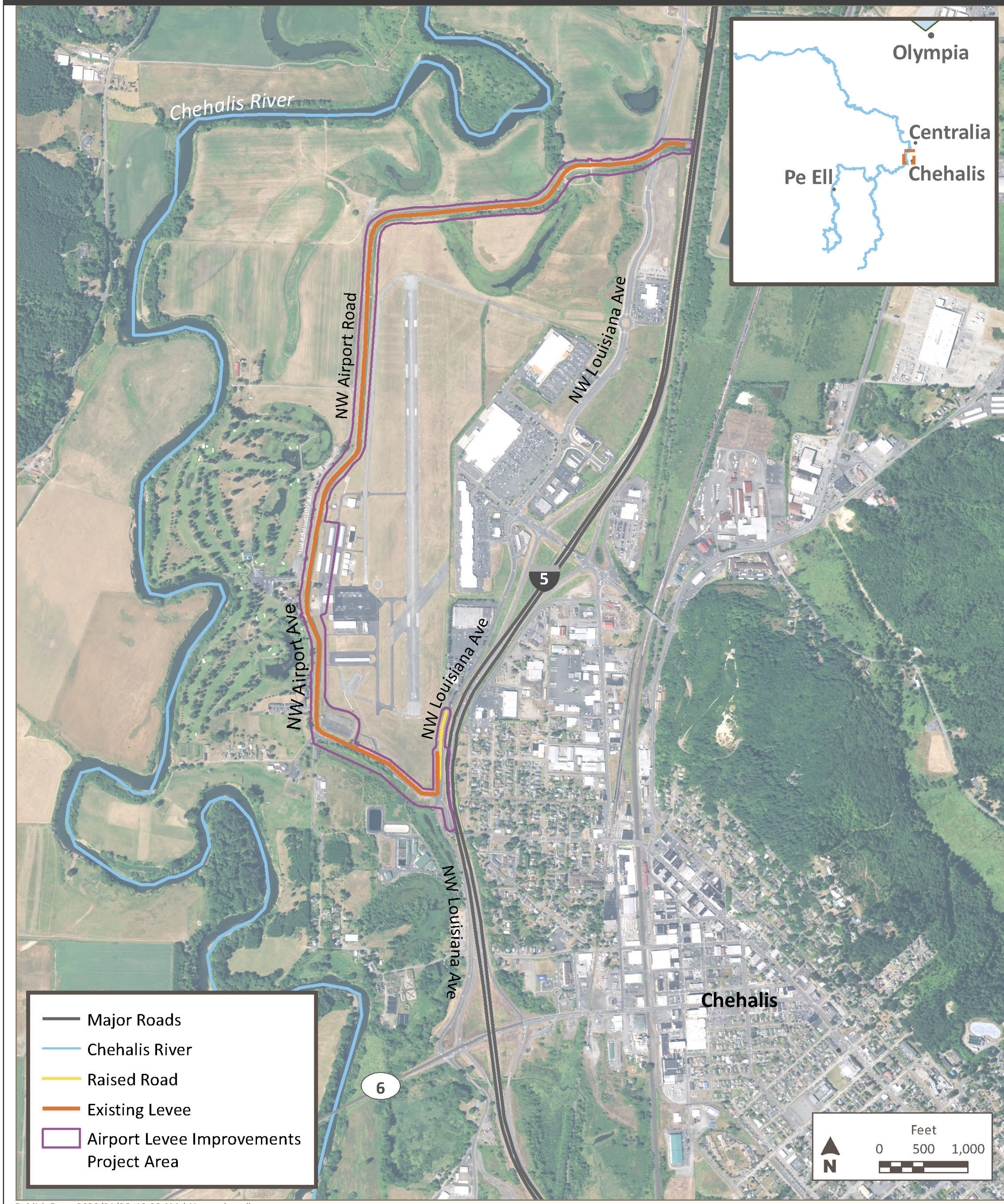
Figure 3.6-3
Study Area: Airport Levee Improvements Project Area



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3.6.2 Impact Analysis

This section describes the approach to direct and indirect impacts, the impact levels, and flooding considerations. Impacts were analyzed for construction and operations. The construction period was assumed to last from 2025 to 2030. Operations were assumed to begin in 2030. The related impacts were assessed for changes that would be expected over a 50-year period, from 2030 to 2080.

3.6.2.1 Direct and Indirect Impacts

This EIS identified the potential direct, indirect, and cumulative impacts of the alternatives that would be different from existing conditions. Existing conditions include those present at the time the Notice of Intent was issued in September 2018. For some resource areas, the EIS also includes a comparison of Alternatives 1 and 2 to the No Action Alternative. This was done to provide additional information about whether the proposed project impacts may be different later in the analysis period. The approach to cumulative impacts is discussed in Chapter 6. Impacts can be adverse or beneficial.

Direct impacts are those that would occur as the result of, and at the same time and place as the activities authorized by a DA permit (40 CFR 1508.8). These impacts may be temporary or permanent in duration, and would only occur as a result of construction activities. Direct impacts would only occur within the flood retention facility and Airport Levee Improvements project areas.

Indirect impacts would occur later in time or farther in distance from the immediate project location but would be attributable to project actions authorized by the DA permit. These impacts could be temporary or permanent, and include secondary effects from construction, such as increases in traffic to and from construction sites. Indirect impacts also include those that would occur as the result of operating the alternatives, such as changes in downstream flooding, including effects in the Chehalis River 100-year floodplain area.

3.6.2.2 Impact Levels

In the EIS, impacts are described as low, medium, or high. Impacts are changes to the existing environment that would be expected as a result of the proposed project and alternatives. The determination is based on best professional judgment to provide a relative comparison for how impactful a change would be. Low impacts may or may not be readily noticeable, while medium impacts would be. High impacts would be substantial and would result in changes that are highly problematic for the affected environmental resource. Specific thresholds used for each environmental resource are presented in Appendix E.

3.6.2.3 Mitigation

Mitigation is an important aspect of the NEPA and DA permitting review process. Mitigation includes measures to avoid, minimize, rectify, reduce, or compensate for lost resources and functions. The Applicant is proposing to implement the measures described in Chapter 7. The Applicant would also be required to implement additional measures that will be identified through the remainder of the NEPA and the DA permitting process, including a compensatory mitigation plan. To advance this process, the Applicant has proposed a conceptual framework, which is also discussed in Chapter 7.

3.6.2.4 Flood Scenarios

The potential for impacts that are influenced by the frequency, duration, and magnitude of flooding are addressed under operations for the project alternatives. This includes the long-term changes expected over the 50-year analysis period. It also includes the episodic impacts that would be expected when the flood retention facility is operating.

Because it is not possible to predict the timing or extent of future flooding, the analysis of operational impacts generally considers two flood scenarios: major and catastrophic. Table 3.6-1 defines these two floods by peak river flows as measured at the Grand Mound gage. This gage is used because it has a long history of measuring peak flows and is a good indicator of when larger floods affecting the Chehalis-Centralia area have occurred. The peak flow measurements for the 1996, 2007, and 2009 floods are shown for reference.

Table 3.6-1
Definition of Chehalis River Floods

FLOOD	FLOOD OCCURRENCE INTERVAL	PEAK FLOW MEASUREMENT
Major	7-year	38,800 cubic feet per second at Grand Mound
Catastrophic	100-year	75,000 cubic feet per second at Grand Mound
1996	Close to 100-year	73,300 cubic feet per second at Grand Mound
2007	Greater than 100-year	79,500 cubic feet per second at Grand Mound
2009	Greater than 7-year	58,700 cubic feet per second at Grand Mound

The definitions of major and catastrophic floods are based on the flow data that corresponds to flood occurrence intervals under current conditions. A flood occurrence interval describes how likely a certain size flood would be. A major flood has a 15% chance of happening in any year. A catastrophic flood has a 1% chance of occurring in a year.

For the purposes of the impact analysis, the EIS generally assume that the flood retention facility would operate on average once every 7 years, which is the average predicted frequency of a major flood. However, where there were differences in predicted impacts between the scenarios, the analysis was based on the most impactful scenario. For example, the analysis of impacts to aquatic species and habitat discusses the impacts from a back-to-back flood. This is a scenario where a major flood one year would be followed by a catastrophic flood the next year.

3.6.2.5 Modeling

The EIS relied on modeling to analyze the potential for certain impacts. Modeling uses computer programs to predict changes. Models are used when the impacts can be quantified or measured numerically. For this EIS, model results predicted what could happen with and without the project alternatives. In general, there is uncertainty in modeling. Therefore, modeling in this EIS provides information that is most useful in comparing the impacts of the alternatives. It is not used to predict the specific changes that would happen as the result of the alternatives. For example, it is not possible to predict when or how much rain may fall in the study area.

Modeling efforts focused on water resources, geomorphology, fish, air quality, noise, and socioeconomics. Modeling natural processes included looking at water quantity and quality, the river's physical characteristics such as channel location and riverbed material, and fish habitat. The outcomes were based on assumptions about how natural processes work, like for example how rain affects river flows. Modeling also looked at how construction and operation would result in air emissions and noise, and how the proposed project would affect income and employment in the study area. More information about the specific methods and results can be found in Sections 4.1, 4.3, 4.5, 5.1, 5.3, and 5.10 and Appendices G, I, K, M, O, and P, respectively.

The modeling relied on hydrology data from the past 30 years as the best available information. Future climate conditions were not modeled in this EIS. However, it is generally accepted that precipitation patterns and air temperatures in the Chehalis Basin will differ in the future compared to the data used in modeling. If there is more precipitation in the future, it is possible that the proposed flood retention facility would operate more frequently. Impacts associated with single floods would be more frequent. Depending on how environmental resources were affected by climate variability over time, it is possible that the operational impacts of the flood retention facility would also differ.

4 NATURAL RESOURCES: AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

This chapter describes the affected environment and potential impacts for natural resources. This includes water quantity and quality, geology and geologic hazards, geomorphology, wetlands and other waters, aquatic species and habitats, and terrestrial species and habitats. The overall approach to the analysis is discussed in Chapter 3. Mitigation is discussed in Chapter 7.

4.1 Water Quantity and Quality

4.1.1 Introduction

This section describes water quantity and quality in the study area. Water quantity refers to the amount of water in the environment and how it moves or flows across the landscape. Water quality is a measure of how suitable water is for different beneficial uses. Examples of beneficial uses include drinking, swimming, or supporting aquatic plants and animals. Water quality is based on physical, chemical, and biological characteristics (USGS 2019a).

This section also describes potential impacts of the alternatives on water quantity and quality. Additional information can be found in the discipline report for water quantity and quality (Appendix G). Information on wetlands and potentially regulated surface waters and aquatic species and habitat are addressed in Section 4.4 and Section 4.5, respectively.

Key Findings

Construction

- Low direct impact from reduced river flows
- Low to medium direct impact from loss of floodplain and related functions
- Low to high impact to water quality
- Low direct impact to groundwater
- Low temporary direct impacts to water use and rights

Operation

- Medium indirect impact from reduced peak flows on the mainstem during major or greater floods with a low impact to downstream tributaries
- Low indirect impact to river flows when the FRE facility is not operating
- Low indirect impact from reduced floodplain function
- Low to high impact to water quality
- Low impact from reduced downstream groundwater recharge
- No impact to water use and rights
- Medium impact to the City of Pe Ell's water supply system

4.1.2 Affected Environment

This section describes water resources in the study area. This includes surface water hydrology and floodplains, surface water quality, groundwater, and water use and water rights. The study area is defined in Section 3.6.

4.1.2.1 Surface Water Hydrology and Floodplains

Surface water hydrology is part of the natural water cycle, which is the continuous movement of water on, above, and below the Earth's surface (USGS 2019b). Surface waters include rivers, streams, lakes and ponds. Surface hydrology includes processes like precipitation, streamflow, and flooding. Floodplains are the lands adjacent to rivers and streams that receive water from those waterbodies during flooding. The following sections discuss surface water hydrology and floodplains.

> **Key Terms**
>
> - **Channel:** Main course that a river flows through, defined by riverbanks
> - **Floodplain:** The river channel and the area outside it where water reaches during a flood
> - **100-year floodplain:** Area covered by a 100-year flood
> - **Streamflow:** Amount of water moving through the river at one time, typically measured in cubic feet per second
> - **Peak flow:** Largest flow that occurs during a flood
> - **Reach or sub-reach:** Section of a river that has a distinct set of characteristics compared to other sections

4.1.2.1.1 Surface Waters

Flood Retention Facility Project Area

Surface waters in the flood retention facility project area include the mainstem Chehalis River and several of its tributaries (Figure 3.6-2). Smaller tributaries in the temporary reservoir footprint include Crim Creek, Lester Creek, Hull Creek, Browns Creek, Big Creek, Roger Creek, and Smith Creek. Multiple smaller unnamed streams and drainages also flow into the Chehalis River and its tributaries inside the temporary reservoir footprint. Mahaffey Creek drains into the river just downstream of the location proposed for the flood retention facility structure.

Airport Levee Improvements Project Area

The Chehalis River does not flow through the Airport Levee Improvements Area. The river is about 800 feet to the west and 630 feet to the north (Figure 3.6-3). There are no Chehalis River tributaries in the Airport Levee Improvements Area. However, several sections of old river channel with standing water, including one oxbow lake, are present.

Chehalis River 100-Year Floodplain

The Chehalis River 100-year floodplain portion of the study area includes the mainstem Chehalis River and its floodplain from the upstream end of the footprint of the temporary reservoir at RM 114 to Porter at approximately RM 33 (Figure 3.6-1). It also includes areas where major tributaries enter the mainstem Chehalis River, called confluences. The 100-year floodplain study area includes the Chehalis River confluences with the South Fork Chehalis River, Newaukum River, Skookumchuck River, and Black River.

4.1.2.1.2 Precipitation

Most surface water in the study area comes from precipitation. In the upper Chehalis River Basin, rainfall is the main type of precipitation. There are some snow-dominated regions in higher-elevation headwater areas of the Cascade Foothills (Newaukum and Skookumchuck River sub-basins) and a small area of the southern Willapa Hills (Stillman Creek Drainage).

Within the upper Chehalis River Basin, annual precipitation ranges from an average of 47 inches in the valley surrounding Centralia to an average of more than 120 inches in the Willapa Hills (WRCC 2010; WSE 2014a). Heavy precipitation typically occurs between November and February. During the summer dry season, monthly average precipitation measured at the Centralia weather station decreases to less than 1 inch (WRCC 2010).

Significant rain events are the main contributor to major or greater flooding in the upper Chehalis River Basin. This is because moisture from the tropics falls as rain in western Washington. When these types of events, called atmospheric rivers, occur in the upper Chehalis Basin, the greatest potential for high rainfall is centered on the Willapa Hills or the Cascade Range foothills (CRBFA 2010).

4.1.2.1.3 Streamflow

Streamflow comes from different sources. This include water from headwater streams and tributaries, precipitation, land surface runoff, outflow from ponds and lakes, and groundwater discharge.

Three Chehalis River mainstem gages are commonly used to define and characterize the flow of the upper basin. Flow is the volume of water moving down a stream or river per unit of time, most often expressed as cfs. The gages have a long, continuous record of data collection (over 60 years of continuous daily streamflow and river stage measurements). They are distributed across the upper, middle, and lower portions of the basin. This means they provide useful information for analysis in the study area:

- Doty (USGS Gage 12020000)
- Grand Mound (USGS Gage 12027500)
- Porter (USGS Gage 12031000)

Average monthly flows for the Chehalis River at these gages are shown in Table 4.1-1. Doty is the closest downstream gage to the proposed flood retention facility project area. Grand Mound is the closest downstream gage to the Chehalis/Centralia area and the Airport Levee Improvements project area. The Porter gage is the furthest downstream gage and is at the end of the study area. Flow in the Chehalis River is generally lowest during the summer dry season (July to September) and highest in the fall and winter (November to March).

Table 4.1-1

Average Monthly Flow (cfs) at U.S. Geological Survey Gage Locations

GAGE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Doty	1,230	1,110	920	585	275	145	68	45	77	285	956	1,260
Grand Mound	6,380	5,690	4,650	3,060	1,440	835	384	243	348	962	3,950	6,270
Porter	9,320	8,120	6,800	4,620	2,240	1,250	619	414	540	1,330	5,470	8,780

Notes:
Monthly data at Doty are available from 1939 to January 2019, at Grand Mound from 1928 to January 2019, and at Porter from 1952 to January 2019.
Sources: USGS 2019d, 2019e, 2019f

4.1.2.1.4 Flooding

Flooding happens when water levels get high enough that water leaves the channel and flows out into the surrounding floodplain, covering land that is normally dry. As flows in the channel increase above the flood stage, the area of floodplain affected by floodwaters increases. The highest flow observed during a flood is known as the peak flow.

Flooding in the Chehalis Basin is typically triggered by heavy rainfall but can also be caused by rain-on-snow events. Rain-on-snow events are most common in both snow-dominated headwaters and rain-snow transitional areas. These areas make up a relatively small part of the Chehalis Basin. Therefore, the risk of rain-on-snow events causing major flooding on a regular basis is considered to be relatively low (Perry et al. 2016).

Large floods have happened many times in the upper Chehalis River Basin over the past several decades. At Grand Mound, the five largest floods recorded over the past 90 years have all happened since 1986. Those floods were in November 1986, January 1990, February 1996, December 2007, and January 2009. Each exceeded flows of 50,000 cfs at Grand Mound (USGS 2019e; WSE 2014b; CRBFA 2010). Table 4.1-2 lists the estimated peak flows for the three most significant recent floods in comparison to major and catastrophic floods evaluated in this EIS.

Table 4.1-2

Peak Flows at U.S. Geological Survey Gage Locations During Key Floods

FLOOD	DOTY (CFS)	GRAND MOUND (CFS)	PORTER (CFS)
Major	18,760	38,800	51,680
Catastrophic	37,000	75,000	89,500
February 1996	28,900	74,800	80,700
December 2007	52,600[1]	79,100	86,500
January 2009	20,100	50,700	58,700

Note:
Sources: WSE 2014a; Corps 2003; USGS 2019d, 2019e, 2019f

Although each of the three most significant floods shown in Table 4.1-2 were the result of unique storm events and conditions, there are many similarities between them. Each of these floods affected the entire Chehalis River Basin. Each resulted in high flows on the mainstem Chehalis River and had contributions from most major tributaries in the basin. For all three floods, the highest flows came from the Willapa Hills and the proposed flood retention facility location. Based on the record of historical large floods, this was found to be true for most major or greater floods (WSE 2014b).

4.1.2.1.5 Floodplains

Floodplains provide a number of important functions, including flood storage, erosion control, water quality improvement, groundwater recharge, and habitat provision. Flood storage occurs when floodwater in the floodplain is held back from entering the channel. This can reduce the amount of water and flooding downstream. When floodwater slows down, particles in the water settle out, which can benefit water quality. Floodplains slow the flow of water where riverbanks are steep by causing water to backup and spread out in other areas where the floodplain is flatter. Spreading floodwater out over a larger area also increases the potential for groundwater recharge because ponded water can infiltrate into the soil and refill underlying aquifers. In addition to these functions, floodplains can also provide habitat for a variety of plant and animal species.

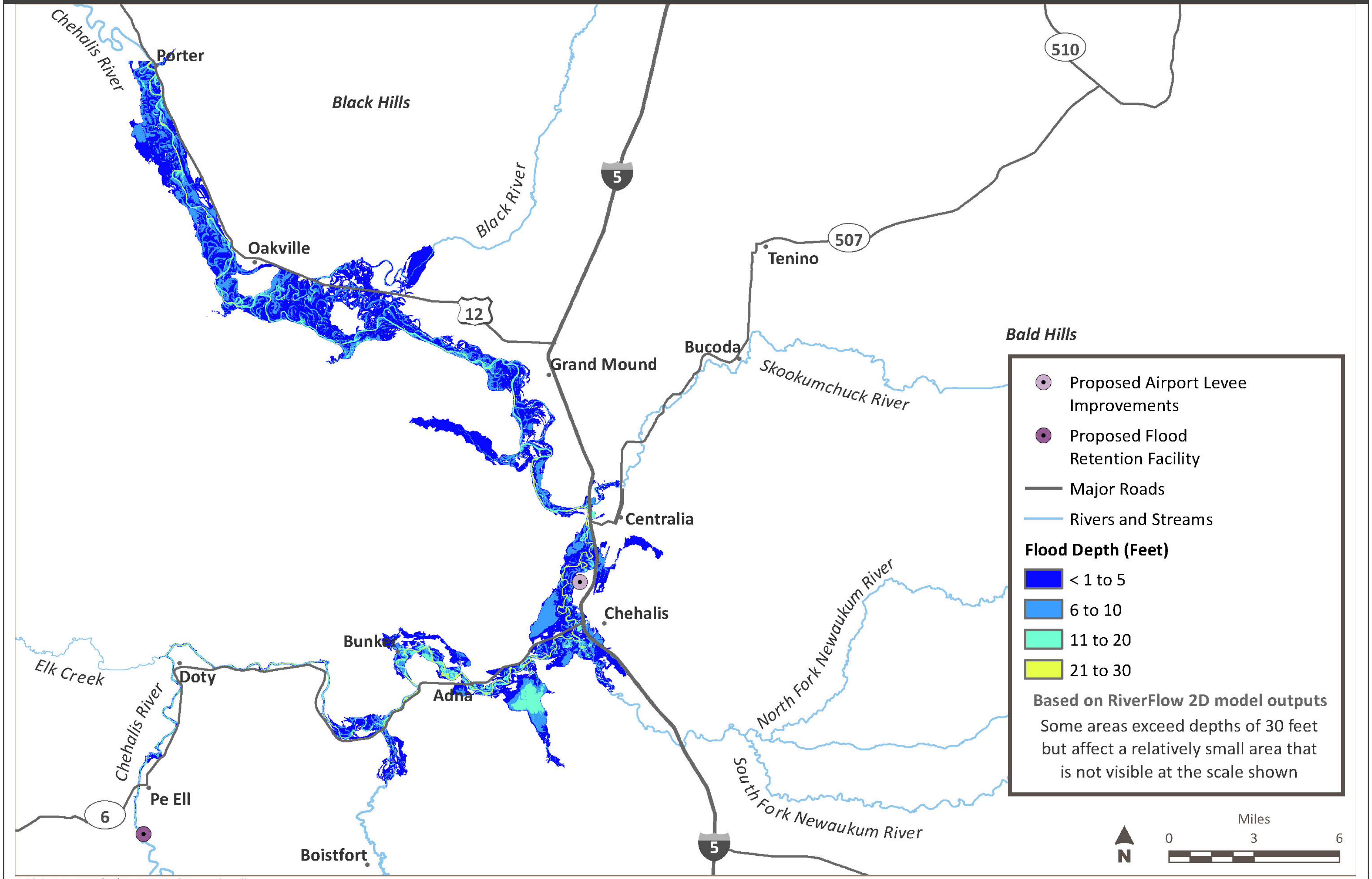
In the flood retention facility project area, the floodplain is generally narrow. Land use in the floodplain is primarily timber production. Because the area adjacent to the river is steep in many places, floodplain functions are more limited. However, steep valley banks can slow the flow of water because of friction with the bank and drag from vegetation, which can reduce downstream erosion. There may also be more habitat provided there than in other, more-developed portions of the Chehalis Basin.

Floodplains are much wider in the Chehalis River valley, which includes the Airport Levee Improvements project area and most of the Chehalis River 100-year floodplain area. As a result, there is more flood storage in the Chehalis River valley than in the upper parts of the study area (WSE 2014a). This part of the floodplain is dominated by agricultural uses, small towns, and rural residential properties. Near Chehalis and Centralia, large portions of the floodplain are developed with industrial, commercial, and residential land uses. Farther downstream, land uses include forest and agriculture.

Figure 4.1-1 shows the extent of a major flood under existing conditions. A major flood covers approximately 28,445 acres. Flood depths generally range from less than 1 to 5 feet, with smaller areas flooding up to approximately 20 feet. The areas that receive the deepest flooding generally occur between the town of Bunker and city of Centralia.

Figure 4.1-2 shows the extent of a catastrophic flood under existing conditions. The flooded area during a catastrophic flood is 8,641 acres larger than during a major flood and the areas flooded generally have greater depths. Between Bunker and Centralia, the majority of flood depths during a catastrophic flood range from less than 1 to 5 feet to 11 to 20 feet. In a few areas, flood depths exceed 21 feet, with a potential maximum depth of 30 feet.

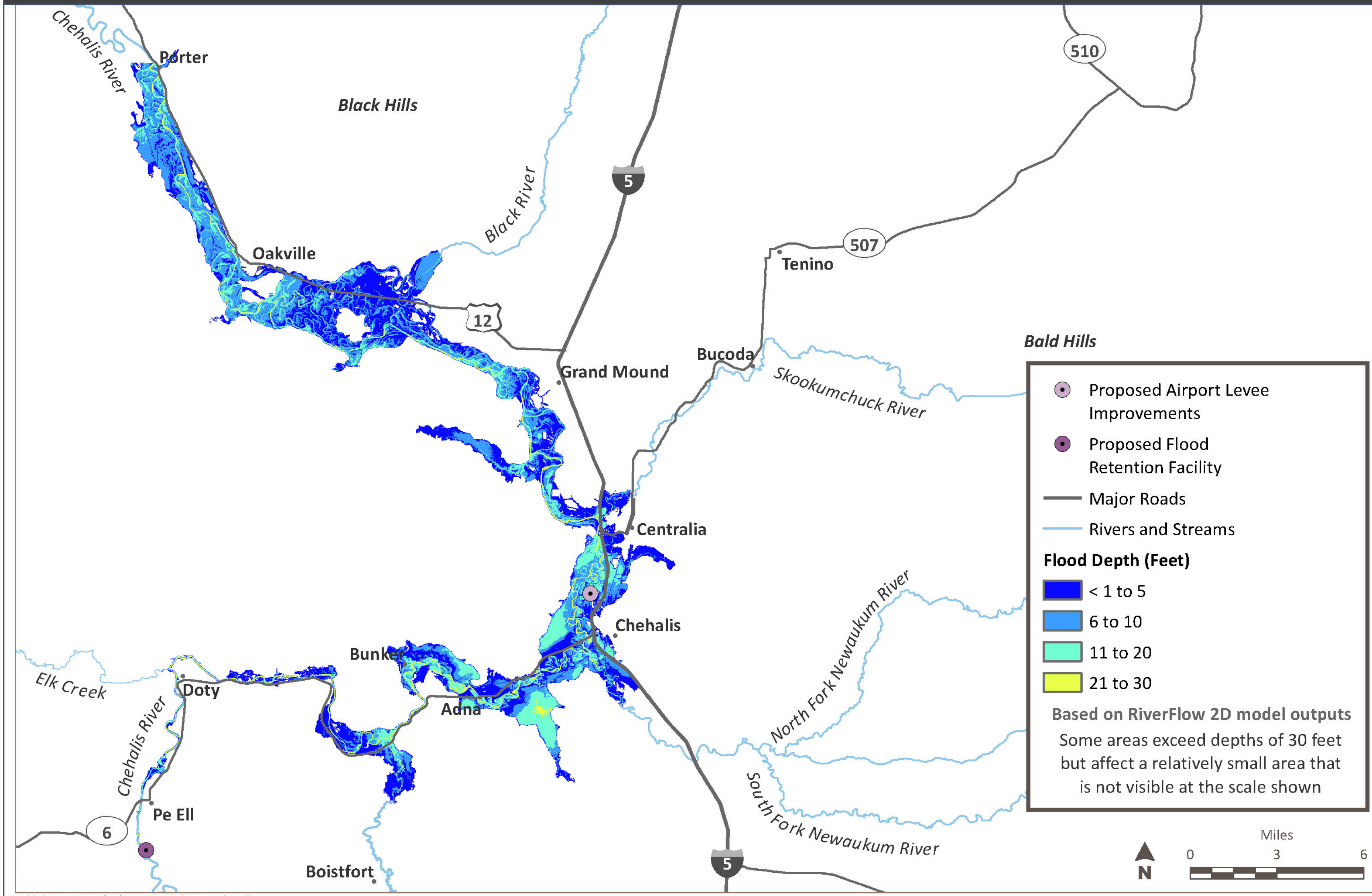
Figure 4.1-1
Major Flood Depths Under Existing Conditions



Publish Date: 2020/07/21, 6:24 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Water_Quality_and_Quantity\AQ_NEPA-EIS_WQQ_B_C_F_G.mxd

No Action, 10-year Flood

Figure 4.1-2
Catastrophic Flood Depths Under Existing Conditions



Publish Date: 2020/07/21, 6:25 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Water_Quality_and_Quantity\AQ_NEPA-EIS_WQQ_B_C_F_G.mxd

No Action, 100-year Flood

4.1.2.2 Surface Water Quality

This section describes existing surface water quality conditions with the greatest potential to be affected by the alternatives. These include temperature, turbidity, dissolved oxygen, nutrients, and chlorophyll *a*. Other water quality parameters, such as fecal coliform bacteria, pH, and toxics, were also analyzed. However, it was determined that these parameters are unlikely to be affected. Therefore, they are not discussed further in this section. Additional information on water quality, including the parameters not discussed, can be found in the discipline report for water quality and quantity (Appendix G).

4.1.2.2.1 Temperature

Appropriate water temperatures are important for maintaining aquatic life. Within the study area, the following three temperature criteria are assigned by Ecology for the protection of salmonids:

- Core Summer Salmonid Habitat (CSSH) of 16°C (60.8°F)
- Salmonid Spawning, Rearing, and Migration of 17.5°C (63.5°F)
- Supplemental Spawning and Incubation Criterion of 13°C (55.4°F)

Based on data collected by Ecology (Ecology 2001, 2019b) and other state-funded studies (e.g., Anchor QEA 2012, 2014), summertime Chehalis River temperatures frequently exceed water quality criteria for core summer salmonid habitat and spawning, rearing, and migration. During the fall-to-spring period (April to October), the supplemental spawning and incubation water quality criterion for temperature is also often exceeded. Supplemental spawning and incubation criteria temperature exceedances do not typically happen in winter months (November to March).

In 2001, Ecology developed and approved a plan to address the high temperature problem in summer and potentially spring and fall (Ecology 2001). Currently, 16 segments of the mainstem Chehalis River in the study area are identified in Ecology's Water Quality Assessment as impaired because of high temperature (Ecology 2019b). Those river segments are all located downstream of the proposed flood retention facility, near Pe Ell, the confluences with Elk Creek, Newaukum River, and Lincoln Creek, and Porter. Five of those river segments are near the Chehalis-Centralia Airport.

4.1.2.2.2 Turbidity

Turbidity refers to the relative clarity of a water sample. Water can become turbid because particles, such as fine sediments like clay and silt, algae, and other fine organic matter, become suspended in the water column. Turbidity depends most often on the amount of suspended sediment in the water. The higher the amount of sediment, the less clear the water sample, resulting in a high turbidity measurement. Higher levels of turbidity restrict the ability of light to penetrate into the water column, which can negatively affect aquatic plants and animals.

Turbidity in the Chehalis River is mainly influenced by instream flow and surface runoff events, but is also affected by land use. Elevated turbidity is a concern within the study area (Green 2009;

Ecology 2010a). One portion of the Chehalis River downstream of the confluence with Lincoln Creek is identified as having potential turbidity problems (Ecology 2019b). Another segment of the Chehalis River upstream of the confluence with Newaukum River also has excessive turbidity (Ecology 2019b).

4.1.2.2.3 Dissolved Oxygen

Dissolved oxygen is the amount of oxygen available to aquatic organisms. Low levels can harm aquatic life. Levels are lower when there are high levels of aquatic species present or high concentrations of organic material. Dissolved oxygen concentrations become lower as water temperatures increase.

Historically, low dissolved oxygen levels in the study area were likely from elevated summer temperatures and high nutrient and organic material levels from municipal and industrial wastewater discharges (Pickett 1992). Dissolved oxygen concentrations in the study area frequently drop below the applicable water quality criteria (Ecology 2000, 2010b, 2019b; Anchor QEA 2012, 2014). Areas where dissolved oxygen concentrations have not met criteria are all located downstream of the proposed flood retention facility, and around the river's confluences with Elk Creek, Newaukum River, and Lincoln Creek. Five of those river sections are located near the Chehalis-Centralia Airport. One section of the Chehalis River near Dryad is also identified as being impaired for dissolved oxygen (Ecology 2019b).

4.1.2.2.4 Nutrients

Nutrients in water, mainly nitrogen and phosphorus, contribute to algal growth. Excessive nutrients can lead to high algal growth, which can block sunlight, reduce dissolved oxygen, and, in some cases, release toxins. Many nutrients occur naturally. Other nutrients come from human activities such as discharge from wastewater treatment plants, agricultural fertilizer use, and stormwater release.

High nutrient concentrations can affect water quality. Typically, nutrient concentrations are higher when dissolved oxygen concentrations are lower. Previous studies showed elevated nutrient concentrations in the Chehalis River downstream of Chehalis due to wastewater treatment plant discharges and industrial point sources (Ecology 1994). As a result, Ecology limited nutrient loads to the river as part of an effort to increase dissolved oxygen concentrations (Ecology 1994, 2000). Recent data show that nutrient concentrations throughout the study area are generally low (Anchor QEA 2014).

Ammonia, a form of nitrogen, is toxic to fish at high concentrations. Four segments of the Chehalis River have ammonia toxicity (Ecology 2000, 2019a). These are from upstream of the confluence with Elk Creek to near Porter. Levels are lower than Washington State toxicity criteria (WAC 173-201A-240).

4.1.2.2.5 Chlorophyll a

Chlorophyll *a* is the main source of natural coloring found in most plants and freshwater phytoplankton species, including green algae. It is needed for photosynthesis, the process that plants use to make energy. When chlorophyll *a* concentrations are high in a waterbody, it generally indicates excessive algal growth. Too much algal growth in a waterbody can lead to less oxygen available in the water for other aquatic species like fish. It also usually indicates poor water quality, often because of high nutrient levels, high water temperature, or both.

Chlorophyll *a* concentrations in the Chehalis River were measured in the study area and were generally low (Anchor QEA 2013, 2014). In Washington, there are no water quality criteria for chlorophyll *a*.

4.1.2.3 Groundwater

Groundwater is water that is contained underground. Shallower groundwater can provide water via wells or springs and may connect with surface waters. The area between groundwater and surface water is called the hyporheic zone. This zone also provides important habitat and refuge for a variety of freshwater animals and parts of some fish life stages (Hancock 2002; Environment Agency 2005; Bouton et al. 2010; Marzadri et al. 2012).

In the study area, groundwater comes from aquifers. Aquifers are underground water layers that provide water via wells or springs (Heath 1983; Gendaszek 2011). There are five aquifers in the study area with the largest called the A aquifer (Gendaszek 2011). The other aquifers are deeper and do not interact with surface waters, like the Chehalis River. Therefore, these are not discussed further.

In the flood retention facility project area, connections between surface waters and the A aquifer are relatively limited (Gendaszek 2011). This is because the river channel is in bedrock covered with a thin layer of soil, which prohibits water from moving between the river and the groundwater below the bedrock. The river in this part of the study area also flows through a relatively steep area. Most groundwater moves quickly downslope into streams and rivers. These conditions limit the extent and function of the hyporheic zone in the flood retention facility project area.

The A aquifer is larger in the Airport Levee Improvements and Chehalis River 100-year floodplain portions of the study area. The A aquifer underlies most of the river within the 100-year floodplain. These downstream conditions allow for a larger hyporheic zone which may extend farther from the river into the floodplain.

Groundwater in the Chehalis Basin A aquifer was found to be of good quality (Appendix G). There are some areas contaminated mostly with nitrate and nitrite nitrogen in the downstream portion of the study area. This is likely from developed land uses and the application of fertilizer.

4.1.2.4 Water Use and Water Rights

Water use refers to the use of surface or groundwater by humans for various purposes, including water supply, irrigation, and industrial and commercial uses, among others. A water right is a legal authorization to use a predefined quantity of public water for a designated purpose that must qualify as a beneficial use.

Actual water use in the Chehalis Basin is highly uncertain. There are thousands of unvalidated water rights claims and the amount of water being diverted for various uses under these claims is unknown

(Ecology 2017a; CBP 2004). Average water use for domestic water supply, irrigation, and livestock watering is estimated to be 113 cfs for the upper Chehalis Basin (CBP 2004). Water usage is highest in the summer when precipitation and river flows are generally the lowest (CBP 2004).

The Chehalis Basin has more than 2,500 water rights (permits and certificates, including both surface water and groundwater; CBP 2004). The total authorized withdrawal in the basin is about 3,000 cfs (Ecology 2017a; CBP 2004). This includes multiple municipal and commercial water providers (CBP 2004).

In addition to water rights for human uses, minimum instream flows have been established by Ecology to protect instream resources. These resources include fish and wildlife, aesthetics, water quality, navigation, livestock watering, and recreation (Ecology 2017b).

Minimum instream flows are not always met under current conditions. At Grand Mound, minimum instream flows range from 165 cfs in August and September to 1,300 cfs from December to April (WAC 173-522-020[2]). An analysis of flow from water years 1929 to 2015 indicated that only 8 years had no days below the minimum instream flow, and the maximum number of days below the minimum instream flows was 154 (42%; Anchor QEA 2016). Minimum instream flows have also been less likely to be met from May through August. When instream flows are below the minimum established for the Chehalis Basin, the holders of water rights issued after March 10, 1976, may be required to stop withdrawing water (WAC 173-522-020). Most of the Chehalis Basin is closed to new water rights because of difficulty in meeting the required minimum instream flows.

4.1.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.1.3.1 Methods

Potential impacts to water quality and quantity were analyzed using quantitative and qualitative methods as summarized in Table 4.1-3. Additional details are presented in Appendix G. The thresholds used to determine the level of impact are described in Appendix E.

Table 4.1-3
Methods for Evaluating Impacts to Water Quantity and Quality

ENVIRONMENTAL RESOURCE	TYPE OF ANALYSIS	MODEL	DESCRIPTION
Surface Water Hydrology	Quantitative	HEC-ResSim	Extent of flooding in temporary reservoir footprint
		RiverFlow2D	Extent of flooding downstream of FRE facility

ENVIRONMENTAL RESOURCE	TYPE OF ANALYSIS	MODEL	DESCRIPTION
Floodplains	Qualitative	None	GIS analysis comparing construction footprint with floodplain
Water Quality	Quantitative	CE-QUAL-W2 (footprint model)	Within temporary reservoir footprint during free-flowing conditions
		CE-QUAL-W2 (temporary reservoir model)	Within temporary reservoir footprint while the temporary reservoir is holding water
		CE-QUAL-W2 (downstream river model)	Downstream of the FRE facility while the river is free-flowing and while the temporary reservoir is holding water
Groundwater	Qualitative	None	Maps and studies of existing groundwater resources
Water Use and Water Rights	Qualitative	None	Existing water use and rights compared to estimated water use during construction

4.1.3.2 No Action Alternative

4.1.3.2.1 Surface Water Hydrology and Floodplains

No Action Alternative Impacts

- Low to high impacts to hydrology and floodplains from continued risk of major or greater flooding
- High impact to water quality (temperature, dissolved oxygen, and turbidity) would continue
- Low impact to groundwater quantity from potential future development
- Low impact to water use and water rights from potential future development

Under the No Action Alternative, many of the existing impacts would continue. Some of the flood damage reduction projects and programs would provide local relief from flooding. However, none are expected to substantially affect regional flood levels. This is because the scale of each project is small relative to the upper Chehalis Basin.

Flooding would be expected to continue under the No Action Alternative. The modeled extents of major and catastrophic flooding are shown in Figures 4.1-1 and 4.1-2. Flood areas and elevations at key locations compared to Alternative 1 are presented in Section 4.1.3.3. There would continue to be low to high impacts to surface water and hydrology, with greater impacts happening during major or greater floods.

4.1.3.2.2 Water Quality

Most of the projects and programs under the No Action Alternative would not be expected to substantially affect water quality. Two exceptions include implementation of Forest Practice Rules and early action reaches for the Aquatic Species Restoration plan. Those programs could result in lower water temperatures in the Chehalis River because they would lead to increased streamside shading and erosion protection. This could lower water temperatures at and downstream of these restoration projects. As that cooler water moved downstream it would eventually encounter areas without sufficient streamside shading to cool the river, and water temperatures would increase.

In 2010, a study was done to look at how temperature, turbidity, dissolved oxygen, and fecal coliform bacteria levels had changed over time (Ecology 2010b). For this EIS, it was assumed that the water quality trends from that study would continue under the No Action Alternative. This is because water quality is not expected to become worse under the No Action Alternative than it is under current (2019) conditions. Existing water quality impacts that are anticipated to remain under the No Action Alternative include those discussed in Section 4.1.2. High impacts to water quality that would be ongoing under the No Action Alternative include the following:

- Temperature: Regular exceedance of applicable water quality criteria during the summer months at various Chehalis River segments from Pe Ell to Porter, with some exceedances occurring in the fall to spring.
- Dissolved oxygen: Regular exceedance of applicable water quality criteria at various Chehalis River segments from Pe Ell to downstream of the confluence with Lincoln Creek.
- Turbidity: Potential exceedances of applicable water quality criteria in the Chehalis River upstream of the confluence with the Newaukum River and downstream of the confluence with Lincoln Creek.

4.1.3.2.3 Groundwater

None of the projects or programs under the No Action Alternative would be expected to affect groundwater. Groundwater withdrawals and use by existing domestic, public water supply, irrigation, and commercial-industrial wells would continue. New development would require new wells into the Chehalis Basin A aquifer for drinking and process water. This could have a low impact to groundwater quantity because groundwater availability is often limited in the study area.

Under the No Action Alternative, groundwater in the Chehalis Basin A aquifer would continue to be susceptible to contamination. This would be true in those areas of the Chehalis Basin that are developed or used for agricultural purposes. Future projects and programs focused on groundwater resource protection would provide some reduction in groundwater contamination potential.

The hyporheic zones of the Chehalis River and its tributaries would also be impacted by surface water pollutants and flow changes under the No Action Alternative. Future projects that would alter the riverbed or adjacent floodplain could also adversely affect the hyporheic zone.

4.1.3.2.4 Water Use and Water Rights

Under the No Action Alternative, existing water uses would likely expand under existing permits as a result of population growth. This would lead to reduced streamflows. New permits may also be granted, leading to additional water use and reduced streamflows. However, new water rights may be difficult to obtain because 2019 was the fifth year in a row that Ecology curtailed water use in the Chehalis Basin (Ecology 2019e).

4.1.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

The following sections describe the potential impacts Alternative 1 would have on water quantity and quality resources. A more detailed discussion of the expected impacts and the methods used to determine those impacts is provided in Appendix G.

4.1.3.3.1 Surface Water Hydrology and Floodplains

Construction

Construction of the FRE facility would result in low impacts to surface water hydrology and medium impacts to floodplains.

> **Alternative 1 Construction Impacts to Surface Water Hydrology and Floodplains**
>
> **Flood Retention Facility Project Area**
> - Low direct impact to river flow from withdrawals and flow diversion
> - Medium direct impact from permanent loss of 11.4 acres of floodplain
> - Medium direct impact from temporary loss of floodplain function
>
> **Airport Levee Improvements Project Area**
> - No impact to surface water hydrology
> - Low direct impact to floodplains if levee is widened

impacts to surface water hydrology include low reductions of river flows near the construction site. These impacts would happen because up to 150 million gallons of river water would be used for making concrete for the FRE facility structure, washing trucks and aggregate, controlling dust, and other construction tasks. The Applicant expects to use approximately 80% of that water during a 10-month period and the remaining 20% over the rest of the construction period. If all the water were used in the shortest amount of time, about 400,000 gallons would be needed per day. This equals a flow of about 0.6 cfs. The lowest river flows near the flood retention facility project area are about 45 cfs, which typically occurs in August (Table 4.1-1). The lowest 7-day low flow that occurs, on average, once every 10 years, is even lower, at 21 cfs (Pickett 1992). If construction used up to 0.6 cfs from the river and flows were consistently the lowest, the withdrawal would be less than 3% of the total river flows.

There would also be a low impact to flows from diverting the river around the construction site. Although the Applicant proposes to have a diversion tunnel in place for 3 years, it was assumed the diversion could be used for the duration of the 5-year construction period. The diversion tunnel would be designed to fully convey up to a 2.8-year flood (about 7,000 cfs). There is about an 89% chance that river flows would exceed the capacity of the diversion tunnel during the 5-year construction period. If a larger flood happened, some amount of river water that would otherwise flow downstream could back up behind the upstream cofferdam. This would cause a low reduction in river flows downstream of the construction site. It could also result in the overtopping of the diversion tunnel and could cause flooding in the dewatered work area.

Impacts to the Chehalis River floodplain would also include medium impacts from the loss of floodplain and associated floodplain functions. This includes temporary and permanent impacts. During construction, equipment and materials would be used and temporarily stored in the floodplain at the construction site. Construction activities would also compact floodplain soils, remove vegetation, and change floodplain topography. These activities would temporarily affect approximately 2.9 acres of floodplain at the FRE facility location and 139 acres in the footprint of the temporary reservoir. Construction of the FRE facility would result in permanently filling 11.4 acres of floodplain. This includes the FRE facility structure and related facilities and spoils areas.

Compared to the total area of the Chehalis River 100-year floodplain in the study area (44,155 acres), the area of permanent floodplain impact (11.4 acres) is relatively small. It represents approximately 0.03% of the total floodplain. Therefore, floodplain impacts would be medium at the local level, nearest to the FRE facility, and low for the Chehalis River floodplain overall.

Construction of the Airport Levee Improvements would result in low impacts to floodplains. There would be no impact to surface water hydrology because the construction activities would be located away from the Chehalis River. The proposed work could involve widening the base and raising portions of the existing levee. This would require the placement of small amounts of fill in the floodplain. Portions of the floodplain would be disturbed by construction equipment use and material storage, but such impacts would be temporary. Floodplain function would return once equipment and stored materials were removed and therefore, the impacts are considered to be low.

Operation

Alternative 1 operations would result in no to medium impacts. FRE facility operational impacts would be low to medium. Operation of the Airport Levee Improvements would have no impacts. This is because the Airport Levee Improvements and operation of the FRE facility would not result in additional flooding in other locations. Alternative 1 would not change or redirect flood flows at this location.

Alternative 1 Operational Impacts to Surface Water Hydrology and Floodplains

Flood Retention Facility Project Area

- Low indirect impact to flows when the FRE facility is not operating
- Low indirect impact from reduced floodplain function

Airport Levee Improvements Project Area

- No impact

Chehalis River 100-Year Floodplain Area

- Medium indirect impact from reduced peak flows during major or greater floods
- Low indirect impact to tributaries from localized flooding

Operation of the FRE facility would result in a medium reduction in peak flows from major or greater flooding of the Chehalis River. This impact would only happen, on average, once every 7 years. Two-dimensional modeling (WSE 2019a, 2019b; Tschetter 2020) was done to see how much flooding would be reduced downstream of the FRE facility structure. Based on this modeling, Alternative 1 would reduce the downstream area affected by a major flood by 10% and a catastrophic flood by 11% (Table 4.1-4).

Table 4.1-4
Area of Land Currently Flooded Compared to Alternative 1

TYPE OF FLOOD	CURRENT AREA OF FLOOD (ACRES)	AREA OF FLOOD WITH ALTERNATIVE 1 (ACRES)	DIFFERENCE IN FLOOD AREA (ACRES)	PERCENT REDUCTION IN FLOOD AREA
Major flood	28,445	25,603	2,842	10%
Catastrophic flood	37,086	33,003	4,083	11%

Operation of the FRE facility is predicted to reduce flood depths by between 0.1 and 8.7 feet during a major flood and between 0.6 and 11.1 feet during a catastrophic flood. The greatest reduction would happen near Doty in both cases. Flooding would also be reduced near Adna and downstream of the South Fork Chehalis River confluence. Figure 4.1-3 and Figure 4.1-4 show the expected reduction in flooding depth for a major and catastrophic flood in the study area compared to existing conditions. The estimated changes in flood depths for various locations in the Chehalis River floodplain under both flood scenarios are shown in Table 4.1-5. Based on the modeling, Alternative 1 would meet three of the four flood damage reduction metrics described in Section 3.2.2. The changes in flood duration that affect transportation corridors are further discussed in Section 5.7. Flood duration changes that affect public services and utilities are discussed in Section 5.8.

Table 4.1-5
Modeled Flood Depth Reductions for Various Locations in the Chehalis River Floodplain

	MAJOR FLOOD STAGE (FEET)			CATASTROPHIC FLOOD STAGE (FEET)		
LOCATION	CURRENT	ALTERNATIVE 1	DIFFERENCE	CURRENT	ALTERNATIVE 1	DIFFERENCE
Near Doty	311.9	303.2	-8.7	319.5	308.4	-11.1
Curtis Store (on South Fork Chehalis River)	229.5	229.4	-0.1	231.9	231.3	-0.6
Downstream of South Fork Chehalis River	214.3	211.4	-2.9	220.1	216.4	-3.8
Near Adna[1]	195.3	192.2	-3.2	198.1	196.7	-1.4
Labree Road (on Newaukum River)	205.5	205.5	0.0	206.2	206.2	0.0
Newaukum River confluence[2]	182.8	181.4	-1.4	185.9	184.4	-1.5
Dillenbaugh Creek at I-5	181.6	180.8	-0.8	186.0	184.6	-1.4
South end of airport, riverward of levee	177.9	177.2	-0.6	181.8	180.1	-1.7
South end of airport, landward of levee	Dry	Dry	0.0	179.9	Dry	NA
North end of airport, riverward of levee	174.5	173.0	-1.5	179.4	177.3	-2.1
North end of airport, landward of levee	Dry	Dry	0.0	179.5	Dry	NA
Mellen Street Bridge[3]	171.5	169.7	-1.8	176.7	174.9	-1.7
Mellen Street just east of I-5	171.9	170.2	-1.7	176.1	175.0	-1.1
Skookumchuck River confluence	170.0	168.5	-1.6	174.9	173.3	-1.6
Upstream of Galvin Road	163.2	161.8	-1.3	167.2	165.6	-1.6
Grand Mound (Prather Road Bridge)[4]	144.1	143.5	-0.5	146.3	145.5	-0.9
Near Rochester	121.3	120.6	-0.7	124.1	123.2	-0.9
Anderson Road	108.5	108.0	-0.5	110.6	110.0	-0.6
Black River confluence	91.0	90.4	-0.7	94.2	93.1	-1.1
Sickman Ford Bridge	79.2	78.5	-0.7	82.5	81.4	-1.0
Porter Creek Road Bridge	50.8	50.3	-0.5	53.2	52.5	-0.7

Notes:
1. This is the closest location to the Adna gage (USGS 12021800) and shows the metric of -4 feet during a catastrophic flood would not be met.
2. This is the closest location to the Chehalis Wastewater Treatment Plant gage (USGS 12025100) and shows the target metric of -0.9 feet during a catastrophic flood would most likely be met.
3. This is the Mellen Street Bridge (USGS 12025500) and shows the target metric of -1 foot during a catastrophic flood would be met.
4. This is the Grand Mound gage (USGS 12027500) and shows the target metric of -0.8 foot during a catastrophic flood would be met.
Source: Tschetter 2019a

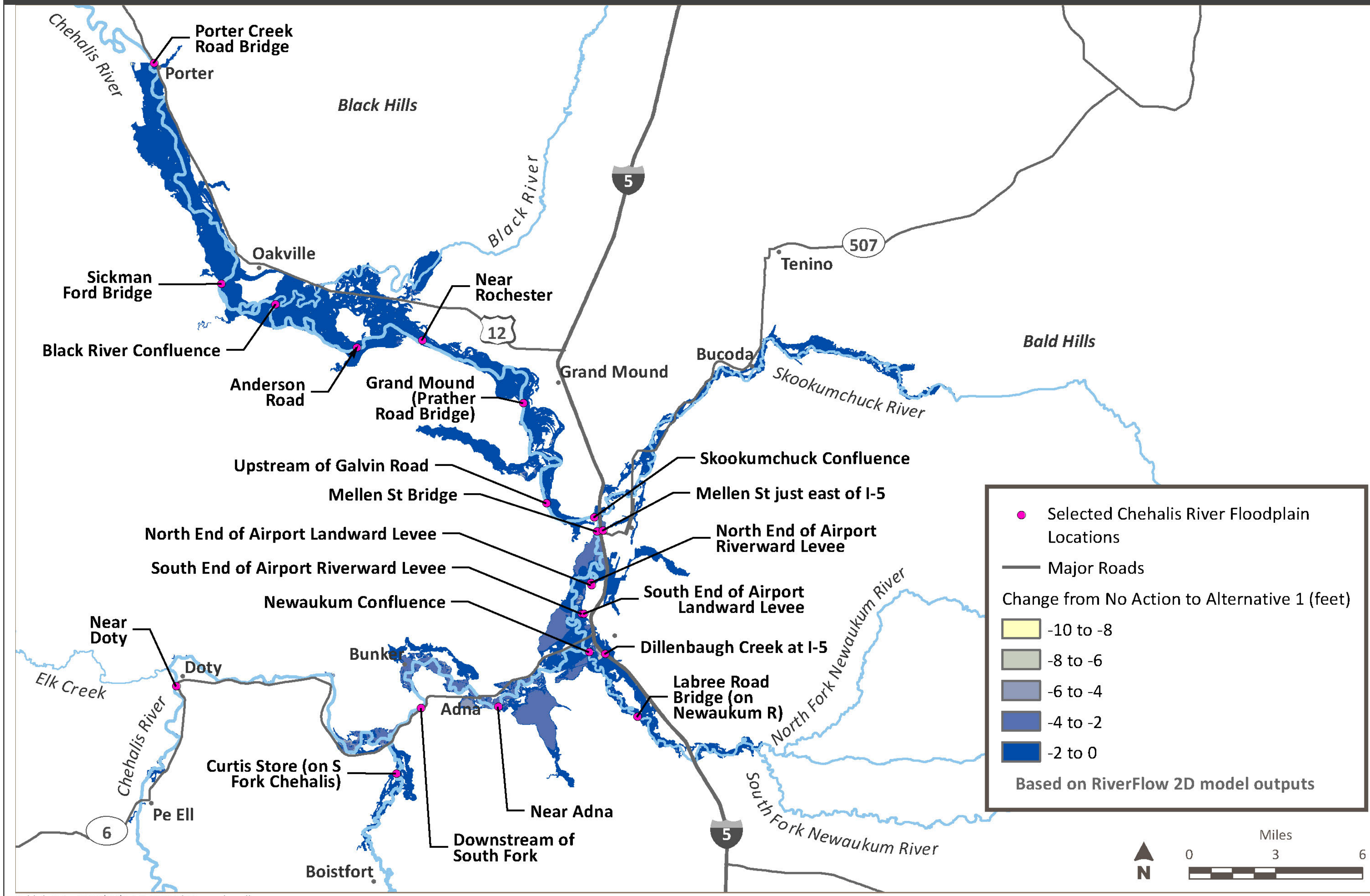
Modeling was also completed for farther downstream of the study area. That area extended from Porter near RM 33 to the mouth of the Chehalis River at RM 0. As shown in the modeling (Tschetter 2020), there would be additional benefits from reduced flooding. Flood depth reduction downstream of the study area ranged from 0.2 to 1.1 feet. The largest reduction in flood depth occurred near Porter Creek Road, with the reduction effect decreasing downstream from that location. These results are not discussed further because they are relatively minor and are not clearly a result of FRE facility operation. This is because there is a narrowing of the floodplain around Porter and the influence on river flows from tributaries and ocean tides becomes greater in areas farther downstream.

During operation, tributaries downstream from the FRE facility are expected to experience small changes in flow near where they enter the Chehalis River (Tschetter 2019b). This is because reduced flows in the mainstem could cause water in the downstream tributaries to back up during floods. The effect is expected to result in minor increases in water elevations extending two to seven miles upstream, depending on the tributary. Tributaries in the footprint of the temporary reservoir would be flooded when the FRE facility is holding water.

During times when the FRE facility is not operating, there would still be the potential for low impacts to river flows immediately upstream of the FRE facility. This could happen if river flows exceed the capacity of the gated outlets but are not high enough for the gates to close. The capacity of the gated outlets is approximately 8,000 cfs. If river flows exceed 8,000 cfs, river water may start to pool behind the open FRE facility structure.

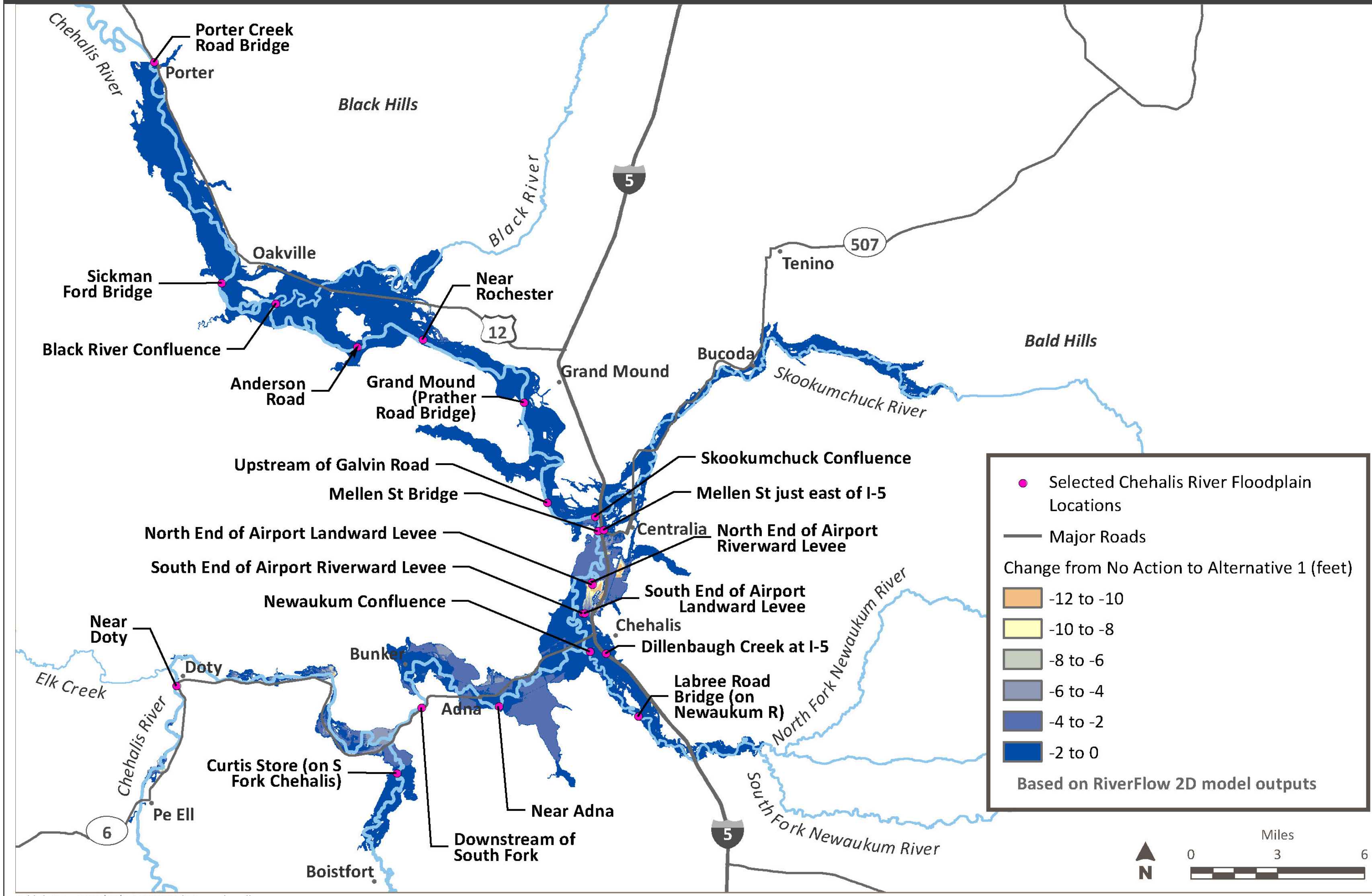
Operation of the FRE facility would not substantially affect floodplain functions because it would not directly modify the existing floodplain. However, by reducing flooding in certain portions of the floodplain during major or catastrophic floods, there would be a reduction in the opportunity for those portions of the floodplain to perform certain functions. Those areas would likely retain the ability to provide floodplain functions but would not be flooded as frequently as they would under the No Action Alternative. Because of this, the impact of operation of the FRE facility on floodplains and floodplain function was determined to be low.

Figure 4.1-3
Potential Changes in Major Flood Depth



Publish Date: 2020/07/17, 3:48 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Water_Quality_and_Quantity\AQ_NEPA-EIS_6_4_3.mxd

Figure 4.1-4
Potential Changes in Catastrophic Flood Depth



Publish Date: 2020/07/17, 3:58 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Water_Quality_and_Quantity\AQ_NEPA-EIS_6_4_4.mxd

4.1.3.3.2 Water Quality

Construction

Construction of the FRE facility and Airport Levee Improvements would have low to high impacts to water quality. Low water quality impacts could occur if construction chemicals from an accidental spill or leaking equipment enter nearby surface waters. Low water quality impacts could also happen if soils are carried into surface waters by stormwater runoff, causing increased turbidity. The increased risks to water quality impacts from chemical leaks and spills and soil erosion would be minimized with stormwater controls in place. Careful management of such controls would be required for up to 5 years. If a larger storm happened, there would be an increase in the potential for water quality impact from such sources. The chance that river flows would exceed the capacity of the diversion tunnel would be about 89% over the 5-year construction period. High water quality impacts would also occur as the result of increased river temperatures from pre-construction vegetation removal in the temporary reservoir area.

> **Alternative 1 Construction Impacts to Water Quality**
>
> **Flood Retention Facility Project Area**
> - Low impacts from potential spills, accidental releases, erosion, and in-water work with a potential for high impacts during a larger storm
> - High impacts from increased river temperatures caused by tree removal in riparian areas of the temporary reservoir
>
> **Airport Levee Improvements Project Area**
> - Low impacts from potential spills, accidental releases, erosion, and work in wetlands that flow to surface waters

Construction of the FRE facility and Airport Levee Improvements would require the use of chemicals such as paint, solvents, and concrete additives. If these chemicals are stored improperly or accidentally spilled, there is a risk that they could enter surface waters. Construction at both sites would also require earthwork, such as grading and stockpiling soil. Stormwater and wind can carry pollutants to nearby waters if they are not properly contained. When pollutants enter water, they can cause harm to aquatic species and adversely affect designated water uses downstream. Potential impacts to aquatic species and habitat are addressed in Section 4.5.

At the FRE facility construction site, much of the work would happen in the Chehalis River channel. In-water construction has higher risks of contamination. The risk would be reduced by dewatering the work area. This would be done by routing the river's flow around the construction site through a diversion tunnel. Temporary dams called cofferdams would be placed in the river channel both upstream and downstream of the construction site. This would both direct water into the tunnel and keep it from entering the work site. During this process, there would be a temporary increase in turbidity from the disturbance of the riverbed and from the placement of fill material when the cofferdams are installed. The increase would last for a few days during the 3-month windows proposed for cofferdam installation and removal. It would not be expected to affect water quality very far downstream.

At the Chehalis-Centralia Airport, the construction site is 630 feet away from the river at its nearest point. As a result, in-water construction would not happen, and the risk of contamination would be lower. There is a wetland ditch on the inside of the levee that may be affected. This ditch flows to a pump station that discharges to a section of the former river channel that is still connected to the Chehalis River. That impact is discussed further in Section 4.4.

The Applicant would be required to get certain permits and approvals listed in Appendix F before construction. If these permits and approvals are issued, there would be conditions to those approvals that would require the Applicant to implement, at a minimum, stormwater pollution, erosion, and spill control measures. For example, many of these approvals would require preparation of a temporary erosion and sediment control plan, stormwater pollution prevention plan, and a spill control and counter measures plan. If a larger storm happened at the FRE facility construction site, there is a potential that these controls would not be enough to keep pollutants or sediment from entering surface waters. To address this risk, the Applicant would include specific provisions in these plans.

Construction of the FRE facility would also require removing larger trees from the footprint of the temporary reservoir. This would be done so that when the temporary reservoir was flooded, trees would not cause safety issues for operation of the FRE facility. It was assumed that the Applicant would remove approximately 485 acres of trees. When trees are removed from a riparian area, water temperatures increase. Temperatures higher than water quality criteria have been observed historically in the Chehalis River (Pickett 1992). Therefore, any further increase of temperature from Alternative 1 would be a high impact. The potential for ongoing impacts from increased temperature is discussed further under Operation.

Operation

The Airport Levee Improvements would be located away from the river channel and would not have a long-term effect on water quality.

Operation of the FRE facility is expected to result in a high, long-term impact to water quality from temperature increases in the Chehalis River both upstream and downstream of the facility. This

Alternative 1 Operational Impacts to Water Quality

Flood Retention Facility Project Area

- High indirect impact from long-term increases in river temperature in spring and summer
- Low indirect impact from long-term increase in turbidity in temporary reservoir
- Medium indirect impact from short-term increases in turbidity when the FRE facility is holding water
- Medium indirect long-term impact to dissolved oxygen in the spring and summer
- Low indirect long-term impact from nutrient and chlorophyll *a* increases

Airport Levee Improvements Project Area

- No impacts from the Airport Levee Improvements

Chehalis River 100-Year Floodplain Area

- High indirect impact from long-term increases in river temperature in spring and summer to RM 100
- Medium indirect long-term impact to dissolved oxygen in the spring and summer
- Medium indirect impact from short-term increases in turbidity when the FRE facility is holding water

impact would be because of the removal of riparian vegetation from the footprint of the temporary reservoir. The loss of trees would reduce the amount of shading along the section of river upstream of the FRE facility, exposing the water surface to more sunlight compared to current conditions. This is expected to be a long-term impact because the Applicant would continue to remove larger trees from this area as part of periodic vegetation management for the FRE facility. In addition, periodic flooding, on average once every 7 years, would make it difficult for trees to regrow.

