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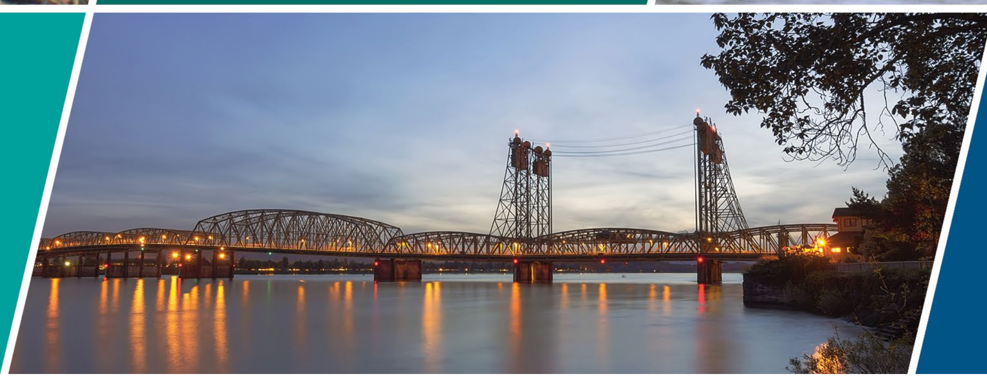

Ecosystems Technical Report

September 2024

OREGON

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Ecosystems Technical Report

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
ADA	Americans with Disabilities Act
ARSC	Aquatic Resources of Special Concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
BO	Biological Opinion
BRT	bus rapid transit
CESCL	Certified Erosion and Sediment Control Lead
CFU	colony forming units
CIA	contributing impervious area
CPC	City of Portland Code
CRC	Columbia River Crossing
CTR	Commute Trip Reduction
C-TRAN	Clark County Public Transit Benefit Area Authority
dB	decibels
dB_{PEAK}	peak decibels
dB_{RMS}	root mean square decibels
dB_{RMS} re: 1 µPa	root mean square decibels referenced to 1 micropascal
dB_{SEL}	decibels sound equivalent level
DEQ	Oregon Department of Environmental Quality
DPS	distinct population segment
DSL	Department of State Lands
Ecology	Washington State Department of Ecology
EFH	essential fish habitat

Acronym/Abbreviation	Definition
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESC	erosion and spill control
ESH	essential salmonid habitat
ESU	evolutionarily significant unit
ezone	environmental overlay zone
FAHP	Federal Aid Highway Program
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FHWCA	Fish and Wildlife Habitat Conservation Area
fps	feet per second
FR	Federal Register
FSCR	Flood Safe Columbia River
ft^2/cfs	square feet per cubic foot per second
FTA	Federal Transit Administration
GIS	geographic information system
I-205	Interstate 205
I-5	Interstate 5
IBR	Interstate Bridge Replacement
IWWW	in-water work window
LCR	Lower Columbia River
LPA	Locally Preferred Alternative
LRT	light-rail transit
LRV	light-rail vehicle

Acronym/Abbreviation	Definition
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MAX	Metropolitan Area Express
MBTA	Migratory Bird Treaty Act
Metro	Oregon Metro
mg/L	milligrams per liter
mL	milliliters
mm	millimeters
MMPA	Marine Mammal Protection Act
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NRI	Natural Resources Inventory
OAR	Oregon Administrative Rule
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHWM	ordinary high water mark
ORBIC	Oregon Biodiversity Information Center
OSWB	Oregon State Weed Board
OTC	Oregon Transportation Commission
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	Pollution Control Plan

Acronym/Abbreviation	Definition
PMLS	Portland Metro Levee System
PNCD	Preliminary Navigation Clearance Determination
PTS	permanent threshold shift
RCW	Revised Code of Washington
RM	river mile
RMS	root mean square
ROD	Record of Decision
SEIS	Supplemental Environmental Impact Statement
SEL	sound exposure level
SEPA	State Environmental Policy Act
SHA	Special Habitat Area
SMP	Shoreline Master Program
SOI	species of interest
SOV	single-occupancy vehicle
SPCC	Spill Prevention, Control, and Countermeasures
SR	State Route
SRKW	Southern Resident (distinct population segment) of killer whale
TESCP	Temporary Erosion and Sediment Control Plan
TMDL	Total Maximum Daily Load
TriMet	Tri-County Metropolitan Transportation District of Oregon
TTS	temporary threshold shift
UFSWQD	Urban Flood Safety and Water Quality District
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard

Acronym/Abbreviation	Definition
USFWS	U.S. Fish and Wildlife Service
VMC	Vancouver Municipal Code
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WNHP	Washington Natural Heritage Program
WNWCB	Washington State Noxious Weed Control Board
WQPMP	Water Quality Protection and Monitoring Plan
WSDOT	Washington State Department of Transportation
WSTC	Washington State Transportation Commission

1. PROGRAM OVERVIEW

This technical report identifies, describes, and evaluates short-term and long-term effects on ecosystem resources from the Interstate Bridge Replacement (IBR) Program's Modified Locally Preferred Alternative (LPA). The construction and operation of transportation infrastructure can have temporary and permanent effects on ecosystem resources, including aquatic and terrestrial fish and wildlife species, botanical species, and habitats for these species. The Modified LPA would be designed to avoid and/or minimize these effects to the extent possible. This report provides mitigation measures for potential effects on these resources when avoidance is not feasible.

The purpose of this report is to satisfy applicable portions of the National Environmental Policy Act (NEPA) 42 United States Code (USC) 4321 "to promote efforts which will prevent or eliminate damage to the environment." Information and potential environmental consequences described in this technical report will be used to support the Draft Supplemental Environmental Impact Statement (SEIS) for the IBR Program pursuant to 42 USC 4332.

The objectives of this report are to:

- Define the study area and the methods of data collection and evaluation used for the analysis (Chapter 2).
- Describe existing ecosystem resources within the study area (Chapter 3).
- Discuss potential long-term, temporary, and indirect effects on ecosystem resources resulting from construction and operation of the Modified LPA compared to the No-Build Alternative (Chapters 4, 5, and 6).
- Provide proposed avoidance and mitigation measures to help prevent, eliminate, or minimize impacts from the Modified LPA (Chapter 7).
- Identify federal, state, and local permits that would be required (Chapter 8).

The IBR Program is a continuation of the previously suspended Columbia River Crossing (CRC) project with the same purpose to replace the aging Interstate 5 (I-5) Bridge across the Columbia River with a modern, seismically resilient multimodal structure. The proposed infrastructure improvements are located along a 5-mile stretch of the I-5 corridor that extends from approximately Victory Boulevard in Portland to State Route (SR) 500 in Vancouver as shown in Figure 1-1.

The Modified LPA is a modification of the CRC LPA, which completed the National Environmental Policy Act (NEPA) process with a signed Record of Decision (ROD) in 2011 and two re-evaluations that were completed in 2012 and 2013. The CRC project was discontinued in 2014. This Technical Report is evaluating the effects of changes in project design since the CRC ROD and re-evaluations, as well as changes in regulations, policy, and physical conditions.

Figure 1-1. IBR Program Location Overview

1.1 Components of the Modified LPA

The basic components of the Modified LPA include:

- A new pair of Columbia River bridges—one for northbound and one for southbound travel—built west of the existing bridge. The new bridges would each include three through lanes, safety shoulders, and one auxiliary lane (a ramp-to-ramp connection on the highway that improves interchange safety by providing drivers with more space and time to merge, diverge, and weave) in each direction. When all highway, transit, and active transportation would be moved to the new Columbia River bridges, the existing Interstate Bridge (both spans) would be removed.
  - Three bridge configurations are under consideration: (1) double-deck truss bridges with fixed spans, (2) single-level bridges with fixed spans, and (3) single-level bridges with movable spans over the primary navigation channel. The fixed-span configurations would provide up to 116 feet of vertical navigation clearance, and the movable-span configuration would provide 178 feet of vertical navigation clearance in the open position. The primary navigation channel would be relocated approximately 500 feet south (measured by channel centerline) of its existing location near the Vancouver shoreline.
  - A two auxiliary lane design option (two ramp-to-ramp lanes connecting interchanges) across the Columbia River is also being evaluated. The second auxiliary lane in each direction of I-5 would be added from approximately Interstate Avenue/Victory Boulevard to SR 500/39th Street.
- A 1.9-mile light-rail transit (LRT) extension of the current Metropolitan Area Express (MAX) Yellow Line from the Expo Center MAX Station in North Portland, where it currently ends, to a terminus near Evergreen Boulevard in Vancouver. Improvements would include new stations at Hayden Island, downtown Vancouver (Waterfront Station), and near Evergreen Boulevard (Evergreen Station), as well as revisions to the existing Expo Center MAX Station. Park and rides to serve LRT riders in Vancouver could be included near the Waterfront Station and Evergreen Station. The Tri-County Metropolitan Transportation District of Oregon (TriMet), which operates the MAX system, would also operate the Yellow Line extension.
  - Potential site options for park and rides include three sites near the Waterfront Station and two near the Evergreen Station (up to one park and ride could be built for each station location in Vancouver).
- Associated LRT improvements such as traction power substations, overhead catenary system, signal and communications support facilities, an overnight light-rail vehicle (LRV) facility at the Expo Center, 19 new LRVs, and an expanded maintenance facility at TriMet's Ruby Junction.
- Integration of local bus transit service, including bus rapid transit (BRT) and express bus routes, in addition to the proposed new LRT service.
- Wider shoulders on I-5 from Interstate Avenue/Victory Boulevard to SR 500/39th Street to accommodate express bus-on-shoulder service in each direction.
  - Associated bus transit service improvements would include three additional bus bays for eight new electric double-decker buses at the Clark County Public Transit Benefit Area

Authority (C-TRAN) operations and maintenance facility (see Section 1.1.7, Transit Operating Characteristics, for more information about this service).

- Improvements to seven I-5 interchanges and I-5 mainline improvements between Interstate Avenue/ Victory Boulevard in Portland and SR 500/39th Street in Vancouver. Some adjacent local streets would be reconfigured to complement the new interchange designs, and improve local east-west connections.
  - An option that shifts the I-5 mainline up to 40 feet westward in downtown Vancouver between the SR 14 interchange and Mill Plain Boulevard interchange is being evaluated.
  - An option that eliminates the existing C Street ramps in downtown Vancouver is being evaluated.
- Six new adjacent bridges across North Portland Harbor: one on the east side of the existing I-5 North Portland Harbor bridge and five on the west side or overlapping with the existing bridge (which would be removed). The bridges would carry (from west to east) LRT tracks, southbound I-5 off-ramp to Marine Drive, southbound I-5 mainline, northbound I-5 mainline, northbound I-5 on-ramp from Marine Drive, and an arterial bridge for local traffic with a shared-use path for pedestrians and bicyclists.
- A variety of improvements for people who walk, bike, and roll throughout the study area, including a system of shared-use paths, bicycle lanes, sidewalks, enhanced wayfinding, and facility improvements to comply with the Americans with Disabilities Act. These are referred to in this document as *active transportation* improvements.
- Variable-rate tolling for motorists using the river crossing as a demand-management and financing tool.

The transportation improvements proposed for the Modified LPA and the design options are shown in Figure 1-2. The Modified LPA includes all of the components listed above. If there are differences in environmental effects or benefits between the design options, those are identified in the sections below.

Figure 1-2. Modified LPA Components

Section 1.1.1, Interstate 5 Mainline, describes the overall configuration of the I-5 mainline through the study area, and Sections 1.1.2, Portland Mainland and Hayden Island (Subarea A), through Section 1.1.5, Upper Vancouver (Subarea D), provide additional detail on four geographic subareas (A through D), which are shown on Figure 1-3. In each subarea, improvements to I-5, its interchanges, and the local roadways are described first, followed by transit and active transportation improvements. Design options are described under separate headings in the subareas in which they would be located.

Table 1-1 shows the different combinations of design options analyzed in this Technical Report. However, **any combination of design options is compatible**. In other words, any of the bridge configurations could be combined with one or two auxiliary lanes, with or without the C Street ramps, a centered or westward shift of I-5 in downtown Vancouver, and any of the park-and-ride location options. Figures in each section show both the anticipated limit of ground disturbance, which includes disturbance from temporary construction activities, and the location of permanent infrastructure elements.

Figure 1-3. Modified LPA – Geographic Subareas

Table 1-1. Modified LPA and Design Options

Design Options	Modified LPA	Modified LPA with Two Auxiliary Lanes	Modified LPA Without C Street Ramps	Modified LPA with I-5 Shifted West	Modified LPA with a Single-Level Fixed-Span Configuration	Modified LPA with a Single-Level Movable-Span Configuration
Bridge Configuration	**Double-deck fixed-span***	Double-deck fixed-span	Double-deck fixed-span	Double-deck fixed-span	**Single-level fixed-span***	**Single-level movable-span***
Auxiliary Lanes	**One***	**Two***	One	One	One	One
C Street Ramps	**With C Street ramps***	With C Street ramps	**Without C Street Ramps***	With C Street ramps	With C Street ramps	With C Street ramps
I-5 Alignment	**Centered***	Centered	Centered	**Shifted West***	Centered	Centered
Park-and-Ride Options	**Waterfront**: * 1. Columbia Way (below I-5); 2. Columbia Street/SR 14; 3. Columbia Street/Phil Arnold Way **Evergreen**: * 1. Library Square; 2. Columbia Credit Union					

Bold text with an asterisk (*) indicates which design option is different in each configuration.

1.1.1 Interstate 5 Mainline

Today, within the 5-mile corridor, I-5 has three 12-foot-wide through lanes in each direction, an approximately 6- to 11-foot-wide inside shoulder, and an approximately 10- to 12-foot-wide outside shoulder with the exception of the Interstate Bridge, which has approximately 2- to 3-foot-wide inside and outside shoulders. There are currently intermittent auxiliary lanes between the Victory Boulevard and Hayden Island interchanges in Oregon and between SR 14 and SR 500 in Washington.

The Modified LPA would include three 12-foot through lanes from Interstate Avenue/Victory Boulevard to SR 500/39th Street and a 12-foot auxiliary lane from the Marine Drive interchange to the Mill Plain Boulevard interchange in each direction. Many of the existing auxiliary lanes on I-5 between the SR 14 and Main Street interchanges in Vancouver would remain, although they would be reconfigured. The existing auxiliary lanes between the Victory Boulevard and Hayden Island interchanges would be replaced with changes to on- and off-ramps and interchange reconfigurations. The Modified LPA would also include wider shoulders (12-foot inside shoulders and 10- to 12-foot outside shoulders) to be consistent with ODOT and WSDOT design standards. The wider inside shoulder would be used by express bus service to bypass mainline congestion, known as “bus on shoulder” (refer to Section 1.1.7, Transit Operating Characteristics). The shoulder would be available for express bus service when general-purpose speeds are below 35 miles per hour (mph).

Figure 1-4 shows a cross section of the collector-distributor (C-D)[1] roadways, Figure 1-5 shows the location of the C-D roadways, and Figure 1-6 shows the proposed auxiliary lane layout. The existing Interstate Bridge over the Columbia River does not have an auxiliary lane; the Modified LPA would add one auxiliary lane in each direction across the new Columbia River bridges.

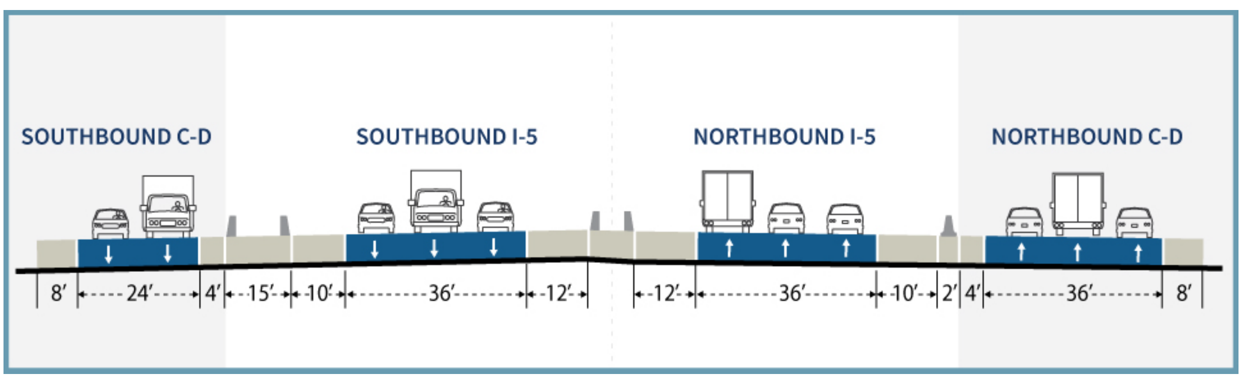
On I-5 northbound, the auxiliary lane that would begin at the on-ramp from Marine Drive would continue across the Columbia River bridge and end at the off-ramp to the C-D roadway, north of SR 14 (see Figure 1-5). The on-ramp from SR 14 westbound would join the off-ramp to the C-D roadway, forming the northbound C-D roadway between SR 14 and Fourth Plain Boulevard. The C-D roadway would provide access from I-5 northbound to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard. The C-D roadway would also provide access from SR 14 westbound to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard, and to the on-ramp to I-5 northbound.

On I-5 northbound, the Modified LPA would also add one auxiliary lane beginning at the on-ramp from the C-D roadway and ending at the on-ramp from 39th Street, connecting to an existing auxiliary lane from 39th Street to the off-ramp at Main Street. Another existing auxiliary lane would remain between the on-ramp from Mill Plain Boulevard to the off-ramp to SR 500.

On I-5 southbound, the off-ramp to the C-D roadway would join the on-ramp from Mill Plain Boulevard to form a C-D roadway. The C-D roadway would provide access from I-5 southbound to the off-ramp to SR 14 eastbound and from Mill Plain Boulevard to the off-ramp to SR 14 eastbound and the on-ramp to I-5 southbound.

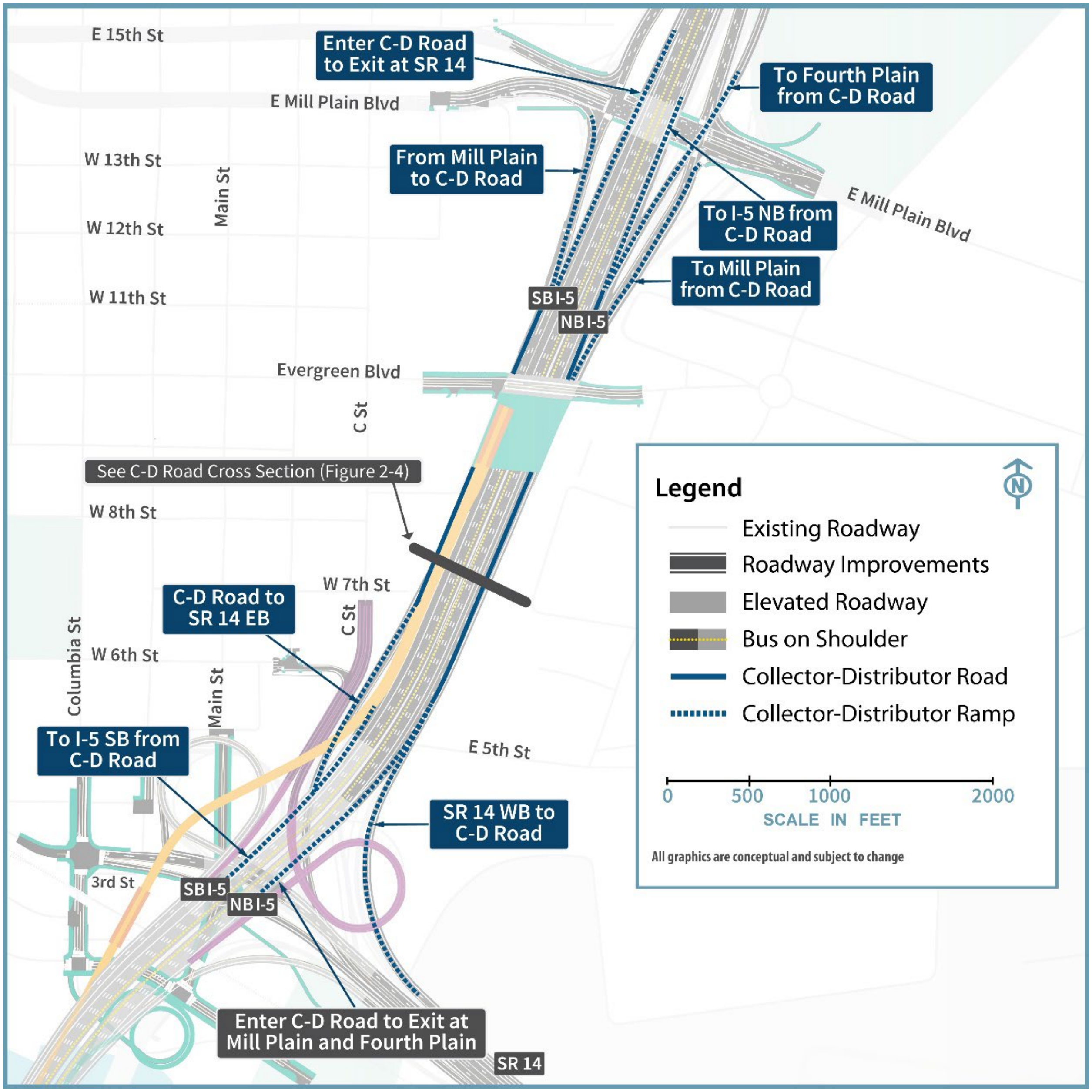
On I-5 southbound, an auxiliary lane would begin at the on-ramp from the C-D roadway and would continue across the southbound Columbia River bridge and end at the off-ramp to Marine Drive. The combined on-ramp from SR 14 westbound and C Street would merge into this auxiliary lane.

Figure 1-4. Cross Section of the Collector-Distributor Roadways



[1] A collector-distributer roadway parallels and connects the main travel lanes of a highway and frontage roads or entrance ramps.

Figure 1-5. Collector-Distributor Roadways



C-D = collector-distributor; EB = eastbound; NB = northbound; SB = southbound; WB = westbound

1.1.1.1 Two Auxiliary Lane Design Option

This design option would add a second 12-foot-wide auxiliary lane in each direction of I-5 with the intent to further optimize travel flow in the corridor. This second auxiliary lane is proposed from the Interstate Avenue/Victory Boulevard interchange to the SR 500/39th Street interchange.

On I-5 northbound, one auxiliary lane would begin at the combined on-ramp from Interstate Avenue and Victory Boulevard, and a second auxiliary lane would begin at the on-ramp from Marine Drive.

Both auxiliary lanes would continue across the northbound Columbia River bridge, and the on-ramp from Hayden Island would merge into the second auxiliary lane on the northbound Columbia River bridge. At the off-ramp to the C-D roadway, the second auxiliary lane would end but the first auxiliary lane would continue. A second auxiliary lane would begin again at the on-ramp from Mill Plain Boulevard. The second auxiliary lane would end at the off-ramp to SR 500, and the first auxiliary lane would connect to an existing auxiliary lane at 39th Street to the off-ramp at Main Street.

On I-5 southbound, two auxiliary lanes would begin at the on-ramp from SR 500. Between the on-ramp from Fourth Plain Boulevard and the off-ramp to Mill Plain Boulevard, one auxiliary lane would be added to the existing two auxiliary lanes. The second auxiliary lane would end at the off-ramp to the C-D roadway, but the first auxiliary lane would continue. A second auxiliary lane would begin again at the southbound I-5 on-ramp from the C-D roadway. Both auxiliary lanes would continue across the southbound Columbia River bridge, and the combined on-ramp from SR 14 westbound and C Street would merge into the second auxiliary lane on the southbound Columbia River bridge. The second auxiliary lane would end at the off-ramp to Marine Drive, and the first auxiliary lane would end at the combined off-ramp to Interstate Avenue and Victory Boulevard.

Figure 1-6 shows a comparison of the one auxiliary lane configuration and the two auxiliary lane configuration design option. Figure 1-7 shows a comparison of the footprints (i.e., the limit of permanent improvements) of the one auxiliary lane and two auxiliary lane configurations on a double-deck fixed-span bridge. For all Modified LPA bridge configurations (described in Section 1.1.3, Columbia River Bridges (Subarea B)), the footprints of the two auxiliary lane configurations differ only over the Columbia River and in downtown Vancouver. The rest of the corridor would have the same footprint. For all bridge configurations analyzed in this document, the two auxiliary lane option would add 16 feet (8 feet in each direction) in total roadway width compared to the one auxiliary lane option due to the increased shoulder widths for the one auxiliary lane option.[2] The traffic operations analysis incorporating both the one and two auxiliary lane design options applies equally to all bridge configurations in this Technical Report.

[2] Under the one auxiliary lane option, the width of each shoulder would be approximately 14 feet to accommodate maintenance of traffic during construction. Under the two auxiliary lane option, maintenance of traffic could be accommodated with 12-foot shoulders because the additional 12-foot auxiliary lane provides adequate roadway width. The total difference in roadway width in each direction between the one auxiliary lane option and the two auxiliary lane option would be 8 feet (12-foot auxiliary lane – 2 feet from the inside shoulder – 2 feet from the outside shoulder = 8 feet).

Figure 1-6. Comparison of Auxiliary Lane Configurations

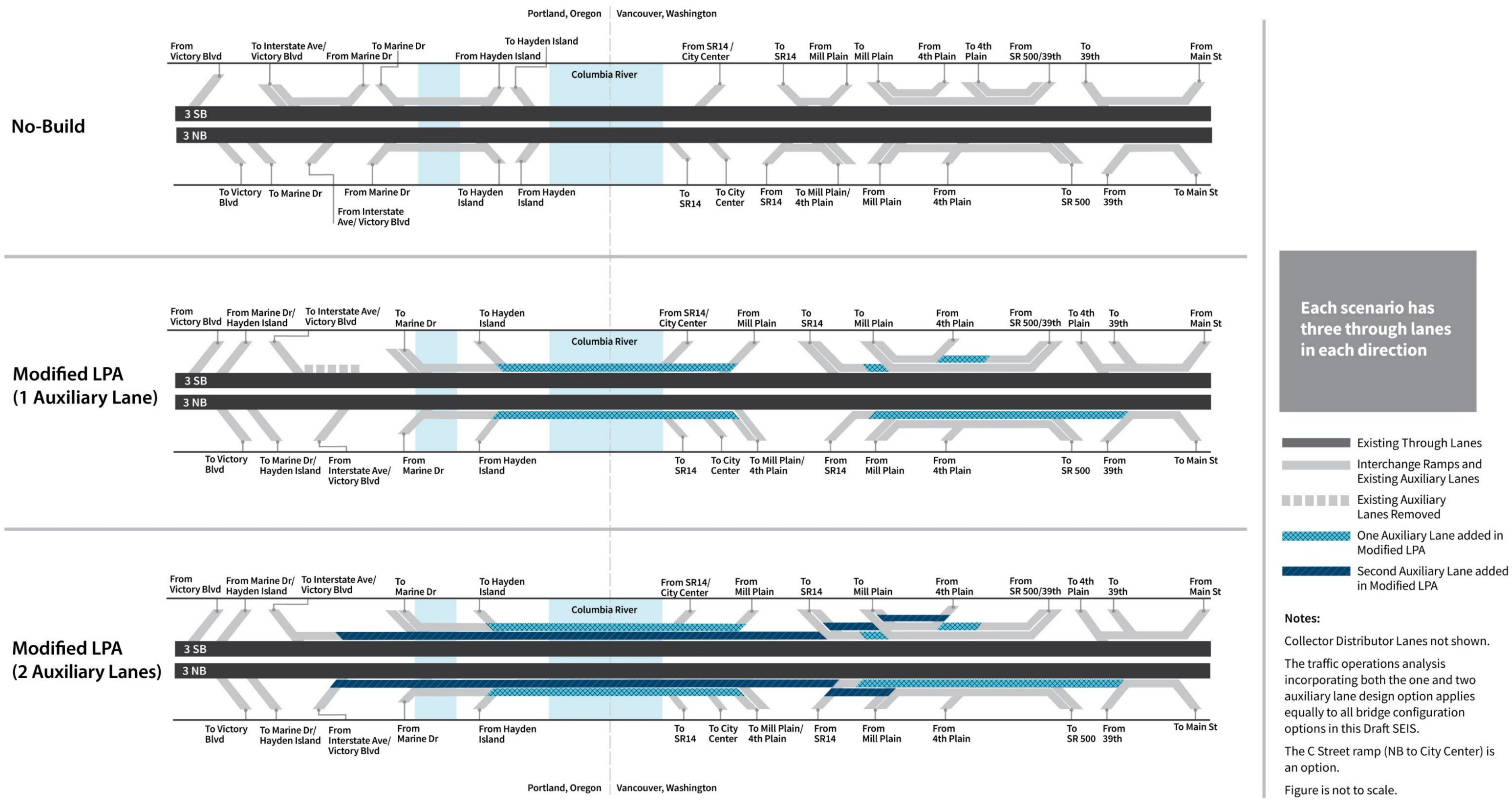
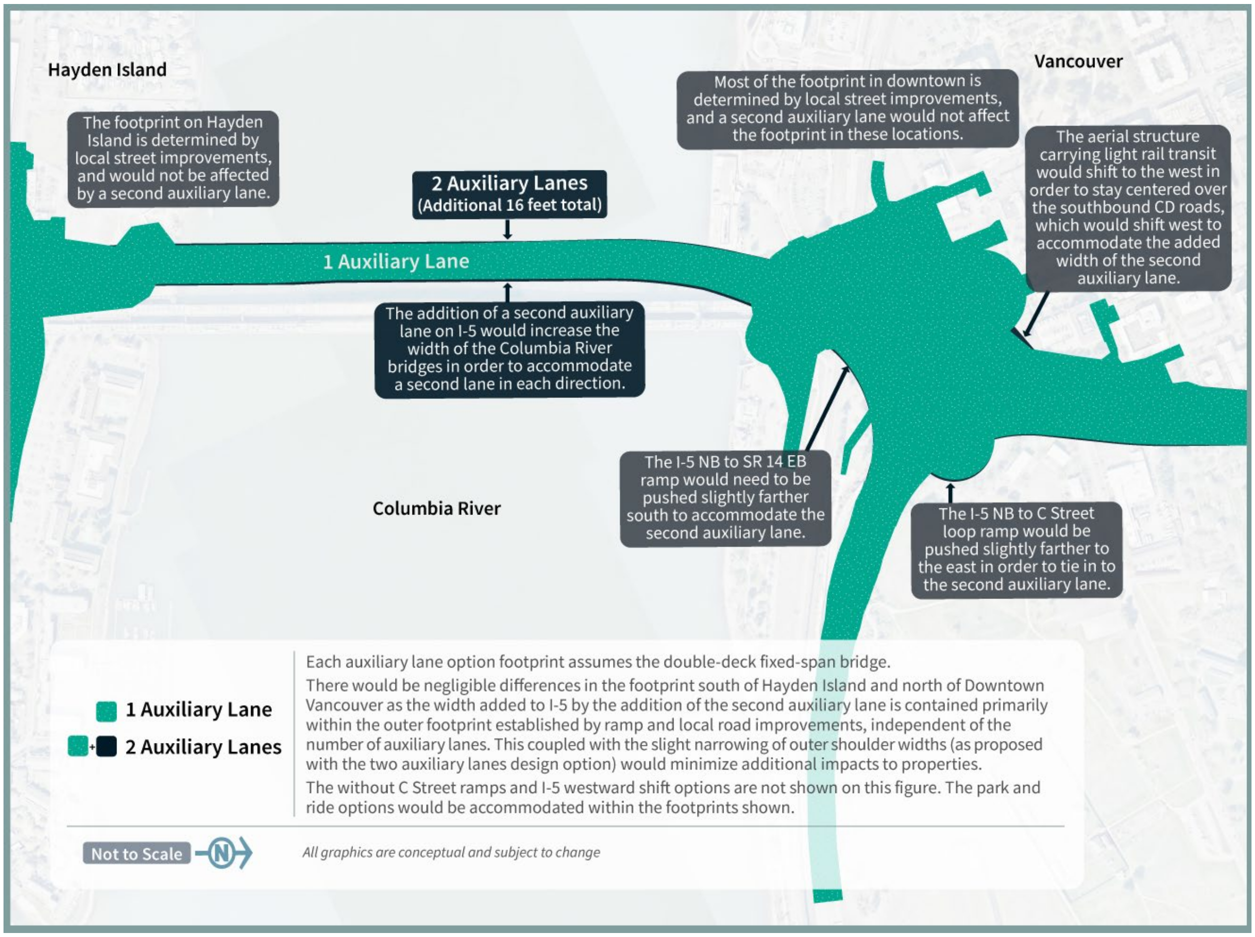


Figure 1-7. Auxiliary Lane Configuration Footprint Differences



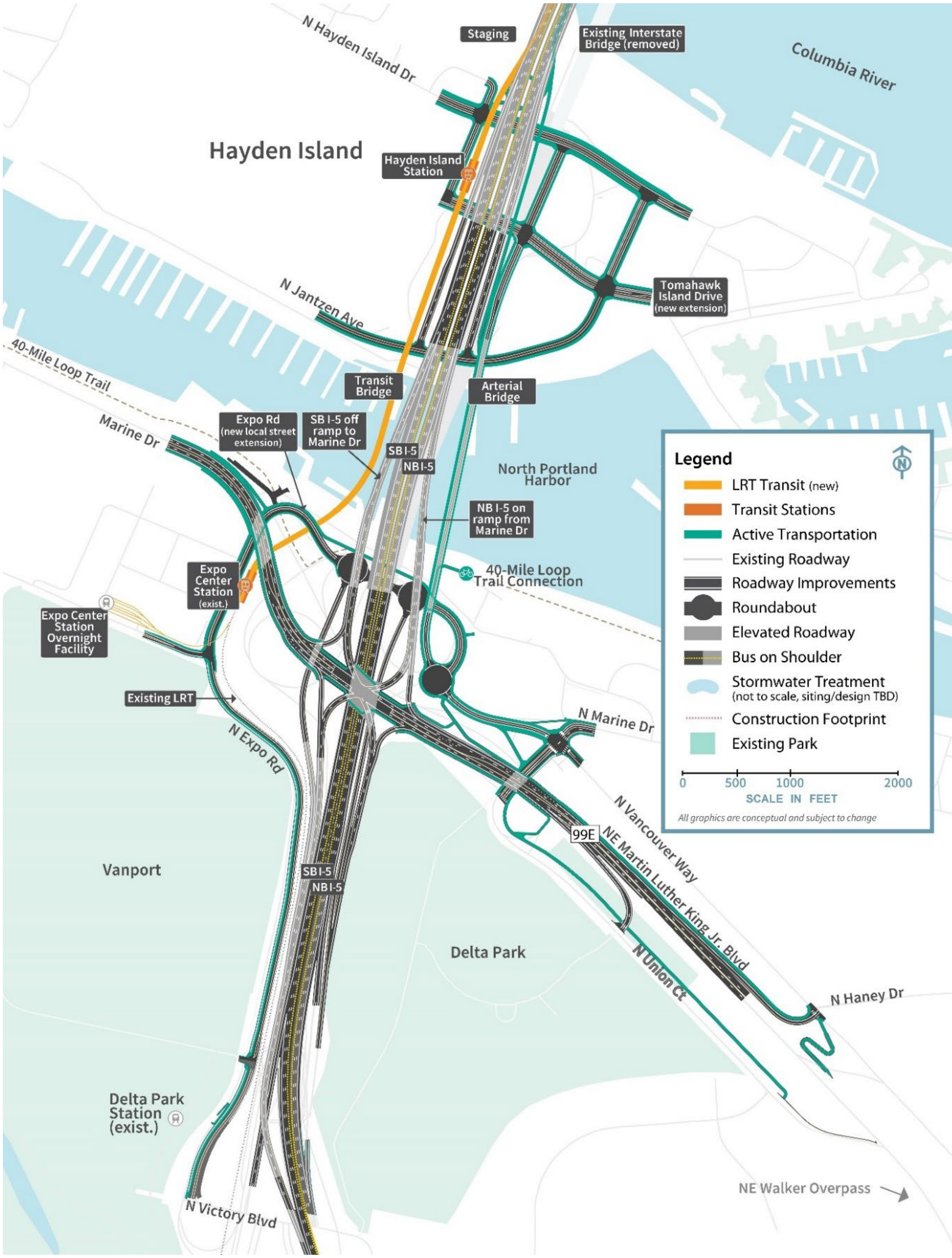
1.1.2 Portland Mainland and Hayden Island (Subarea A)

This section discusses the geographic Subarea A shown in Figure 1-3. See Figure 1-8 for highway and interchange improvements in Subarea A, including the North Portland Harbor bridge. Figure 1-8 illustrates the one auxiliary lane design option; please refer to Figure 1-6 and the accompanying description for how two auxiliary lanes would alter the Modified LPA's proposed design. Refer to Figure 1-3 for an overview of the geographic subareas.

Within Subarea A, the IBR Program has the potential to alter three federally authorized levee systems:

- The Oregon Slough segment of the Peninsula Drainage District Number 1 levee (PEN 1).
- The Oregon Slough segment of the Peninsula Drainage District Number 2 levee (PEN 2).
- The PEN1/PEN2 cross levee segment of the PEN 1 levee (Cross Levee).

Figure 1-8. Portland Mainland and Hayden Island (Subarea A)



LRT = light-rail transit; NB = northbound; SB = southbound; TBD = to be determined

The levee systems are shown on Figure 1-9, and intersections with Modified LPA components are described throughout Section 1.1.2, Portland Mainland and Hayden Island (Subarea A), where appropriate. Within Subarea A, the IBR Program study area intersects with PEN 1 to the west of I-5 and with PEN 2 to the east of I-5. PEN 1 and PEN 2 include a main levee along the south side of North Portland Harbor and are part of a combination of levees and floodwalls. PEN 1 and PEN 2 are separated by the Cross Levee that is intended to isolate the two districts if one of them fails. The Cross Levee is located along the I-5 mainline embankment, except in the Marine Drive interchange area where it is located on the west edge of the existing ramp from Marine Drive to southbound I-5.[3]

There are two concurrent efforts underway that are planning improvements to PEN1, PEN2, and the Cross Levee to reduce flood risk:

- The U.S. Army Corps of Engineers (USACE) Portland Metro Levee System (PMLS) project.
- The Flood Safe Columbia River (FSCR) program (also known as "Levee Ready Columbia").

The Urban Flood Safety and Water Quality District (UFSWQD)[4] is working with the USACE through the PMLS project, which includes improvements at PEN 1 and PEN 2 (e.g., raising these levees to elevation 38 feet North American Vertical Datum of 1988 [NAVD 88]).[5] Additionally, as part of the FSCR program, UFSWQD is studying raising a low spot in the Cross Levee on the southwest side of the Marine Drive interchange.

The IBR Program is in close coordination with these concurrent efforts to ensure that the IBR Program's design efforts consider the timing and scope of the PMLS and the FSCR proposed modifications. The intersection of the IBR Program proposed actions to both the existing levee configuration and the anticipated future condition based on the proposed PMLS and FSCR projects are described below, where appropriate.

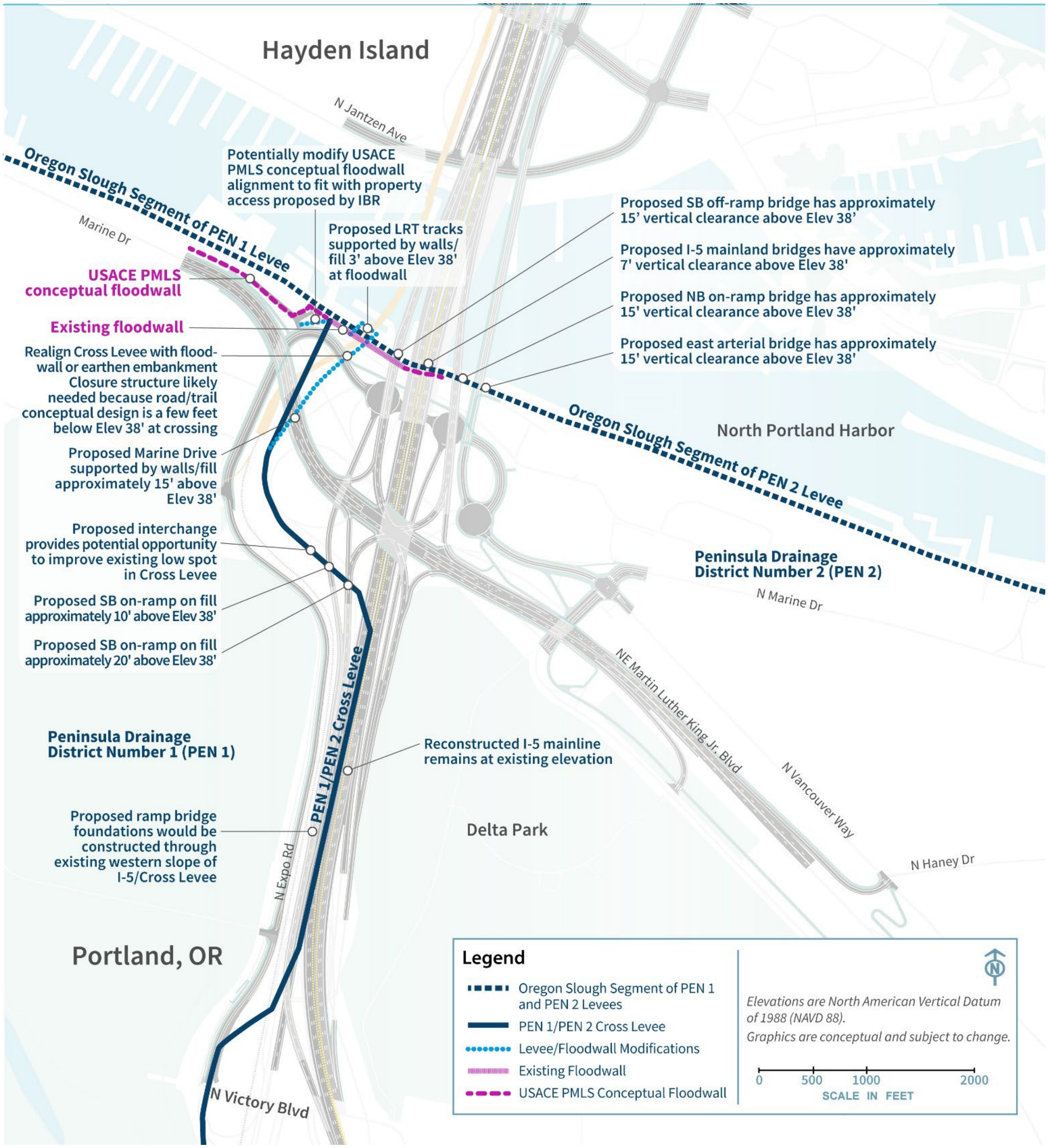
1.1.2.1 Highways, Interchanges, and Local Roadways

VICTORY BOULEVARD/INTERSTATE AVENUE INTERCHANGE AREA

The southern extent of the Modified LPA would improve two ramps at the Victory Boulevard/Interstate Avenue interchange (see Figure 1-8). The first ramp improvement would be the southbound I-5 off-ramp to Victory Boulevard/ Interstate Avenue; this off-ramp would be braided below (i.e., grade separated or pass below) the Marine Drive to the I-5 southbound on-ramp (see the Marine Drive Interchange Area section below). The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Victory Boulevard and from Interstate Avenue.

[3] The portion of the original Denver Avenue levee alignment within the Marine Drive interchange area is no longer considered part of the levee system by UFSWQD.
[4] UFSWQD includes PEN 1 and PEN 2, Urban Flood Safety and Water Quality District No. 1, and the Sandy Drainage Improvement Company.
[5] NAVD 88 is a vertical control datum (reference point) used by federal agencies for surveying.

Figure 1-9. Levee Systems in Subarea A



The existing I-5 mainline between Victory Boulevard/Interstate Avenue and Marine Drive is part of the Cross Levee (see Figure 1-9). The Modified LPA would require some pavement reconstruction of the mainline in this area; however, the improvements would mostly consist of pavement overlay and the profile and footprint would be similar to existing conditions.

MARINE DRIVE INTERCHANGE AREA

The next interchange north of the Victory Boulevard/Interstate Avenue interchange is at Marine Drive. All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5. The new configuration would be a single-point urban interchange. The new interchange would be centered over I-5 versus on the west side under existing conditions. See Figure 1-8 for the Marine Drive interchange's layout and construction footprint.

The Marine Drive to I-5 southbound on-ramp would be braided over I-5 southbound to the Victory Boulevard/Interstate Avenue off-ramp. Martin Luther King Jr. Boulevard would have a new more direct connection to I-5 northbound.

The new interchange configuration would change the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard. An improved connection farther east of the interchange (near Haney Street) would provide access to westbound Martin Luther King Jr. Boulevard for these two streets. For eastbound travelers on Martin Luther King Jr. Boulevard exiting to Union Court, the existing loop connection would be replaced with a new connection farther east (near the access to the East Delta Park Owens Sports Complex).

Expo Road from Victory Boulevard to the Expo Center would be reconstructed with improved active transportation facilities. North of the Expo Center, Expo Road would be extended under Marine Drive and continue under I-5 to the east, connecting with Marine Drive and Vancouver Way through three new connected roundabouts. The westernmost roundabout would connect the new local street extension to I-5 southbound. The middle roundabout would connect the I-5 northbound off-ramp to the local street extension. The easternmost roundabout would connect the new local street extension to an arterial bridge crossing North Portland Harbor to Hayden Island. This roundabout would also connect the local street extension to Marine Dr and Vancouver Way.

To access Hayden Island using the arterial bridge from the east on Martin Luther King Jr. Boulevard, motorists would exit Martin Luther King Jr. Boulevard at the existing off-ramp to Vancouver Way just west of the Walker Street overpass. Then motorists would travel west on Vancouver Way, through the intersection with Marine Drive and straight through the roundabout to the arterial bridge.