Based on temperature modeling, this loss of riparian shading could increase river temperature by as much as 2°C in the spring and summer (Anchor QEA 2017). Certain sections of the river are already impaired for temperature. Any increase greater than 0.3°C in impaired sections of the river during this time of year would exceed the applicable criteria for salmonid protection. Alternative 1 is expected to increase temperature by more than 0.3°C from RM 114 to approximately RM 100 (the confluence with Elk Creek). The impacted area includes two sections of the river where temperature criteria are in place. One section is downstream of Pe Ell, and the other is both upstream and downstream of Doty. Potential impacts to fish and other aquatic species are described in Section 4.5.

When the FRE facility is holding water, the model indicated that there could also be either a slight increase or decrease in upstream and downstream river temperatures compared to the No Action Alternative. If it happened, this effect would begin shortly after the temporary reservoir begins holding water and last through emptying of the temporary reservoir. Whether the temporary reservoir water was colder or warmer than the Chehalis River would depend on the time of year when the flood happened and the temperature of the air around the time when the water was released.

For example, if the FRE facility was operated in the fall, water released from the temporary reservoir could make the river warmer for a few days. This would result in a medium temperature increase. Modeling has shown that the water temperature in the temporary reservoir stays about the same as it was when the temporary reservoir filled. This means that relatively warm water would fill the temporary reservoir and be released a month or so later, when cooler air temperatures may have caused the river temperatures to cool. This effect would be the opposite if the flood happened in the late spring if air temperatures warmed the river during the time the temporary reservoir was holding relatively colder water. This would result in a low decrease in water temperature. Appendix G provides more details on the temperature modeling approach and results.

Operation of the FRE facility would also cause a medium, short-term increase in turbidity upstream and downstream of the facility when the temporary reservoir is draining. As the temporary reservoir fills, some of the suspended sediment would settle out. When the flood danger passes, the gates would be opened to drain the temporary reservoir. The finer sediments that had settled to the bottom would then be resuspended and a pulse of turbid water would be released back into the river. Based on the modeling, increased turbidity levels related to this pulse were predicted to exceed the applicable water quality criteria during temporary reservoir drawdown (Anchor QEA 2019c). Because this would only happen while the temporary reservoir is holding water, this impact is expected to occur once every 7 years on average.

Modeling also showed there would be another pulse of increased sediment during the first storm following a period when the temporary reservoir is holding water. Based on the model, this short-term increase in turbidity would also be expected to exceed applicable water quality criteria. Because such events would occur soon after an event when the temporary reservoir is holding water, they are expected to happen infrequently.

In addition to occasional short-term increases in turbidity, operation of the FRE facility would also cause a low, long-term potential for increased turbidity in the temporary reservoir. This is because of the removal of riparian vegetation from this area. The loss of trees could increase soil erosion. During storms, rainwater could carry away slightly more soil into the river compared to the No Action Alternative. This effect could decrease over time as vegetation grows in the cleared areas. As plants and small trees grew, their root systems would stabilize surrounding soil, and their leaves would prevent rain from directly impacting the soil.

As discussed further in Section 4.3, there is expected to be less sediment transported downstream of the FRE facility over the long term. Therefore, it is unlikely that Alternative 1 would result in long-term changes in turbidity upstream of the Newaukum River confluence. That portion of the river is identified as being water quality impaired by turbidity.

Alternative 1 would also result in decreases in dissolved oxygen to the Chehalis River confluence with Elk Creek. Multiple sections of river also have criteria in place for low dissolved oxygen and would potentially be impacted by this decrease.

Operation of the FRE facility is not expected to have a substantial impact to nutrient loading or chlorophyll *a*. There are no long-term changes proposed that would result in substantial increases in nitrogen or phosphorus from FRE facility operation. Increased river temperatures in the vicinity of the proposed FRE facility could result in slightly higher increases of chlorophyll *a* compared to the No Action Alternative. However, modeling predicts a low increase (PSU 2017) where concentrations in the study area are already considered to be low.

4.1.3.3.3 Groundwater

Construction

Construction of Alternative 1 would have low impacts to shallow groundwater. This includes low effects on groundwater movement, connection to the river, and the zone between surface and groundwater (hyporheic zone). No impacts to groundwater recharge or deeper aquifers are expected. This is because the deeper aquifers are separated from surface waters by multiple confining layers. Construction of Alternative 1 would also result in a low increase in the potential for groundwater to become contaminated. Most of these impacts would happen at the FRE facility project site because there would be more ground disturbance during construction than at the Airport Levee Improvements project area.

> **Alternative 1 Construction Impacts to Groundwater**
>
> **Flood Retention Facility Project Area**
>
> - Low temporary and permanent direct impacts to shallow groundwater movement and connectivity
> - Low temporary and permanent direct impacts to hyporheic zone from channel dewatering and in-water work
> - Low temporary direct impact from increased potential for groundwater contamination
>
> **Airport Levee Improvements Project Area**
>
> - Low temporary direct impact from increased potential for groundwater contamination

Construction activities, including use and storage of equipment, would compact the underlying soils. This would reduce the ability of water to flow through the soil into shallow groundwater. Construction of the FRE facility could also change the way that groundwater flows where permanent structures extend below the ground. In these areas, water would not be able to flow underground as easily. Despite these low changes in flow patterns, groundwater would continue to move downslope toward the Chehalis River and its tributaries.

In the temporary reservoir area, the removal of trees would increase the potential for stormwater flows to reach groundwater. This would happen because there would be fewer trees to intercept rain and stormwater flows.

Construction of the FRE facility would have low temporary and permanent impacts to the hyporheic zone. During construction, an approximately 1,350-linear-foot section of the Chehalis River channel would need to be dewatered for 2 to 5 years. This would be accomplished using instream cofferdams and a diversion tunnel. Removal of flowing surface water from that section of channel, placement of the cofferdams, and construction of the FRE facility would eliminate a portion of the hyporheic zone in those locations. Once the cofferdams are removed and the river is returned to its natural course, the hyporheic zone would reestablish in a portion of the channel over time. Downstream connectivity through the adjacent hyporheic zone corridor would also be cut off by the FRE facility structure.

Construction of the Airport Levee Improvements is not expected to have an impact to groundwater recharge, movement, connectivity, or the hyporheic zone. All construction work would occur outside of the active river channel. The work would not impact the sections of remnant stream channel or oxbow lakes located to the west and northwest of the project area.

Construction of both the FRE facility and Airport Levee Improvements would cause a low increase in the potential for groundwater contamination. Potential sources would include accidental releases or spills of fuel, vehicle fluids, or liquid construction materials (e.g., paint, solvents). If such materials are spilled or leaked onto the ground, they could potentially infiltrate into underlying groundwater. Groundwater flow could then transport the contamination into downslope surface waters or underlying aquifers. The implementation of standard BMPs for construction vehicle usage and material handling would reduce the potential for contamination.

Operation

Operation of Alternative 1 would have a low indirect impact to shallow groundwater. There would be low changes affecting groundwater recharge and the hyporheic zone. No impacts to groundwater quality are expected.

Operation of the FRE facility would temporarily reduce groundwater recharge from the river to the adjacent shallow aquifer when the FRE facility was holding water. This would affect a relatively short section of river immediately downstream of the FRE facility. This is because flood flows that would otherwise flow into the shallow aquifer through the soil layers would no longer happen.

Alternative 1 Operational Impacts to Groundwater

Flood Retention Facility Project Area

- Low indirect impact to groundwater recharge from reduced major or greater flooding
- Low indirect impact to the hyporheic zone from reduced interconnectivity

Airport Levee Improvements Project Area

- No impact

Chehalis River 100-Year Floodplain Area

- Low indirect impact to the hyporheic zone from reduced interconnectivity

Operation of the FRE facility during major or greater storms would also reduce the area and duration of flooding downstream of the FRE facility. Because a smaller area would be flooded and for a shorter period, the potential for overbank flood recharge in the floodplain would decrease. Overbank flood recharge is a relatively minor contributor to total groundwater recharge in the Chehalis Basin. Because of this, and because the temporary reservoir would hold water relatively infrequently (once every 7 years on average), these impacts would be low.

Operation of the FRE facility would have low impacts to the hyporheic zone interconnectivity both upstream and downstream of the FRE facility. This would happen because of small-scale changes to the area between the Chehalis River and shallow groundwater that could limit interconnectivity. Upstream of the FRE facility, there could be an accumulation of sediment while the temporary reservoir is holding water that could clog the spaces in the hyporheic zone over time. This would limit the groundwater and surface water interactions that support aquatic life in the hyporheic zone. Some of this material would likely be flushed out during higher flows or when the temporary reservoir is drained after an impoundment event. Downstream of the FRE facility, there could be less sediment and organic material carried into the hyporheic zone by surface water. This could have a low impact by reducing the amount of food sources for aquatic animals.

Operation of the Airport Levee Improvements would not cause any adverse impacts to groundwater resources. Because the work would occur within the footprint of the existing levee, there would be no reduction in the area available for groundwater recharge. Also, because there would be no new disturbance to the A aquifer, groundwater connectivity and quality would not be affected. In addition, the Airport Levee Improvements would not impact the hyporheic zone. The levee would be located outside of the active Chehalis River channel. It would also be outside the sections of remnant stream channel and oxbow lakes located to the west and northwest of the project area.

4.1.3.3.4 Water Use and Rights

Construction

Construction of Alternative 1 would have a low temporary impact to water use and water rights.

Construction of the FRE facility would need water for various construction processes, including dust control, truck washing, aggregate washing, and concrete production. Because the flood retention facility project site does not have a developed water supply source, water for construction uses would need to come directly from the Chehalis River.

It is estimated that the Applicant would need up to 150 million gallons of river water during construction of the FRE facility. Approximately 80% of this, or 120 million gallons, would be used during a 10-month period. This is equivalent to about 400,000 gallons per day (278 gallons per minute or 0.6 cfs) over the 10-month period. As discussed in Section 4.1.3.3.1, this would be a 3% reduction in river flow under the lowest flow conditions. This is not expected to affect downstream water users and would therefore be a low impact.

Because the Applicant does not currently have a water right to use water from the river, the Applicant would need to either obtain one or buy water from someone who has a water right. Potential options for obtaining the right to use water from the river include the following:

- Purchase water from an entity that holds a water right in this portion of the Chehalis Basin
- Lease or transfer an existing water right from an entity that holds a downstream water right
- Obtain a new temporary water right permit from Ecology

> **Alternative 1 Construction Impacts to Water Use and Rights**
>
> **Flood Retention Facility Project Area**
> - Low direct temporary impact to water use and rights from withdrawals
> - Medium indirect impact to Pe Ell's water supply system due to need to relocate the transmission pipeline at the proposed location of the FRE facility
>
> **Airport Levee Improvements Project Area**
> - No impact
>
> **Chehalis River 100-Year Floodplain Area**
> - No impact

The Applicant could select one of several options to obtain a water right. Options are described in Appendix G. Regardless of the option selected, the impact to water use and rights would be low.

The City of Pe Ell's water supply system pipeline passes through the proposed location of the FRE facility and would need to be relocated. The Applicant would work with the City to relocate the existing pipeline. The temporary disruption would result in a medium impact.

Construction of the Airport Levee Improvements is not expected to impact water use or water rights. No direct water withdrawals from the Chehalis River would be needed to construct the levee improvements. Water used during construction would be mostly limited to such activities as dust control and truck washing, which could be supplied by existing municipal sources.

Operation

Operation of the FRE facility would not affect water availability in the Chehalis River for water right holders. However, it would have a medium impact to the town of Pe Ell's water system.

Operation of Alternative 1 would not require the use of water. However, operation of the FRE facility would reduce peak flows in the Chehalis River downstream of the FRE facility structure. This reduction in flows would not be expected to affect downstream users because there would be adequate water in the system to meet projected demand.

The FRE facility would only hold water during major and larger floods when the flow in the Chehalis River is predicted to be above 38,800 cfs at Grand Mound. Accordingly, flow reduction from FRE facility operation would only decrease river flows when those flows are substantially higher than the authorized total withdrawal and water usage rates for the basin. Because of this, FRE facility operation is not expected to affect water availability or the rights of water right holder in the basin.

Pe Ell's water intake structure is on Lester Creek, which is a tributary to Crim Creek. Crim Creek enters the Chehalis River just upstream of the proposed FRE facility location. The elevation of the Pe Ell intake on Lester Creek is approximately 640 feet (Gray & Osborne 2015). This is above the water level elevation of the temporary reservoir when the FRE facility is holding water. The estimated water level of the temporary reservoir is 568 feet above mean sea level during a major flood and 604 feet above during a catastrophic flood. Because of this, holding of water in the temporary reservoir is not expected to affect the intake structure or require its relocation or modification.

Alternative 1 Operational Impacts to Water Use and Rights

Flood Retention Facility Project Area

- No impact to water use and water rights
- Medium indirect impact to Pe Ell's water supply system due to location of raw water transmission pipeline in temporary reservoir footprint

Airport Levee Improvements Project Area

- No impact

Chehalis River 100-Year Floodplain Area

- No impact

The raw water transmission pipeline that carries water from the intake to Pe Ell's water treatment plant extends under the footprint of the temporary reservoir. It is also attached to one of the existing bridges that crosses the Chehalis River. Because this pipeline could be damaged during an event when the temporary reservoir is holding water, it would either need to be modified or relocated. Such changes would be a medium impact to the town of Pe Ell's water system.

The Airport Levee Improvements project would have no impact to water use and water rights because it would not decrease flows or otherwise affect users' ability to divert water.

4.1.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

As noted in Chapter 3, the potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1. Construction impacts would also be similar, but slightly lower, as noted below.

Alternative 2 construction would result in slightly less impacts to water quantity and quality because of the reduced size of the flood retention facility foundation. Although the foundation of the FRO facility would be smaller than the foundation of the FRE facility, nearly the same level of disturbance would be required to build the structure. Less concrete would be needed for the structure. The duration of construction would be approximately 9 months less than for the FRE facility. Therefore, the Applicant would also need to divert less water from the Chehalis River for the project.

4.2 Geology and Geologic Hazards

4.2.1 Introduction

Geology refers to the materials and processes that make up the earth. Examples of geologic hazards include landslides or earthquakes. This section describes geology and soils and geologic hazards in the study area and the potential impacts that would result from the alternatives. Additional details can be found in Appendix H, the discipline report for geology and geologic hazards. Potential water quality impacts are discussed in greater detail in Section 4.1. Section 4.3 presents additional information about how geology and geologic conditions affect the movement of soils and other materials in the river.

Key Findings

Construction

- Low to medium direct impact from increased erosion
- Medium direct impact from bedrock removal
- Low impact from increased landslide risk
- Low direct impact from increased exposure to earthquake hazards

Operation

- Low to high indirect impact from increased erosion
- Low to medium indirect impact from increased landslide risk
- Low indirect impact from increased exposure to earthquake hazards
- High impact from unlikely event of an earthquake causing FRE facility failure during operation
- Low indirect impact for increased risk of waves or induced shaking in the temporary reservoir

4.2.2 Affected Environment

This section describes geology, soils, and geologic hazards in the study area. The study area, defined in Section 3.6, also includes a 250-foot buffer area around the flood retention facility and Airport Levee Improvements project area for geology and geologic hazards.

4.2.2.1 Geology and Soils

This section describes geology and soils in the study area.

4.2.2.1.1 Flood Retention Facility Project Area

This part of the study area is hilly and underlain by bedrock composed of two main rock formations: the volcanic Crescent Formation, and the overlying and younger sedimentary McIntosh Formation. The Crescent Formation is made mainly of lava (basalt) that developed cracks as the lava flows cooled. The McIntosh Formation is made up of sedimentary rocks. Rock from the Crescent Formation typically breaks down into cobbles and gravel and silt and sand soil particles. Sedimentary rock from the McIntosh formation typically weathers into softer particles that are broken down into sand, silt, and clay soil particles. In the upper watershed, these types of soils break down somewhat easily over time and wash away during larger rain events.

Erosion in this area is influenced by the amount of vegetation cover and the steepness of the slopes. In forested areas, erosion potential is often lower than in areas where trees have been harvested. This is because vegetation cover can soften the effect of rain hitting the ground and washing away bare soil. Steeper slopes are also more susceptible to erosion because stormwater and gravity can cause soils to move downhill over time.

The Chehalis River mainly cuts through bedrock. As the Chehalis River has carved through the bedrock in this area over time, it has deposited cobbles, gravel, and some sand along its path. Near the location of the proposed flood retention facility, the river deposits become wider and finer grained. There are no unique areas of bedrock or other geologic features in this part of the study area.

4.2.2.1.2 Airport Levee Improvements Project Area

The airport and levee are located on artificial fill placed on top of the Chehalis River floodplain alluvial sediments. The levee surface and sod-covered side slopes (Corps 2019) have a low erosion potential unless the sod cover is disturbed.

4.2.2.1.3 Chehalis River 100-Year Floodplain Area

The floodplain and terraces along the river tend to have a high sand content. This is because, as the river flows towards the mouth, finer sediments continue to settle out. Some areas of the river, as noted in Table 4.3-1, have underlying bedrock.

4.2.2.2 Geologic Hazards

The geologic hazards in the study area include steep slopes that are more prone to landslides and earthquake activity. Volcanic activity and mines can also present hazards. However, as discussed in greater detail in Appendix H, there are no volcanoes or mines in the immediate vicinity of the study area. No lava flows and volcanic mudflows are likely to reach the study area. Therefore, risks of volcanic or mine hazards are not discussed further.

Earthquake activity can cause damage to structures from liquefaction and ground shaking. Liquefaction happens when ground shaking causes certain types of soils to become so unstable they can no longer safely support structures. If ground shaking is severe enough, it can also damage buildings and other types of structures and create unsafe conditions for people.

Depending on the location, earthquakes can also cause landslides or rockfalls. If the earthquake is near a large body of water, like a reservoir or lake, large waves may be created. If severe enough, the back-and-forth water movement and waves can damage buildings, roads, or other infrastructure along the shoreline. Because no large bodies of water presently occur in the study area, there is currently a very low risk from large waves.

4.2.2.2.1 Flood Retention Facility Project Area

As noted previously, much of the proposed flood retention facility project area is relatively steep. These slopes are generally susceptible to landslides. Detailed landslide mapping and geotechnical investigations identified 27 large previous landslides located in the flood retention facility project area

(CBS 2014, 2015, 2019; Shannon & Wilson 2017). Nine of these landslides show signs of being active, and four of these are potentially hazardous (CBS 2017).

There is also a potential for rock falls in the flood retention facility project area. Rock falls could happen in areas where steeper bedrock slopes are covered by areas with shallow soils. These conditions exist immediately adjacent to the proposed flood retention facility site.

There are no known active surface faults in the proposed flood retention facility area (WGIP 2019). However, large earthquakes in the general vicinity may originate from the coastal Cascadia Subduction Zone (CSZ) and numerous inland comparatively shallow (crustal) faults. The chance of earthquakes in the study area is very low.

The largest potential earthquake and associated ground shaking in the study area would be from a CSZ earthquake. The CSZ extends from northern California, along Oregon and Washington, and ends in southwestern British Columbia. The next strongest potential earthquake and associated ground shaking would be from the potentially active Doty-Salzer fault system or the potentially active Scammon Creek fault. Both are crustal faults (Sadowski et al. 2018). The Doty-Salzer fault system is about 10 miles east of the proposed flood retention facility project area. The Scammon Creek fault is located more than 16 miles northeast of the proposed flood retention facility. Few buildings or people are present in the flood retention facility project area that would be exposed to ground shaking hazards.

4.2.2.2.2 Airport Levee Improvements Project Area

Inspection of the Airport Levee Improvements project area found that slopes are generally stable (Corps 2019). As noted above, the greatest risks from earthquake activity in the study area are from the CSZ, followed by the Doty-Salzer fault system and the Scammon Creek fault. The Doty-Salzer fault underlies the Airport Levee Improvements project area. The southeastern extent of the Scammon Creek fault crosses the study area only at the location of the proposed Airport Levee Improvements. The Chehalis-Centralia Airport is built on soils that are susceptible to liquefaction. An earthquake could cause damage to structures in the area.

4.2.2.2.3 Chehalis River 100-Year Floodplain Area

As the topography in this part of the study area becomes flatter, the potential for landslides becomes lower. The same risks noted earlier from a large-scale earthquake also exist. All the soils in the flatter portions of the Chehalis River 100-year floodplain area have medium to high risk of liquefaction (WGIP 2019). Liquefaction features have been identified along the banks of the Chehalis River from the city of Chehalis to downstream of Porter (Obermeier and Dickenson 2000). This part of the study area is developed, and the structures present in the area could be at risk of damage if liquefaction were to occur during an earthquake.

4.2.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.2.3.1 Methods

The analysis of potential impacts to geology, soils, and geologic hazards was qualitative. The analysis considered how proposed construction and operation would affect the resources and might expose people and property to increased risks from geologic hazards. Appendix H provides a detailed discussion of methods used to assess the potential impacts. Appendix E describes the thresholds used to determine the level of impacts.

4.2.3.2 No Action Alternative

4.2.3.2.1 Geology and Soils

Under the No Action Alternative, the potential for impacts to geology and soil would most likely be low. Impacts would mainly occur as the result of ground-disturbing activities that could temporarily increase the potential for erosion. This would include continued timber harvest in the flood retention facility project area and continued development in the Chehalis River 100-year floodplain area. Additional construction activities could temporarily increase erosion. Stormwater and erosion control measures that would be required would minimize these impacts.

> **No Action Alternative Impacts to Geology and Soils**
>
> - Low impact from increased risk of erosion during ground disturbing activities
> - High impact from continued erosion risk during major or greater floods

Current widespread flooding in the study area would be expected to continue. Although proposed localized flood damage reduction actions would minimize flood damage, the level of flood damage reduction would not be enough to offset widespread flooding. Potential high impacts to soils from increased erosion during major or greater flooding would continue.

4.2.3.2.2 Geologic Hazards

Under the No Action Alternative, the potential for landslides or earthquakes to happen would be the same as existing conditions. There could be a low increase in risk from continued growth and development.

> **No Action Alternative Impacts to Geologic Hazards**
>
> - No to low impacts from increased exposure to risk of earthquake hazards

There are several active landslides in the flood retention facility project area. Under the No Action Alternative, it is expected that timber harvest would continue similar to existing conditions. Therefore, the risks from landslides or earthquakes in this area would not likely change.

Under the No Action Alternative, no specific improvements are proposed for the airport levee. Therefore, it is expected that risks from landslides or other hazards in this area would also not likely change compared to existing conditions.

In the Chehalis River 100-year floodplain area, continued growth would result in new construction. New structures could be at risk from landslides, liquefaction, and earthquakes. Compliance with building standards would minimize impacts from most geologic hazards.

4.2.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts from construction and operation of Alternative 1.

4.2.3.3.1 Geology and Soils

> **Alternative 1 Construction Impacts to Geology and Soils**
>
> **Flood Retention Facility Project Area**
> - Low to medium direct impact from increased erosion
> - Medium direct impact from bedrock removal
>
> **Airport Levee Improvements Project Area**
> - Low direct impact from increased erosion

Construction

Alternative 1 would result in low to medium impacts to geology and soils.

Low to medium increased soil erosion would occur in the flood retention facility project area from ground-disturbing activities. These activities would be required to prepare the site for construction and material stockpile. During site preparation, vegetation would be removed, and large areas of bare soil would be exposed. Tree removal within the temporary reservoir area would also result in increased erosion potential. It was assumed that the Applicant would remove approximately 485 acres of trees prior to operation. Tree removal activities would directly disturb soils. Areas where trees have been removed would have a high erosion potential when it rains. Stormwater would run off more quickly because the vegetation would be greatly reduced.

The Applicant would be required to obtain the necessary permits and approvals listed in Appendix F, including a construction NPDES permit. It is expected this would include compliance with applicable BMPs, including stormwater and erosion control actions consistent with the *Stormwater Management Manual for Western Washington* (Ecology 2019). Because of the scale of the construction and its 5-year construction period, the terms of the NPDES permit would require ongoing monitoring and maintenance during construction activities and during rainstorms. In the event of a larger storm where BMPs failed, the impacts could be high.

Construction of the FRE facility would also result in a medium impact from bedrock excavation. Approximately 920,000 cubic yards of rock and soil would be removed to prepare the foundation at the proposed FRE facility site. Approximately 210,000 cubic yards of that excavated material would be bedrock.

Construction would also require quarry excavation, resulting in a medium impact to geologic resources. Approximately 127,000 cubic yards of excavated material would be required for foundation backfill to construct the structure. Much of this backfill material would come from quarries located in the project area. Excavation at the quarries would also remove a large quantity of bedrock to use as aggregate. That aggregate would be used in concrete for facility construction, and for upgrading access roads. Approximately 937,000 cubic yards of aggregate would be required to construct the FRE facility. A smaller amount would be required for road work.

Construction of the Airport Levee Improvements would result in low impacts from soil erosion associated with vegetation removal and removal of structures and obstructions. The levee side slopes are the steepest location in this project area and have the greatest potential for erosion and slope instability. Use of construction vehicles along the top of the levee would result in a low increase in soil erosion potential because the levee surface is relatively flat and covered with gravel. No excavation would be required.

Operation

Alternative 1 operation would result in no to high impacts to geology and soils. There would be low to high impacts in the flood retention facility project area and no impacts from the Airport Levee Improvements.

Over time, there would be low to high increased erosion in the footprint of the temporary reservoir. The Applicant would remove trees from this area during pre-construction vegetation management. Trees are not likely to reestablish in the lower elevations due to periodic flooding. The Applicant would also continue to remove trees to maintain safe operation for the FRE facility. As a result, the potential for landslides in this area would increase compared to existing conditions. Over time, soil would move downslope. Depending on the location, the soil would eventually be delivered to local streams and the Chehalis River. Sediment delivery in the Chehalis River 100-year floodplain area is discussed in Section 4.3.

> ### Alternative 1 Operational Impacts to Geology and Soils
>
> **Flood Retention Facility Project Area**
> - Low to high indirect impact from increased erosion
>
> **Airport Levee Improvements Project Area**
> - No impact

Periodic flooding would also result in low to medium increased erosion in other parts of the flood retention facility project area. This would occur mainly from flooding of existing roadways.

Soil impacts following completion of the Airport Levee Improvements would be the same as existing conditions. That is, there would be sites where localized erosion or instability might occur related to driving on the airport levee top, major floods, or intense rainfall. Monitoring and regular maintenance would minimize the potential for temporary or permanent soil erosion impacts from routine airport operations.

4.2.3.3.2 Geologic Hazards

Construction

Alternative 1 would result in a low increase in risk of landslides and exposure to harm or damage from earthquakes.

> ### Alternative 1 Construction Impacts to Geologic Hazards
>
> **Flood Retention Facility Project Area**
>
> - Low direct impact from increased landslide risk during blasting and bedrock excavation at the FRE facility construction site
> - Low direct impact from increased risk from earthquakes
>
> **Airport Levee Improvements Project Area**
>
> - Low direct impact from soil erosion
> - Low direct impact from increased risk from earthquakes

Construction of the FRE facility would result in a low increase in the risk of landslides from bedrock excavation. This would include blasting activities and the creation of steep bedrock slopes after excavation to prepare the site for constructing the FRE facility.

There are four existing and potentially hazardous landslides in the vicinity of the FRE facility and the footprint of the temporary reservoir. Construction would remove additional soil and vegetation in this area. This would result in unstable soils and an increase in landslide potential. The Applicant would construct retaining walls and drainage controls to improve soil stability in these areas. With these measures in place, landslide potential during construction would be low.

While the FRE facility is under construction, it would not be earthquake resistant. The risk of large-scale earthquakes in the study area is very low. Therefore, there would be a low increase in risk of exposure of people or structures to harm compared to existing conditions.

The increase in potential geologic hazard impacts at the Chehalis-Centralia Airport from construction of the Airport Levee Improvements would be low compared to existing conditions. No large areas of excavation are proposed that could create steep slopes. There would be a low increase in risk in the unlikely event of an earthquake during construction.

Operation

Alternative 1 operation would result in low to high impacts. There would be no impacts in the Airport Levee Improvements project area.

> ### Alternative 1 Operational Impacts to Geologic Hazards
>
> **Flood Retention Facility Project Area**
>
> - High impact from slope instability, road instability, stream sedimentation, and hillslope and road erosion in temporary reservoir when the FRE facility is operating
> - Low to medium impact from increased landslide risk over the long term
> - High impact from unlikely event of an earthquake causing FRE facility failure during operation
> - Low indirect impact from risk of waves and induced seismicity in the temporary reservoir
>
> **Airport Levee Improvements Project Area**
>
> - No impact

Operation of the proposed FRE facility would result in a medium increase in landslide risk over time. Impacts from existing large landslides within the temporary reservoir inundation zone would generally be low because of proposed stability improvements. The Applicant is proposing to update the analysis of existing landslide stability and determine final detailed plans for their stabilization. There would be a medium risk of landslides in the vegetation management areas as a result of tree removal and associated root decay. High slope instability, road instability, stream sedimentation, and hillslope and road erosion potential would occur during drawdown of the temporary reservoir. The long-term risks would be greater and potentially higher in the event of larger floods or more frequent flooding.

FRE facility operation would also increase the risk of damage or harm from hazards from earthquakes. As noted previously, the chance of a large-scale earthquake is very low. There is an even lower chance that an earthquake would happen while the temporary reservoir was full. The Applicant would be required to meet applicable design standards and to comply with the Washington Dam Safety Program. Therefore, this impact is considered to be low. If the FRE facility failed when it was full, a very large volume of water would be released. If substantial amounts of water reached populated areas located downstream, there could be a high impact from damages and injuries in that area. These damages could impact all elements of the natural and built environments. The likelihood of these impacts occurring is low. This is because it is unlikely that a large earthquake would occur during the approximately 30 days every 7 years that the temporary reservoir is holding water.

In addition to the potential impacts from earthquakes causing damage to the FRE facility, there could be a slight increase in risks related to large waves. This impact would occur if an earthquake happened when the temporary reservoir was holding water. Because it is unlikely that a large-scale earthquake would occur when the temporary reservoir was holding water, the likelihood of impacts from large waves is low.

In addition, there would be a slight potential for induced ground shaking. This happens when the act of reservoir filling causes the earth to shake. This phenomenon can occur due to the addition of considerable water weight to the Earth's surface (Foulger et al. 2018). Based on the volume of water, the short fill time when used, and the possibility of this occurring approximately every 7 years, the potential for this to occur is considered low.

As noted earlier, the Airport Levee Improvements would be constructed to meet applicable design standards. The improved levee would be operated in the same way as the existing levee. No other activities are proposed during operation that have the potential for ongoing geologic hazard impacts.

4.2.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

As noted in Chapter 3, the potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1. Therefore, this section focuses on construction of the FRO facility under Alternative 2.

Alternative 2 would be similar to Alternative 1, except the FRO facility would be built on a smaller foundation than the FRE facility and the construction period would be about 9 months shorter. Overall, construction impacts with respect to soils and geologic hazards would be the same as described for Alternative 1, but slightly lower. Lower impacts would occur because of the reduced size of the FRO facility and the reduced time frame of construction. Bedrock impacts would be less extensive because less excavation would be needed for construction of the smaller FRO facility.

4.3 Geomorphology

> **Key Findings**
>
> **Construction**
> - Low to medium impact from increased sediment load in the flood retention facility project area
> - High impact to sediment loading in the flood retention facility project area if the capacity of the diversion tunnel is exceeded
> - Low to high direct impact to sediment transport from increased sediment deposition
> - Medium to high impacts from reduced LWM
> - Low impacts to LWM transport
> - No impact to channel movement
>
> **Operation**
> - High impacts to sediment loading and transport in the flood retention facility project area
> - Low to medium impacts to sediment loading and transport in the Chehalis River 100-year floodplain area
> - Medium to high impact to LWM
> - No to medium impact to channel movement
> - High impact if sediment deposition in the mainstem increases localized flooding at confluences with some major tributaries

4.3.1 Introduction

Geomorphology is the study of landforms and the processes that create and shape them. Fluvial geomorphology focuses on the processes that change the shapes of rivers, which is the focus of this section. This includes how water and sediment, which can be sand, gravels, and cobbles, move in a river, and how landforms are created by the river. It also includes processes that affect LWM within a river.

This section describes the processes that have shaped and are continuing to shape the Chehalis River in the study area. It also describes how those processes and the Chehalis River could be affected by the alternatives. Additional detail is provided in Appendix I, the discipline report for geomorphology. Section 4.1 describes the river and Section 4.2 describes geology.

4.3.2 Affected Environment

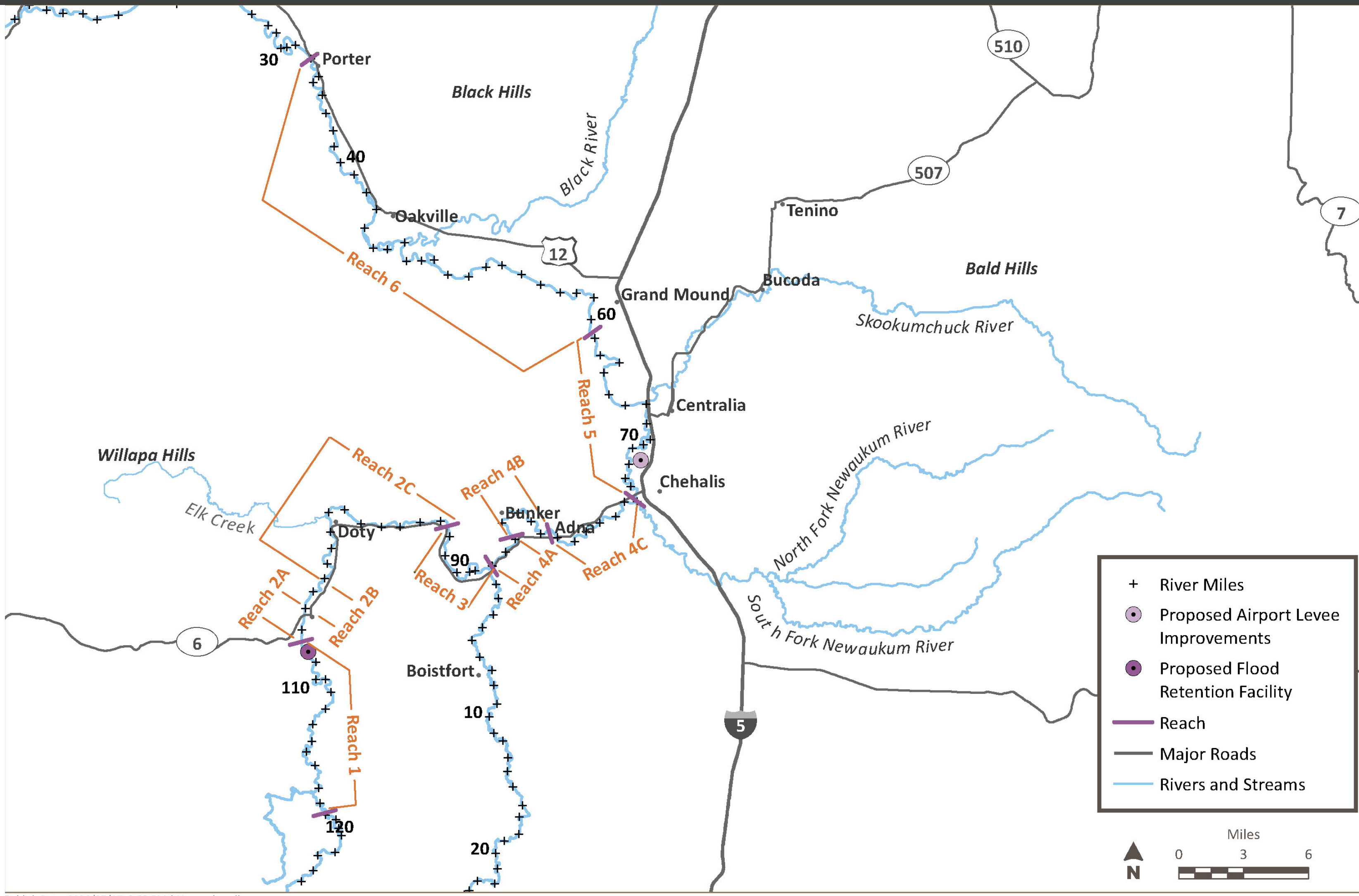
This section describes the geomorphic characteristics of the Chehalis River in the study area. This includes sediment load and transport, supply and transport of LWM, and channel movement. The study area is defined in Section 3.6. Because, as discussed in Section 4.1, the Airport Levee Improvements would not affect river flows, impacts to geomorphology in that area are not expected and are not discussed further in this section.

4.3.2.1 Chehalis River Geomorphic Characteristics

The Chehalis River is confined by bedrock in the vicinity of the proposed flood retention facility. In the Chehalis River 100-year floodplain area, the Chehalis River alternates between steeper confined and less steep unconfined reaches. When river flows are high enough, sediment tends to move through confined reaches and build up in unconfined reaches.

Because of the variability in the Chehalis River, the study area was broken into six geomorphic reaches. Reaches 2 and 4 were further broken into subreaches because that part of the study area is more complex. These reaches and subreaches were selected based on whether the river was confined or unconfined and where tributaries enter the river mainstem (Figure 4.3-1).

Figure 4.3-1
Geomorphic Reaches



Publish Date: 2020/07/17, 3:33 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Geomorphology\AQ_NEPA-EIS_Geomorph_Reach_Map.mxd

Source: WGD and Anchor QEA 2014

Each reach includes the Chehalis River channel and the 100-year floodplain on either side of the river between the RM markers listed in the table. Junctions with tributaries are noted because they provide water, sediment, and wood that can alter conditions in the mainstem. Table 4.3-1 and the following sections summarize the existing geomorphic characteristics of the study area.

Table 4.3-1
Geomorphic Descriptions by Reach and Subreach

GEOMORPHIC REACH/ SUBREACH	LOCATION	DESCRIPTION	GEOMORPHIC CHARACTERISTICS
1	Headwaters to RM 107.5	Extends from headwaters to just upstream of Pe Ell. Includes the flood retention facility site. Channel slope of 1%.	Channel confined by steep-sided valley with bedrock outcrops. River is steep and sediment moves through this reach.
2A	RM 107.5 to RM 105.9	Sediment from 2007 flood located and being actively reworked in this reach. Pe Ell area. Channel slope of 0.24%.	Channel confined. River not as steep as Reach 1, but sediment moves through this reach.
2B	RM 105.9 to RM 104.4	A large log jam likely occurred at the downstream end during the 2007 flood, which resulted in the channel filling in with sediment. Channel slope of 0.21%.	Substantial channel movement occurs. Sediment generally builds up in this reach.
2C	RM 104.4 to RM 93.5	Elk Creek enters the mainstem Chehalis River in this sub-reach. Bedrock outcrops and Rainbow Falls located in this reach. Channel slope of 0.18%.	Channel confined. River not as steep as Reach 1, but sediment moves through this reach.
3	RM 93.5 to RM 88	Extends from RM 93.5 to the confluence with the South Fork Chehalis River. This reach is in an unconfined area with a much lower gradient than Reach 2. The bed comprises more gravel and less cobble compared to Reaches 1 and 2. Channel slope of 0.05%.	Channel movement occurs. Sediment generally builds up in this reach.
4A	RM 88 to RM 85.9	South Fork Chehalis River enters at the upstream end of this reach. Channel slope of 0.14%.	Confined channel. Sediment added to River from South Fork Chehalis in this reach. Sediment moves through this reach.
4B	RM 85.9 to RM 81.6	Near city of Adna. Channel slope of 0.11%.	Channel movement occurs. Sediment generally builds up.

GEOMORPHIC REACH/ SUBREACH	LOCATION	DESCRIPTION	GEOMORPHIC CHARACTERISTICS
4C	RM 81.6 to RM 75.3	Newaukum River enters mainstem Chehalis River at downstream end of this sub-reach. Channel slope of 0.05%.	Channel moderately confined. Sediment builds up in this reach. Finer-grained substrate (in general) than upstream reaches. Sediment added to the Chehalis River by the Newaukum River in this reach.
5	RM 75.3 to RM 61.7	Extends from the confluence of the Newaukum River downstream to RM 61.7. This river channel in this reach is relatively flat. The slope of the river is controlled by several bedrock shelves that span the river between RM 65.5 and RM 61.7. Grain size of bed materials is finer than in Reaches 1 through 4. The Skookumchuck River enters this reach at RM 67. Channel slope of 0.03%.	River channel is very flat in this reach and the channel is moderately unconfined to moderately confined at outcrops. Limited movement of larger bed materials such as cobbles through this area. Cobble and gravel sediment added to the Chehalis River by the Skookumchuck River in this reach.
6	RM 61.7 to RM 33	This reach extends from a bedrock control at RM 61.7 to the end of the study area at Porter (RM 33). The Chehalis River flows through a 2- to 3-mile-wide valley. Black River enters mid-reach. Channel slope of 0.07%.	River channel relatively flat, but steeper than Reach 5. Channel is unconfined, the floodplain is very wide, and channel movement occurs.

4.3.2.1.1 Sediment Load and Transport

Sediment Load

In the study area, sediment loads into the Chehalis River come from different sources. Sediment comes from erosion of upland slopes and riverbanks, erosion of the riverbed itself, and landslides. Sediment also comes from tributaries as they enter the mainstem of the river. In the study area, the main sources of upland erosion come from areas disturbed by timber harvest, agriculture, and development.

Riverbank and riverbed erosion happen when river flows move sediment to other locations from within the river. This is a natural, ongoing geomorphic process. Over time, this process shapes the river. The amount of sediment that moves to downstream areas increases when the river flows increase. In this way, rainfall that results in increased river flows can cause larger amounts of sediment loading in downstream areas of the Chehalis River.

Sediment also enters the river from landslides, which have been observed in the flood retention facility project area (Ward and Russell 1994; WGD and Anchor QEA 2017). There were nine active landslides in this area between 1955 and 2009. The amount of sediment input into the Chehalis River from each of these landslides was estimated to range between approximately 20,000 tons (2009) to 1.3 million tons (1978) (WGD and Anchor QEA 2017). Most of the landslides have happened high on the valley walls and were not caused by flooding at their base (Weyerhaeuser 1994a; Sarikhan et al. 2008). In other words, these landslides were not caused by Chehalis River flows. Instead, they were likely caused by other factors such as site-specific geologic conditions or weakening of the slope due to heavy rain. No other landslides were observed elsewhere in the study area because of the relatively flatter terrain.

Sediment also enters the Chehalis River where tributaries enter the mainstem, bringing sediment that has eroded from their watersheds, riverbanks, and riverbeds. The main tributaries in the study area include the South Fork Chehalis River, the Newaukum River, the Skookumchuck River, and the Black River. Average annual sediment load into the mainstem Chehalis River from these tributaries ranges from 3,000 tons per year (Black River) to 36,000 tons per year (Newaukum River) (WGD and Anchor QEA 2012). There are also many creeks that enter the Chehalis River within the study area that also provide smaller amounts of sediment.

Sediment Load and Transport Terms

- **Sediment:** Soil mineral particles (sand, silt, clay) and fragmented rock materials (gravel, cobble, rocks) that are moved into and by the river
- **Sediment load:** Amount and type of sediment that enters a river from landslides, upland erosion, or erosion from the riverbanks or riverbed
- **Sediment size:** Type of sediment based on its size, including from smallest to largest (e.g., clay, silt, sand, gravel, cobble)
- **Substrate:** Surface makeup of the riverbed
- **Sediment transport:** Movement of sediment from one part of the river to another, influenced by sediment load, river flow, sediment size, the slope of the riverbed, and whether the channel is confined or unconfined
- **Sediment deposition:** Buildup of sediment in one area of a river
- **Fining:** Sediment size is decreasing
- **Coarsening:** Sediment size is increasing

Sediment Transport

Within the study area, gravel and cobble from the riverbed generally begin to move downstream at flows of approximately 6,000 cfs or greater as measured at the Doty gage (USGS 12020000) (Appendix I). This flow is about five times the average winter flows at Doty (1,200 cfs) and lower than flows from a 2-year flood (9,900 cfs). For additional context, flows at Doty during the 2007 flood were 52,600 cfs. Section 4.1 provides information on typical and peak flows in the Chehalis River at various locations in the study area. Smaller amounts of fine sediment can be transported at much lower rates. Transport rate increases when water moves faster. The transport rate may increase more at higher flow rates.

In general, coarser sediments, such as gravels and cobbles, tend to move through the river in Reaches 1, 2A, 2C, and 4A. They tend to build up in Reaches 2B, 3, 4B, 4C, 5, and 6. Finer sediments, such as clays, silts and sands, move through the river in all reaches. This is because those sediments can be moved by lower flow velocities than larger sediments.

The typical size of the sediments in the river changes moving downstream. In general, sediment sizes are larger (gravel and cobbles) in upstream reaches, and smaller in the downstream reaches. This trend, called fining, has been observed in many similar rivers.

In the study area, the Chehalis River shows this trend towards fining in two places. Bedrock shelves in Reach 5 between RM 65.5 and 61.7 keep some of the finer sediments from moving farther downstream, somewhat resetting the fining process in downstream reaches. Sediments become finer moving from Reach 1 to the bedrock shelves in Reach 5. Beyond these shelves, the size of sediment becomes coarser again, then continues to become finer downstream (WGD and Anchor QEA 2014).

The total amount of sediment moving in the river during a specific river flow is difficult to predict. This is because there is always variation in sediment loading and in sediment transport. However, estimates of how much sediment is moving in the river for different river flows was developed using available data (WGD and Anchor QEA 2017). Based on these estimates, the amount of sediment moving in the river is about 40 tons per day for flows of 1,000 cfs, 12,000 tons per day for flows at 10,000 cfs, and 150,000 tons per day for flows at 50,000 cfs at each location in the Chehalis River (WGD 2019).

4.3.2.1.2 Large Woody Material

LWM provides diverse aquatic habitat and interacts with river flows and sediment to alter channel movement and shape. LWM comes from whole trees, logs, stumps and branches that enter the channel from landslides, bank erosion, and channel movement. These processes happen mainly during large storms. Peak flows and floodwaters mobilize, carry, and deposit LWM in downstream channel and floodplain areas, often in logjams. LWM deposited in one location by a flood can be mobilized again and deposited farther downstream during a later flood.

Current levels of LWM in the Chehalis River are low compared to rivers of similar size (Weyerhaeuser 1994a, 1994b; Smith and Wenger 2001; WGD and Anchor QEA 2017). Past timber harvest has left a limited supply of LWM in the watershed.

Most LWM enters the Chehalis River in Reaches 3, 4B, and 6, but LWM loading was also observed in Reach 5. LWM in other reaches appears to have been moved during large floods and is mainly deposited on gravel bars either as single pieces or in occasional jams.

4.3.2.1.3 Channel Movement

> **Channel Movement Terms**
>
> - **Channel movement:** Changes in the location of the channel within the floodplain or in the width of the channel over time
> - **Channel confinement:** Inability of a channel to move side-to-side because of natural features such as steep valley slopes or bedrock outcrops or because of human-created structures such as levees

Over time, the movement of sediment and LWM through a river can cause the river channel to move or change shape. As the riverbank erodes in some areas, sediment is deposited in others. This naturally causes the river to meander. This can cause problems for people living within the floodplain because the riverbank can erode, causing damage to land and property.

In Reaches 2B, 3, 4B, the lower section of 5, and 6 (Table 4.3-1), the river channel can move within the floodplain, and has done so in the past. Based on an analysis of historical maps and photographs from 1876 to 2009 (WGD and Anchor QEA 2012), the channel in these areas has moved from 300 to 4,000 feet, with the largest movement happening in Reach 6. Reach 6 also experienced some abrupt changes in the location of the channel prior to 1945.

A study to outline and compare historical riverbank locations was done using historical photographs to calculate the average annual amount of channel movement that occurred in Reaches 2B, 3, and 4B using data from 1945 to 2013 (Anchor QEA and WGD 2017). The channel in these areas was found to move between 2 and 65 feet per year, depending on the location. It was observed that channel movement occurred at flows lower than those that would happen during a major or greater flood. This means that channel movement is not always caused by large floods, and could happen even in the absence of major or greater flooding. Channel movement was observed in most areas as a slow continuous bank erosion on the outside of meander bends. The only rapid change to a new channel occurred in Reach 2B during the 2007 flood, which was likely caused by a large log jam that formed during that flood.

4.3.2.2 2007 Flood

The 2007 flood resulted in substantial geomorphic effects on the Chehalis River. An estimated 5.7 to 8.7 million tons of sediment from landslides entered headwaters upstream of the proposed flood retention facility during the 2007 flood (WGD and Anchor QEA 2017). Much of this material was fine-grained clay, silt, and sand that was carried to downstream areas. Some coarser material was also transported to downstream areas, but much of the material remains in the flood retention facility project area.

Based on a comparison of historical photographs, the channel width increased following the 2007 flood from the headwaters (RM 113) to the confluence with the South Fork (RM 88). The change was greatest in unconfined areas where channel movement is most active. There was also an increase in gravel bars upstream of RM 91.5. Gravel bars form because of sediments being deposited in the river channel. The channel widens because the gravel bars take up room in the river and force the water to move around them. This often results in bank erosion, which widens the river at the gravel bar locations. Since 2007, the channel has been slowly narrowing due to vegetation growth on top of the gravel bars. Over time, it is anticipated that the channel will coarsen as sediments are carried downstream.

The landslides that happened during the 2007 flood yielded a large amount of LWM. About 700 acres of landslides deposited LWM to Chehalis River headwaters, Stillman Creek, and the South Fork Chehalis River watershed (Entrix 2009). Much of the LWM was deposited in the floodplain and has been subsequently cleared as part of flood cleanup actions. Photographs from 2008 show large amounts of wood at RM 104 to RM 105, RM 88 to RM 91, along parts of the South Fork Chehalis River, and smaller amounts near Adna.

It is expected that the riverbed in reaches with finer-grained substrates deposited during the 2007 flood will gradually coarsen to more closely reflect the substrate size prior to the flood. Based on an estimate of the amount of stored sediment and understanding of sediment transport in the Chehalis River, it will likely take several decades for the channel to return to pre-2007 conditions.

4.3.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.3.3.1 Methods

The analysis of potential impacts to geomorphology considered information from reports, technical studies, field visits, and modeling. In most cases, the impacts were qualitatively assessed using this information. In other cases, the impacts were quantified based on computer modeling. The methods used are summarized in Table 4.3-2. Appendix I provides a detailed discussion of methods used to assess the potential impacts. Appendix E provides a description of the thresholds used to determine the level of impacts.

Table 4.3-2
Methods for Geomorphology Impact Analysis

ENVIRONMENTAL RESOURCE	TYPE OF ANALYSIS	MODEL	DESCRIPTION
Sediment Loading	Quantitative (temporary reservoir and tributaries)	None	Quantitative field studies of suspended load, interpolation for bedload estimates, and landslide estimates
Sediment Transport	Quantitative (RM 118 to 75)	HEC-RAS	1-D Hydraulic and sediment transport model
	Qualitative (RM 75 to 33)	None	Supplemental hydraulic information from flood modeling and field observations

ENVIRONMENTAL RESOURCE	TYPE OF ANALYSIS	MODEL	DESCRIPTION
Large Woody Material	Qualitative	None	Based on changes to hydraulics predicted by the 1D- Hydraulic model and FRE facility operations plan
Channel Migration	Qualitative	None	Based on changes to hydraulics predicted by the 1D- Hydraulic model and FRE facility operations plan

4.3.3.2 No Action Alternative

The No Action Alternative would not result in substantial changes affecting geomorphic processes. Certain projects and programs would provide local relief from flooding (e.g., elevating structures). However, these projects and programs are not expected to result in substantial changes in flow velocities and water levels in the study area. This is because the scale of each project is small relative to the overall Chehalis River mainstem and floodplain. This means that geomorphic processes are generally expected to remain the same as existing conditions. In the event of a major or greater flood, geomorphic processes would be affected in the same way as described in Section 4.3.2.2. This includes the potential for high impacts during major or greater floods.

> **No Action Alternative Impacts to Geomorphology**
>
> - No to low impacts to sediment loading and transport
> - No to low impact to LWM input or transport
> - No to low impact to channel movement
> - Low to high impacts from continued risk of major or greater flooding

In the flood retention facility project area, sediment and LWM input from upland slopes may slightly increase. This is because of the WDNR Forest Practices Habitat Conservation Plan, which would lead to larger trees in forested areas. This would reduce erosion and increase the supply of LWM.

4.3.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts of construction and operation of Alternative 1 on geomorphology in the study area.

4.3.3.3.1 Construction

Sediment Load and Transport

Alternative 1 would result in low to high impacts to sediment load and transport.

> ### Alternative 1 Construction Impacts to Sediment Load and Transport
>
> - Low to medium direct impact to sediment loading from increased erosion
> - High impact to sediment loading if the capacity of the division tunnel is exceeded
> - Low to high direct impact to sediment transport from increased sediment deposition
> - No to low direct impact downstream of the construction site

FRE facility construction would result in low to medium impacts to sediment loading from increases in sediment entering the Chehalis River from within the flood retention facility project area (Reach 1). Construction would also result in a low to high impact to sediment transport by affecting the amount and size of sediment moving in this part of the river. Low impacts to sediment load and transport are expected during the construction period below the FRE facility construction site in the Chehalis River 100-year floodplain area.

As discussed in Section 4.2, Alternative 1 would increase the risk of erosion at the FRE facility construction site as the result of vegetation removal, extensive grading, and in-water work. In addition, it was assumed the Applicant would remove trees from approximately 485 acres of the temporary reservoir area, including areas along the riverbank. This acreage represents the area within the temporary reservoir that would be covered by water when the FRE facility operated during a 20-year flood. Vegetation removal would expose soils in the FRE facility project area, increasing the risk of erosion. The resulting impact would be a low to medium increase in sediment loading.

Construction would also result in a low to high impact to sediment transport in the flood retention facility project area (Reach 1). This would be a result of diverting flows around the construction site. Under most flow conditions, the impacts would be low. The diversion tunnel is designed to allow for sediment transport similar to natural river conditions for flows at or below the tunnel design capacity.

At flows that exceed the design capacity, generally equivalent to a 2.8-year flood, it is possible that the water could back up and flood the construction site. There is about an 89% chance of this happening during the 5-year construction period. Flooding inside the construction site could disturb soils and carry away other material. If the flooded construction site overtopped the downstream cofferdam, sediment could be carried farther downstream. This would increase sediment loads in the river and increase sediment transport through Reach 1. There could be increased erosion upstream of the diversion tunnel inlet and increased sediment deposition downstream of the diversion tunnel outlet. Over time, these conditions could result in fining of the sediment upstream of the diversion tunnel due to backwatering and coarsening of the sediment downstream of the diversion tunnel from scouring. If this were to happen, the impact could rise to high.

Large Woody Material

> **Alternative 1 Construction Impacts to Large Woody Material**
>
> - Medium to high direct impact from reduced LWM input in temporary reservoir area
> - Low direct impact from reduced downstream LWM transport through the diversion tunnel

Alternative 1 construction would result in medium to high impacts to LWM input. There would also be low impacts to transport during the 5-year construction period. The impacts would begin during the construction period but would be permanent because they would last through operation.

As noted previously, it was assumed that the Applicant would remove trees from approximately 485 acres in the footprint of the temporary reservoir. Therefore, there would be less LWM that could eventually enter the river. This would result in a high impact. It is possible that a plan could be developed by the Applicant to provide LWM for habitat creation in other parts of the study area. Mitigation is addressed in Chapter 7.

During the construction period, under most flow conditions, there would be a low impact to the transport of LWM through the diversion tunnel in Reach 1. This is because velocities through the diversion tunnel would be similar to existing conditions. However, some larger trees that exceed the dimensions of the diversion tunnel may not be able to pass through. Because most trees of this size would otherwise be removed from the area for commercial harvest, this impact would remain low during the 5-year construction period.

Channel Movement

> **Alternative 1 Construction Impacts to Channel Movement**
>
> - No impact during construction

Construction of the FRE facility is not expected to result in any impacts to channel movement. Construction would not directly change the location of the river channel above or below the FRE facility structure. The river channel in Reach 1 is confined by bedrock that allows for little to no side-to-side movement. As noted above, flow rates through the diversion tunnel are anticipated to be similar to existing conditions under most conditions. There would be some low impacts from increased sediment transport in this reach. However, these impacts are not anticipated to be substantial enough to affect channel movement during the construction period.

4.3.3.3.2 Operation

Sediment Load and Transport

Operation of the FRE facility would result in low to high impacts to sediment loading and low to medium impacts to sediment transport. The severity and type of impacts varies by reach.

Under Alternative 1, there would be a high impact to sediment loading and transport in the flood retention facility project area (Reach 1). This is because Alternative 1 operation would result in a substantial increase in sediment input, deposition, and fining in this area.

Increases in sediment loading in the flood retention facility project area would happen because of increased upland erosion. As discussed above, there would be fewer trees to hold the soil in place along the riverbank as the result of ongoing vegetation management activities and periodic flooding. This would make it more likely for sediments to enter the Chehalis River.

> ### Alternative 1 Operational Impacts to Sediment Load and Transport
>
> **Flood Retention Facility Project Area**
>
> - High indirect impact to sediment loading from increased erosion and landslide risk
> - High indirect impact to sediment transport from increased sediment storage and fining
> - High indirect impact from the riverbed becoming shallower in the footprint of the temporary reservoir
>
> **Chehalis River 100-Year Floodplain Area**
>
> - Low to medium indirect impacts from decreased sediment, changes to bed substrate, and riverbed elevation in Reaches 2 to 4A
> - Low indirect impacts in Reaches 4B to 6
> - High indirect impact if reduced flooding increased deposition in the mainstem at some major tributary confluence locations

Periodic flooding in the temporary reservoir would also loosen soils and increase the risk of landslides in this part of the river. When the FRE facility holds water, the soil in the temporary reservoir would become saturated. As the temporary reservoir drains, those saturated soils would no longer be held in place by the pressure of water in the temporary reservoir. Such conditions would increase the likelihood of landslides (WGD and Anchor QEA 2014). Approximately 10% of the temporary reservoir area was estimated to contain soils on slopes steep enough that they may become unstable as a result of periodically flooding the temporary reservoir (WGD and Anchor QEA 2014). Compared to the amount of sediment that currently enters the river in Reach 1, Alternative 1 would be expected to result in a high increase in sediment loading over time.

When the FRE facility is operating and the gated outlets are partially closed, sediment being transported into Reach 1 from upstream areas would build up within the footprint of the temporary reservoir. Fine sediments, which would otherwise be transported downstream, would instead be deposited within the channel and at higher elevations along the riverbanks.

Some of this material would later be carried downstream when the gated outlets opened. However, an additional approximately 50,000 tons of sediment would remain in Reach 1 and would not be moved downstream (based on modeling), resulting in a high impact to sediment transport. Over time, the riverbed in Reach 1 would become shallower and wider as sediment builds up in Reach 1.

In the Chehalis River 100-year floodplain area (Reaches 2A through 6), there would be low to medium decreases in sediment load and low to medium changes in sediment transport. Specific impacts to sediment movement and deposition (increase or decrease) vary by reach. If flows were high enough to cause mainstem flows to back up at major tributaries, there could also be a high impact from increased sediment deposition in those locations.

As noted above, the sediment load moving out of Reach 1 would decrease over time. This means there would be less sediment transported to downstream reaches compared to existing conditions. There would also be a low to medium increase in erosion of the channel and coarsening of the sediment size from Reach 2 to about Reach 4A. The severity of impacts would decrease moving downstream of the proposed FRE facility. This is because the effects of the FRE facility on water and sediment inputs and transport are expected to be muted by tributary inputs and grade controls at RM 62 and 65 (WGD 2012, 2014). Downstream of Reach 4A, impacts to sediment transport would be low.

Under Alternative 1, it is possible that there could be more sediment deposition in the mainstem over time at the confluence of primary tributaries. If enough sediment were deposited by tributaries and mainstem flows were not high enough to move this sediment farther downstream over time, flooding in these areas could become worse. If this happened, this would be a high impact. Whether this would happen depends on the factors described below.

The main way this buildup could happen would be from the tributaries flooding. If flows from the tributaries were great enough to cause flows in the mainstem to back up, the decreased water velocity in the mainstem could result in sediment deposition in these areas. Modeling showed increased sediment deposition in the mainstem upstream of some of these tributaries after major or greater flooding.

The reason that Alternative 1 could cause an impact is because peak flows from major or greater floods in the mainstem would be reduced by the operation of the FRE facility. The reduced flows could be insufficient to move the accumulated sediments at confluence areas downstream. Under existing conditions, buildup of sediment is moved farther downstream by mainstem river flows over time.
As noted in Section 4.3.3, coarse sediment generally begins to move within the system at flows of about 6,000 cfs as measured at the Doty gage. Flows of this rate would continue under Alternative 1. However, operation of the FRE facility would reduce the largest peak flows from major or greater flooding compared to existing conditions. This could limit the amount of sediment transport that occurs during such floods under existing conditions.

It is also possible that impacts of Alternative 1 during a single catastrophic flood could be greater by comparison than the long-term changes that would occur over the course of the analysis period. This is because one such flood could result in larger amounts of sediment and LWM being delivered to the

Chehalis River than several smaller floods combined. This material would take years or perhaps decades to move through the study area and could have substantial impacts to sediment load, sediment size, and deposition and erosion patterns in the river during that time. For example, the 2007 flood set records for 24-hour precipitation in the upper Chehalis Basin and added large amounts of sediment and LWM to the Chehalis River. It is estimated that between 5 and 8 million tons of sediment were delivered to the Chehalis River because of landslides during that one flood. The combination of high flows and sediment and LWM loading into the river resulted in geomorphic changes throughout the Chehalis River system. The river is still responding to changes caused by this flood (WGD and Anchor QEA 2014).

Large Woody Material

Alternative 1 operation would result in medium to high impacts from reduced LWM input and transport. The impacts would be high in Reaches 1 through 4C, and medium to high in Reaches 5 and 6.

In the flood retention facility (Reach 1), there would be much less LWM because of ongoing vegetation management and periodic flooding in the footprint of the temporary reservoir. The Applicant would continue to harvest and remove LWM from this area for safe operation of the FRE facility. Periodic flooding is also expected to prevent larger trees from regrowing along the riverbanks.

Alternative 1 Operational Impacts to Large Woody Material

Flood Retention Facility Project Area

- High indirect impact from reduced LWM input and transport (Reach 1)

Chehalis River 100-Year Floodplain Area

- High indirect impact from reduced LWM to RM 75
- Medium indirect impact from reduced LWM to RM 33

Alternative 1 operation would also have a high impact to the transport of LWM through Reach 1. This is because most LWM would not be able to pass below the FRE facility. Although the gated outlets would be open most of the time, LWM that is wider than 3 feet in diameter or longer than 15 feet would not be able to pass through the structure to downstream reaches. When the gated outlets are partially closed, most debris, including LWM, would be blocked. Either way, LWM is expected to accumulate above the FRE facility. As noted in Chapter 3, this material would be periodically collected and removed from the temporary reservoir footprint under the operational plan for the FRE facility (Anchor QEA 2017). Some of this material could be manually transported downstream of the FRE facility and reintroduced into the river channel.

In the Chehalis River 100-year floodplain area, there would be a medium to high impact to LWM input and transport. Because much of the LWM input into the temporary reservoir would be retained upstream of the FRE facility, there would be less LWM available for transport. This would cause a high reduction in LWM input and transport downstream of the facility in Reaches 2A through 4C. Medium to high decreases in LWM input and transport are expected in Reaches 5 and 6.

The transport of LWM downstream of the FRE facility would also be reduced because peak flows from major or greater floods would be reduced. Because LWM levels are low under current conditions, this is likely to result in a further reduction in aquatic habitat diversity.

Channel Movement

There would be a medium widening of the Chehalis River channel in the footprint of the temporary reservoir. This is because of sediment deposition. When the FRE facility was operating and the temporary reservoir was filled, much of that sediment would be deposited in and around the river channel in the lowest parts of the temporary reservoir footprint. Once the gated outlets reopen, higher flows would move through the reach and create a wider wetted channel. This could result in a braided channel instead of a single flow channel. Although channel width and complexity would increase in that reach, channel movement would be minimal due to the surrounding bedrock that confines the existing river channel.

Alternative 1 Operational Impacts to Channel Movement

Flood Retention Facility Project Area

- Medium indirect impact from widening of the Chehalis River (Reach 1)

Chehalis River 100-Year Floodplain Area

- Medium indirect impact from reduced channel movement in Reaches 2B and 3
- Low indirect impact from reduced channel movement in Reaches 4B, 5, and 6
- No impact to confined channels (Reaches 2A, 2C, 4A, and 4C)

In the Chehalis River 100-year floodplain area, there would be low to medium impacts from reduced channel movement. Alternative 1 would reduce the influence of peak flows from major or greater flooding. There would be no impact to reaches that are currently confined and have no movement potential (Reaches 2A, 2C, 4A, and 4C). Channel movement would be affected in downstream reaches that are subject to channel movement (Reaches 2B, 3, 4B, and 6, and the lower part of Reach 5). Impacts are expected to be medium in Reaches 2B and 3 and low for Reaches 4B, 5, and 6.

As noted in Section 4.3, channel movement also occurs at flows that are not high enough to trigger FRE facility operation. Bank erosion and channel movement associated with these flows (less than a major flood) would continue in unconfined reaches (Reaches 2B, 3, 4B, and 6, and the lower part of Reach 5).

Under Alternative 1, the elimination of peak flows from major or greater floods would be expected to decrease bank erosion and subsequent channel movement over time in Reaches 2B, 3, 4B, and 6, and the lower part of Reach 5. In addition, as riverbanks become more stable, more streamside vegetation could grow in areas that previously eroded during larger floods. The increased riparian vegetation would also work to stabilize the banks and potentially further reduce channel movement in unconfined reaches.

This reduction in peak flows corresponds to reductions in both LWM and sediment load. Reaches 4B, 6, and the lower part of Reach 5, which are farther downstream from the FRE facility, are expected to experience relatively low reduction in channel movement. This is because the effects of flow changes from FRE facility operation would diminish with distance.

Based on the analysis of Chehalis River channel movement rates between 1945 and 2013, most major channel movement events were caused by channel-spanning log jams coupled with high flow in the river. A major channel movement is one where the channel moves suddenly. Log jams of that size typically occur during extreme floods when large amounts of LWM can be supplied to the river from upstream landslides. Reduced peak flows during major or greater floods would decrease LWM inputs from the upper portion of the basin, reducing the likelihood that channel-spanning log jams would form (WGD and Anchor QEA 2014). As a result, a medium reduction in the occurrence of channel movements would likely occur with FRE facility operation. However, the reduction in channel movement also results in reduction of complexity of the channel (and habitats) in the river.

4.3.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Construction and operation of the FRO facility and the Airport Levee Improvements would be the same as for Alternative 1. The only difference between the two alternatives considered as part of this evaluation is the difference in the structure bases. Alternative 2 would have a smaller base overall. However, the difference would be negligible with respect to the potential to alter geomorphology.

4.4 Wetlands and Other Waters

4.4.1 Introduction

This section describes wetlands and other waters in the study area. Wetlands have characteristics of both terrestrial and aquatic lands. The Corps defines wetlands as "… areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (33 CFR 328.3[b]). Other waters include non-wetland waterbodies such as rivers, streams, and lakes.

This section also describes how the alternatives would impact those resources. Additional information on the analyses used to prepare this section can be found in Appendix J, the discipline report on wetlands and other waters. Information about the characteristics of other waters is in Section 4.1.

Key Findings

Construction

- High direct impact to wetlands, other waters, and buffers from permanent loss and/or conversion in the flood retention facility and Airport Levee Improvements project areas combined
- Low to high direct permanent impacts to other wetland, other waters, and buffers in the flood retention facility project area
- Low to medium direct permanent impacts to wetlands and buffers in the Airport Levee Improvements project area
- Low direct temporary impacts to wetlands and other waters from increased erosion and risk of spills

Operation

- Medium indirect impact from periodic disturbance of wetlands, other waters, and buffers in the lower temporary reservoir footprint
- Low indirect impact from periodic disturbance of other waters, and stream buffers in the upper temporary reservoir footprint
- No impact to wetlands, other waters, or buffers from Airport Levee Improvements
- Low indirect impact to wetlands, other waters, and stream buffers in the Chehalis River 100-year floodplain study area

4.4.2 Affected Environment

This section describes wetlands and other waters in the study area, as defined in Section 3.6.

4.4.2.1 Wetlands

Wetlands perform a variety of functions in the environment. Common functions include storing water, filtering sediments and nutrients from runoff, and providing fish and wildlife habitat.

Wetland presence is usually determined by the presence of all three of the following characteristics:

- Prevalence of plants that are adapted to wet conditions (hydrophytic vegetation)
- Soils that have specific characteristics of being wet for long periods of time (hydric soils)
- Standing water or the presence of saturated soils for prolonged periods (wetland hydrology)

Wetland Terms

- **Wetland delineation:** identification of the boundary between wetlands and uplands based on the three wetland characteristics (water-dependent plants, soil with wet characteristics, and wetland hydrology)
- **Wetland classification:** wetland groups based on shared characteristics such as plant type, water flow pattern, or location in the landscape
- **Wetland rating:** Assignment of wetland ranking based on their sensitivity to disturbance, significance in the watershed, rarity, ability to be replaced, and the beneficial functions they provide to society

Wetlands were delineated by the Applicant in the flood retention facility and Airport Levee Improvement project areas. Those delineations provided a preliminary inventory for the purpose of impact analysis under NEPA. During the DA permit review process, the Applicant will provide the Corps with an updated delineation based on the specifics of the selected alternative. The Applicant will be required to demonstrate that wetlands have been delineated and classified accurately, and that all impacts have been sufficiently avoided, minimized, and mitigated.

Wetlands were delineated using the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Delineation Manual: Western Mountains, Valleys and Coast Region (Version 2.0)* (USACE 2010). The methods described in these documents focus on determining the presence or absence of the three wetland characteristics (hydrophytic vegetation, hydric soils, and wetland hydrology) to identify wetlands and map their boundaries in the field. Additional information on the wetland delineation methods and mapping process are provided in Appendix J.

The delineation also included identification of direct surface water connections between wetlands and other waters. The presence of direct surface water connections is important in determining whether a wetland is a jurisdictional water of the United States under Section 404 of the CWA. A direct surface water connection also influences wetland function and values and is important to understanding how a wetland impact could affect a connected surface water. The boundaries and conditions of wetlands in the study area that extend outside of the study area were estimated based on visual observations. The boundaries of such wetlands were not delineated because they were located on private property.

Delineated wetlands were classified using both the Cowardin classification system (Cowardin et al. 1979) and Washington's hydrogeomorphic classification system (Hruby 2014). More information on these wetland classification systems can be found in Appendix J.

Delineated wetlands were also rated and categorized using Ecology's *Washington State Wetland Rating System – Western Washington: 2014 Update* (Hruby 2014). That system is used to differentiate wetlands based on their sensitivity to disturbance, significance in the watershed, rarity, ability to be replaced, and the beneficial functions they provide to society. The rating system analyzes three major functions (water quality improvement, hydrologic functions, and wildlife habitat) and assigns a function score for each. It also considers the presence of special characteristics specific to certain wetland types.

The rating system assigns wetlands a category from I to IV. Category I wetlands represent the most rare or unique wetland types, wetlands that are highly sensitive to disturbance, wetlands that are difficult to replace, or wetlands that perform high levels of functions. Category IV wetlands represent commonly occurring wetland types that are often heavily disturbed and provide the lowest levels of function. They are relatively easy to replace with a relatively high potential for improvement. Wetlands rated as Category II or III wetlands fall in between these two conditions. Wetland categories are used in assessing potential wetland impacts and determining appropriate mitigation. Wetland categories and function scores are also used by cities and counties to determine wetland buffer widths.

Wetland buffer widths were determined for delineated wetlands. Wetland buffers are the protective upland zone around wetlands. Buffers protect wetlands by filtering pollutants from stormwater runoff, reducing erosion, and by slowing down floodwaters. They also provide habitat for wildlife that move between wetlands and upland areas. Buffers are required by the state of Washington's Growth Management Act, which requires local governments to protect critical areas, including wetlands. Local government critical areas ordinances specify buffer width requirements for wetlands within the jurisdictional boundaries of that local government.

4.4.2.1.1 Flood Retention Facility Project Area

Ninety-three individual wetlands totaling 10.86 acres were delineated in the flood retention facility project area. Maps and details of the wetlands in this area are included in the *Chehalis River Basin Flood Damage Reduction Project: Wetland, Water, and OHWM Delineation Report* (Anchor QEA 2018). Many of these wetlands are associated with streams or other drainage features such as roadside ditches. Of the 93 wetlands identified in the flood retention facility project area, 13 were rated as Category II wetlands and 80 were rated as Category III wetlands under the Washington State Wetland Rating System.

Wetland buffers were based on the Lewis County Critical Areas Ordinance (LCC 17.35A612). That section of the ordinance assigns buffer width based on land use intensity and the habitat function scores determined by the wetland rating system. The total area of wetland buffer was combined with the overlapping stream buffers, as discussed in Section 4.4.2.2.1.

4.4.2.1.2 Airport Levee Improvements Project Area

Eight wetlands totaling 7.78 acres were delineated in the Airport Levee Improvements project area. Seven of those wetlands extend off site. Maps and details of the wetlands in this area are included in the *Chehalis-Centralia Airport Levee Wetland Delineation Report* (Anchor QEA 2019a). Five of the on-site wetlands were rated as Category II wetlands. Three were rated as Category III wetlands. All seven off-site wetlands were rated as Category II wetlands.

Buffers were assigned using guidelines from the Critical Areas chapter of Chehalis Municipal Code (CMC) 17.23. Three of the identified wetlands were assigned an 80-foot-wide buffer, two were assigned a

100-foot buffer, and three were assigned a 150-foot buffer. Overall, a total of 21.76 acres of wetland buffers were identified in the Airport Levee Improvements project area.

4.4.2.1.3 Chehalis River 100-Year Floodplain Area

Wetlands were not delineated in the Chehalis River 100-year floodplain area because of its large size and the lack of project features proposed within it. Instead, potential wetlands were identified in that area using two existing wetland inventories that are based on the analysis of aerial imagery: the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) and Ecology's 2011 Modeled Wetland Inventory. Both of these datasets were used to provide a general range of the potential wetlands present. The NWI maps a total of 6,906 acres of potential wetlands and other aquatic habitats in the Chehalis River 100-year floodplain. The NWI also maps riverine areas, which typically include non-wetland rivers and streams. The 2011 Modeled Wetland Inventory dataset mapped a total of 11,033 acres of potential wetlands and other aquatic habitats in the Chehalis River 100-year floodplain. Unvegetated or partially vegetated open-water areas, gravel bars, or streambanks are considered non-wetland aquatic areas.

When compared with the NWI dataset, the 2011 Modeled Wetland Inventory identified 4,127 more acres of wetlands and other aquatic habitat in the Chehalis River 100-year floodplain. Some of these differences are because of Ecology's inclusion of a potentially disturbed wetlands cover class, which captures agricultural lands that have a high potential to be wetlands. The NWI mapping does not include such a category.

Wetland buffers were not determined in the Chehalis River 100-year floodplain because wetlands in that area were not visited in the field and could not be rated.

4.4.2.2 Other Waters

Other waters are non-wetland waterbodies, including rivers, streams, and lakes. They are commonly characterized by flowing or permanently standing water that is largely unvegetated and lacks underlying hydric soil. Other waters provide a number of important functions including the conveyance and storage of surface water, transportation of sediments and nutrients, and provision of habitat for fish and other aquatic organisms.

Other waters were identified and mapped in the field by the Applicant during the wetland delineations for the flood retention facility and Airport Levee Improvement project areas. Other water boundaries were identified using the OHWM as defined in 33 CFR 328.3(c)(6).

A discussion of the specific methods used to identify and map the OHWM of other waters are provided in the discipline report for wetlands and other waters (Appendix J).

4.4.2.2.1 Flood Retention Facility Project Area

Other waters delineated in the flood retention facility project area included 118 streams and the Chehalis River (Appendix J). No ponds or lakes are present. The total length and area of the delineated streams was estimated to be 17 miles and 114 acres, respectively. Delineated streams range from large river and stream systems, to primary and secondary tributaries of these systems, to isolated channels that flow subsurface before reaching a flowing channel. The streams that are present include perennial (year-round) and annual seasonal (intermittent) flow. All of the identified streams drain into the Chehalis River.

Stream buffers were determined using the requirements of the Lewis County Shoreline Master Program (SMP; Lewis County 2017) and the Lewis County Critical Areas Ordinance (LCC 17.38.400-510). Stream buffers ranged from 75 to 200 feet. More details on the rationale for buffer widths are found in Appendix J.

Because wetland and stream buffers in the flood retention facility project area overlap in many places, wetland and stream buffers were combined. Overall, the total area of wetland and stream buffers in the flood retention facility project area was estimated to be 487.03 acres. Many of those buffers also extend outside of the flood retention facility project area. The buffer area outside of the study area was not calculated.

4.4.2.2.2 Airport Levee Improvements Project Area

No non-wetland other waters were found in the Airport Levee Improvements project area. All delineated areas, including the excavated drainage ditches, were considered to be wetlands.

4.4.2.2.3 Chehalis River 100-Year Floodplain Area

Based on the National Hydrography Dataset (NHD), a total of 1,739 mapped segments of named and unnamed rivers, streams, and drainages occur in the Chehalis River 100-year floodplain. These waters primarily include perennial and intermittent streams. Total length of those stream was estimated to be approximately 263 miles. Because the NHD maps streams using lines, it was not possible to calculate the area of those features.

Stream buffers in the Chehalis River 100-year floodplain were not determined because the streams were estimated using existing mapping and not visited in the field.

4.4.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.4.3.1 Methods

The potential impacts to wetlands and other waters were evaluated quantitatively in the flood retention facility and Airport Levee Improvements project areas and qualitatively for the Chehalis River 100-year floodplain. The analysis considered how construction and operation of the alternatives could affect wetlands and other waters. Additional detail is presented in Appendix J. Appendix E describes the thresholds used to determine the level of impacts.

4.4.3.2 No Action Alternative

Projects that would involve the placement of dredged or fill material into a federally regulated wetland or other water would need to obtain a DA permit from the Corps. Other state and local permits and certifications would also be required. These permits would include non-voluntary measures to avoid and minimize impacts to wetlands and other waters. Mitigation to address unavoidable impacts would also be required to replace lost wetland area and functions. Projects that impact non-federally regulated wetlands would still be required to obtain authorizations from the state and relevant city or county. Some projects would involve restoration that may create, reestablish, or restore wetlands and other waters in the study area. Although some individual wetlands and other waters in the study area may be lost, overall area and function in the watershed would be largely preserved. Therefore, there would be low impacts to wetlands and other waters in the study area under the No Action Alternative.

> **No Action Alternative Impacts to Wetlands and Other Waters**
>
> - Low impacts to wetlands
> - Low impacts to other waters

4.4.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to wetlands and other waters from construction and operation of Alternative 1.

4.4.3.3.1 Construction

Construction of Alternative 1 would result in direct impacts to wetlands in the flood retention facility and Airport Levee Improvements project areas. Other waters would only be impacted in the temporary reservoir footprint. When the wetland impacts in both project areas are considered together, the combined effects would result in high direct impacts on Category II wetlands. The impacts for each part of the study area are described separately below.

> **Alternative 1 Construction Impacts to Wetlands and Other Waters**
>
> - High direct impact to wetlands, other waters, and buffers from permanent loss and/or conversion in the flood retention facility and Airport Levee Improvements project areas combined

Flood Retention Facility Project Area

Construction of the FRE facility would result in low to high impacts from the loss and disturbance of wetlands, other waters, and wetland and stream buffers. There could also be a low impact from increased risk of spills and erosion.

Construction of the FRE facility would require excavation and placement of various types of fill material (e.g., soil, gravel, concrete) into wetlands, other waters, and their respective buffers. The purpose of these excavation and fill placement activities would be to construct the FRE facility, establish staging and spoil placement areas, and construct haul and access roads. Large-scale vegetation removal from preconstruction vegetation management activities in the temporary reservoir footprint would also cause permanent impacts to wetlands, other waters, and their associated buffers.

Alternative 1 Construction Impacts to Wetlands and Other Waters

Flood Retention Facility Project Area

- Medium direct impact from permanent loss of wetlands, other waters, and associated buffers at the FRE facility
- Medium direct permanent impact to wetlands and buffers from pre-construction vegetation management
- High direct impacts to other waters from pre-construction vegetation management
- Low direct temporary impact to other waters from FRE facility construction
- Low direct impact to wetlands and other waters from increased erosion and risk of spills

Wetland impacts from excavation and fill placement for FRE construction are summarized in Table 4.4-1 and shown in Figures 4.4-1 and 4.4-2. Impacts would mainly happen in Category III wetlands, although a few Category II wetlands would also be affected. All wetland impacts from excavation and fill placement would result in the permanent loss of wetland area. All wetland functions and values provided by those wetlands would also be lost. Excavation and fill placement would result in a medium impact to wetlands in this part of the study area because of the area that would be affected and the type of functions that would be lost.

Table 4.4-1
Direct Permanent Impacts to Wetlands in the Flood Retention Facility Project Area

CONSTRUCTION ACTIVITY	WETLAND CATEGORY	IMPACT AREA (ACRES)
Excavation/Grading/Staging/FRE Facility Structure	III	0.66
Spoil Placement	III	0.47
Staging Area	III	0.03
Haul Road On-site	II and III	0.07
Excavation and Fill Placement Impacts Subtotal		***1.23***
Pre-construction Vegetation Management	II and III	6.39
Tree Removal Impacts Subtotal		6.39
Total Wetland Impacts		**7.62**

Figure 4.4-1
Impacts to Wetlands and Other Waters from FRE Facility Construction

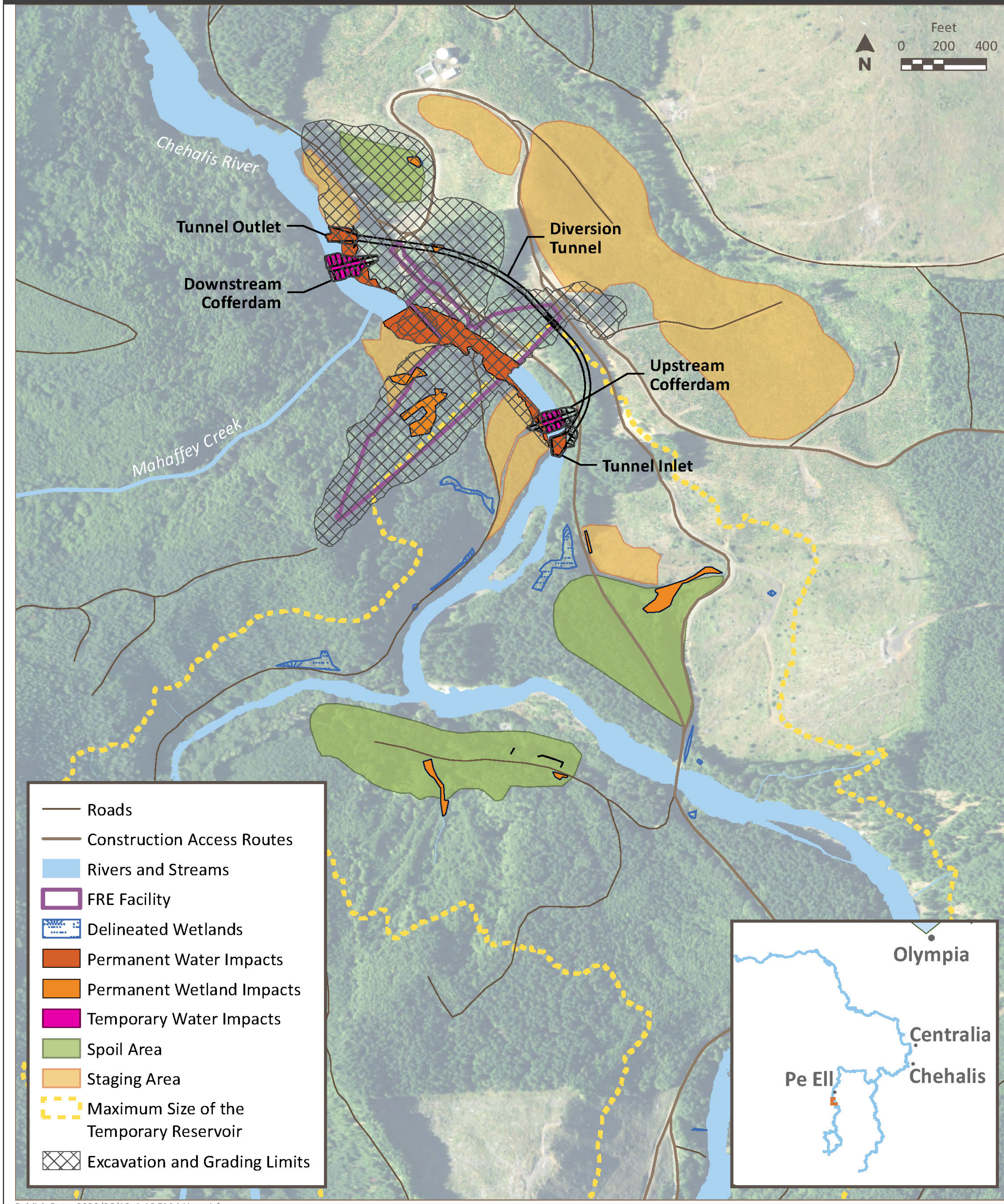


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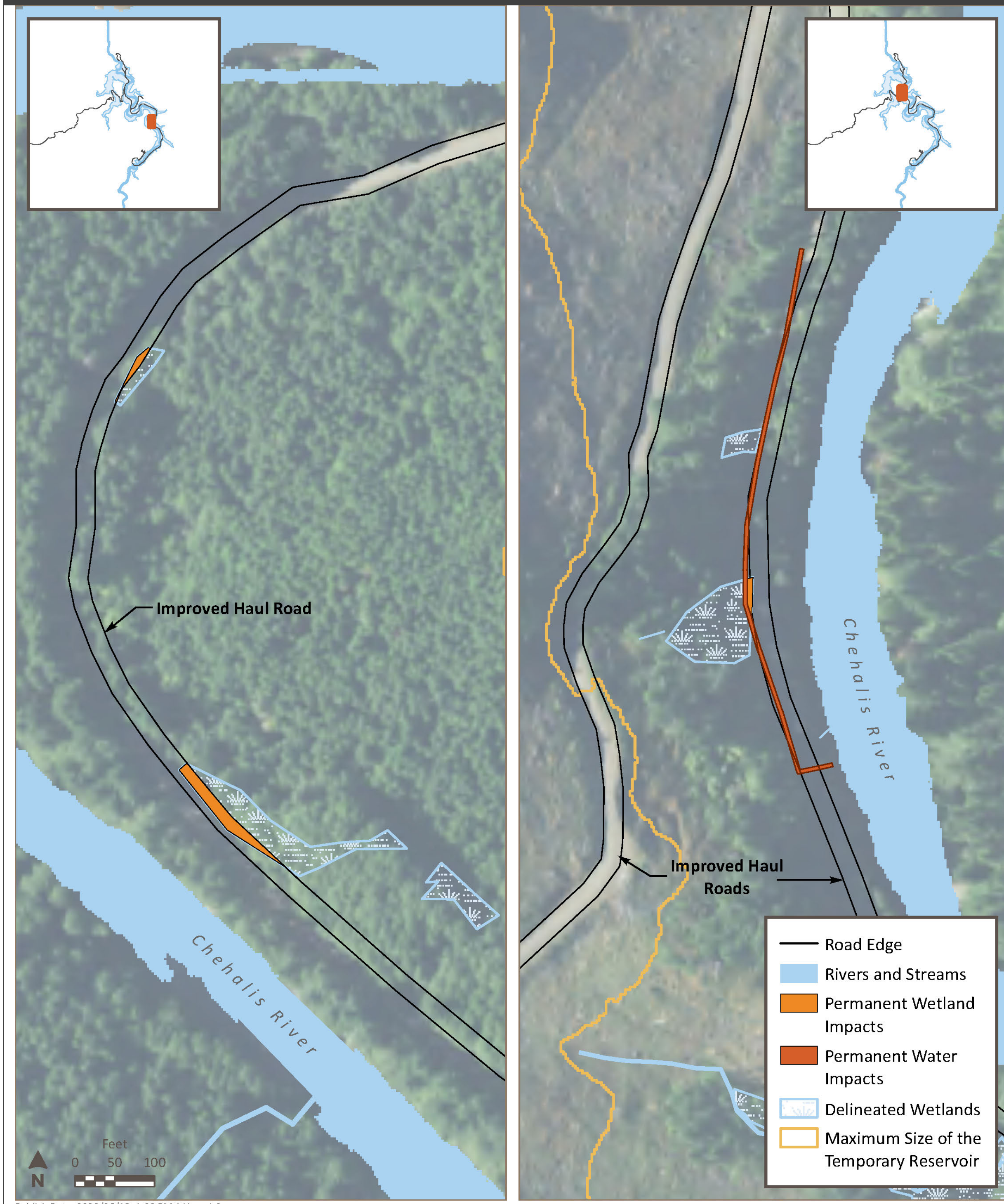
Figure 4.4-2
Impacts to Wetlands and Other Waters from Haul Road Construction



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Wetlands in the footprint of the temporary reservoir would also experience permanent disturbance from pre-construction vegetation management. Those activities would affect 6.39 acres of Category II and III wetlands (Table 4.4-1). Following tree removal, some forested wetlands would be permanently converted to scrub-shrub or emergent wetlands. Tree removal equipment operating in wetlands would crush understory plants and potentially compact wetland soils. Surface and subsurface drainage patterns that route water into wetlands would also be altered. Impacts of tree removal on wetland functions and values could include a reduction in those wetland's ability to provide hydrologic, water quality improvement, and habitat functions. These disturbances may also allow for invasive species to establish.

Excavation and fill placement for construction of the FRE facility would also disturb the Chehalis River channel and other unnamed streams and drainages (Table 4.4-2). These impacts include low temporary impacts and medium permanent impacts to other waters.

Table 4.4-2
Direct Construction Impacts to Other Waters within the Flood Retention Facility Project Area

CONSTRUCTION ACTIVITY	WATER NAME	WATER TYPE	IMPACT DURATION	IMPACT AREA (ACRES)
Cofferdams/Staging	Chehalis River	Perennial Stream	Temporary	0.61
Dewatering	Chehalis River	Perennial Stream	Temporary	2.16
Subtotal Temporary Impacts from Excavation, Fill Placement, and Dewatering				***2.77***
Diversion Tunnel Inlet/Outlet	Chehalis River	Perennial Stream	Permanent	0.36
FRE Facility	Chehalis River	Perennial Stream	Permanent	1.55
Spoil Placement	Unnamed Stream	Intermittent Stream	Permanent	0.03
Haul Road (on-site)	Unnamed Stream	Intermittent Stream	Permanent	0.11
Haul/Access Roads (off-site)	Unnamed Streams	Intermittent Streams	Permanent	0.60
Subtotal Permanent Impacts from Excavation and Fill Placement				***2.65***
Pre-Construction Vegetation Management	Chehalis River and Named/Unnamed Streams	Perennial and Intermittent Streams	Permanent	93.65
Subtotal Permanent Impact from Tree Removal				***93.65***
Total Combined Impacts				**99.07**

Low temporary impacts include fill material placed for cofferdam construction and instream staging and the dewatering of a portion of the Chehalis River channel (Table 4.4-2). Fill placed for cofferdam construction and instream staging would eventually be removed at the end of construction. The temporary cofferdams and diversion tunnel would divert the river around the construction site, dewatering part of the channel. That section of channel would be rewatered once the river is routed back into the channel and through the completed FRE facility structure.

There would also be medium impacts from permanent loss of other waters. These impacts would occur because of excavation and fill placement for the diversion tunnel inlet/outlet, FRE facility, spoil placement areas, and access and haul road improvements. Those activities would eliminate the natural elements of the river or stream channel in those locations. Impacts to intermittent streams from spoil placement and staging area construction would likely require rerouting the affected resources into pipes or culverts, permanently changing their location and configuration. Impacts associated with access roads would mostly happen from culvert installation and associated fill placement. Although flow conveyance would continue, the existing condition of the channel in the location of the impact would be permanently altered.

In addition to diverting the Chehalis River during construction, flow would also need to be diverted from Mahaffey Creek. Mahaffey Creek is a perennial stream that enters the Chehalis River along the west riverbank. It is just downstream from the proposed FRE facility and between the two cofferdams (Figure 4.4-1). Diversion of Mahaffey Creek would most likely occur upstream of where it naturally enters the Chehalis River. A pipe or excavated diversion channel would reroute flow in the stream to a point in the Chehalis River downstream of the cofferdams. Because the location and type of diversion required are unknown, temporary impacts from the diversion of Mahaffey Creek could not be estimated.

Proposed tree removal in the temporary reservoir area would also result in high permanent disturbance to 93.65 acres of other waters. This would include the Chehalis River and many of its tributaries. The area affected is broken into elevation zones that correspond to the areas most likely to be flooded during operations. It was assumed that approximately 89.76 acres of disturbance would occur in the lowest elevations of the temporary reservoir footprint. Another 3.89 acres of disturbance would occur in the next lowest elevations. Trees removed from the channel banks could destabilize the streambanks, causing increased potential for erosion, sedimentation, and stream channel widening. Tree removal would also affect riparian habitat, reducing functions and values in adjacent waterbodies.

In addition to the wetland and other water impacts, excavation and fill placement for the construction of the FRE facility would result in the loss of approximately 11.12 acres of existing wetland and stream buffer. This would be a medium permanent impact.

Tree removal activities would also result in high disturbance to 340.44 acres of wetland and stream buffers. Buffers dominated by trees would be converted to scrub-shrub or to other non-woody plants. Understory vegetation would be crushed, and soils would be compacted by forestry equipment and tree removal activities. Such activities would reduce complexity and the buffer’s ability to protect the functions and values of the wetlands and streams that they surround.

Low impacts to wetlands and other waters could also occur from erosion and sedimentation, accidental chemical releases, changes in surface water flow patterns, and the introduction and spread of invasive species. Most of those potential impacts are related to stormwater runoff from construction staging and spoil placement areas. Such runoff could carry sediments and other materials into wetlands or other waters located adjacent to or downslope from those areas. These low impacts could be minimized by the use of standard erosion control and construction equipment operation and staging BMPs. Construction may also introduce and spread invasive species in wetlands and other waters adjacent to construction areas. Invasive species plant materials and seeds could be transported to the project site by construction equipment. Workers could also inadvertently spread invasive species if their boots, clothing, or tools carry invasive species seeds or other plant parts. Areas with disturbed soil from construction activities would provide invasive species an opportunity to spread or establish. Standard weed control BMPs would minimize the occurrence of these types of impacts.

Airport Levee Improvements Project Area

Under Alternative 1, wetlands in the Airport Levee Improvements project area would be affected by excavation and fill activities. Impacts would include the loss of approximately 4.54 acres of wetlands, including 3.96 acres of Category II wetland and 0.58 acre of Category III wetlands (Figure 4.4-3). These impacts would result in a medium loss of wetlands and associated functions and values. These impacts are based on the assumption that the levee base would need to be widened, which may or may not be needed, to support the proposed levee improvements. If the Airport Levee Improvements could be constructed without widening the levee base, most or all of the wetland impacts would not occur. No direct impacts to other waters would occur as part of the Airport Levee Improvements.

Alternative 1 Construction Impacts to Wetlands and Other Waters

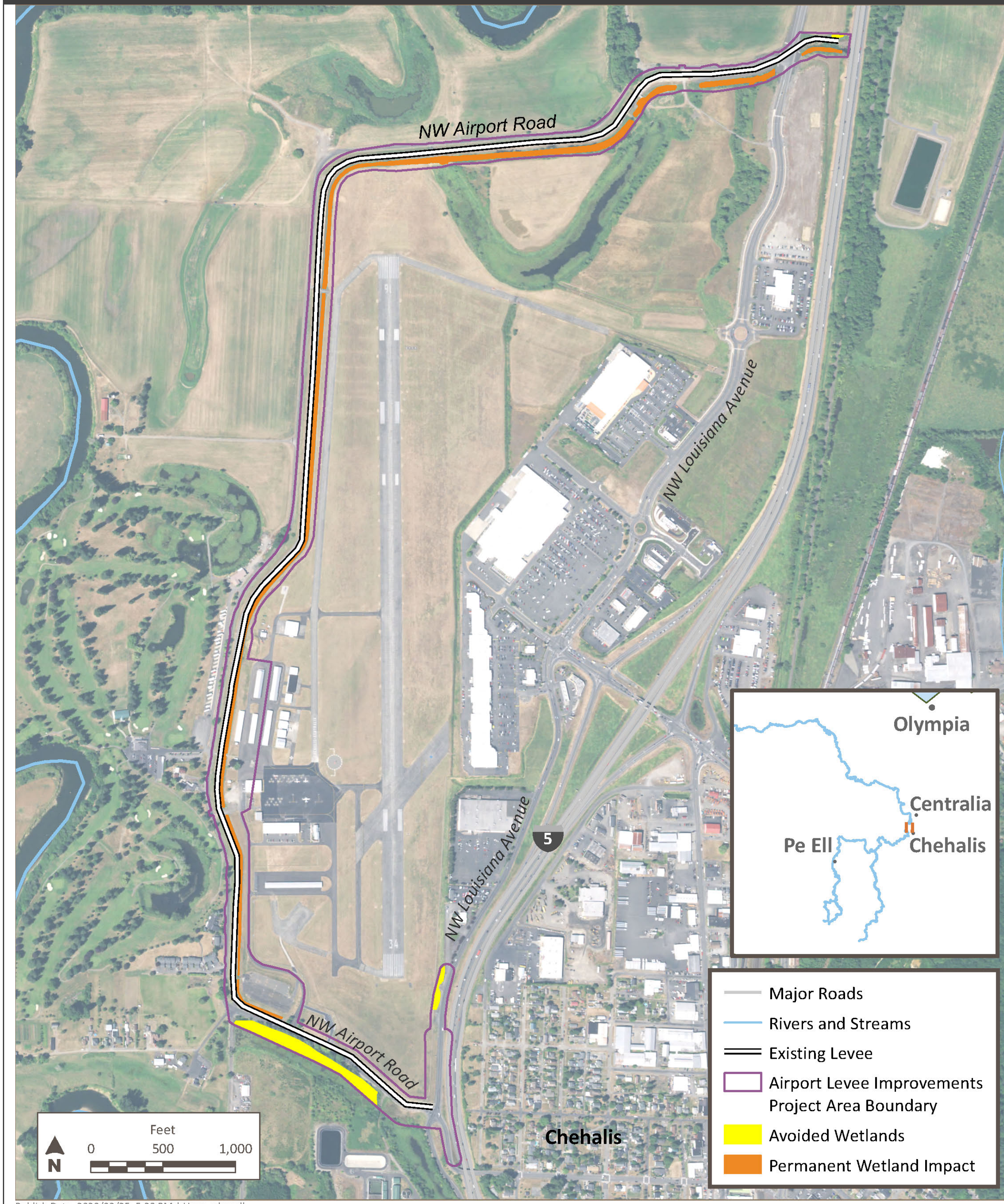
Airport Levee Improvements Project Area

- Medium direct impact from permanent loss of wetlands
- Medium impact from disturbance of wetland buffers
- Low impact to wetlands and wetland buffers from increased risk of erosion and spills
- No impacts to other waters

Construction of the Airport Levee Improvements would also cause medium impacts to wetland buffers near work areas. It was assumed that raising the levee could require further widening of the levee base. If this happened, approximately 16.61 acres of existing wetland buffers could be affected.

During construction, low impacts to wetlands could also occur from erosion, sedimentation, accidental chemical releases, and the spread of invasive species. As with the FRE facility, the use of standard construction BMPs for erosion control, equipment usage, and site management would minimize impacts to wetlands from these types of activities.

Figure 4.4-3
Impacts to Wetlands from Airport Levee Improvements



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4.4.3.3.2 Operation

Flood Retention Facility Project Area

Operation of the FRE facility would result in low to medium indirect impacts to wetlands, other waters, and their associated buffers in the footprint of the temporary reservoir. This is because they would be flooded when the temporary reservoir fills with water. This would happen on average once every 7 years.

> ### Alternative 1 Operational Impacts to Wetlands and Other Waters
>
> **Flood Retention Facility Project Area**
>
> - Medium indirect impact from disturbance to wetlands, other waters, and buffers from periodic flooding in the lower temporary reservoir footprint
> - Low indirect impact from disturbance to wetlands, other waters, and stream buffers from periodic flooding in the upper temporary reservoir footprint

Approximately 5.71 acres of wetlands and 89.76 acres of other waters are located in the lowest part of the temporary reservoir (between elevations of 424 and 567 feet). These wetlands are the most likely to be affected by flooding when the temporary reservoir is holding water. That zone would likely be flooded for up to 25 days once every 7 years on average (Anchor QEA 2016). Approximately 0.68 acre of wetlands and 3.89 acres of other waters in the next highest area (between 567 and 584 feet) could also be affected by flooding while the temporary reservoir is holding water. However, this area would be under water less frequently. The highest area would likely be flooded for up to 4 days once every 20 years on average (Anchor QEA 2016).

There are two areas in the footprint of the temporary reservoir at higher elevations than those described above. These are high enough that the chance of them being flooded when the FRE facility is operating is even lower. These areas would be affected by ongoing tree removal. There are approximately 1.77 acres of wetlands and 11.80 acres of other waters in the area between 584 and 612 feet. That zone has a 1% chance of being flooded in a given year and would likely be flooded for up to 1 day once every 100 years. The uppermost area is between 612 to 627 feet. That area has approximately 1.46 acres of wetlands and 7.33 acres of other waters. It has less than a 1% change of being flooded in any given year. Flooding would last less than 1 day.

Flooding of these areas could impact the growth of vegetation both within and adjacent to wetland areas, in riparian zones, and in uplands. When flooding causes plants to die, the structure of wetlands and other waters could be altered, affecting their ability to perform or provide ecological functions and values. This would mostly happen when trees and shrubs die and are replaced with emergent vegetation and seedlings.

Wetlands and other waters in the temporary reservoir area could also be buried if landslides are triggered during drawdown of the temporary reservoir and by sediment deposition from retained floodwaters. Over time, material deposited by landslides and sedimentation would replace the existing soils and could alter the composition of wetland vegetation communities. Wetland functions such as water storage would also be affected if wetlands were filled in with sediment. Such impacts would most likely affect those wetlands located closest to the FRE facility and in the lowermost portions of the temporary reservoir.

Wetland and stream buffers in the footprint of the temporary reservoir would also be affected by periodic prolonged flooding. The largest impacts would likely be in those buffers located in the two lowest areas, which would be under water for between 4 to 25 days. Those areas include approximately 294.13 acres of buffer between 424 and 567 feet and 46.32 acres of buffer between 567 to 584 feet. An additional 146.59 acres of wetland and stream buffers in the uppermost areas (between 584 and 627 feet) would also be subject to impacts from periodic flooding. Impacts related to flooding would be greater if the upper Chehalis Basin experienced back-to-back floods when the FRE facility is in operation. Overall, impacts from FRE facility operation on upstream wetlands and other waters are expected to be medium.

Airport Levee Improvements Project Area

Operation of the Airport Levee Improvements would include routine levee maintenance and regular levee inspections. No impact to wetlands or other waters would be expected. Some vegetation in wetland buffers would temporarily be affected by maintenance activities such as mowing and weed control.

Alternative 1 Operational Impacts to Wetlands and Other Waters

Airport Levee Improvements Project Area

- No impacts

Chehalis River 100-Year Floodplain Area

- Low indirect impact to floodplain wetlands from reduction of major or greater flooding

Chehalis River 100-Year Floodplain

Operation of the FRE facility would cause low indirect impacts to wetlands, other waters, and wetland and stream buffers in the Chehalis River 100-year floodplain area. While operation of the FRE facility would reduce flooding in the Chehalis River 100-year floodplain during a major or greater flood, wetlands in this area are not reliant on that flooding as a supporting source of hydrology. Wetlands in locations that are flooded relatively infrequently are supported by other water sources including groundwater, surface runoff, and precipitation. Because those other water sources would be unaffected by FRE facility operation, no wetland loss is expected to occur in those portions of the floodplain. The extent and depth of overbank flooding in those areas would be reduced but would not result in a measurable effect on wetland area and function.

The reduction of occasional flooding could potentially reduce natural disturbances such as sediment and LWM deposition. Occasional flooding may change wetland characteristics by causing natural disturbance in those areas. For example, occasional flooding may deposit sediments and LWM into such wetlands or may alter wetland vegetation communities by killing plants that have low flood tolerance. This could result in a change in wetland functions over time. Because of the relative infrequency of such flooding, the overall impact would be low.

4.4.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Construction of Alternative 2 would result in the same level of impact to wetlands as Alternative 1 but slightly fewer impacts to other waters. This is because the footprint of the FRO facility is slightly smaller and would occupy approximately 0.21 acre less than Alternative 1 (Figures 4.4-1 and 4.4-2). All other construction impacts to other waters would be the same as those that would occur under Alternative 1. As noted in Chapter 3, the potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1.

4.5 Aquatic Species and Habitats

4.5.1 Introduction

Aquatic habitat is land that is usually or always covered with water. Examples of aquatic habitats are rivers, streams, and bays. Aquatic species are plants and animals that live in aquatic habitats. Changes to aquatic habitats may also cause changes to aquatic species. Common examples of aquatic species include fish, shellfish, and plants, like mosses and liverworts. Amphibians are considered partially aquatic and are discussed in Section 4.6.

This section describes aquatic species and habitats in the study area. It also describes how the alternatives would impact these resources. Additional information on aquatic habitats and species is presented in Appendix K, the discipline report for aquatic species and habitats. Information about water quantity and quality characteristics of aquatic habitats in the study area is provided in Section 4.1.

Key Findings

Construction

- High direct impacts to anadromous salmonids and lamprey in the study area
- Low to medium direct impacts to other native fish in the study area
- Low to medium direct impacts to freshwater mussels and aquatic plants in the flood retention facility project area
- Low to medium temporary indirect impacts to aquatic species in the flood retention facility project area
- Low impact to the number of anadromous salmonids at the Chehalis Basin scale
- High impact to spring-run Chinook at the Chehalis Basin scale from loss of habitat diversity in the study area
- Low indirect impact to downstream marine mammals outside of the study area that rely on salmon for food

Operation

- High indirect impacts to anadromous salmonids and lamprey in the study area
- Medium indirect impacts to other native fish, freshwater mussels, and aquatic plants in the study area
- Low impact to the number of anadromous salmonids at the Chehalis Basin scale
- High impact to spring-run Chinook at the Chehalis Basin scale from loss of habitat diversity in the study area
- Low indirect impact to downstream marine mammals outside of the study area that rely on salmon for food

4.5.2 Affected Environment

This section describes the general characteristics of aquatic habitat in the study area. It also describes the aquatic species likely to be found in the study area. These species include fish, freshwater mussels, and aquatic plants. The section also describes marine mammals that are outside of the study area but that rely on salmon for food. The study area is defined in Section 3.6 and includes nine tributaries that flow into the upper Chehalis River above the proposed facility at RM 108, and their respective sub-basins (Figure 5.1-2 of Appendix K). The study area does not include the Airport Levee Improvements project area.

4.5.2.1 Aquatic Habitat Conditions

In the flood retention facility project area, within the footprint of the proposed temporary reservoir, there are approximately 118 streams and creeks totaling 17 miles and covering 114 acres. In this part of the study area, the upper mainstem Chehalis River is formed where the East and West Forks meet at approximately RM 119. Crim, Roger, Thrash, Big, Cinnabar, and George creeks flow into the East Fork Chehalis River. Lester Creek flows into Crim Creek. Sage Creek flows into the West Fork Chehalis River (Figure 5.1-2 of Appendix K; Caldwell et al. 2004).

In the Chehalis River 100-year floodplain area, the mainstem becomes wider. There are some reaches of narrow bedrock and some that are more open and flatter with more connection to a broader floodplain. This part of the study area includes 75 miles of the Chehalis River and approximately 43,107 acres of floodplain. Rivers, streams, and drainages total about 263 miles. These include the downstream ends of the South Fork Chehalis River, Newaukum River, Skookumchuck River, Black River, and several smaller creeks (Figure 5.1-1 of Appendix K; USGS NHD dataset [USGS 2020]).

River flows are discussed in greater detail in Section 4.1, but in general, heavy precipitation and corresponding peak river flows usually happen between November and February. Streamflow is important because it affects many aspects of the aquatic environment. It can influence water quality and the movement of sediment and the river channel. When streamflow is low, it can also leave some animals stranded or make it difficult for them to move around.

Flooding is a natural part of the aquatic environment in the study area. Large floods can scour the riverbed and move large amounts of sediment downstream. This can destroy aquatic habitat in the process. However, some species, like salmon and trout, are adapted to live with floods (Ferguson 2020). Floods can also be beneficial to aquatic habitat. In the Chehalis Basin, floods can move LWM from upstream to downstream areas, creating complex instream habitat and providing nutrients to the river.

While the Chehalis River provides quality habitat for many species, there are certain parts of the river that have water quality problems. As discussed in Section 4.1, the main water quality issues include high temperature, low dissolved oxygen, and high turbidity:

- High temperature: Chehalis River temperatures frequently exceed water quality criteria for salmon. If water temperature is too high, it can damage plant or animal tissue, change growth patterns, and make it difficult to live or reproduce.
- Low dissolved oxygen: Chehalis River dissolved oxygen concentrations frequently drop below the applicable water quality criteria. When dissolved oxygen is low, there is less oxygen for aquatic plants and animals.
- High turbidity: Certain areas of the Chehalis River also have problems with turbidity. High turbidity can affect plants and animals, for example, by blocking light needed for photosynthesis and making it difficult to find food. Turbidity caused by solid particles can also block animal gills, making it difficult to breathe.

Aquatic habitat in the study area is also directly affected by the geomorphic processes that shape the river. There are some areas where finer material makes up the riverbed, while in other areas the riverbed is made up of larger material. The makeup of the riverbed is important because it influences the type of species that can live, feed, and reproduce in that environment.

4.5.2.2 Fish

This section describes existing habitat conditions for fish in the study area. It also describes the native and non-native fish likely to be found in the study area, and which are special status.

4.5.2.2.1 Habitat Conditions

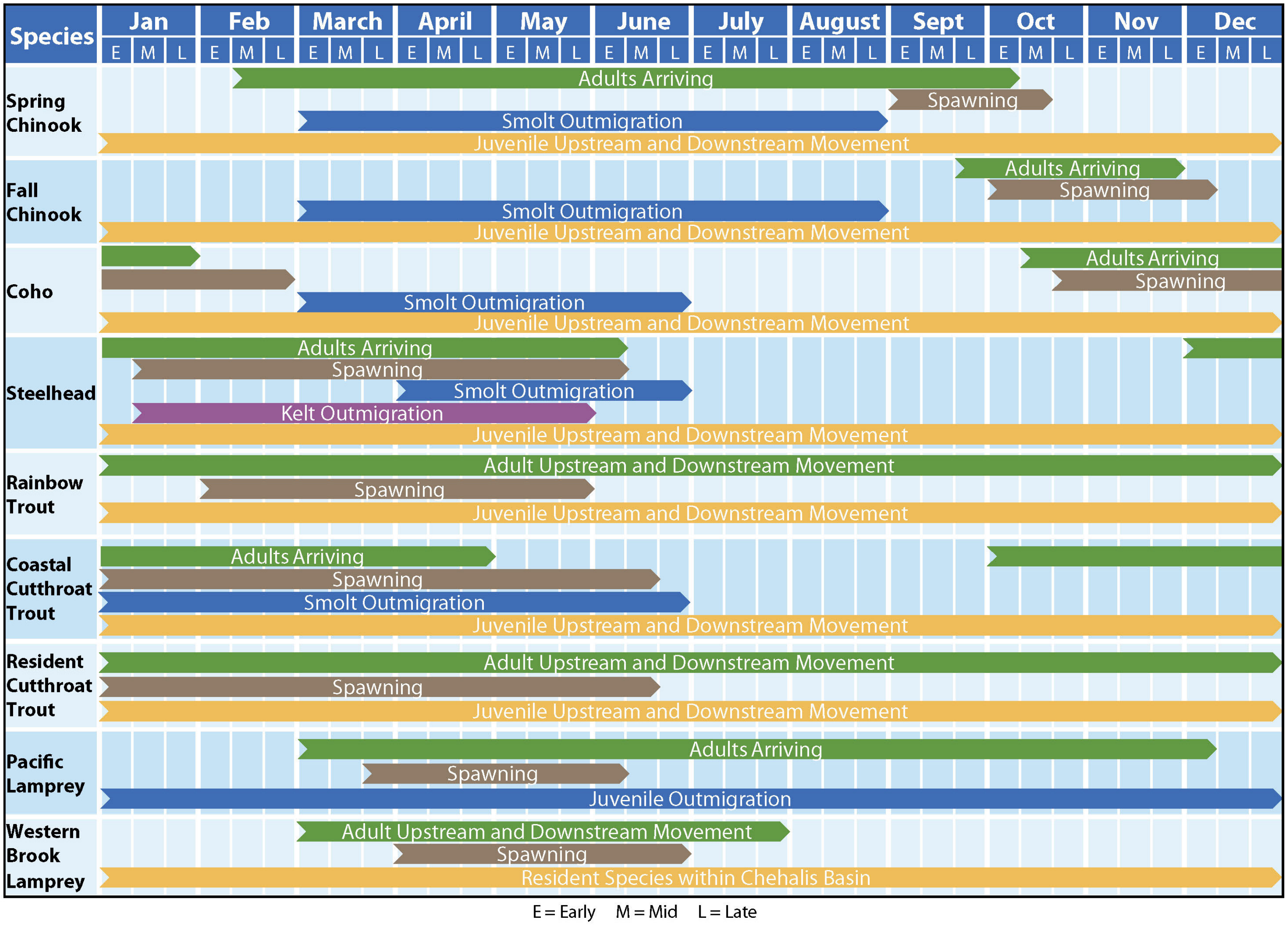
Fish require certain conditions to live and reproduce. This includes the right river flow, water quality conditions, and makeup of materials on the riverbed. Different species have different requirements depending on the stage of their life cycle. Some species are anadromous, which means they migrate to the ocean and back as part of their life cycles. The typical migration periods and life stages of key species in the study area are presented in Figure 4.5-1.

Spawning refers to the period in the life cycle when fish are reproducing. The places where fish lay eggs are referred to as spawning sites. Habitat with a high number of spawning sites is high in diversity. Sites where juvenile fish grow larger are called rearing sites. Rearing refers to the period in the life cycle when fish grow and mature. Rearing sites require different instream flows than spawning sites, along with connections to the floodplain.

Anadromous fish do best when the water temperatures remain cool and waterways are not blocked by natural or manmade structures, like rocks or culverts. Fish also need places to rest and hide from predators. These areas are provided by deep pools, areas where streamflow is lower, and areas where there is natural cover provided by things like LWM that has fallen into the river (NOAA 2005; 50 CFR 226).

Within the study area, there is habitat that is designated as especially important for fish. This includes essential fish habitat (EFH), which has the right water and riverbed conditions needed for spawning, breeding, feeding, or growth to maturity (NOAA 2019a). The upper and lower Chehalis Basin, including the entire study area, have been designated as EFH for Chinook salmon and coho salmon (NOAA 2019b). Stream reaches where Chinook salmon and coho salmon spawning and rearing are known to occur (NOAA 1999) are of particular concern for resource managers. The downstream end of the Chehalis River 100-year floodplain area, RM 45 to RM 33, is designated critical habitat for bull trout (*Salvelinus confluentus*; USFWS 2019c, Figure 5.1-1 in Appendix K) under the Endangered Species Act (ESA). The study area also includes two priority aquatic habitats designated by WDFW in the study area: fresh deepwater habitats and instream habitats (WDFW 2008). Both types are found throughout the study area.

Figure 4.5-1
Anticipated Migration Periods of Select Fish Species and Life Stages in the Chehalis Basin



Note: Kelts are steelhead that can reproduce multiple times and return to the ocean after spawning. A smolt is a young salmon that is migrating from rearing freshwaters to the ocean.

Flood Retention Facility Project Area

There are some areas of quality habitat in the flood retention facility project area. This includes deep pools and shallow areas with gravel bottoms. There is more of this higher quality habitat in this area compared to upstream areas of other large tributaries in the Chehalis Basin (Winkowski et al. 2018a).

Aquatic habitat in this area has been degraded over time mainly from timber harvest and land use practices. In general, these activities have reduced the number of trees in this part of the study area. This has increased the risk of erosion and sedimentation, reduced the amount of LWM in the river, and increased water temperatures (WGD and Anchor QEA 2017; Winkowski et al. 2018a; Appendix I). Large amounts of fine sediment can reduce the survival of incubating eggs by burying and suffocating them. Lack of LWM means aquatic habitat is less complex and less beneficial for aquatic species. Higher water temperatures negatively affect spawning and rearing conditions. In some areas, these activities have also led to channel getting deeper from excessive streambed erosion (ASRPSC 2019). Excessive streambed erosion and lack of LWM reduces spawning habitat and means that fewer deep pools form, which reduces rearing habitat.

Connections to the floodplain provide important off-channel habitat for rearing. These connections are reduced in this part of the study area because of natural channel restriction and human influences. Natural barriers in this part of the study area are caused by low or no flow in one or more seasons or by waterfalls. There are also at least 52 full or partial human-built fish passage barriers in the study area, including old culverts, bridges, and fish ladders (ASRPSC 2019). These barriers prevent the upstream migration of adults to their spawning grounds and the downstream migration of juvenile fish to Grays Harbor. Barriers also reduce or prevent the natural movement of gravel used for spawning and LWM that provides habitat for fish.

Over time, habitat in this part of the study area has also been altered by natural processes like flooding (WGD and Anchor QEA 2017; Anchor QEA 2014; GHLE 2011). Large floods, such as the one in 2007, can damage habitat by moving large amounts of sediment and moving the river channel. Floods can also cause beneficial changes, like increasing the input and transport of LWM.

Chehalis River 100-Year Floodplain

Fish habitat in the Chehalis River 100-year floodplain is of moderate quality. There are some salmon and trout spawning areas, but fewer than in the flood retention facility project area. There are also seasonally flooded and off-channel habitats used by salmon, lamprey, and other native fishes (Hayes et al. 2019). However, some areas are degraded. There are generally poor streamside conditions due to agricultural, commercial, and residential development. Existing problems, including high water temperatures, low dissolved oxygen, and high turbidity, could become worse without further intervention.

Roads and highways have disconnected some floodplain habitat from the river. Floodplain connections are more common toward the downstream end of the study area, and migration routes to Grays Harbor are passable.

There is less LWM in the mainstem Chehalis River as the result of timber harvest and development. There are also some river reaches with large amounts of fine sediments, which can reduce fish survival. These occur especially at the mouths of the South Fork Chehalis and Newaukum rivers.

Similar to the flood retention facility project area, large floods have affected aquatic habitat in this part of the study area. As noted previously, there are adverse and beneficial impacts from flooding.

4.5.2.2.2 Native Fish

Native fish in the study area include salmon, trout, and lamprey. Some of these are designated as special status by the federal or state government. Native species likely to be found in the study area and their status are presented in Appendix K. The most common fish in the flood retention facility project area are salmon, steelhead, and trout (Winkowski et al. 2018a). Native non-salmonids and other non-native species are the most common fish in the Chehalis River 100-year floodplain (Winkowski et al. 2018a).

Special-status species with the potential to be in the study area include bull trout, which is a federally threatened species and a state species of concern. Bull trout have not been observed in the study area, but could be present, most likely in the downstream end (USFWS 2004; Winkowski et al. 2018a). Additional information about the status and habitat preferences of bull trout is presented in Appendix K.

There is also one state sensitive species, Olympic mudminnow (*Novumbra hubbsi*), and eight state species of concern. Mudminnow have been identified in the Chehalis River 100-year floodplain area but have not been identified in the flood retention facility project area. Of the state species of concern, spring-run and fall-run Chinook salmon, coho salmon, steelhead, and river lamprey (*Lampetra ayresii*) are also of local importance and are discussed further below. Chum salmon (*Oncorhynchus keta*), leopard dace (*Rhinichthys falcatus*), and mountain sucker (*Catostomus platyrhynchus*) are also state species of concern. Chum salmon spawn outside of the study area but could be present in the lower portion of the Chehalis River 100-year floodplain study area. Leopard dace and mountain sucker are present in both the flood retention facility project area and the Chehalis River 100-year floodplain area.

The Washington Natural Heritage Program (WNHP) catalogs animal and plant species known to exist in the state of Washington and develops a rank for each species to guide conservation efforts. The WNHP List of Animal Species with Ranks includes 41 freshwater or anadromous fish species with the potential to be in the study area (Appendix K). Thirty-five of these species have been confirmed in the study area during field investigations. Most of these species include non-listed (both federal and state) native and non-native fish, which have WNHP global and state rankings ranging from low to secure. Seven species with confirmed presence in the study area have state program rankings of vulnerable or more at risk, including chum salmon, Pacific lamprey (*Entosphenus tridentatus*), river lamprey, western brook lamprey (*Lampetra richardsoni*), and Olympic mudminnow. Lamprey are discussed below in a separate section.

Pacific eulachon (*Thaleichthys pacificus*) and the Northern Distinct Population segment of green sturgeon (*Acipenser medirostris*) are special-status species that are assumed not to be present in the study area. Eulachon spawning is generally limited to parts of the river influenced by tides. In the Chehalis River, this is approximately 9 miles downstream of the study area. Green sturgeon have designated critical habitat in Grays Harbor and the tidally influenced lower reach of the Chehalis River. However, they are not documented to spawn in Washington and are believed to be restricted to estuaries in other river systems.

Salmon and Trout

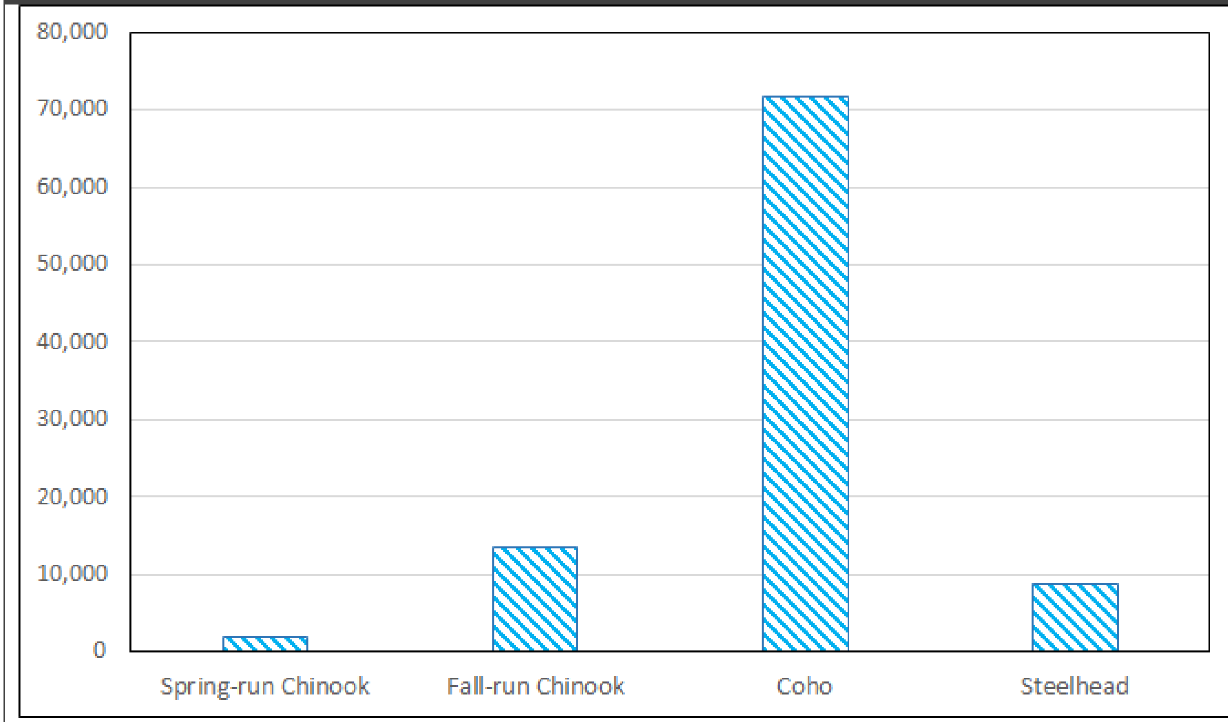
Salmon and trout are part of a family of fish known as salmonids. Of the native species likely to be found in the study area, Chinook salmon, coho salmon, and steelhead are especially important salmonids with respect to recreational, commercial, or tribal fisheries. For context, the relative population sizes of existing runs in the Chehalis Basin are shown in Figure 4.5-2. Within the study area, wildlife studies show that Chinook salmon, coho salmon, and steelhead primarily spawn above RM 98 of the Chehalis River (Ronne et al. 2018). Below RM 98, these species primarily spawn in tributaries that are not part of the study area.

Chinook Salmon

Despite being the same species, different groups of Chinook salmon migrate upstream at different times of the year. Chinook salmon that begin entering freshwater as early as February are called spring-run. Chinook salmon that wait to enter freshwater until September through November are called fall-run.

Recently, scientists have found evidence that spring-run Chinook salmon are genetically different from fall-run Chinook salmon (Thompson et al. 2019). This has led scientists to re-examine estimates of spring-run Chinook salmon population abundance, or total number of adult fish. As a result, there is concern that the population of spring-run Chinook salmon in the Chehalis Basin is smaller and at greater risk than previously thought. Information about the current estimates of spring-run and fall-run Chinook salmon are presented in Table 4.5-1.

Figure 4.5-2
Relative 10-year Average Run Sizes for Important Salmonids in the Chehalis Basin



Note:
The source of these data is a spreadsheet dated August 8, 2019, from Mike Scharpf of WDFW, as cited in ICF 2019. The 10-year run sizes were averaged from 2009 to 2018.

Table 4.5-1
Chinook Salmon, Coho Salmon, and Steelhead Presence in the Study Area

SPECIES	FLOOD RETENTION FACILITY	CHEHALIS RIVER 100-YEAR FLOODPLAIN (RM 108 TO 75)	CHEHALIS BASIN
Chinook salmon, spring-run	23 fish, average[1] 3 fish, 1 redd (nest)[2]	31 – 39 redds[3]	1,749 fish[4]
Chinook salmon, fall-run	320 fish, average [1] 578 fish, 230 redds[2]	199 – 480 redds[3]	13,782 fish[4]
Coho salmon	858 fish, average [1] 2128 fish, 961 redds[2]	5 redds[3] (both years)	71,787 fish[4]
Steelhead	1,295 fish, average[1] 956 fish, 589 redds[2]	7 – 53 redds[3]	8,657 fish[4]

Notes:
1. Five-year average estimated adult fish abundance based on weekly redd surveys above the FRE between 2013 – 2014 and 2017 – 2018. Species-specific multiplication factors are used to calculate the number of adult fish from the number of redds (Ronne et al. 2020).
2. Most recent available abundance results from weekly redd surveys above the FRE in 2018-2019 (Ronne et. al. 2020).
3. Redd surveys were only conducted below the proposed flood retention facility, down to the confluence with the Newaukum at RM 75.5 in the Chehalis 100-year floodplain, during the 2017-2018 and 2018-2019 seasons. Because surveys were only performed for one week, during peak spawning, the number of adult fish was not estimated (Ronne et al. 2018, Ronne et al. 2020).
4. Average run sizes for 2009 to 2018 based on spreadsheet dated August 8, 2019, from Mike Scharpf of WDFW, as cited in ICF 2019, and shown in Figure 4.5-2.

Because spring-run Chinook salmon migrate earlier in the year than other salmon species, they experience lower flows and higher water temperatures, which are harsher conditions than what other salmon species experience. Spring-run Chinook salmon are also more susceptible to fish passage barriers since they prefer to spawn in the upper reaches of watersheds. Most fall-run Chinook salmon spawn downstream of the flood retention facility project area.

Coho Salmon

Chehalis coho salmon are part of the Southwest Washington population, which has a fairly low risk of extinction. However, because of recent declines of the species in some areas of Southwest Washington, there is increasing concern over their status (WDFW 2019c; WDNR 2017). Table 4.5-1 provides information about their presence in the study area. Along with juvenile steelhead, juvenile coho salmon are the most abundant fish species in the flood retention facility project area during the summer (Winkowski et al. 2018a). Coho salmon spawn throughout the Chehalis Basin, but prefer to spawn farther upstream than spring-run Chinook salmon.

Winter Steelhead

Chehalis River winter-run steelhead (referred to from here on as steelhead) are part of the Southwest Washington population. This population has a very low risk of extinction (WDFW 2019c; WDNR 2017). Steelhead spawn in mainstem and tributary habitats throughout the Chehalis Basin, but like coho salmon, prefer to spawn farther upstream.

Unlike other salmon species, some steelhead can reproduce multiple times and return to the ocean after spawning. These steelhead are called kelts. There is limited information about kelts in the Chehalis Basin. However, in other areas of the Pacific Northwest, kelts can make up 1.6% to 58% of spawning adults each year (Hatch and Branstetter 2002; Hatch et al. 2013). Because of the physical demands of spawning, kelts that encounter unfavorable water quantity and quality conditions (such as low flow or high temperatures) or fish migration barriers, are at higher risk of dying before they can recover and reach the ocean.