From Hayden Island, motorists traveling south to Portland via Martin Luther King Jr. Boulevard would turn onto the arterial bridge southbound and travel straight through the roundabout onto Vancouver Way. At the intersection of Vancouver Way and Marine Drive, motorists would turn right onto Union Court and follow the existing road southeast to the existing on-ramp onto Martin Luther King Jr. Boulevard.

The conceptual floodwall alignment from the proposed USACE PMLS project is located on the north side of Marine Drive, near two industrial properties, with three proposed closure structures[6] for property access. The Modified LPA would realign Marine Drive to the south and provide access to the two industrial properties via the new local road extension from Expo Road. Therefore, the change in access for the two industrial properties could require small modifications to the floodwall alignment (a potential shift of 5 to 10 feet to the south) and closure structure locations.

Marine Drive and the two southbound on-ramps would travel over the Cross Levee approximately 10 to 20 feet above the proposed elevation of the improved levee, and they would be supported by fill and retaining walls near an existing low spot in the Cross Levee.

The I-5 southbound on-ramp from Marine Drive would continue on a new bridge structure. Although the bridge's foundation locations have not been determined yet, they would be constructed through the western slope of the Cross Levee (between the existing I-5 mainline and the existing light-rail).

NORTH PORTLAND HARBOR BRIDGES

To the north of the Marine Drive interchange is the Hayden Island interchange area, which is shown in Figure 1-8. I-5 crosses over the North Portland Harbor when traveling between these two interchanges. The Modified LPA proposes to replace the existing I-5 bridge spanning North Portland Harbor to improve seismic resiliency.

Six new parallel bridges would be built across the waterway under the Modified LPA: one on the east side of the existing I-5 North Portland Harbor bridge and five on the west side or overlapping the location of the existing bridge (which would be removed). From west to east, these bridges would carry:

- The LRT tracks.
- The southbound I-5 off-ramp to Marine Drive.
- The southbound I-5 mainline.
- The northbound I-5 mainline.
- The northbound I-5 on-ramp from Marine Drive.
- An arterial bridge between the Portland mainland and Hayden Island for local traffic; this bridge would also include a shared-use path for pedestrians and bicyclists.

Each of the six replacement North Portland Harbor bridges would be supported on foundations constructed of 10-foot-diameter drilled shafts. Concrete columns would rise from the drilled shafts and connect to the superstructures of the bridges. All new structures would have at least as much vertical navigation clearance over North Portland Harbor as the existing North Portland Harbor bridge.

Compared to the existing bridge, the two new I-5 mainline bridges would have a similar vertical clearance of approximately 7 feet above the proposed height of the improved levees (elevation 38 feet

[6] Levee closure structures are put in place at openings along the embankment/floodwall to provide flood protection during high water conditions.

NAVD 88). The two ramp bridges and the arterial bridge would have approximately 15 feet of vertical clearance above the proposed height of the levees. The foundation locations for the five roadway bridges have not been determined at this stage of design, but some foundations could be constructed through landward or riverward levee slopes.

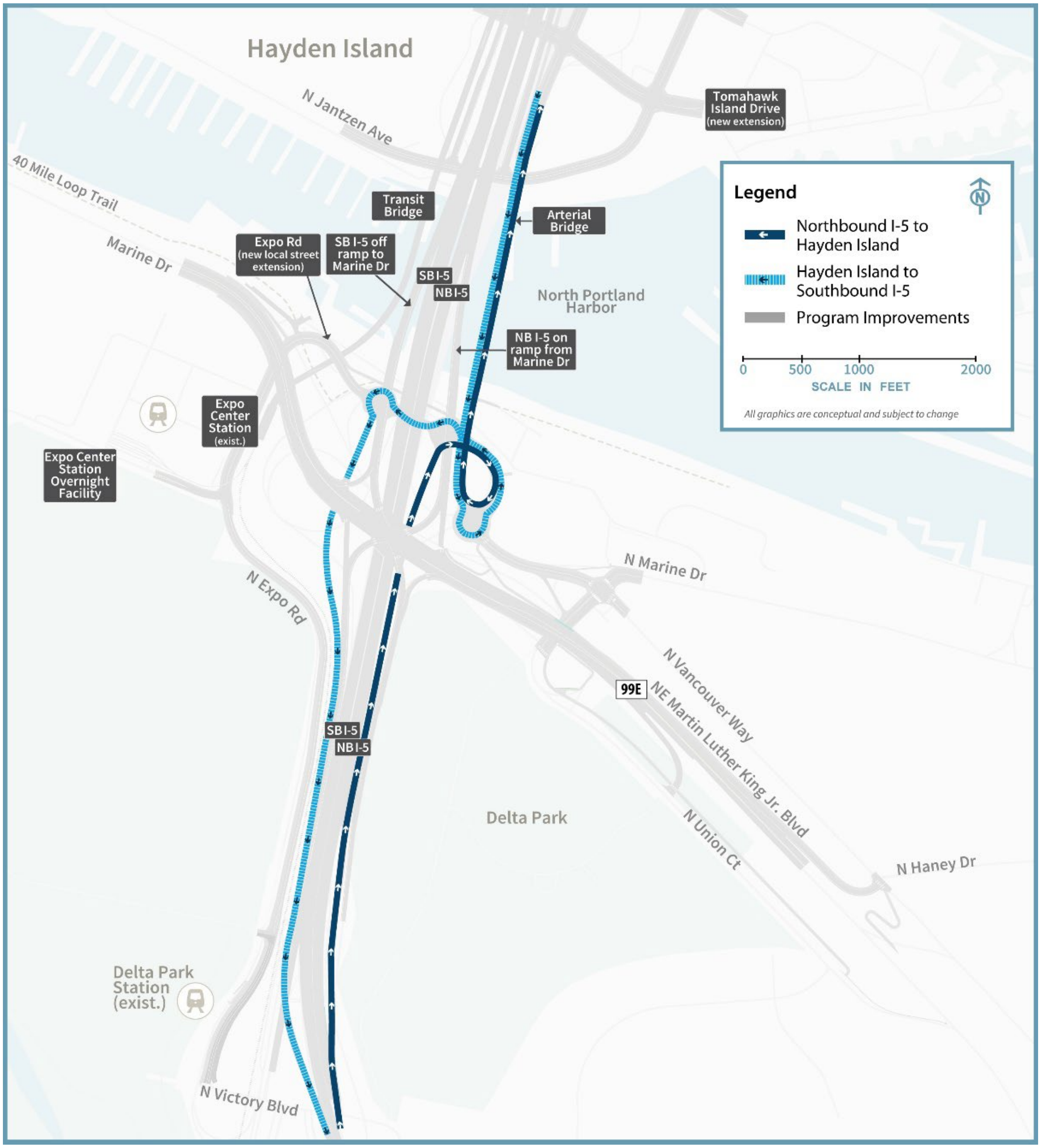
HAYDEN ISLAND INTERCHANGE AREA

All traffic movements for the Hayden Island interchange would be reconfigured. See Figure 1-8 for a layout and construction footprint of the Hayden Island interchange. A half-diamond interchange would be built on Hayden Island with a northbound I-5 on-ramp from Jantzen Drive and a southbound I-5 off-ramp to Jantzen Drive. This would lengthen the ramps and improve merging/diverging speeds compared to the existing substandard ramps that require acceleration and deceleration in a short distance. The I-5 mainline would be partially elevated and partially located on fill across the island.

There would not be a southbound I-5 on-ramp or northbound I-5 off-ramp on Hayden Island. Connections to Hayden Island for those movements would be via the local access (i.e., arterial) bridge connecting North Portland to Hayden Island (Figure 1-10). Vehicles traveling northbound on I-5 wanting to access Hayden Island would exit with traffic going to the Marine Drive interchange, cross under Martin Luther King Jr. Boulevard to the new roundabout at the Expo Road local street extension, travel east through this roundabout to the easternmost roundabout, and use the arterial bridge to cross North Portland Harbor. Vehicles on Hayden Island looking to enter I-5 southbound would use the arterial bridge to cross North Portland Harbor, cross under I-5 using the new Expo Road local street extension to the westernmost roundabout, cross under Marine Drive, merge with the Marine Drive southbound on-ramp, and merge with I-5 southbound south of Victory Boulevard.

Improvements to Jantzen Avenue may include additional left-turn and right-turn lanes at the interchange ramp terminals and active transportation facilities. Improvements to Hayden Island Drive would include new connections to the new arterial bridge over North Portland Harbor. The existing I-5 northbound and southbound access points from Hayden Island Drive would also be removed. A new extension of Tomahawk Island Drive would travel east-west through the middle of Hayden Island and under the I-5 interchange, thus improving connectivity across I-5 on the island.

Figure 1-10. Vehicle Circulation between Hayden Island and the Portland Mainland



NB = northbound; SB = southbound

1.1.2.2 Transit

A new light-rail alignment for northbound and southbound trains would be constructed within Subarea A (see Figure 1-8) to extend from the existing Expo Center MAX Station over North Portland Harbor to a new station at Hayden Island. An overnight LRV facility would be constructed on the southeast corner of the Expo Center property (see Figure 1-8) to provide storage for trains during hours when MAX is not in service. This facility is described in Section 1.1.6, Transit Support Facilities. The existing Expo Center MAX Station would be modified to remove the westernmost track and platform. Other platform modifications, including track realignment and regrading the station, are anticipated to transition to the extension alignment. This may require reconstruction of the operator break facility, signal/communication buildings, and traction power substations. Immediately north of the Expo Center MAX Station, the alignment would curve east toward I-5, pass beneath Marine Drive, cross the proposed Expo Road local street extension and the 40-Mile Loop Trail at grade, then rise over the existing levee onto a light-rail bridge to cross North Portland Harbor. On Hayden Island, proposed transit components include northbound and southbound LRT tracks over Hayden Island; the tracks would be elevated at approximately the height of the new I-5 mainline. An elevated LRT station would also be built on the island immediately west of I-5. The light-rail alignment would extend north on Hayden Island along the western edge of I-5 before transitioning onto the lower level of the new double-deck western bridge over the Columbia River (see Figure 1-8). For the single-level configurations, the light-rail alignment would extend to the outer edge of the western bridge over the Columbia River.

After crossing the new local road extension from Expo Road, the new light-rail track would cross over the main levee (see Figure 1-9). The light-rail profile is anticipated to be approximately 3 feet above the improved levees at the existing floodwall (and improved floodwall), and the tracks would be constructed on fill supported by retaining walls above the floodwall. North of the floodwall, the light-rail tracks would continue onto the new light-rail bridge over North Portland Harbor (as described above).

The Modified LPA's light-rail extension would be close to or would cross the north end of the Cross Levee. The IBR Program would realign the Cross Levee to the east of the light-rail alignment to avoid the need for a closure structure on the light-rail alignment. This realigned Cross Levee would cross the new local road extension. A closure structure may be required because the current proposed roadway is a few feet lower than the proposed elevation of the improved levee.

1.1.2.3 Active Transportation

In the Victory Boulevard interchange area (see Figure 1-8), active transportation facilities would be provided along Expo Road between Victory Boulevard and the Expo Center; this would provide a direct connection between the Victory Boulevard and Marine Drive interchange areas, as well as links to the Delta Park and Expo Center MAX Stations.

New shared-use path connections throughout the Marine Drive interchange area would provide access between the Bridgeton neighborhood (on the east side of I-5), Hayden Island, and the Expo Center MAX Station. There would also be connections to the existing portions of the 40-Mile Loop Trail, which runs north of Marine Drive under I-5 through the interchange area. The path would continue along the extension of Expo Road under the interchange to the intersection of Marine Drive and Vancouver Way, where it would connect under Martin Luther King Jr. Boulevard to Delta Park.

East of the Marine Drive interchange, new shared-use paths on Martin Luther King Jr. Boulevard and on the parallel street, Union Court, would connect travelers to Marine Drive and across the arterial bridge to Hayden Island. The shared-use facilities on Martin Luther King Jr. Boulevard would provide westbound and eastbound cyclists and pedestrians with off-street crossings of the interchange and would also provide connections to both the Expo Center MAX Station and the 40-Mile Loop Trail to the west.

The new arterial bridge over North Portland Harbor would include a shared-use path for pedestrians and bicyclists (see Figure 1-8). On Hayden Island, pedestrian and bicycle facilities would be provided on Jantzen Avenue, Hayden Island Drive, and Tomahawk Island Drive. The shared-use path on the arterial bridge would continue along the arterial bridge to the south side of Tomahawk Island Drive. A parallel, elevated path from the arterial bridge would continue adjacent to I-5 across Hayden Island and cross above Tomahawk Island Drive and Hayden Island Drive to connect to the lower level of the new double-deck eastern bridge or the outer edge of the new single-level eastern bridge over the Columbia River. A ramp down to the north side of Hayden Island Drive would be provided from the elevated path.

1.1.3 Columbia River Bridges (Subarea B)

This section discusses the geographic Subarea B shown in Figure 1-3. See Figure 1-11 for highway and interchange improvements in Subarea B. Refer to Figure 1-3 for an overview of the geographic subareas.

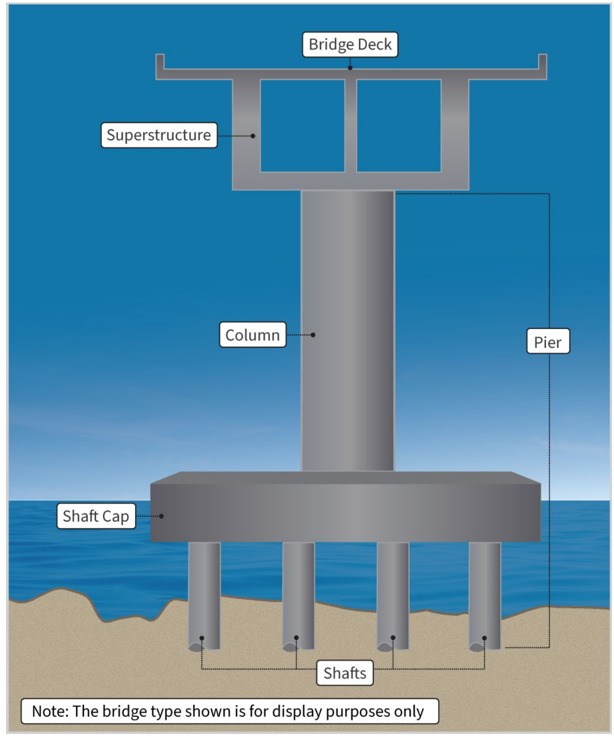
Figure 1-11. Columbia River Bridges (Subarea B)

1.1.3.1 Highways, Interchanges, and Local Roadways

The two existing parallel I-5 bridges that cross the Columbia River would be replaced by two new parallel bridges, located west of the existing bridges (see Figure 1-11). The new eastern bridge would accommodate northbound highway traffic and a shared-use path. The new western bridge would carry southbound traffic and two-way light-rail tracks. Whereas the existing bridges each have three lanes with no shoulders, each of the two new bridges would be wide enough to accommodate three through lanes, one or two auxiliary lanes, and shoulders on both sides of the highway. Lanes and shoulders would be built to full design standards.

As with the existing bridge (Figure 1-13), the new Columbia River bridges would provide three navigation channels: a primary navigation channel and two barge channels (see Figure 1-14). The current location of the primary navigation channel is near the Vancouver shoreline where the existing lift spans are located. Under the Modified LPA, the primary navigation channel would be shifted south approximately 500 feet (measured by channel centerlines), and the existing center barge channel would shift north and become the north barge channel. The new primary navigation channel would be 400 feet wide (this width includes a 300-foot congressionally or USACE-authorized channel plus a 50-foot channel maintenance buffer on each side of the authorized channel) and the two barge channels would also each be 400 feet wide.

Figure 1-12. Bridge Foundation Concept



The existing Interstate Bridge has nine in-water pier sets,[7] whereas the new Columbia River bridges (any bridge configuration) would be built on six in-water pier sets, plus multiple piers on land (pier locations are shown on Figure 1-14). Each in-water pier set would be supported by a foundation of drilled shafts; each group of shafts would be tied together with a concrete shaft cap. Columns or pier walls would rise from the shaft caps and connect to the superstructures of the bridges (see Figure 1-12).

BRIDGE CONFIGURATIONS

Three bridge configurations are being considered: (1) double-deck fixed-span (with one bridge type), (2) a single-level fixed-span (with three potential bridge types), and (3) a single-level movable-span (with one bridge type). Both the double-deck and single-level fixed-span configurations would provide 116 feet of vertical navigation clearance at their respective highest spans; the same as the CRC LPA. The CRC LPA included a double-deck fixed-span bridge configuration. The single-level fixed-span configuration was developed and is being considered as part of the IBR Program in response to physical and contextual changes (i.e., design and operational considerations) since 2013 that necessitated examination of a refinement in the double-deck bridge configuration (e.g., ingress and egress of transit from the lower level of the double-deck fixed-span configuration on the north end of the southbound bridge).

[7] A pier set consists of the pier supporting the northbound bridge and the pier supporting the southbound bridge at a given location.

Figure 1-13. Existing Navigation Clearances of the Interstate Bridge

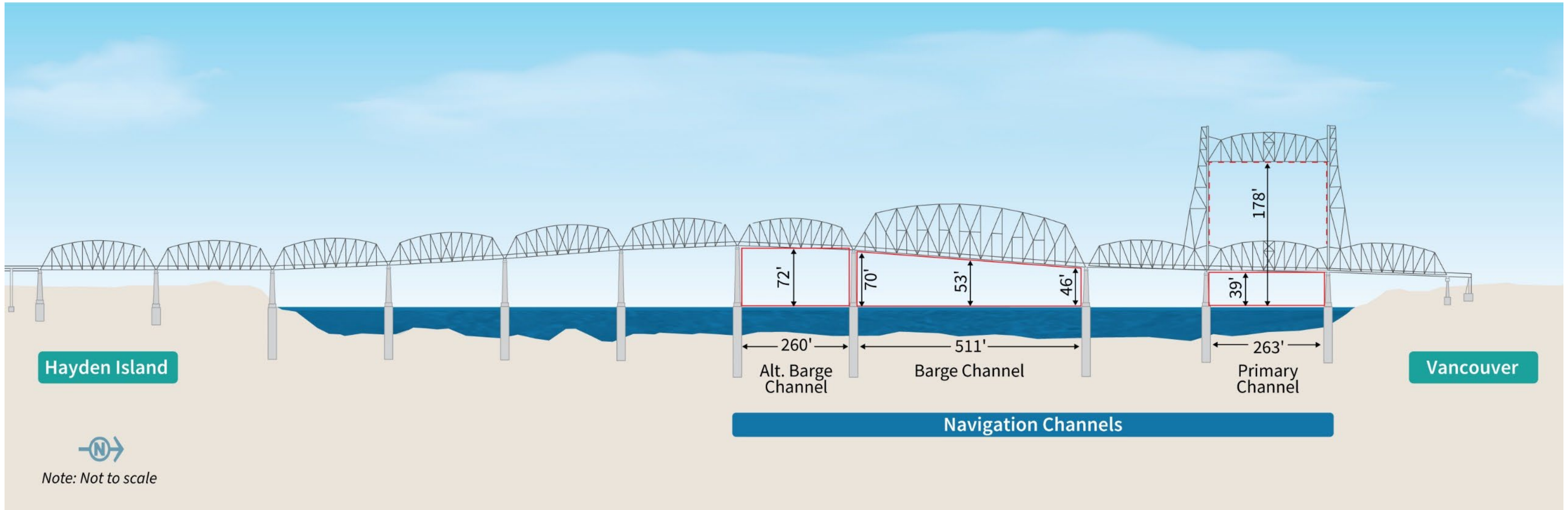
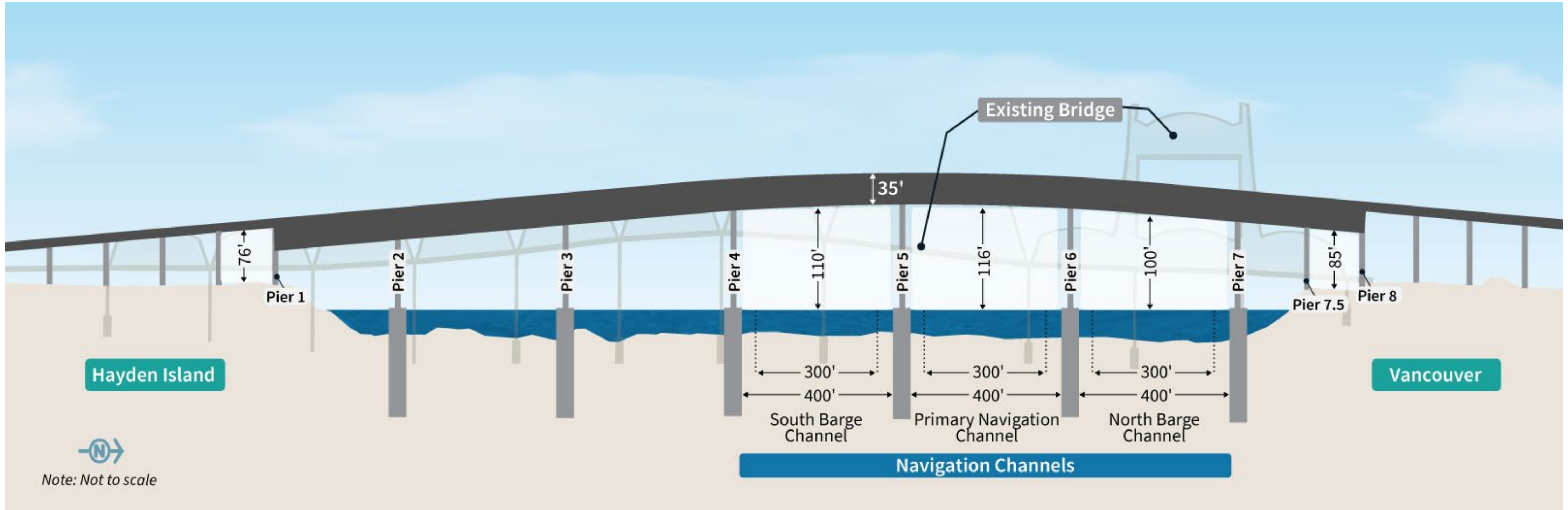


Figure 1-14. Profile and Navigation Clearances of the Proposed Modified LPA Columbia River Bridges with a Double-Deck Fixed-Span Configuration



Note: The location and widths of the proposed navigation channels would be same for all bridge configuration and bridge type options. The three navigation channels would each be 400 feet wide (this width includes a 300-foot congressionally or USACE-authorized channel (shown in dotted lines) plus a 50-foot channel maintenance buffer on each side of the authorized channel). The vertical navigation clearance would vary.

Consideration of the single-level movable-span configuration as part the IBR Program was necessitated by the U.S. Coast Guard's (USCG) review of the Program's navigation impacts on the Columbia River and issuance of a Preliminary Navigation Clearance Determination (PNCD) (USCG 2022). The USCG PNCD set the preliminary vertical navigation clearance recommended for the issuance of a bridge permit at 178 feet; this is the current vertical navigation clearance of the Interstate Bridge.