Lamprey

There are three species of lamprey within the study area: Pacific lamprey, river lamprey, and western brook lamprey. Pacific lamprey are anadromous and return to spawn in the Chehalis River from the end of March through the middle of June. Spawning adults prefer areas with shallow, fast-moving water and a riverbed that has a variety of gravel sizes. Pacific lamprey have been found throughout the study area (Winkowski et al. 2016). River lamprey are also anadromous and spawn at the upstream end of streams with riffles and gravel. Depending on their life stage, the fish may live in side channels where river flows are lower, or in deep river channels. Western brook lamprey are not anadromous (Ostberg et al. 2018). Adults spawn in freshwater in areas with coarse gravel and riffles at the head of small streams. Some western brook lamprey have been observed in the Chehalis River 100-year floodplain study area, but not in the flood retention facility project area (Winkowski et al. 2016).

4.5.2.2.3 Non-Native Fish

Non-native fish can cause problems for native fish. This is because some non-native species eat native fish or outcompete them for food and the best aquatic habitat. There are 10 non-native fish species known to be present in the study area downstream of Rainbow Falls at RM 98, including American shad (*Alosa sapidissima*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), common carp (*Cyprinus carpio*), largemouth bass (*Micropterus salmoides*), pumpkinseed (*Lepomis gibbosus*), rock bass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*), and catfish (*Ictalurid* spp.) (Hayes et al. 2019; Winkowski and Zimmerman 2019). Most of these fish are found in off-channel wetlands rather than in the mainstem. Largemouth bass and smallmouth bass present the greatest threat to native fish in the study area.

4.5.2.3 Freshwater Mussels

Freshwater mussels that could be present in the study area include western ridged mussels (*Gonidea angulate*), western pearlshell (*Margaritifera falcata*), and floater mussels (*Anodonta* sp.). Western ridged mussels and western pearlshells are ranked by the state as vulnerable.

Freshwater mussels were found in the mainstem Chehalis River upstream of Rainbow Falls during a study completed by WDFW (Winkowski et al. 2018a). Most mussels were concentrated between Rainbow Falls and the confluence of the Newaukum River and were in numbers great enough to be considered the dominant riverbed substrate (Winkowski et al. 2018a). Another study identified eight beds of western ridged mussels in the Chehalis Basin, co-occurring with western pearlshell and floaters, but the exact location of the beds was not given (Blevins 2018). Populations of all three species were found in areas with bank edges and fine sediment, gravel, clay, and boulder substrates (Blevins 2018).

Freshwater mussels play an important role in local food webs, water quality, and nutrient cycling. Adult mussels are filter feeders, using a siphon to pull small organic particles such as algae, bacteria, and detritus out of the water column. Much of the ingested material is subsequently deposited on the riverbed, where it becomes an important food source for aquatic insects and other invertebrates that are at the center of the aquatic food web. Mussel filter feeding improves water quality and chemistry, improving habitat conditions for other aquatic species like salmon and trout. Freshwater mussels rely on those same fish for reproduction, by attaching to the gills of host fish as larvae for a period of several days to several months before dropping off and settling onto the substrate.

Western ridged mussels are usually found in low- to mid-elevation streams along streambanks. They prefer fine substrate more than other freshwater mussels, but are usually not found in areas with extremely soft substrate. The reproductive strategy of western ridged mussels is not clear, but hosts may include fish that inhabit colder water such as trout and salmon.

Western pearlshells can be found along the banks of small headwater streams. However, these mussels more commonly live along the banks of larger rivers in areas with large boulders and sand, gravel, and cobble riverbeds. Western pearlshell larvae are released from adult mussels around July. Host fish in the Chehalis Basin may include trout, salmon, and speckled dace (*Rhinichthys osculus*). After releasing from the host fish, juveniles burrow in the sediment, where they mature in 9 to 12 years and live for up to 100 years.

Floaters can tolerate conditions low in oxygen and grow faster in high-nutrient waters such as lakes, ponds, marshes, and sandbars. Larvae are released around spring and summer, and several fish species can serve as a host. Juvenile mussels burrow in the sediment, where they mature in 4 to 5 years and live for up to 10 years (Nedeau et al 2009).

4.5.2.4 Aquatic Plants

Aquatic plant species that are present in the study area include common duckweed (*Lemna minor*), two common mosses (*Racomitrium* spp. and *Scleropodium* spp.), two common liverworts (*Pellia* spp. and *Marchantia* spp.), Canadian waterweed (or American waterweed; *Elodea canadensis*), common pondweed (*Potamogeton natans*), and yellow pond lily (also called yellow waterlily or spatterdock; *Nuphar lutea* or *Nuphar polysepala*). Water howellia (*Howelia aquatilis*) is a federally listed threatened species with the potential to be in the study area. Blunt-leaved pondweed (*Potamogeton obtusifolius*) is a state sensitive species that may also be found in the study area.

Common duckweed, the two common mosses, and the two common liverworts were encountered in the flood retention facility project area during a survey (Anchor QEA 2018). Common mosses and common liverworts can be found in the splash zone at the edge of streams or within the open channel. Common duckweed is a floating plant that prefers still or slow-moving waters and is often found along the shoreline after water levels have dropped (Ecology 2019a). Rooted plants are generally not found in high-energy river and stream systems such as those in the flood retention facility project area.

Common duckweed, Canadian waterweed, common pondweed, and yellow pond lily were encountered during a field survey in the Chehalis River 100-year floodplain study area between RM 36.5 and RM 107.6 (Hayes et al. 2019). Canadian waterweed is a submersed plant often found in freshwater rivers and ponds. Common pondweed is a rooted aquatic plant with floating leaves and is often found in shallow ponds or slow-moving water. Yellow pond lily is a rooted plant with floating leaves that is found in shallow ponds and slow-moving streams (Ecology 2019a). Water howellia has not been confirmed in this section of the Chehalis River, but the species could be present. Native plant species require specific water quantity and quality conditions to be present.

Brazilian elodea (*Egeria densa*) and parrotfeather (*Myriophyllum aquaticum*) are non-native aquatic plant species confirmed to be present in the study area. Brazilian elodea is a submersed plant found in slow-moving freshwater. Parrotfeather easily adapts to habitats high in nutrients and can also be found in smaller freshwater ponds and streams (Simon and Peoples 2006). A reach of the mainstem Chehalis River downstream of Centralia has been listed as impaired because of the presence of these two invasive non-native species (Ecology 2019b).

4.5.2.5 Marine Mammals

Marine mammals are not expected to be in the study area. However, killer whales and sea lions are known to eat salmon that migrate to and from the study area. These marine mammals include Southern Resident killer whales (*Orcinus orca*), California sea lions (*Zalophus californianus*), and Steller sea lions (*Eumetopias jubatus*). Southern Resident killer whales are federally listed as endangered. Southern Resident pods (groups of whales) travel from central-southeast Alaska to central California. They spend most of the year off the coasts of Washington and southern Vancouver Island, British Columbia, and in the Salish Sea near the San Juan Islands (NOAA 2010). The Southern Resident killer whale diet is composed primarily of Chinook salmon, but also includes steelhead, coho salmon, and chum salmon (Hanson et al. 2010). California and Steller sea lions are also present off the coasts of Washington. California sea lions are opportunistic feeders whose diet includes a variety of fish, including salmon. The diet of Steller sea lions also includes salmon (NOAA 2010).

4.5.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.5.3.1 Methods

The analysis of potential impacts considered how aquatic habitats and species would be affected without and with the project alternatives. The impact analysis considered information from reports, technical studies, field visits, and modeling. In most cases, the impacts were qualitatively assessed by reviewing available information and using best professional judgment to predict the general range of impacts. In other cases, the impacts were quantified based on modeling. Modeling was done to quantify the impacts to salmonids, including spring-run Chinook salmon, fall-run Chinook salmon, coho salmon, and steelhead. This included two computer programs: the Ecosystem Diagnostic and Treatment (EDT) model, and the EDT integrated with Life Cycle Models (EDT-LCM).

> **Fish Models**
>
> Two computer models were used to predict how salmon species would be affected by the proposed project.
>
> **EDT** provides the results as a snapshot in time for set habitat and river flow conditions.
>
> **EDT-LCM** provides results as long-term trends when certain conditions, such as flow, can change.
>
> The models made assumptions about how fish could be affected by the proposed project in two areas:
>
> - The flood retention facility project area above Crim Creek (RM 114 to RM 108)
> - The Chehalis 100-year floodplain study area down to Rainbow Falls (RM 108 to RM 98)

The fish modeling predicted how the proposed project would affect the following three factors for each of the four fish species:

- Diversity: the number and pattern of spawning sites
- Abundance: the number of fish

- Productivity: the number of young fish that survive and return to spawn as adults

A summary of the results for diversity and abundance are presented in this section. Productivity and abundance are strongly related. Therefore, productivity results are not presented. Modeling results and more details about how the modeling was done are included in Appendix K. Appendix E describes the thresholds used to determine the level of impacts.

4.5.3.2 No Action Alternative

Under the No Action Alternative, there would be no to low adverse impacts and some beneficial impacts to aquatic habitats and aquatic species in the flood retention facility project area compared to existing conditions. There would be low to medium adverse impacts and beneficial impacts in the Chehalis River 100-year floodplain.

> No Action Alternative Impacts to Aquatic Habitats
>
> **Flood Retention Facility Project Area**
> - No to low adverse impacts overall and some beneficial impacts
>
> **Chehalis River 100-year Floodplain Study Area**
> - Low to medium impacts overall and some beneficial impacts from habitat restoration
> - High impacts from continued flood risk, including some beneficial impacts

4.5.3.2.1 Aquatic Habitats

Flood Retention Facility Project Area

Aquatic habitat conditions in the flood retention facility project area are expected to remain generally the same under the No Action Alternative. Depending on variability of the climate, increased extremes in temperature and river flows could reduce habitat quality over time. However, there are other factors that could improve quality. For example, timber harvest would continue to follow the WDNR Forest Practices Habitat Conservation Plan in the managed forestland, which includes most of the land in this project area. As part of the habitat conservation plan, streamside trees are protected from harvest and would likely continue to grow over the analysis period. This would provide shading to keep water temperatures cool and contribute to aquatic habitat diversity through the increased input of LWM over time.

Chehalis River 100-Year Floodplain

The quality of aquatic habitat in the Chehalis River 100-year floodplain study area is expected to decrease under the No Action Alternative compared to existing conditions. There would be medium adverse impacts from continued growth and development and beneficial impacts from restoration and local flood risk management projects. The adverse and beneficial impacts from flooding would also continue.

Continued major or greater flooding would result in primarily adverse impacts. However, flooding does also result in some beneficial impacts. Floods can result in gravel recruitment, redistribution of silt and the removal of fine sediment from the spawning gravels, and displacement of predators (Ferguson 2020). During smaller floods, flows across the floodplain connect nearby wetlands, ponds, oxbows, and other off-channel habitats that are important for fish rearing or that support species that rely on periodic flooding. Smaller floods can also provide benefits such as increases in aquatic food supply, nutrients, primary production, and groundwater recharge (Talbot et al. 2018).

Under the No Action Alternative, restoration actions would improve aquatic habitat in targeted areas. This includes actions such as the early action Aquatic Species Restoration Plan projects, ongoing local programs and activities intended to reduce flood-related damage, and the WSDOT culvert replacement program. Some of these activities would restore stream and off-channel habitats and reduce bank erosion, while others would focus on creating, restoring, and enhancing wetlands. These actions would lead to localized areas of improvement. However, they are not robust enough to improve aquatic habitat quality at or approaching the scale of a watershed.

4.5.3.2.2 Aquatic Species

Under the No Action Alternative, aquatic species and habitat would benefit from some restoration actions and be adversely affected by continued development. In the flood retention facility project area, there would be low to no adverse impacts and some beneficial impacts. In the Chehalis River 100-year floodplain area, it is expected that aquatic species populations would experience low to medium adverse impacts despite restoration activities. There would be low to medium impacts to salmonids at the scale of the Chehalis Basin. This is expected to result in low impacts to marine mammals that eat salmon.

> ### No Action Alternative Impacts to Aquatic Species
>
> **Flood Retention Facility Project Area**
>
> - No to low adverse impacts and some beneficial impacts
>
> **Chehalis River 100-year Floodplain Study Area**
>
> - Low to medium direct impacts to spring-run Chinook salmon, fall-run Chinook salmon, lamprey, other native fish, and freshwater mussels
> - Medium to high direct impacts to coho salmon and steelhead
>
> **Chehalis Basin**
>
> - Low to high impacts to coho salmon and spring-run and fall-run Chinook salmon
> - Beneficial impact to steelhead
> - Low impact to marine mammals outside of the study area

Flood Retention Facility Project Area

The abundance of aquatic species in the flood retention facility project area would remain about the same. Modeling showed that the population of all four modeled fish would be stable or slightly improve over time. This is mainly because of the assumption that streamside trees would continue to grow and provide improved habitat.

Chehalis River 100-Year Floodplain Area

The abundance of native fish and freshwater mussels in the Chehalis River 100-year floodplain area are expected to decline compared to existing conditions. This is because habitat quality is expected to generally decrease over the analysis period, as discussed in Section 4.5.3.2.1.

Adverse impacts from non-native fish species, including competition and predation on native species, would also continue. Non-native plant species form dense mats that shade out native plants. This gives a competitive advantage to non-native fish species that prefer aquatic plants more than native salmonids (Dibble 2009). The current trend toward decreasing habitat quantity and quality over time means there is a potential that invasive species abundance could increase.

Predicted declines for salmonids are generally an indicator that most native fish species would also experience declines. The fish modeling predicted impacts to spring-run and fall-run Chinook salmon that were classified as low to medium. This is because abundance would be stable or decrease slightly in the Chehalis River 100-year floodplain study area. Modeled major floods showed population declines of approximately 10% compared to current conditions. This decline could be important for spring-run Chinook salmon because less than 40 adult individuals were estimated to occur in this area. The modeling predicted that all four species would also be able to recover from back-to-back floods under the No Action Alternative.

Larger decreases in abundance were predicted for coho salmon and steelhead. In the Chehalis River 100-year floodplain (to RM 98), it was estimated that these species would experience medium to high adverse impacts. Depending on the size of a flood, the abundance of these species could decline by approximately 30% to 50% during a flood year, compared to current conditions. Steelhead have an extremely small spawning population (fewer than about 15 adult individuals) in this area. Further decline could have a substantial adverse effect on this population (McElhany et al. 2000).

Direct benefits to fish species would result from the WSDOT statewide culvert replacement fish passage restoration program. Under this program, WSDOT replaces culverts that do not allow fish to move upstream and downstream with culverts or bridges that allow fish to move. As noted earlier, aquatic species would also benefit from restoration and flood risk management actions. However, these benefits are not anticipated to outweigh the adverse impacts from increased growth and development.

Chehalis Basin

Under the No Action Alternative, there would be notable declines in abundance and habitat diversity when considering populations outside the study area. Based on the modeling, the level of declines would be low for coho salmon, medium for fall-run Chinook salmon, and high for spring-run Chinook salmon. Steelhead would not experience declines. Impacts would be high for spring-run Chinook salmon because of a 12% decrease in spawning and rearing habitat diversity, an already small population size, and ongoing declines in abundance and productivity. There would be a predicted 7% decrease in abundance and 3% decrease in diversity for fall-run Chinook salmon. This would be a medium impact because they have a larger population and more spawning areas than spring-run Chinook salmon. Impacts would be low for coho salmon, with a predicted 3.5% decrease in abundance, because they have a much larger population than Chinook salmon (Figure 4.5-2). Steelhead would experience increases in abundance and diversity at the Chehalis Basin scale under the No Action Alternative.

Killer whales and sea lions living in Grays Harbor that eat salmon may experience low impacts from the slight decreases in abundance of salmon, particularly Chinook salmon. A recent WDFW technical memorandum reported that salmon from the study area are a small percentage of all the salmon in Grays Harbor (Ronne 2019). Therefore, it is likely that these marine mammal populations would lose a small part of their food source.

4.5.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to aquatic species and habitats from construction and operation of Alternative 1.

4.5.3.3.1 Construction

Alternative 1 would result in low to high direct and indirect impacts to aquatic species during the construction period in the flood retention facility project area. There would also be low to high impacts in the Chehalis River 100-year floodplain area and at the scale of the Chehalis Basin. Alternative 1 construction would also result in permanent changes that would cause high impacts to aquatic habitat. These impacts are discussed in Section 4.5.3.3.2.

Fish

Alternative 1 construction would result in direct adverse impacts to fish and fish habitat that would range from low to high, depending on the species. There would also be low to medium indirect impacts affecting all fish and their habitat.

Alternative 1 construction would generally contribute to decreases in the abundance of fish in the flood retention facility project area. These activities would also result in declines in fish health and habitat quality in this area.

Fish that spawn and rear above the proposed FRE facility, including salmonids and lamprey, are expected to experience medium to high impacts. This is because their existing populations are already very low or because they prefer to spawn in areas that would be less available or not available during construction. Most other fish would experience low to medium impacts. Shiner, dace, and sucker species would likely experience lower

> **Alternative 1 Construction Impacts to Fish**
>
> **Flood Retention Facility Project Area**
> - High direct impacts to anadromous salmonids and lamprey
> - Low to medium direct impacts to other native fish
> - No impacts to federally listed bull trout, Pacific eulachon, or green sturgeon
> - Medium direct impacts to freshwater mussel
> - Low to medium indirect impacts to fish from increased risk of spills, leaks, and turbidity
>
> **Chehalis River 100-Year Floodplain Study Area**
> - High direct impacts to anadromous salmonids and lamprey
>
> **Chehalis Basin**
> - Low direct impact to the abundance of anadromous salmonids
> - High direct impact to spring-run Chinook from loss of habitat diversity in the study area

impacts because there is more habitat in areas of the Chehalis River downstream of the proposed construction site (Winkowski et al. 2018).

Table 4.5-2 shows the anticipated changes in abundance and diversity for modeled salmonids. The results are presented as a percent change compared to the No Action Alternative to isolate the impacts of Alternative 1 over time. There would be high impacts to salmonids in the study area above Rainbow Falls (RM 98). This is because there is important spawning habitat in this part of the study area. Adverse effects would generally cause declines in the abundance of fish and habitat diversity. Downstream of Rainbow Falls, the impacts were not modeled but would be low to medium. Changes in abundance and diversity were not modeled downstream of Rainbow Falls because spawning in this part of the study area would be much less affected by the proposed project.

The impacts to the combined abundance of anadromous salmonids in the study area would be low when considered at the scale of the Chehalis Basin. However, there would be a high impact to spring-run Chinook salmon habitat from losses in the study area that would be notable at the basin scale. This is because there are very few spawning areas for spring-run Chinook salmon under existing conditions, many of which are located in the affected area. Any further decrease would worsen population declines for this species.

Table 4.5-2

Construction Impacts to Salmonids Abundance and Diversity compared to the No Action Alternative

SPECIES	FLOOD RETENTION FACILITY PROJECT AREA (ABUNDANCE/DIVERSITY)	CHEHALIS RIVER 100-YEAR FLOODPLAIN AREA (TO RAINBOW FALLS) (ABUNDANCE/DIVERSITY)	CHEHALIS BASIN (ABUNDANCE/DIVERSITY)
Spring-run Chinook salmon	-78% / -77%	-7% / -50%	+1.3% / -12%
Fall-run Chinook salmon	-40% / -54%	-13% / +11%	0.0% / -0.3%
Coho salmon	-72% / -83%	-2% / -43%	-0.1% / -0.5%
Steelhead	-53% / -38%	-27% / -78%	-0.1% / -1.3%

There would be no impact to federally listed bull trout, Pacific eulachon, or green sturgeon because these species are not likely to be found near the flood retention facility project area.

The discussion below describes more specifically how fish and fish habitat would be affected by construction. The discussion generally applies to all fish but impacts by species are noted where there are differences.

FRE facility construction would require diverting the Chehalis River around the construction site for up to 5 years. Diversion of Mahaffey Creek would also be required. It was assumed that work directly within the river to install the diversion tunnel would happen during specified work windows put in place for the protection of fish from July 1 through September 30. Fish species that would be affected include those listed in Appendix K as potentially present in the flood retention facility project area. Some salmonids and lamprey may have more than one life stage present during this time, as shown in Figure 4.5-1. Spring-run Chinook salmon may be especially sensitive during this time because adults arrive throughout the summer and spawning begins in early September.

Diversion activities would require work directly in the river. Building the in-water structures and draining the work site could increase the risk that fish could be harmed. BMPs would be implemented to minimize these risks, such as using slow dewatering rates for less harmful fish removal, and implementing buffers around blasting. However, risks cannot be eliminated, and fish present during construction would still experience medium impacts.

Construction would result in a temporary loss of 2.77 acres of aquatic habitat because of dewatering the work area, cofferdams, and staging. Some additional area would also be affected from dewatering Mahaffey Creek. Fish would not be able to use this area while it was dewatered. Any eggs present in this area would be lost. The losses would result in high local impacts because it would affect the potential of the habitat to produce and support native fish of all species.

Construction would also result in high impacts from the permanent loss of 2.05 acres of fish habitat. Habitat loss from constructing the FRE facility would include EFH and WDFW priority habitat.

Construction would also require pre-construction vegetation management, including harvest of trees from the footprint of the temporary reservoir. This would reduce streamside vegetation and increase the potential for adverse impacts to water quality because of increased erosion and sedimentation in the river. Less streamside vegetation would also result in long-term temperature increases and loss of aquatic species prey resources. Periodic flooding would also result in the loss of habitat within the footprint of the temporary reservoir. These impacts are discussed further in Section 4.5.3.3.2.

Construction noise could adversely affect fish by disrupting normal behavior patterns or damaging ear structures. The loudest noise levels would happen during blasting. The Applicant has proposed blasting to occur at a minimum of 25 feet from the water's edge. The Applicant has also proposed to implement BMPs that would minimize sound levels to below levels that have been shown to disrupt behavior in salmonids and other fish species. Depending on how effective these measures are, the impact to fish could range from low to high.

Because construction would last for more than one season (up to 5 years), some species of adult fish would need to move past the construction site to reach spawning grounds located farther upstream. Fish passage assumptions are shown in Table 3.4-1. Upstream fish passage would be provided by a temporary trap-and-transport facility, targeting adult anadromous salmonids. Once eggs hatched and fish were large enough to move downstream, fish could pass downstream through the construction site using the diversion tunnel.

As shown in Table 4.5-3, overall fish passage rates would be substantially reduced compared to existing conditions. This is especially true for upstream passage of adults through the trap-and-transport facility. The reason upstream passage rates would be lower is because it is expected that some fish would die while being collected, transported, or placed above the construction site. Some fish may also die from delayed effects of stress and injury before they have a chance to spawn. Stress and injury can occur from handling, reduced water quality, or longer holding times during trap and transport. Picket weirs, a common method for controlling fish movement, also have less than 100% capture efficiency, reducing the overall number of fish that are trapped. It is possible that other options that could improve fish passage may be put in place.

Table 4.5-3
Fish Passage Survival Rates during Construction

TARGET SPECIES	OVERALL FISH PASSAGE SURVIVAL RATE
UPSTREAM VIA TEMPORARY TRAP AND TRANSPORT	
Adult Spring-run Chinook Salmon	63%
Adult Fall-run Chinook Salmon	66%
Adult Coho Salmon	41%
Adult Steelhead	45%
Adult Coastal Cutthroat	Similar to coho salmon and steelhead
Adult Pacific Lamprey	No passage provided
Juvenile Salmonids and Other Native Fishes	No passage provided
ADULT DOWNSTREAM VIA DIVERSION TUNNEL	
Steelhead (kelts)	0%
Coastal Cutthroat (kelts)	0%
JUVENILE DOWNSTREAM VIA DIVERSION TUNNEL	
Spring-run Chinook Salmon	85%
Fall-run Chinook Salmon	85%
Coho Salmon	85%
Steelhead	95%
Coastal Cutthroat	85%
Pacific Lamprey	95%

Because no upstream passage is specifically proposed for Pacific lamprey, other native fish, or juvenile salmonids, it was assumed these species would not be able to pass through the construction site. This means these species would not be able to spawn or rear in suitable habitat above the construction site. This would have a high impact to Pacific lamprey and juvenile salmonids because of their documented behavior patterns and known habitat. There is a lack of research on the importance of suitable spawning areas above the construction site for mountain whitefish (*Prosopium williamsoni*), speckled dace, and largescale sucker (*Catostomus macrocheilus*) populations.

As noted in Table 4.5-3, downstream passage for juvenile fish would be somewhat reduced compared to existing conditions. It is also expected that most juvenile fish would pass the picket weir that would be put in place as part of the trap-and-transport facility.

In general, it is expected that few adult salmonids would move downstream of the construction site once they had spawned. The exception would be steelhead and coastal cutthroat kelts. It is expected they would move through the diversion tunnel in a manner similar to existing conditions, but would be unable to get downstream past the picket weir. For this reason, it was assumed that there would be no downstream passage for these fish. It is unclear what level of impact this would have on steelhead and coastal cutthroat because the percent of the adult population that returns to the ocean is unknown for the upper Chehalis River Basin. More details of how fish passage rates were calculated can be found in Appendix K.

Disruption of fish movement would also occur in road stream crossings that would be upgraded as part of the construction process. Disruption of fish passage from these types of activities is expected to be short term and result in low impacts. Long-term fish passage impacts caused by the FRE facility are discussed in Section 4.5.3.3.2.

There would also be low to medium indirect impacts to fish from habitat degradation during the construction period. This would mainly happen because of the increased risk of spills, leaks, and high turbidity. Leaking and spills can occur from faulty equipment or work-site accidents. The impact would be greater if a flood greater than 3-year occurred. Flows from this flood could overcome structures used to isolate work and storage areas, mobilizing construction-related pollutants and soil into the water and downstream aquatic habitats (Appendix K). Turbidity could result from soil erosion caused by construction activities and stormwater runoff. The Applicant would be required to obtain permits and approvals to protect water resources. This would require the implementation of BMPs, such as project-specific erosion and sediment control plans, water quality monitoring, and spill prevention plans.

> ## Alternative 1 Construction Impacts
>
> **Freshwater Mussels and Aquatic Plants**
>
> - Medium direct impacts in the flood retention facility project area from habitat impacts
> - Low to medium direct impacts from increased risk of spills, leaks, and turbidity
>
> **Marine Mammals**
>
> - Low indirect impact to downstream marine mammals outside of the study area that rely on salmon for food

Freshwater Mussels and Aquatic Plants

Alternative 1 would result in medium impacts to freshwater mussels and aquatic plants during the construction period. The greatest impact would happen as the result of dewatering the construction site. Any plants or animals present would be stranded and killed. This would be an adverse impact to those local populations. However, there are many other areas in the study area where these species are present that would not be affected. Increased construction noise is not expected to rise to the level that would affect freshwater mussels if BMPs are implemented. The potential for water quality impacts from increased contamination or turbidity would be minimized through the implementation of BMPs. However, plants and mussels could experience high impacts if contaminant spills occurred.

As noted above, construction would also result in permanent changes to habitat. These changes would cause medium long-term impacts to freshwater mussels and aquatic plants from increased water temperatures and sedimentation. These impacts are discussed further in Section 4.5.3.3.2.

Marine Mammals

There is expected to be a low impact to downstream marine mammal predators that rely on salmon. This is because there would be a low impact to the number of anadromous salmon at the scale of the Chehalis Basin. In addition, salmon above the FRE facility are less than 5% of the fish that travel through the Chehalis Basin and Grays Harbor (Ronne 2019).

4.5.3.3.2 Operation

Alternative 1 operation would result in low to high indirect impacts to aquatic species and habitat. The level of impact would depend on how each species uses the study area.

Fish

This section describes the impacts in the flood retention facility project area and the Chehalis River 100-year floodplain. In the flood retention facility project area, the impacts are described for when the FRE facility is operating and when it is not. This section also discusses the impacts of Alternative 1 at the Chehalis Basin scale.

Alternative 1 Operational Impacts to Fish

Flood Retention Facility Project Area

- High indirect impacts to anadromous salmonids and lamprey
- Medium indirect impacts to other native fish

Chehalis River 100-Year Floodplain Study Area

- High indirect impacts to anadromous salmonids and lamprey
- Low to medium indirect impacts to other native fish

Chehalis Basin

- Low indirect impacts to overall number of anadromous salmonids
- High indirect impacts to spring-run Chinook salmon from loss of habitat diversity in the study area

Flood Retention Facility Project Area

There would be medium to high impacts to fish and fish habitat in the flood retention facility project area. Fish with the potential to be affected are those listed in Appendix K as being potentially present in the flood retention facility project area.

Alternative 1 operation would generally contribute to decreases in the abundance of fish in the flood retention facility project area for the reasons discussed further below. Some impacts would happen when the FRE facility operates, once every 7 years on average. Other impacts would happen even in years when the river was free-flowing through the gated outlets.

FRE facility operation would have the greatest impact to fish that rely on spawning and rearing habitat above the FRE facility. This is because operation of the FRE facility would reduce the availability of, and access to, spawning and rearing habitat upstream of the facility. Because many anadromous salmonids and lamprey rely on upstream spawning and rearing habitat, these fish would experience the highest impacts. Table 4.5-4 shows how salmonids would be adversely affected in years when the FRE facility was operating compared to years when it was not. The results are presented as a percent change compared to the No Action Alternative to isolate the impacts of Alternative 1 over time. Trend modeling showed that, by mid-century, operation of the FRE facility would reduce the spring-run Chinook salmon population to fewer than 20 fish, putting it at risk for permanent loss in this area. Other fish, like lamprey, that spawn and rear around the FRE facility would also likely experience declines in years when the FRE facility was operating.

Table 4.5-4
Salmonid Impacts in the Flood Retention Facility Project Area

SPECIES	ALTERNATIVE 1 COMPARED TO NO ACTION ALTERNATIVE	
	FREE-FLOWING (ABUNDANCE/DIVERSITY)	FRE FACILITY OPERATING (ABUNDANCE/DIVERSITY)
Spring-run Chinook salmon	-40%/-31%	-100%/-100%
Fall-run Chinook salmon	-22%/-46%	-68%/-75%
Coho salmon	-24%/-27%	-44%/-26%
Steelhead	-14%/-13%	-21%/-20%

Note:
The results presented in this table show the greatest possible impact under each scenario. Appendix K provides additional details on the modeling results.

Non-salmonid native fish would likely experience medium to high impacts during FRE facility operation. The impacts would be lower than for salmonids and lamprey because non-salmonid fish could use other habitats that would not be flooded or blocked.

impacts to fish during FRE facility operation would mainly happen because of loss of habitat, reduced fish passage and fish survival, and short-term increases in turbidity. These impacts would affect all fish likely to be found in this part of the study area. Where impacts are different for different species, they are noted in the following paragraphs.

During FRE facility operation, approximately 94 acres of EFH and WDFW priority habitat in the footprint of the temporary reservoir would be flooded. This would cause a high impact to salmonids and lamprey because of their use of this habitat. Any eggs or fry in the temporary reservoir would likely experience 100% mortality due to sedimentation and extensive changes in habitat conditions.

Fish passage would also be restricted or reduced when the FRE facility was operating. When the gated outlets were partially closed, there would be no downstream passage for up to 32 days. Delays in migration can cause juvenile salmon and trout to experience poorer downstream conditions, such as warmer temperatures and lower flows, increased exposure to predation, and potentially reduced ocean survival (Freshwater et al. 2016; Marschall et al. 2011). Delays in migration for steelhead kelts in poor physical condition after spawning could result in increased mortality (Hatch et al. 2013). The Applicant would operate a CHTR facility to transport fish above the FRE facility. With this system in place, there would be medium adverse impacts to migrating fish due to mortality and other stress-related impacts to reproductive success. Impacts would not be higher because the impact would happen on average once every 7 years. Fish passage rates for salmonids would be about 90%. Passage for coastal cutthroat trout and Pacific lamprey is conservatively estimated at 54% because less is known about providing passage for these species.

FRE facility operation would also cause short-term increases in turbidity. As discussed in Section 4.1, turbidity levels within the footprint of the temporary reservoir and immediately downstream of the FRE facility are predicted to exceed applicable water quality criteria for a short period. Impacts to aquatic species from temporary turbidity increases would be minor because they would be relatively infrequent.

When the river was free-flowing through the gated outlets and the FRE facility was not operating, there would be medium to high impacts to fish over time. The main impacts would be a result of fewer streamside trees in the footprint of the temporary reservoir from ongoing vegetation management and periodic flooding. This change would lead to unfavorable water quality conditions for fish spawning and survival, in addition to reduced fish passage through the gated outlets. Over time, there would be less LWM input, less prey diversity, and changes to the riverbed that could affect the local food web and spawning conditions downstream of the FRE facility.

Aquatic organisms are adapted to live within a certain temperature range. As temperatures exceed this range, the number of species and individuals within those species capable of living and successfully reproducing under those conditions declines (USGS 2019). Behavior changes such as early migration can also occur (Bergendorf 2002). The increase in water temperature could also change patterns of aquatic habitat use within the river system. Warmer water temperature could allow non-native predators to migrate farther upstream into the temporary reservoir footprint and immediately downstream of the proposed flood retention facility. Currently, largemouth and smallmouth bass have not been detected above the confluence with the South Fork Chehalis River, and no non-native fish species have been detected upstream of Rainbow Falls (Winkowski et al. 2018a).

Increases in water temperature are expected to have the greatest impact to salmon and trout and other native fish species that require colder water for spawning and rearing. These species include the special-status species Chinook salmon, coho salmon, steelhead, coastal cutthroat trout, Pacific lamprey, river lamprey, leopard dace, and mountain sucker. Increased temperatures would mainly affect species and life stages that use the temporary reservoir footprint between May and October to RM 110. This would adversely affect all native species shown in Figure 4.5-1.

Impacts caused by temperature increases could be worsened by declines in dissolved oxygen concentrations, which frequently do not meet state water quality criteria. Alternative 1 is expected to cause further impacts in areas affected by temperature.

Fish could be affected by reduced passage over time. Fish passage survival through the FRE facility is expected to be lower than under existing Chehalis River instream conditions. The reduction in fish passage survival is dependent on species, life stage, and movement direction. In general, adult upstream passage for salmonids, cutthroat trout, and lamprey would only be slightly reduced, ranging from 92% to 96% survival. Juvenile upstream passage would be more reduced, ranging from 64% to

79% survival. Downstream survival for adults and juveniles would range from 74% to 95%. More detailed analysis of fish passage survival can be found in Appendix K.

Alternative 1 would also reduce the amount of LWM in the system overall. This would cause adverse impacts to fish and fish habitat. The Applicant could be required to establish a program for the ongoing transport of LWM downstream of the FRE facility as a condition of a permitting or approval process.

Changes in habitat-forming processes caused by the operation of the flood retention facility would happen continuously over time. This includes changes in how sediment travels within the river, where sediment erodes and where it deposits, how the river channel moves, what types of materials make up the riverbed, and where LWM collects. Section 4.3 discusses the effects of Alternative 1 on geomorphology in the Chehalis River.

Sediment in the riverbed within the temporary reservoir footprint is expected to be finer over time compared to existing conditions and the No Action Alternative. This part of the study area is expected to become wider and shallower because of increases in fine sediment. This change could impact spawning and rearing habitat for salmon and trout and other native fish that require sand, gravel, and cobbles in specific size ranges (Bergendorf 2002; Winkowski and Kendall 2018).

Chehalis River 100-Year Floodplain Area

There would be low to high impacts to fish and fish habitat in the Chehalis River 100-year floodplain area. Fish likely to be affected include those with the potential to be found in this part of the study area, as listed in Appendix K.

Alternative 1 operation would generally contribute to decreases in the abundance of fish in this part of the study area. Table 4.5-5 shows how anadromous salmonids would be adversely affected compared to the No Action Alternative. The results are presented as a percent change compared to the No Action Alternative to isolate the impacts of Alternative 1 over time. There would be high impacts to spring-run Chinook salmon, fall-run Chinook salmon, and steelhead. Impacts would range from medium adverse to beneficial for coho salmon. Coho salmon mostly spawn above RM 108, but reduced streambed scour may increase the amount of suitable spawning habitat in the Chehalis 100-year floodplain in years when the facility operates. Steelhead would experience the greatest impacts. Trend modeling showed that, after mid-century, operation of the FRE facility would drive a 100% decline in steelhead abundance, resulting in a permanent loss of the steelhead population in this area. Impacts to spring-run Chinook salmon are also notable because of their already low abundance. Further, the recent spawning survey (2018-2019) conducted between the proposed FRE facility footprint and the Newaukum River confluence found the most redds above RM 98 (Table 4.5-2), where operational impacts would be more pronounced.

Other fish like lamprey and resident trout that live below the FRE facility and prefer cooler water would also likely experience similar declines. Non-salmonid native fish, including shiner, sculpin, dace, and pikeminnow species have higher abundance and more habitat near and below RM 98 in the study area, so impacts to these species would be low to medium. Mountain whitefish have been detected in low numbers just below RM 108. This species may experience high impacts in this area, but there is limited information available.

Table 4.5-5
Salmonid Impacts in the Chehalis River 100-Year Floodplain Area

	ALTERNATIVE 1 COMPARED TO NO ACTION ALTERNATIVE	
SPECIES	FREE-FLOWING (ABUNDANCE/DIVERSITY)	FRE FACILITY OPERATING (ABUNDANCE/DIVERSITY)
Spring-run Chinook salmon	-11%/-60%	-21%/-40%
Fall-run Chinook salmon	-10%/0%	-14%/-13%
Coho salmon	+1%/-20%	-1%/+100%
Steelhead	-62%/-78%	-100%/-100%

Note:
Results are presented for the greatest possible impact under each scenario. Complete results can be found in Appendix K.

The main impacts in this part of the study area would happen because of the degradation of habitat over time. Habitat impacts that originate in the flood retention facility project area would extend downstream. This includes the same impacts from increases in temperature and turbidity and decreases in LWM that were described above for the flood retention facility project area. Because there would be an increase in sediment deposition above the FRE facility, there would also be less sediment in the Chehalis River 100-year floodplain. There would also be changes to river-forming processes that would affect fish habitat. These impacts would happen regardless of whether the FRE facility was operating.

As noted in Section 4.1, temperature impacts are expected downstream to about RM 100. This increase would happen in summer months and as noted previously, would have a high impact to fish. There would also be occasional increases in turbidity immediately below the FRE facility. This would happen on average once every 7 years when the temporary reservoir was releasing water. However, this impact would be infrequent and short term.

There would also be changes to geomorphic processes that would affect habitat. This includes a high reduction in sediment load and fining to RM 81.6 and a high reduction of LWM to RM 75. Taken together, these impacts to habitat-forming processes could be high on spawning and rearing habitat for salmonids and lamprey downstream to RM 98. Impacts between RM 98 and 75 are considered low for salmonid habitat because most of the salmonid spawning habitat is located above RM 98 (Ronne et al. 2018). Impacts to non-salmonid native fish species and their habitat would be low to medium because they have important habitat between RM 98 and RM 75 (Hayes et al. 2019). There would be low to medium impacts to these habitat-forming processes for the remainder of the study area to RM 33. However, there could be localized changes to fish habitat because of increased deposition and flooding at the tributary confluences.

Chehalis Basin

The fish modeling results at the Chehalis Basin scale are shown in Table 4.5-6. The results are presented as a percent change compared to the No Action Alternative to isolate the impacts of Alternative 1 over time. At this scale, there would be low impacts to the overall abundance of anadromous fish. However, there would be high impacts to spring-run Chinook salmon. This is mainly from the loss of habitat diversity in the study area that would be notable in the context of overall habitat in the Chehalis Basin. impacts to spring-run Chinook salmon would be more severe because they have a small population size and rely more heavily on habitat above and below the proposed flood retention facility to RM 98 for spawning.

Table 4.5-6
Salmonid Impacts at the Chehalis Basin Scale

SPECIES	ALTERNATIVE 1 COMPARED TO NO ACTION ALTERNATIVE	
	FREE-FLOWING (ABUNDANCE/DIVERSITY)	FRE FACILITY OPERATING (ABUNDANCE/DIVERSITY)
Spring-run Chinook salmon	+1%/-6%	-2%/-13%
Fall-run Chinook salmon	+1%/0%	0%/0%
Coho salmon	+1%/0%	0%/0%
Steelhead	0%/-1%	0%/-1%

Note:
Results are presented for the greatest possible impact under each scenario. Complete results can be found in Appendix K.

Freshwater Mussels and Aquatic Plants

Alternative 1 operation would result in medium impacts to freshwater mussels and aquatic plants. The main impacts would happen as the result of increases in temperature and sedimentation over time. These impacts would be greatest in the flood retention facility project area but would extend downstream. Temperature increases would extend to RM 100 and sediment transport changes would happen throughout the study area.

The riverbed within the temporary reservoir footprint is expected to be composed of more fine sediment over time compared to existing conditions and the No Action Alternative. An increase in fine sediment could also bury and kill or injure aquatic plants or freshwater mussels that are unable to move to avoid the fine sediment.

Freshwater mussels would also be adversely affected by temperature increases. Because freshwater mussels have a lifecycle that depends on fish species, mussel distributions could also change as fish movements and distributions change.

Aquatic plants would also be adversely impacted by increases in temperature. Aquatic plants such as mosses and liverworts are sensitive to light and temperature, and too much of either can cause damage and reduced photosynthesis (Stream Bryophyte Group 1999). Because mosses and liverworts can strongly influence the types and abundance of stream invertebrate species (Stream Bryophyte Group 1999), this is considered to be a medium impact. Increases in temperature could allow non-native plant species such as parrotfeather and Brazilian elodea to expand farther upstream. In the area downstream of the FRE facility to RM 100, there is greater likelihood that these two plant species could expand their range.

Marine Mammals

Alternative 1 would have low impacts to marine mammals that rely on Chinook salmon as prey. This is because there would be a low decline in the combined abundance of anadromous salmonids at the Chehalis Basin scale. In addition, Chinook salmon above the FRE facility are less than 5% of the total population that travels through the Chehalis Basin and Grays Harbor (Ronne 2019). There would be no impact to marine mammals in years that the FRE facility does not operate because there would be no to low impacts to Chinook salmon at the Chehalis Basin scale during those years.

4.5.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

As noted in Chapter 3, the potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1. Therefore, this section focuses on construction of the FRO facility under Alternative 2.

The FRO facility would be identical to the FRE facility except that the FRO facility would have a smaller foundation. This could result in differences in impacts related to construction. The operation of either of the two flood retention facilities would be identical. The Airport Levee Improvements under Alternative 2 would be identical to those under Alternative 1. Therefore, no difference in impacts is expected relative to the Airport Levee Improvements.

Construction of Alternative 2 would result in slightly less direct and indirect impact to aquatic species and habitat compared to Alternative 1. The footprint of the FRO facility would be slightly smaller than that of the FRE facility. Fill placement impacts to the Chehalis River from construction of the FRO facility downstream stilling basin would be approximately 0.21 acre less than what would occur with the FRE facility. Construction of Alternative 2 would be expected to complete approximately 9 months earlier than Alternative 1, so temporary impacts would not last as long. All other construction impacts to aquatic species and habitat from fill placement and vegetation removal activities would be the same as those that would occur with Alternative 1.

4.6 Terrestrial Species and Habitats

4.6.1 Introduction

Terrestrial species are plants and animals that live mostly or entirely on land. Examples of terrestrial plants include trees, shrubs, and herbs that prefer upland or riparian habitats. Terrestrial wildlife includes mammals, birds, invertebrates, reptiles, and amphibians. Terrestrial habitats are the places where animals and plants live that are found on land. Examples include forests, grasslands, deserts, shorelines, and underground habitats like caves and burrow systems.

This section describes terrestrial species and habitats in the study area. It also describes how the alternatives would affect these resources. Additional details can be found in Appendix L, the discipline report for terrestrial species and habitat.

> ### Key Findings
>
> **Construction**
>
> - High direct impacts and medium indirect impacts to terrestrial habitat in the flood retention facility project area
> - Low to high impacts to wildlife in the flood retention facility project area
> - High direct impacts to ESA-listed species and amphibians in the flood retention facility project area
> - Low direct impacts to Willapa Hills elk
> - Low direct and indirect impacts in the Airport Levee Improvements project area
> - No impacts in the Chehalis River 100-year floodplain area
>
> **Operation**
>
> - Medium to high indirect impacts to terrestrial habitat in the flood retention facility project area
> - Low to high indirect impacts to wildlife in the flood retention facility project area
> - No impacts in the Airport Levee Improvements project area
> - Low indirect impacts in the Chehalis River 100-year floodplain

4.6.2 Affected Environment

This section describes the terrestrial species and habitats in the study area. The study area is defined in Section 3.6 and includes a 0.5-mile buffer around the flood retention facility construction area and a 500-foot buffer around the Airport Levee Improvements project area for construction noise.

4.6.2.1 Terrestrial Plant Species

The following sections discuss terrestrial plant species in the study area.

4.6.2.1.1 Flood Retention Facility Project Area

This part of the study area includes plants found in managed commercial forests and also includes plants along wetlands, rivers, and streams that are adapted to wetter conditions (Quinn et al. 2020). The main species in the forested areas is Douglas-fir (*Pseudotsuga menziesii*). The understory includes fewer plants because shading of the trees limits their ability to grow. Understory plants include western swordfern (*Polystichum munitum*), Pacific bleeding heart (*Dicentra formosa*), Pacific waterleaf (*Hydrophyllum tenuipes*), and redwood sorrel (*Oxalis oregana*). Plants found along wetlands or waterways include red alder (*Alnus rubra*), big-leaf maple (*Acer macrophyllum*), western hemlock (*Tsuga* *heterophylla*), western red-cedar (*Thuja plicata*), and Douglas-fir. Common shrubs include red elderberry (*Sambucus racemosa*), salmonberry (*Rubus spectabilis*), vine maple (*Acer circinatum*), cascara (*Rhamnus purshiana*), and snowberry (*Symphoricarpos albus*). These areas also include western swordfern, redwood sorrel, Pacific bleeding heart, Pacific waterleaf, and piggyback plant (*Tolmiea menziesii*).

Two federally threatened, five state endangered, and four state threatened plants may potentially be present in the flood retention facility project area (Appendix L). No critical habitat for federally listed plants is present in the flood retention facility project area.

4.6.2.1.2 Airport Levee Improvements Project Area

This part of the study area includes non-woody plants with a few scattered shrubs and saplings along the fringes. Common plants include reed canarygrass (*Phalaris arundinacea*), field horsetail (*Equisetum arvense*), teasel (*Dipsacus fullonum*), creeping bentgrass (*Agrostis stolonifera*), and fescue (*Festuca* spp.). Shrubs include Himalayan blackberry (*Rubus armeniacus*), trailing blackberry (*Rubus ursinus*), snowberry, Nootka rose (*Rosa nutkana*), and Douglas hawthorn (*Crataegus douglasii*).

Three federally threatened, five state endangered, and four state threatened plants may be present in the vicinity of the Airport Levee Improvements project area (Appendix L). However, suitable habitat for these species is not present, and they are unlikely to occur in the area. No critical habitat or federally listed plants are present in the Airport Levee Improvements project area.

4.6.2.1.3 Chehalis River 100-Year Floodplain

Plant communities in this part of the study area include mixed conifer-hardwood forests and woodlands, deciduous shrublands, grasslands and forblands, agricultural lands, and developed land. The forested and woodland areas are dominated by red alder, Sitka spruce (*Picea sitchensis*), Douglas-fir, western hemlock, western red-cedar, and big-leaf maple. There are also small numbers of Oregon white oak (*Quercus garryana*) and black cottonwood (*Populus balsamifera*) trees. Common shrubs include snowberry, salmonberry, Pacific ninebark (*Physocarpus capitatus*), oceanspray (*Holodiscus discolor*), red elderberry, various willow species (*Salix* spp.), and trailing blackberry. Himalayan blackberry and Scotch broom (*Cytisus scoparius*) are also present. Plants in the agricultural areas of the floodplain include row crops, orchards, and perennial, annual cut, and bale grasses. There are also plants in landscaped areas.

Numerous special-status plant species may be found in the Chehalis River 100-year floodplain. These species and their federal and state status are listed in Appendix L. No critical habitat for federally listed plant species is known to occur in the Chehalis River 100-year floodplain area.

4.6.2.2 Terrestrial Habitats

4.6.2.2.1 Flood Retention Facility Project Area

Habitat in the flood retention facility project area is mostly stands of trees managed for commercial timber harvest. There is also some riparian habitat, wetlands, and off-channel aquatic habitat along the Chehalis River and its tributaries. Riparian habitats include mixed coniferous and deciduous trees and saplings. There is also a diverse understory of shrubs and non-woody plants. Snags, downed logs, areas of bare ground, and unvegetated areas are also present. There are also a small number of caves, exposed cliffs, and unvegetated rock outcroppings with moderate to steep slopes.

The closest designated marbled murrelet (*Brachyramphus marmoratus*) critical habitat is 1.5 miles outside of the flood retention facility project area. There are WDFW Priority Habitats in the study area, including Biodiversity Areas and Corridors, Riparian, Cavity-nesting Ducks Breeding Areas, Waterfowl Concentrations, and Snags and Logs (WDFW 2019b). In addition, WDFW maps the range of the Willapa Hills elk herd (*Cervus elaphus*) as Priority Habitat in the flood retention facility project area. All terrestrial WDFW Priority Habitats for Lewis, Thurston, and Grays Harbor counties and their potential presence in the study area are listed in Appendix L.

4.6.2.2.2 Airport Levee Improvements Project Area

There is very little natural habitat in this part of the study area. Much of it has been displaced by agricultural, residential, and urban land uses over the last century and a half. There is still some habitat provided in agricultural land, mowed (managed) grassland associated with airport runways, and some lightly managed upland buffer areas around nearby wetlands. The airport levee is about 5 to 8 feet above the surrounding flat landscape, separating the airport from surrounding farmlands in the 100-year floodplain. The levee and adjacent NW Airport Road likely keep some animals from moving between habitats. For example, some animals might not be able to move between the airport and wetland buffer to the north.

There are no mapped proposed or designated critical habitats within 10 miles of the Airport Levee Improvements project area. WDFW maps two terrestrial Priority Habitats for waterfowl and cavity-nesting ducks (WDFW 2019b).

4.6.2.2.3 Chehalis River 100-Year Floodplain

The most common terrestrial habitats in this part of the study area are unmanaged forested, scrub-shrub, and riparian areas bordered by various agricultural lands and rural development. Downstream of RM 76 near Chehalis, the main habitat is provided by agricultural lands on the west side of the floodplain. The Chehalis-Centralia urban center and the I-5 corridor are the main features on the east side of the floodplain and provide little habitat. The downstream area includes a mix of vegetated riparian areas, agricultural lands, and rural development.

Within the Chehalis River 100-year floodplain, there is critical habitat for marbled murrelet and Oregon spotted frog (*Rana pretiosa*; USFWS 2019b). However, most of the marbled murrelet critical habitat is located outside of the Chehalis River 100-year floodplain. The mapped Oregon spotted frog critical habitat overlaps with the Black River Habitat Management Area. Mapped WDFW terrestrial Priority Habitats include oak woodlands and agricultural fields that support various waterfowl and other bird species.

4.6.2.3 Terrestrial Wildlife Species

This section summarizes the terrestrial wildlife species with the potential to be in the study area. Appendix L lists the special-status wildlife species that may be present in the study area.

4.6.2.3.1 Flood Retention Facility Project Area

Common wildlife in this part of the study area includes various mammals, birds, reptiles, amphibians, and invertebrates. Three federally listed species (gray wolf [*Canis lupus*], Northern spotted owl [*Strix occidentalis caurina*], and marbled murrelet), may potentially occur in Lewis County and have suitable habitat in the flood retention facility project area.

4.6.2.3.2 Airport Levee Improvements Project Area

Terrestrial wildlife species in this part of the study area are those that are common in emergent and scrub-shrub wetlands, maintained landscape areas, and agricultural lands. Animals that spend time in this area may be used to the noise and disturbance from the airport and road traffic. There may also be suitable habitat for the federally threatened streaked horned lark (*Eremophila alpestris strigata*), which can often be found in managed, open grasslands around airports.

4.6.2.3.3 Chehalis River 100-Year Floodplain

Terrestrial wildlife species in this part of the study area include a wide variety of mammals, birds, reptiles, amphibians, and invertebrates that are typical of floodplain habitats. Several federally listed threatened or endangered species may be present in this part of the study area (Appendix L). These include gray wolf, four pocket gopher subspecies, marbled murrelet, streaked horned lark, yellow-billed cuckoo (*Coccyzus americanus*), northern spotted owl, Oregon spotted frog, and Taylor's checkerspot butterfly (*Euphydryas editha taylori*).

4.6.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

4.6.3.1 Methods

The analysis of potential impacts considered how construction and operation of the alternatives could affect terrestrial species and habitats. Habitat impacts were evaluated quantitatively in the flood retention facility and Airport Levee Improvements project areas and qualitatively for the Chehalis River 100-year floodplain. Impacts to terrestrial plants and wildlife considered how likely it was that a species would be in the affected area and how much exposure to disturbance, such as increased construction noise or filling of the temporary reservoir during operation, the species would experience. Appendix L provides additional detail about the methods. Appendix E describes the thresholds used for the level of impacts.

4.6.3.2 No Action Alternative

Under the No Action Alternative, there are not expected to be substantial changes affecting terrestrial species or habitat compared to existing conditions. Overall, the impacts are expected to be low.

> **No Action Alternative Impacts to Terrestrial Species and Habitats**
>
> - Low temporary impacts from vegetation removal and ground disturbance
> - Beneficial impacts to some species in certain areas from habitat restoration
> - Low to high impacts from continued risk of flooding with some species benefitting from flooding

Continued growth and development would result in a low impact. This includes continued risks related to construction, which could impact water quality, eliminate or disturb habitat, and facilitate the spread of invasive species. Potential impacts would be addressed through compliance with required permits and approvals.

There may also be beneficial impacts from ongoing projects intended to reduce flooding or restore habitat. Some of these projects would restore riparian and off-channel habitat and reduce bank erosion. In addition, implementation of the WDNR Forest Practices Habitat Conservation Plan would improve forested habitats in the study area.

The risk of flooding would also continue. While flooding can destroy habitat and harm some plants and animals, floods can also be beneficial to some species. For example, flooding supports wetlands, riparian areas, and floodplains by providing additional sources of water, sediment, and nutrients. Nutrient-rich soils and flood-dependent seed dispersal would benefit many flood-tolerant plants. Periodically flooded wetlands, riparian areas, and floodplains provide rich habitat and travel corridors for terrestrial wildlife, such as insects, amphibians, reptiles, birds, and mammals.

Terrestrial plant and wildlife species, including state and federally listed species, would be exposed to impacts from development and continued flooding. This could result in displacement, injury, or death. Species that prefer upland habitats may benefit from projects that reduce the extent or frequency of flooding and from land management practices that limit floodplain development.

4.6.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to terrestrial species and habitats resulting from construction and operation of Alternative 1.

4.6.3.3.1 Construction

> **Alternative 1 Construction Impacts to Terrestrial Species and Habitats**
>
> - High direct impacts to terrestrial habitat in the flood retention facility project area from vegetation removal
> - Medium indirect impacts to habitat from conversion from forest to shrubs/plants
> - Low to high direct and indirect impacts to wildlife, including the following:
>   - Medium direct impact if state-threatened Torrey's peavine is removed
>   - High direct impacts to marbled murrelets from increased noise and loss of potentially suitable habitat
>   - High direct impact to amphibians in the flood retention facility project area
>   - Low direct impacts to Willapa Hills elk in the flood retention facility project area
> - Low direct and indirect impacts in the Airport Levee Improvements project area
> - No impacts in the Chehalis River 100-year floodplain area

Flood Retention Facility Project Area

Impacts to terrestrial species and habitats would range from low to high. There would be medium to high direct impacts to habitat and plants mainly related to pre-construction vegetation management in the footprint of the temporary reservoir. There would be low to high impacts to wildlife. This includes the potential for a high direct impact to marbled murrelets and amphibians. There would be low direct impacts to Willapa Hills elk.

Alternative 1 would result in high direct impacts to terrestrial habitat and plants. This would mainly be from pre-construction vegetation management that would harvest trees from up to 485 acres. Trees, shrubs, and plants would also need to be cleared from the FRE facility construction site and quarries. Tree removal would involve the use of heavy equipment. It was assumed this would crush or otherwise permanently degrade vegetation in affected areas. Areas of permanent direct impacts to vegetated terrestrial habitat by habitat type are provided in Appendix L. Overall, the permanent features associated with the FRE facility would permanently replace approximately 26 acres of mature managed forestland and riparian areas that provide high-quality habitat.

Torrey's peavine (*Lathyrus torreyi*), a state threatened plant, may potentially be present in the flood retention facility project area. If it is present, it could be removed during vegetation removal, resulting in a medium impact. Federally listed plant species are unlikely to be present or impacted in the flood retention facility project area.

Alternative 1 would also result in medium indirect impacts to habitat from conversion. Habitat in the footprint of the temporary reservoir would change from forested to shrub and herbaceous. In addition, damage or disturbance during construction would likely affect habitat over time. This would happen by reducing plant growth and reproduction and thereby reducing opportunities for wildlife species to use the habitat for shelter, foraging, and breeding.

Alternative 1 would result in low to high direct impacts to wildlife, mainly as the result of habitat loss and disturbance from construction noise. This would include high impacts to some special-status species, as discussed below. In general, terrestrial wildlife species that are less capable of relocating or avoiding disturbance (e.g., reptiles, amphibians, non-winged invertebrates) could be injured or killed during construction and would experience higher impacts. Mammals, such as gophers (family Geomyidae), moles, voles, shrews, and mice, could be disturbed or harmed as a result of construction. This is because they do not typically travel far and depend more on ground burrowing and rock crevices for cover. Wildlife species that can more easily move around and cover larger distances include large mammals, birds, and winged invertebrates. These species would have a lower risk of injury or harassment. Some wildlife species may return to construction areas at the end of daily activities, while others may relocate into adjoining habitats with less construction disturbance.

Construction activities, resulting noise and vibration, and disturbing terrestrial habitat could disrupt foraging, nesting, breeding, and rearing activities for some terrestrial wildlife species. Individuals not actively rearing young would most likely abandon affected habitat during construction. This could result in an increased likelihood of mortality from direct and indirect competition for resources and increased exposure to predation in adjoining habitats. If adults were to leave while rearing young, there could be a higher chance abandoned individuals would not survive, depending on the species.

Some construction activities would create continuous noise, whereas noise associated with other construction activities, such as blasting, would be intermittent. Locations within about 0.5 mile of blasting would experience occasional instances of noise exceeding ambient levels. Continuous construction noise would exceed background levels closer to the noise source. Noise impacts to birds could result in responses such as area avoidance and interruption to feeding, nesting, and roosting. Direct injury or mortality of wildlife may occur where animals are in close proximity to blasting or other high-noise-producing activities.

Potential impacts to amphibians would be high. These species would be most affected by impacts to wetlands, stream channels, and riparian areas in the construction footprint. Diversion of the Chehalis River would require individuals in that area to relocate to other habitats. If individual animals are handled during dewatering, injury or mortality may result. Impacts may also occur upstream and downstream of the construction footprint as a result of adverse water quality or flow changes. These impacts could include increased predation risk, breeding and foraging disruption, and harm to larval life stages (Chivers et al. 2013). Affected amphibians would include those that use instream areas such as the coastal tailed frog (*Ascaphus truei*), giant salamander (genus Dicamptodon), and Columbia torrent salamander (*Rhyacotriton kezeri*). Species that use the stream margin and associated still water areas would also be affected. These include the Dunn's salamander (*Plethodon dunni*), Van Dyke's

Salamander (*Plethodon vandykei*), Pacific treefrog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*), rough-skinned newt (*Taricha granulosa*), and western toad (*Anaxyrus boreas*; Hayes et al. 2015, 2016). If present in the project area, Oregon spotted frogs could also be affected by construction activities.

Several federal and state special-status species may occur in the flood retention facility project area (Appendix L). These include the gray wolf, western gray squirrel (*Sciurus griseus*), northern spotted owl, and marbled murrelet. Gray wolves in the area would be more capable of moving to adjacent habitats to avoid impacts. Marbled murrelet and northern spotted owl nestlings, and western gray squirrel kits that could not survive outside of their nest would be the most vulnerable to direct impacts from construction, especially tree removal. If nests are present, direct injury or mortality to adults and nestlings could be avoided by removing trees outside of the nesting season. Marbled murrelets have very specific nesting site requirements and a strong preference for using the same nesting site every year. Removal of suitable nesting trees could affect the future reproductive success of marbled murrelets in the area. No impacts to designated critical habitat would occur because no critical habitat is present within the geographic range of project impacts.

A small portion of the mapped WDFW Priority Habitat for the Willapa Hills elk herd occurs in the flood retention facility project area. This habitat would be permanently and directly impacted by construction of the FRE facility through the removal of vegetation and construction of impervious structures. These impacts would be low in the context of the elk herd's large range, although habitat connectivity would be reduced.

Construction activities could result in medium temporary impacts and long-term habitat degradation. Temporary impacts would occur from increased risks from accidental spills. Temporary habitat degradation would result from the increased potential for erosion and slope destabilization caused by vegetation removal, excavation, and access road construction. Long-term impacts could include increased risk of slope instability and spread of invasive species. Tree removal in the temporary reservoir footprint would convert forest-dominated habitats to predominantly scrub-shrub and non-woody plants. Much of the understory biomass material (e.g., snags, downed logs, other woody material) in that area is also likely to be removed. This material provides important habitat for amphibians, small mammals, birds, and invertebrates. These activities would impact connectivity with other habitats outside of the flood retention facility project area.

Indirect impacts to terrestrial wildlife species would be primarily medium, resulting from potential changes to long-term wildlife species composition. Medium impacts from construction could also include changes in wildlife habitat types and fragmentation of habitats. Additionally, when construction activities cause wildlife species to relocate into nearby habitat unaffected by construction, increased wildlife competition for resources may occur in those adjoining habitats.

Alterations to riparian areas, including the removal or reduction of instream shading, would affect amphibian species that rely heavily on the interaction between land and water for habitat. These impacts would also affect federal and state special-status species that may be present in the area.

Airport Levee Improvements Project Area

Direct impacts to habitat in this part of the study area would be low and temporary. Impacts would mainly result from the removal of non-woody plants, including weedy species such as reed canarygrass, Canada thistle (*Cirsium arvense*), American vetch (*Vicia americana*), teasel, and prickly lettuce (*Lactuca serriola*). A small number of Pacific willow (*Salix lasiandra*) saplings and other shrubs may also be removed. Construction could introduce and spread invasive plant species (e.g., reed canarygrass, Himalayan blackberry, Scotch broom) into disturbed areas. State and federally listed plant species are unlikely to be present in or near the project area and would not be impacted.

The majority of construction in this area would occur within the existing levee footprint and would not affect high-quality habitat. Mapped WDFW Priority Habitats in the Airport Levee Improvements project area include freshwater pond habitat and freshwater forested and shrub wetland habitat. Other WDFW Priority Habitats present in the project area include breeding areas and nesting habitat for cavity-nesting ducks and waterfowl concentrations. Direct impacts may result from increased construction noise, although these impacts would be low and temporary.

Direct construction impacts to terrestrial wildlife species would be low. Disturbance to nearby terrestrial wildlife species may potentially occur due to construction equipment use, vehicle traffic, and human presence. Construction noise is only expected to be heard within 500 feet of the activity. Wildlife that can move around more easily (e.g., mammals, birds, winged invertebrates) would likely avoid the area during construction. Ground-burrowing mammals, reptiles, and invertebrates that reside within the footprint of the existing levee may be injured or become distressed in a way that disrupts their behavior during construction. State and federal special-status species are unlikely to be present in the area and would not be affected. Direct impacts to critical habitat would not occur because none is mapped within 10 miles of the Airport Levee Improvement project area.

Indirect impacts from construction would also be low. Ground disturbance could increase the potential for erosion, create opportunities for the spread of invasive species, or result in changes to the structure or quality of habitat. Terrestrial species and habitats may also be indirectly impacted by accidental release of contaminants from construction equipment or materials onto pervious surfaces or via stormwater runoff. Habitats that could be affected generally provide limited value and functions for wildlife because most surrounding land is developed for human use.

Chehalis River 100-Year Floodplain

No direct or indirect construction-related impacts to terrestrial habitats and species in the Chehalis River 100-year floodplain are anticipated. The proposed project would not involve any construction in this area aside from the construction occurring in the FRE facility and Airport Levee Improvement project areas, which have been previously addressed.

4.6.3.3.2 Operation

Flood Retention Facility Project Area

Impacts from operation on terrestrial habitats would be medium to high in the footprint of the temporary reservoir. State and federally listed plant species are not likely to grow in the area because they prefer undisturbed habitats. Operation would also result in no to high impacts to wildlife. This would include high impacts to amphibians that depend on riparian habitats, low impacts to Willapa Hills elk, and no impacts to marbled murrelets.