The IBR Program is carrying forward the three bridge configurations to address changed conditions, including changes in the USCG bridge permitting process, in order to ensure a permittable bridge configuration is within the range of options considered. The IBR Program continues to refine the details supporting navigation impacts and is coordinating closely with the USCG to determine how a fixed-span bridge may be permittable. Although the fixed-span configurations do not comply with the current USCG PNCD, they do meet the Purpose and Need and provide potential improvements to traffic (passenger vehicle and freight), transit, and active transportation operations.

Each of the bridge configurations assumes one auxiliary lane; two auxiliary lanes could be applied to any of the bridge configurations. All typical sections for the one auxiliary lane option would provide 14-foot shoulders to maintain traffic during construction of the Modified LPA and future maintenance.

Double-Deck Fixed-Span Configuration

The double-deck fixed-span configuration would be two side-by-side, double-deck, fixed-span steel truss bridges. Figure 1-15 is an example of this configuration (this image is subject to change and is shown as a representative concept; it does not depict the final design). The double-deck fixed-span configuration would provide 116 feet of vertical navigation clearance for river traffic using the primary navigation channel and 400 feet of horizontal navigation clearance at the primary navigation channel, as well as barge channels. This bridge height would not impede takeoffs and landings by aircraft using Pearson Field or Portland International Airport.

Figure 1-15. Conceptual Drawing of a Double-Deck Fixed-Span Configuration

Note: Visualization is looking southwest from Vancouver.

The eastern bridge would accommodate northbound highway traffic on the upper level and the shared-use path and utilities on the lower level. The western bridge would carry southbound traffic on the upper level and two-way light-rail tracks on the lower level. Each bridge deck would be 79 feet wide, with a total out-to-out width of 173 feet.[8]

Figure 1-16 is a cross section of the two parallel double-deck bridges. Like all bridge configurations, the double-deck fixed-span configuration would have six in-water pier sets. Each pier set would require 12 in-water drilled shafts, for a total of 72 in-water drilled shafts. Each individual shaft cap would be approximately 50 feet by 85 feet. This bridge configuration would have a 3.8% maximum grade on the Oregon side of the bridge and a 4% maximum grade on the Washington side.

Single-Level Fixed-Span Configuration

The single-level fixed-span configuration would have two side-by-side, single-level, fixed-span steel or concrete bridges. This report considers three single-level fixed-span bridge type options: a girder bridge, an extradosed bridge, and a finback bridge. The description in this section applies to all three bridge types (unless otherwise indicated). Conceptual examples of each of these options are shown on Figure 1-17. These images are subject to change and do not represent final design.

This configuration would provide 116 feet of vertical navigation clearance for river traffic using the primary navigation channel and 400 feet of horizontal navigation clearance at the primary navigation channel, as well as barge channels. This bridge height would not impede takeoffs and landings by aircraft using Pearson Field or Portland International Airport.

The eastern bridge would accommodate northbound highway traffic and the shared-use path; the bridge deck would be 104 feet wide. The western bridge would carry southbound traffic and two-way light-rail tracks; the bridge deck would be 113 feet wide. The I-5 highway, light-rail tracks, and the shared-use path would be on the same level across the two bridges, instead of being divided between two levels with the double-deck configuration. The total out-to-out width of the single-level fixed-span configuration (extradosed or finback options) would be 272 feet at its widest point, approximately 99 feet wider than the double-deck configuration. The total out-to-out width of the single-level fixed-span configuration (girder option) would be 232 feet at its widest point. Figure 1-18 shows a typical cross section of the single-level configuration. This cross section is a representative example of an extradosed or finback bridge as shown by the 10-foot-wide superstructure above the bridge deck; the girder bridge would not have the 10-foot-wide bridge columns shown on Figure 1-18.

There would be six in-water pier sets with 16 in-water drilled shafts on each combined shaft cap, for a total of 96 in-water drilled shafts. The combined shaft caps for each pier set would be 50 feet by 230 feet.

This bridge configuration would have a 3% maximum grade on both the Oregon and Washington sides of the bridge.

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[8] "Out-to-out width" is the measurement between the outside edges of the bridge across its width at the widest point.

Figure 1-16. Cross Section of the Double-Deck Fixed-Span Configuration

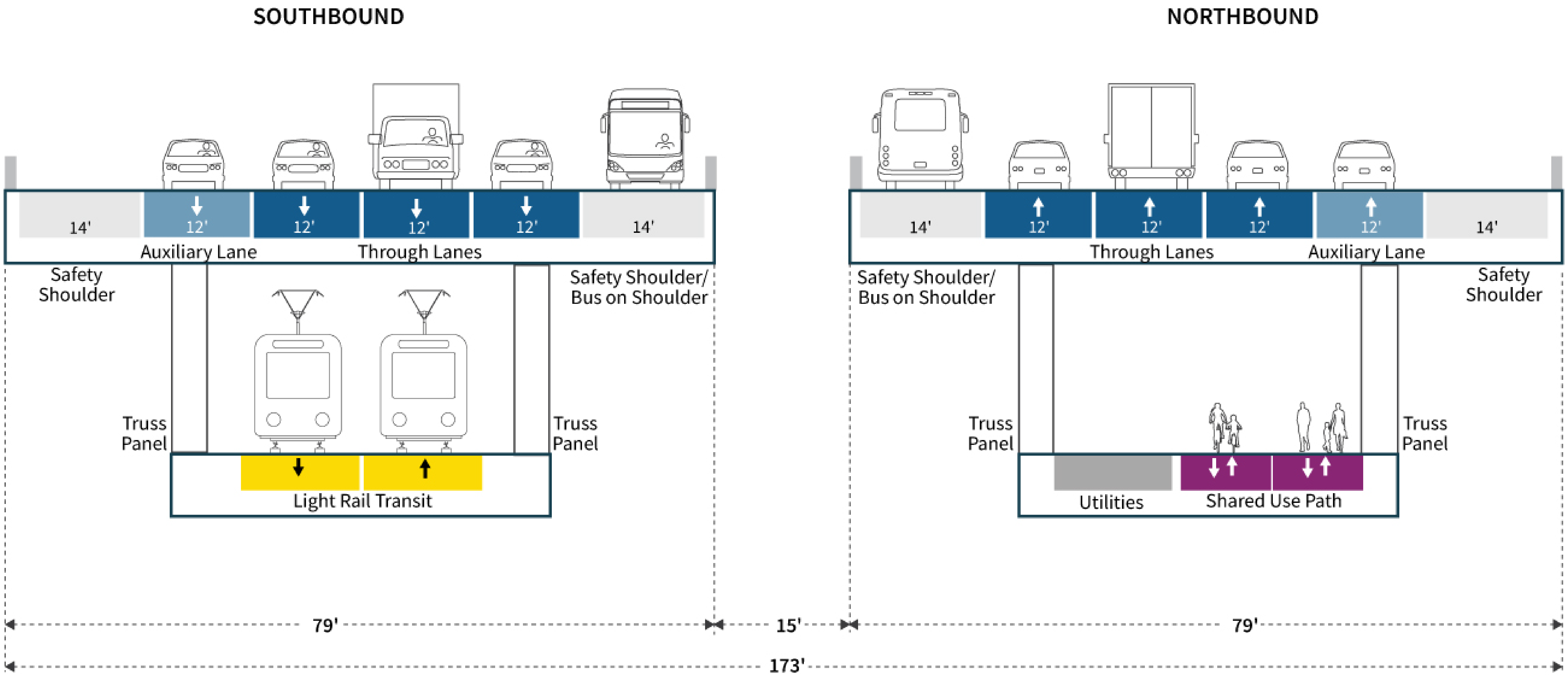
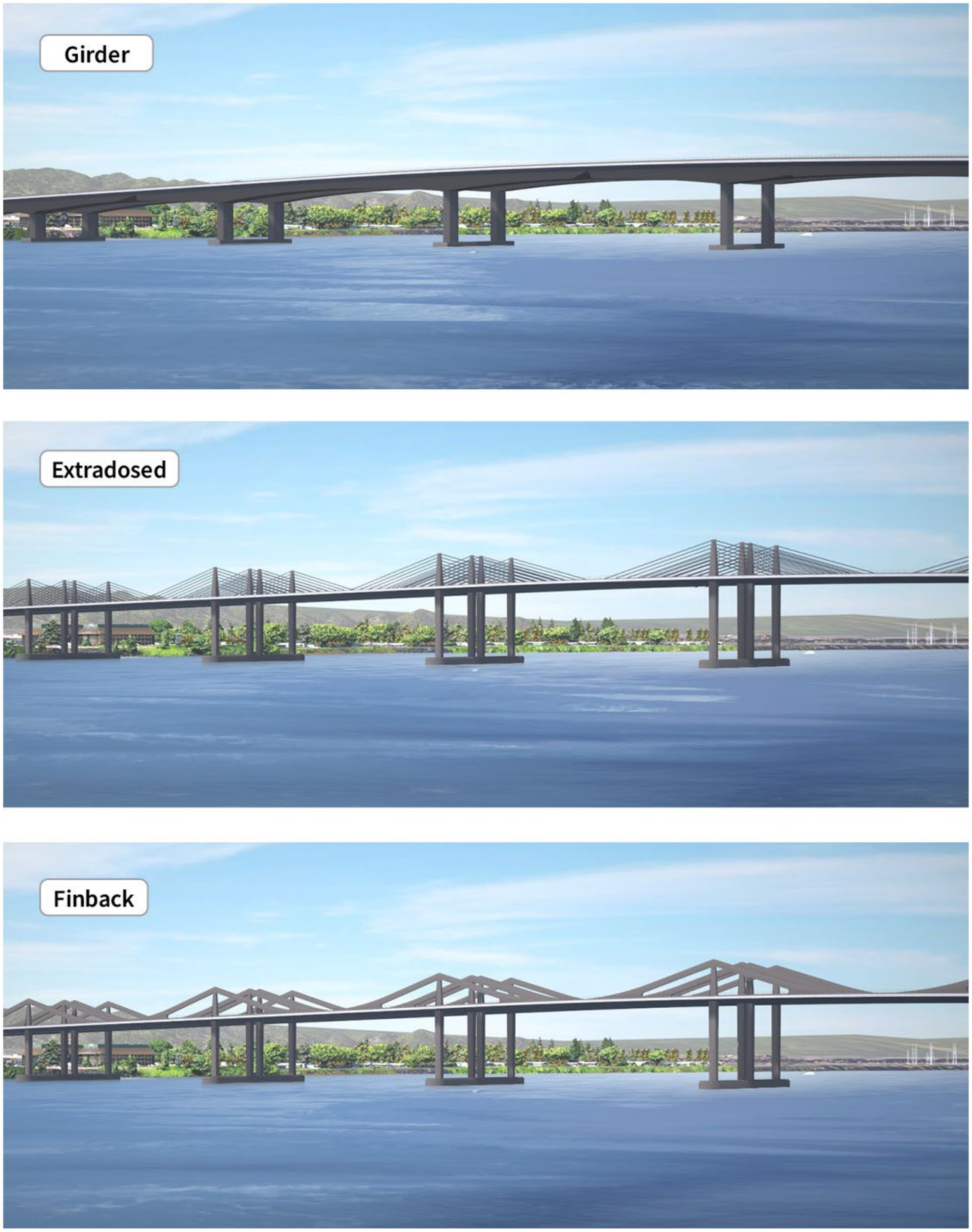
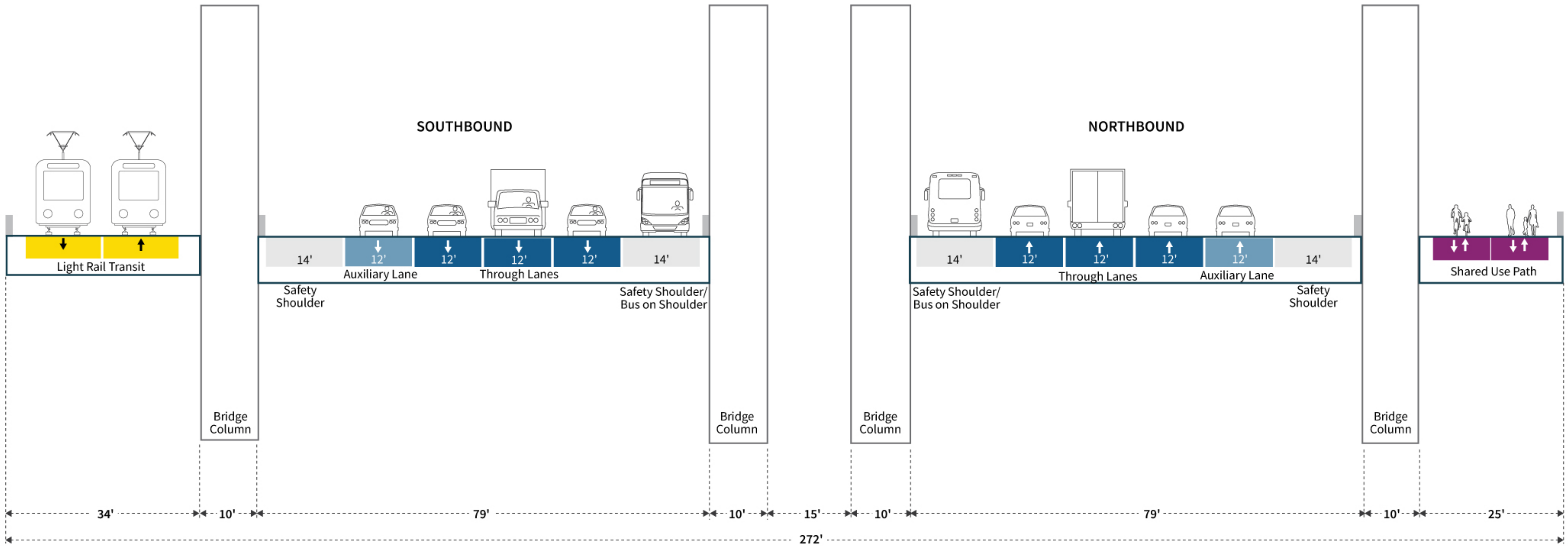


Figure 1-17. Conceptual Drawings of Single-Level Fixed-Span Bridge Types



Note: Visualizations are for illustrative purposes only. They do not reflect property impacts or represent final design. Visualization is looking southwest from Vancouver.

Figure 1-18. Cross Section of the Single-Level Fixed-Span Configuration (Extradosed or Finback Bridge Types)



Note: The cross section for a girder type bridge would be the same except that it would not have the four 10-foot bridge columns making the total out-to-out width 232 feet.

Single-Level Movable-Span Configuration

The single-level movable-span configuration would have two side-by-side, single-level steel girder bridges with movable spans between Piers 5 and 6. For the purpose of this report, the IBR Program assessed a vertical lift span movable-span configuration with counterweights based on the analysis in the *River Crossing Bridge Clearance Assessment Report – Movable-Span Options,* included as part of Attachment C in Appendix D, Design Options Development, Screening, and Evaluation Technical Report. A conceptual example of a vertical lift-span bridge is shown in Figure 1-19. These images are subject to change and do not represent final design.

Figure 1-19. Conceptual Drawings of Single-Level Movable-Span Configurations in the Closed and Open Positions

Note: Visualizations are for illustrative purposes only. They do not reflect property impacts or represent final design. Visualization is looking southeast (upstream) from Vancouver.

A movable span must be located on a straight and flat bridge section (i.e., without curvature and with minimal slope). To comply with these requirements, and for the bridge to maintain the highway, transit, and active transportation connections on Hayden Island and in Vancouver while minimizing property acquisitions and displacements, the movable span is proposed to be located 500 feet south of the existing lift span, between Piers 5 and 6. To accommodate this location of the movable span, the IBR Program is coordinating with USACE to obtain authorization to change the location of the primary navigation channel, which currently aligns with the Interstate Bridge lift spans near the Washington shoreline.

The single-level movable-span configuration would provide 92 feet of vertical navigation clearance over the proposed relocated primary navigation channel when the movable spans are in the closed position, with 99 feet of vertical navigation clearance available over the north barge channel. The 92-foot vertical clearance is based on achieving a straight, movable span and maintaining an acceptable grade for transit operations. In addition, it satisfies the requirement of a minimum of 72 feet of vertical navigation clearance (the existing Interstate Bridge's maximum clearance over the alternate (southernmost) barge channel when the existing lift span is in the closed position).

In the open position, the movable span would provide 178 feet of vertical navigation clearance over the proposed relocated primary navigation channel.

Similar to the fixed-span configurations, the movable span would provide 400 feet of horizontal navigation clearance for the primary navigation channel and for each of the two barge channels.

The vertical lift-span towers would be approximately 243 feet high; this is shorter than the existing lift-span towers, which are 247 feet high. This height of the vertical lift-span towers would not impede takeoffs and landings by aircraft using Portland International Airport. At Pearson Field, the Federal Aviation Administration issues obstacle departure procedures to avoid the existing Interstate Bridge lift towers; the single-level movable-span configuration would retain the same procedures.

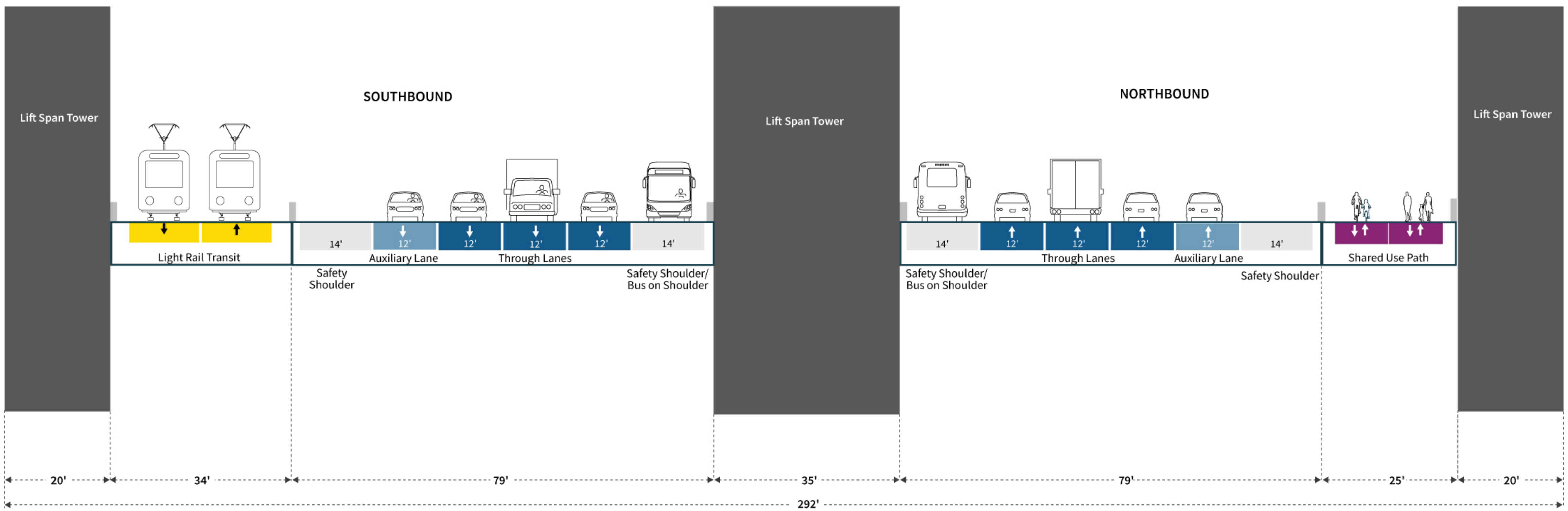
Similar to the single-level fixed-span configuration, the eastern bridge would accommodate northbound highway traffic and the shared-use path, and the western bridge would carry southbound traffic and two-way light-rail tracks. The I-5 highway, light-rail tracks, and shared-use path would be on the same level across the bridges instead of on two levels as with the double-deck configuration. Cross sections of the single-level movable-span configuration are shown in Figure 1-20; the top cross section depicts the vertical lift spans (Piers 5 and 6), and the bottom cross section depicts the fixed spans (Piers 2, 3, 4, and 7). The movable and fixed cross sections are slightly different because the movable span requires lift towers, which are not required for the other fixed spans of the bridges.

There would be six in-water pier sets and two piers on land per bridge. The vertical lift span would have 22 in-water drilled shafts each for Piers 5 and 6; the shaft caps for these piers would be 50 feet by 312 feet to accommodate the vertical lift spans. Piers 2, 3, 4, and 7 would have 16 in-water drilled shafts each; the shaft caps for these piers would be the same as for the fixed-span options (50 feet by 230 feet). The vertical lift-span configuration would have a total of 108 in-water drilled shafts.

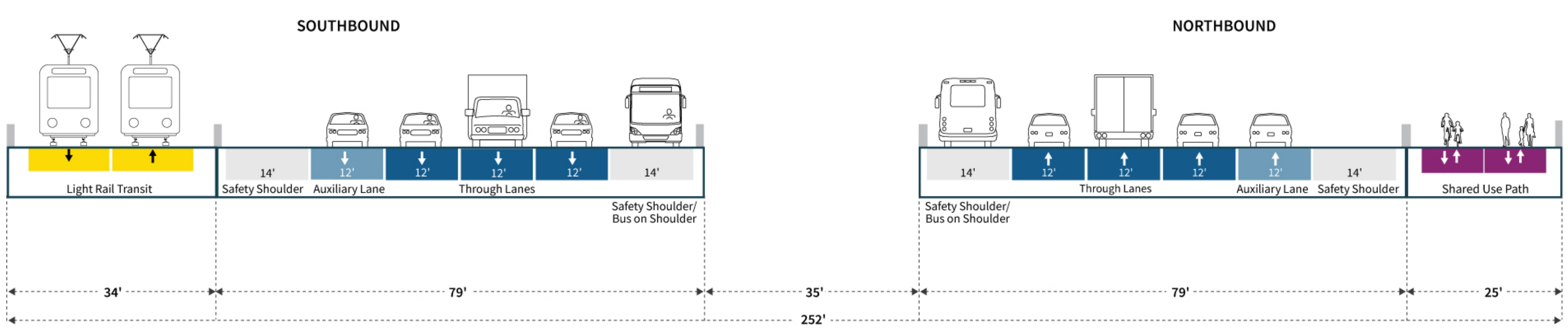
This single-level movable-span configuration would have a 3% maximum grade on the Oregon side of the bridge and a 1.5% maximum grade on the Washington side.

Figure 1-20. Cross Section of the Single-Level Movable-Span Bridge Type

Single-level Bridge with Movable Span - Vertical Lift Span Cross-section (Piers 5 and 6)



Single-level Bridge with Movable Span - Fixed Spans Cross-section (Piers 2, 3, 4, and 7)



Summary of Bridge Configurations

This section summarizes and compares each of the bridge configurations. Table 1-2 lists the key considerations for each configuration. Figure 1-21 compares each configuration's footprint. The footprints of each configuration would differ in only three locations: over the Columbia River and at the bridge landings on Hayden Island and Vancouver. The rest of the I-5 corridor would have the same footprint. Over the Columbia River, the footprint of the double-deck fixed-span configuration would be 173 feet wide. Comparatively, the finback or extradosed bridge types of the single-level fixed-span configuration would be 272 feet wide (approximately 99 feet wider), and the single-level fixed-span configuration with a girder bridge type would be 232 feet wide (approximately 59 feet wider). The single-level movable-span configuration would be 252 feet wide (approximately 79 feet wider than the double-deck fixed-span configuration), except at Piers 5 and 6, where larger bridge foundations would require an additional 40 feet of width to support the movable span. The single-level configurations would have a wider footprint at the bridge landings on Hayden Island and Vancouver because transit and active transportation would be located adjacent to the highway, rather than below the highway in the double-deck option.

Figure 1-22 compares the basic profile of each configuration. The lower deck of the double-deck fixed-span and the single-level fixed-span configuration would have similar profiles. The single-level movable-span configuration would have a lower profile than the fixed-span configurations when the span is in the closed position.

Figure 1-21. Bridge Configuration Footprint Comparison

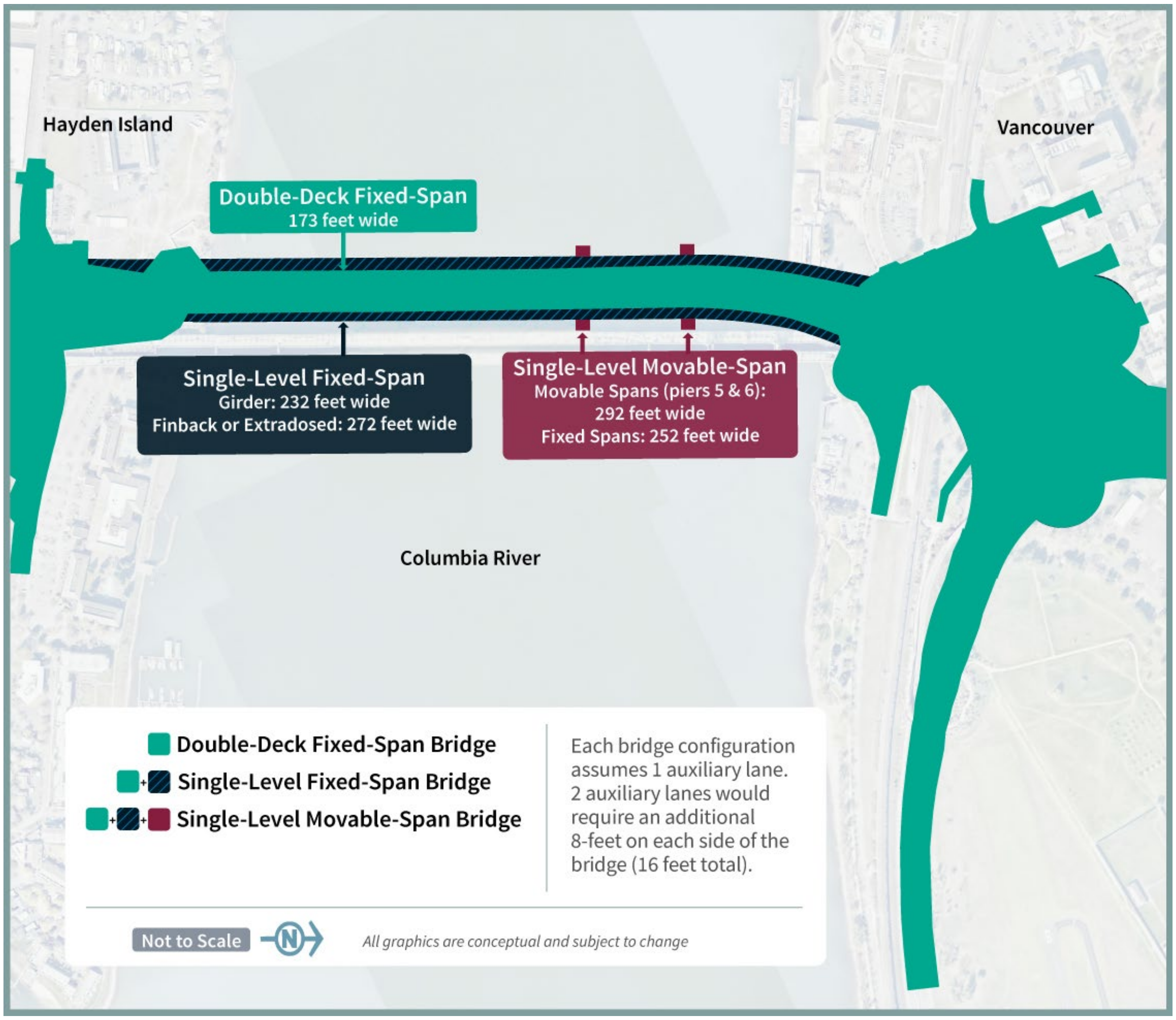
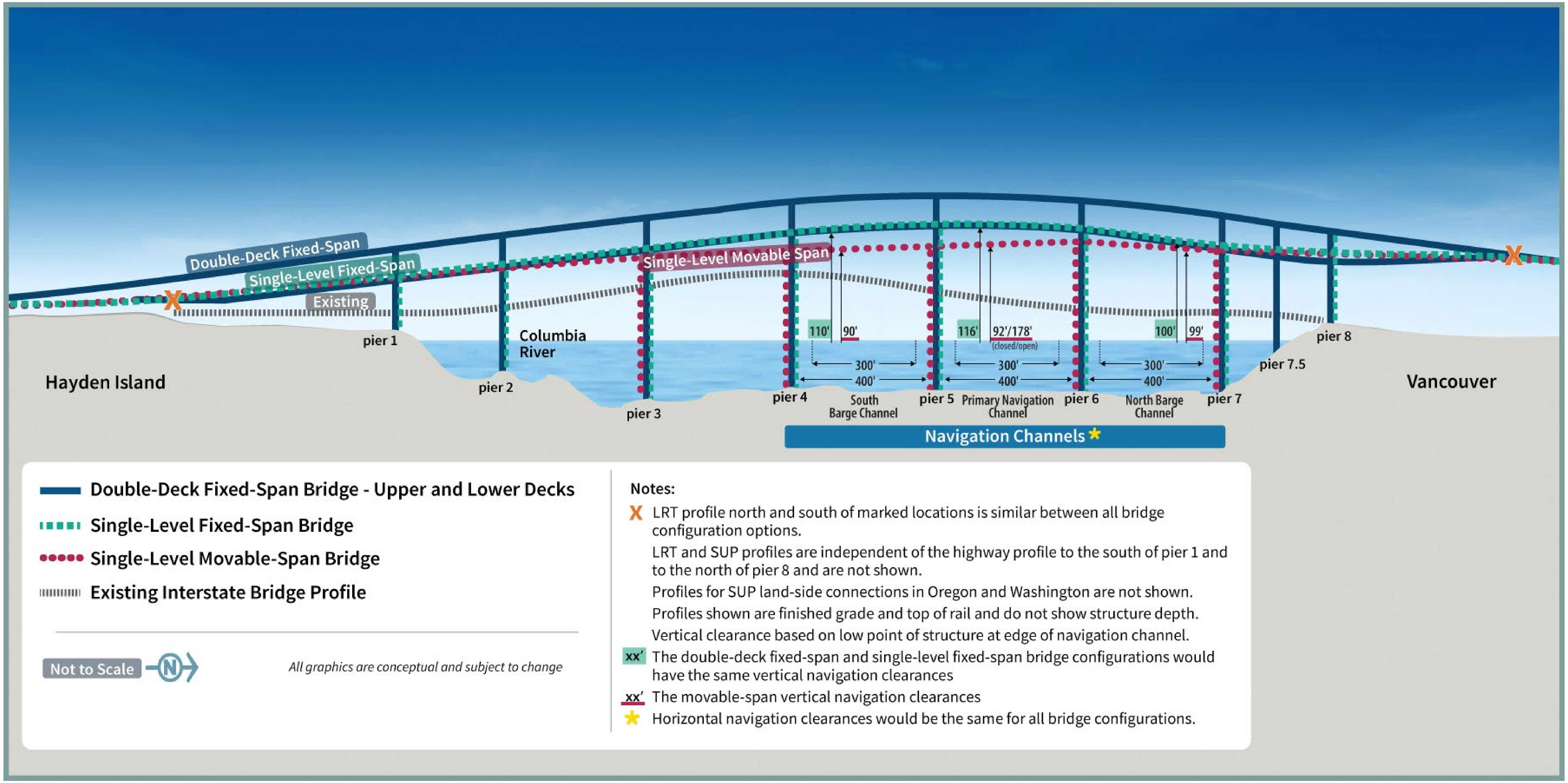


Figure 1-22. Bridge Configuration Profile Comparison



LRT = light-rail transit; SUP = shared-use path

Table 1-2. Summary of Bridge Configurations

	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Bridge type	Steel through-truss spans.	Double-deck steel truss.	Single-level, concrete or steel girders, extradosed or finback.	Single-level, steel girders with vertical lift span.
Number of bridges	Two	Two	Two	Two
Movable-span type	Vertical lift span with counterweights.	N/A	N/A	Vertical lift span with counterweights.
Movable-span location	Adjacent to Vancouver shoreline.	N/A	N/A	Between Piers 5 and 6 (approximately 500 feet south of the existing lift span).
Lift opening restrictions	Weekday peak AM and PM highway travel periods. [b]	N/A	N/A	Additional restrictions to daytime bridge openings; requires future federal rulemaking process and authorization by USCG (beyond the assumed No-Build Alternative bridge restrictions for peak AM and PM highway travel periods).[b] Typical opening durations are assumed to be 9 to 18 minutes [c] for the purposes of impact analysis but would ultimately depend on various operational considerations related to vessel traffic and river and weather conditions. Additional time would also be required to stop traffic prior to opening and restart traffic after the bridge closes.

	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Out-to-out width [d]	138 feet total width.	173 feet total width.	Girder: 232 feet total width. Extradosed/Finback: 272 feet total width.	• 292 feet at the movable span. • 252 feet at the fixed spans.
Deck widths	52 feet (SB) 52 feet (NB)	79 feet (SB) 79 feet (NB)	Girder: • 113 feet (SB) • 104 feet (NB) Extradosed/Finback: • 133 feet (SB) • 124 feet (NB)	113 feet SB fixed span. 104 feet NB fixed span.
Vertical navigation clearance	Primary navigation channel: • 39 feet when closed. • 178 feet when open. Barge channel: • 46 feet to 70 feet. Alternate barge channel: • 72 feet (maximum clearance without opening).	Primary navigation channel: • 116 feet maximum. North barge channel: • 100 feet maximum. South barge channel: • 110 feet maximum.	Primary navigation channel: • 116 feet maximum. North barge channel: • 100 feet maximum. South barge channel: • 110 feet maximum.	Primary navigation channel: • Closed position: 92 feet. • Open position: 178 feet. North barge channel: • 99 feet maximum. South barge channel: • 90 feet maximum.
Horizontal navigation clearance	263 feet for primary navigation channel. 511 feet for barge channel. 260 feet for alternate barge channel.	400 feet for all navigation channels (300-foot congressionally or USACE-authorized channel plus a 50-foot channel maintenance buffer on each side).	400 feet for all navigation channels (300-foot congressionally or USACE-authorized channel plus a 50-foot channel maintenance buffer on each side).	400 feet for all navigation channels (300-foot congressionally or USACE-authorized channel plus a 50-foot channel maintenance buffer on each side).

	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Maximum elevation of bridge component (NAVD 88)[e]	247 feet at top of lift tower.	166 feet.	Girder: 137 feet. Extradosed/Finback: 179 feet at top of pylons.	243 feet at top of lift tower.
Movable span length (from center of pier to center of pier)	278 feet.	N/A	N/A	450 feet.
Number of in-water pier sets	Nine	Six	Six	Six
Number of in-water drilled shafts	N/A	72	96	108
Shaft cap sizes	N/A	50 feet by 85 feet.	50 feet by 230 feet.	Piers 2, 3, 4, and 7: 50 feet by 230 feet. Piers 5 and 6: 50 feet by 312 feet (one combined footing at each location to house tower/equipment for the lift span).
Maximum grade	5%	4% on the Washington side. 3.8% on the Oregon side.	3% on the Washington side. 3% on the Oregon side.	1.5% on the Washington side. 3% on the Oregon side.
Light-rail transit location	N/A	Below highway on SB bridge.	West of highway on SB bridge.	West of highway on SB bridge.
Express bus	Shared roadway lanes.	Inside shoulder of NB and SB (upper) bridges.	Inside shoulder of NB and SB bridges.	Inside shoulder of NB and SB bridges.

	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Shared-use path location	Sidewalk adjacent to roadway in both directions.	Below highway on NB bridge.	East of highway on NB bridge.	East of highway on NB bridge.

a When different bridge types are not mentioned, data applies to all bridge types under the specified bridge configuration.

b The No-Build Alternative assumes existing conditions that restrict bridge openings during weekday peak periods (Monday through Friday 6:30 a.m. to 9 a.m.; 2:30 p.m. to 6 p.m., excluding federal holidays). This analysis estimates the potential frequency for bridge openings for vessels requiring more than 99 feet of clearance.

c For the purposes of the transportation analysis (see the Transportation Technical Report), the movable-span opening time is assumed to be an average of 12 minutes.

d "Out-to-out width" is the measurement between the outside edges of the bridge across its width at the widest point.

e NAVD 88 (North American Vertical Datum of 1988) is a vertical control datum (reference point) used by federal agencies for surveying.

NB = northbound; SB = southbound; USCG = U.S. Coast Guard

1.1.4 Downtown Vancouver (Subarea C)

This section discusses the geographic Subarea C shown in Figure 1-3. See Figure 1-23 for all highway and interchange improvements in Subarea C. Refer to Figure 1-3 for an overview of the geographic subareas.

1.1.4.1 Highways, Interchanges, and Local Roadways

North of the Columbia River bridges in downtown Vancouver, improvements are proposed to the SR 14 interchange (Figure 1-23).

SR 14 INTERCHANGE

The new Columbia River bridges would touch down just north of the SR 14 interchange (Figure 1-23). The function of the SR 14 interchange would remain essentially the same as it is now, although the interchange would be elevated. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Downtown Vancouver I-5 access to and from the south would be at C Street as it is today, while downtown connections to and from SR 14 would be from Columbia Street at 3rd Street.

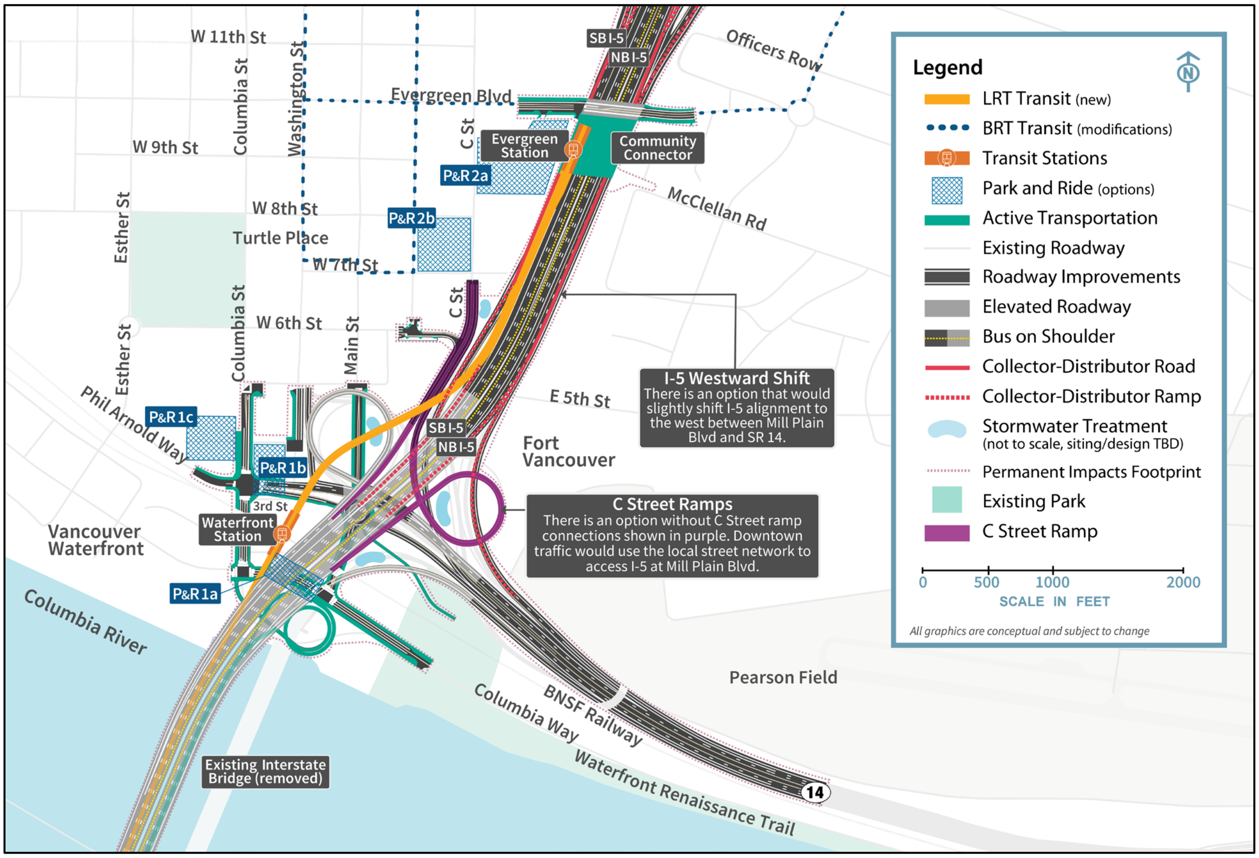
Main Street would be extended between 5th Street and Columbia Way. Vehicles traveling from downtown Vancouver to access SR 14 eastbound would use the new extension of Main Street to the roundabout underneath I-5. If coming from the west or south (waterfront) in downtown Vancouver, vehicles would use the Phil Arnold Way/3rd Street extension to the roundabout, then continue to SR 14 eastbound. The existing Columbia Way roadway under I-5 would be realigned to the north of its existing location and would intersect both the new Main Street extension and Columbia Street with T intersections.

In addition, the existing overcrossing of I-5 at Evergreen Boulevard would be reconstructed.

Design Option Without C Street Ramps

Under this design option, downtown Vancouver I-5 access to and from the south would be through the Mill Plain interchange rather than C Street. There would be no eastside loop ramp from I-5 northbound to C Street and no directional ramp on the west side of I-5 from C Street to I-5 southbound. The existing eastside loop ramp would be removed. This design option has been included because of changes in local planning that necessitate consideration of design options that reduce the footprint and associated direct and temporary environmental impacts in Vancouver.

Figure 1-23. Downtown Vancouver (Subarea C)



BRT = bus rapid transit; LRT = light-rail transit; NB = northbound; P&R = park and ride; SB = southbound

Design Option to Shift I-5 Westward

This design option would shift the I-5 mainline and ramps approximately 40 feet to the west between SR 14 and Mill Plain Boulevard. The westward I-5 alignment shift could also be paired with the design option without C Street ramps. The inclusion of this design option is due to changes in local planning, which necessitate consideration of design options that that shifts the footprint and associated direct and temporary environmental impacts in Vancouver.

1.1.4.2 Transit

LIGHT-RAIL ALIGNMENT AND STATIONS

Under the Modified LPA, the light-rail tracks would exit the highway bridge and be on their own bridge along the west side of the I-5 mainline after crossing the Columbia River (see Figure 1-23). The light-rail bridge would cross approximately 35 feet over the BNSF Railway tracks. An elevated light-rail station near the Vancouver waterfront (Waterfront Station) would be situated near the overcrossing of the BNSF tracks between Columbia Way and 3rd Street. Access to the elevated station would be primarily by elevator as the station is situated approximately 75 feet above existing ground level. A stairwell(s) would be provided for emergency egress. The number of elevators and stairwells provided would be based on the ultimate platform configuration, station location relative to the BNSF trackway, projected ridership, and fire and life safety requirements. Passenger drop-off facilities would be located at ground level and would be coordinated with the C-TRAN bus service at this location. The elevated light-rail tracks would continue north, cross over the westbound SR 14 on-ramp and the C Street/6th Street on-ramp to southbound I-5, and then straddle the southbound I-5 C-D roadway. Transit components in the downtown Vancouver area are similar between the two SR 14 interchange area design options discussed above.

North of the Waterfront Station, the light-rail tracks would continue to the Evergreen Station, which would be the terminus of the light-rail extension (see Figure 1-23). The light-rail tracks from downtown Vancouver to the terminus would be entirely on an elevated structure supported by single columns, where feasible, or by columns on either side of the roadway where needed. The light-rail tracks would be a minimum of 27 feet above the I-5 roadway surface. The Evergreen Station would be located at the same elevation as Evergreen Boulevard, on the proposed Community Connector, and it would provide connections to C-TRAN's existing BRT system. Passenger drop-off facilities would be near the station and would be coordinated with the C-TRAN bus service at this location.

PARK AND RIDES

Up to two park and rides could be built in Vancouver along the light-rail alignment: one near the Waterfront Station and one near the Evergreen Station. Additional information regarding the park and rides can be found in the Transportation Technical Report.

> Park and rides can expand the catchment area of public transit systems, making transit more accessible to people who live farther away from fixed-route transit service, and attracting new riders who might not have considered using public transit otherwise.

Waterfront Station Park-and-Ride Options

There are three site options for the park and ride near the Waterfront Station (see Figure 1-23). Each would accommodate up to 570 parking spaces.

1. Columbia Way (below I-5). This park-and-ride site would be a multilevel aboveground structure located below the new Columbia River bridges, immediately north of a realigned Columbia Way.
2. Columbia Street/SR 14. This park-and-ride site would be a multilevel aboveground structure located along the east side of Columbia Street. It could span across (or over) the SR 14 westbound off-ramp to provide parking on the north and south sides of the off-ramp.
3. Columbia Street/Phil Arnold Way (Waterfront Gateway Site). This park-and-ride site would be located along the west side of Columbia Street immediately north of Phil Arnold Way. This park and ride would be developed in coordination with the City of Vancouver's Waterfront Gateway program and could be a joint-use parking facility not constructed exclusively for park-and-ride users.

Evergreen Station Park-and-Ride Options

There are two site options for the park and ride near the Evergreen Station (see Figure 1-23).

1. Library Square. This park-and-ride site would be located along the east side of C Street and south of Evergreen Boulevard. It would accommodate up to 700 parking spaces in a multilevel belowground structure according to a future agreement on City-owned property associated with Library Square. Current design concepts suggest the park and ride most likely would be a joint-use parking facility for park-and-ride users and patrons of other uses on the ground or upper levels as negotiated as part of future decisions.
2. Columbia Credit Union. This park-and-ride site is an existing multistory garage that is located below the Columbia Credit Union office tower along the west side of C Street between 7th Street and 8th Street. The existing parking structure currently serves the office tower above it and the Regal City Center across the street. This would be a joint-use parking facility, not for the exclusive use of park-and-ride users, that could serve as additional or overflow parking if the 700 required parking spaces cannot be accommodated elsewhere.