> **Alternative 1 Operational Impacts to Terrestrial Species and Habitats**
>
> - Medium to high indirect impacts to terrestrial habitat in the footprint of the temporary reservoir
> - No to high indirect impact to wildlife in the footprint of the temporary reservoir, including
>   - High impacts to amphibians
>   - Low impacts to Willapa Hills elk herd
>   - No impact to marbled murrelets
> - No impacts in the Airport Levee Improvements project area
> - Low indirect impacts to amphibians in the Chehalis River 100-year floodplain area, including Oregon spotted frog critical habitat along the Black River
> - Low indirect impacts from no major or greater flooding in the Chehalis River 100-year floodplain area

Medium to high impacts to terrestrial habitats would mainly happen in the footprint of the temporary reservoir from periodic flooding. This would result in the death of small trees, shrubs, and non-woody plants. Upland, riparian, and wetland habitats and habitats associated with caves, exposed cliffs, and unvegetated rock outcroppings may also become flooded. The affected area would also include important habitat used by Western toads and other amphibians. These impacts would happen once every 7 years on average. Ongoing indirect impacts from changing the existing mix of plant species over time and loss of associated habitat value are also likely. These impacts would also affect WDFW Priority Habitats present in the temporary reservoir footprint, including riparian areas and habitats associated with caves, exposed cliffs, and snags and logs.

The operational impacts from the flood retention facility on wildlife species would be low to high. High impacts would result for amphibians because of continued degradation of unique habitat in the temporary reservoir footprint. Wildlife could be displaced, injured, or killed in the temporary reservoir area during vegetation management activities and when the temporary reservoir is flooded. Other wildlife, such as birds, deer, and elk, would be able to access adjoining habitats, and the impact would be low. Displaced wildlife may experience increased difficulty finding resources such as food, water, and shelter. Some species may be able to tolerate disturbance and changes in their habitat, such that they would return to the area after the disturbance or expand their use of nearby habitats. Wildlife may also experience indirect impacts from changes to water quality or quantity in the temporary reservoir area that could affect their source of food. For example, a reduced abundance of fish in the upper Chehalis River could affect wildlife species whose diet includes fish, such as eagles, ospreys, and fishers.

The impact to the Willapa Hills elk herd's migration corridors would be low when the temporary reservoir fills with water. Wildlife impacts would also affect state and federally listed species that may be present in the area. No indirect impacts from facility operation on marbled murrelet critical habitat would occur because operational effects do not overlap with designated critical habitat.

A high impact to amphibians would occur during operation. This is because amphibians rely on riparian habitat that connects uplands to waterbodies, and are particularly vulnerable to habitat changes (Wake 1991). Vegetation management and filling of the temporary reservoir would temporarily or permanently remove habitat used by amphibians. Vegetation management activities may also displace, injure, or kill individual amphibians in the area. Important habitat conditions for amphibians include regular ground surface moisture and cool temperatures. These conditions would be affected by the loss of riparian cover from vegetation management and periodic flooding of the temporary reservoir, and from decreased downstream inundation. Loss of riparian vegetation along streams would increase water temperatures and decrease water quality, as well as limit habitat for foraging, cover, and breeding. Amphibian foraging would be affected by reductions in prey species.

Filling of the temporary reservoir would result in injury or mortality, and loss of habitat, for Dunn's and Van Dyke's salamanders. These species cannot tolerate flooding of their stream-margin terrestrial habitats, even for short periods of time. No opportunities for moving to other habitats would exist after the temporary reservoir fills, and populations could become isolated from each other (HMWSTS 2014).

Western toad breeding is more extensive in the flood retention facility project area than in other portions of the study area (Hayes et al. 2016). As such, this species may experience especially high impacts compared to other amphibians. Western toads may continue to use the slack water margins of the Chehalis River and its tributaries for spawning. This use would rely on the neighboring upland areas providing useable habitat that does not prevent western toad movement. Because western toads lay their eggs in the shallow submerged portion of shorelines, filling and emptying the temporary reservoir would interfere with egg laying.

Airport Levee Improvements Project Area

Continued operations at the airport would include routine mowing of airfields and the levee. Terrestrial wildlife would continue to use available habitats suitable for the species. Therefore, operation of Alternative 1 would have no indirect impacts to terrestrial habitats and species.

Chehalis River 100-Year Floodplain

Indirect impacts from operation on terrestrial plant species in the Chehalis River 100-year floodplain are anticipated to be low over the long term. Plants that rely on major flooding are rare in the project area. Plant species composition may change in limited areas in the floodplain as a result of reduced flooding during a major or greater flood. The changes in flow in the Chehalis River resulting from operation may reduce the dispersal of seeds. This could affect the diversity of plant species and their ability to spread to new areas in the 100-year floodplain. State and federally listed plant species would not be affected by changes in flooding. However, flood risk management may also lead to continued development in the floodplain, which could reduce potential habitat for listed plant species.

Operation may affect habitats in the Chehalis River 100-year floodplain that are normally covered by water during a major or greater flood. Habitats that rely on overbank flooding would be adversely affected, while habitats associated with drier conditions would benefit. Vegetation management in the temporary reservoir area would limit the amount of small woody material and LWM and other organic materials from entering the floodplain downstream of the FRE facility. This would affect downstream riparian habitat. These impacts may also affect WDFW Priority Habitats in the 100-year floodplain, including waterfowl concentration areas, oak woodlands, and wet prairie.

Indirect impacts from operation on terrestrial wildlife species in the Chehalis River 100-year floodplain are anticipated to be low. Some terrestrial wildlife species, such as burrowing mammals, may benefit from reduced flooding. Other species may be indirectly impacted by a reduction in flood extents during a major or greater flood that could result in less habitat for foraging and overwintering. Vegetation removal in the temporary reservoir area would result in higher river water temperatures. Increased water temperatures in the Chehalis River 100-year floodplain area may cause amphibians to alter their behaviors or avoid certain habitats. Warmer water temperatures may also create preferable conditions for predators, which can outcompete and prey on many native species. Reducing the frequency and extent of flooding may limit seed dispersal of vegetation that supports terrestrial species in the floodplain. Flood risk management may also reduce disturbance of listed wildlife species that prefer upland habitats, such as pocket gophers.

Oregon spotted frog critical habitat in the Chehalis River 100-year floodplain may be affected by operation of the FRE facility. This critical habitat overlaps an approximately 1.5-mile stretch of the Black River Habitat Management Area associated with the Black River, a tributary to the Chehalis River. impacts to this critical habitat could include a decrease in the amount of water, organic debris, and nutrients that reach the habitat when the FRE facility is retaining water during floods. Water in these habitats comes primarily from the Black River, rather than the Chehalis River. However, operation of the FRE facility would slightly reduce some backwater flooding in the Black River Habitat Management Area during major or greater floods. Reduced flooding in this area may reduce the area of ponded habitat for Oregon spotted frog. Because FRE facility operation would occur on average every 7 years and outside of the Oregon spotted frog breeding season (February through March), these impacts are anticipated to be low.

4.6.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Construction of Alternative 2 would result in similar impacts to terrestrial habitats as Alternative 1. Table 4.6-1 summarizes the difference in area of permanent direct impacts to terrestrial vegetated habitat between Alternatives 1 and 2 (a difference of approximately 1 acre). Although the footprint of the FRO facility would be slightly smaller than the FRE facility, the extent of tree removal in the temporary reservoir area would be the same. The same construction staging area, spoil sites, quarries, and access road would be used for FRO facility construction, resulting in a similar level of impact to habitats from such activities. The potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1.

Table 4.6-1
Direct Impacts to Terrestrial Habitat from Alternative 2 Compared to Alternative 1

CONSTRUCTION ACTIVITY	TERRESTRIAL HABITAT TYPE	DIFFERENCE IN IMPACT AREA COMPARED TO FRE FACILITY (ACRES)
FRO Facility and Associated Grading	Developed-Vegetated	0.01
	Douglas-fir-Western Hemlock Forest and Woodland	-0.41
	Grassland and Forbland	-0.42
	Sitka Spruce Forest	-0.22
	Western Red-cedar-Western Hemlock Forest	-0.01
	Western Red-cedar-Western Hemlock Forest (Riparian)	0.02
	Total	**-1.04**

5 BUILT ENVIRONMENT: AFFECTED ENVIRONMENT AND POTENTIAL IMPACTS

This chapter describes the affected environment and potential impacts for the built environment. This includes air quality, visual quality, noise and vibration, land use, recreation, cultural resources, transportation, public services and utilities, environmental health and safety, socioeconomics, and environmental justice. The overall approach to the analysis is discussed in Chapter 3. Mitigation is discussed in Chapter 7.

5.1 Air Quality

5.1.1 Introduction

This section describes existing air quality and the potential impacts of the alternatives. Air quality refers to the level of pollution in the air. Air quality is critical for human and environmental health. Pollutants can come from natural or human sources, and the levels of pollutants in the air can be affected by climate, topography, and meteorological conditions. Air quality is monitored and regulated by federal, state, and local agencies, which set emission standards for certain pollutants called criteria pollutants.

> Key Findings
>
> **Construction**
> - Low direct temporary impact from increased criteria pollutant emissions
> - Low direct temporary impact from increased dust and odors
> - Low indirect impact from off-site truck emissions
>
> **Operation**
> - Low indirect impact from increased criteria pollutant emissions
> - No impacts from the Airport Levee Improvements

This section also considers greenhouse gas (GHG) emissions. GHGs are air pollutants that trap solar energy in the atmosphere and contribute to variability in global climate.

5.1.2 Affected Environment

This section describes current air quality in the study area, which includes all of Lewis County, Washington. The study area is larger than for other resources because air emissions move through the air and can be influenced by regional conditions such as weather.

5.1.2.1 Federal Regulation

Air quality in the study area is regulated by federal and state law. EPA establishes federal National Ambient Air Quality Standards (NAAQS) for six common pollutants known as criteria pollutants. These include ground-level ozone, particulate matter (PM, measured as PM_{10} and $PM_{2.5}$), carbon monoxide, lead, sulfur dioxide, and nitrogen dioxide. Criteria pollutants are found all over the country. They can harm human health and the environment and cause property damage. Criteria pollutants are monitored because if levels in the air exceed NAAQS, air quality is determined to be poor and further action must be taken to improve it.

5.1.2.2 Southwest Clean Air Agency

The Washington Clean Air Act further establishes the framework under which the Southwest Clean Air Agency (SWCAA) may regulate specific sources of pollution in the study area. The regulations, rules, and policies that apply, as well as specific permits and standards that would be required for the proposed project, are listed in Appendix F. These apply to stationary sources and fugitive dust during construction. SWCAA also manages odor complaints in the region, which are addressed on a case-by-case basis.

5.1.2.3 Attainment Status

Air quality in Lewis County is good overall.

Local air quality is measured against the national and state air quality standards. If measured data show that an area meets the standards, the area is designated by EPA as an “attainment area.” Areas that do not meet the standards are designated as “non-attainment areas.” Areas where EPA cannot determine an attainment status for certain pollutants are designated as “unclassifiable.” States must develop State Implementation Plans for meeting standards in non-attainment areas. Lewis County is currently designated unclassifiable for sulfur dioxide (SO_2) because of limited information[2] and as an attainment area for all other criteria pollutants (Ecology 2018).

5.1.2.4 De Minimis Air Quality Levels

De minimis levels can be used for projects in attainment areas to gauge the general magnitude of air emissions. De minimis levels are based on the NAAQS and represent criteria pollutant emission levels below which no substantial impacts would occur. De minimis levels applicable to the project are presented in Table 5.1-1. Although lead is considered a criteria pollutant, it is not a common air pollutant associated with project sources and is not included in Table 5.1-1. As long as predicted emissions do not exceed de minimis levels, the proposed activities would not be expected to result in an impact to air quality.

[2] While Ecology has modeled emissions to demonstrate the area continues to meet the SO_2 standard, EPA requested additional evaluations to support the proposed attainment designation. Because of resource constraints and the low risk of the area violating the standard, Ecology chose to concur with EPA’s decision to designate the area as "unclassifiable.”

Table 5.1-1
De Minimis Levels of Air Pollutants

POLLUTANT	DE MINIMIS LEVELS (TONS PER YEAR)
Ozone[1], sulfur dioxide (SO_2), or nitrogen dioxide (NO_2)	100
Carbon monoxide (CO)	100
Particulate matter (PM_{10})	100
Particulate matter ($PM_{2.5}$)	100

Note:
1. Measured as volatile organic compounds or nitrogen oxides.

5.1.2.5 *Existing Sources of Air Emissions*

Several large stationary sources of air pollution are present in Lewis County, including three sawmills and three electric energy generation facilities (SWCAA 2020). Two of the sawmills are located in the central part of the county, more than 30 miles east of the proposed Airport Levee Improvements. The other sawmill and the energy generation facilities are located in the Chehalis-Centralia area.

Existing criteria pollutant and GHG emissions in the study area are also produced by vehicles, construction activities, and fugitive dust. Vehicle emissions occur along transportation corridors, including I-5 and SR 6, and in surrounding communities. Emissions are also generated at the Chehalis-Centralia Airport by aircraft and support vehicles. Construction equipment and commercial timber operations also generate emissions. Fugitive dust is generated by forestry operations on dirt roads and soil-moving activities at construction sites. Odors are generated from exhaust from heavy-duty commercial equipment.

The location of the proposed flood retention facility is surrounded by managed forest. Air emissions and fugitive dust in this area are generated mainly from commercial timber operations. Sources of air emissions in the vicinity of the Chehalis-Centralia Airport include vehicles on roadways and airport activities.

5.1.2.6 *People and Properties Affected by Air Quality*

Along with sources of pollutants, air quality analyses often consider the people and properties that may be the most affected by pollutants. These may be classified by use. For example, residents may be exposed to pollutants for longer periods of times, and recreationalists may be exposed to pollutants while lung function is high (such as a runner). The nearest residence in the area of the proposed flood retention facility is approximately 3,200 feet to the northeast of the construction site. There is also limited recreational use in the area by people who obtain recreational permits from Weyerhaeuser, which owns the land (Weyerhaeuser 2019). Residences and a golf course are located along the western side of NW Airport Road. The golf course and some of the residences are as close as 75 feet from the proposed Airport Levee Improvements. A recreational trail runs along the top of the levee.

5.1.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.1.3.1 Methods

Construction emissions were assessed using the EPA NONROAD model. This model considers EPA regulations for mobile air pollution sources. It is used to estimate air pollution inventories. Operational emissions were assessed qualitatively. Appendix M provides additional information about methods and results. Appendix E describes the thresholds used to determine the level of impact.

5.1.3.2 No Action Alternative

> **No Action Alternative Impacts to Air Quality**
>
> - Low impact from construction emissions
> - Low impact from vehicle emissions caused by traffic congestion during major or greater floods (continued)

Air quality impacts would be low under the No Action Alternative. Some actions would involve construction equipment, which could result in temporary emissions of criteria pollutants, fugitive dust, odors, and GHGs. Construction impacts would be temporary and would not likely affect long-term attainment. As population increases, traffic and resulting emissions would also likely increase, resulting in a low impact. Under the No Action Alternative, major or greater floods would continue to disrupt travel and close roads. The resulting traffic congestion and rerouting would result in increased vehicle emissions. These emissions are expected to be temporary and not to exceed air quality standards.

5.1.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts associated with Alternative 1.

5.1.3.3.1 Construction

Alternative 1 would result in a low impact to air quality from emissions of criteria pollutants, which would be below de minimis levels, as shown in Table 5.1-2. In addition, low levels of fugitive dust and odors would be generated by construction equipment, trucks, and vehicles. The Applicant would be required to obtain the necessary permits and approvals that would further ensure emissions did not exceed levels that would cause an unauthorized air quality impact.

Alternative 1 Construction Impacts to Air Quality

- Low direct and indirect impacts from criteria pollutant emissions that would be below the federal de minimis levels
- Approximately 1,950 metric tons of carbon dioxide equivalents (CO_2e) per year during construction
- Low direct impacts from temporary increases in dust and odors

Criteria pollutant emissions were estimated for the single busiest year of Alternative 1 construction. This was done by modeling the busiest single year of FRE facility construction and conservatively assuming that Airport Levee Improvements would happen at the same time and result in the same level of emissions. As shown in Table 5.1-2, total annual emissions for the worst construction year of Alternative 1 would be well below de minimis levels. Therefore, impacts to air quality from emissions associated with Alternative 1 construction would be low.

Table 5.1-2
Alternative 1 Air Emissions for the Maximum Annual Construction Activity (Tons per Year)

CRITERIA POLLUTANT	MODELED EMISSIONS FOR FRE FACILITY CONSTRUCTION	ESTIMATED EMISSIONS FOR AIRPORT LEVEE CONSTRUCTION [2]	TOTAL ESTIMATED EMISSIONS	DE MINIMIS LEVELS
Ozone[1], SO_2, or NO_2	13.0	13.0	26	100
CO	9.6	9.6	19.2	100
PM_{10}	0.6	0.6	1.2	100
$PM_{2.5}$	0.5	0.5	1.0	100

Notes:
1. Measured as volatile organic compounds or nitrogen oxides.
2. Conservatively assumed to be equal to the busiest year of FRE facility construction.

The results do not include emissions from the proposed concrete batch plant. This is the facility that would be used to form concrete for the FRE facility. Batch plant emissions would mainly be particulate matter (PM_{10} and $PM_{2.5}$). Based on the expected size of the plant, emissions are likely to be similar to the modeled emissions for FRE facility construction. This means the total emissions including the proposed concrete batch plant would be below the de minimis levels. In addition, the Applicant would be required to meet all applicable air quality standards prior to operating the batch plant. This would include obtaining a permit for a new emission source consistent with state regulations. Therefore, use of the concrete batch plant during construction is not expected to result in an air quality impact.

GHG emissions from construction were also modeled. Following the same methods for criteria pollutants, it is estimated that Alternative 1 would result in 1,949.9 metric tons of carbon dioxide equivalents (CO_2e) per year during construction. Using the EPA GHG calculator (EPA 2019), this level of CO_2e emissions is roughly equivalent to 5 million miles driven by the average car.

Fugitive dust would also be generated by construction activities for the FRE facility and Airport Levee Improvements. The main sources would come from rock crushing, loading and transporting aggregate materials, and cement production at the FRE facility. Fugitive dust would also be generated during road improvements and use. Dust can travel over long distances when areas are open (such as fields) and exposed to high winds. Because the area surrounding the proposed FRE facility is forested, dust would not likely travel over large distances. No residences are in the flood retention facility project area, and standard BMPs would be implemented at both construction sites. Workers would be exposed to some level of dust and other air emissions during construction. Because BMPs would control dust levels, impacts from fugitive dust would be low.

Odors would be produced by construction equipment and vehicle exhaust. However, odors dissipate with distance and the nearest residences would not be exposed to odors. Workers associated with the project would be exposed to odors during construction. As noted earlier, residences are located within 75 feet of the Airport Levee Improvements, and recreationalists may be present in the area. Construction would produce odors that could be noticeable in the immediate vicinity of levee construction. However, exposure to odors would be temporary and intermittent, and impacts would be low.

Indirect emissions are expected to be low under Alternative 1. Indirect air quality impacts would be generated by trucks traveling from off site to the construction areas. Approximately 40,000 to 60,000 truck trips are assumed to be required between the FRE facility construction site and off-site surrounding areas. Approximately 5,725 truck round trips would be necessary between off-site areas and the Airport Levee Improvements project area. It is expected that these trucks would likely come from the local market, but increased truck traffic could increase local emissions. Use of these trucks would not impact Lewis County's attainment status for air quality. Therefore, increases in emissions from off-site traffic would be low.

5.1.3.3.2 Operation

Potential air quality impacts from operation would be low. Criteria pollutant emissions, fugitive dust, and odors during operation would come from periodic maintenance equipment, truck, and vehicle traffic. It is expected that Alternative 1 would result in low indirect emissions from off-site transportation in most years.

> **Alternative 1 Operational Impacts to Air Quality**
>
> - Low indirect impacts from emissions for FRE facility maintenance, vegetation management, and truck traffic
> - Negligible impacts from emissions for operation and maintenance of the Airport Levee Improvements

The main activity that could impact air quality would be vegetation management. Removing trees from the temporary reservoir area would generate emissions from periodic truck trips and the use of logging equipment. Impacts from operation on air quality would be substantially less than impacts from construction. Therefore, operation of the FRE facility would also be below de minimis levels and would not affect regional air quality.

Operation of the Airport Levee Improvements would involve annual inspections, requiring infrequent and limited activity. Therefore, these activities would generate only negligible emissions.

5.1.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

The construction-related air quality impacts of Alternative 2 would be similar to but less than Alternative 1. Overall air emissions would be somewhat less because the level of construction activities would be lower. Operational impacts would be the same as Alternative 1.

5.2 Visual Quality

5.2.1 Introduction

Visual quality is the value that people place on viewing their surrounding environment. Views can be of natural elements or of built elements. When a change to a view happens, people may react negatively if important elements of the view change and reduce the overall visual quality.

This section describes the existing visual characteristics in the study area, viewers who could be affected by the alternatives, and potential impacts of the alternatives.

Key Findings

Construction

- Low to medium direct impacts from FRE facility construction activities that would be visible from adjacent hillsides
- Low direct impacts at the Airport Levee Improvements project area where construction activities would not stand out to people nearby
- Low indirect downstream impacts during construction from increased turbidity

Operation

- Low to medium indirect impacts from visual changes caused by the FRE facility in an otherwise natural viewshed
- Low indirect impacts in the Airport Levee Improvements project area
- Beneficial indirect impact from flood damage reduction in the Chehalis River 100-year floodplain

5.2.2 Affected Environment

This section describes visual resources and sensitive viewers in the study area, as defined in Section 3.6. The study area includes a 0.5-mile buffer around the flood retention facility project area and a 0.25-mile buffer around the Airport Levee Improvements project area. This is to account for views of the proposed facilities by the public.

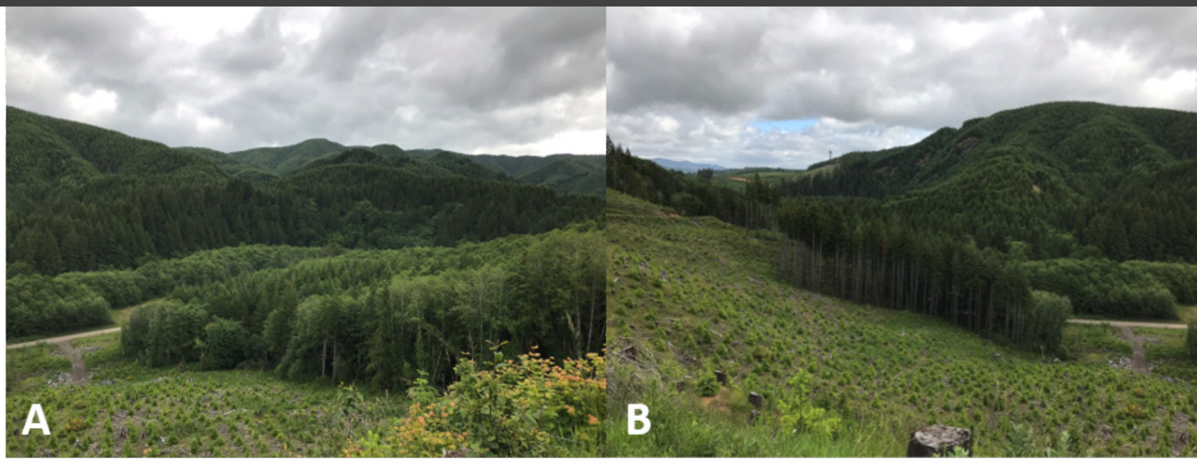
5.2.2.1 Flood Retention Facility Project Area

There are no protected views, designated scenic resources, or wild and scenic rivers in this part of the study area. The proposed flood retention facility would be located on privately owned, forested property. Existing views near this location include natural elements and few artificial features. Downstream from the proposed flood retention facility, the upper Chehalis River bends and braids in a general northeasterly direction. Upstream, the banks of the Chehalis River consist of a mix of sand and gravel bars with some larger rocks and downed trees. The banks of the upper Chehalis River include trees and some shrubs, and the river cuts through rolling hills. Figure 5.2-1 shows a typical view of the river in late spring, approximately 6 miles upstream of the proposed flood retention facility.

Figure 5.2-1
Typical View of the Upper Chehalis River in Late Spring, Approximately 6 Miles Upstream of the Proposed Flood Retention Facility

The surrounding rolling hills include a patchwork of conifer stands that are at various stages of growth and density. This includes some areas that have been recently clear cut. Constructed features near the proposed flood retention facility location include bridges, road culverts, local power lines, and unpaved logging access roads. These roads are mainly gravel and dirt. Figure 5.2-2 (Panel A) shows a typical view of the forested hillside east of the proposed flood retention facility, facing generally southeast toward the Chehalis River. Figure 5.2-2 (Panel B) shows a typical view of the hillside east of the proposed flood retention facility, facing generally northeast, where a clear cut has recently happened.

Figure 5.2-2
Typical Forested and Clear-Cut Views of the Hillside Near the Proposed Flood Retention Facility



There are two important viewpoints within this part of the study area. These include the Willapa Hills Trail and the Weyerhaeuser Pe Ell South Permit Area. These were identified because they are publicly accessible areas nearest to the proposed flood retention facility and temporary reservoir.

This viewpoint from the scenic Willapa Hills State Park Trail is located where the trail crosses the Chehalis River approximately 1 mile northwest of the proposed flood retention facility. From this location, recreationalists can see the Chehalis River, agricultural pastures, rural homes, and forested hills (NWSRS 2019). The project elements would not be visible from this location based on the viewshed analysis described in Appendix N. Therefore, no photograph from this location is provided.

The second viewpoint is on Weyerhaeuser's private property in the Pe Ell South Permit Area. Only workers and permit-holding recreationalists are allowed in that area. Views are of the forested river corridor looking down and northwest to the proposed flood retention facility location (Figure 5.2-3).

Figure 5.2-3
Existing View Towards Proposed Flood Retention Facility Location from Nearby Ridgeline

5.2.2.2 Airport Levee Improvements Project Area

The Chehalis-Centralia Airport is located in a mix of agricultural and urban development. The land is relatively level to gently rolling with meandering streams and oxbow lakes. Figure 5.2-4 shows the general view of the Airport Levee Improvements project area from the existing levee, with airport buildings on the left, the gravel trail in the center, and NW Airport Way on the right. The airport levee runs around the northern, western, and southern parts of the airport. The top is used as a gravel recreational trail. The airport, including the parking lot and hangars, is clearly visible from the top of the levee. It is also possible to see retail businesses to the east and Riverside Golf Club to the west.

The proposed Airport Levee Improvements would be visible from surrounding local roads, the I-5 corridor to the east, and the Riverside Golf Club to the west. The viewpoint of the levee from the Riverside Golf Club is shown in Figure 5.2-5. This viewpoint was selected because recreational users are likely to be more sensitive to the proposed improvements than motorists.

Figure 5.2-4
Typical View of the Airport Levee Improvements Project Area from the Existing Levee

Figure 5.2-5
View of the Existing Airport Levee from Riverside Golf Club

5.2.2.3 Chehalis River 100-Year Floodplain

Downstream of the proposed flood retention facility, the Chehalis River meanders through Pe Ell, Rainbow Falls State Park, and the urban areas of Chehalis and Centralia. Near Pe Ell, the river is narrow but opens into a wider valley with views of sparsely populated, largely agricultural areas near Adna. Near Chehalis and Centralia, more development and major infrastructure is visible from the floodplain. This includes I-5 and major rail lines that cross the river floodplain. North of Centralia the Chehalis River turns west towards Porter, where views become more agricultural and rural.

5.2.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.2.3.1 Methods

Visual impacts were qualitatively assessed using a viewshed analysis. A viewshed analysis takes information about the shape of the land and finds the places where people would be able to see the proposed project features. The analysis then considers how views from these places would change because of the alternatives. Visual impacts are higher when the views noticeably change for a larger number of people. Appendix E describes the thresholds for assessing the level of visual impacts. The viewshed analysis is described in more detail in Appendix N.

5.2.3.2 No Action Alternative

Under the No Action Alternative, visual impacts would range from low to high. Current timber harvest activities in the flood retention facility project area would continue, resulting in low impacts. Timber workers and recreationalists would continue to see changes from timber harvest activities similar to those in Figure 5.2-2.

> **No Action Alternative Impacts to Visual Quality**
>
> - Low impact in the flood retention facility project area from ongoing timber harvest
> - Beneficial impact from habitat restoration in some areas
> - High impacts from continued risk of major or greater flooding would continue

Farther downstream, impacts would be low to high. Habitat restoration actions would improve visual quality by preserving or creating a more natural visual character. Ongoing major or greater flooding would continue to have adverse visual impacts that could be high. Flooding can erode and overtop streambanks, uproot trees and vegetation, and deposit a variety of debris throughout the study area. Local and emergency flood-fighting actions could leave a patchwork of engineered features and inconsistent basic visual elements that may contrast with the existing visual character.

5.2.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts associated with Alternative 1.

5.2.3.3.1 Construction

Potential impacts to visual quality from construction activities would be low to medium.

Construction impacts in the flood retention facility project area would be low to medium. This is because most construction would not be visible outside the immediate construction work site. The viewshed analysis showed that the rolling hills of the river corridor completely blocked views of the proposed FRE facility from the Willapa Hills Trail. The viewshed analysis did find that the FRE facility could be visible from the ridgeline in the Pe Ell South Permit Area. As shown in Figure 5.2-3, trees in the foreground would likely block views of the site. However, if these trees were ever removed by others, the FRE facility could be visible from this location. Activities that could degrade the visual quality include tree removal, stockpiles, staging of construction material, dewatering of the river, and the increased presence of people, vehicles, traffic, and built features. These activities would change the existing forested view to views of a large structure that would contrast with the natural landscape. Although it is expected that people would not be given permission to enter the area during construction, recreationalists would likely be granted permission to enter the general vicinity once construction is completed. Because this view would only be visible to a limited number of people, this would be a medium visual impact.

> ### Alternative 1 Construction Impacts to Visual Quality
>
> **Flood Retention Facility Project Area**
> - Low direct impacts in the flood retention facility project area
> - Medium direct impacts if certain trees were removed that would otherwise screen views
>
> **Airport Levee Improvements Project Area**
> - Low direct impacts from Airport Levee Improvements construction
>
> **Chehalis River 100-Year Floodplain Area**
> - Low indirect impacts from a slight chance that a larger storm could increase turbidity

Construction at the FRE facility and temporary reservoir site would likely require some lighting and introduce some sources of glare from machinery. No recreational permit access would be provided during construction, which would limit the number of viewers. Additionally, ridgeline viewpoints that are farther away would not experience nighttime lighting impacts because Weyerhaeuser prohibits movement around recreational lands at night (Weyerhaeuser 2019).

Construction activities to raise the airport levee would result in a low visual impact. Direct impacts would include the removal of vegetation, earthwork, staging of levee construction material, and an increased number of people and amount of heavy vehicle traffic. These activities would be somewhat similar to general activity that already happens at the Chehalis-Centralia Airport.

Construction activities at the proposed FRE facility and the Chehalis-Centralia Airport would not likely result in indirect impacts to visual quality. However, if a large amount of rainfall occurred in areas of exposed soil during the construction period, BMPs could fail. This could cause sediment-laden stormwater to enter the river and cause increased turbidity downstream of the FRE facility construction site. Depending on the extent of the storm, visible changes could be seen from the Willapa Hills Trail.

Construction of the Airport Levee Improvements could create dust that is visible to recreationalists from the Riverside Golf Club.

5.2.3.3.2 Operation

Potential impacts to visual quality from operation in the FRE facility study area would be low to medium. Operational activities at the Chehalis-Centralia Airport would have low long-term impacts to visual quality.

> **Alternative 1 Operational Impacts to Visual Quality**
>
> - Low to medium indirect impact from visual changes cause by the FRE facilities in an otherwise natural viewshed
> - Low indirect impact in the Airport Levee Improvements project area
> - Beneficial indirect impact from flood reduction in the Chehalis River 100-year floodplain

Impacts in the flood retention facility project area would be low to medium. This is because the FRE facility would be a new structure in an otherwise natural area. The main project elements that would be visible include the FRE facility structure, spoil areas, quarries, harvested hillsides, and the CHTR facility. A picture of what the proposed FRE facility would look like is provided in Figure 2.2-1 in Appendix D.

As noted previously, the FRE facility and supporting elements would not be visible from the Willapa Hills Trail. Views of the FRE facility and temporary reservoir from the Pe Ell South Permit Area would likely be limited because the views are blocked by existing trees. If these trees are removed, the FRE facility could be visible to permit-holding recreationalists who access the site. This would result in substantial changes to views seen from this location. Because the number of people who are likely to see these changes is small, this would be a medium visual impact.

When the FRE facility is impounding water, there is also a potential for impacts to visual quality. The change from terrestrial landscape to aquatic landscape would modify the setting, although the setting would maintain a natural character. There may also be some increased glare off the surface of the temporary reservoir. The temporary reservoir would contain water for up to 32 days once every 7 years, on average. This change would most likely occur in winter when there would likely be few recreationalists in Weyerhaeuser recreational areas. The potential visual impacts from filling the temporary reservoir would be low.

Nighttime lighting would be required at the FRE facility site. The public is unlikely to see the site from either viewpoint. In addition, Weyerhaeuser does not allow recreational motorists at night (Weyerhaeuser 2019).

The Airport Levee Improvements would look similar to the existing condition and the visual impacts from operation would be low. Figure 5.2-6 shows a simulation of how the new levee would look from the Riverside Golf Club. Compared to the view of the existing levee in Figure 5.2-5, the proposed Airport

Levee Improvements would not result a large visual change. Raising the levee would block the view of the existing airport buildings in the distance. Because the Airport Levee Improvements would prevent off-site buildings from being visible to recreational users, these impacts may be considered beneficial. Operational activities at the Chehalis-Centralia Airport would be the same as for the current levee maintenance and management. Therefore, visual impacts from operation of the Airport Levee Improvements would be low.

Figure 5.2-6
Viewpoint 3 – Simulation of the Airport Levee Improvements from Riverside Golf Club

Operation of the proposed FRE facility is expected to reduce flooding during a major or greater flood in the Chehalis River. A reduction in floods would reduce the number of times when downstream visual quality is adversely impacted. A reduction in flooding would also reduce the need for local and emergency flood-fighting actions that could leave a patchwork of engineered features. Overall, operation of the proposed FRE facility is expected to have a long-term benefit to visual quality in the Chehalis River 100-year floodplain.

5.2.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Similar to Alternative 1, the construction-related impacts from Alternative 2 on visual quality would be low. The construction period for Alternative 2 would be shorter than for Alternative 1, and the base of the FRO facility would have a slightly smaller footprint than the base of the FRE facility. For the same reasons discussed under Alternative 1, Alternative 2 would result in low to medium indirect impacts to visual quality. The operational impacts would be the same as for Alternative 1.

5.3 Noise and Vibration

5.3.1 Introduction

Sound is energy transmitted by waves that travel typically through air or water. Sound can be considered a noise, depending on its quality, intensity, or repetition. Sound can also be considered noise depending on who hears it and what that person is doing when it is heard. For example, a person may react differently to the same sound while working than they would when they are sleeping. Some people may consider a sound a noise while others are not bothered by it. Vibration is the repetitive motion of an object moving back and forth that shakes the ground or an object. Vibrations can be felt by people and may cause building damage.

Key Findings

Construction

- Low to medium direct impacts from construction equipment and blasting
- Low indirect impacts from noise from trucks hauling materials
- No direct or indirect vibration impacts because no structures are nearby

Operation

- Low indirect impacts from equipment and vehicle use at the FRE facility
- No impacts from Airport Levee Improvements

This section describes the existing sources and noise levels in the study area, people and structures who may be sensitive to increased noise and vibration, and the potential impacts of the alternatives on noise and vibration.

5.3.2 Affected Environment

This section describes existing sources and levels of noise and vibration in the study area, which includes the flood retention facility and Airport Levee Improvements project areas. It also describes the people or structures that could be affected by increased noise or vibration.

Sound is measured in decibels (dB). A-weighted decibels (dBA) measures sound by how the average human ear responds to sound. The average range of human hearing typically ranges from 0 dBA (the threshold of hearing) to 140 dBA (the threshold for pain). Noise is measured through the use of several measurements, including the following:

- **Equivalent Sound Level (L_{eq})** is the constant noise level that would result in the same total sound energy being produced over a given period. It is useful for representing a varying sound source over time as a single number.
- **Maximum Sound Level (L_{max})** is the highest sound level measured during a single noise event (e.g., a hammer strike or quarry blast).

Noise-sensitive land uses are types of land use where people may be more adversely affected by prolonged increases in noise over ambient levels. Examples of such land use include residential areas, hospitals, schools, recreational areas, and daycare facilities where any prolonged exposure to increased noise would be more noticeable. Some forms of recreational use, such as camping and hunting, rely on quiet conditions.

Vibrations can affect any structure. Older structures are generally more sensitive to vibration due to age and building material. Hospitals and laboratories may also be especially sensitive to vibration due to the presence of sensitive equipment. Ground-borne vibration is a technical term to define human-made vibratory motions through the ground, as opposed to vibration caused by geological changes such as earthquakes. For example, explosions, jackhammers, trains, and heavy trucks can all cause ground-borne vibrations. Ground vibration is measured in terms of peak particle velocity, which is the maximum velocity experienced by any point in a structure during a vibration event.

The proposed flood retention facility would be located in a rural area largely surrounded by forest. There is existing noise from commercial timber operations, but ambient noise levels are generally low (generally between 52 and 60 dBA; USFS 1996). The nearest place that could be affected by noise associated with the action alternatives is a residence located approximately 3,200 feet to the northeast. Recreational permit holders in Weyerhaeuser's Pe Ell South Permit Area could also be affected by noise. The number of these recreational permits is limited (550 permits were available for the 2015/2016 recreation season; Weyerhaeuser 2019). Recreational access is expected to be prohibited during construction. The nearest vibration-sensitive land use is a Weyerhaeuser office and maintenance shop located off Muller Road approximately 1,500 feet north of the proposed flood retention facility.

The proposed Airport Levee Improvements would be located in the Chehalis-Centralia area with higher ambient noise levels. Noise in this portion of the study area comes from vehicles on local roads and highways, airport activities, and construction. Ambient noise in this area is estimated to be between 64 and 70 dBA (WSDOT 2019). Several residences are located along the western side of NW Airport Road, some of which are within 75 feet of the proposed construction area. In addition, a recreational trail runs on top of the levee and a golf course is located to the west. The closest vibration-sensitive land use is an airport building approximately 75 feet east of the proposed Airport Levee Improvements.

5.3.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.3.3.1 Methods

Construction noise levels were assessed using the Federal Highway Administration's Roadway Construction Noise Model. This model predicts noise levels from typical construction equipment (FHWA 2006). The number and type of equipment used were estimated based on typical construction activities expected for the alternatives. The model was used to identify the short-term changes in noise during construction and to determine whether noise levels could affect nearby noise-sensitive land uses. Construction activities for the FRE facility are assumed to last for up to 5 years. It was assumed that the loudest construction phase would be when FRE facility construction and blasting would be occurring at the same time. Certain construction activities, such as blasting, may cause vibrations. Impacts of vibrations from construction were assessed qualitatively. Operational impacts were assessed qualitatively by comparing the expected level of activity during construction. Appendix O provides additional information on methods and results. Appendix E describes the thresholds used to determine the impacts level.

5.3.3.2 No Action Alternative

No Action Alternative Impacts to Noise and Vibration

- Low impacts from construction noise
- Low impacts from continued flooding disrupting traffic and increasing noise in some areas

It is expected that current noise-generating activities within the proposed location of the flood retention facility and airport levee would continue. Noise levels would be similar to those described in Section 5.3.2.

Many actions included in the No Action Alternative would involve construction that would use heavy equipment, which could result in periodic increases in local noise and vibration levels. Because the exact construction activities are undefined, these increases cannot be quantified. Impacts from these construction activities would likely be low.

It is also assumed that without controls, the potential for existing periodic floods to disrupt transportation systems, including temporary road closures, would continue. This could result in periodic increases in noise in areas not currently experiencing traffic noise due to traffic rerouting and congestion. These impacts would be low and temporary.

5.3.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to noise and vibration from construction and operation of Alternative 1.

5.3.3.3.1 Construction

Alternative 1 Construction Impacts to Noise and Vibration

- Low direct impacts to nearest residences located relatively far from FRE facility construction
- Medium direct impacts from the Airport Levee Improvements because residences are located nearby
- No impacts from vibrations

Potential noise and vibration impacts from construction activities would be low at the FRE facility project area but could cause medium temporary nuisance impacts to residents at the Airport Levee Improvements project area. All construction activity, including FRE facility blasting, would happen between 7:00 a.m. and 10:00 p.m. unless a variance is granted, consistent with WAC 173-60-050 and Lewis County regulations. These rules allow for construction and blasting noise if conducted during daytime hours.

The closest sensitive land use to FRE facility construction, a residence, is approximately 3,200 feet to the northeast. The highest noise level from construction activities was estimated to have an L_{max} value of 57.9 dBA and an L_{eq} value of 49.6 dBA at 3,200 feet (Appendix O). Normally acceptable noise levels in residential/recreational areas range from 55 to 60 dBA L_{max} (WAC 173-60-040). Trees and hills would shield this residence from some noise from construction and blasting, and actual noise levels would be lower.

Increased noise may also affect workers in the area. Workers would be in the construction area and would experience higher noise levels than the nearest residence. Noise from blasting could be as high as 94 dBA at 50 feet from the activity. Workers would wear hearing protection to minimize the impacts of noise.

Vibration from construction of the FRE facility is not expected to affect any nearby structures because the closest structure is over 1,500 feet away. Vibration levels from construction equipment at 25 feet are generally less than established safety criteria. Therefore, at 1,500 feet from the source, no vibration is expected (FTA 2006).

Construction activities for the Airport Levee Improvements would increase noise levels. The closest places that could be affected by noise are residences that are located along NW Airport Road. The highest level of construction noise was estimated to have an L_{max} value of 77.7 dBA at 100 feet, with an L_{eq} value of 78.4 dBA. Construction would only occur between 7:00 a.m. and 10:00 p.m. Construction activities could result in increased intermittent noise that would be a nuisance for nearby residences.

Vibration from Airport Levee Improvements construction activities are not likely to affect any nearby structures, which would be located as close as 75 feet from construction. As noted in Appendix O, vibration levels from construction equipment at 25 feet are generally less than established safety criteria.

Construction activities would also have the potential to result in low indirect impacts from truck traffic. It was assumed that approximately 40,000 to 55,000 truck round trips between the quarries and construction site would occur, which represents about 30 truck trips per day. Approximately 4,000 to 6,000 additional truck round trips are expected to the construction site from off site. Although this would be an increase compared to existing conditions, the anticipated routes (Figure 2.2-5 of Appendix D) are located in mainly rural, unpopulated areas with very few people that could be affected by noise. Therefore, this increase is anticipated to be low.

Approximately 5,725 truck round trips are assumed to be needed during construction of the Airport Levee Improvements. Trucks would use NW Airport Road to haul materials to and from the site, and the top of the airport levee would be used for site access. This would cause a slight increase in noise, but the area is developed and has frequent vehicle traffic and airport noise. Therefore, this increase is anticipated to be low.

5.3.3.3.2 Operation

Operation and maintenance of the FRE facility would produce periodic noise and vibration, primarily vegetation and debris management activities. Noise would be generated from periodic truck movements and the temporary use of logging equipment. Impacts from noise and vibration during operation would be substantially lower than construction noise and vibration impacts because there would be much less activity. The impacts from operation are not expected to affect nearby residences. Impacts would be low.

> **Alternative 1 Operational Impacts to Noise and Vibration**
>
> **Flood Retention Facility Project Area**
> - Low indirect noise impacts to recreational users and workers
> - No vibration impacts
>
> **Airport Levee Improvements Project Area**
> - No noise or vibration impacts

Noise would also be generated by water being impounded and released during reservoir operations. These increases in noise would be temporary and only occur once every 7 years on average. Because of the infrequency of this noise and the lack of residences in the area, these impacts would be low.

As discussed in Chapter 3, operation of the Airport Levee Improvements would involve annual inspections, requiring infrequent and limited activity. Therefore, operation of Alternative 1 would generate no additional noise or vibration at this location compared to existing conditions, and would have no impact.

5.3.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

The construction-related direct noise and vibration impacts of Alternative 2 would be similar to but less than Alternative 1. Overall noise levels would be somewhat less because construction would be of a shorter duration. The operational impacts of Alternative 2 would be the same as for Alternative 1.

5.4 Land Use

5.4.1 Introduction

Land use refers to how land can be and is used. Land can be publicly or privately owned, which can influence how it is used and what is allowed. This section describes land uses in the study area and potential impacts from the alternatives. Impacts to other environmental resources with the potential to affect land use include air quality, noise and vibration, recreation, transportation, and socioeconomics. These topics are addressed in Sections 5.1, 5.3, 5.5, 5.7, and 5.10, respectively.

> ### Key Findings
>
> **Construction**
>
> - Medium direct impact from permanent conversion of 790 acres from commercial forestlands to essential public facilities
> - Low direct impact to nearby land uses from increased traffic, disruption of airport operations, and noise and dust
>
> **Operation**
>
> - Medium indirect impact from long-term land use changes from commercial forestlands to the proposed FRE facility and temporary reservoir
> - Beneficial impact to land uses in the Chehalis River 100-year floodplain flood damage reduction

5.4.2 Affected Environment

This section describes the land uses in the study area, as defined in Section 3.6. The study area includes a 0.5-mile buffer around the proposed flood retention facility and related elements and a 0.25-mile buffer around the Airport Levee Improvements. It also includes the Chehalis River 100-year floodplain area, which extends through Lewis, Thurston, and Grays Harbor counties. Existing land uses are shown in Figures 2.2-1 through 2.2-3.

5.4.2.1 Flood Retention Facility Project Area

The site of the proposed flood retention facility and temporary reservoir, and the immediately surrounding area is used for commercial forestry. This land is owned primarily by Weyerhaeuser. A smaller property is owned by the Panesko Tree Farm (Lewis County 2019). Weyerhaeuser manages its operations according to its Habitat Conservation Plan (HCP) to protect special-status species. Ongoing timber harvests at the Panesko Tree Farm and Weyerhaeuser properties are also required to comply with the Forest Practices Act (RCW 76.09) and the Lewis County Critical Areas Ordinance (CAO; LCC 17.38).

Recreation is also allowed on Weyerhaeuser land. The flood retention facility project area is within Weyerhaeuser's Pe Ell South Permit Area and can be accessed with a recreational permit. Additional information about recreational use is provided in Section 5.5.

The flood retention facility project area is in an area designated as Forest Resource Lands under Lewis County zoning. The Chehalis River shoreline is designated as Rural Conservancy under the Lewis County Coalition SMP (Lewis County 2017). Designated critical areas include shoreline buffers, wetlands, steep slopes, critical aquifer recharge area, and erosion hazard areas.

5.4.2.2 Airport Levee Improvements Project Area

The existing airport levee protects aviation and commercial land uses from flooding risk. Under the CMC, the airport is zoned as Essential Public Facility. This area is governed under the City of Chehalis Comprehensive Plan.

Commercial flight service at the airport ended in 1958 (City of Chehalis 2019). Non-commercial flights, such as corporate, medical, and law enforcement flights, continue at the Chehalis-Centralia Airport (Lewis County 2013). A second runway was removed in the 1990s and redeveloped as commercial property. Commercial tenants include grocers, restaurants, auto services, and retail stores. These commercial land uses provide the majority of revenue for the airport (Chehalis-Centralia Airport 2008). To the west of the Airport Levee Improvements area is the Riverside Golf Course, and to the north are agricultural fields. East of the Airport Levee Improvements area are numerous retail properties and I-5. Land uses to the south include open space, flood storage, residential, light industry, and the current and former wastewater treatment plants for the City of Chehalis.

5.4.2.3 Chehalis River 100-year Floodplain

Land use in the Chehalis River 100-year floodplain area is primarily agricultural, with some residential and commercial uses near the more populated areas. Agricultural use occurs mainly between the towns of Pe Ell and Grand Mound. The most widespread land uses in the Chehalis River 100-year floodplain are livestock grazing, dairy farms, crops, and rural residences. The highest population concentration in the project area is around the cities of Centralia and Chehalis. This is where I-5, SR 507, SR 6, and major railways (Union Pacific [UP] Railway and BNSF Railway Company) come together. This urbanized zone of the project area supports the following land uses:

- Urban development (residential and mixed land uses at higher density)
- Industrial areas (warehouses and wood product processing)
- Commercial areas
- Parks, open space, natural areas
- Institutions (medical facilities, schools, post offices, fire stations)
- Infrastructure (roads, railways, and the Chehalis-Centralis Airport)

The Chehalis River riparian corridor runs adjacent to population centers, agricultural areas, and commercial forests. These areas are managed by local jurisdictions for recreation, protection of critical areas, and flood mitigation.

Land use plans and regulations that apply to the study area include those described in Appendix F. These include comprehensive land use plans for individual cities and counties. Because the study area has experienced severe flooding across multiple towns, cities, and counties, some land use plans were developed jointly between multiple municipalities. These include the following:

- Lewis County Multi-Jurisdictional Hazard Mitigation Plan (2016 update; developed jointly with Lewis County and representatives of nine cities and towns)

- Lewis County Coalition SMP (that jointly administers shoreline regulations for Lewis County and cities of Centralia, Chehalis, Morton, and Winlock)

Common goals of each municipality's plan include measures to reduce the effects of hazards, including flooding. Hazard mitigation goals developed in the Lewis County Multi-Jurisdictional Hazard Mitigation Plan will be implemented by all plan participants (Lewis County 2016). Notable goals include the following:

- Implement comprehensive land use planning (e.g., reduce vulnerability of new development)
- Update critical areas ordinances
- Restrict development in the 100-year floodplain that potentially increases flood hazard
- Encourage the retention of open space
- Continue participation and implementation of projects recommended by the Flood Authority

5.4.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.4.3.1 Methods

The impact analysis considered the extent to which construction and operation of the alternatives would alter land uses or conflict with applicable land use plans, policies, or allowed uses. This involved qualitatively assessing whether the proposed activities would be incompatible with ongoing and future land uses or applicable plans, policies, and regulations. It was assumed that commercial forestry in the flood retention facility project area would no longer occur under Alternatives 1 and 2.

5.4.3.2 No Action Alternative

Under the No Action Alternative, the potential for land use impacts is expected to range from low to high.

> **No Action Alternative Impacts to Land Use**
>
> - Low impact from ongoing projects that would be required to comply with applicable land use policies and plans
> - High impact from continued disruption during major or greater floods

Temporary construction disturbance and potential conversion of existing land uses to another use would be low impacts. Commercial forestry and airport operations would continue in a manner similar to existing conditions. Growth and associated development would also likely proceed in a manner consistent with applicable regulations, policies, and plans.

Overall, growth and development within the floodplain of the study area has been low in recent years and has been concentrated in Centralia and Chehalis (Anchor QEA 2016). Population growth estimates from 2010 through 2018 are provided in Table 5.4-1.

Table 5.4-1
Estimated Population and Growth Rates by County

GEOGRAPHIC AREA	2010	2018	PERCENTAGE CHANGE (2010 TO 2018)	AVERAGE ANNUAL GROWTH RATE (2010 TO 2018)
State of Washington	6,724,540	7,294,336	8%	1.0%
Grays Harbor County	72,797	71,967	-1%	-0.1%
Lewis County	75,455	76,947	2%	0.2%
Thurston County	252,264	274,684	9%	1.1%

Note:
Source: U.S. Census Bureau 2020a.

Population density and development are targeted to increase within the Lewis County Urban Growth Area (UGA; Lewis County 2018; City of Chehalis 2017; City of Centralia 2018). Residential, commercial, and industrial land uses are most likely to increase in the UGA. Sufficient developed and potentially developable parcels for residential uses occur in the UGA and growth would be consistent with existing land uses (Anchor QEA 2016). Any increase in commercial development is also expected to occur consistent with land use regulations.

Land use changes and development in Thurston County are expected to be minimal. The Chehalis River 100-year floodplain in Thurston County is zoned for long-term farm use and is not likely to experience land use changes under the No Action Alternative. Increased development and density were not recommended in these areas according to the Thurston County Comprehensive Plan and Grand Mound Sub-Area Plan for the Grand Mound UGA (Thurston County 1995, 1996).

Agricultural uses in the Chehalis River 100-year floodplain are not expected to experience land use changes that would be incompatible with existing land use regulations. Agricultural land uses are usually affected by market conditions more than population growth (Klein and Reganold 1997). Existing parcels and land uses within the existing population centers are expected to provide enough room for the projected population growth, resulting in minimal conversion of agricultural land uses to other uses (Anchor QEA 2016).

Under the No Action Alternative, the risk of floods in the Chehalis River 100-year floodplain would continue. The No Action Alternative includes projects to reduce flood hazards. Although these projects would help with localized flood risk management, it is expected that there would still be a risk of major to catastrophic flooding within the Chehalis River 100-year floodplain.

In the event of a major or greater flood, high land use impacts would occur. Under the No Action Alternative, structures within the Chehalis River 100-year floodplain area would continue to be at risk of flooding (WSE 2019). In the event of major or catastrophic flooding, existing structures would likely be damaged by flooding (Table 5.4-2). Flood damage can be severe enough to result in lasting impacts to the land. Continued flooding could result in the conversion or restriction of land uses because the existing land uses may become incompatible with areas that experience regular and severe flooding.

Table 5.4-2
Flood Impacts to Valuable Structures Under the No Action Alternative

FLOOD SCENARIO	NUMBER OF FLOODED STRUCTURES
Major	163
Catastrophic	1,261

Notes:
Structures of value were identified using Google Street View and National Agriculture Imagery Program (NAIP) aerial photographs and include schools, residences, and similar buildings.
Sheds and small garages were excluded from the dataset.

5.4.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to land use from construction and operation of Alternative 1.

5.4.3.3.1 Construction

Alternative 1 would result in low to medium direct impacts and low indirect impacts to land use as the result of construction activities. At the flood retention facility project area, there would be medium impacts from the conversion of existing uses that could conflict with zoning. In the Airport Levee Improvements project area, there would be low impacts from disturbing airport operations.

> **Alternative 1 Construction Impacts to Land Use**
>
> - Medium direct impact from potential zoning conflicts in the conversion of 790 acres from commercial forestland to Essential Public Facility
> - Low indirect impact to timber harvest uses near the FRE facility from forest road closures and increased traffic
> - Low direct impact from Airport Levee Improvements because of a temporary interruption of the airport runway and from increased noise and dust

The flood retention facility project area is zoned by Lewis County as Forest Resource Lands (Lewis County 2017). Construction of the FRE facility would result in the conversion of 790 acres from commercial forestland. This includes approximately 12 acres for the proposed FRE facility and approximately 778 acres for the temporary reservoir footprint. It is expected the proposed land use would be considered Essential Public Facility, requiring a change in the underlying zoning classification (WAC 365-196-550).

Approval to convert commercial forestlands to the proposed land use of essential public facilities would be required from Lewis County. This would require rezoning and conversion of land use through a comprehensive plan amendment, consistent with LCC 17.05 and LCC 17.125. Lewis County planning documents emphasize the long-term use of Forest Resource Lands for commercial forestry uses. The rezoning would be inconsistent with current Forest Resource Lands zoning and local land use regulations (CAO and SMP). The Applicant would be required to obtain necessary permits and approvals before construction. Any inconsistencies with existing local land uses would be addressed through local permit review. This would be a medium impact.

The Applicant would also need to work with Weyerhaeuser and Lewis County to ensure that the land use change is consistent with other land use plans and policies. This would include but not be limited to Weyerhaeuser's HCP, the Washington State Forest Practices HCP, Lewis County critical areas regulations, and the Lewis County Comprehensive Plan.

Construction of the FRE facility and pre-construction vegetation management in the footprint of the temporary reservoir could cause indirect land use impacts by blocking some access to forest roads used for commercial timber harvest. Access to existing forest roads within the footprint of the temporary reservoir may be closed for short periods during vegetation management activities. Roads within the footprint of the temporary reservoir are not likely to be closed for the whole entire construction period. In addition, increased traffic to and from the construction site would have the potential to cause low increases in traffic in the vicinity of the construction site.

Construction activities associated with the Airport Levee Improvements could temporarily interrupt normal usage of the runway. Construction activities may be required within the designated runway protection zone. If this were to occur, the Applicant would work closely with the airport to coordinate construction sequencing, resulting in only a low impact.

The proposed Airport Levee Improvements would be consistent with the existing land use. The proposed activities would likely fall under the category of Flood Control (CMC 17.30.020). Flood Control is either a permittable land use or a conditional use depending on location in the Airport Service District. There would be no conflict with applicable zoning or land use plans.

Construction of the flood retention facility and Airport Levee Improvements would result in low indirect impacts to land use from increased traffic, noise, and dust. Low disruptions to ongoing timber operations could occur in the flood retention facility project area. Construction noise and dust at the Airport Levee Improvements project area could also result in low disturbance to nearby residents and recreationalists.

5.4.3.3.2 Operation

> **Alternative 1 Operational Impacts to Land Use**
>
> - Beneficial impact from reduced risk of major or greater flooding in the Chehalis River 100-year floodplain area
> - Low indirect impact from increased growth and development because of decreased flood risk

Alternative 1 operation would result in beneficial impacts in the Chehalis River 100-year floodplain area from reducing flood risk. This reduced risk could result in a low increase in growth and development in the floodplain.

Alternative 1 would reduce the depth and duration of flooding in the 100-year floodplain downstream of the FRE facility to RM 33 near Porter. Downstream of RM 33, additional benefits would occur but can be less clearly attributed to Alternative 1. The area of flood damage reduction resulting from Alternative 1 is as follows:

- During a major flood, flooding in the study area would be reduced from 28,400 acres to 25,600 acres.
- During a catastrophic flood, the flooded area would be reduced from 37,100 acres to 33,000 acres.

Flood damage reduction is expected to be greatest in areas around Centralia, Chehalis, and Grand Mound. Residential and commercial development is most concentrated in this area. Alternative 1 would reduce flood damage in the 100-year floodplain, including a reduced number of structures that would be flooded, as listed in Table 5.4-3.

Table 5.4-3
Flood Impacts to Valuable Structures Under the No Action Alternative and Alternative 1

ALTERNATIVE	FLOOD SCENARIO	NUMBER OF FLOODED STRUCTURES
No Action	Major	163
	Catastrophic	1,261
Alternative 1	Major	108
	Catastrophic	569
Reduction with Alternative 1	Major	55
	Catastrophic	692

Alternative 1 would reduce flood damage in the Chehalis River 100-year floodplain, resulting in long-term beneficial impacts to agricultural, residential, recreational, and commercially zoned areas. Critical infrastructure would also be protected from flooding, including sections of I-5 and the Chehalis-Centralia Airport. Essential public facilities, including those shown in Figures 2.2-1 through 2.2-3, would also experience reduced flooding.

Reduced flooding could increase the area of developable land in the 100-year floodplain, especially around Chehalis and Centralia. By effectively reducing the area of the 100-year floodplain, Alternative 1 may increase the likelihood of development. If population growth substantially exceeds the projected numbers, Alternative 1 could support additional development on parcels where flooding is reduced or eliminated. There is currently undeveloped land that is already available in the study area. The existing area of developable land could accommodate between 407 and 914 new structures in this area. This is expected to be enough for current and projected population growth (Anchor QEA 2016).

5.4.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

The construction-related direct and indirect impacts of Alternative 2 on public land use would be low, similar to Alternative 1. The construction impacts at the flood retention facility project area would be slightly reduced because of the smaller size and shorter duration of construction. The operational impacts of Alternative 2 would be the same as Alternative 1.

5.5 Recreation

5.5.1 Introduction

Recreation refers to activities that people do for enjoyment. Some examples of recreational activities include hunting, fishing, hiking, camping, birdwatching, kayaking, or whitewater rafting. Recreational resources can occur on public or private lands. Places where people go for recreation in the study area are typically outdoors. Examples of recreational resources include parks, campgrounds, natural areas, or special facilities like golf courses or trails. This section describes existing recreational resources in the study area and potential impacts of the alternatives.

Key Findings

Construction

- Low direct impact from reduced access to the Pe Ell South Permit Area
- High direct impact from loss of 6 miles of river no longer open for boating
- Low indirect impact at Willapa Hills Trail
- Low direct impacts from closure of the Airport Levee Trail for 1 year
- Low indirect impacts from increased dust, noise, and other construction disturbance

Operation

- Low indirect impact from the loss of less than 1% of the Pe Ell South Permit Area
- High indirect impact from the loss of more than 6 miles of fishing and boating in the Chehalis River upstream of the FRE facility
- Medium indirect impact to recreational fisheries overall with a high impact to some fisheries
- Beneficial indirect impact in the Chehalis River 100-year floodplain from decreased flood damage

5.5.2 Affected Environment

This section describes the existing recreational facilities in the study area, as defined in Section 3.6. This includes a 0.5-mile buffer around the proposed flood retention facility project area and a 0.25-mile buffer around the Airport Levee Improvements project area.

5.5.2.1 Flood Retention Facility Project Area

Weyerhaeuser allows recreational use to those who are granted a Weyerhaeuser Recreational Permit to the Pe Ell South Permit Area. This area covers approximately 98,053 acres and extends outside of the flood retention facility project area. For the 2015/2016 recreation season, 550 permits were sold for the Pe Ell South Permit Area. Recreational permits are in high demand. Permits can be purchased for motorized vehicle access or nonmotorized vehicle access. The Pe Ell South Permit Area provides opportunities for fishing, hunting, berry picking, hiking, camping, biking, and horseback riding. The access points closest to the flood retention facility project area are located off of Pe Ell MacDonald Road, approximately 6.1 miles east of the proposed flood retention facility, and off of SR 6, approximately 4.7 miles west of the proposed flood retention facility (Weyerhaeuser 2019).

The reach of the Chehalis River that includes the proposed flood retention facility site is also used for recreational boating. This reach is listed as a Class III–IV whitewater area by the American Whitewater Association. It can only be accessed with a Weyerhaeuser Recreational Permit.

5.5.2.2 Airport Levee Improvements Project Area

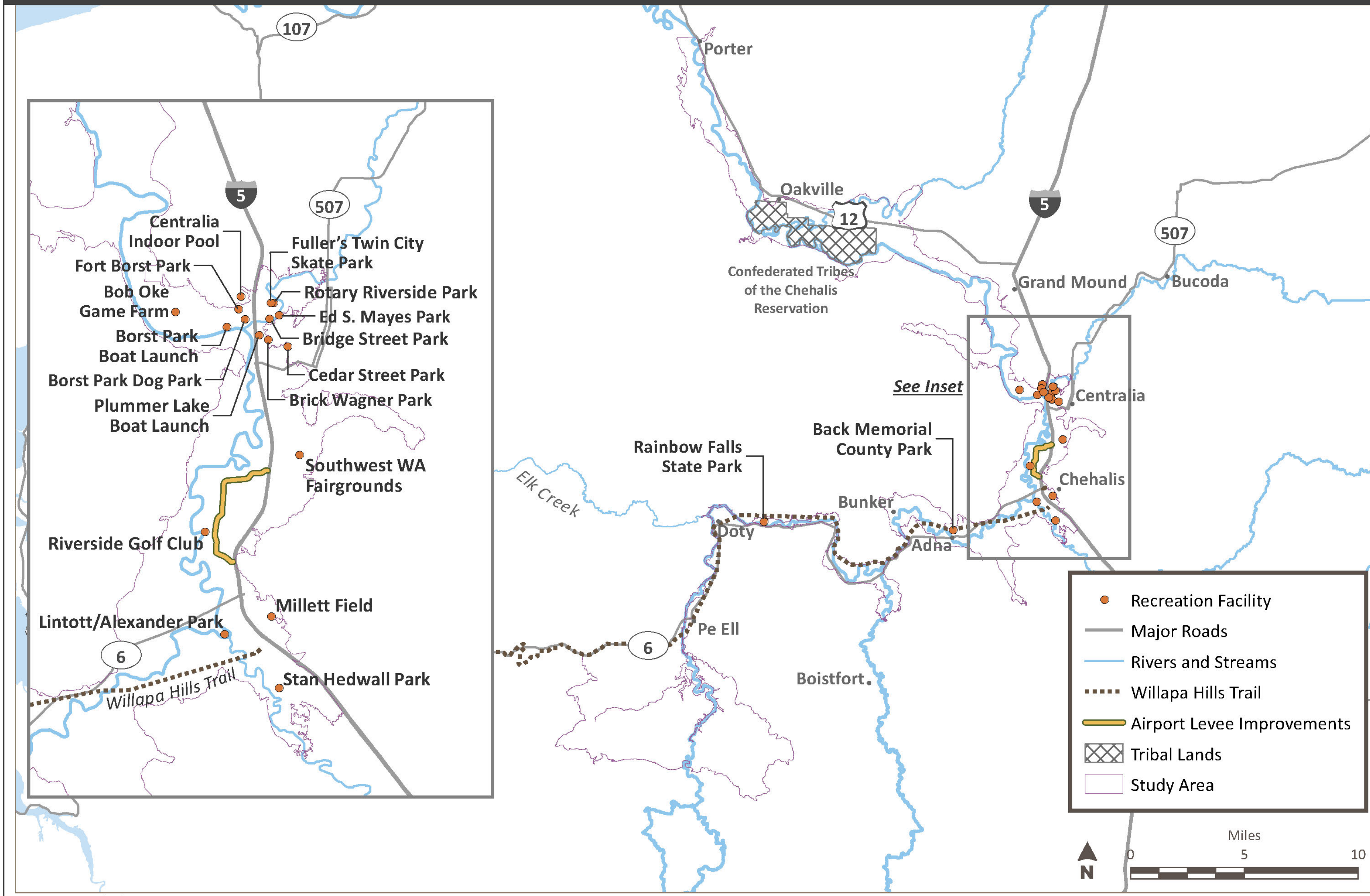
Within the Airport Levee Improvements project area, there are two main recreational resources: the Airport Levee Trail and the Riverside Golf Club. The Airport Levee Trail is a 3.5-mile-long-loop that is primarily a gravel trail located on top of the existing levee. This trail is a collaboration between the Corps Levee Safety Program, the Chehalis-Centralia Airport, and Lewis County Community Trails. Users can follow the trail north and east to its connection with NW Louisiana Avenue northeast of the airport, and continue on the sidewalk and NW Airport Road (Lewis County Community Trails 2019). The Riverside Golf Club is open to the public. It includes an 18-hole course, a covered driving rage, and a practice putting and chipping area. Riverside Golf Club also includes the Riverside Recreational Vehicle (RV) Park, which provides 36 full RV hookups (Riverside Golf Club 2019).