1.1.4.3 Active Transportation

Within the downtown Vancouver area, the shared-use path on the northbound (or eastern) bridge would exit the bridge at the SR 14 interchange, loop down on the east side of I-5 via a vertical spiral path, and then cross back below I-5 to the west side of I-5 to connect to the Waterfront Renaissance Trail on Columbia Street and into Columbia Way (see Figure 1-23). Access would be provided across state right of way beneath the new bridges to provide a connection between the recreational areas along the City's Columbia River waterfront east of the bridges and existing and future waterfront uses west of the bridges.

Active transportation components in the downtown Vancouver area would be similar without the C Street ramps and with the I-5 westward shift.

At Evergreen Boulevard, a community connector is proposed to be built over I-5 just south of Evergreen Boulevard and east of the Evergreen Station (see Figure 1-23). The structure is proposed to include off-street pathways for active transportation modes including pedestrians, bicyclists, and other micro-mobility modes, and public space and amenities to support the active transportation facilities. The primary intent of the Community Connector is to improve connections between downtown Vancouver on the west side of I-5 and the Vancouver National Historic Reserve on the east side.

1.1.5 Upper Vancouver (Subarea D)

This section discusses the geographic Subarea D shown in Figure 1-3. See Figure 1-24 for all highway and interchange improvements in Subarea D. Refer to Figure 1-3 for an overview of the geographic subareas.

1.1.5.1 Highways, Interchanges, and Local Roadways

Within the upper Vancouver area, the IBR Program proposes improvements to three interchanges—Mill Plain, Fourth Plain, and SR 500—as described below.

MILL PLAIN BOULEVARD INTERCHANGE

The Mill Plain Boulevard interchange is north of the SR 14 interchange (see Figure 1-24). This interchange would be reconstructed as a tight-diamond configuration but would otherwise remain similar in function to the existing interchange. The ramp terminal intersections would be sized to accommodate high, wide heavy freight vehicles that travel between the Port of Vancouver and I-5. The off-ramp from I-5 northbound to Mill Plain Boulevard would diverge from the C-D road that would continue north, crossing over Mill Plain Boulevard, to provide access to Fourth Plain Boulevard via a C-D roadway. The off-ramp to Fourth Plain Boulevard would be reconstructed and would cross over Mill Plain Boulevard east of I-5, similar to the way it functions today.

FOURTH PLAIN BOULEVARD INTERCHANGE

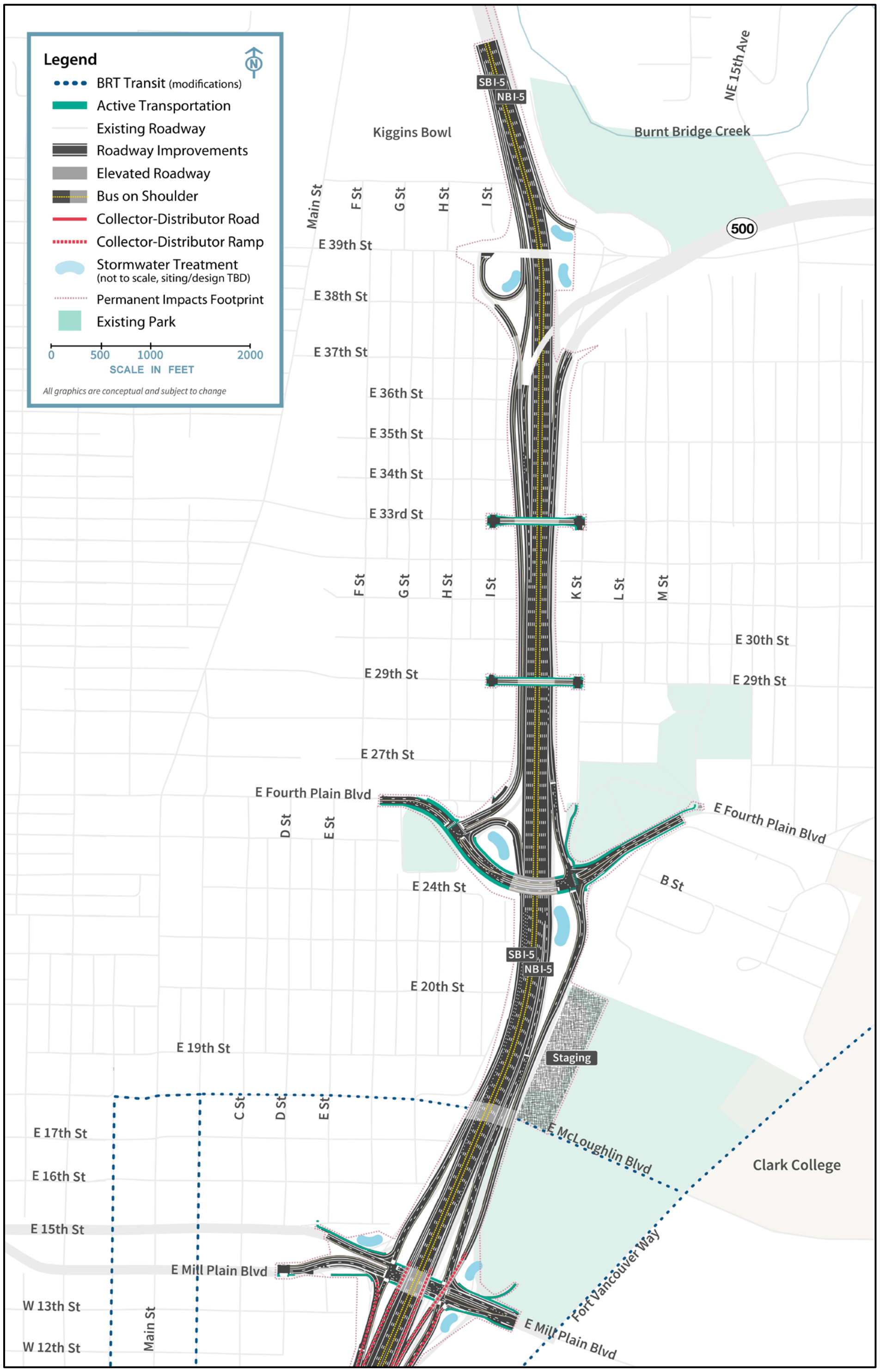
At the Fourth Plain Boulevard interchange (Figure 1-24), improvements would include reconstruction of the overpass of I-5 and the ramp terminal intersections. Northbound I-5 traffic exiting to Fourth Plain Boulevard would first exit to the northbound C-D roadway which provides off-ramp access to Fourth Plain Boulevard and Mill Plain Boulevard. The westbound SR 14 to northbound I-5 on-ramp also joins the northbound C-D roadway before continuing north past the Fourth Plain Boulevard and Mill Plain Boulevard off-ramps as an auxiliary lane. The southbound I-5 off-ramp to Fourth Plain Boulevard would be braided below the 39th Street on-ramp to southbound I-5. This change would eliminate the existing nonstandard weave between the SR 500 interchange and the off-ramp to Fourth Plain Boulevard. It would also eliminate the existing westbound SR 500 to Fourth Plain Boulevard off-ramp connection. The existing overcrossing of I-5 at 29th Street would be reconstructed to accommodate a widened I-5, provide adequate vertical clearance over I-5, and provide pedestrian and bicycle facilities.

SR 500 INTERCHANGE

The northern terminus of the I-5 improvements would be in the SR 500 interchange area (Figure 1-24). The improvements would primarily be to connect the Modified LPA to existing ramps. The off-ramp from I-5 southbound to 39th Street would be reconstructed to establish the beginning of the braided ramp to Fourth Plain Boulevard and restore the loop ramp to 39th Street. Ramps from existing I-5 northbound to SR 500 eastbound and from 39th Street to I-5 northbound would be partially reconstructed. The existing bridges for 39th Street over I-5 and SR 500 westbound to I-5 southbound would be retained. The 39th Street to I-5 southbound on-ramp would be reconstructed and braided over (i.e., grade separated or pass over) the new I-5 southbound off-ramp to Fourth Plain Boulevard.

The existing overcrossing of I-5 at 33rd Street would also be reconstructed to accommodate a widened I-5, provide adequate vertical clearance over I-5, and provide pedestrian and bicycle facilities.

Figure 1-24. Upper Vancouver (Subarea D)



BRT = bus rapid transit; TBD = to be determined

1.1.5.2 Transit

There would be no LRT facilities in upper Vancouver. Proposed operational changes to bus service, including I-5 bus-on-shoulder service, are described in Section 1.1.7, Transit Operating Characteristics.

1.1.5.3 Active Transportation

Several active transportation improvements would be made in Subarea D consistent with City of Vancouver plans and policies. At the Fourth Plain Boulevard interchange, there would be improvements to provide better bicycle and pedestrian mobility and accessibility; these include bicycle lanes, neighborhood connections, and a connection to the City of Vancouver's planned two-way cycle track on Fourth Plain Boulevard. The reconstructed overcrossings of I-5 at 29th Street and 33rd Street would provide pedestrian and bicycle facilities on those cross streets. No new active transportation facilities are proposed in the SR 500 interchange area. Active transportation improvements at the Mill Plain Boulevard interchange include buffered bicycle lanes and sidewalks, pavement markings, lighting, and signing.

1.1.6 Transit Support Facilities

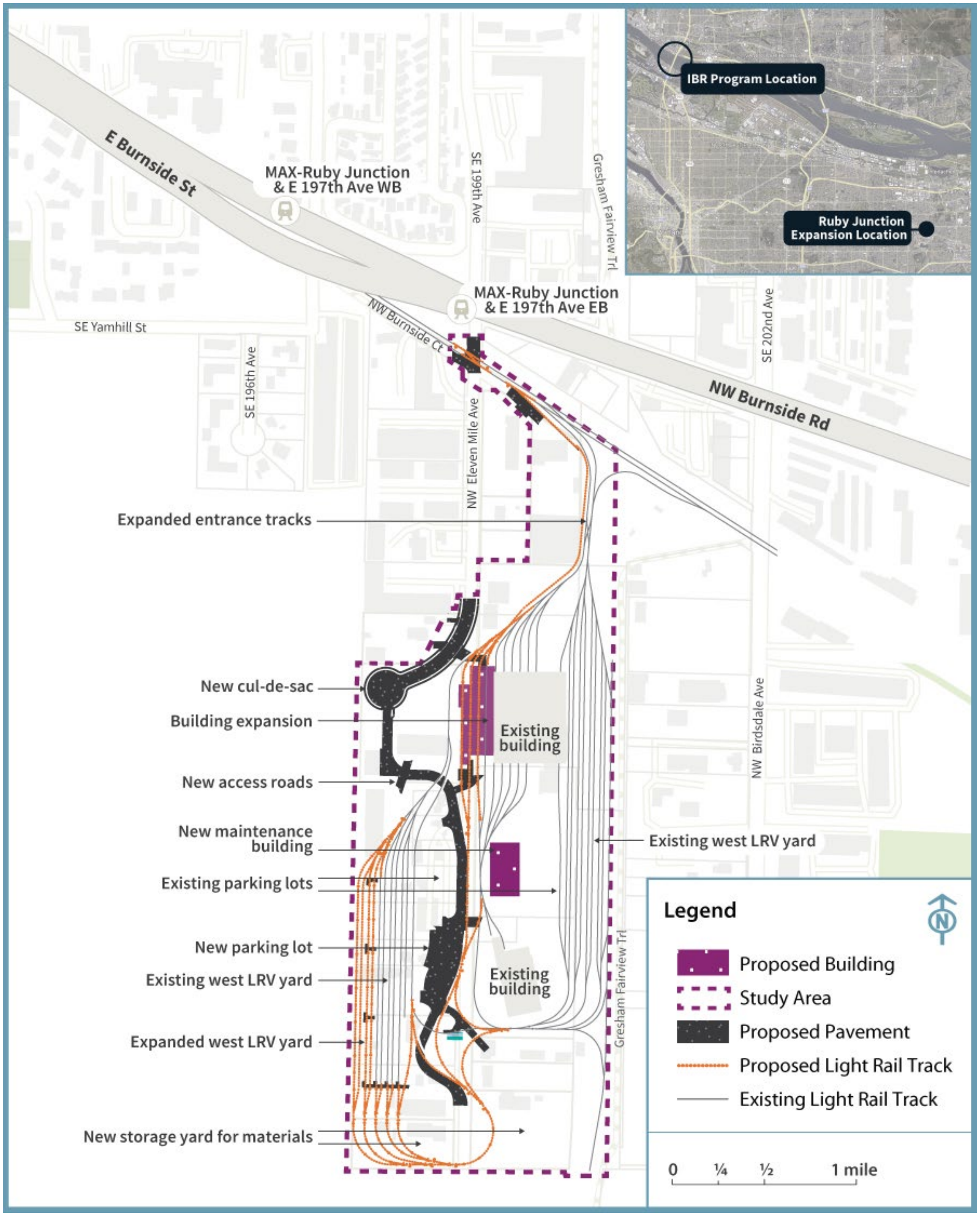
1.1.6.1 Ruby Junction Maintenance Facility Expansion

The TriMet Ruby Junction Maintenance Facility in Gresham, Oregon, would be expanded to accommodate the additional LRVs associated with the Modified LPA's LRT service (the Ruby Junction location relative to the study area is shown in Figure 1-25). Improvements would include additional storage for LRVs and maintenance materials and supplies, expanded LRV maintenance bays, expanded parking and employee support areas for additional personnel, and a third track at the northern entrance to Ruby Junction. Figure 1-25 shows the proposed footprint of the expansion.

The existing main building would be expanded west to provide additional maintenance bays. To make space for the building expansion, Eleven Mile Avenue would be vacated and would terminate in a new cul-de-sac west of the main building. New access roads would be constructed to maintain access to TriMet buildings south of the cul-de-sac.

The existing LRV storage yard, west of Eleven Mile Avenue, would be expanded to the west to accommodate additional storage tracks and a runaround track (a track constructed to bypass congestion in the maintenance yard). This expansion would require partial demolition of an existing TriMet building (just north of the LRV storage) and would require relocating the material storage yard to the properties just south of the south building.

Figure 1-25. Ruby Junction Maintenance Facility Study Area



EB = eastbound; LRV = light-rail vehicle; WB = westbound

All tracks in the west LRV storage yard would also be extended southward to connect to the proposed runaround track. The runaround track would connect to existing tracks near the existing south building. The connections to the runaround track would require partial demolition of an existing TriMet building plus full demolition of one existing building and partial demolition of another existing building on the private property west of the south end of Eleven Mile Avenue. The function of the existing TriMet building would either be transferred to existing modified buildings or to new replacement buildings on site.

The existing parking lot west of Eleven Mile Avenue would be expanded toward the south to provide more parking for TriMet personnel.

A third track would be needed at the north entrance to Ruby Junction to accommodate increased train volumes without decreasing service. The additional track would also reduce operational impacts during construction and maintenance outages for the yard. Constructing the third track would require reconstruction of Burnside Court east of Eleven Mile Avenue. An additional crossover would also be needed on the mainline track where it crosses Eleven Mile Avenue; it would require reconstruction of the existing track crossings for vehicles, bicycles, and pedestrians.

1.1.6.2 Expo Center Overnight LRV Facility

An overnight facility for LRVs would be constructed on the southeast corner of the Expo Center property (as shown on Figure 1-8) to reduce deadheading between Ruby Junction and the northern terminus of the MAX Yellow Line extension. Deadheading occurs when LRVs travel without passengers to make the vehicles ready for service. The facility would provide a yard access track, storage tracks for approximately 10 LRVs, one building for light LRV maintenance, an operator break building, a parking lot for operators, and space for security personnel. This facility would necessitate relocation and reconstruction of the Expo Road entrance to the Expo Center (including the parking lot gates and booths). However, it would not affect existing Expo Center buildings.

The overnight facility would connect to the mainline tracks by crossing Expo Road just south of the existing Expo Center MAX Station. The connection tracks would require relocation of one or two existing LRT facilities, including a traction power substation building and potentially the existing communication building, which are both just south of the Expo Center MAX Station. Existing artwork at the station may require relocation.

1.1.6.3 Additional Bus Bays at the C-TRAN Operations and Maintenance Facility

Three bus bays would be added to the C-TRAN operations and maintenance facility. These new bus bays would provide maintenance capacity for the additional express bus service on I-5 (see Section 1.1.7, Transit Operating Characteristics). Modifications to the facility would accommodate new vehicles as well as maintenance equipment.

1.1.7 Transit Operating Characteristics

1.1.7.1 LRT Operations

Nineteen new LRVs would be purchased to operate the extension of the MAX Yellow Line. These vehicles would be similar to those currently used for the TriMet MAX system. With the Modified LPA, LRT service in the new and existing portions of the Yellow Line in 2045 would operate with 6.7-minute average headways (defined as gaps between arriving transit vehicles) during the 2-hour morning peak period. Mid-day and evening headways would be 15 minutes, and late-night headways would be 30 minutes. Service would operate between the hours of approximately 5 a.m. (first southbound train leaving Evergreen Station) and 1 a.m. (last northbound train arriving at the station), which is consistent with current service on the Yellow Line. LRVs would be deadheaded at Evergreen Station before beginning service each day. A third track at this northern terminus would accommodate layovers.

1.1.7.2 Express Bus Service and Bus on Shoulder

C-TRAN provides bus service that connects to LRT and augments travel between Washington and Oregon with express bus service to key employment centers in Oregon. Beginning in 2022, the main express route providing service in the IBR corridor, Route 105, had two service variations. One pattern provides service between Salmon Creek and downtown Portland with a single intermediate stop at the 99th Street Transit Center, and one provides service between Salmon Creek and downtown Portland with two intermediate stops: 99th Street Transit Center and downtown Vancouver. This route currently provides weekday service with 20-minute peak and 60-minute off-peak headways.

Once the Modified LPA is constructed, C-TRAN Route 105 would be revised to provide direct service from the Salmon Creek Park and Ride and 99th Street Transit Center to downtown Portland, operating at 5-minute peak headways with no service in the off-peak. The C-TRAN Route 105 intermediate stop service through downtown Vancouver would be replaced with C-TRAN Route 101, which would provide direct service from downtown Vancouver to downtown Portland at 10-minute peak and 30-minute off-peak headways.

Two other existing C-TRAN express bus service routes would remain unchanged after completion of the Modified LPA. C-TRAN Route 190 would continue to provide service from the Andresen Park and Ride in Vancouver to Marquam Hill in Portland. This route would continue to operate on SR 500 and I-5 within the study area. Route headways would be 10 minutes in the peak periods with no off-peak service. C-TRAN Route 164 would continue to provide service from the Fisher's Landing Transit Center to downtown Portland. This route would continue to operate within the study area only in the northbound direction during PM service to use the I-5 northbound high-occupancy vehicle lane in Oregon before exiting to eastbound SR 14 in Washington. Route headways would be 10 minutes in the peak and 30 minutes in the off-peak.

C-TRAN express bus Routes 105 and 190 are currently permitted to use the existing southbound inside shoulder of I-5 from 99th Street to the Interstate Bridge in Vancouver. However, the existing shoulders are too narrow for bus-on-shoulder use in the rest of the I-5 corridor in the study area. The Modified LPA would include inside shoulders on I-5 that would be wide enough (14 feet on the Columbia River bridges and 11.5 to 12 feet elsewhere on I-5) to allow northbound and southbound buses to operate on the shoulder, except where I-5 would have to taper to match existing inside shoulder widths at the north and south ends of the corridor. Figure 1-8, Figure 1-16, Figure 1-23, and Figure 1-24 show the potential bus-on-shoulder use over the Columbia River bridges. Bus on shoulder could operate on any of the Modified LPA bridge configurations and bridge types. Additional approvals (including a continuing control agreement), in coordination with ODOT, may be needed for buses to operate on the shoulder on the Oregon portion of I-5.

After completion of the Modified LPA, two C-TRAN express bus routes operating on I-5 through the study area would be able to use bus-on-shoulder operations to bypass congestion in the general-purpose lanes. C-TRAN Route 105 would operate on the shoulder for the full length of the study area. C-TRAN Route 190 would operate on the shoulder for the full length of the corridor except for the distance required to merge into and out of the shoulder as the route exits from and to SR 500. These two express bus routes (105 and 190) would have a combined frequency of every 3 minutes during the 2045 AM and PM peak periods. To support the increased frequency of express bus service, eight electric double-decker or articulated buses would be purchased.

If the C Street ramps were removed from the SR 14 interchange, C-TRAN Route 101 could also use bus-on-shoulder operations south of Mill Plain Boulevard; however, if the C Street ramps remained in place, Route 101 could still use bus-on-shoulder operations south of the SR 14 interchange but would need to begin merging over to the C Street exit earlier than if the C Street ramps were removed. Route 101 would operate at 10-minute peak and 30-minute off-peak headways. C-TRAN Route 164 would not be anticipated to use bus-on-shoulder operations because of the need to exit to SR 14 from northbound I-5.

1.1.7.3 Local Bus Route Changes

The TriMet Line 6 bus route would be changed to terminate at the Expo Center MAX Station, requiring passengers to transfer to the new LRT connection to access Hayden Island. TriMet Line 6 is anticipated to travel from Martin Luther King Jr. Boulevard through the newly configured area providing local connections to Marine Drive. It would continue west to the Expo Center MAX Station. Table 1-3 shows existing service and anticipated future changes to TriMet Line 6.

As part of the Modified LPA, several local C-TRAN bus routes would be changed to better complement the new light-rail extension. Most of these changes would reroute existing bus lines to provide a transfer opportunity near the new Evergreen Station. Table 1-3 shows existing service and anticipated future changes to C-TRAN bus routes. In addition to the changes noted in Table 1-3, other local bus route modifications would move service from Broadway to C Street. The changes shown may be somewhat different if the C Street ramps are removed.

Table 1-3. Proposed TriMet and C-TRAN Bus Route Changes

Bus Route	Existing Route	Changes with Modified LPA
TriMet Line 6	Connects Goose Hollow, Portland City Center, N/NE Portland, Jantzen Beach and Hayden Island. Within the study area, service currently runs between Delta Park MAX Station and Hayden Island via I-5.	Route would be revised to terminate at the Expo Center MAX Station. Route is anticipated to travel from Martin Luther King Jr. Boulevard through the newly configured Marine Drive area, then continue west to connect via facilities on the west side of I-5 with the Expo Center MAX Station.
C-TRAN Fourth Plain and Mill Plain bus rapid transit (The Vine)	Runs between downtown Vancouver and the Vancouver Mall Transit Center via Fourth Plain Boulevard, with a second line along Mill Plain Boulevard. In the study area, service currently runs along Washington and Broadway Streets through downtown Vancouver.	Route would be revised to begin/end near the Evergreen Station in downtown Vancouver and provide service along Evergreen Boulevard to Fort Vancouver Way, where it would travel to or from Mill Plain Boulevard or Fourth Plain Boulevard depending on clockwise/counterclockwise operations. The Fourth Plain Boulevard route would continue to serve existing Vine stations beyond Evergreen Boulevard.
C-TRAN #2 Lincoln	Connects the 99th Street Transit Center to downtown Vancouver via Lincoln and Kaufman Avenues. Within the study area, service currently runs along Washington and Broadway Streets between 7th and 15th Streets in downtown Vancouver.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.
C-TRAN #25 St. Johns	Connects the 99th Street Transit Center to downtown Vancouver via St. Johns Boulevard and Fort Vancouver Way. Within the study area, service currently runs along Evergreen Boulevard, Jefferson Street/Kaufman Avenue, 15th Street, and Franklin Street in downtown Vancouver.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.
C-TRAN #30 Burton	Connects the Fisher's Landing Transit Center with downtown Vancouver via 164th/162nd Avenues and 18th, 25th, 28th, and 39th Streets. Within the study area, service currently runs along McLoughlin Boulevard and on Washington and Broadway Streets between 8th and 15th Streets.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.