5.5.2.3 Chehalis River 100-Year Floodplain

There are many parks and facilities in this part of the study area (Figure 5.5-1) where people enjoy a variety of activities, including fishing and boating on the river. These facilities serve the general public both in local communities and on a regional level. Three of the recreational facilities have experienced severe damage during past floods. These include Rainbow Falls State Park, the Southwest Washington Fairgrounds, and the Willapa Hills State Park Trail. Each is discussed in more detail as follows:

- Rainbow Falls State Park includes 129 acres of recreational land and 3,400 feet of shoreline along the Chehalis River. It provides 3 miles of hiking trails, including a connection to the Willapa Hills State Park Trail, and fishing, swimming, wildlife viewing, and interpretive activities (Washington State Parks and Recreation Commission 2019a). Approximately 69,780 day visitors and 5,980 campers visited the park between July 2009 and May 2010 (FEMA 2012). The park is accessed via a bridge across the Chehalis River that was washed out during the 2007 flood, preventing access to the northern portion of the park (FEMA 2012). The bridge has since been replaced.
- The Southwest Washington Fairgrounds provides over 60 acres of land and 100,000 square feet of multiuse buildings for public and private events. The Southwest Washington Fair, which draws more than 65,000 visitors, occurs on the fairgrounds every year in mid-August. The Washington State Garlic Fest and Craft Show is another major event that takes place every summer at the fairgrounds. Numerous other events, such as gun shows, car shows, and dog shows, occur at the Southwest Washington Fairgrounds throughout the year (Southwest Washington Fairgrounds 2019). The Southwest Washington Fairgrounds have a history of flooding. The 1996 flood completely flooded the fairgrounds, and the 2007 and 2009 floods damaged numerous buildings (Mittge 2011; Ecology 2017).
- The Willapa Hills State Park Trail extends west for 56 miles from Chehalis to South Bend in Willapa Bay. Within the study area, the trail surface is asphalt from Chehalis to Adna and gravel from Adna to west of Pe Ell. Portions of the trail and bridges that support the trail are planned for future improvements (Washington State Parks and Recreation Commission 2019b). Several bridges associated with the trail were damaged by the 2007 flood and have since been repaired and reopened (TrailLink 2019; WSPF 2019).

Figure 5.5-1
Existing Recreational Facilities in the Study Area



Publish Date: 2020/01/02, 12:10 PM | User: adowell
Filepath: \\orcas\gis\Jobs\WA_OFM_1023\NEPA\Maps\Discipline_Report\Recreation\AQ_NEPA-EIS_Recreation_A_Recreational_Facilities.mxd

Recreational fishing in the Chehalis River occurs by boat and at numerous locations along the banks. Within the Chehalis River 100-year floodplain area, WDFW regulates recreational fishing, which varies throughout the year depending on the species.

The most recent recreational fish harvest data, as reported by WDFW (2019c), are from April 2017 through March 2018. Data for salmon and steelhead harvested from the entire Chehalis River are shown in Table 5.5-1. In 2019, the upper Chehalis River was closed to all fishing from May through September because of a low forecast for spring-run Chinook salmon.

Table 5.5-1
Salmon and Steelhead Harvest in the Chehalis River from April 2017 through March 2018

SPECIES	MONTHS	TOTAL CATCH
Chinook	August through September	20
Chum	October	20
Coho	September through December	4,119
Jack[1] Chinook	September through October	148
Jack Coho	September through November	1,390
Steelhead	June through July, November through March	538
	Total	**6,235**

Notes:
1. Jacks are male salmon that return to freshwater streams 1 or 2 years earlier than their counterparts.
Source: WDFW 2019c

Boating on the Chehalis River is another form of recreational activity in the study area. Kayakers, whitewater rafters, canoers, and other small-craft boaters may use the river for recreation. Kayaking and canoeing are popular between the SR 6 bridge over the Chehalis River and Rainbow Falls State Park (Discover Lewis County 2019). The American Whitewater Association's whitewater rapid ratings of the Chehalis River are provided in Table 5.5-2.

Table 5.5-2
Whitewater Classes of the Chehalis River within the Study Area

REACH	LENGTH (MILES)	CLASS[1]
West Fork to Pe Ell	13.8	III–IV
Pe Ell to Doty	6.0	II
Rainbow Falls to Meeskill	3.2	II

Notes:
1. River reaches are rated by whitewater classes, with Class I rapids being the easiest to navigate and Class VI being the most difficult.
2. The Chehalis River downstream of Meeskill does not have a whitewater class.
Source: American Whitewater Association 2019

5.5.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.5.3.1 Methods

Impacts to recreational facilities resulting from construction and operation of the alternatives were evaluated qualitatively. This analysis looked at the potential impacts to recreational users during construction. This included the potential to block access to recreational areas or to disrupt recreational activities through visual or noise disturbance. Impacts from operation of the alternatives were evaluated by determining how changes to flooding in the Chehalis River 100-year floodplain area would affect recreational facilities and users. Impacts from operation of the temporary reservoir on recreational users in the area were also evaluated.

5.5.3.2 No Action Alternative

> No Action Alternative Impacts to Recreation
>
> - Beneficial localized impact to recreational fishing from restoration actions
> - Low to high impact from continued disruption during major or greater flooding

Under the No Action Alternative, there would be no construction-related impacts to recreational facilities in those project areas. Commercial forestry and airport operations would continue in a manner similar to existing conditions.

Under the No Action Alternative, the risk of floods in the Chehalis River 100-year floodplain area would continue. Some of the projects included in the No Action Alternative may slightly reduce localized flood damage, although these reductions would not measurably affect recreational resources in the study area. Continued growth and development, particularly in the Chehalis-Centralia area, could slightly increase the use of and demand for recreational resources. With continued flooding, more users would be affected by closures of recreational facilities than under the existing conditions. Impacts of flooding on recreational facilities would be low to high, depending on the severity of the flood.

The No Action Alternative includes habitat restoration actions that would benefit fish populations. These actions would, in turn, result in benefits to recreational fishing. Effects of the No Action Alternative on aquatic species are discussed in Section 4.5.3.2.

5.5.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to recreation from construction and operation of Alternative 1.

5.5.3.3.1 Construction

Alternative 1 Construction Impacts to Recreation

- Low direct impact from reduced access to the Pe Ell South Permit Area
- High direct impact from loss of 6 miles of river no longer open for boating
- Low indirect impacts from disruption to Willapa Hills trail access points due to increased truck traffic
- Low direct impacts from closure of the Airport Levee Trail for 1 year
- Low indirect impacts from increased dust, noise, and other construction disturbance

Construction of Alternative 1 would have low to high impacts as the result of temporary disruptions to recreational activities in these areas.

Construction of the flood retention facility would result in low to high direct impacts to recreation. The flood retention facility project area is expected to be closed to recreation during construction. Areas that are expected to be closed include the FRE facility construction footprint, the quarries, and the 485-acre portion of the temporary reservoir footprint where tree removal would occur. This would have a low impact (less than 1% reduction of area) on users of the Pe Ell South Permit Area. General access to the Pe Ell South Permit Area would not be affected by construction because the vehicle access points are located far away from the proposed FRE facility. However, at least 6 miles of the Chehalis River upstream of the proposed FRE facility would be closed to recreational uses such as fishing and boating during construction. It was assumed that users would not be allowed access to these areas after construction and that these impacts would be permanent. This would be a high impact.

FRE facility construction would also have a low indirect impact to the Willapa Hills Trail from increased construction traffic. It was assumed trucks would use Muller Road to access the FRE facility construction site. The Willapa Hills State Park Trail crosses Muller Road near its intersection with Grabski Road. Increased truck traffic associated with construction of this alternative could cause delays for users of the trail at this location.

Construction of the Airport Levee Improvements would result in temporary and low direct impacts to recreational resources. The Airport Levee Trail was assumed to be closed for the 1-year period of construction to allow for the improvements to be built. The trail would reopen once construction was complete. Users of the Airport Levee Trail would be displaced during this period and would have to use other trails in the Centralia-Chehalis area. The closest trail to the Airport Levee Trail is the Willapa Hills State Park Trail, which can be accessed approximately 1.5 miles to the south.

Recreational users in areas near construction activities would also experience low temporary indirect impacts. For example, the Riverside Golf Club and RV Park would experience temporary increases in dust, emissions, visual disturbance, and noise. This could take away from the recreational experiences of these users.

5.5.3.3.2 Operation

Operation of Alternative 1 would result in low to high impacts. Low to high impacts in the flood retention facility project area could happen from reduced access to recreational resources. In the Chehalis River 100-year floodplain downstream of the proposed FRE facility, operation would result mostly in beneficial recreation impacts. However, impacts to recreational fisheries would be high because of the reduction in fish populations. There would be no impacts from the Airport Levee Improvements.

> **Alternative 1 Operational Impacts to Recreation**
>
> - Low indirect impacts from the loss of less than 1% of the Pe Ell South Permit Area for recreational use
> - High indirect impact from the loss of more than 6 miles of fishing and boating in the Chehalis River upstream of the FRE facility
> - Medium indirect impact to recreational fisheries with a high impact to some fisheries
> - Beneficial indirect impacts in the Chehalis River 100-year floodplain from decreased flood damage
> - No impacts in the Airport Levee Improvements project area

Assuming the flood retention facility project area would be permanently closed to recreation, operation of the proposed temporary reservoir would result in low to high impacts to recreational users. Hiking, hunting, and camping would be restricted in this area, but as discussed above, this area accounts for less than 1% of the entire Pe Ell South Permit Area, and would be a low impact. People engaged in fishing and boating in the flood retention facility project area would experience a high impact because it was assumed that up to 6 miles of the Chehalis River in this area would be permanently closed to these activities.

Operation of Alternative 1 would also impact fish populations throughout the Chehalis Basin, particularly salmon and trout. The impacts to fish are discussed in greater detail in Section 4.5. Reduced populations could result in a high impacts to recreational fishing for these fish. This is because of the potential reduction in likelihood of catching fish and the possibility that regulatory catch limits may decrease to protect sensitive species. Game fish other than salmon and trout are less likely to be affected by Alternative 1 because they do not rely on spawning habitat that would be disturbed in the temporary reservoir area. Therefore, the overall impact to fishing would be medium.

Alternative 1 would not affect boating in the Chehalis River downstream of the proposed flood retention facility because flows in the river would continue even when the flood retention facility is operating. The river would also have very high flows during these periods, when boating use is anticipated to be low.

Alternative 1 would also benefit recreational opportunities in the Chehalis River 100-year floodplain. This is because the facilities shown in Figure 5.5-1 would experience a lower risk of flood damage. Access to these facilities would also benefit from reduced flood risk.

Operation of the Airport Levee Improvements would include routine maintenance and inspections similar to existing conditions. These activities would have no impact compared to existing conditions.

5.5.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Impacts during construction of Alternative 2 would be similar to but less than those described under Alternative 1. This is because Alternative 2 would require a shorter construction timeline and smaller construction footprint. The operational impacts of Alternative 2 would be the same as Alternative 1.

5.6 Cultural Resources

5.6.1 Introduction

Cultural resources include prehistoric or historic sites or districts, sacred sites, traditional cultural properties (TCPs), buildings, structures, or objects that are eligible for listing or are listed in the National Register of Historic Places. This section considers the affected environment for these resources, including previously recorded cultural resources within the study area. It also describes impacts to cultural resources that would result from the alternatives. The analysis is based on information provided by the Applicant related to compliance with Section 106 of the National Historic Preservation Act (NHPA). Under the NHPA, cultural resources that are listed or eligible for listing in the NRHP are referred to as historic properties.

> **Key Findings**
>
> **Construction**
>
> - High direct impact to cultural resources, including archaeological sites and traditional cultural properties
>
> **Operation**
>
> - High indirect impact to cultural resources, including archaeological sites and traditional cultural properties.
> - Beneficial indirect impact from reduced risk of flood damage

5.6.2 Affected Environment

This section describes the natural and cultural settings as they relate to cultural resources in the study area, which is defined in Section 3.6. This section summarizes the study area's geology, flora and fauna, precontact setting, ethnographic setting, and historical setting. These are factors that can influence cultural resources in the study area.

5.6.2.1 Geologic Considerations

The geology of a location can influence how people move across and use the land, the types of resources that are available, and whether the physical remnants of human activities are preserved. There are two main geologic areas in the study area: the Willapa Hills province and the Puget Basin (Schuster et al. 2009). The flood retention facility project area is located in the Willapa Hills province. The Airport Levee Improvements project area and Chehalis River 100-year floodplain area are located at the southern end of the Puget Basin. All portions of the study area are located south of the southernmost extent of any recorded glacial advance in the region (Booth et al. 2003; Schasse 1987). Therefore, they have the potential to contain as-yet undocumented archaeological resources.

5.6.2.2 Flora and Fauna

The study area is in the Puget Sound-subtype of the western hemlock vegetation zone. Softwoods, such as Douglas-fir, western hemlock, and western red cedar, are the dominant tree species in the region, while hardwoods such as red alder and big-leaf maple are less common and found near water courses or riparian habitats. Understory shrubs with potential food and resource value in this zone include swordfern, bracken fern (*Pteridium aquilinum*), Oregon grape (*Mahonia aquifolium*), vine maple, blackberry (*Rubus* spp.), oceanspray, salal (*Gaultheria shallon*), blueberries and huckleberries (*Vaccinium* spp.), and red elderberry. Plants with bulbs or rhizomes, such as common camas (*Camassia quamash*) and tiger lily (*Lilium columbianum*), were collected from prairie environments for food (Franklin and Dyrness 1988; Gunther 1945; Pojar and Mackinnon 1994).

Terrestrial animals of potential food and resource value in the region include mule deer (*Odocoileus hemionus*), elk, black bear (*Ursus americanus*), squirrels (*Sciurius* sp.) and raccoon (*Procyon lotor*) (Eder 2002). Four species of salmon and trout spawn in the Chehalis River and its tributaries, including Chinook salmon, chum salmon, coho salmon, and steelhead (Hiss and Knudsen 1993).

5.6.2.3 Precontact Context

The precontact archaeological record of this region has not been studied in depth. Existing studies focused on the Washington coastlines and interior Puget Sound region. They do not provide any detail on the Chehalis River region (Nelson 1990; Wessen 1990). Because of the limited understanding of the region's precontact history, a two-phase cultural sequence was proposed during an evaluation of proposed flood risk management measures along the Chehalis River (Herbel and Schalk 2002): the Early Holocene Period (10,000 to 4,000 years before present [BP]); and the Late Holocene Period (4,000 to 100 years BP). These two phases can generally be distinguished by changes in land use. The Early Holocene is marked by a mobile hunter-gatherer-fisher lifestyle. The Late Holocene is when more complex, permanent villages were established, and innovations in technology led to a rise in fishing, particularly for salmon. Other characteristics of the Late Holocene include increased food storage, development of art styles, and use of canoes.

5.6.2.4 Ethnographic Context

5.6.2.4.1 Flood Retention Facility Project Area and Chehalis River 100-Year Floodplain Area

The flood retention facility project area is within the traditional territory of the Kwalhioqua (Krauss 1990; Spier 1936). The traders and explorers in the late eighteenth century did not record the Kwalhioqua cultures or language in much detail. Based on the minimal information known, there were two subgroups: the Willapa and the Suwal. The Suwal occupied the drainage of the Chehalis River upriver from Centralia. Descendants of the Suwal integrated with the Upper Chehalis, Cowlitz, and Shoalwater Bay peoples prior to the establishment of the reservation system (Ruby and Brown 1995). This area was also used by the Upper Chehalis and Cowlitz, who have been associated with the vicinities of Chehalis, Boisfort, and Pe Ell in the Chehalis River 100-year floodplain area. The Upper Chehalis people near the town of Pe Ell were known as the *cȧxʷásnʔ* (Hajda 1990). Descendants of the groups identified above are now members of the Chehalis Tribe, Cowlitz, QIN, Shoalwater Bay Tribe, and the Squaxin Island Tribe. They inhabit communities throughout southwestern Washington (Ruby and Brown 1992). Parts of the study area were also traditionally inhabited by the Hoquiam and Wishkah people. The waters in the study area, including the Chehalis River, were seasonally used by the Quinault people. Today, the people of the Quinault and the Chehalis hold a connection to, and actively derive cultural and spiritual importance from, the ecosystems within the study area (Hajda 1990; Ruby and Brown 1992).

In the 1830s, a malaria epidemic spread through this region, resulting in shifts among group divisions. The Suwal were absorbed by the Upper Chehalis and Cowlitz groups (Hajda 1990). By 1898, only two speakers of Kwalhioqua were identified by ethnographers and linguists (Krauss 1990).

Villages consisted of lodges built of split cedar poles and covered with bark. Floors were furnished with rush mats. Subsistence was focused on hunting and gathering in the uplands, but people also fished seasonally using spears, weirs, and traps. Locations of Kwalhioqua villages are not known. However, there was an Upper Chehalis village at Rainbow Falls, knowns as *Wah-moss* (Swindell 1942), where lamprey were caught as they ascended the falls (Marr et al. 1980).

Following the passage of the Donation Land Act of 1850, non-Native settlement in the region increased and the United States government began treaty negotiations with Native people in Western Washington. In 1855, Washington territorial governor Isaac Stevens and representatives from the upper Chehalis, Cowlitz, Chinook, Lower Chehalis, Quinault, Queets, and Satsop held the Chehalis River Treaty Council. The purpose was to negotiate the establishment of reservations and usual and accustomed fishing and gathering rights in exchange for the cessation of Native American title to lands to the west of the Cascade Mountain range. Treaty negotiations were ultimately unsuccessful because many of the tribes that were represented at the council objected to the proposed reservation locations and groupings, which would relocate many people away from their traditional areas. Later that year, the Quinault, Quileute, and Hoh signed the Treaty of Olympia and the Quinault Reservation was established. The QIN's reservation is located outside of the Chehalis Basin. However, the QIN's usual and accustomed fishing grounds include the entire Chehalis Basin. The majority of the Upper Chehalis and some Cowlitz remained at what became the Chehalis Reservation in 1864. A reservation for the Chehalis Tribe was established by executive order in 1864 (Ruby and Brown 1992). Today, descendants of the Upper and Lower Chehalis and Cowlitz are members of the federally recognized Chehalis Tribe. The Chehalis Tribe has customarily fished, hunted, and harvested in the Chehalis Basin. Descendants of the Cowlitz are also members of the federally recognized Cowlitz Indian Tribe, which is located in southwest Washington.

5.6.2.4.2 Airport Levee Improvements Project Area

The Chehalis-Centralia Airport and the surrounding floodplain are within the traditional territory of the Upper Chehalis People or the *qʷayaił* (Marr et al. 1980; Spier 1936). The subgroup of Upper Chehalis who lived near the townsite of Chehalis was known as the *ʔil̓ awiqs* (Hajda 1990). The Upper Chehalis are considered to be part of the larger shared cultural group of Southwestern Coast Salish people (Hajda 1990).

Upper Chehalis villages were often located along the Chehalis River and its tributaries. Permanent winter villages consisted of cedar plank houses that could be occupied by up to eight or 10 families. A village known as *téw̓tn̓* was located approximately 1 mile above (upriver) from the mouth of the Skookumchuck River, which would be near today's Chehalis-Centralia Airport. Many other villages were located along the Chehalis River, including at today's cities of Centralia and Chehalis. Temporary seasonal houses were made of cedar-bark slabs or pole frames covered with boughs or mats.

Subsistence focused on fishing, and included salmon, steelhead, and lamprey. Freshwater clams and crayfish were also part of the traditional Chehalis diet. Fishing technology included spears, hooks, nets, traps, and weirs (Marr et al. 1980). The Chehalis also hunted deer, elk, and other small game.

As indicated above, the Chehalis Basin continues to provide important grounds for fishing, hunting, and gathering by tribes. The Chehalis Tribe has customarily fished, hunted, and harvested in the Chehalis Basin. The QIN usual and accustomed fishing grounds include the entire Chehalis Basin.

5.6.2.5 Historical Context

5.6.2.5.1 Flood Retention Facility Project Area and Chehalis River 100-Year Floodplain Area

The town of Pe Ell was established by farmers in the 1850s, but the local industry soon switched to logging. In the 1880s, several small logging towns were established along nearby Rock and McCormick Creeks (Kirk and Alexander 1995). An 1891 survey map of the vicinity shows a trail and series of homesteads located in the Chehalis River 100-year floodplain portion of the study area (U.S. Surveyor General 1891), including homesteads near the mouth of Browns Creek, near the mouth of Smith Creek, at the mouth of Alder Creek, and beyond Thrash Creek (U.S. Surveyor General 1903, 1909). In the early 1900s, six other homesteads were located along Roger Creek and its tributaries.

Land use in the study area included logging and quarrying. In 1900, Weyerhaeuser purchased a reported 900,000 acres of land from the Northern Pacific Railway for timber production (Holstine 2002). No quarries were identified in records from 1918 (Washington Geological Survey 1921), but some were shown on a 1953 map halfway between Hull Creek and Murphy's Point, at Murphy's Point, and at Fisk Falls (USGS 1953a).

Infrastructure development in the study area included construction and operation of a water line from the Chehalis River to the town of Pe Ell by the Washington Light and Water System Company in the early twentieth century (Holstine 2002). The reservoir and intake for the water system was located on Lester Creek, within the Chehalis River 100-year floodplain portion of the study area. The Northern Pacific Railway line to Pe Ell was completed in 1914. Development of Shepard Road included an evolution from a dirt route in the 1940s to its improved condition crossing the Chehalis at Murphy's Point and Fisk Falls by 1960 (USGS 1941, 1953a, 1953b; Metsker Map Company 1960).

5.6.2.5.2 Airport Levee Improvements

The earliest known map of the Airport Levee Improvements project area was prepared in 1856 and does not record any homesteads, trails, or other features (U.S. Surveyor General 1856, 1860). The Chehalis-Centralia Airport was established in 1927 on 44 acres of land. The airport expanded a year later, adding 50 acres, and then again in the 1940s when another 200 acres were added (City of Chehalis 2017).

During World War II, the Corps made improvements to the property, including constructing the Chehalis-Centralia Airport Levee, which was completed in 1943.

A portion of the levee is on land formerly owned by L. Blaser in 1948 and later C. Blaser and others in 1960 and 1962 (Metkser Map Company 1948, 1960, 1962). Historical maps show a complex of buildings once stood within the Airport Levee Improvements project area (USGS 1954, 1975, 1985). The County purchased the property in 2003 and razed the buildings between 2005 and 2007 (Mueller 2016). The remaining concrete foundations, slabs, and historical debris were recorded in 2008 as part of archaeological site 45LE194 (Kelly and McCroskey 2009).

5.6.2.6 Historic Properties

This section describes resources that have been determined to be potentially eligible for or are listed in the NRHP, as identified through research and consultation with affected tribes and other consulting parties. Historic properties can include built resources, archaeological resources, or TCPs. The methods for evaluating these resources are described in Section 5.6.3.1.

5.6.2.6.1 Historic Built Resources

Historic built resources are buildings, structures, and infrastructure that are eligible for or listed in the NRHP. No historic built resources have been documented in the study area. Section 5.6.2.5 provides information on the general historical context of the study area.

5.6.2.6.2 Archaeological Resources

Archaeological surveys were completed for the flood retention facility and Airport Levee Improvements project areas. Table 5.6-1 lists the archaeological sites that have been documented in this area. Specific information about these sites is sensitive and protected under Section 304 of the NHPA. Of the 14 archaeological sites identified in the study area, 13 are located in the flood retention facility project area and one is located in the Airport Levee Improvements project area. A total of 11 sites were determined by the Corps to not be eligible for listing in the NRHP, and three were determined eligible. Additional details about these archaeological sites are provided in the *Chehalis Basin Flood Damage Reduction Project Archaeological Survey and Built Environment Assessment* and *Major Changes to Project and Findings since May 2019 Draft Section 106 Report*.

Table 5.6-1
Archaeological Sites in the Study Area

SITE	AGE	LOCATION	ELIGIBLE FOR NRHP
45LE978	Precontact	Flood Retention Facility Project Area	Yes
45LE979	Historic	Flood Retention Facility Project Area	No
45LE980	Precontact	Flood Retention Facility Project Area	No
45LE981	Precontact	Flood Retention Facility Project Area	No
45LE982	Historic	Flood Retention Facility Project Area	No
45LE983-IO	Precontact isolate	Flood Retention Facility Project Area	No

SITE	AGE	LOCATION	ELIGIBLE FOR NRHP
45LE984-IO	Historic isolate	Flood Retention Facility Project Area	No
45LE985-IO	Precontact isolate	Flood Retention Facility Project Area	No
45LE986	Precontact	Flood Retention Facility Project Area	Yes
45LE987	Precontact	Flood Retention Facility Project Area	No
45LE988-IO	Precontact isolate	Flood Retention Facility Project Area	No
45LE989	Historic/Precontact	Flood Retention Facility Project Area	No
45LE990	Precontact	Flood Retention Facility Project Area	No
45LE194	Historic/Prehistoric	Airport Levee Improvements Project Area	Yes

Notes:
Precontact: Resources dating to a period that predates Native American contact with European Americans. In southwestern Washington, contact occurred in the early nineteenth century.
Historic: Resources dating to the period following Native American contact with European Americans; up to approximately 50 years ago.
Isolate: Individual, isolated, items greater than 50 years old.

In addition to the known archaeological sites located in the study area, much of the study area retains the potential to contain buried and as-yet undocumented archaeological sites. The floodplains and terraces that border the Chehalis River in the study area include landforms suitable for habitation, resource collection, and resource processing activities.

5.6.2.6.3 *Traditional Cultural Properties*

The significance of a TCP is based on its association with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social intuitions of a living community. The ability for a TCP to convey its significance would be impacted if its accessibility, or the conditions considered important to the TCP's function, changes for the community associated with it.

Three TCPs have been identified in the study area. Information relating to the traditional use and location of TCPs is sensitive and protected under Section 304 of the NHPA. For this reason, it is not included in in the EIS. Formal Section 106 consultation between the Corps and Native American tribes is ongoing to determine whether additional TCPs are present in the study area, and to determine the nature and extent of the potential for impacts.

5.6.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.6.3.1 Methods

The analysis of impacts was completed in accordance with Section 106 of the NHPA of 1966, as amended. Section 106 requires that effects on historic properties be taken into consideration in any federal undertaking.

The CEQ NEPA regulations (40 CFR 1500–1508) provide the basis for evaluating project impacts.
As described in Section 1508.27 of these regulations, the criteria of context and intensity are considered together when determining the severity of the change introduced by a project.

Impact analysis in this section is also consistent with the NHPA criteria for adverse effect (36 CFR 800.5). Under these regulations, a proposed project has an effect on an historic property when a project may alter, directly or indirectly, the characteristics of the property that may qualify the property for inclusion in the NRHP (36 CFR 800.5[a]). An effect is considered adverse when a project may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

5.6.3.1.1 Historic Built Resources

Records searches were completed for the flood retention facility and Airport Levee Improvements project areas. These searches looked for structures that were 45 years or older. A records search was not completed for the Chehalis River 100-year floodplain study area because there would be no activities proposed in these areas that would adversely affect these resource types. Flood damage reduction benefits on these resources were evaluated qualitatively.

5.6.3.1.2 Archaeological Resources

Archaeological surveys, including a pedestrian subsurface survey, were performed at the flood retention facility project area between June and December 2018, and at the Airport Levee Improvements project area in August 2018. A pedestrian survey consists of archaeologists walking side-by-side at evenly spaced intervals to inspect the ground surface for exposed archaeological deposits or features. A subsurface survey includes shovel probes consisting of hand-excavated cylindrical holes excavated at evenly spaced intervals to look for buried archaeological deposits or features. Nearly all of the current Airport Levee Improvements project area was surveyed, except for a small portion at the southern end of the project area for which access was not granted. Because of local topographic and logistical conditions, including steep slopes and dense vegetation, only the accessible portions of the flood retention facility (those with slopes less than 30%) were subject to archaeological survey. These surveys identified a total of 14 archaeological sites and no historic built resources. Three of the archaeological sites are potentially eligible for listing in the NRHP.

For archaeological sites, resource integrity (a resource's ability to convey its significance) is most commonly derived from whether the resource contains artifacts or features (such as a fire pit or house pit) that are diagnostic for both a specific activity and a specific time period. If an archaeological site is damaged, destroyed, or removed, it would likely lose the ability to convey its significance. This would be considered an adverse effect under Section 106 of the NHPA.

5.6.3.1.3 Agency and Tribal Consultation

The Corps is serving as the lead agency under Section 106 of the NHPA. The Applicant, the Washington Department of Archaeology and Historic Preservation, the Chehalis Tribe, the Cowlitz Indian Tribe, QIN, Nisqually Indian Tribe, Shoalwater Bay Tribe, and Ecology have been identified as consulting parties for this undertaking.

5.6.3.2 No Action Alternative

Under the No Action Alternative, continued growth and development in the study area could potentially result in low to high impacts to cultural resources. However, it is expected that these impacts would be addressed through compliance with applicable regulations and would therefore, result in a medium impact. In addition, the risk of major or greater floods would remain. Depending on the extent and location of floods, there is a chance that cultural resources could be adversely affected through flood-related damage, resulting in low to high impacts, depending on the circumstance.

> **No Action Alternative Impacts to Cultural Resources**
>
> - Low to medium impact from ongoing development
> - Low to high impacts from continued flooding

5.6.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to cultural resources associated with Alternative 1. This includes impacts to resources eligible for or listed in the NRHP (historic properties). This may also include human remains and any associated cultural items in the study area.

5.6.3.3.1 Construction

Construction activities, such as excavation and grading, have the potential to directly damage, destroy, or remove historic properties, including archaeological sites and TCPs. There is also the potential that construction could disturb undocumented sites or human remains.

> **Alternative 1 Construction Impacts to Cultural Resources**
>
> - High direct impact to cultural resources from construction of the FRE facility, including eligible archaeological site and traditional cultural properties
> - Construction of the FRE facility and Airport Levee Improvements may damage, destroy, or remove undocumented cultural resources

Construction of Alternative 1 would result in destruction of one of the three potentially eligible archaeological sites in the flood retention facility project area (45LE978). Direct construction-related impacts are not anticipated for the other two archaeological sites (45LE986 and 45LE194). This is because the Applicant has designed the project to avoid the sites and would implement measures as needed to minimize the impacts (Chapter 7).

As noted above, much of the study area along the Chehalis River retains the potential to contain buried and as-yet undocumented archaeological sites. Construction activities in the flood retention facility and Airport Levee Improvements project areas have the potential to damage, destroy, or remove archaeological sites or other cultural resources. If eligible resources were inadvertently damaged from construction, this would be an adverse impact. As part of the Section 106 of the NHPA process, the Corps will resolve adverse effects to historic properties through consultation with the consulting parties.

TCPs have been identified in the study area through consultation between the Corps and Native American tribes. Consultation is ongoing to determine whether additional TCPs are present in the study area and to determine the nature and extent of project-related impacts. As currently proposed, construction activities would result in a high impact to one of the three TCPs in the study area.

5.6.3.3.2 Operation

Operation of the FRE facility has the potential to expose or damage archaeological sites as a result of periodic inundation of the temporary reservoir. This would only happen when the temporary reservoir fills during a catastrophic flood. Operation of Alternative 1 would reduce flood damage in the Chehalis River 100-year floodplain. Reduction in the frequency and intensity of flooding and erosion would benefit archaeological sites and historic buildings, including presently undocumented resources. Consultation regarding impacts to TCPs is ongoing as of the writing of this document.

Alternative 1 Operational Impacts to Cultural Resources

- Medium to high indirect impact to cultural resources, including archaeological sites and traditional cultural properties
- Beneficial impact from flood damage reduction in the Chehalis River 100-year floodplain would reduce the likelihood of cultural resource damage from major or greater floods

Archaeological site 45LE986 is located on a low-lying river terrace about 30 feet above the Chehalis River in the footprint of the proposed temporary reservoir. The site is located in a part of the temporary reservoir that would be flooded during a catastrophic flood, which would happen on average once every 100 years. The site is more than 100 feet outside the downslope boundary of a mapped landslide (landslide [LS] 9; Chehalis Basin Strategy 2019a). Geotechnical evaluations of LS-9 revealed that it has very limited potential to be mobilized through the process of inundating and drawing down the temporary reservoir (Chehalis Basin Strategy 2019a, 2019b).

However, during catastrophic floods, water would infiltrate and saturate the sediments beneath the site. Subsequent drawdown would drain water from these sediments. This process could loosen soils, causing erosion of the terrace face and small-scale slope instability. Because 45LE986 is immediately adjacent to the riverbank, bank erosion could adversely impact the site if floodwaters reached this elevation. The likelihood of this happening is low. Therefore, this is a medium impact. However, if flooding happened to the extent that the site was damaged, this would be a high impact.

Neither of the other known archaeological sites would be disturbed during operation. Site 45LE194 is located away from areas that would be affected by operation.

As noted above, formal consultation between the Corps and federally recognized Native American tribes is ongoing to determine whether additional TCPs are present in the study area, and to determine the nature and extent of project-related impacts. The consultation efforts that have occurred up to this point indicate that operation of Alternative 1 would result in a high impact to the two other TCPs.

5.6.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Direct and indirect impacts to historic properties from Alternative 2 are expected to be the same as those described under Alternative 1.

5.7 Transportation

5.7.1 Introduction

Transportation resources include the methods that are used to move people and freight, including personal vehicles, cargo vehicles, rail, and aircraft. Transportation also includes the infrastructure that supports these methods of travel.

This section describes the transportation network, which includes roadways, railways, transit, air travel, bike and pedestrian facilities, and traffic circulation in areas that could be potentially affected by the alternatives. This section also evaluates potential impacts of the alternatives on the transportation system. Recreational use of transportation resources, such as recreational boating, is addressed in Section 5.5.

Key Findings

Construction

- Low direct impact to roadways in the flood retention facility and Airport Levee Improvements project areas from periodic road closures and traffic delays
- Low direct impact to pedestrians and cyclists from the Airport Levee Improvements
- Low direct and indirect impact to the Chehalis-Centralia Airport from construction affecting runway use and increased construction activity
- Low indirect impact to roads surrounding the flood retention facility and Airport Levee Improvements project areas from increased traffic to and from construction sites
- Beneficial impact to forest roads longer-term from widening and repairs

Operation

- Low indirect impact to traffic and roads at the FRE facility
- Beneficial longer-term impact to forest roads from widening and repairs
- No impact at the Chehalis/Centralia Airport
- Beneficial indirect impact to the regional transportation network in from reduced flooding and related closures, delays, and damage
- Benefit to transportation because I-5 would no longer flood during a catastrophic flood

5.7.2 Affected Environment

This section describes the conditions of the transportation network in the study area. Commercial boats are not used in the study area and are therefore not discussed.

5.7.2.1 Flood Retention Facility Project Area

The main roadway in this part of the study area is SR 6, which runs through Pe Ell, serving as a connector road between I-5 and Willapa Bay. Arterial and secondary roads in the vicinity of Pe Ell include Main Street, East Pe Ell Avenue, Muller Road, 3rd Street, Wells Road, and 1st Street.

There also two main local access roads in the flood retention facility project area, which are FR 1000 and FR 1010. Additional roads in this area include FR 1020, FR A-line, FR F-line, and an unnamed forest road leading to the proposed Huckleberry Ridge quarry site. These roads are used for forestry operations and permitted recreational access to the managed forest. They are owned and maintained by Weyerhaeuser. Portions of these roads have become flooded during past catastrophic floods, such as the 2007 flood.

5.7.2.2 Airport Levee Improvements Project Area

Arterial and secondary roads in the vicinity of the proposed Airport Levee Improvements include NW Airport Road, NW River Street, NW Florida Avenue, Airport Road, and NW Louisiana Road. Roads in Chehalis have experienced some of the most substantial flooding and flood damage in the Chehalis Basin. Other than serving as a connector road and local highway near the flood retention facility, SR 6 also runs through Chehalis. SR 6 was closed in many places during the 1996, 2007, and 2009 floods (WSDOT 2014).

The Chehalis-Centralia Airport is jointly operated by Lewis County and the City of Chehalis. It is located just west of I-5 at the Chamber Way Interchange in Chehalis (Lewis County 2017). The Chehalis-Centralia Airport covers 438 acres and has one asphalt runway measuring 5,000 feet by 140 feet. Through the 2017 calendar year, the airport had an average of 131 aircraft operations per day, of which 90% was general aviation, 9% was air taxi, and less than 1% was military (AirNav 2019). The Chehalis-Centralia Airport is protected by a levee system, but these levees have overtopped during past catastrophic floods, including the 2007 flood (Ruckelshaus 2012).

5.7.2.3 Chehalis River 100-Year Floodplain

State and federal highways serve the urban areas of Lewis County, and local roads connect the less densely populated areas. Numerous local roads cross through the Chehalis River 100-year floodplain area. These roadways are concentrated in the areas of Pe Ell, Doty, Adna, Chehalis, Centralia, Grand Mound, and Oakville.

The existing regional transportation network comprises portions of major roads including I-5, SR 6, U.S. Route 12 (US 12) and SR 507. Descriptions of major roadways are provided in Table 5.7-1.

Table 5.7-1
Major Roadways within the Study Area

ROADWAY	DESCRIPTION
I-5	The main north/south highway for the western United States, connecting with the borders of Mexico and Canada and running through California, Oregon, and Washington.
US 12	The primary east/west travel route between I-5 and the Cascade Range.
US 101	Travels northwest from I-5 to the Olympic Peninsula.
SR 6	Travels east/west between I-5 and the Pacific Coast, and connects Chehalis and Pe Ell.
SR 507	Runs north/south through Lewis County.
SR 508	Runs east/west through Lewis County.

Characteristics of regional roads can be monitored or measured using metrics such as level of service[3] (LOS), average daily traffic volumes, and truck versus passenger vehicle traffic. Table 5.7-2 presents characteristics of LOS and corresponding regional roads in the study area. Major roads at the regional

[3] Level of service is a measurement of motor vehicle traffic service quality with respect to traffic flow on roadways.

level that serve the project area have an LOS of C or D. Table 5.7-3 shows the average daily traffic volumes for major roads in the study area.

Table 5.7-2
Level of Service for I-5, SR 6, US 12, and SR 507

LEVEL OF SERVICE	CHARACTERISTICS OF TRAFFIC	VOLUME TO CAPACITY RATIO	REGIONAL ROAD
A	Free flow, low volumes and densities, high speeds. Drivers can maintain their desired speeds with little or no delay and are unaffected by other vehicles.	<0.60	N/A
B	Reasonably free flow, operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed.	0.60 to 0.70	N/A
C	Speeds remain near free flow, but freedom to maneuver is noticeably restricted.	0.70 to 0.80	I-5 north of the Thurston County line SR 6 between Pe Ell and I-5 US 12 between Rochester and Porter
D	Speed begins to decline with increasing volume. Freedom to maneuver is further reduced, and the traffic stream has little space to absorb disruptions.	0.80 to 0.90	I-5 between SR 508 and Thurston County line SR 507 between I-5 and Hanaford Valley Road US 12 between I-5 and Rochester
E	Unstable flow with volume at or near capacity. Freedom to maneuver is extremely limited, and level of comfort afforded to the driver is poor.	0.90 to 1.00	N/A
F	Breakdown in flow. Both speeds and volumes can drop to zero.	>1.00	N/A

Note:
Sources: Thurston Regional Planning Council 2016; WSDOT 2020a

Table 5.7-3
Average Daily Traffic Volume Ranges for Major Roadways in the Study Area

ROADWAY	SECTION OF ROADWAY	AVERAGE DAILY TRAFFIC RANGE
SR 6	I-5 to Highway 603	11,000
	Highway 603 to Adna	5,800 to 6,900
	Adna to Pe Ell	2,400 to 3,900
I-5	Chehalis to Centralia	51,000 to 77,000
SR 507	I-5 to the Skookumchuck River	5,100 to 13,000
US 12	I-5 to Forstrom Road SW	11,000 to 15,000

ROADWAY	SECTION OF ROADWAY	AVERAGE DAILY TRAFFIC RANGE
	Forstrom Road SW to Porter	5,600 to 8,400

Note:
Source: WSDOT 2020a

WSDOT classifies roads based on the amount of freight carried over the course of a year. The roads that handle the most freight are classified as T-1 routes. T-1 routes handle over 10 million tons of freight annually. In the project area, only I-5 is considered a T-1 freight route. US 12 is classified as a T-2 freight route. T-2 freight routes carry between 4 and 10 million tons of freight per year (Lewis County 2018). SR 6 and SR 507 are T-3 routes, which carry 300,000 to 4 million tons of freight per year (WSDOT 2020b).

Past flooding of roadways in the study area has blocked access to communities in the Chehalis River 100-year floodplain, including Adna, Dryad, Doty, Pe Ell, Centralia, and Chehalis. Roads that have been historically flooded in the upper reaches of the study area include SR 6, Leudinghaus Road, Boistfort Road, Curtis Hill Road, and Bunker Creek Road. Roadways in Centralia and Chehalis that have been blocked by past flooding include I-5, SR 6, SW Riverside Drive, SW Newaukum Avenue, N National Avenue, NE Kresky Avenue, NW Airport Road, and NW Louisiana Avenue.

WSDOT typically closes I-5 between exits 68 and 88 when flooding is projected to overtop I-5 in the Centralia-Chehalis area. Closure of I-5 is based on NOAA flood projections, gage data, and visual cues. WSDOT schedules the closure to promote driver safety and to identify the safest detour.

As noted above, flooding occurs on many of the regional roadways, especially I-5 and SR 6. Because I-5 is a major corridor for the movement of people and freight, as well as a primary route for local trips, flooding of I-5 can result in substantial travel delays. WSDOT has developed an emergency detour route using SR 7 and US 12 when I-5 is closed due to flooding. Passenger cars are able to use the detour without any restrictions. WSDOT requires freight trucks to use a different system to control traffic volumes and maintain access for emergency responders. Trucking companies must apply for permits through the Commercial Vehicle Information Systems and Networks program to access the detour route. This detour route was used during the 2007 flood (WSDOT 2008). Criteria for activating the detour route are that I-5 has been closed for 24 hours, is predicted to be closed for at least 3 days, and that the National Guard has been activated (WSDOT 2019b).

5.7.2.3.1 Railways

The existing regional transportation network also supports BNSF Railway Company, UP Railway, Puget Sound and Pacific Rail Line, Port of Chehalis Rail Line, the Tacoma Rail Mountain Division Line, and Amtrak. BNSF Railway is a mainline serving Centralia and Chehalis, part of a larger network spanning from Canada to Oregon. UP Railway operates a north-south mainline through a portion of the Chehalis Basin, from Chehalis, north through Thurston County to Tacoma. The Port of Chehalis rail line serves Chehalis. A steam train runs on a portion of the tracks. The Tacoma Rail Mountain links Centralia and Chehalis to communities in Thurston County and is used primarily for freight car storage (Lewis County

2018). Amtrak provides passenger rail transportation on the BNSF line between Vancouver, British Columbia, and Los Angeles, California. These railroad lines have flooded to the point of closure during past catastrophic floods, including the 2007 flood (Ruckelshaus 2012).

5.7.2.3.2 Pedestrians and Bicycles

Sidewalks are located on a majority of the streets within the Cities of Centralia and Chehalis. Paved shoulders and shared roadways provide pedestrian and bicycle transport in much of the rural areas. Bicycle paths serve several streets throughout Chehalis, including Market Street/National Avenue, Kresky Avenue, Chehalis Avenue, and Saint Helens Avenue/Lawrence Road (Corps 2003). Bicyclists may also use the road network in the study area, including local and regional roadways.

5.7.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.7.3.1 Methods

Impacts to transportation resources were evaluated qualitatively. The analysis considered how project alternatives may impact the regional transportation network, including major and secondary roads, forest roads, airports, railways, sidewalks, and bicycle paths. The analysis also considered the potential effects of improving existing forest roads and constructing new temporary construction access roadways.

5.7.3.2 No Action Alternative

Under the No Action Alternative, the traffic impacts would range from low to high, with high impacts happening as the result of major or greater flooding.

Population growth in the region would continue under the No Action Alternative and lead to low increases in traffic delays in the study area compared to existing conditions. These delays could result in a decrease in the functionality of the associated roadways (Tomtas 2017).

> **No Action Alternative Impacts to Transportation**
>
> - Low impact from continued population growth in the region and associated increased traffic delays
> - Low to high impact from continued flooding causing road and rail closures, infrastructure damage, and Chehalis-Centralia Airport closures

Although some future projects under the No Action Alternative may reduce the frequency and severity of floods, flooding would continue in the study area, resulting in low to high impacts. Flooding would continue to impact the transportation network in the Chehalis River 100-year floodplain through road and rail closures, physical damage to infrastructure, and closure of the Chehalis-Centralia Airport.

Modeling shows that I-5 would continue to flood at selected locations during a catastrophic flood under the No Action Alternative (WSE 2019a, 2019b; Tschetter 2020). Modeling showed there would be no flooding of I-5 during a major flood at these same locations. Additional information about the modeling results is presented in Appendix G.

Flooding of I-5 would result in unsafe conditions for motorists, and the highway would be closed in these areas. During a closure of I-5, LOS would be nonexistent. WSDOT would continue to use its existing emergency detour routes when I-5 is closed due to flooding, as discussed in Section 5.7.2.3. Modeled flood depths and flood-related closure durations for a catastrophic flood are shown in Table 5.7-4.

Table 5.7-4
Duration of I-5 Closure and Maximum Flood Depth during a Catastrophic Flood Under the No Action Alternative

LOCATION	DURATION OF FLOOD CLOSURE	MAXIMUM FLOOD DEPTH
I-5 Approximately 1,700 feet North of SW 13th Street Overcrossing	12 hours	1.2 feet
I-5 at SR 6 Overcrossing	3 hours	0.3 foot
I-5 at NW Chamber of Commerce Way	46 hours	5.5 feet

Notes:
Model uncertainties means that a depth of zero feet could range from zero to 3 inches
Sources: WSE 2019a, 2019b; Tschetter 2020

Modeling has also shown that a catastrophic flood would reach US 12 and SR 6 (WSDOT 2014). The roads would be closed as follows:

- US 12 would be closed for 152 hours (6 days and 8 hours). The primary closure would occur east of Oakville and west of Anderson Road (also known as County Line Road).
- SR 6 would close for 51 hours (2 days and 3 hours). The closure would occur in multiple places on SR-6 because this road parallels and crosses over the Chehalis River several times.

5.7.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to transportation from construction and operation of Alternative 1.

5.7.3.3.1 Construction

Alternative 1 Construction Impacts to Transportation

- Low direct impact to roadways in the flood retention facility and Airport Levee Improvements project areas from periodic road closures and traffic delays
- Low direct impact to pedestrians and cyclists from construction of the Airport Levee Improvements because of temporary closures of sections of NW Airport Road and the Airport Levee Trail
- Low direct and indirect impact to the Chehalis-Centralia Airport from construction affecting runway use and increased construction activity
- Low indirect impact to roads surrounding the flood retention facility and Airport Levee Improvements project areas from increased traffic to and from construction sites
- Beneficial impact to forest roads longer-term from widening and repairs

Alternative 1 construction would require truck access and construction staging and may result in periodic road closures. Increased traffic and road closures could cause local low direct impacts to the existing transportation system in the flood retention facility and Airport Levee Improvements project areas. No direct impacts would occur on the regional transportation network in the Chehalis River 100-year floodplain area because construction would not occur in this area.

A large quantity of aggregate would be needed for constructing the FRE facility, although the impacts of transporting these materials would be low. A total of 40,000 to 55,000 truck round trips are assumed to be needed between the quarries and construction site. Over a construction period of approximately 5 years and with construction anticipated to occur 5 days a week, this would equate to 30 to 42 trucks per day. These trips would happen only on forest roads and would not interfere with public roadway traffic. Users of the forest roads, such as recreational users and forestry workers, might experience slight delays. Access to the residences located north of the proposed FRE facility site would not be affected because they are not near the truck routes. Improvements to the forest roads would be made to support construction vehicles and equipment. Construction of these improvements would cause low temporary impacts because sections of the roads may be closed, resulting in vehicle delays. The proposed project would result in a long-term benefit to these roads because they would be widened and repaired.

Construction of the Airport Levee Improvements would have low impacts to transportation, including temporary disruptions on NW Airport Road and adjacent roadways from construction traffic and temporary road closures. Approximately 5,725 truck round trips are assumed to be needed during construction of the Airport Levee Improvements. Over a construction period of approximately 1 year and with construction anticipated to occur 5 days a week, this would equate to 22 trucks per day. Trucks would use NW Airport Road to haul materials to and from the site, and the top of the levee would be used for site access. NW Louisiana Avenue to the south would be the preferred off-site route to avoid the congested traffic area east of the airport. These additional truck trips would result in low impacts to transportation. Temporary access ramps would be installed at road crossings and driveways to provide access during construction. Permanent ramps would be installed in locations where roads are raised, or where levees are constructed adjacent to driveways. A traffic management plan would be implemented during construction of the Airport Levee Improvements to minimize these impacts.

Low impacts to pedestrians and bicyclists would result from construction of the Airport Levee Improvements. These impacts would be caused by temporary closures of sections of NW Airport Road and along the trail at the top of the existing levee. Pedestrian and bike access would still be maintained, but potentially redirected in a few occurrences.

Construction of the Airport Levee Improvements would involve the use of construction equipment and vehicles in the vicinity of the existing runway. The presence of equipment near the runway, in particular in the flight path at the north end of the runway, may be a hazard to aircrafts during takeoff and landing. The Applicant would work closely with the airport to coordinate construction sequencing, resulting in only low impacts.

Construction activities would not have any direct impacts to rail traffic. Train travel and operations would continue during the construction period.

Localized delays along roadways used by project truck traffic would result in a low indirect impact to transportation. Approximately 4,000 to 6,000 truck round trips (three to five trucks per day) are expected to travel to the FRE facility construction site from off site. Trucks traveling to and from the FRE facility and Airport Levee Improvements would travel on local roads. The increase in truck traffic on these roads could easily be accommodated based on local traffic levels, including LOS that are already relatively high in the project area. Existing roadways used as haul roads would be surveyed before and after construction and restored to pre-construction conditions. It was assumed that FRE facility construction would require implementation of a traffic management plan for road use in Pe Ell.

Construction of the Airport Levee Improvements may result in low impacts to airport operations. These impacts would result from increased dust, vehicle and equipment emissions, noise, and visual disturbance to airport employees and pilots using the runway. The Applicant would work closely with the airport to coordinate construction sequencing and impact avoidance.

5.7.3.3.2 Operation

> **Alternative 1 Operational Impacts to Transportation**
>
> - Low indirect impact to roadways in and surrounding the flood retention facility
> - Beneficial longer-term impact to the forest transportation network from road widening and repairs
> - Low indirect impacts from flooding on up to 9.95 miles of FR 1000
> - No impacts from the Airport Levee Improvements
> - Beneficial indirect impacts to the regional transportation network from reduced road closure, delays, and damage during major or greater floods
> - Benefit to transportation because I-5 would no longer flood during a catastrophic flood

Alternative 1 would result in low impacts in the flood retention facility project area and no impacts in the Airport Levee Improvements project area. Alternative 1 would result in beneficial impacts in the Chehalis River 100-year floodplain area. This is because there would be reduced flooding and flood-related road closures and damages.

Alternative 1 operation would result in a low increase in traffic in the flood retention facility project area. This level of increase is expected to result in negligible transportation impacts. When the FRE facility is operating and the temporary reservoir is holding water, approximately 7.57 and 9.95 miles of the existing FR 1000 would be flooded during a major and catastrophic flood, respectively. When FR 1000 is flooded, a bypass route would be used to provide access to the temporary reservoir area and to managed forestlands in areas outside of the temporary reservoir. Vehicles used to access the FRE facility during operation would cause slight increased traffic on SR 6, local roads in Pe Ell, and FR 1000. These impacts would be low.

Operation of the Airport Levee Improvements would include routine maintenance and inspections similar to existing conditions. These activities would not result in any impacts compared to existing conditions.

Alternative 1 would result in a net benefit to the regional transportation network in the Chehalis River 100-year floodplain area. This is because the level of regional flooding would be reduced, and transportation network closures and delays would be reduced. Specifically, modeling showed the locations on I-5 in Table 5.7-4 would have no flooding under Alternative 1 (WSE 2019a, 2019b; Tschetter 2020).

Section 4.1 provides more information on flood damage reduction that would benefit the transportation network. Reduced flood damage would benefit roadways, railways, bike and pedestrian facilities, and the operations of the Chehalis-Centralia Airport. This is because these facilities would remain open during heavy rain that would otherwise result in their closure under existing conditions. Under severe rain, some of these facilities may become temporarily flooded and unusable, but they would not stay flooded as long as they would under existing conditions.

5.7.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

As noted in Chapter 3, the potential impacts associated with operation of Alternative 2 would be the same as for Alternative 1. Therefore, this section focuses on construction of the FRO facility under Alternative 2.

The construction-related direct impacts of Alternative 2 on transportation would be similar to Alternative 1 but would be slightly reduced because of the reduced construction duration of the flood retention facility. Direct impacts would be reduced slightly due to fewer truck trips. It was assumed that 34,000 to 46,750 truck round trips (15% less than Alternative 1) would be required between the quarries and the construction site. A total of 3,400 to 5,100 truck round trips (15% less than Alternative 1) were assumed between the construction site and off-site locations. This would equate to 26 to 36 trucks per day between the quarries and the construction site, and 3 to 4 trucks per day between the construction site and off-site locations. These impacts would be low.

5.8 Public Services and Utilities

5.8.1 Introduction

Public services and utilities include fire and emergency services, police services, schools, hospitals, water, sewer and solid waste, and electricity and gas. These public services and utilities are important to everyday life for residents. Reductions in the quality of service could affect individuals and communities. This section describes the affected environment for public services and utilities and the potential impacts that would result from the alternatives.

> **Key Findings**
>
> **Construction**
> - Low indirect impact from small increases in demand, including wildfire risk
> - Medium direct impact from potential conflicts with the City of Pe Ell's raw water pipeline during FRE facility construction
>
> **Operation**
> - Low indirect impact from small increases in demand
> - Low indirect impact to emergency service providers in the flood retention facility project area during major or greater floods
> - Beneficial indirect impact from reduction in major or greater flooding in the Chehalis River 100-year floodplain area

5.8.2 Affected Environment

The study area includes Lewis, Thurston, and Grays Harbor counties. This is because public services and utilities in these counties would serve the areas potentially affected by the alternatives.

5.8.2.1 Fire and Emergency Services

There are 18 fire districts in Lewis County. The proposed flood retention facility is served primarily by Fire District 11, which includes one station located in Pe Ell (Lewis County 2018). Additional fire service within the study area is provided by city or regional fire departments. The Chehalis Fire Department employs firefighters serving the City of Chehalis, including the Airport Levee Improvements area, and other parts of Lewis County. Fire services in the City of Centralia and surrounding neighborhoods are provided by the Riverside Fire Authority, a combined agency composed of the Centralia Fire Department and Lewis County Fire District 12. The Riverside Fire Authority has eight fire stations (City of Centralia 2018).

Fire protection on state-owned and private forestlands within unincorporated areas of Lewis County is provided by the Washington Department of Natural Resources Wildfire (DNR Wildfire) wildland firefighting department. DNR Wildfire is the state's largest on-call fire department with 1,500 employees protecting 13 million acres of private and state-owned forest lands (DNR 2019). DNR Wildfire typically provides support to local fire districts when fires occur on forestlands.

Emergency medical services throughout Lewis County are provided by 20 fire departments and one private ambulance company located in Centralia. The Pe Ell Fire Department is the closest emergency response service to the proposed flood retention facility, located approximately 2.5 miles away by road.

In addition to the fire control and emergency services described in this section, additional services are provided in the Chehalis River 100-year floodplain area by numerous cities, Thurston and Grays Harbor counties, and the Chehalis Tribe. Grays Harbor County also has an emergency management department responsible for emergency preparedness and response.

5.8.2.2 Police Services

The Lewis County Sheriff's Office provides law enforcement services within the county, including to the flood retention facility area. Lewis County employs 24 law enforcement officers (Lewis County 2019). The Washington State Patrol provides traffic enforcement on state highways and drug enforcement, Hazardous Materials Team oversight, and incident response services.

The Chehalis Police Department serves the Airport Levee Improvements area and employs a force of 18 law enforcement officers (City of Chehalis 2019). The Centralia Police Department employs 30 law enforcement officers, six reserve officers, eight full-time civilians, and three part-time civilians (City of Centralia 2018).

The Chehalis River 100-year floodplain area is also served by the Washington State Patrol, Centralia Police Department, the Chehalis Reservation Police Department, and the sheriff's departments of Grays Harbor, Thurston, and Lewis counties.

5.8.2.3 Schools

There are 13 public school districts in Lewis County. The proposed flood retention facility would be located within the Pe Ell School District, and the Airport Levee Improvements would be within the Chehalis School District. The Pe Ell School District includes one school, and the Chehalis School District includes seven schools (Lewis County 2018). The Centralia School District includes 10 schools (Lewis County 2018; City of Centralia 2018). Centralia College is also located in Centralia (City of Centralia 2018). Numerous additional primary and secondary schools and school districts occur throughout the Chehalis River 100-year floodplain area.

5.8.2.4 Hospitals

Lewis County and the cities of Chehalis and Centralia are served by Providence Centralia Hospital in Centralia. The hospital is located approximately 28 miles northeast of the proposed flood retention facility by road and 4 miles north of the proposed Airport Levee Improvements by road (Figure 2.2-2). The Providence Centralia Hospital is a full-service hospital providing an emergency room and 127 hospital beds (Providence 2019). Several other regional hospitals and clinics include Grays Harbor Community Hospital, Seamar Community Health Centers, and Valley View Health Centers.

5.8.2.5 Water

The *Lewis County Comprehensive Plan* identifies 15 major public and private water utility systems that provide water throughout Lewis County (Lewis County 2018). The four main systems, Pe Ell, Boistfort Valley Water, Chehalis, and Centralia, produce an estimated 1.6 million gallons per year.

The study area is serviced by multiple water districts. Areas of unincorporated Lewis County are served by the Pe Ell water system in the area of Pe Ell, and the Boistfort Valley Water Corporation, which provides drinking water to unincorporated areas of Boistfort, Curtis, Adna, and Claquato. The City of Centralia's water system is operated and maintained by the Centralia Water Department. The Chehalis Water Division is responsible for the procurement, treatment, and distribution of potable water, and operation and maintenance of all city water facilities. Unincorporated areas of Thurston County in the study area are served by Thurston Public Utility District (PUD). The City of Oakville Public Works Department provides water service to its residents. Domestic water supply in rural areas is primarily from individual wells.

The Town of Pe Ell's primary water intake structure is located on Lester Creek, a tributary to Crim Creek which discharges to the Chehalis River just upstream of the proposed flood retention facility (Gray & Osborne 2015). When flows are low in Lester Creek, Pe Ell draws its water from the Chehalis River, but only in limited quantities (FEMA 2008). Additional information about water rights and use are addressed in Section 4.1.

5.8.2.6 Solid Waste and Sewer Services

Solid waste services in Lewis County are provided under contract with LeMay, Inc. (City of Centralia 2018). LeMay operates two transfer stations: one in Centralia and the other just east of Morton. Trash collected in Lewis County is ultimately disposed in Wasco County Landfill in Wasco County, Oregon (Lewis County 2018). Lewis County's *Solid and Hazardous Waste Management Plan* allows for the disposal of small quantities (less than 220 pounds per month) of hazardous wastes at the Hazo Hut, which is part of the Central Transfer Station in Centralia (Lewis County Solid Waste Utility 2008).

The Chehalis Wastewater Division is responsible for the collection and treatment of wastewater from Chehalis, Napavine, Lewis County Sewer District No. 4, and associated service areas. Wastewater is treated to state and federal standards and discharged to the Chehalis River. Services provided by the Chehalis Wastewater Division include wastewater treatment and collection system operation and maintenance (City of Chehalis 2018). The City of Centralia's wastewater treatment plant provides primary and secondary treatment for the city. It is located northwest of the city's UGA boundary and discharges treated wastewater to the Chehalis River (City of Centralia 2018). Lewis County operates six sewer districts outside of incorporated jurisdictions (Lewis County 2018).

The Chehalis River 100-year floodplain area includes several wastewater treatment plants and solid waste facilities. Grays Harbor County manages its sewer plant and solid waste. Thurston County Public Works supplies sewer services for approximately 800 county residents within the study area (Thurston County 2019). In rural communities that are outside of service areas, wastewater treatment is primarily through private septic systems and solid waste disposal is the responsibility of residents.

5.8.2.7 Electricity and Gas

Electricity throughout Lewis County is provided by Lewis County PUD No. 1, except for areas of Centralia and Lewis County covered by Centralia City Light. Lewis County PUD No. 1 serves more than 31,000 customers (Lewis County PUD 2019). Centralia City Light supplies power to approximately 10,000 customers in Centralia and nearby areas. Of these customers, approximately 84% are residential users and 16% are commercial or industrial users.

Within the Chehalis Basin, electrical power is also generated by the Bonneville Power Association, the Cowlitz Falls Hydroelectric Project, the Wynoochee River Project, and the Yelm Project. Transmission and distribution are provided by Grays Harbor County, Lewis County, or local municipalities (City of McCleary or Centralia City Light). There are power plants, overhead and underground transmission and distribution lines, and substations located throughout the study area.

Natural gas is provided throughout Lewis County by Puget Sound Energy, including within the cities of Chehalis and Centralia (Lewis County 2018; City of Chehalis 2017). Natural gas pipelines operated by Puget Sound Energy, Cascade Natural Gas, and Williams Gas serve the region.

5.8.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.8.3.1 Methods

Impacts to public services and utilities were evaluated qualitatively. The analysis considered potential disruptions, access or operational barriers, and increases in demand for public services or utilities from construction and operation of the alternatives.

5.8.3.2 No Action Alternative

> **No Action Alternative Impacts to Public Services and Utilities**
>
> - Low to medium impact to public services and utilities from increased demand and damages from continued flood risk
> - Medium impact from flood related road closures affecting public service response times and utility maintenance

Under the No Action Alternative, low to medium impacts to public services and utilities could occur related to utility damage, interruption of utility and public services, and demand for emergency response from continued risk of floods. The greatest potential for these impacts to occur are in the Chehalis River 100-year floodplain area.

Public services and utilities would remain vulnerable to flooding. Catastrophic flooding would result in increased risks to public health and safety, which would increase the need for fire, police, or other emergency service response. Flooding may also damage utility infrastructure, leading to low impacts from interrupted utility services and service outages. Road closures from flooding would also adversely affect public services and utilities by impeding emergency response, repair, or maintenance access, resulting in medium impacts. The No Action Alternative includes existing and planned floodproofing activities that may address some potential public service and utility impacts.

5.8.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to public services and utilities from construction and operation of Alternative 1.

5.8.3.3.1 Construction

Alternative 1 would result in low to medium direct impacts to public services and utilities from construction. This would be from a low increase in the demand for public services. There would also be a medium impact due to the potential to disrupt the City of Pe Ell's water supply.

Construction activities would result in a low increase in the demand for public services. This would include a low increase in demand for fire emergency response, police services, emergency medical response, water, sewage, waste disposal, and electricity.

> **Alternative 1 Construction Impacts to Public Services and Utilities**
>
> - Low indirect impact from small increases in the demand for fire/emergency response, law enforcement, emergency medical services, electrical supply, sewage management, hazardous waste disposal, and use of water
> - Medium direct impact from potential conflicts with the City of Pe Ell's raw water pipeline during FRE facility construction

It was assumed that the Applicant would employ established BMPs and adhere to existing regulations during construction to reduce the risk of fire and other emergencies. This includes following Occupational Safety and Health Act (OSHA) protocols, maintaining and implementing a spill control and cleanup plan, emergency response plan, and maintaining fire response equipment on site. Blasting supplies would be used and stored in accordance with applicable requirements. In the event of a fire during construction in the FRE facility project area, the Pe Ell Fire Department would provide emergency response services with support from DNR Wildfire, if needed.

Police service may be needed to prevent or respond to theft, vandalism, or trespassing within the construction area. However, the demand would be low because of the site's remote location. It is anticipated that the Lewis County Sheriff's Office would be able to supply enforcement needs, along with the Washington State Patrol for enforcement on state highways.