Bus Route	Existing Route	Changes with Modified LPA
C-TRAN #60 Delta Park Regional	Connects the Delta Park MAX station in Portland with downtown Vancouver via I-5. Within the study area, service currently runs along I-5, Mill Plain Boulevard, and Broadway Street.	Route would be discontinued.

1.1.8 Tolling

Tolling cars and trucks that would use the new Columbia River bridges is proposed as a method to help fund the bridge construction and future maintenance, as well as to encourage alternative mode choices for trips across the Columbia River. Federal and state laws set the authority to toll the I-5 crossing. The IBR Program plans to toll the I-5 river bridge under the federal tolling authorization program codified in 23 U.S. Code Section 129 (Section 129). Section 129 allows public agencies to impose new tolls on federal-aid interstate highways for the reconstruction or replacement of toll-free bridges or tunnels. In 2023, the Washington State Legislature authorized tolling on the Interstate Bridge, with toll rates and policies to be set by the Washington State Transportation Commission (WSTC). In Oregon, the legislature authorized tolling giving the Oregon Transportation Commission the authority to toll I-5, including the ability to set the toll rates and policies. Subsequently, the Oregon Transportation Commission (OTC) is anticipated to review and approve the I-5 tollway project application that would designate the Interstate Bridge as a “tollway project” in 2024. At the beginning of 2024, the OTC and the WSTC entered into a bi-state tolling agreement to establish a cooperative process for setting toll rates and policies. This included the formation of the I-5 Bi-State Tolling Subcommittee consisting of two commissioners each from the OTC and WSTC and tasked with developing toll rate and policy recommendations for joint consideration and adoption by each state’s commission. Additionally, the two states plan to enter into a separate agreement guiding the sharing and uses of toll revenues, including the order of uses (flow of funds) for bridge construction, debt service, and other required expenditures. WSDOT and ODOT also plan to enter into one or more agreements addressing implementation logistics, toll collection, and operations and maintenance for tolling the bi-state facility.

The Modified LPA includes a proposal to apply variable tolls on vehicles using the Columbia River bridges with the toll collected electronically in both directions. Tolls would vary by time of day with higher rates during peak travel periods and lower rates during off-peak periods. The IBR Program has evaluated multiple toll scenarios generally following two different variable toll schedules for the tolling assessment. For purposes of this NEPA analysis, the lower toll schedule was analyzed with tolls assumed to range between $1.50 and $3.15 (in 2026 dollars as representative of when tolling would begin) for passenger vehicles with a registered toll payment account. Medium and heavy trucks would be charged a higher toll than passenger vehicles and light trucks. Passenger vehicles and light trucks without a registered toll payment account would pay an additional $2.00 per trip to cover the cost of identifying the vehicle owner from the license plate and invoicing the toll by mail.

The analysis assumes that tolling would commence on the existing Interstate Bridge—referred to as pre-completion tolling—starting April 1, 2026. The actual date pre-completion tolling begins would depend on when construction would begin. The traffic and tolling operations on the new Columbia

River bridges were assumed to commence by July 1, 2033. The actual date that traffic and tolling operations on the new bridges begin would depend on the actual construction completion date. During the construction period, the two commissions may consider toll-free travel overnight on the existing Interstate Bridge, as was analyzed in the Level 2 Toll Traffic and Revenue Study, for the hours between 11 p.m. and 5 a.m. This toll-free period could help avoid situations where users would be charged during lane or partial bridge closures where construction delays may apply. Once the new I-5 Columbia River bridges open, twenty-four-hour tolling would begin.

Tolls would be collected using an all-electronic toll collection system using transponder tag readers and license plate cameras mounted to structures over the roadway. Toll collection booths would not be required. Instead, motorists could obtain a transponder tag and set up a payment account that would automatically bill the account holder associated with the transponder each time the vehicle crossed the bridge. Customers without transponders, including out-of-area vehicles, would be tolled by a license plate recognition system that would bill the address of the owner registered to that vehicle's license plate. The toll system would be designed to be nationally interoperable. Transponders for tolling systems elsewhere in the country could be used to collect tolls on I-5, and drivers with an account and transponder tag associated with the Interstate Bridge could use them to pay tolls in other states for which reciprocity agreements had been developed. There would be new signage, including gantries, to inform drivers of the bridge toll. These signs would be on local roads, I-5 on-ramps, and on I-5, including locations north and south of the bridges where drivers make route decisions (e.g., I-5/I-205 junction and I-5/I-84 junction).

1.1.9 Transportation System- and Demand-Management Measures

Many well-coordinated transportation demand-management and system-management programs are already in place in the Portland-Vancouver metropolitan region. In most cases, the impetus for the programs comes from state regulations: Oregon's Employee Commute Options rule and Washington's Commute Trip Reduction law (described in the sidebar).

The physical and operational elements of the Modified LPA provide the greatest transportation demand-management opportunities by promoting other modes to fulfill more of the travel needs in the corridor. These include:

- Major new light-rail line in exclusive right of way, as well as express bus routes and bus routes that connect to new light-rail stations.
- I-5 inside shoulders that accommodate express buses.
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians and improve connectivity, safety, and travel time.
- Park-and-ride facilities.
- A variable toll on the new Columbia River bridges.

In addition to these fundamental elements of the Modified LPA, facilities and equipment would be implemented that could help existing or expanded transportation system management measures maximize the capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs in the study area. These signs alert drivers to incidents and events, allowing them to seek alternate routes or plan to limit travel during periods of congestion.
- Replacement or expanded traveler information systems with additional traffic monitoring equipment and cameras.
- Expanded incident response capabilities, which help traffic congestion to clear more quickly following accidents, spills, or other incidents.
- Queue jumps or bypass lanes for transit vehicles where multilane approaches are provided at ramp signals for on-ramps. Locations for these features will be determined during the detailed design phase.
- Active traffic management including strategies such as ramp metering, dynamic speed limits, and transit signal priority. These strategies are intended to manage congestion by controlling traffic flow or allowing transit vehicles to enter traffic before single-occupant vehicles.

State Laws to Reduce Commute Trips

Oregon and Washington have both adopted regulations intended to reduce the number of people commuting in single-occupancy vehicles (SOVs). Oregon's Employee Commute Options Program, created under Oregon Administrative Rule 340-242-0010, requires employers with over 100 employees in the greater Portland area to provide commute options that encourage employees to reduce auto trips to the work site. Washington's 1991 Commute Trip Reduction (CTR) Law, updated as the 2006 CTR Efficiency Act (Revised Code of Washington §70.94.521) addresses traffic congestion, air pollution, and petroleum fuel consumption. The law requires counties and cities with the greatest traffic congestion and air pollution to implement plans to reduce SOV demand. An additional provision mandates "major employers" and "employers at major worksites" to implement programs to reduce SOV use.

1.2 Modified LPA Construction

The following information on the construction activities and sequence follows the information prepared for the CRC LPA. Construction durations have been updated for the Modified LPA. Because the main elements of the IBR Modified LPA are similar to those in the CRC LPA (i.e., multimodal river crossings and interchange improvements), this information provides a reasonable assumption of the construction activities that would be required.

The construction of bridges over the Columbia River sets the sequencing for other Program components. Accordingly, construction of the Columbia River bridges and immediately adjacent highway connections and improvement elements would be timed early to aid the construction of other components. Demolition of the existing Interstate Bridge would take place after the new Columbia River bridges were opened to traffic.

Electronic tolling infrastructure would be constructed and operational on the existing Interstate Bridge by the start of construction on the new Columbia River bridges. The toll rates and policies for tolling (including pre-completion tolling) would be determined after a more robust analysis and public process by the OTC and WSTC (refer to Section 1.1.8, Tolling).

1.2.1 Construction Components and Duration

Table 1-4 provides the estimated construction durations and additional information of Modified LPA components. The estimated durations are shown as ranges to reflect the potential for Program funding to be phased over time. In addition to funding, contractor schedules, regulatory restrictions on in-water work and river navigation considerations, permits and approvals, weather, materials, and equipment could all influence construction duration and overlap of construction of certain components. Certain work below the ordinary high-water mark of the Columbia River and North Portland Harbor would be restricted to minimize impacts to species listed under the Endangered Species Act and their designated critical habitat.

Throughout construction, active transportation facilities and three lanes in each direction on I-5 (accommodating personal vehicles, freight, and buses) would remain open during peak hours, except for short intermittent restrictions and/or closures. Advanced coordination and public notice would be given for restrictions, intermittent closures, and detours for highway, local roadway, transit, and active transportation users (refer to the Transportation Technical Report, for additional information). At least one navigation channel would remain open throughout construction. Advanced coordination and notice would be given for restrictions or intermittent closures to navigation channels as required.

Table 1-4. Construction Activities and Estimated Duration

Component	Estimated Duration	Notes
Columbia River bridges	4 to 7 years	• Construction is likely to begin with the main river bridges. • General sequence would include initial preparation and installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
North Portland Harbor bridges	4 to 10 years	• Construction duration for North Portland Harbor bridges is estimated to be similar to the duration for Hayden Island interchange construction. The existing North Portland Harbor bridge would be demolished in phases to accommodate traffic during construction of the new bridges.
Hayden Island interchange	4 to 10 years	• Interchange construction duration would not necessarily entail continuous active construction. Hayden Island work could be broken into several contracts, which could spread work over a longer duration.
Marine Drive interchange	4 to 6 years	• Construction would need to be coordinated with construction of the North Portland Harbor bridges.

Component	Estimated Duration	Notes
SR 14 interchange	4 to 6 years	• Interchange would be partially constructed before any traffic could be transferred to the new Columbia River bridges.
Demolition of the existing Interstate Bridge	1.5 to 2 years	• Demolition of the existing Interstate Bridge could begin only after traffic is rerouted to the new Columbia River bridges.
Three interchanges north of SR 14	3 to 4 years for all three	• Construction of these interchanges could be independent from each other and from construction of the Program components to the south. • More aggressive and costly staging could shorten this timeframe.
Light-rail	4 to 6 years	• The light-rail crossing would be built with the Columbia River bridges. Light-rail construction includes all of the infrastructure associated with light-rail transit (e.g., overhead catenary system, tracks, stations, park and rides).
Total construction timeline	9 to 15 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work and river navigation considerations, permits and approvals, weather, materials, and equipment, could all influence construction duration.

1.2.2 Potential Staging Sites and Casting Yards

Equipment and materials would be staged in the study area throughout construction generally within existing or newly purchased right of way, on land vacated by existing transportation facilities (e.g., I-5 on Hayden Island), or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Criteria for suitable sites include large, open areas for heavy machinery and material storage, waterfront access for barges (either a slip or a dock capable of handling heavy equipment and material) to convey material to the construction zone, and roadway or rail access for landside transportation of materials by truck or train.

Two potential major staging sites have been identified (see Figure 1-8 and Figure 1-23). One site is located on Hayden Island on the west side of I-5. A large portion of this parcel would be required for new right of way for the Modified LPA. The second site is in Vancouver between I-5 and Clark College. Other staging sites may be identified during the design process or by the contractor. Following construction of the Modified LPA, the staging sites could be converted for other uses.

In addition to on-land sites, some staging activities for construction of the new Columbia River and North Portland Harbor bridges would take place on the river itself. Temporary work structures, barges, barge-mounted cranes, derricks, and other construction vessels and equipment would be present on the river during most or all of the bridges' construction period. The IBR Program is working with USACE and USCG to obtain necessary clearances for these activities.

A casting or staging yard could also be required for construction of the overwater bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, a slip or a dock capable of handling heavy equipment and material, a large area suitable for a concrete batch plant and associated heavy machinery and equipment, and access to a highway or railway for delivery of materials. As with the staging sites, casting or staging yard sites may be identified as the design progresses or by the contractor and would be evaluated via a NEPA re-evaluation or supplemental NEPA document for potential environmental impacts at that time.

1.3 No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2045 if the Modified LPA is not built. This alternative makes the same assumptions as the Modified LPA regarding population and employment growth through 2045, and it assumes that the same transportation and land use projects in the region would occur as planned.

Regional transportation projects included in the No-Build Alternative are those in the financially constrained 2018 *Regional Transportation Plan* (2018 RTP) adopted in December 2018 by the Metro Council (Metro 2018) and in March 2019 (RTC 2019) by the Southwest Washington Regional Transportation Council (RTC) Board of Directors is referred to as the 2018 RTP in this report. The 2018 RTP has a planning horizon year of 2040 and includes projects from state and local plans necessary to meet transportation needs over this time period; financially constrained means these projects have identified funding sources. The Transportation Technical Report lists the projects included in the financially constrained 2018 RTP.

The implementation of regional and local land use plans is also assumed as part of the No-Build Alternative. For the IBR Program analysis, population and employment assumptions used in the 2018 RTP were updated to 2045 in a manner consistent with regional comprehensive and land use planning. In addition to accounting for added growth, adjustments were made within Portland to reallocate the households and employment based on the most current update to Portland's comprehensive plan, which was not complete in time for inclusion in the 2018 RTP.

Other projects assumed as part of the No-Build Alternative include major development and infrastructure projects that are in the permitting stage or partway through phased development. These projects are discussed as reasonably foreseeable future actions in the IBR Cumulative Effects Technical Report. They include the Vancouver Waterfront project, Terminal 1 development, the Renaissance Boardwalk, the Waterfront Gateway Project, improvements to the levee system, several restoration and habitat projects, and the Portland Expo Center.

In addition to population and employment growth and the implementation of local and regional plans and projects, the No-Build Alternative assumes that the existing Interstate Bridge would continue to operate as it does today. As the bridge ages, needs for repair and maintenance would potentially increase, and the bridge would continue to be at risk of mechanical failure or damage from a seismic event.

2. METHODS

This section describes the methods used to prepare this technical report to:

- Identify the study area and relevant laws and regulations.
- Collect data, assess impacts, and evaluate possible mitigation measures.

Ecosystem resources addressed in this report include:

- Special-status species
- Fish, wildlife, and plants, and their habitats within and around the study area
- Protected habitats
- Migratory birds and marine mammals
- Rare plants and noxious weeds

The methods and analysis were designed to comply with NEPA and relevant federal, state, and local laws and builds on those developed for the CRC project. To address the potential environmental impacts associated with the Modified LPA, the methods used for this ecosystems analysis have been updated for the IBR Program to reflect changes in regulations and policy, data sources, and physical conditions, and as follows:

- Compile an updated/current list of species of interest (SOI)[9] from local, state, and federal resource and management agencies.
- Review available geographic information system (GIS) data regarding species/habitat presence and baseline habitat condition.
- Review and update as necessary SOI life-history and habitat requirements to reflect changes in best available science.
- Conduct supplemental field surveys as necessary to validate or update baseline assumptions.
- Review changes to local, state, and federal regulatory/policy regarding ecosystem management, evaluation of effects, and compensatory mitigation.
- Discusses potential impacts on ecosystem resources with species experts, local resource managers, and agency biologists.

2.1 Study Area

This evaluation of effects on ecosystems includes two study areas: a primary study area and a secondary study area. Figure 2-1 shows the ecosystems primary study area, and Figure 2-2 shows the ecosystems secondary study area.

[9] SOI is not a specific category of governmental or nongovernmental organization-designated species, but rather refers to native species identified through tribal, local, state, and federal coordination as locally important due to their regulatory status, rarity, and/or special habitat considerations.

The ecosystems primary study area is defined as all areas that would be directly affected by the Modified LPA, including the footprint (or ground/water disturbance) of the permanent and temporary structures, roadway and interchange improvements, transit improvements, stormwater facilities, and staging and access areas, including areas in the Columbia River and North Portland Harbor where work would be performed from barges and temporary structures.

The primary study area runs along a 5-mile segment of I-5, approximately between the SR 500 interchange in Washington and the I-5/Columbia Boulevard interchange in Oregon and the expansion area around TriMet's existing Ruby Junction Maintenance Facility in Gresham, Oregon. In downtown Vancouver, the primary study area includes potential park-and-ride locations. Most physical changes associated with the Modified LPA would occur in the primary study area, though certain activities such as mitigation and conservation could occur outside of it.

The ecosystems secondary study area is a larger area in which construction-related and indirect effects could occur. The secondary study area includes the following:

- **Elevated underwater noise:** Areas in the Columbia River and North Portland Harbor where underwater noise could be elevated during impact and vibratory pile-driving installation and removal. Due to the curvature of the river and islands present, underwater noise from impact pile driving is expected to reach land before it reaches ambient levels. This includes aquatic portions of the Columbia River and North Portland Harbor within direct line of sight of in-water pile-driving/removal activities, in which underwater noise levels could be temporarily elevated. This area, approximately 5.5 miles downstream and 12.5 miles upstream, encompasses the Columbia River from approximately river mile (RM) 101 to 118. Within North Portland Harbor, underwater noise from construction activities would extend approximately 3.5 miles downstream and approximately 1.9 miles upstream.
- **Elevated terrestrial noise:** Portions of the Columbia River and North Portland Harbor where terrestrial noise could be elevated during pile installation and removal and other upland construction activities. During pile driving and other construction activities, airborne noise would be elevated above ambient levels within approximately 9,000 feet over open water and within approximately 3,500 feet over land.
- **In-water turbidity:** Portions of the Columbia River and North Portland Harbor where in-water turbidity could be temporarily elevated during construction. This includes an area approximately 300 feet downstream of the area of construction and demolition activities, which corresponds to the anticipated length of the mixing zone that would be authorized in the Section 401 Water Quality Certifications, in which water quality conditions could be temporarily impaired during certain construction activities.
- **Stormwater pollutants:** Portions of the Columbia River and North Portland Harbor, downstream of an existing or proposed stormwater outfalls, in which stormwater pollutant loading and/or concentration could be affected. The study area for potential stormwater effects extends downstream to the mouth of the Columbia River.
- **Changes in land use:** Areas where the IBR Program may indirectly induce changes in land use, development, and/or traffic patterns, and where those induced changes could, in turn, result in impacts such as new impervious surface, in-water work, and impacts to aquatic and

terrestrial habitat features that could affect ecosystem resources. This includes areas within approximately 0.50 miles from each of the transit stations associated with IBR Program, portions of Hayden Island, and portions of the city of Vancouver.

- **Southern Resident distinct population segment (DPS) killer whale (SRKW) prey base:** Areas off the Pacific coast where the IBR Program may indirectly affect the availability of salmonid species from the Columbia River as prey for SRKW. This area encompasses the whales' entire coastal range from the mouth of the Columbia River and its plume, south as far as central California (Weitkamp 2010; Shelton et al. 2019), and north as far as southeast Alaska (Carretta et al. 2023) and including the Strait of Juan de Fuca and the Salish Sea (Weitkamp 2010; Shelton et al. 2019).

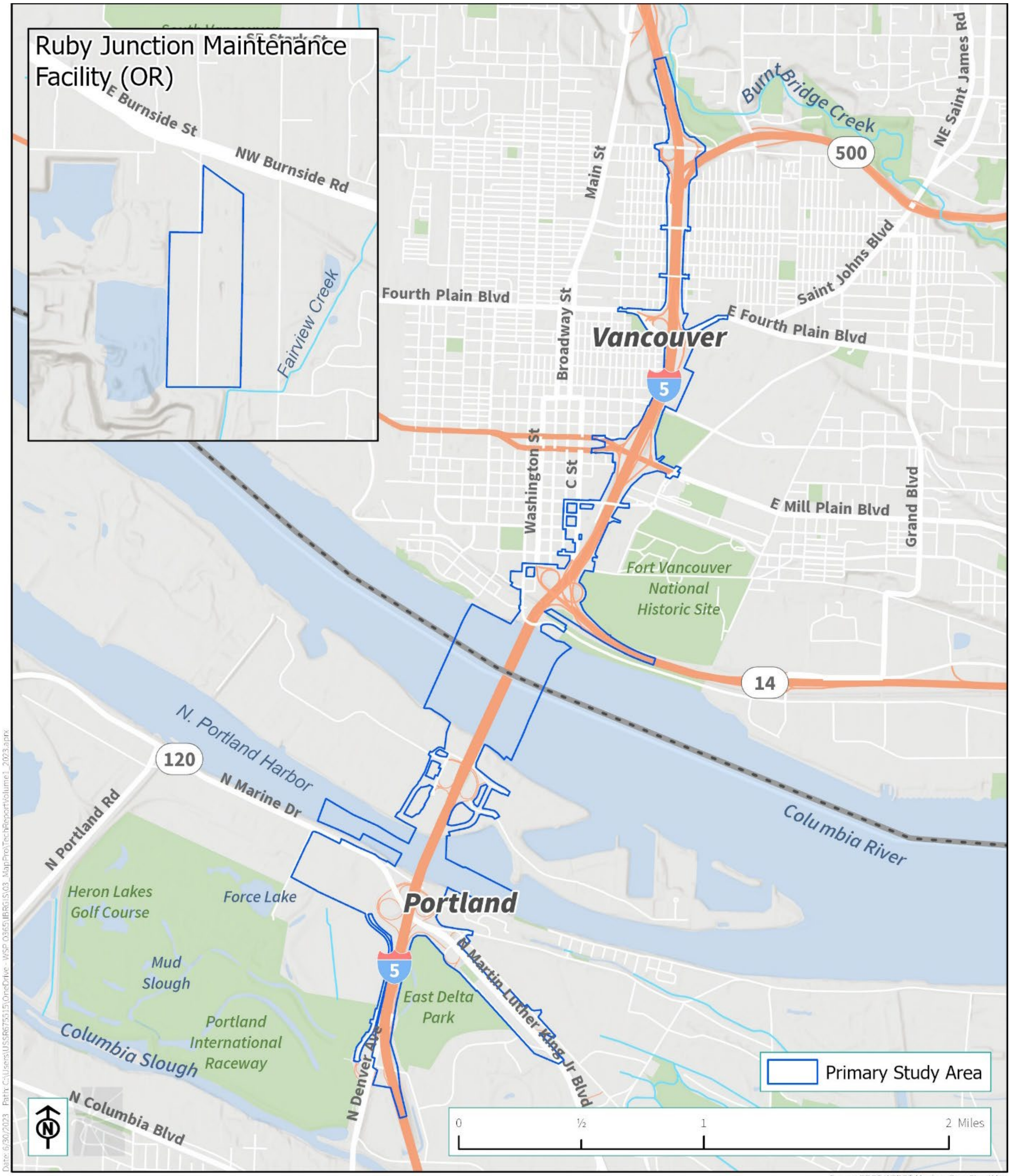
2.2 Relevant Laws and Regulations

This section lists the likely or potentially applicable regulations, standards, and guidelines for assessing and documenting regulatory compliance relative to ecosystem resources. The applicability of each regulation may depend on the design and/or jurisdiction.