It was assumed that the Applicant would adhere to established safety procedures (including OSHA regulations), and the risks of injury would be low, as noted in Section 5.9. For that reason, few if any emergency services would be needed during construction. Therefore, construction is not expected to affect the quality of service provided by Providence Centralia Hospital, Boistfort Valley Fire Department EMT response, or other emergency service providers throughout the Chehalis Basin.

Construction would require water for dust control, wetting concrete, road compaction, and other construction purposes. Water would either be provided by connections to the Pe Ell or Boistfort water utility systems, from water trucks obtaining water from their location of origin, or the Chehalis River. As noted in Section 4.1, the overall demand for water to construct the FRE facility is low. The amount needed is relatively small relative to the total water produced by water utility systems in the study area and throughout Lewis County. The overall impact to water supply for neighboring communities would be low. While existing facilities can likely accommodate this demand, downstream water users could have water that they would otherwise use diverted during construction of the FRE facility. This impact is discussed in detail in Section 4.1.

It is anticipated that sewage would be collected in portable toilets during construction of the FRE facility and access roads/quarries. Solid waste generated during construction (e.g., packaging materials) would be collected and stored within the staging areas before disposal or recycling at the appropriate facilities. This would likely occur through the LeMay-operated transfer stations in Centralia or east of Morton, with ultimate trash disposal at Wasco County Landfill. The volume of solid waste generated during construction of the FRE facility and access roads/quarries would be minimal compared to the annual volume of solid waste managed at Wasco County Landfill.

It was assumed that disposal of any hazardous materials used during construction, such as fuels and lubricant oils, would happen in compliance with all applicable regulations. If construction generated hazardous waste in excess of 220 pounds per month, alternative disposal facilities to the Hazo Hut would be identified and used.

The FRE facility would require an electrical supply during construction. Electricity would be provided either with on-site diesel-powered generators, through a distribution line connected to the grid, or a combination of both. Electricity interconnection routes and locations would be coordinated with Lewis County PUD No. 1 if needed. Electricity demand during construction would be minimal and within the existing capacity of Lewis County PUD No. 1. Installation of interconnections may require interruption of electrical service in the vicinity of the FRE facility for a short time. Construction is not anticipated to require any natural gas connections or service.

Utility relocation would be required during construction. Pe Ell's water intake structure on Lester Creek is well above the maximum elevation of the temporary reservoir, and the intake would not need to be relocated (Gray & Osborne 2015). However, the raw water pipeline passes through the proposed location of the FRE facility and would need to be relocated. The pipeline also extends through the footprint of the temporary reservoir and may need to be relocated or modified during construction of the FRE facility. Coordination with utility providers would occur to identify utilities potentially affected and to inform utility customers prior to interruptions, to the extent practicable. For some utilities, relocation outside of the temporary reservoir footprint may be required. Any relocations would occur through a separate entitlement process in adherence with all applicable regulations. Relocation of utilities may result in short-term interruptions in service availability, which would be considered medium impacts.

For public services and utilities provided at the county level, construction of the Airport Levee Improvements would affect the same providers as construction of the FRE project elements. For public services and utilities provided at the city or other local level, construction of the Airport Levee Improvements would affect providers specific to the cities of Chehalis and Centralia. The Applicant would replace any existing utility infrastructure that may be temporarily affected by the proposed project. These activities would be coordinated with existing utility providers to minimize any service disruptions.

5.8.3.3.2 Operation

Alternative 1 would result in a low indirect impact to public services and utilities from increased demand at the FRE facility project area, and no additional impact compared to existing conditions in the Airport Levee Improvements project area. Potential impacts in the Chehalis River 100-year floodplain area would be beneficial, as described in this section.

FRE facility operation would require an electrical supply to be provided through a distribution line interconnection with the grid. This poses an inherent increased risk of fire compared to existing conditions. Facility maintenance would also require use of flammable materials such as lubricants and cleaners, which may pose a fire risk.

Alternative 1 Operational Impacts to Public Services and Utilities

- Low indirect impact to public services and utilities from small increases in the demand for water, electricity, sewer service, and fire emergency responses
- Low indirect impact to emergency service providers in the flood retention facility project area when the FRE facility is holding water
- Beneficial indirect impact to public services and utilities from reduction in major or greater flooding in the Chehalis River 100-year floodplain area

Routine temporary reservoir area vegetation management activities including vegetation thinning would require the use of equipment (e.g., chainsaws, skid steer tree pullers, or chippers) that uses flammable materials, including fuel, lubricants, and cleaners. Adherence to established BMPs and existing regulations would ensure that equipment and activities related to FRE facility operation minimize fire risks and the need for fire response. Lewis County fire departments and emergency response services, as well as DNR Wildfire, would be available to provide response in the unlikely event of an operational fire emergency. Fire response services from surrounding counties and towns would also be available to provide response during catastrophic events.

While the FRE facility is holding water, fire and other emergency response access on roadways within the temporary reservoir area may be restricted. Conversely, flood damage reduction in areas downstream of the FRE facility would improve emergency response access during storm events by reducing roadway flooding and associated closures. These areas include portions of Pe Ell, Chehalis, and Centralia, which are densely populated compared to the FRE facility project area. Traffic impacts are discussed in detail in Section 5.7.

Reduced flooding has the inherent effect of reducing the potential for injury or loss of life within the Chehalis River 100-year floodplain area. This would reduce demand on fire and emergency services and would provide a long-term operational benefit.

Operation would not require additional hospital facilities in Lewis County and would not exceed the capacity of emergency response services.

The FRE facility would require electricity, water supply, and sewage disposal service. The amount of electricity consumed at the FRE facility is expected to be minimal compared to the power available. Power demand would be limited to operating the fish ladder and providing lighting.

Demand on water provided by water utility systems in Lewis County would be minimal. Demand on sewer service would similarly be minimal and limited to meeting the sewage disposal needs of facility personnel. Sewer service would either be provided by the local Lewis County sewer district or via an on-site septic system. Under either scenario, the relatively low operational sewer demands are not expected to exceed the existing sewer district capacity or land needs for an appropriately sized septic system. If needed, a septic system would be built by a Lewis County-licensed installer in accordance with all requirements of the Washington Department of Health and Lewis County. Minimal amounts of solid waste would be generated at the FRE facility, which would be collected on site and transported to a licensed disposal or recycling facility. The FRE facility is anticipated to generate little or no hazardous waste. Any such waste would be disposed of at an appropriate facility.

The airport levee would require occasional inspection and maintenance, which may result in marginal disruptions in fire, emergency, or police services. These maintenance actions would be the same as under existing conditions. Operation would have no effect on schools, electricity, gas, water, sewer, or solid waste services. The Airport Levee Improvements would have no additional impact to public utilities as compared to existing conditions.

In the Chehalis River 100-year floodplain area, Alternative 1 would reduce peak river flows during flooding. This would reduce the demand for emergency services. Emergency service response would also be improved because there would be fewer flood-related road closures. Utility providers, customers, and school workers and students would benefit from reduced road closures after storms. Schools, electricity, gas, water, sewer, or solid waste services would also benefit from reduced interruptions caused by flooding.

Operation of the FRE facility during storms would substantially improve police service response within the existing 100-year floodplain areas downstream of the FRE facility. Less flooding would result in fewer roadway closures that could delay or block police access in Pe Ell, Chehalis, and Centralia. Access and response time in unincorporated county areas by the Lewis and Thurston County Sheriff's Offices would also be improved. Decreased flooding in the Chehalis River 100-year floodplain during storms would also improve access for maintaining and repairing utilities.

5.8.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Construction impacts under Alternative 2 would be slightly lower than Alternative 1 because of the smaller size of the flood retention facility and shorter duration of construction. The operational impacts of Alternative 2 would be the same as for Alternative 1.

5.9 Environmental Health and Safety

5.9.1 Introduction

Environmental health and safety includes both the potential risks to people and the environment from exposure to hazardous materials, and the potential risks to people resulting from dangerous conditions, or physical safety. Hazardous materials may harm people, property, and the environment. Impacts from hazardous materials occur through exposure that can cause direct injury or increase the likelihood of disease or illness. Physical safety is the condition of being protected from danger or injury. Physical safety impacts occur when there is an increase in the potential risk of harm or injury, most often from changes in environmental conditions.

This section describes environmental health and safety impacts that workers and the public may experience as a result of the alternatives. Physical safety impacts related to geologic hazards are addressed in Section 4.2.

Key Findings

Construction

- Medium direct impact from increased risk of exposure to hazardous materials and potentially dangerous conditions
- Low indirect impact from transporting construction materials

Operation

- Low indirect impact from limited use of hazardous materials and heavy equipment needed for operation and maintenance of the FRE facility
- No impact from the Airport Levee Improvements
- Beneficial impact from reduced risk of major or greater flooding in the Chehalis River 100-year floodplain area

5.9.2 Affected Environment

This section describes the existing conditions related to hazardous materials and physical safety in the study area. The study area is defined in Section 3.6. For environmental health and safety, this includes a 0.25-mile buffer to account for any existing contaminated sites that may be present in areas adjacent to construction activities.

5.9.2.1 Hazardous Materials

Exposure to hazardous materials most often occurs when there is an accidental spill or release. Exposure can occur at the same time as the incident or much later, depending on the circumstance. Within the study area, both types of hazardous materials exposure risks exist.

Ongoing timber harvest in the flood retention facility project area and airport operations in the Airport Levee Improvements project area require the handling, storage, and transport of chemicals. Some of these chemicals may be regulated as hazardous materials. As noted in Appendix F, these activities are required to comply with applicable regulations to minimize the risk of incidents and accidental exposure. However, when accidental releases happen, site contamination can also occur. Contaminated sites can harm the environment, animals, and humans by exposing them to hazardous materials.

Contaminated sites within the study area were identified by reviewing federal databases for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (EPA 2019a) and Resource Conservation and Recovery Act (RCRA) sites (EPA 2019b). Within the study area, Ecology manages and oversees the cleanup of contaminated sites under state authority through the Model Toxics Control Act (MTCA). Any MTCA sites that were determined to be cleaned up and for which No Further Action letters have been issued by Ecology were not included.

No CERCLA sites were identified within the study area. No RCRA sites were identified within the flood retention facility construction project area. A total of 15 RCRA sites were identified close to the Airport Levee Improvements project area. None of these sites were subject to cleanup actions, indicating that they were either treatment, storage, or disposal facilities associated with RCRA-listed chemicals. The two RCRA facilities closest to the Airport Levee Improvements project area, Home Depot and Walmart, are located between the airport levee and I-5. Both the Home Depot and Walmart are classified as small-quantity generators.[4]

The presence of MTCA contaminated sites in the study area was determined by reviewing the state of Washington's Cleanup Site Database (Ecology 2019). No state-managed cleanup sites were identified within the flood retention facility construction area. The following two state-managed cleanup projects were identified within and immediately surrounding the Airport Levee Improvements construction area. Both are associated with petroleum contamination:

- Chehalis-Centralia Airport (Cleanup Site ID [CSID] No. 2658)
- Kmart site (CSID No. 2659)

Both sites have been given the lowest-priority rank of 5 by Ecology. This indicates a low likelihood for human and ecological exposures to hazardous materials. Some cleanup action has occurred for both of the sites.

Sites with environmental contamination from hazardous agricultural wastes (e.g., manure lagoons) and residues (e.g., pesticides) could also be present within the study area. These sites are not documented in the federal or state databases. They are most likely to occur in farmlands in the Chehalis River 100-year floodplain area.

5.9.2.2 Physical Safety

Physical safety risks exist throughout the study area. Natural hazards such as flooding, earthquakes, wildfires, poisonous plants, and poisonous or venomous animals exist to varying degrees.
Work, transportation, and routine human activities occur over widespread areas and present risks to the physical safety of workers and the public. Ongoing work activities, including timber harvest in the flood retention facility project area and airport operations in the Airport Levee Improvements project area,

[4] Small-quantity generators are facilities that generate more than 100 kilograms (or about 220 pounds) but less than 1,000 kilograms (or about 2,205 pounds) of hazardous waste per month.

present some risks to physical safety. These activities are subject to compliance with state and federal regulations to promote worker safety, as noted in Appendix F.

5.9.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.9.3.1 Methods

Environmental health and safety impacts were evaluated qualitatively. The analysis considered hazardous materials transported and used for construction of the flood retention facility and the Airport Levee Improvements, as well as the presence of existing contaminated sites. The analysis of impacts to physical safety considered the types of risks that would be expected from large construction projects that use heavy equipment. It was assumed that construction and operation of the alternatives would follow standard environmental health and safety practices. These practices would be the responsibility of the contractors doing the work.

5.9.3.2 No Action Alternative

5.9.3.2.1 Hazardous Materials

The No Action Alternative would result in low to medium impacts from risks of exposure to hazardous materials.

Impacts from ongoing timber harvest would be low in the flood retention facility project area. Impacts from continued airport operations would be the same as the existing conditions in the Airport Levee Improvements project area. Additional development actions could also require the use of hazardous materials. As noted previously, the required implementation of safe handling practices would continue to minimize risks of exposure.

> No Action Alternative Impacts to Environmental Health and Safety
>
> - Low impact from ongoing activities and anticipated growth and development
> - Medium impacts from continued risk of major of greater flooding

Under the No Action Alternative, current flooding conditions in the Chehalis River 100-year floodplain area would also continue, although some future actions may reduce the frequency and severity of floods over time. Ongoing flooding could mobilize contaminants adjacent to the river in the form of agricultural waste storage lagoons or as residues from the application of pesticides, herbicides, and fertilizers. Floods could also mobilize hazardous materials from federal or state cleanup sites within the study area. If hazardous materials did mobilize during a flood, the potential for human and ecological exposures could increase and hazardous materials could migrate to previously uncontaminated areas. Although compliance with safe handling, storage, and transport regulations would be required, the study area has a history of major to catastrophic flooding. In such cases, the risks of hazardous materials exposure would be greater, and impacts are considered to be medium.

5.9.3.2.2 Physical Safety

The No Action Alternative would result in low to medium physical safety impacts. These impacts would be from the continuation of existing risks and low increases related to actions anticipated under the No Action Alternative. The impacts would be similar to those under existing conditions. As noted previously, the required implementation of safe working conditions would continue to minimize these impacts.

The No Action Alternative would also include the continuation of physical safety impacts from major or greater flooding. Historically, floods have led to injury, livestock deaths, and unsafe conditions along the Chehalis River and its tributaries. Ongoing flooding may continue to cause physical safety impacts to workers who are tasked with removing unstable flood debris. Recreational users of waterbodies in the study area would also continue to be at risk of encountering flood debris during periods of high water. Motorists would continue to experience flood-related hazardous driving conditions, including on I-5. These conditions could lead to cars getting stuck in floodwaters, citizens becoming stranded, and a strained emergency medical system. The most severe impacts would happen on average once every 100 years. Therefore, this impact would be medium.

5.9.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to environmental health and safety from construction and operation of Alternative 1.

5.9.3.3.1 Hazardous Materials

Construction

Alternative 1 would result in a medium direct impact from increased risk of exposure to hazardous materials during construction.

> **Alternative 1 Construction Impacts to Hazardous Materials**
>
> - Medium direct impact from increased risk of exposure to hazardous materials
> - Low indirect impact from increased risk of exposure to hazardous materials during transport to construction areas

Hazardous materials used during construction would likely include the use of substances such as equipment fuel, cleaners, lubricating oils, and concrete. Exposure to these substances may harm workers and the environment. Impacts from hazardous materials could include the following:

- Increased risk of human exposures to fuels, oils, solvents, lubricants, pressurized gases, oxygen and acetylene, hydraulic fluid, fly ash, dust, and blasting compounds via dermal contact and ingestion
- Increased risk of human exposures to dust, hydrocarbon emissions, and volatile compounds by inhalation

- Increased risk of human and ecological exposures to hazardous materials because of spills to soils, surface waters, and groundwater

Construction activities could also uncover previously unknown hazardous materials in the Airport Levee Improvements project area. Although two cleanup sites were identified in the study area, both sites have been assigned the lowest level risk by Ecology. In addition, hazardous materials could be present because they are stored at the airport. Because the levee is situated at a higher elevation than where hazardous materials could be present in the area, exposure during construction is unlikely. In the event hazardous materials are uncovered, human and ecological exposures are possible. These impacts would be low because of the low risk of exposure.

Implementation of required BMPs consistent with applicable regulations would avoid or minimize these impacts. However, because FRE facility construction would last up to 5 years, the workers would experience medium impacts.

Alternative 1 would result in low indirect impacts from hazardous materials exposure during construction. This impact could happen if an incident involving hazardous materials took place during travel to or from construction sites. The potential for exposures could be avoided or minimized through implementation of BMPs.

Operation

Alternative 1 would result in a low impact from the increased risk of exposure to hazardous materials during operation in the flood retention facility project area. There would be no impact in the Airport Levee Improvements project area and a beneficial impact in the Chehalis River 100-year floodplain area.

Impacts from hazardous materials during operation of the FRE facility would be similar to, but less than, those that existed during construction. There would be fewer hazardous materials present and less activity that could lead to spills. Operation would require the use of hazardous materials, such as hydraulic fluid and petroleum products. Use of these materials may result in exposure to workers and the environment. Concentrations of hazardous materials and potential duration of exposure would be small and could be avoided or minimized through the implementation of BMPs. If herbicides are used to manage plants surrounding the FRE facility and within the temporary reservoir, there would be potential for human and ecological exposures.

Alternative 1 Operational Impacts to Hazardous Materials

- Low indirect impact from limited use of hazardous materials and heavy equipment needed for operation and maintenance of the FRE facility
- No impact from the Airport Levee Improvements
- Beneficial impact in the Chehalis River 100-year floodplain by reducing the likelihood of hazardous materials transported by floodwaters

Operation of the Airport Levee Improvements would result in no impacts. Impacts from hazardous materials during maintenance of the Airport Levee Improvements would be limited to the use of pesticides and herbicides to control vegetation, similar to what would be expected to occur under existing conditions and the No Action Alternative.

In the Chehalis River 100-year floodplain area, the impacts resulting from exposure to hazardous materials would be reduced compared to existing conditions. This is because peak flood levels would be reduced as the result of Alternative 1. The likelihood of hazardous agricultural wastes and residues, waste from backed up sewers, and hazardous materials washed off of roadways and parking lots being transported by floodwaters would be reduced. The areas where flooding would be reduced are shown in Figure 3.6-1.

5.9.3.3.2 Physical Safety

Construction

Alternative 1 would result in low to medium impacts from increased physical safety risks to workers during construction.

> **Alternative 1 Construction Impacts to Physical Safety**
>
> - Medium direct impact from potentially dangerous conditions present during construction
> - Low indirect impact from increased traffic and risks from transporting construction materials

Construction of the FRE facility would use heavy equipment that could temporarily affect the safety of workers. Increased risks to workers could include the following:

- Use of heavy equipment and vehicles in confined areas with reduced visibility, obstructions, and uneven ground
- Slips, trips, falls, pinches, and impacts
- Blasting of rock and other materials

Construction of the Airport Levee Improvements would also require the use of heavy equipment that may result in temporary safety impacts to workers.

Implementation of required best practices would minimize these risks. This would include a rock blasting plan. The rock blasting plan would include the following measures:

- Safety procedures that minimize the potential for human presence in the blasting area and flyrock zone (the area in which blast-induced rock fall could occur) during the blasting period
- Compliance with codes and permit requirements governing noise levels
- Use of blast curtains and other debris containment practices to control debris produced by blasting activities
- Monitoring of blast activities and limiting of peak particle velocities induced by blasting operations

- Use of water spray or other BMPs to control the dust produced from blasting activities

However, FRE facility construction would last up to 5 years and involve extensive site modification and preparation. Therefore, the risks to workers would be medium.

Alternative 1 would result in low indirect impacts to the physical safety of the public during construction. Impacts outside the construction areas could include collision risks as the result of increased traffic and transporting construction materials. The Applicant would be required to implement a traffic control plan to minimize these impacts.

The potential for indirect impacts resulting from construction of the Airport Levee Improvements would be similar to, but less than those resulting from construction of the FRE facility. Indirect impacts associated with the Airport Levee Improvements would be lower because the complexity and duration of construction would be less.

Operation

Alternative 1 would result in a beneficial impact to physical safety by reducing flooding in the Chehalis River 100-year floodplain. It would also result in a low impact from minor increases in physical safety risks in the flood retention facility project area. Operations would be similar at the Airport Levee Improvements project area and would not result in an increase in risks compared to existing conditions.

> **Alternative 1 Operational Impacts to Physical Safety**
>
> - Low indirect impact from the limited use of heavy equipment at the FRE facility
> - No impact from Airport Levee Improvements
> - Beneficial impact from reduced flooding risk

Beneficial impacts in the Chehalis River 100-year floodplain would happen because Alternative 1 would reduce the frequency, severity, and duration of flooding. This would reduce the potential for flood damage to affect the public, including a reduction in physical damage, injury, or death.

There would be a low impact at the flood retention facility. This would happen when there was a need for worker activity and the potential use of heavy equipment. These two factors would increase safety risks because of accidents that could happen with heavy equipment, and the possibility of slips, trips, falls, and pinches. During the time when the temporary reservoir is impounding water, workers would not be allowed in the temporary reservoir footprint. Safety precautions would be followed to avoid or minimize impacts to physical safety during this time.

5.9.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Similar to Alternative 1, the direct impacts from increased risks of hazardous materials exposure and to physical safety under Alternative 2 would be medium, and the indirect impacts would be low. These impacts would be reduced slightly compared to Alternative 1 because the construction period would be shorter. The operational impacts of Alternative 2 would be the same as Alternative 1.

5.10 Socioeconomics

5.10.1 Introduction

Socioeconomics covers the ways social and economic factors interact with changes in the natural or built environment. This section describes existing socioeconomic conditions and how the alternatives could impact these conditions.

Key Findings

Construction

- Low direct impact to population
- Low to medium direct impact to housing
- Beneficial impact to income, employment, and government revenues
- Medium to high direct and indirect impact to ecosystem services

Operation

- No impact to population or housing
- Beneficial impact to income, employment, and tax revenue, including reduced flood risk
- High impacts to ecosystem services

5.10.2 Affected Environment

The study area for the socioeconomic analysis includes Grays Harbor, Lewis, Pacific, and Thurston counties. The analysis uses this county-level study area because the alternatives could affect socioeconomic factors that are typically measured and reported at the county level.

Socioeconomic factors considered include population, housing, income and employment, government revenue, timber and agricultural production, and ecosystem services.

5.10.2.1 Population

About 445,000 people, or about 6% of Washington's population, live in the study area. Approximately 286,500 of these people live in Thurston County, which includes the state capital, Olympia. In the rest of the study area, most people live in rural areas (U.S. Census Bureau 2020a).[5]

The population of the study area has been growing much more slowly than the state of Washington, except in Thurston County. The population of Grays Harbor County declined slightly between 2010 and 2018, while the populations of Lewis and Pacific Counties grew by about 2%. Over the next 60 years, the population in the study area is expected to grow slowly, except in Thurston County, where the average growth rate is expected to increase at about 1% per year (OFM 2017).

5.10.2.2 Housing

Temporary housing in the study area includes rental housing, hotels and motels, and campgrounds.

Housing in the study area is relatively more available than for the state on average. In 2018, Lewis County had a rental vacancy rate of about 4.7%, and a total housing vacancy rate of about 13%. Statewide, the corresponding rates are 3.7% and 8.6%, respectively (U.S. Census Bureau 2020b).

Hotels and motels in the study area are mostly in the Chehalis-Centralia area and in the Olympia-Tumwater area. There is limited availability of hotels and motels outside of these areas. There are none

[5] The U.S. Census Bureau defines a rural area as any location not in an urban area (an area with a population of at least 2,500 people).

within 20 miles of the proposed flood retention facility and 20 within about 30 miles. Hotels and motels in this region have a 50% to 70% occupancy rate in the winter season and an 80% to 100% occupancy rate in the summer (Marriott 2020; Centralia Square 2020; King Oscar Motel 2020).

There are at least 13 RV parks and campgrounds in a 20-mile radius around Chehalis-Centralia. During summer months, many are full, especially during weekends and holidays. Rainbow Falls State Park is the only campground within 20 miles of the proposed flood retention facility. Other camping options are available near Centralia.

5.10.2.3 Income and Employment

The size of the economy in the study area is measured in two ways: the value of labor, goods, and services, and the number of people employed. Total labor income includes the income from employees and business owners. In 2018, total labor income for the study area was about $12 billion, which was about 3.6% of total labor income in Washington. Total output represents the total economic activity in a region. The total economic output for the study area was about $33 billion in 2018, which was about 3.5% of Washington's total output (Appendix P).

In 2018, about 202,000 people age 16 years and older were employed either full-time or part-time in the study area (BEA 2020a). This represented about 5% of total employment in Washington. Employment in Thurston County (about 129,000 in 2018) represented about 64% of the total employment in the study area. Employment opportunities have increased throughout the study area since 2010, but not evenly. Employment in Lewis and Thurston Counties has grown by almost 12% and 20%, respectively, while employment has grown by just 3% and 9% in Grays Harbor and Pacific Counties (BEA 2020a).

Unemployment rates in the study area had been declining since 2010 when they reached highs caused by the 2008 recession. However, unemployment rates have more recently increased as the result of the COVID-19 pandemic. In 2018, Thurston County's unemployment rate was similar to the statewide average of about 4.5%. Unemployment rates in Pacific, Lewis, and Grays Harbor counties had been consistently higher than the statewide average. As of May 2020, unemployment in the study area ranged from 14.4% to 19.3% (BLS 2020; ESD 2020).

In 2018, four sectors employed over half of workers in the study area: government (23%), health care (11%), retail trade (11%), and accommodation and food service (7%). The construction sector employed about 5% of workers in the study area in 2018. The majority of the construction employment was located in Thurston County. About 20% of total employment in the study area was distributed across a variety of sectors that derive from or depend on natural resources, including farming, forestry and fishing, recreation, and mining (BEA 2020b).

5.10.2.4 Government Revenue

State, county, and local governments rely on a variety of taxes and revenue sources to fund public services and programs. At the state level, the retail sales and use tax is the largest tax revenue source, making up 33% of total revenue collections in 2019 (OFM 2019). The statewide retail sales and use tax rate is 6.5%. Counties in the study area also have a sales tax. At the county level, property tax revenue is the most important tax revenue source. It makes up about 24% of total revenue and 55% of tax revenues collected in 2017 (Washington State Auditor's Office 2020).

A smaller source of tax revenue for the state and counties in Washington is the timber excise tax. Timberland owners pay a 5% excise tax on the value of timber harvested. 80% of the tax collected goes to the county, while 20% goes to the state. Timber excise taxes made up 2.5% of Lewis County's total revenue in 2017, and just 0.1% of state tax revenue in 2019 (Washington State Auditor's Office 2020; OFM 2019; LEAP 2020).

Other taxes potentially relevant to the action alternatives in Washington include lodging taxes, fuel taxes, license taxes, and real estate excise taxes. Washington does not tax personal income.
Local governments levy a lodging tax on transient rentals (less than 30 consecutive days). The state of Washington does not collect revenues from a lodging tax.

5.10.2.5 Timber and Agricultural Production

Timber and agricultural production contribute to the economy of the study area by generating income through the sale of forest and farm products. Lewis County produced the highest volume of timber within the study area in 2017, followed by Grays Harbor County. The majority of timber produced in each county in 2017 came from private land (WDNR 2018). The top crops grown in the study area were forage for livestock (e.g., hay and pasture), followed by Christmas trees and berries. Cattle and chickens were the primary livestock products (USDA 2019). The value of agriculture products sold in the study area in 2017 was about $384 million (USDA 2019).

5.10.2.6 Ecosystem Services

Ecosystem services are the benefits people obtain from ecosystems (Millennium Ecosystem Assessment 2003). While the economic value of ecosystem services can be difficult to measure, a recent ecosystem services study was conducted for the Chehalis Basin (Gustanski et al. 2020). This study estimated the dollar value per acre for each land use in the basin. The ecosystem service benefits were estimated to range from $1.1 to $15.7 billion per year. The ecosystem services that the alternatives are likely to affect include recreation, flood risk reduction, habitat for species, and cultural and spiritual importance. For this EIS, ecosystem services were qualitatively evaluated for each of these resources separately rather than from the land use perspective used by Gustanski et al (2020).

5.10.2.6.1 Recreation

People who live in the study area and from elsewhere participate in land and water-based recreation in the study area. Section 5.5 describes the types of recreation and recreation facilities in the study area that the alternatives would affect.

The Weyerhaeuser land in the study area surrounding the proposed flood retention facility is open to recreation by permit. Permits for the 2019 to 2020 season within the Pe Ell South Permit Area of the Weyerhaeuser property cost $350 per family. In the 2015-2016 permit year, 550 permits were sold for the Pe Ell South Permit Area, which covers about 98,000 acres (Weyerhaeuser 2019).

People also engage in water-based recreation in the study area, including non-motorized boating and fishing. The Chehalis River above Pe Ell is passable for kayaking and whitewater rafting. Field reports suggest that road access from Weyerhaeuser lands to the recommended put-ins for the West Fork to Pe Ell run have not been accessible for at least the last 10 years (American Whitewater 2020). Boating on the Chehalis below Pe Ell is more popular. This stretch of river is known for the Pe Ell River Run from Pe Ell to Rainbow Falls, which people have been participating in annually for over 40 years. The amount people are willing to pay for a non-motorized boating trip, in addition to trip supplies like gas, food, and equipment, is $116 per person per trip (Rosenberger et al. 2017). The value per person per trip for fishing is $73 (Rosenberger et al. 2017).

5.10.2.6.2 Flood Risk and Flooding Damages

In the Chehalis Basin, flooding is common and often results in large costs for communities. Costs may include lost property, expenses to hold back floodwater and repair damage, and people’s time invested in preparation, response, and recovery efforts. As described in Chapter 2, there have been eight substantial floods in the Chehalis River Basin in the past 60 years. These floods disrupted economic activity and resulted in economic costs, including loss of physical property, agricultural crops, and business income in the study area. Floods are also traumatic events that can adversely impact people’s physical and emotional health. Flooding in 1996, 2007, and 2009 caused closures on I-5 and imposed costs on travelers inside and outside the study area. The 2007 flood caused over $900 million in damages in the Chehalis River Basin, which represents a significant proportion of the annual economic activity in the study area (Ruckelshaus Center 2012).

5.10.2.6.3 Habitats and Species

People also value ecosystems because they provide habitat that supports species that they care about. Some people hunt, fish, or gather wild species, and sell them to earn income, share them with friends and family, or enjoy them. Some people enjoy seeing wild species when they are outside, or through their depiction in art or education materials. People also value habitat and species through their importance to cultural and spiritual traditions.

The value of habitats and species depends on how people use or experience them. Species that are relatively rare may have a high value because people or future generations want to have an opportunity to encounter them, or do not want them to go extinct. People typically value species they use for food, medicine, or other purposes more than those that are not useful or are harmful. Some people place a higher value on species that are easy or interesting to observe, are symbolic, or otherwise hold special meaning.

Salmon fisheries provide economic value in the study area. The commercial value of a fish ranges from $5 to $48, depending on the species. The value of a fish caught by a sport fisherman, which reflects both the value of the fish and the experience of fishing, ranges from $32 to $165.

5.10.2.6.4 Cultural and Spiritual Importance

Ecosystems contribute to cultural and spiritual experience. This includes how groups and individuals identify themselves, their sense of place, and spirituality. Ecosystems also serve as a link to past and future generations. The lower Chehalis River was traditionally inhabited by the Hoquiam and Wishkah people. Waters in the study area, including the Chehalis River, were and continue to be used by the Quinault people. Today, the people of the QIN and the Chehalis Tribe maintain a connection with the ecosystem in the study area directly and through its role in sustaining cultural practices and spiritual meaning. Cultural ecosystem services are defined by place, tradition, and continuity of use and practice. This means they are inherently not replaceable with other types of resources or ecosystems elsewhere, and cannot be measured in dollars.

5.10.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.10.3.1 Methods

This socioeconomic analysis looked at the impacts qualitatively and quantitatively. The analysis of impacts to population, housing, government revenue, and ecosystem services was qualitative. The analysis considered available data, current trends, and assessed how the alternatives would cause changes. The analysis of impacts to income and employment was quantitative, using an economic model (IMPLAN 2018) and planning-level estimates of project costs and schedules. More information about the methods, assumptions, and data sources used in this analysis is provided in Appendix P.

5.10.3.2 No Action Alternative

Under the No Action Alternative, socioeconomics in the study area would largely continue as described in Section 5.10.2. Actions anticipated under the No Action Alternative would contribute to low increases in population and housing demand.

There could also likely be some increase in beneficial impacts to employment, income, and government revenues over time related to increased growth compared to existing conditions. Under the No Action Alternative, the land underlying the flood retention facility project area would continue to be used for commercial timber production and recreation. Weyerhaeuser would harvest timber in accordance with their harvest

> **No Action Alternative Impacts to Socioeconomics**
>
> - Low direct impact to population and housing
> - Beneficial impacts to income and employment, and government revenue would continue
> - Low to high impact to ecosystem services from continued flood risk

schedule of 40- to 50-year rotations (CBWG 2014). This timber production would generate timber for local mills and revenue to counties and the state via the timber excise tax. These ongoing harvests would produce total timber excise tax revenue of about $82,000 over the 55-year study period. About $66,000 of this would be distributed to Lewis County during this time. This revenue would represent a beneficial impact.

Local floodproofing efforts are not anticipated to result in substantial decreases in flood risk or economic damage at a basin-wide scale. Damage from major or greater floods would continue, resulting in high socioeconomic impacts. Ecosystem services would also continue to be adversely affected by major or greater flooding and increased growth and development. In some circumstances, habitat restoration actions would improve ecosystem services. However, in general, the ability to derive benefits could decline as ecosystem health is expected to continue to decline.

5.10.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to socioeconomics from construction and operation of Alternative 1.

5.10.3.3.1 Construction

Alternative 1 Construction Impacts to Socioeconomics

- Low direct impacts to population
- Low to medium direct impacts to housing
- Beneficial impact to income
- Beneficial impact to employment by reducing unemployment by 0.6%
- Beneficial impact from increased government revenues
- Medium to high direct and indirect impacts to ecosystem services

Population and Housing

Alternative 1 construction would result in a low direct impact to population because FRE facility construction would increase the demand for construction labor. This could cause some people to relocate to the study area. Approximately 1,910 workers may be employed at the peak of FRE facility construction. Most of these workers would likely come from the study area, but some may move to the study area from elsewhere. At the peak of construction, the local population could temporarily increase by about 478 workers, possibly along with some of their families. This represents 0.6% of the 2018 population of Lewis County and would be a low increase. The Airport Levee Improvements would require 62 workers during the year it would be constructed. It is expected these workers would likely come from the study area and would not affect population.

The increase in temporary workers would result in a low to medium temporary impact to housing. The degree of impact would depend on how many workers needed temporary housing, the type that they chose (e.g., house versus motel), and the time of year that they were renting. Many construction jobs would be short term, but some could extend for months, or possibly years. Depending on the length of their assignment, workers from outside the study area could rent housing (e.g., a house or apartment), or stay in a hotel/motel, RV park, or campground.

If all 478 workers sought rental housing, they would take approximately 34% of the available rental houses in Lewis County. This is a substantial proportion of the Lewis County's available rental housing. This could reduce the rental vacancy rate below its current level of 4.7%. As demand for rental housing increases, rental prices may increase. This could adversely affect anyone looking for housing during construction, but would be a beneficial impact to people with housing to rent.

Some workers from outside the study area would have shorter employment commitments. These workers may rent a hotel or motel room, or park a trailer in an RV park or campground. The closest temporary lodging options to the FRE facility are in the Chehalis-Centralia area.[6] There likely is sufficient short-term lodging to absorb increased demand during the winter season, when occupancy rates range from 50% to 70%. However, increases in demand during the summer season, when occupancy rates typically range from 80% to 100%, could result in limited availability for workers. This could also mean that some people who usually stay in these locations are also less able to do so. This increase in demand could potentially increase prices. The impact in the Chehalis-Centralia area during peak construction could be low to high, depending on the season.

Income and Employment

Alternative 1 would result in low to medium increases in income and employment. This would be a beneficial impact. These increases would happen because of Alternative 1 construction spending. The economic impacts of spending are considered in terms of direct, indirect, and induced effects. Direct effects happen when money is initially spent to pay for workers and materials for Alternative 1 construction. Indirect effects happen when those people or businesses then buy other goods or services. Induced effects happen when people and businesses increase household or business spending as a result of increased income. Alternative 1 would result in all three types of impacts, which are presented in Table 5.10-1 and discussed below.

The total estimated construction cost for Alternative 1 is about $566 million over the 5-year construction period.[7] Most, if not all, of these costs would be spent in the study area. The average annual direct expenditure, or costs to build Alternative 1 equal about 0.3% of the economic activity in the study area in 2018. Construction spending in the study area would be re-spent on additional supplies and services to support construction of Alternative 1. These subsequent rounds of spending are the indirect impacts. As workers and businesses make more money, they tend to spend more and would generate increased economic activity, or induced impacts.

[6] The Rainbow Falls Campground is closer to the FRE facility, but has a 2-week limit on stays so would not likely be an option for most workers.

[7] This includes budget for the FRE facility, the CHTR facility, and the Airport Levee Improvements. The costs have been escalated to adjust for the timing of spending starting in 2025. These estimates do not include additional costs for roads, land acquisitions, permitting costs, additional studies, various other soft costs (e.g., planning, engineering), or other non-construction costs.

Under Alternative 1, construction spending would result in direct, indirect, and induced impacts to labor income and output. It is estimated that Alternative 1 would result in around $502 million in total labor income. Alternative 1 is estimated to result in about $896 million in total output over the 5-year construction period. Appendix P provides a detailed overview of how these estimates were produced.

Table 5.10-1
Economic Impacts from Alternative 1-Related Construction Spending

IMPACT TYPE	LABOR INCOME	OUTPUT
Direct Effects	$379,569,454	$497,231,559
Indirect Effects	$39,430,872	$125,484,686
Induced Effects	$83,414,881	$273,165,811
Total Effect	**$502,415,207**	**$895,882,057**

Note:
Source: ECONorthwest analysis performed using IMPLAN (2018). Detailed assumptions and methodology are included in Appendix P.

Construction of Alternative 1 would also result in a beneficial impact to employment. This is because Alternative 1 would create additional jobs that would reduce unemployment. It would also indirectly result in the creation of additional jobs from the increase in economic activity described above. Alternative 1 would create 1,433 local jobs over the course of construction, potentially resulting in a reduction in unemployment in the study area of up to 0.6%.

Alternative 1 would also result in the creation of additional job-years. A job-year refers to one full or part-time job for 1 year. This would happen as Alternative 1-related spending during construction trickles through the regional economy in the study area. These indirect and induced impacts would support approximately 860 additional job-years. Accounting for the direct jobs described above, the total Alternative 1-supported temporary employment (i.e., during construction) in the study area was estimated to be 2,770 job-years.

Government Revenue

Alternative 1 construction would result in beneficial impacts to government revenue. There would be low increases from the retail sales and use tax, property taxes, and timber excise taxes.

Alternative 1 would generate revenues for state and local jurisdictions that would collect retail sales and use tax on construction spending. The expected revenue would be approximately $3.5 million in Washington (state and counties).

Alternative 1 would result in changes that would alter the property tax structure from existing conditions. The specific impact would depend on whether the Applicant purchases or leases the land and the underlying land use classification. If the Applicant leased the land, Weyerhaeuser would continue to pay property taxes. The specific amount would depend on what the tax assessor determined the correct land use classification would be and there could be a change compared to existing conditions. If the land use was designated as Essential Public Facility, the tax revenue collected may decrease compared to existing conditions. If the Applicant purchased the land, there may no longer be a need to pay property tax, because of the change in land use classification to Essential Public Facility. If the assessed value of the property declines, Lewis County would not collect less revenue from property taxes overall. Instead, revenue would remain constant and the tax obligation would be redistributed across parcels on the tax roll, increasing tax rates and taxes owed by other property owners. This would be a low adverse impact for property owners in the county. No changes in property tax are expected during operation for the Airport Levee Improvements.

Alternative 1 would likely result in a low increase in timber excise tax revenues from the harvest and sale of 408 acres of marketable timber within the footprint of the temporary reservoir. The specific assumptions and analysis are provided in Appendix P. This could yield $278,884 in timber excise tax revenues based on 2025 values. This value is $196,572 higher than the amount estimated to be collected over the study period for the No Action Alternative. This represents about 9% of the value of the timber excise tax collected in Lewis County in 2017 and would be a low contribution to total tax revenues. Alternative 1 would likely have no impact to the price of timber in regional markets, although it may decrease the price at the local level temporarily during construction.

Ecosystem Services

As discussed in Section 5.5, Alternative 1 construction would result in high impacts to recreation in the flood retention project area. This would also be a high impact to this aspect of ecosystem services. Recreational boaters launching from the Chehalis River upstream of the proposed facility would no longer be able to complete a continuous paddle of the West Fork to Pe Ell section of the Chehalis River. It is expected that Alternative 1 would permanently restrict paddlers from using this section of the river.

As noted in Section 4.1, construction of Alternative 1 would result in medium impacts to floodplain functions from the permanent loss of floodplain in the flood retention facility project area. Therefore, this would also be a medium impact to this aspect of ecosystem services.

Impacts to habitats and species arising from construction disturbance are described in Sections 4.5 and 4.6 as low to high, depending on the species and location. These impact levels would generally translate as low to high adverse impacts to the value people derive from interacting with these resources. Impacts to salmonids arise from impairments to habitat and increased risk of mortality. To the extent construction of Alternative 1 would reduce the number of fish, it would produce adverse impacts for people who value fish.

Construction would impact water quality, vegetation, and terrestrial and aquatic habitat. It would also reduce the abundance of aquatic and terrestrial animals. Because cultural services are defined by place, tradition, and continuity of use and practice, alternative resources may not be able to provide the same specific value or services as those that are lost. Therefore, the impacts to these resources could negatively affect the cultural and spiritual values for some people. The Corps will continue to consult with affected tribes regarding potentially impacted resources.

5.10.3.3.2 Operation

> **Alternative 1 Operational Impacts to Socioeconomics**
>
> - No impact to population or housing
> - Beneficial impacts to income, employment, and tax revenue, including reduced downstream flood risk
> - High impact to ecosystem services

Population and Housing

Operation of Alternative 1 would not impact population or housing. Alternative 1 would require three to four additional employees to operate and maintain the FRE facility and no additional employees at the Airport Levee Improvement site. These workers could be hired locally or recruited from outside the region to fill the positions. The total increase in population in the study area would be very small relative to the population of the study area.

Income and Employment

Alternative 1 would result in low to medium increases in income and employment. Operating the FRE facility would cost approximately $603,000 per year plus an additional $25,000 per year for the CHTR facility (2017 dollars; HDR 2018). Maintaining the Airport Levee Improvements would cost approximately $8,000 per year (EES 2016). Escalating the costs to 2030 dollars, the total annual operation expenditures are expected to be approximately $994,676 per year for Alternative 1.

The average annual labor income impact from operations would be approximately $287,734, and total output would be approximately $949,514. This represents a beneficial impact within the study area.

Three to four permanent full-time employees would be hired to operate the flood retention facility. The indirect and induced effect of these jobs would support approximately one to two additional jobs in the study area per year. This would result in a total of six jobs in the study area. These jobs represent a very small increase in employment, relative to total employment in the study area.

Government Revenue

Alternative 1 operation would result in low impacts to government revenue. There would be increases in revenue from the retail sales and use tax. Property taxes could increase, decrease, or stay the same.

Alternative 1 operational spending would generate sales and use tax revenue at the state and local levels. Total annual operation costs would result in a very small increase in tax revenue. This represents a beneficial impact.

Depending on whether the Applicant leases or purchases the land, the impact to property tax revenue could increase, decrease, or stay the same. The reasons for this are discussed in Section 5.1.3.3.1. Regardless, the overall impact would be low.

As noted above, operating the FRE facility would remove timberland from production. Once the initial sale was complete, it was assumed that future harvest and sales would not happen. This would result in a small decrease in timber excise tax revenue.

Ecosystem Services

The following describes the impacts of Alternative 1 operations on ecosystem services. The operational impacts to recreation, flood risk and damages, habitats and species, and cultural and spiritual importance would range from low to high.

Operations would result in a high recreational impact from the closure of up to 6 miles of the Chehalis River in the flood retention facility project area. There would also be medium to high impacts to recreational fisheries. These impacts are discussed in greater detail in Section 5.5. Overall, there would be a high impact to ecosystem services from loss of water access in this part of the study area.

Operation of Alternative 1 would reduce the risk of major or greater floods and the damage associated with them. This would result in beneficial and low to high adverse impacts. The beneficial impacts would happen because people would be more likely to invest in affected communities over time. In addition, agriculture is regularly affected by flooding. Reducing the risk of flood damage would reduce the costs associated with crop and livestock loss. This would increase the financial health of agricultural operations, particularly small operations that tend to be more vulnerable and less likely to withstand recurrent losses.

The adverse impacts to habitats and species during operation would produce adverse socioeconomic impacts. These impacts would result from filling and emptying of the temporary reservoir, harvesting in the temporary reservoir area, and fish passage alterations.

The adverse impacts to cultural and spiritual importance during operation would be similar to the adverse impacts that would arise during construction of Alternative 1. These impacts would happen mainly because of adverse effects on the natural environment. The impacts to this aspect of ecosystem services would be low to high, depending on the specific location and species affected.

5.10.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

Construction of Alternative 2 would require fewer resources and less time than Alternative 1. Alternative 2 is assumed to result in about $298 million in spending on direct construction costs for the FRO facility (HDR 2018; 2017 dollars), compared with about $358 million for Alternative 1. This lower amount of spending would reduce the estimate of income, employment, and retail sales and use tax revenue from construction.

The direct, indirect, and induced labor income is estimated to be around $435 million over the 5-year construction period (dollars escalated to year when spending occurs). The total output from Alternative 2 (direct spending plus indirect and induced effects) would be about $776 million. These values would be 13.4% lower than Alternative 1. Table 5.10-2 summarizes these economic impacts of Alternative 2-related spending in the regional study area.

Table 5.10-3
Economic Impacts from Alternative 2-Related Construction Spending

IMPACT TYPE	LABOR INCOME	OUTPUT
Direct Effect	$328,847,709	$430,786,664
Indirect Effect	$34,161,737	$108,716,208
Induced Effect	$72,268,177	$236,662,751
Total Effect	**$435,277,623**	**$776,165,622**

Note:
Source: ECONorthwest analysis performed using IMPLAN (2018). Detailed assumptions and methodology are included in Appendix P.

Employment during the construction period would also be lower. Alternative 2 would employ at least 1,680 full-time and part-time workers at some point during the construction period (a 12% decrease compared to Alternative 1). Impacts to housing are likely to be similar to those described for Alternative 1. Because sales and use tax revenues are calculated based on construction spending, they would similarly be 13.4% lower under Alternative 2 compared to Alternative 1. Other impacts to government revenue, including timber excise tax and property tax, would be the same as Alternative 1. Impacts to ecosystem services would be the same in Alternative 2 and Alternative 1.

The operational impacts would be the same under Alternative 2 as under Alternative 1.

5.11 Environmental Justice

5.11.1 Introduction

Executive Order 12898 (1994) directs federal agencies to consider environmental justice by identifying and addressing whether its actions would disproportionately affect minority and low-income (environmental justice) populations. This section describes the study area for the environmental justice analysis and identifies existing impacts to environmental justice populations. It then identifies potential impacts of the alternatives that could disproportionately affect these populations. Additional detail is included in Appendix Q.

Key Findings

Construction

- High direct and indirect impacts from high natural resources impacts
- Low direct impacts from increased air and noise emissions

Operation

- High indirect disproportionate impact from natural resource impacts
- Beneficial impact from reducing risk of major or greater flooding

5.11.2 Affected Environment

This section describes the environmental justice populations within the study area. The study area is defined in Section 3.6. For environmental justice, it also includes the census blocks that intersect the study area (Appendix Q).

5.11.2.1 Minority Populations

A block group is considered to contain a "minority population" if 50% of the total population identifies as an ethnic or racial minority, or if the percentage of the minority population is more than 10% higher than the minority population of the county where it is located.[8] This analysis also includes tribal members living outside of the identified census block groups, as described below.

A large majority of the people in Grays Harbor, Lewis, Pacific, and Thurston counties identify as "white alone." Thurston County has the highest proportion of people who identify as a minority, at about 18% of the population. Lewis County has the lowest, with about 9% of people identifying as a minority. In the state of Washington as a whole, about 24% of people identify as a minority. Hispanic/Latino is the predominant minority population in all geographies. Census data are summarized in Appendix Q.

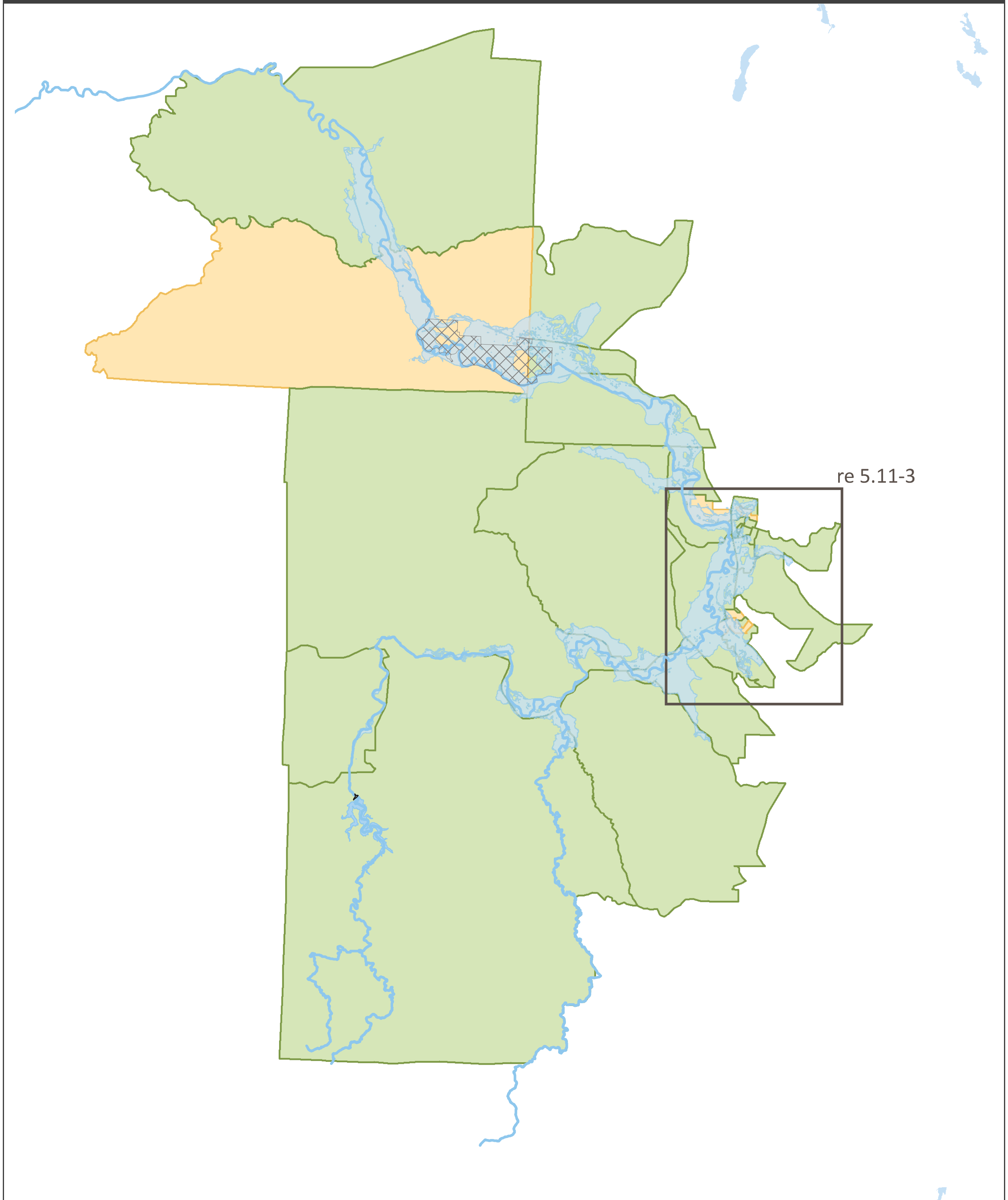
Census block groups within environmental justice populations are shown in Figures 5.11-1 and 5.11-2. No census block groups in the study area have a minority population greater than 50%. Five census block groups have a minority population that is more than 10% higher than the minority population of the county in which it resides. One of these census block groups is in Grays Harbor County and includes portions of the Chehalis Indian Reservation. This census block group has a high proportion of people who identify as American Indian/Alaska Natives. The other four census block groups are in Lewis

[8] These criteria capture both the 50% standard and the meaningfully greater standard outlined in CEQ (1997).

County. None of the five census block groups are within 0.5 mile of the flood retention facility project area. One of the five census block groups is within 0.5 mile of the Airport Levee Improvements project area. The remainder are near the city limits of Centralia and Chehalis.

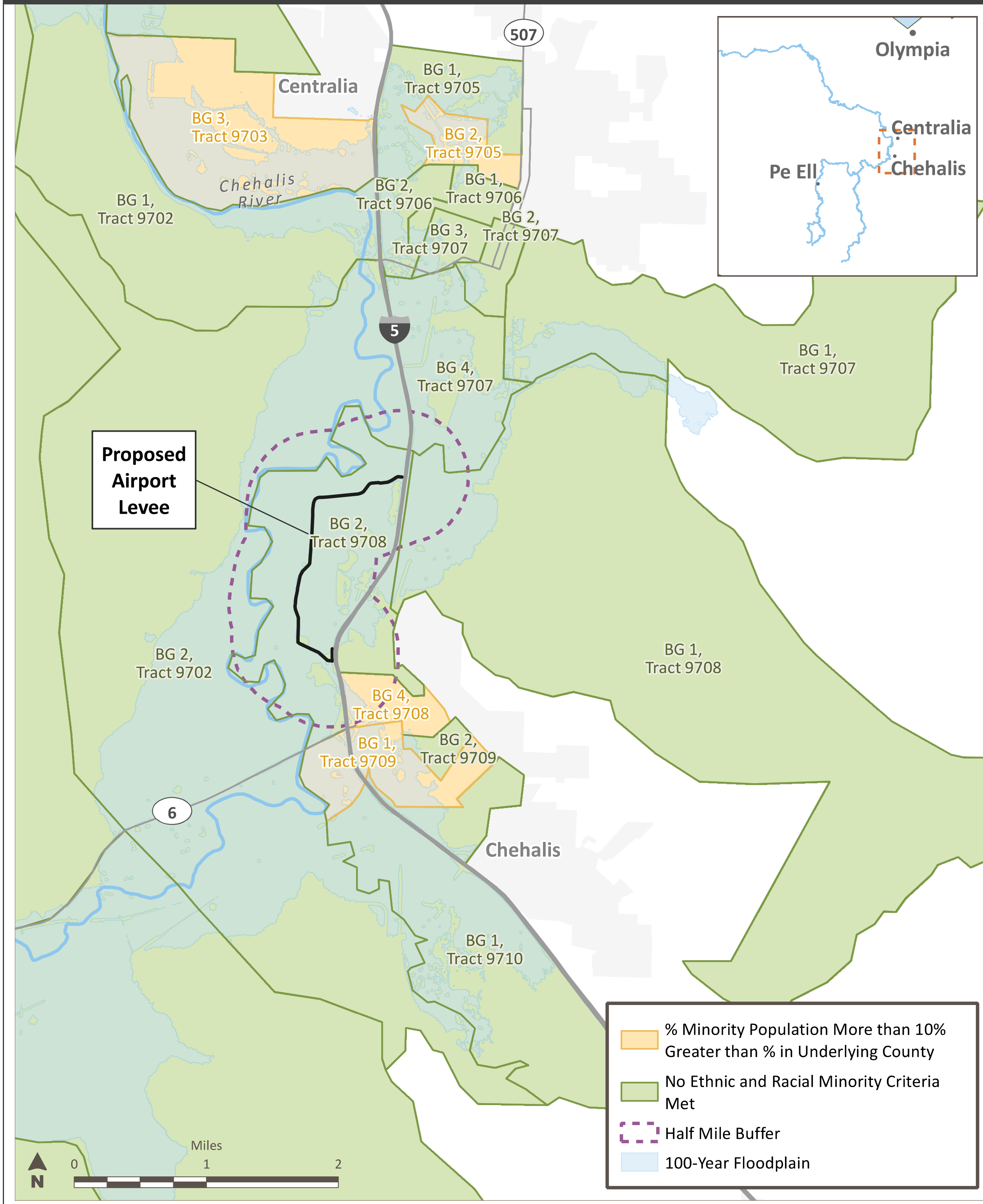
The Chehalis River and other waters in the study area are used by tribes. As noted in Section 5.6, the Chehalis Tribe and QIN have customarily fished, hunted, and harvested in the Chehalis Basin.
The Chehalis Reservation is also located in the census block groups that make up the study area (Appendix Q). Although the QIN's reservation is not within the study area, the QIN's usual and accustomed fishing grounds include the entire Chehalis Basin.

Figure 5.11-1
Relevant Environmental Justice Populations based on Minority Status Criteria



Source: U.S. Census Bureau 2020a, 2020b, 2020d; ECONorthwest analysis

Figure 5.11-2
Relevant Environmental Justice Populations based on Minority Status Criteria (Inset)



Source: U.S. Census Bureau 2020a, 2020b, 2020d; ECONorthwest analysis

5.11.2.2 Low-Income Populations

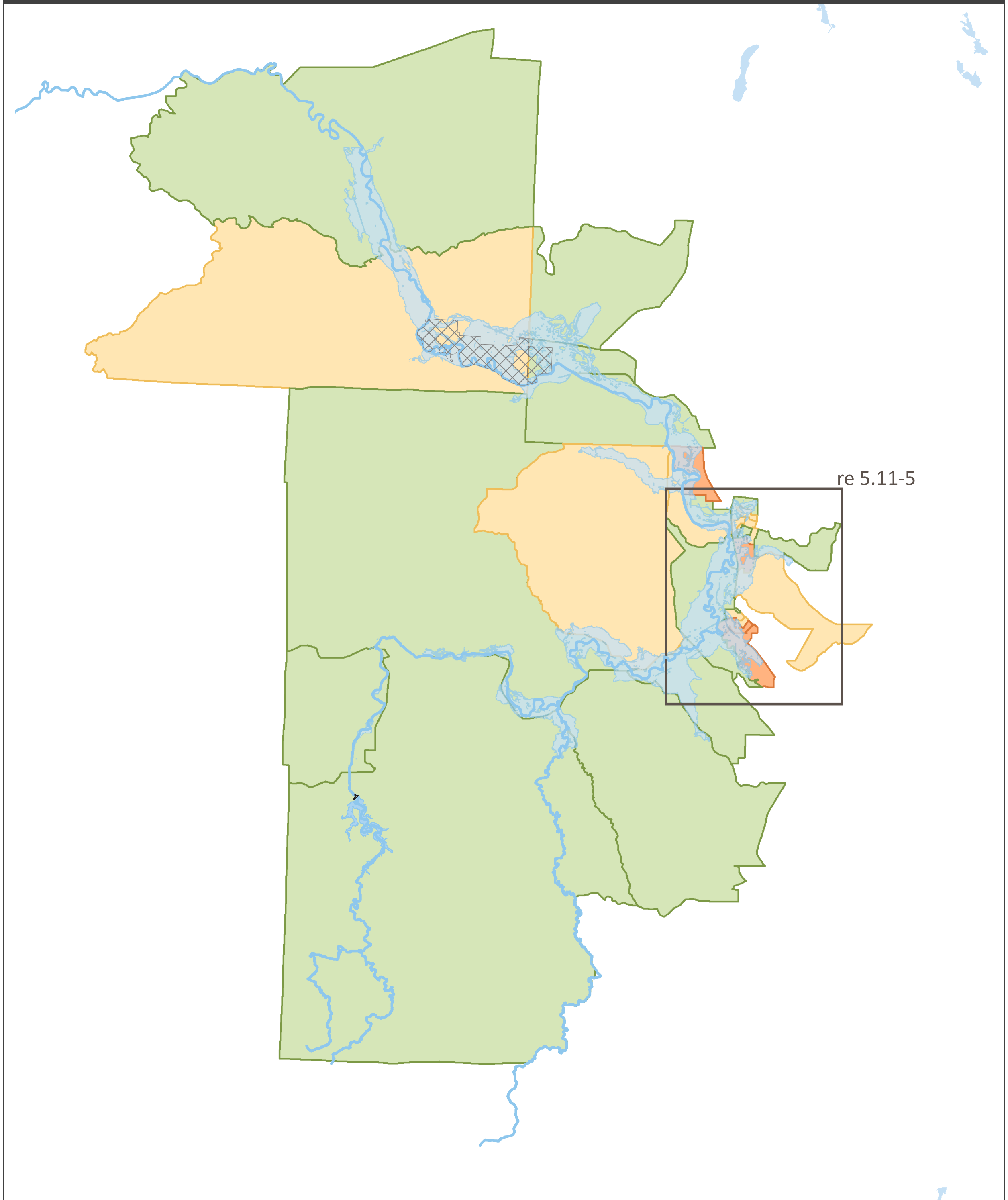
A block group is considered to contain a "low-income population" if 20% or more of the block group population has an income level below the U.S. Census Bureau's poverty threshold.[9] The analysis also identified block groups where the proportion of the population with an income level below the poverty threshold exceeds the county proportion.

The percentage of the population below the U.S. Census poverty threshold in Grays Harbor, Lewis, Pacific, and Thurston counties ranges from 11% in Thurston County to over 17% in Pacific County. For the state of Washington as a whole, 11.5% of the population falls below the U.S. Census poverty threshold. The census data are presented in Appendix Q.

Figure 5.11-3 and Figure 5.11-4 show the locations of low-income block groups. There are four census block groups in which over 20% of the population is below the U.S. Census poverty threshold. All of these block groups are located in Lewis County. There are 11 census block groups in which the proportion of people below the poverty level is greater than that of the county in which they live. Of these combined 15 census block groups, four were also identified as having substantial minority populations. None of the 15 census block groups are within 0.5 mile of the FRE facility project area. Three of the 15 census block groups are within 0.5 mile of the Airport Levee Improvements project area. Of those three, one has a population in which over 20% of the population is below the U.S. Census poverty threshold.

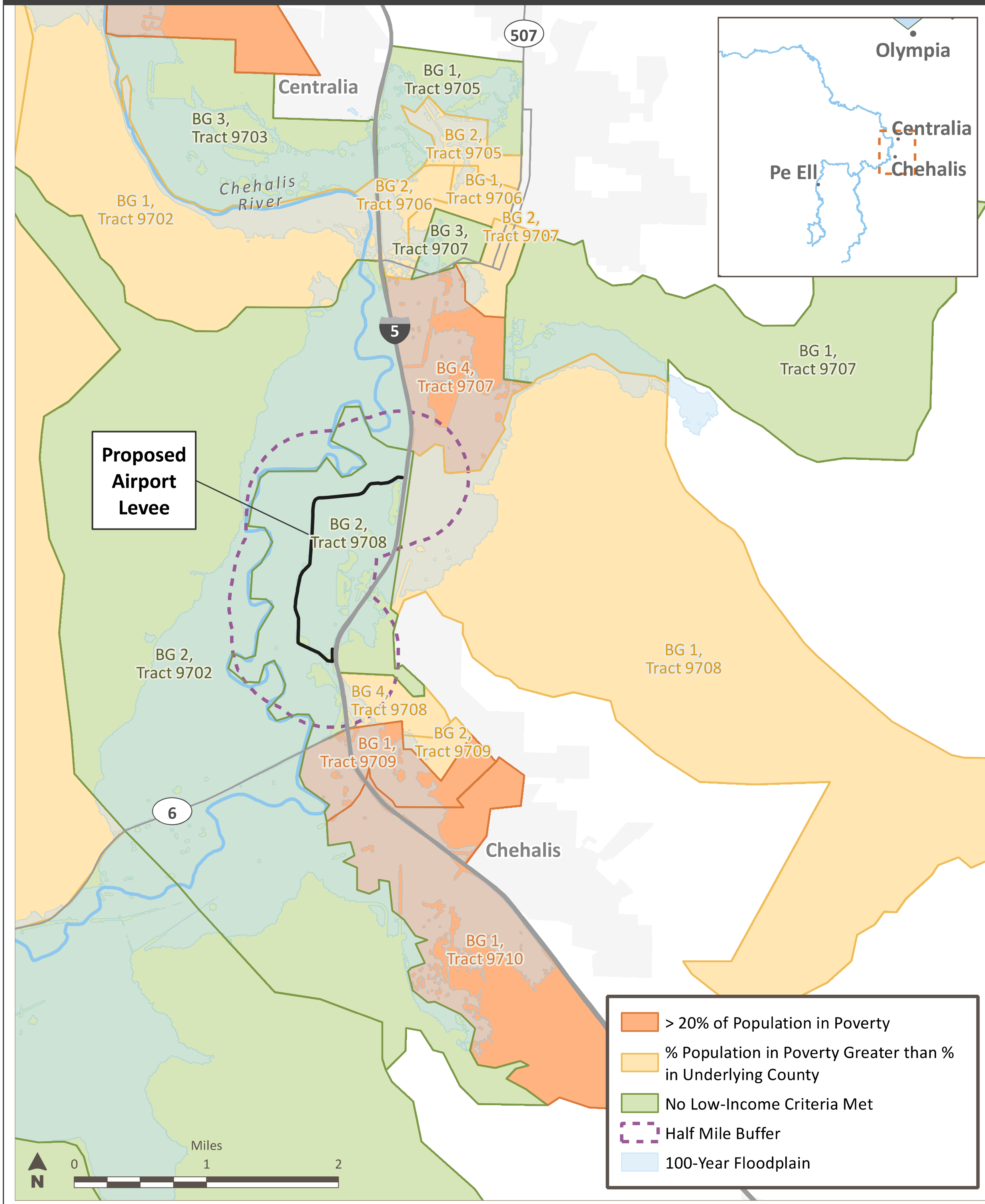
[9] The U.S. Census Bureau's poverty thresholds in 2018 are available at https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html. In 2018, the poverty threshold for a family of four was $25,700 in total annual income.

Figure 5.11-3
Relevant Environmental Justice Population based on Income Status Criteria in the Study Area



Sources: U.S. Census Bureau 2020c; ECONorthwest analysis

Figure 5.11-4
Relevant Environmental Justice Population based on Income Status Criteria in the Study Area (Inset)



Sources: U.S. Census Bureau 2020c; ECONorthwest analysis

5.11.3 Potential Impacts

This section describes the methods and impacts of the No Action Alternative and Alternatives 1 and 2.

5.11.3.1 Methods

This analysis qualitatively evaluated whether the alternatives would disproportionately affect environmental justice populations compared to the general population of the study area. It considered how the alternatives might adversely affect people in the study area and assessed where that subset of impacts would be more severe for environmental justice populations. Impacts may be higher for some groups that are closer to the impact, have unique vulnerabilities or exposure pathways, are less able to participate in decision-making processes, and experience cumulative stressors (FIWGEJ 2016).

The types of impacts considered included those that could affect people's incomes, cultural or spiritual experience, or health and safety. The impacts potentially relevant to environmental justice populations are identified and described in Chapter 4 and the preceding sections of Chapter 5. Specifically, the analysis incorporated impacts related to terrestrial and aquatic species, air quality, noise, earthquake risk, and hydrology. Impacts related to other resources, such as drinking water quality, recreation, and visual quality are unlikely to disproportionately impact environmental justice populations. This is because the impacts do not intersect with an environmental justice population or because the impacts would be negligible for all populations.

5.11.3.2 No Action Alternative

> **No Action Alternative Impacts to Environmental Justice**
>
> - Medium to high impact from continued declines in aquatic and terrestrial species important to environmental justice populations, including tribes
> - High impacts from continued risk of major or greater flooding

As noted in Sections 4.5 and 4.6, the No Action Alternative could benefit aquatic and terrestrial habitats and species in some cases. However, many species, like salmon, are still expected to decline over the analysis period. Changes in the availability and productivity of aquatic and terrestrial species would adversely impact people in the study area. This is especially true for people that may depend on them for food, medicine, fiber, economic livelihood, and the definition, experience, and transmission of cultural and spiritual values. Because of the potential for medium to high impacts to these resources, there is a potential for medium to high impact to environmental justice populations that may rely on them.

Under the No Action Alternative, damaging floods would continue to occur throughout the Chehalis Basin. These floods would continue to result in high disproportionate impacts to the environmental justice populations that live within the Chehalis River 100-year floodplain area. Studies have found that socially vulnerable populations are often more exposed to flood damage and less equipped to recover from it (Emrich et al. 2019; Walker and Burningham 2011). The costs imposed by preparing for and recovering from floods may further disadvantage environmental justice populations. Environmental justice populations that would be most adversely impacted by the No Action Alternative are those residing within the Chehalis River 100-year floodplain, and potentially those who are employed by businesses within the floodplain. Prevailing negative trends in the health of terrestrial and aquatic habitat and species would also have the potential to fall disproportionately on environmental justice populations, particularly tribes.

5.11.3.3 Alternative 1 (Proposed Project): Flood Retention Expandable (FRE) Facility and Airport Levee Improvements

This section describes the potential impacts to environmental justice populations from construction and operation of Alternative 1.

5.11.3.3.1 Construction

Alternative 1 would result in high impacts to aquatic species and habitat, including spring-run Chinook salmon, fall-run Chinook salmon, coho salmon, steelhead, lamprey, and other native fish species. Impacts are expected to be largest for spring-run Chinook salmon. High disturbance to terrestrial plant and animal species is also expected to occur during the construction of the FRE facility.

> **Alternative 1 Construction Impacts to Environmental Justice**
>
> **Construction**
>
> - High direct and indirect impacts from a reduced ability to derive culturally and spiritually meaningful enjoyment in the study area
> - Low direct impact from increased air and noise emissions

Changes in the availability and productivity of aquatic and terrestrial species would adversely impact people in the study area. Some people may depend on these resources for food, medicine, fiber, economic livelihood, and the definition, experience, and transmission of cultural and spiritual values. The Chehalis and Quinault people, in particular, have depended on these resources since time immemorial and would be disproportionately adversely impacted by their diminished availability and productivity. These impacts would happen as the result of construction and continue over the long-term during operation.

Alternative 1 has a low potential to result in disproportionate impacts to human health. This is because construction of the FRE facility and Airport Levee Improvements is expected to have low temporary impacts to air quality from emissions and fugitive dust and odors. Although levels are expected to remain below federal air quality impact emissions levels, any increase in exposure to these pollutants may adversely affect sensitive and vulnerable populations. Both low-income and minority environmental justice populations are within 0.5 mile of the Airport Levee Improvements. Impacts of construction on these populations would be low. The low air quality impacts that could arise from constructing the FRE facility likely pose a negligible risk to environmental justice populations because there are no relevant populations within 0.5 mile of the facility. Impacts related to noise may also pose low temporary adverse effects on environmental justice populations during construction of the Airport Levee Improvements. Noise impacts related to constructing the FRE facility are not likely to affect environmental justice populations because they are not present in the area.

5.11.3.3.2 Operation

> **Alternative 1 Operational Impacts to Environmental Justice**
>
> - High indirect disproportionate impact from natural resource impacts
> - Beneficial impact from reducing risk of major or greater flooding

As noted above, the adverse impacts to aquatic and terrestrial habitats and species would begin with construction and continue over the course of operation. As discussed in Section 4.5, this includes high adverse impacts to fish, including native salmon, trout, and lamprey. Section 4.6 describes the potential for high adverse impacts to terrestrial plants and animals. Changes in the availability and productivity of aquatic and terrestrial species would adversely impact people in the study area that may depend on them.

Air quality and noise impacts from operation of the FRE facility likely pose a negligible risk to environmental justice populations because there are no relevant populations within 0.5 mile of the facility. Adverse impacts from operation of the Airport Levee Improvements would be negligible, and there would be no change compared to the existing conditions.

Operating the FRE facility and the Airport Levee Improvements would reduce the frequency and extent of flooding downstream. Reducing flooding costs and disruption would potentially have a greater benefit for environmental justice communities than for the general population because of their limited capacity to respond to disruptions and absorb increased costs (Emrich et al 2019). This would be a long-term beneficial impact.

5.11.3.4 Alternative 2: Flood Retention Only (FRO) Facility and Airport Levee Improvements

The potential impacts of Alternative 2 on environmental justice populations would be the same as Alternative 1.

6 CUMULATIVE IMPACTS

6.1 Introduction

Cumulative impacts are caused by the incremental impact of the alternatives when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant actions, which take place over time (40 CFR 1508.7).

This chapter describes the regulatory setting and methods used to analyze cumulative impacts. It also identifies the past, present, and reasonably foreseeable future actions considered in the evaluation. Finally, it assesses the proposed project's contribution to the cumulative impacts. The cumulative impacts analysis helps decision makers understand the full range of consequences of a proposed project.

6.2 Methods

This cumulative impacts analysis was prepared in accordance with NEPA (32 CFR 651.16, 40 CFR 1508.07) and the Corps' NEPA Environmental Regulations (33 CFR 230). Guidance developed by CEQ in *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997) was also considered.

As discussed in Chapters 4 and 5, Alternative 1 would result in greater construction impacts than Alternative 2. The operational impacts for the alternatives would be the same. Therefore, this chapter focuses on the incremental contribution of Alternative 1 to cumulative impacts.

Based on CEQ guidance, the following approach was used to evaluate the cumulative impacts of the proposed project on all resources:

- Determine the cumulative impacts study area for each environmental resource. The study area used to evaluate cumulative impacts for each resource is the same as was used in Chapters 4 and 5 of this EIS.
- Assess the existing condition of each resource as it has been affected by past actions. This is based on information provided in the corresponding Affected Environment sections of Chapters 4 and 5.
- Describe the cumulative impacts of all past, present, and reasonably foreseeable future actions on each resource in the study area. This focuses on the actions listed in Table 6.4-1.
- Assess how Alternative 1 would contribute to cumulative impacts.

6.3 Past Actions

This section describes past and present actions that have affected each resource in the Affected Environment sections, as described in Chapters 4 and 5.

Various activities over the past 150 years have shaped the landscape of the Chehalis Basin. These activities include urbanization, agriculture, ranching, logging, gravel mining, industrial waste disposal, dredging and filling, and removal of large wood from rivers. They also include installation of dams, levees, and diversions. Agriculture and ranching activities have modified aquatic habitat. This has happened through the removal of river side channels, sloughs, and ponds. These activities also resulted in straightening small streams and removing riparian vegetation and removing snags and logjams. In the 1880s, logging became a major industry in the Chehalis Basin, including the use of splash dams. These activities caused damage to aquatic species and habitats and a loss of riparian vegetation. Aquatic habitat function was also impacted from increased erosion and stream temperature, resulting in a reduction in water quality.

Rivers and streams in the Chehalis Basin have a long history of human disturbance. In the early 1900s, instream gravel mining in the Chehalis River and its tributaries was largely unregulated. While permits became required for instream gravel mining in 1945, the resulting damage to habitat continued until the 1970s. At that point, portions of the watershed were either closed to gravel mining or allowable mining activities were modified to a sustainable level. Significant quantities of dredged materials were placed in wetlands and tidelands. These materials were from extensive dredging in Grays Harbor and the estuarine portion of the Chehalis River in the early 1900s. Removal of dredged materials from the estuary resulted in degradation and loss of rearing habitats for aquatic and semi-aquatic species. Beginning in the 1920s, pulp production had a negative effect on the water quality of Grays Harbor. This resulted in low dissolved oxygen, high temperatures, and the presence of toxins. In the early 1970s, two dams were built in the Chehalis Basin: one on the Wynoochee River and the other on the Skookumchuck River. Currently, the Skookumchuck Dam has no fish passage facilities. The Wynoochee Dam allows for passage of adult and juvenile salmonids.

Large floods occur regularly in the Chehalis Basin, causing major damage to the human environment. Damages include loss of property, adverse effects on public health and safety, and major disruptions and damage to transportation systems. There have been multiple temporary closures of I-5. The three most recent floods, in 1996, 2007, and 2009, were the largest on record. Much of the flood damage occurred in the cities of Chehalis and Centralia, where there is more intensive development in the floodplain.

6.4 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions include specific projects and actions that are likely to occur in the study area during the analysis period. These include projects that are funded and permitted at the time this EIS is being prepared. It also includes projects identified for future implementation by several tribal and local government planning documents. Future actions that could contribute to cumulative impacts with the project alternatives were evaluated. The locations of these actions are described in Table 2.1-1 of Appendix D.

6.5 Cumulative Impacts by Resource Area

This section describes the cumulative impacts for each resource area. The study area for each resource is the same as described in Chapters 4 and 5.

6.5.1 Water Quantity and Quality

Periodic flooding has and continues to shape the Chehalis River and its floodplain. River flows are greatly influenced by rainfall patterns. Higher flows generally happen in the winter and lower flows in the summer. Timber harvest in the upper part of the Chehalis Basin has adversely affected water quality over time, mainly due to increased erosion and temperatures. Land use development has also altered the floodplain, increased surface and groundwater use, and adversely affected water quality. Water rights in the Chehalis Basin are highly uncertain. In past years, water use has been curtailed to ensure there is sufficient water for more senior water rights.

Adverse water quality impacts in the flood retention facility project area would be reduced through implementation of the Washington Forest Practices Rules. Continued development actions, such as the projects in the 2020-2023 Regional Transportation Improvement Program, would affect water quantity and quality by increasing impervious surface area and stormwater runoff. Some stormwater treatment would likely be required to minimize these effects. Development actions would also make existing water quality problems worse in certain segments of the Chehalis River. Some of the reasonably foreseeable future actions, such as the ASRP and CFAR Program, would result in long-term benefits. These benefits would be linked to reduced flooding and peak flows, and improved water quality.

As discussed in Section 4.1, Alternative 1 would result in temporary and permanent impacts to water resources in the flood retention facility project area. These impacts would contribute to a cumulative impact. Some of these impacts would extend to the Chehalis River 100-year floodplain study area. Temporary impacts during construction include changes to river flows, adverse water quality impacts, and some river water use for construction. The main permanent impacts include reduced river flows during major or greater floods and increases in temperature. The contributions from Alternative 1 to cumulative impacts to surface waters and floodplains would be substantial to RM 33. The contributions to cumulative impacts to water quality from temperature increases would be substantial to RM 100. Because Alternative 1 would not result in notable changes to groundwater or water use and rights over the long term, there would be no cumulatively substantial impact to these water resources.

The Airport Levee Improvements would not result in substantial changes to water resources. Therefore, these activities would not contribute to cumulative impacts to water quality or water quantity.

6.5.2 Geology and Geologic Hazards

In the flood retention facility project area, timber harvest has and continues to impact geologic resources. This is mainly from increasing the potential for erosion and landslides. In the Airport Levee Improvements project area and Chehalis River 100-year floodplain study area, agriculture and other land use development have adversely affected soil quality and quantity. These activities have resulted in the movement of soils from one area to another and decreases in soil quality.

Continued timber harvest in managed forests would remove large quantities of trees. Implementation of best practices through the Washington Forest Practices Rules would improve soil conditions over time by reducing erosion and risks associated with slope instability. Continued growth and development in the Chehalis River 100-year floodplain would continue to result in the adverse impacts described above.

Section 4.2 discusses how Alternative 1 would result in temporary and permanent impacts to geology and geologic hazards in the flood retention facility project area. There would also be an impact from the exposure of people in the Chehalis River 100-year floodplain study area to geologic hazards if the FRE facility failed. These impacts would contribute to cumulative impacts. Temporary impacts would mainly happen because of increased erosion potential in areas disturbed by construction. The main permanent impacts include continued erosion potential, increased risk of landslides, and resource extraction from quarry development and use. The flood retention facility would contribute to cumulatively substantial impacts to geology or geologic hazards in this part of the study area.

Construction of the Airport Levee Improvements may affect soil erosion, although these impacts would be localized and short term. Conditions during operation of the Airport Levee Improvements would be the same as the existing conditions. Because of the lack of a measurable impact, the Airport Levee Improvements would not contribute to cumulative impacts to geology or geologic hazards.

6.5.3 Geomorphology

The Chehalis River has been shaped over time by complex geomorphologic processes. Some processes have been altered by human intervention. For example, in some cases, development activities have affected the river by controlling flows and stabilizing some riverbanks that typically erode. Human intervention has often focused on limiting flooding or bank sloughing that causes damage or safety concerns. Over time, these activities have changed how the river has formed. In some cases, these past and present actions have adversely affected the quantity and quality of aquatic habitat in parts of the river. Cumulative impacts to aquatic species and habitat are discussed in Section 6.5.5.

Reasonably foreseeable future actions would further increase sediment loading, alter sediment transport, decrease LWM input, and alter channel movement. None of these actions are at the scale that would substantially alter geomorphic processes in the river within the analysis period. Instead, it is expected that these activities would result in localized impacts.

As discussed in Section 4.3, Alternative 1 would alter geomorphic processes that would affect the Chehalis River from the flood retention facility project area to the Chehalis River 100-year floodplain study area. These impacts would contribute to cumulative impacts. This would include reducing peak flows from major or greater flooding, increasing sediment loading above the FRE facility and decreasing it below, and altering sediment transport. Alternative 1 would also result in a decrease in LWM in the river and generally reduce channel movement. When considered in combination with the reasonably foreseeable future actions, Alternative 1 would contribute to cumulatively substantial impacts to geomorphological processes.

6.5.4 Wetlands and Other Waters

Loss of wetlands and waters has happened in the flood retention facility project area mainly as the result of timber harvest activities. In the Airport Levee Improvement project area and Chehalis River 100-year floodplain study area, agriculture and land use development have been the main factors in these declines.

Reasonably foreseeable future actions, like ASRP, would improve wetlands and waters. All actions that could affect wetlands and waters of the United States would be required to avoid, minimize, and mitigate for adverse impacts as part of the permitting process. However, when considered together, these actions would likely result in further declines in the quantity and quality of wetlands and waters overall.

Based on preliminary project plans and impact analysis, the FRE facility and associated features, such as staging areas and access roads, would result in approximately 5.44 acres of impact to the Chehalis River and other streams, and 1.23 acres of wetland impacts (Section 4.4). Tree removal in the footprint of the temporary reservoir would impact approximately 6.39 acres of wetlands and 93.65 acres of other waters. The Airport Levee Improvements would impact approximately 4.54 acres of wetlands and no other waters. These impacts would contribute to cumulative impacts. The Applicant would be required to mitigate for impacts to wetland and waters to ensure there was no net loss. Therefore, Alternative 1 would not contribute to cumulatively substantial impacts to wetlands.

6.5.5 Aquatic Species and Habitats

The quantity and quality of aquatic species and habitats in the study area have declined over time. Anadromous salmon and lamprey populations are particularly vulnerable. The current state of aquatic resources has been affected mainly by land use and development. Current issues of concern include habitat degradation, loss of important spawning and rearing habitat, and blocked fish passage. These activities have converted aquatic habitat to other uses and degraded quality.

Some reasonably foreseeable future actions would improve conditions for aquatic species and habitat. This includes the WSDOT culvert replacement program. Others would result in increased development that would put additional pressure on sensitive species and important aquatic habitat. When considered in combination, it is expected that the quantity and quality of aquatic species in the study area would continue to decline.

As discussed in Section 4.5, Alternative 1 would adversely affect aquatic species and habitat in the flood retention facility project area and Chehalis River 100-year floodplain study area. These impacts would contribute to cumulative impacts. The highest impacts would be on anadromous salmonids and lamprey in these areas. This is because the number of fish in these areas is already low and/or they rely on important habitat that would be blocked or degraded by Alternative 1. The impacts to these fish would not be notable outside the study area, with the exception of spring-run Chinook salmon. Based on modeling, the adverse impacts to this species would be cumulatively substantial.

Alternative 1 would result in the permanent loss of 2.05 acres of EFH and WDFW Priority Habitat in the flood retention facility project area. It would also result in long-term adverse impacts from increased water temperature and reductions in fish passage. There would also be changes to the river bottom that would impact spawning and rearing. When the FRE facility was operating, there would be additional habitat losses in the footprint of the temporary reservoir totaling approximately 94 acres. These impacts would also impact other native fish, freshwater mussels, and aquatic plants. These impacts would contribute to cumulative impacts. Because the future status of aquatic resources in the study area is expected to worsen, impacts from Alternative 1 would contribute to cumulatively substantial adverse impacts to aquatic species and habitats.

6.5.6 Terrestrial Species and Habitats

The quantity and quality of terrestrial species and habitats in the study area have declined over time. In the flood retention facility project area, this is mainly because of past and ongoing timber harvest. These activities have resulted in the loss of old-growth forest that provided important habitat for sensitive species. In the Airport Levee Improvement project area and Chehalis River 100-year floodplain study area, terrestrial resources have mainly been affected by land use development. These actions have led to the loss and degradation of habitat for many native species.

Some reasonably foreseeable future actions would improve conditions for terrestrial species and habitat. Others, like continued timber harvest and land use development would put additional pressure on sensitive species and important terrestrial habitat. When considered in combination, it is expected that the quantity and quality of terrestrial species in the study area would continue to decline.

Alternative 1 would result in permanent impacts to terrestrial species and habitat in the flood retention facility project area. These impacts would contribute to cumulative impacts. There is not expected to be a contribution to cumulative impacts in the Airport Levee Improvements project area or Chehalis River 100-year floodplain study area. Timber harvest would be expected to continue to proceed in compliance with requirements to appropriately minimize impacts to terrestrial species and habitat. Because of the severity of impacts to terrestrial species and habitats resulting from the construction of the flood retention facility, Alternative 1 construction would contribute to cumulatively substantial impacts to terrestrial species and habitat.

6.5.7 Air Quality

The study area is in attainment for all criteria pollutants. Reasonably foreseeable future actions would increase the emission of criteria pollutants over the course of the analysis period. Increased emissions of criteria pollutants in the study area would occur mainly as the result of increased growth and traffic. There could also be intermittent, localized sources of air emissions from construction-related activities.

As discussed in Section 5.1, the analysis of air quality impacts considered whether the anticipated emissions from Alternative 1 would exceed de minimis thresholds for criteria pollutants. Because they do not, Alternative 1 would not contribute to a regional air quality impact. Therefore, the low emissions from Alternative 1 are not expected to contribute to cumulative impacts.

6.5.8 Visual Quality

Existing views in the flood retention facility project area are relatively high quality. They are mainly of the natural landscape, including the Chehalis River and rolling forested hills. Over time, the visual quality in this part of the study area was altered by commercial forest activities. Views of the Airport Levee Improvements project area are of relatively lower quality. This is because of development over time, including the Chehalis-Centralia Airport. Although there are some open views of the river valley, natural views are mixed with different built features. This includes the Chehalis-Centralia Airport, Riverside Golf Club, residences, agriculture, and related infrastructure.

Some of the reasonably foreseeable future actions would affect visual quality in the study area over the course of the analysis period. Ongoing timber harvest in the flood retention facility project area would adversely affect visual quality by creating large areas where trees were removed. These areas would detract from the overall visual quality as viewed by a small number of recreationalists granted permits to access Weyerhaeuser property. The Chehalis-Centralia Airport Property Master Plan includes continued development of the airport and commercial properties. Continued development in this part of the study area would intensify the urban feel of views in this area. The I-5/Chamber Way Interchange Improvements project would change the existing views of I-5 from the study area. The changes would entail adding more lanes and modifying the configuration of the existing interchange.

As discussed in Section 5.2, Alternative 1 would affect visual quality in the study area because the permanent FRE facility and temporary reservoir would be constructed in the flood retention facility project area. These impacts would contribute to cumulative impacts. In combination with continued timber harvest, the permanent FRE facility and temporary reservoir could become even more visible to recreationalists from ridgelines within this part of the study area. This is because tree harvest could remove trees that would otherwise screen these features from view. However, the number of people who are likely to see these changes is small. Therefore, Alternative 1 would not contribute to a cumulatively substantial impact to visual quality in the flood retention facility project area.

In the Airport Levee Improvements project area, visual quality is currently marginal. Alternative 1 would raise the levee to a higher elevation than the existing condition. Construction of Alternative 1 would temporarily impact visual quality. However, the levee is not readily visible from nearby points of interest, and points of interest are not largely visible from the levee. There could be a higher impact if construction of other reasonably foreseeable future actions were to occur at the same time. These impacts would contribute to cumulative impacts. Once Alternative 1 construction is complete, the levee would be higher in some places. As noted in Section 5.2, this would likely be a beneficial visual impact. It could serve to screen views of increased development from the Riverside Golf Club and nearby residences. Therefore, the Airport Levee Improvements, in combination with other past, present, and reasonably foreseeable future actions, would not contribute to a cumulatively substantial impact.

6.5.9 Noise and Vibration

Noise and vibration in the flood retention facility project area has been influenced by timber harvesting over time. Otherwise, that part of the study area is not developed, and sources of noise are from the natural environment. The Airport Levee Improvements project area has been developed over time and is now urbanized. As a result, there are relatively high ambient noise levels from airport operations, traffic, and commercial property use.

Reasonably foreseeable future actions that may impact noise and vibration in the flood retention facility project area include ongoing timber harvest. The nearest residence is located about 0.6 mile away, so residents may only occasionally notice the noise of timber operations. In the Airport Levee Improvements project area, implementation of the Airport Property Master Plan and I-5/Chamber Way Interchange Improvements project may increase noise. Any increases would be heard by residents or users of the Riverside Golf Club and Airport Levee Trail.

Section 5.3 explains how construction of the flood retention facility under Alternative 1 would increase noise and vibration. The loudest activity would be controlled blasting. Operation of the FRE facility would produce low levels of periodic noise and vibration. This would be primarily due to vegetation management activities in the footprint of the temporary reservoir. These impacts would contribute to cumulative impacts. It is possible that some residents may hear noise from ongoing timber harvest activities. However, those properties would not noticeably hear noise or feel vibrations from Alternative 1. A small number of recreational users may experience combined noise impacts if timber harvesting happened at the same time as flood retention facility construction. However, as noted in Section 5.5, it was assumed that recreational users would not be allowed near the construction site. Therefore, residents and recreationalists are not likely to experience cumulatively substantial impacts related to noise as a result of the project.

Noise produced by construction of the Airport Levee Improvements could result in high intermittent nuisance impacts to nearby residences. This is because of their proximity to the levee. These impacts would contribute to cumulative impacts. Vibration produced by Alternative 1 construction would not impact structures. Long-term operation and maintenance of the Airport Levee Improvements would not affect noise compared to the existing condition. If construction of the Airport Levee Improvements happened at the same time as construction of any reasonably foreseeable future actions, a short-term cumulatively substantial impact would occur. Because the raised levee would not create noise, Alternative 1 would not contribute to a long-term cumulatively substantial impact in this area.

6.5.10 Land Use

Land uses in the study area have been shaped by natural and human influences. Land in the flood retention facility project area has been altered by commercial forestry. These activities have reduced the number of older trees and created sections where forest age is more varied. Land in the Airport Levee Improvements project area has been influenced by commercial, residential, and recreational development.

Several reasonably foreseeable future actions would modify the current uses of land in the study area. Continued timber harvest in the flood retention facility project area would proceed in accordance with applicable permits and approvals and is consistent with underlying land uses. Implementation of the Chehalis-Centralia Airport Property Master and 2020-2023 Regional Transportation Improvement Program projects are expected to proceed in a manner consistent with underlying land uses and zoning. They would also be completed in compliance with all required land use permits and approvals.

Reasonably foreseeable future actions in the Chehalis River 100-year floodplain that may impact land use include habitat restoration actions. These include the ASRP, the Chehalis Flood Storage and Habitat Enhancement Master Plan, Chehalis Fisheries Restoration Program, and the Recreation and Conservation Office Salmon Recovery Funding Board Projects. These projects would include land acquisitions to conserve and restore natural habitat, which may result in a change from the current land uses. These changes would be on a small scale, and in compliance with local zoning and land use requirements.

As discussed in Section 5.4, Alternative 1 would result in the permanent conversion of 790 acres from a land use of commercial forestland to Essential Public Facility in the flood retention facility project area. These impacts would contribute to cumulative impacts. Construction would require approval from Lewis County to convert commercial forestlands. This would require rezoning and conversion of land use through a comprehensive plan amendment. This land conversion would be small in contrast to the vast areas of commercial forestry uses in the area. Therefore, Alternative 1 would not contribute to a cumulatively substantial impact to land use in the flood retention facility project area.

The Airport Levee Improvements under Alternative 1 would be consistent with the existing land use. Construction activities associated with the Airport Levee Improvements could temporarily interrupt normal usage of the runway. If any reasonably foreseeable future actions also required the airport to temporarily close, there could be a short-term cumulatively substantial impact. However, there would be no long-term contribution to cumulative impacts to land use from the Airport Levee Improvements.

Alternative 1 operation would benefit land uses by reducing flood damage in segments of the Chehalis River 100-year floodplain. Reductions in the duration and depth of flooding are expected to be greatest in the population centers of Centralia, Chehalis, and Grand Mound. Flood damage reduction would have long-term beneficial effects on agricultural, residential, recreational, and commercially zoned areas. Critical infrastructure would also be protected from flooding. Development within the 100-year floodplain is expected to continue, consistent with land use regulations. By effectively reducing the area of the 100-year floodplain, Alternative 1 may slightly increase the likelihood of this development. However, there is sufficient developable land expected to accommodate future growth. Because Alternative 1 would largely benefit land uses by protecting land from flood damage, it would not contribute to cumulative land use impacts in the study area.

6.5.11 Recreation

Recreational opportunities in the flood retention facility project area have been greatly influenced by private timber harvest. As land was acquired for commercial harvest, the access to private lands has become more limited. In the vicinity of the proposed flood retention facility project area, this has resulted in limited permitted access to more than 15 miles of the Chehalis River. In the Airport Levee Improvements project area, recreational opportunities have been shaped by the Chehalis-Centralia Airport and residential and commercial development. Because the main uses of this component of the study area are for air travel, recreational access is relatively limited. The main resources that have been developed in this area are the Airport Levee Trail and Riverside Golf Club. While much of the Chehalis River 100-year floodplain has been developed, some of this development includes various trails, parks, and fairgrounds, and golf courses.

Continued timber harvest in the flood retention facility project area would continue to temporarily affect recreational access to timberlands.

Implementation of the Chehalis-Centralia Airport Property Master Plan would involve some recreational improvements. Other actions would also provide recreational opportunities in the Chehalis River 100-year floodplain. Planned restoration projects in the Chehalis River 100-year floodplain would benefit fish habitat. These habitat improvements could benefit fish populations. Overall, these would result in a beneficial impact to recreation.

The flood retention facility would result in the closure of approximately 1% of the Pe Ell South Permit Area, which is used for outdoor recreation. General access to the greater Pe Ell South Permit Area would not be affected by construction. During operation, some of the forest roads would become flooded when the temporary reservoir is full of water. This could damage the roads and prevent access to certain areas by recreational users. These impacts would be small given the vast area of recreational opportunities in other parts of the Pe Ell South Permit Area. These impacts would contribute to cumulative impacts. However, when added to the low recreational access impacts resulting from continued timber harvest in the area, these impacts would not be cumulatively substantial.

The Airport Levee Trail would be included as a component of the Airport Levee Improvements, similar to the existing conditions. Nearby recreational facilities, such as the Riverside Golf Club, would be unaffected by the raised levee. Short-term impacts associated with construction would include the closure of the Airport Levee Trail for 1 year. There would be no long-term operational impacts to recreation from the Airport Levee Improvements, and the temporary impacts would not contribute to cumulative impacts to recreation in the study area.

Alternative 1 operation would also benefit recreation in the Chehalis River 100-year floodplain downstream of the proposed flood retention facility. Flood damage reduction would allow more recreational facilities to remain open during major or greater floods, and experience fewer temporary closures because of damage from floods. Therefore, operation of Alternative 1 would not contribute to cumulative effects on recreation.

As discussed in Sections 4.5 and 5.5, Alternative 1 would negatively impact recreational fishing, which would contribute to cumulative impacts. Habitat improvement projects would benefit recreational fishing, but not to the extent that they would offset the Alternative 1 impacts. Therefore, Alternative 1 would contribute to cumulatively substantial impacts to recreational fishing.

6.5.12 Cultural Resources

Cultural resources that are potentially eligible for, or are listed in, the NRHP include archaeological sites, historic built resources, and TCPs. There are no historic built resources in the study area. Archaeological sites and TCPs have been affected by past land uses. In the flood retention facility project area, these resources have been impacted by past and present timber harvest. In the Airport Levee Improvements project area and Chehalis River 100-year floodplain study area, these resources have been adversely impacted by disturbance. This disturbance has been primarily caused by population growth and development, as well as restoration activities. These past actions have resulted in inadvertent destruction or degradation of cultural resources.

Several reasonably foreseeable future actions could impact cultural resources. This is because any ground disturbance has the potential to disturb buried cultural resources. Historic resources, such as old buildings and structures, may also be disturbed during construction of these projects. These impacts are unknown at this time. It was assumed that these projects would comply with federal, state, and local regulations. However, some unavoidable adverse impacts would likely destroy or degrade cultural resources.

Impacts of Alternative 1 on cultural resources would contribute to cumulative impacts. As discussed in Section 5.6, Alternative 1 construction would result in destruction of one of the three potentially eligible archaeological sites in the flood retention facility project area (45LE978). Construction activities would also adversely affect TCPs. Undocumented archaeological sites could also be damaged, destroyed, or removed by construction activities. Operation of the flood retention facility could expose or damage archaeological sites as a result of periodic inundation of the temporary reservoir. Periodic filling of the temporary reservoir would affect one archaeological site (45LE978). Operation could also affect TCPs in the study area. Mitigation for unavoidable impacts to cultural resources would be determined through ongoing consultation between the Corps and consulting parties. However, Alternative 1 would result in the loss of additional cultural resources that would contribute to a cumulatively substantial impact.

6.5.13 Transportation

The regional transportation system currently consists of forest roads in the flood retention facility project area. There are state and interstate highways, local roads, and the Chehalis-Centralia Airport in the Airport Levee Improvements project area and Chehalis River 100-year floodplain study area. The development of this system has improved mobility, freight transport, and introduced air travel to the region. Flood conditions have resulted in damage and temporary closures to the transportation network. When flooding is projected, WSDOT typically closes I-5 between exits 68 and 88 and implements an emergency detour route using SR 7 and US 12.

In the flood retention facility project area, continued timber harvest in managed forests would impact transportation. This is because logging trucks use the transportation network, resulting in increased traffic and potential delays. In the Airport Levee Improvements project area, commercial development would increase traffic over the long term. Implementation of the 2020-2023 Regional Transportation Improvement Program and WSDOT Culvert Replacement Program would result in temporary road closures, detours, or other traffic disruptions during construction. Some of the projects in the 2020-2023 Regional Transportation Improvement Program, such as the I-5/Chamber Way - Interchange Improvements, would improve traffic movement over the long term. This would benefit traffic movement.

Impacts of Alternative 1 on transportation would contribute to cumulative impacts. As discussed in Section 5.7, construction of the flood retention facility may cause periodic road closures. Construction of forest road improvements may require temporarily closing some forest roads. This could result in short-term delays, primarily to vehicles associated with commercial timber harvest. When the temporary reservoir fills with water, up to 9.95 miles of forest roads would need to be closed because they would be under water. Road users that would be affected would be primarily related to timber harvest and recreation. A bypass route would be used to provide access to managed forestlands in areas outside of the temporary reservoir. Because of the low level of vehicles that would be impacted by the closure and detour, the flood retention facility would not contribute to a cumulatively substantial impact to transportation in the flood retention facility project area.

Construction of the Airport Levee Improvements would require truck trips that could cause temporary traffic disruptions on NW Airport Road and NW Louisiana Avenue. These impacts would contribute to cumulative impacts. Raising of the levee would not affect transportation over the long-term, and would therefore not contribute to a cumulatively substantial impact.

Alternative 1 operation would benefit roadways, railways, bike and pedestrian facilities, and the Chehalis-Centralia Airport, because the level of regional flooding would be reduced. Specifically, modeling showed the locations on I-5 in Table 5.7-4 would no longer flood under Alternative 1 during a catastrophic flood (WSE 2019a, 2019b; Tschetter 2020). Operation of Alternative 1 would benefit transportation in the Chehalis River 100-year floodplain, and would not contribute to cumulative impacts.

6.5.14 Public Services and Utilities

As populations have grown over time, the need for public services and utilities has increased. Services, including fire, emergency, police, schools, and hospitals, have been developed to serve the growing population. Utility providers include water, sewer, solid waste, electricity, and natural gas. These utilities and services are more prevalent in the urban areas near I-5.

Reasonably foreseeable future actions could impact public services and utilities because they may result in temporary utility conflicts during construction. They could also result in temporary traffic disruptions, which could impact emergency service response. These actions would be coordinated with utility providers and include implementation of project-specific traffic control plans. No long-term impacts would occur.

Section 5.8 explains that Alternative 1 could result in a temporary increase in the potential need for police, fire, and other emergency services because of the potentially dangerous conditions associated with construction activities. Routine vegetation management activities during operation of the flood retention facility would also potentially increase emergency services demand. Alternative 1 construction and operation would require use of water, sewer, and electricity utilities. These impacts are unlikely to measurably affect emergency services or utilities in the region, and would not contribute to a cumulative impact. Pe Ell's water intake structure on Lester Creek would not be affected by operation of the temporary reservoir. However, the raw water pipeline from that intake to the water treatment plant may need to be relocated or modified. Relocation of the line would be coordinated with utility providers but may result in short-term interruptions in service availability. Because impacts to utilities would be temporary and localized, Alternative 1 would not contribute to a cumulative impact.

Flood damage reduction in the Chehalis River 100-year floodplain during operation would reduce the potential for loss of lives or injury, which would reduce demand on fire and emergency services. Because these impacts would be beneficial, operation of Alternative 1 would not contribute to cumulative impacts to public services in the Chehalis River 100-year floodplain.

6.5.15 Environmental Health and Safety

Hazardous materials may be present in the study area. Development and other human disturbance in the study area have resulted in spills and releases of hazardous materials. Some of these spills and releases have been cleaned up, while others remain. A total of 15 RCRA sites were identified near the

Airport Levee Improvements project area. In addition, two state-managed cleanup projects are located near the Airport Levee Improvements project area.

Physical safety risks in the study area have resulted from increased population and development. These risks are primarily associated with natural occurrences where people live, including flooding, earthquakes, wildfires, poisonous plants, and poisonous or venomous animals. In addition, timber harvest in the flood retention facility project area and airport operations in the Airport Levee Improvements project area would continue. These activities would present some risks to physical safety because of heavy equipment use.

Reasonably foreseeable future actions could impact environmental health and safety in the study area. Impacts would be associated with construction, which may use or otherwise expose people to hazardous materials. Construction would also increase safety risks because heavy equipment would be used. It was assumed that all of these actions would comply with regulations and industry standards.

As discussed in Section 5.9, Alternative 1 construction and operation would result in increased risk of human and ecologic exposures to hazardous materials. In addition, Alternative 1 would use heavy equipment that could temporarily increase safety risks for workers. These impacts would contribute to cumulative impacts. The Applicant would be required to implement BMPs and comply with regulations and industry safety standards. This would minimize the risk of exposures to hazardous materials and physical harm. Because these risks would be individually and cumulatively small, Alternative 1 would not contribute to cumulatively substantial impacts to environmental health and safety.

6.5.16 Socioeconomics

Over time, population growth in the study area resulted in the development of local and regional economies. This includes timber, agriculture, commercial, and industrial markets. More recently, this growth has slowed. Population growth in the study area is occurring at a much slower rate than the state of Washington as a whole. Total labor income for the study area in 2018 was about $12 billion. This represents about 3.6% of total labor income in Washington. Total economic output in 2018 for the study area was about $33 billion. This is about 3.5% of Washington's total output. Thurston County's unemployment rate is similar to the statewide average. However, the unemployment rate in Pacific, Lewis, and Grays Harbor counties have been consistently higher than the statewide average. Unemployment rates have more recently increased as the result of the COVID-19 pandemic. Timber and agricultural production continue to provide large contributions to the economy in the study area.

Reasonably foreseeable future actions would result in a measurable economic benefit by employing workers. Some of these projects, such as timber harvests and implementation of the Chehalis-Centralia Airport Property Master Plan, would benefit the economy by generating long-term revenue. These benefits would also include increased tax revenue. These actions would negatively impact ecosystem services by degrading habitats. However, restoration projects would improve ecological functions and have a long-term benefit on these services.

As discussed in Section 5.10, housing availability would be affected by the need to house up to 478 workers at the peak of construction of the flood retention facility. This represents up to 0.6% of the 2018 population of Lewis County, and a much smaller percentage of the study area population. Most workers would likely commute from the Chehalis-Centralia area, where there is sufficient hotel and motel capacity. Construction of the Airport Levee Improvements would not likely require lodging for workers. Alternative 1 construction costs would benefit the economy by providing up to 2.9% of the economic activity in the study area. Spending related to construction would produce sales and use tax revenue. In addition, harvesting the timber in the temporary reservoir area would benefit the economy by generating timber excise tax revenue. This increase in economic activity would benefit the local and regional economy. Because construction of Alternative 1 would result in local and regional economic benefits, it would not contribute to cumulative impacts.

Operation of Alternative 1 would result in benefits to income, employment, and tax revenue. Operation would not affect population or housing demand because additional housing would not be needed. Because Alternative 1 operation would result in only beneficial effects on socioeconomics, it would not contribute to cumulative impacts.

Alternative 1 would impact ecosystem services related to habitats, species, and cultural and spiritual importance. These impacts would contribute to cumulative impacts. Adverse impacts to fish could reduce the value people derive from commercial, recreational, and subsistence use of the fish. Adverse impacts to water quality, vegetation, and terrestrial and aquatic habitats and species could adversely affect the ability for people to derive culturally and spiritually meaningful enjoyment. Because these resources would be negatively affected, Alternative 1 would contribute to a cumulatively substantial impact to ecosystem services.

6.5.17 Environmental Justice

Low-income and minority populations were historically present and remain within the study area. These populations are not present in the flood retention facility project area, so that area was not evaluated for cumulative impacts to environmental justice populations. Five census block groups have a minority population more than 10% higher than the minority population of the county in which it is located. One of the five census blocks groups is located within 0.5 mile of the Airport Levee Improvements project area. Three of the other five census block groups are located near the city limits of Chehalis and Centralia. The remaining census block group includes portions of the Chehalis Indian Reservation and includes a high proportion of people who identify as American Indian/Alaska Natives. The QIN and Chehalis Tribe seasonally use portions of the study area for various reasons. The study area includes four census blocks where over 20% of the population is below the U.S. Census poverty threshold. These are all located in Lewis County.

Reasonably foreseeable future actions could impact environmental justice because they may require acquisition of property or increase construction-related disturbance to low-income or minority populations. Projects included in the 2020-2023 Regional Transportation Improvement Program may also increase long-term traffic noise in adjacent properties, which may impact environmental justice populations.

Because low-income and minority populations are located with 0.5 mile of the Airport Levee Improvements, its construction would result in low temporary disproportionate impacts (Section 5.11). These impacts would contribute to cumulative impacts. Construction would result in low temporary impacts to air quality and noise. Any increase in exposure to air pollutants may adversely affect sensitive and vulnerable populations. Operation of the Airport Levee Improvements would not impact environmental justice populations because it would function similarly to the existing condition. If construction of the Airport Levee Improvements occurred at the same time as construction of reasonably foreseeable future actions, a short-term cumulatively substantial impact would occur. Operation of Alternative 1 would benefit environmental justice populations in the Chehalis River 100-year floodplain by reducing flood damage. Because of these benefits, Alternative 1 would not contribute to cumulatively substantial impacts to environmental justice populations related to flooding.

Ecological changes from Alternative 1 construction and operation would impact a number of aquatic species. These impacts would contribute to cumulative impacts. High disturbance and destruction of native plants, terrestrial animals, and freshwater mussels would also be expected. These impacts would disproportionately impact people in the study area, particularly the QIN and Chehalis Tribe. These tribes may depend on affected resources for food, fiber, economic livelihood, and cultural and spiritual values. Impacts to these resources from Alternative 1 would contribute to cumulatively substantial impacts to environmental justice populations.

7 MINIMIZATION AND MITIGATION

7.1 Introduction

Mitigation is an important aspect of the NEPA and DA permitting review process. Mitigation has been considered during the development of this Draft EIS and will continue to be considered throughout the permit application review process. Mitigation includes measures to avoid, minimize, rectify, reduce, or compensate for lost resources and functions.

This chapter describes measures proposed by the Applicant to avoid, minimize, and compensate for potential adverse environmental impacts from construction and operation of the proposed project. This includes the measures listed in Section 7.2 and Section 7.3 to minimize potential impacts to the natural and built environment, respectively. These measures correspond to the potential adverse environmental impacts presented in Chapters 4 and 5 of this Draft EIS. The Applicant has also proposed a conceptual framework to compensate for any permanent impacts to aquatic and terrestrial resources. The Applicant’s conceptual framework is discussed in Section 7.4.

The Final EIS will present updated potential mitigation measures. These measures will be based on continued evaluation by the Corps, coordination with the Applicant, consultation with tribes and resource agencies, and comments received on this Draft EIS. The Corps will document any mitigation requirements in the ROD.

7.2 Measures to Address Impacts to the Natural Environment

This section identifies Applicant-proposed measures to address potential impacts to the natural environment from the proposed project.

7.2.1 Water Quantity and Quality

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to water quantity and quality. The Applicant would:

- Prepare a Pre-Flood Preparation Plan to mitigate against potential floods that could result in cofferdam overtopping during construction. Measures in the Pre-Flood Preparation Plan may include moving equipment, cleaning the site, and avoiding concrete pours.
- Prepare staging and construction laydown areas with appropriate site grading, surfacing, and drainage provisions and BMPs.
- Use BMP specifications from the current version of WSDOT Standard Specifications for Road, Bridge, and Municipal Construction and Lewis County standards. BMPs may include items such as silt fences, vegetated strips, brush barriers, compost socks, wheel wash stations, and temporary stockpile and slope stabilization coverings.

- Use existing roads to the extent practicable during construction and operations.
- Provide a dry work area within the Chehalis River. The dry work area would be developed in the first period of in-water work by installing protection features to isolate the diversion tunnel portals from the river.
- Develop a vegetation management plan to address vegetation management within the temporary reservoir and adjacent riparian buffers during construction and operation.

7.2.2 Geology

The measures listed in Section 7.2.1 are intended to minimize potential impacts to geology.

7.2.3 Geomorphology

The measures listed in Section 7.2.1 are intended to minimize potential impacts to geomorphology.

7.2.4 Wetlands and Other Waters

The measures identified in Section 7.2.1 are intended to minimize potential impacts to wetlands and other waters.

7.2.5 Aquatic Species and Habitats

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to aquatic species and habitats. The Applicant would:

- Develop and implement a compensatory mitigation plan.
- Limit in-water work to a window agreed upon by the Corps and WDFW.
- Conduct construction activities that do not require being in or near the Chehalis River as far away from the river as practicable. This would apply to the majority of the construction work, including most blasting, construction truck operation, foundation drilling/grouting, and material processing. The Applicant would use buffer distances between the construction area and river channel to minimize vibration transmission to the river. Specific buffer distances would be developed in coordination with the appropriate regulatory agencies.
- Develop and implement a blasting plan that includes:
  - Not blasting within the active river channel (with water flowing).
  - Using buffer distances that follow jurisdictional requirements or industry standards.
  - Implementing a minimum 25-foot-wide dry working space buffer between the blast site and the cofferdam during excavation for the flood retention facility foundation.
  - Employ noise and vibration attenuation measures to minimize or eliminate effects to fish in regions where blasting pressure waves may still be harmful.
- Ensure that the temporary trap-and-transport facility conforms to the most current version of the NMFS and WDFW upstream fish passage and screening design guidelines and criteria. Juvenile salmonids, resident fish, and lamprey that are incidentally captured would be transported upstream of the construction area and released back into the Chehalis River.

Upstream and downstream passage of juvenile salmonids, resident fish, and lamprey during operation of the temporary passage facility would continue to be discussed as the project progresses.

- Develop the diversion tunnel for downstream fish passage in consultation with NMFS and WDFW during final design.
- Slowly dewater the area between the upstream and downstream cofferdams as water is diverted into the diversion tunnel and maintain flows in the Chehalis River downstream of the project site. This would facilitate safe and timely removal of fish and avoid impacts to other natural resources downstream.
- Simultaneously dewater the diversion tunnel, rewater the natural river channel and conduits, and remove all fish from the diversion tunnel. The Applicant would also remove or cease to operate the fish barrier associated with the temporary trap-and-transport facility.
- Select professionals with training, knowledge, and skills in the safe handling of fish when fish must be captured and removed from the areas to be dewatered.
- Return all captured and collected fish to the Chehalis River at locations that are both sufficient for the fish to recover and reorient themselves to the river environment, and that are identified in consultation with the governing fisheries agencies.
- Comply with the operational standards described in the Operations Plan for the flood retention facility conduit gates and permanent collect, hold, transport, and release facility prior to removal of the temporary trap-and-transport fish passage facility.
- Make LWM salvaged from the temporary reservoir available for release downstream.

7.2.6 Terrestrial Species and Habitats

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to terrestrial species and habitats. The Applicant would:

- Develop and implement a compensatory mitigation plan.
- Remove temporary roads within the active construction site and restore those locations to pre-project conditions after construction activities to minimize erosion impacts to vegetation.
- Coordinate flood retention facility foundation blasting and final quarry development and timing if ESA-listed terrestrial species are found to influence the construction sequencing. ESA-related blasting measures could be implemented if bald eagles, marbled murrelets, or northern spotted owl nests/breeding occurrences are documented in proximity to blasting locations. Blast timing restrictions for bald eagles would similarly be determined during permitting consultations, as required under the Bald and Golden Eagle Protection Act.

7.3 Measures to Address Impacts to the Built Environment

This section identifies the measures proposed by the Applicant and that may be required by the Corps related to the built environment. It is understood that the Applicant would comply with applicable permits and approvals discussed in Chapter 8 and Appendix F. The measures in Section 7.2 would also offset impacts to built resources.

7.3.1 Air Quality

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to public services and utilities. The Applicant would:

- Commit to not burning cleared vegetation at the FRE facility site, quarry site, routes of new roads or within the footprint of the temporary reservoir.

7.3.2 Cultural Resources

Per Section 106 of the NHPA, the Applicant would be required to implement the mitigation measures listed in the Memorandum of Agreement (MOA). The MOA would be developed by the Corps in consultation and coordination with tribes, the Washington Department of Archaeology and Historic Preservation, and other consulting parties.

7.3.3 Transportation

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to transportation. The Applicant would:

- Improve existing roads to provide safe temporary access to and around the construction site. Existing roads would also be improved to allow others to bypass the construction site.
- Include the use of appropriate BMPs for all road construction activity to minimize potential impacts from construction traffic on non-project traffic, and to provide reliable access for emergency service vehicles.

7.3.4 Public Services and Utilities

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to public services and utilities. The Applicant would:

- Work with the City of Pe Ell to replace the existing water pipeline and Chehalis River crossing.
- Complete an engineer’s report to evaluate the potential for impacts on portions of the City of Pe Ell’s water system pipeline that are located within the temporary reservoir.

7.3.5 Environmental Health and Safety

The Applicant has identified the following measures (BMPs and design elements) intended to minimize potential impacts to environmental health and safety. The Applicant would:

- Require the selected contractor to provide a rock blasting plan for review prior to rock blasting to minimize impacts to environmental health and safety.

7.3.6 Environmental Justice

The measures listed in this chapter are intended to also minimize potential impacts to environmental justice populations.

7.4 Applicant Proposed Compensatory Mitigation Plan

In addition to the measures listed in Section 7.2 and Section 7.3, the Applicant has proposed a conceptual framework to compensate for any permanent impacts to aquatic and terrestrial resources (Kleinschmidt 2020). Compensation is required for project impacts that cannot be avoided or further minimized. Compensation means ensuring that lost functions and values are replaced. The framework, described in Section 7.4.1, is conceptual and identifies mitigation concepts the Applicant anticipates implementing and a range of potential mitigation locations. A detailed compensatory mitigation plan would be developed as the NEPA and permitting processes progress through coordination with the Applicant, the Corps, and other regulatory agencies.

7.4.1 Conceptual Framework

The Applicant identified nine mitigation types to categorize mitigation opportunities in the conceptual framework. These mitigation types are intended to compensate for unavoidable impacts to aquatic and terrestrial resources. The Applicant is focusing on an area that is largely the same as the upper Chehalis Basin upstream of where the Skookumchuck River empties into the Chehalis River (Figure 3.1-1).

- Riparian Buffer Expansion: Plant trees along the banks of rivers and streams to provide shade and enhance other riparian functions.
- Hyporheic Exchange Enhancements: Modify stream channels and banks to increase the influence of shallow groundwater on surface water. These modifications would be intended to create or expand areas of cool water in streams to provide juvenile fish with improved habitat.
- Cold Water Retention Structures: Create floodplain channels, backwater alcoves, channel margin pockets, and other features to collect colder groundwater. These features would be intended to create areas of cool water in streams to improve fish habitat.
- Instream Modifications: Construct habitat features in stream channels to improve habitat complexity, create areas of cool water, and retain spawning gravels.
- Off-channel Modifications: Enhance off-channel habitat to reconnect, enhance, and expand off-channel habitat.
- Gravel Retention Jams: Construct large instream structures using LWM and rock to accumulate and retain spawning gravels.

- Fish Passage: Remove small dams and replace culverts to improve fish passage.
- Wetland Enhancement: Enhance, restore, or expand wetlands to benefit wildlife species.
- Upland Forest Conservation: Conserve and enhance specific habitats to benefit targeted wildlife species.

7.4.2 Potential Impacts of the Conceptual Framework

The purpose of implementing the mitigation types listed in Section 7.4.1 would be to compensate for lost resources. If implemented, these mitigation types could also result in some adverse impacts. These adverse impacts would mainly be short-term, although there could be some adverse long-term impacts, depending on the location of mitigation.

The mitigation projects would involve a variety of construction activities but would generally be expected to include site grading, road work, vegetation removal and planting, in-water work, and replacement of culverts. These activities would require the use of heavy equipment such as backhoes, dump trucks, and front-end loaders. Heavy equipment would be used for activities such as grading streambanks and channels, placing habitat features in aquatic habitat, and replacing undersized culverts.

Implementation of the proposed activities would result in impacts to both the natural and built environment. The main adverse impacts would occur while the construction activities are happening. The types of impacts that would be expected during construction include the following:

- Potential alterations in surface water hydrology and floodplains
- Potential water quality impacts, mainly from risk of spills, leaks, and turbidity
- Groundwater impacts, including to the hyporheic zone, most likely from grading and alteration of any wetlands or waters
- Increased erosion and risk of geologic hazards
- Impacts to geologic resources
- Alterations to geomorphic processes
- Impacts to wetlands, other waters, and their buffers
- Impacts to aquatic species and habitat, including special-status species, from increased disturbance and water quality impacts
- Impacts to terrestrial species and habitat, including special-status species, from increased disturbance and loss of habitat
- Impacts to air quality
- Visual impacts from the presence of construction equipment and activity, vegetation removal, grading, and stockpiling
- Increased noise and potentially some vibration, mainly from use of heavy equipment
- Potential short-term conflicts with surrounding land uses or applicable plans, policies, or zoning
- Disturbance to or loss of recreational areas and opportunities

- Adverse impacts to cultural resources, including resources eligible for listing in the NRHP, most likely from ground disturbance or impacts to traditional cultural properties
- Increased construction traffic on local roadways with the potential for roadway damage or disruption of access to emergency service providers
- Potential disruption to public service or utility infrastructure
- Increased risk of environmental health and safety impacts from operation of construction equipment

The level of impacts would range from low to high, depending on where the activities took place and the amount and quality of the resources affected. For example, high natural resources impacts would happen where the activities involved large areas or especially sensitive resources. In the upper Chehalis River Basin, this could include impacts to the critical habitat for northern spotted owl, marbled murrelet, or Oregon spotted frog. There could also be high impacts if a substantial area of Essential Fish Habitat or WDFW priority habitats were adversely affected. Most of the areas initially under consideration by the Applicant would be in undeveloped or agricultural lands. These areas generally have few people. Therefore, there is a lower likelihood for impacts to the built environment. The main exception would be that there could be high impacts to cultural resources. This is because more remote and undeveloped areas typically have a higher probability for containing intact archaeological resources. Appendix F provides additional information about considerations for determining the level of adverse impacts.

Like the proposed project, construction of the mitigation types would also result in socioeconomic impacts that would mostly be beneficial. This would happen because the construction activities would create jobs in the region and increase government tax revenues. Some adverse impacts would also likely happen. Adverse socioeconomic impacts would likely be low to medium because the amount of resources and the duration of construction would be lower than the proposed project.

There could also be some short-term adverse impacts to ecosystem services and environmental justice populations. These impacts would not likely be high because the adverse impacts would only last during construction. The anticipated changes would also not likely disproportionately affect environmental justice populations.

There is a potential for adverse long-term impacts and some cumulative impacts. Long-term impacts would mainly happen as the result of land use conversion. For example, existing agricultural lands could be converted to conservation easements or other protected natural lands. Cumulative impacts from construction would happen where multiple mitigation types may be implemented close together or at the same time and in areas close to other construction projects expected under the No Action Alternative.

8 CONSULTATION AND COMPLIANCE

8.1 Introduction

This chapter describes the public involvement process to date, and future opportunities to provide comments to the Corps on the proposed project. It also describes the compliance requirements that the Corps must follow in completing the EIS and considering the permit application. It concludes with a summary of the applicable regulations and the permits and approvals the Applicant would be required to obtain.

8.2 Public Involvement

Public, agency, and tribal consultation for the EIS began in fall 2018. It has continued throughout this environmental review process. This has included input during formal public scoping, input to be provided during the Draft EIS public comment period, and technical input from agencies and tribes related to government-to government consultations described in Section 8.3. This chapter summarizes the public and agency consultation and coordination activities to date. It also outlines next steps following the conclusion of the Draft NEPA EIS public comment period.

8.2.1 EIS Scoping Process

The Corps and Ecology held a 31-day joint scoping period for the environmental review process from September 28, 2018, to October 29, 2018. During this time, the Corps solicited comments on the scope of the EIS, the range of reasonable project alternatives, and the potentially significant issues. Two joint NEPA/SEPA public scoping meetings were held on October 16, 2018, and October 17, 2018.

A total of 265 comments were provided. This included comments from federal, state, and local agencies, tribes, and the public. The Corps considered these comments in the development of the Draft EIS. A summary of the scoping process and substantive comments are provided in the Scoping Report (Corps 2018).

8.2.2 Draft EIS Public Comment Period

The Draft EIS was circulated for a 60-day public comment period beginning with the issuance of the Notice of Availability in the Federal Register. Comments on the EIS can be submitted online, at one of the public hearings, by email, or by mail, as described in Chapter 1.

8.2.3 Next Steps

The Corps will consider comments received on the Draft EIS in the development of the Final EIS. The Final EIS will include a response to comments. The Corps will use the Final EIS to inform its permit decision about the proposed project.

The Corps will prepare and issue a ROD to document the Corps' permit decision for the proposed project. The ROD will also document consistency with other applicable regulations, statutes, and guidance and will conclude the Corps' NEPA process.

8.3 Consultation

This section describes agency and tribal consultation and the obligations of the Corps for consultation in the NEPA process.

8.3.1 NEPA Cooperating Agencies

The NEPA implementing regulations allow the lead agency (the Corps) to invite other federal agencies or federally recognized tribes to participate in the NEPA process as cooperating agencies. A federal agency or federally recognized tribe may also request the lead agency to designate it as a cooperating agency. Cooperating agencies are federal agencies or tribes with jurisdiction by law or special expertise regarding a proposed project (40 CFR 1501.6, 1508.5). Cooperating agencies assist the lead agency by participating in the NEPA process as early as possible. They also assist in developing information, preparing environmental analyses, and making staff available to provide additional expertise for the analyses.

The EPA, QIN, and Chehalis Tribe were invited to be cooperating agencies. The EPA declined the invitation. The QIN accepted and later withdrew. The Chehalis Tribe has not formally responded as of the time of publication of this document.

8.3.2 National Historic Preservation Act

Section 106 of the NHPA requires the Corps to consider the effects of the proposed project on historic properties eligibility for or listed in the NRHP. This analysis is presented in Section 5.6. The Applicant, the Washington Department of Archaeology and Historic Preservation, Chehalis Tribe, Cowlitz Indian Tribe, QIN, Nisqually Indian Tribe, Shoalwater Bay Tribe, and Ecology have been identified as consulting parties for this EIS.

Through the course of consultation, the Corps has determined that the proposed project would have an adverse impact to eligible historic properties. The Corps is continuing to work with the consulting parties to determine avoidance, minimization, and mitigation measures necessary to address these impacts. Mitigation for any adverse effects will be described in a MOA, which will be completed prior to issuance of the ROD.

8.3.3 Endangered Species Act

Section 7 of the ESA requires a federal agency to ensure its actions do not jeopardize the continued existence of any federally listed threatened or endangered species. The Corps will initiate Section 7 consultation with NMFS and USFWS during the permit review process. Through the consultation, NMFS and USFWS will evaluate project impacts to listed species and will identify reasonable and prudent measures that would be needed to minimize impacts to listed species. Consultation would be completed prior to issuance of the ROD.

8.3.4 Government-to-Government Consultation and Tribal Engagement

The federal government has a unique legal and political relationship with tribal governments as sovereign nations. This federal trust responsibility is established through, and confirmed by, the U.S. Constitution, treaties, statutes, executive orders, and judicial decisions. The Corps has regulations and tribal policies regarding the trust responsibility. In recognition of the federal government's trust responsibility, the Corps engages in consultation and collaboration with tribal governments when a proposed project may affect a tribe or its resources. In an effort to ensure regular engagement and participation in the EIS, multiple avenues were identified for tribal engagement:

- Participation in the NEPA process as a cooperating agency
- Tribal engagement and government-to-government consultation

The government-to-government relationship and the process for developing open and transparent communication, effective collaboration, and informed federal decision-making is described in the following:

- EO 13175, Consultation and Coordination with Indian Tribal Government
- EO 13007, Indian Sacred Sites
- Secretarial Order 3206, American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act
- Presidential Memorandum on Tribal Consultation, November 5, 2009
- Presidential Memorandum on Government-to-Government Relations with Native American Tribal Governments, April 29, 1994

In addition, NHPA Section 106 requires federal agencies to consult with Indian tribes on undertakings on tribal lands and on historic properties of significance to the tribes that may be affected by an undertaking (36 CFR 800.2 [c][2]). The Corps coordinated and consulted with tribal governments and engaged with tribal leaders and their staff whose interests might be affected by activities proposed in this EIS.

The QIN requested government-to-government consultation with the Corps on August 15, 2017. The QIN was offered opportunities to participate through a variety of venues, ranging from one-on-one phone calls to technical team meetings to special briefings.

In addition to tribal engagement, the QIN decided to engage in the NEPA process for a time as a cooperating agency by entering into a Cooperating Agency Agreement with the Corps.
On September 22, 2019, the QIN terminated the agreement and withdrew as a cooperating agency.

8.4 Compliance

This section describes compliance requirements for the evaluation and protection of resources in this EIS, including a summary of the anticipated permits and approvals that the Applicant would be required to obtain. The section also includes the analysis of irreversible and irretrievable commitment of resources and short-term uses versus long-term productivity.

8.4.1 Applicable Regulations

Appendix F lists the regulations, statutes, and guidelines that apply to the protection of the natural and built environment. These regulations were considered in evaluating impacts and identifying potential mitigation measures to offset those impacts.

8.4.2 Required Permits and Approvals

Appendix F also lists the anticipated permits and approvals that the Applicant would be required to obtain. These permits and approvals would require the Applicant to avoid, minimize, and mitigate for adverse impacts to the natural and built environment. Specific measures and a conceptual mitigation framework have been proposed by the Applicant, as discussed in Chapter 7.

8.4.3 Irreversible or Irretrievable Commitment of Resources

NEPA regulations require an EIS to consider the irreversible or irretrievable commitments of resources as part of the evaluation of environmental consequences. An irreversible commitment of a resource is one that would continue to be committed throughout the life of the proposed project (50 years). An irretrievable commitment of resources refers to those resources that would be unavailable for use by future generations. Alternative 1 would require natural and human-made resources. The main commitment would be for construction of the FRE facility. However, resources would also be committed during facility operations and for the Airport Levee Improvements.

Alternative 1 would result in an irreversible commitment of wetlands, vegetation, soils and bedrock, land use, cultural resources, and habitat, including terrestrial and aquatic habitat that is used by federal- and state-listed fish and wildlife species. The permanent impacts are discussed in Chapters 4 and 5. Alternative 1 would also require an irretrievable commitment of surface waters and construction materials. Construction of the flood retention facility would require minor river water withdrawal and some quarry use and development for concrete production. Alternative 2 uses would be slightly lower than Alternative 1.

8.4.4 Short-Term Uses Versus Long-Term Productivity

NEPA regulations require an EIS to evaluate short-term uses of environmental resources versus maintenance and enhancement of long-term productivity. Within the context of this EIS, short-term refers to the construction period, while long-term refers to the operational life of the proposed project and beyond.

Short-term uses of the environment would generally be the same as the construction impacts for each environmental resource in Chapters 4 and 5 of this Draft EIS. In evaluating short-term uses versus long-term productivity, the main considerations include the commitment of water resources, wetland and vegetation, terrestrial habitat and species, aquatic habitat and species, and land use. Long-term productivity of surface water, floodplains, and wetlands would be adversely impacted by construction. This would happen through the permanent reduction of Chehalis River 100-year floodplain functions, removal of trees, and increased water temperature, damaging habitat for various terrestrial and aquatic wildlife species. Declines in aquatic species, including salmon, are predicted regardless of whether the proposed project takes place. Long-term construction impacts to land use would be the permanent conversion of commercial forestland to Essential Public Facility. However, in the Chehalis River 100-year floodplain area, most of the long-term impacts of decreased flooding from the flood retention facility would benefit existing land uses. Critical infrastructure in agricultural, residential, recreational, and commercially zoned areas would be at less risk from major floods.