2.2.1 Federal

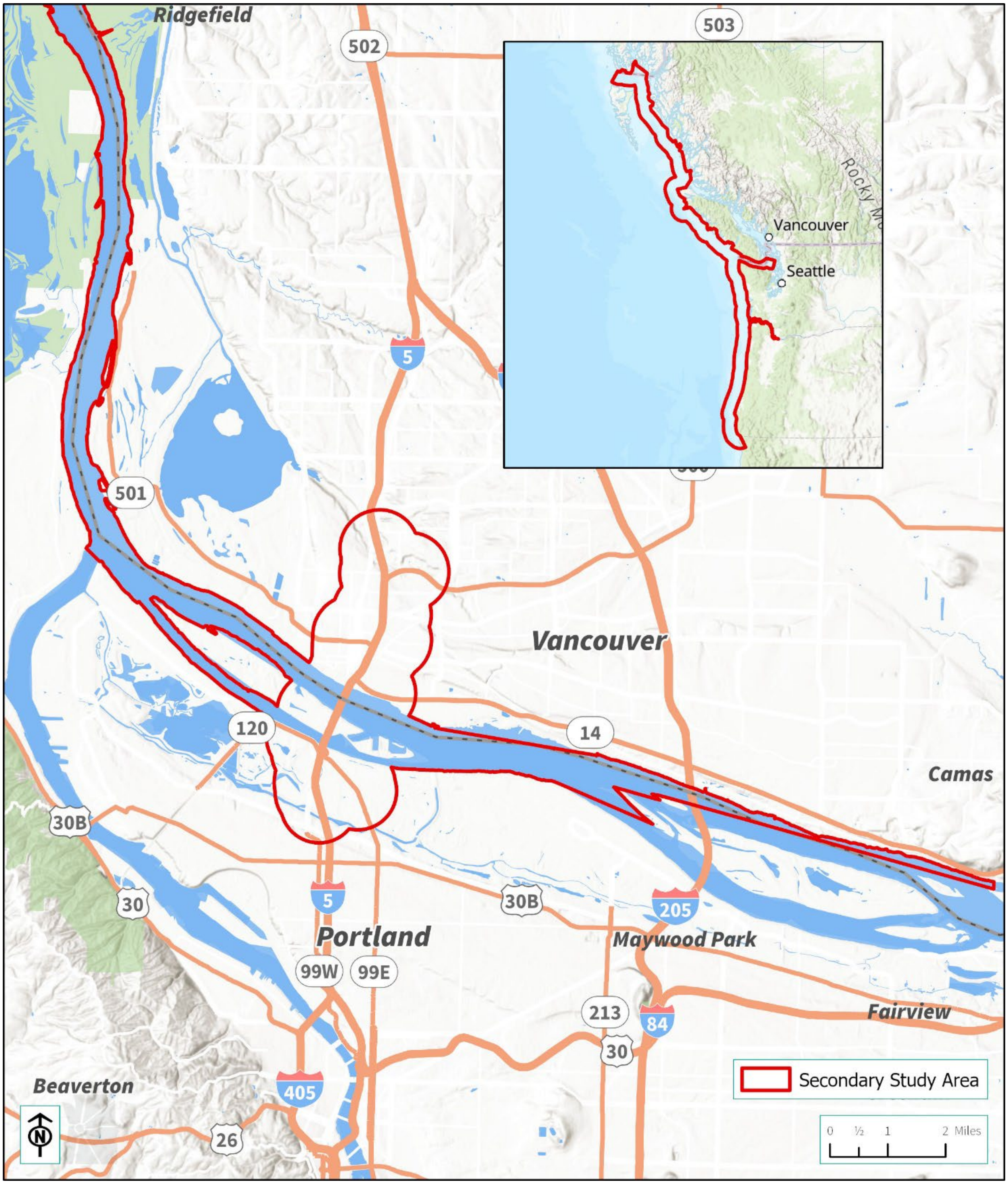
- NEPA. 1969. 42 USC, 4321 et seq., as amended.
- Endangered Species Act (ESA). 1973. 16 USC 1531-1544, as amended.
- Migratory Bird Treaty Act (MBTA). 1936. 16 USC 703-712, as amended.
- Bald and Golden Eagle Protection Act (BGEPA). 1940. 16 USC 668a–d, as amended.
- Fish and Wildlife Coordination Act. 1934. 16 USC 661-667e, as amended.
- Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). 1976. 16 USC 1801–1882, as amended.
- Marine Mammal Protection Act (MMPA). Title I. 1972. 16 USC 1361–1389, 16 USC 1401–1407, 1411–1417, and 1421-1421h, as amended.
- Clean Water Act. 1977. 33 USC 1251–1376, as amended.
- Rivers and Harbors Act. 1899. 33 USC 403, as amended.
- Invasive Species. 64 Federal Register (FR) 6183. Executive Order 13112. February 8, 1999.

Figure 2-1. Ecosystems Primary Study Area



Source: ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 2-2. Ecosystems Secondary Study Area



2.2.2 State – Oregon

- Oregon's ESA. 2003. Oregon Revised Statutes (ORS) 496.171-192 and Oregon Administrative Rule (OAR) 635-100.
- Fish Passage; Fishways; Screen Devices; Hatcheries Near Dams. 2001. ORS 509.580-910 and OAR 635-412-0005 to 0040.
- Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces. 1973. OAR 660-15-0000 (5).
- Oregon's Removal-Fill Law. 2002. ORS 196.800 to 990 and ORS 196.600 to 692.
- Issuance and Enforcement of Removal-Fill Authorizations, OAR 141-085-0005 to 141-089-0615.
- Aquatic Resources of Special Concern (ARSC) OAR 141-085-0690 (4)(a).
- Water Quality Standards, OAR 340-041.
- Plants; Inspection, Quarantine, Pest and Weed Control. ORS 570.500.
- Wildlife Policy. ORS 496.012. 1973.
- In-Water Blasting Permits. OAR 635-425-0000 to 0050. 1973.
- Oregon Comprehensive Wildlife Conservation Strategy. Oregon Department of Fish and Wildlife (ODFW). 2016.
- Oregon Habitat Mitigation Policy. OAR 635-415.

2.2.3 State – Washington

- State Environmental Policy Act. 1971. Revised Code of Washington (RCW) 43.21C, and Washington Administrative Code (WAC) 197-11; WAC 220-600; and WAC 468-12.
- Shoreline Management Act of 1971. 1971. RCW 90.58, WAC 173-18-100, and WAC 173-22.
- Growth Management Act. 1990. RCW 36.70A.
- Hydraulic Code. 1949. Chapter 77.55 RCW. WAC 220-660.
- Fishways, flow, and screening. 1949. RCW 77.57, as amended.
- Washington State Wildlife Action Plan. 2015.
- Policy of Washington Department of Fish and Wildlife and Western Washington Treaty Tribes Concerning Wild Salmonids. Washington Department of Fish and Wildlife (WDFW). 1997.
- Invasive/non-native species; WAC 220-640.
- Noxious weeds – control boards. 1969. RCW 17.10, as amended; "State noxious weed list." WAC 16-750.
- State and protected species; WAC 220-610.
- Wildlife to be classified, RCW 77.12.020.

2.2.4 Local – Portland

- Environmental Zones. 1994. City of Portland Code (CPC) 33.430, as amended.
- CPC Title 11. Trees.
- Portland Plant List. City of Portland Administrative Rule. ARB-ENN-7.01.

2.2.5 Local – Vancouver

- Critical Areas Protection Ordinance. 2005. City of Vancouver - Vancouver Municipal Code (VMC) 20.740.
- Fish and Wildlife Habitat Conservation Areas. 2005. VMC 20.740.110.
- Shoreline Management Area. 2005. VMC 20.760.
- Comprehensive Plan, 2011-2030. 2018. Environmental Policies. City of Vancouver.
- State Environmental Policy Act Regulations. 2004. VMC 20.790.
- Street Trees. VMC 12.04; and Tree Conservation. VMC 20.770.

2.3 Effects Guidelines

Local, state, and federal agencies provide guidance in determining impacts on ecosystem resources. This impact assessment considered impacts to aquatic and terrestrial species and their habitats, taking into consideration federal and state regulatory status, species' ecology and critical life stages (e.g., breeding), primary biological factors where applicable (e.g., critical habitat), and other relevant factors.

The following potential effects on aquatic resources were identified and evaluated:

- Short-term impacts on water quality during construction.
- Short- and long-term impacts from artificial lighting, avian predation, and hydraulic shadowing.
- Short- and long-term impacts on fish passage.
- Short- and long-term impacts on, or disturbance of, individual fish, including SOI.
- Short-term hydroacoustic impacts during construction.
- Short- and long-term impacts to sensitive aquatic habitats.
- Short-term impacts to water quality from construction stormwater.
- Long-term impacts related to stormwater from new contributing impervious area.
- Indirect effects on aquatic resources associated with changes in land use and traffic patterns.
- Indirect effects on the prey base for SRKW.

The following potential impacts to terrestrial and botanical resources were identified and evaluated:

- Short- and long-term impacts to sensitive terrestrial habitats.
- Short-term impacts to terrestrial wildlife from terrestrial noise during construction.
- Short- and long-term impacts to, or disturbance of, individual terrestrial wildlife or plant species, including SOI.
- Short- and long-term impacts on wildlife passage.
- Short- and long-term impacts on individual SOI plant species.

2.4 Data Collection Methods

Desktop reviews and analyses were conducted to document the presence and baseline condition of aquatic, riparian, and terrestrial habitat features, including rare or protected habitat types, within the primary and secondary study area and to document the degree of use of these study areas by SOI. Existing data, including previously prepared environmental reviews, were the primary sources of data used to conduct this assessment.[10]

The following process was used to collect fish, wildlife, and botanical resource data for this report:

1. Obtained a list of potential SOI and their habitats (including rare habitat types) from the Oregon Biodiversity Information Center (ORBIC), U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries), WDFW, and Washington Department of Natural Resources, Natural Heritage Program (WNHP).
   - Contacted federal, state, and local agencies, and local biologists and experts.
   - Examined studies, plans, and reports prepared by local, state, and federal agencies and private organizations for information on species and habitats that may occur within the primary and secondary study areas. These studies included the technical documentation prepared for the CRC project, WDFW Priority Habitats and Species database, ODFW Natural Resources Information Management Program database, ORBIC Rare Species Location Data Request, and Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan.
2. Determined SOI habitat requirements.
   - Examined studies, plans, and reports, and consulted with local biologists, federal, state, and local agencies, and environmental nongovernmental organizations.
   - Identified the extent and location of designated critical habitat for listed species within the study areas.
   - Evaluated the study areas for the presence and absence of primary biological factors for each designated critical habitat.
3. Delineated areas surveyed and delineated SOI habitats found.

[10] If required, targeted field surveys to verify the findings of the desktop analysis would be completed in 2023. Additional information obtained from field surveys would be evaluated and documented in the IBR Program's Final Supplemental EIS.

4. Determined potential habitat types and their associated species.
    - Obtained and reviewed recent aerial photography to identify and classify habitat types according to descriptions defined in Johnson and O'Neil (2001) and to evaluate the potential presence of any ARSC as defined in OAR 141-085-0510(3).
    - Obtained GIS maps of habitats, documented species locations, locally protected zones, critical habitats, and other ecological features. Resource classifications included essential fish habitat (EFH) (NOAA Fisheries), regionally significant habitat (Oregon Metro [Metro]), essential salmonid habitat (ESH) (Oregon Department of State Lands [DSL]), priority habitats (WDFW), critical areas (City of Vancouver), and environmental zones (City of Portland).
5. Qualitatively (e.g., by visual observation) characterized and assessed the condition of terrestrial and aquatic habitats for features important to fish, wildlife, and plants.
    - Aquatic characteristics of interest included water quality, substrate composition, bank stability, channel condition, fish passage, bathymetric characteristics, and riparian conditions. Streams were evaluated for their potential to support fish and other aquatic resources. Sources included published data from appropriate agencies (e.g., Washington State Department of Ecology [Ecology], Oregon Department of Environmental Quality [DEQ], WDFW, and ODFW).
    - Riparian habitat condition for fish and wildlife at the location of the I-5 crossings of the Columbia River, North Portland Harbor, and Columbia Slough. Riparian conditions were documented at Burnt Bridge Creek where it runs parallel to I-5 near the northern boundary of the primary study area. Habitat elements assessed included vegetation type and density, stream characteristics, and presence of any piers, footings, riprap, or other structures below the ordinary high-water mark (OHWM).
    - Terrestrial characteristics such as opportunities for wildlife passage, habitat distribution, structure, and composition, and habitat fragmentation or connectivity.
    - Wetlands and other waters that provide functions, values, and habitats that are limited in quantity because they are naturally rare or have been disproportionately lost due to prior impacts.

2.5 Analysis Methods

2.5.1 Aquatic Resource Impacts

A combination of quantitative and qualitative assessments were conducted to identify and evaluate the potential long-term, short-term, and indirect impacts on aquatic resources:

- Qualitative assessment:
    - ➢ Short- and long-term impacts on water quality from construction.
    - ➢ Short- and long-term impacts from changes in artificial lighting, avian predation, and hydraulic shadowing.
    - ➢ Short- and long-term impacts on fish passage.

  - Indirect effects on aquatic resources associated with changes in land use and traffic patterns.
  - Short- and long-term impacts to, or disturbance of, individual fish, including SOI.
- Quantitative assessment:
  - Short-term hydroacoustic impacts from pile driving using the NOAA Fisheries–approved pile driving calculator.
  - Short- and long-term impacts on aquatic habitats by overlaying project design with GIS mapping data.
  - Long-term impacts related to stormwater from new contributing impervious area.

2.5.2 Terrestrial and Botanical Resource Impacts

A combination of quantitative and qualitative assessments were conducted to identify and evaluate the potential long-term, temporary, and indirect impacts on terrestrial resources, including botanical resources:

- Qualitative assessment:
  - Short- and long-term impacts on wildlife passage.
  - Short- and long-term impacts on, or disturbance of, individual terrestrial wildlife or plant species, including SOI.
  - Short-term impacts to terrestrial wildlife from terrestrial noise during construction.
- Quantitative assessment:
  - Short- and long-term impacts on sensitive terrestrial habitats by overlaying project design with GIS mapping data.

2.6 Mitigation Measures Approach

A bi-state coordination effort was used to define a mitigation approach and identify mitigation measures for the Modified LPA that would be consistent with the mitigation policies of applicable local, state, and federal governments. The approach to developing mitigation measures followed the hierarchical “mitigation sequencing” approach common to these regulatory frameworks:

- Avoid impacts through design modification or by not taking a certain action or parts of the action.
- Minimize impacts on ecosystem resources by limiting the degree or magnitude of the action and its implementation by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts.
- Rectify impacts by repairing, rehabilitating, or restoring the affected resource.
- Reduce or eliminate the impact over time by preservation and maintenance operations.
- Compensate for unavoidable impacts by replacing, enhancing, or providing substitute resources or environments.

Compensation for unavoidable impacts were developed consistent with state and federal mitigation rules and guidance. The federal "Compensatory Mitigation for Losses of Aquatic Resources" Final Rule (33 Code of Federal Regulations part 332) prioritizes the use of mitigation bank credits, or in lieu of fee program credits, when available, but also allows for permittee-responsible mitigation projects, where appropriate. State and local agencies, including DSL, Ecology, WDFW, and the Cities of Portland and Vancouver, also have established regulatory frameworks that apply to mitigation within their respective jurisdictions.

In choosing among mitigation options, factors including the likelihood of success, ecological sustainability, practicability of long-term monitoring and maintenance, and relative costs were evaluated. The goal of mitigation is to avoid and minimize impacts to the extent practicable, and to provide compensatory mitigation for unavoidable impacts, such that there is no net loss of habitat function. The chosen compensatory mitigation may provide habitats and benefits for non-regulated species and resources beyond those that are required for compensation. It may also address the non-regulatory species and habitats identified in this technical report.

Refer to the IBR Program's Wetlands and Other Waters Technical Report for further details on wetland compensatory mitigation needs and requirements.

2.7 Coordination

This ecosystems technical report has been developed in collaboration with federal, state, and local agencies, including the USACE, USFWS, NOAA Fisheries, ODFW, WDFW, DSL, DEQ, Ecology, City of Vancouver, and City of Portland. Regular meetings were held with representatives from these agencies, tribes, and other interested parties. Several agency working groups were developed to provide input as the Modified LPA was developed, impacts evaluated, and mitigation measures developed.

3. AFFECTED ENVIRONMENT

The ecosystems primary and secondary study areas include portions of the mainstem Columbia River, associated tributaries, and nearby terrestrial habitats on both the Washington and Oregon sides of the Columbia River. This section describes the affected environment, including the baseline condition of aquatic, terrestrial, and botanical resource habitat within the study areas,[11] and the species that use these habitats, including SOI.

The Interstate Bridge connects two major metropolitan areas. The surrounding landscape is characterized by urban development interspersed with remnant natural habitat areas in the form of riparian buffers, open space and parks, and the mainstem Columbia River. Where they remain, natural habitats within the study areas are generally small, fragmented, and modified from their historic conditions. Nevertheless, these areas do provide habitat for a variety of plants, terrestrial wildlife, birds, and fish, including both common species and species with special regulatory status.

3.1 Overview

3.1.1 Aquatic Resource Overview

The study areas are located within the lower Columbia River subbasin. The Columbia River and its tributaries form the dominant aquatic system in the Pacific Northwest. The 1,214-mile-long Columbia River drains 259,000 square miles of the northwestern U.S. and southern British Columbia, Canada, into the Pacific Ocean. Currently, 23 mainstem and more than 300 tributary dams regulate the flow of the Columbia River to the Pacific Ocean (Bottom et al. 2005). Saltwater intrusion from the Pacific Ocean extends approximately 23 miles upstream from the Columbia River mouth at Astoria. Coastal tides influence the flow rate and river level up to Bonneville Dam at RM 146.1 (ISAB 2000).

Mainstem aquatic habitat in the lower Columbia River has been substantially altered from its historic condition by a variety of factors, including basin-wide water management operations, construction and operation of mainstem hydroelectric projects, growth of native avian and pinniped predator populations, introduction of non-native species (e.g., smallmouth bass, walleye, channel catfish, and invertebrates), and other human practices that have degraded water quality and habitat.

Within the lower Columbia River subbasin, including the study areas, flooding was historically a frequent occurrence, contributing to habitat diversity via flow to side channels and deposition of woody debris. The lower Columbia River estuary is estimated to have once had 75% more tidal wetlands than the current estuary because tidal waters used to reach floodplain areas that are now diked. Tidal wetlands provided feeding and resting habitat for juvenile salmonids in the form of low-velocity marshland and tidal channel habitats (Bottom et al. 2005).

[11] The study area for this ecosystems analysis consists of a primary study area and a secondary study area, as described in Chapter 2. Where the more general term “study area” is used in this document, it is inclusive of both study areas.

Dams built on the river between the 1930s and 1970s significantly altered the timing and velocity of hydrologic flow and reduced peak season discharges. Availability of aquatic habitat for native fish, particularly those that rely heavily on low-velocity side-channel habitat for holding, feeding, and rearing, has declined as a result of these changes to habitat-forming processes. Aquatic habitat components affected by these changes include the amount and distribution of woody debris (e.g., controlled flows and navigation management discourage free transport of large wood), rates of sand and sediment transport, variations in temperature patterns, the complexity and species composition of the food web, the distribution and abundance of salmonid predators, the complexity and extent of tidal marsh vegetation, and seasonal patterns of salinity (LCFRB 2010a, 2010b).

In general, aquatic habitats in the study areas have been extensively modified from their historical condition, yet they continue to provide suitable habitat for a variety of aquatic organisms, including both native and non-native fish species and marine mammals.

3.1.2 Terrestrial Resource Overview

Terrestrial habitats within the study areas are classified within the western forest ecoregion (Omernik 1987), with elevations ranging from sea level to 11,240 feet. The Pacific Northwest temperate rainforest is one of the most productive forest regions in the world. Forest types of this ecoregion include those dominated by coniferous species (e.g., Douglas fir [*Pseudotsuga menziesii*], Sitka spruce [*Picea sitchensis*], western hemlock [*Tsuga heterophylla*], and true firs [*Abies* spp.]), and those dominated by deciduous species (e.g., Oregon white oak [*Quercus garryana*]) and bigleaf maple [*Acer macrophyllum*]). Riparian areas adjacent to surface waters, and forested wetlands, are frequently dominated by black cottonwood (*Populus balsamifera ssp. trichocarpa*), Oregon ash (*Fraxinus latifolia*), and red alder (*Alnus rubra*). Other wetland areas include a mix of native shrubs and emergent species. Terrestrial portions of the study areas historically consisted primarily of a mix of closed canopy forest/woodlands in upland areas, interspersed with patches of grassland savannah and prairie, with forested riparian habitat adjacent to water, and emergent floodplain wetlands (Aikens 2006).

The suite of wildlife species originally inhabiting the study areas and surrounding landscape in the lower Columbia Basin included at least 18 amphibian species (e.g., Pacific treefrog [*Pseudacris regilla*]); 15 reptile species (e.g., western pond turtles [*Actinemys marmorata*]); 154 bird species (e.g., woodpeckers, owls, songbirds, waterfowl); and 69 mammal species (e.g., elk [*Cervus canadensis*], cougar [*Puma concolor*], coyote [*Canis latrans]*, and bobcat [*lynx rufus*]) (Aikens 2006). The study areas are also located within the Pacific Flyway, the major north–south route for migratory birds that extends from Patagonia to Alaska. Many species of migratory birds use the area for resting, feeding, and breeding.

Native Americans lived in the region for 11,000 years before the arrival of Euro-American settlers. However, human populations were low in the region relative to levels that were present after settlement by Euro-Americans (Aikens 2006). Since approximately the mid-1800s, human population growth and development has gradually displaced and reduced the quality and quantity of wildlife habitat. These changes have made the study areas unsuitable as habitat for many species of native mammals, birds, amphibians, reptiles, and other wildlife that were once common.

Some species that once occurred in the study areas, such as the grizzly bear (*Ursus arctos*), California condor (*Gymnogyps californianus*), and gray wolf (*Canis lupus*), have been completely extirpated. Other species, such as the streaked horned lark (*Eremophila alpestris strigata*), are still present in the study areas, but their abundance and distribution have declined to the point of requiring regulatory protection. Still, other native species continue to occur in the study areas, but in smaller and more fragmented populations than occurred historically. Other species have adapted to the change in habitat conditions, persisting or even benefiting from the changes (e.g., coyote, raccoons [*Procyon lotor*], and red-tailed hawks [*Buteo jamaicensis*]).

In general, most terrestrial habitat within the study areas is limited to relatively small, fragmented patches that currently support species that are tolerant of some degree of human disturbance, and with relatively small home ranges and restricted habitat requirements. The most highly functioning terrestrial habitats are the remaining forested riparian and wetland habitats, particularly those that have connectivity to other areas of intact habitat.

3.1.3 Botanical Resource Overview

Most natural habitat for botanical resources within the study areas has been lost or highly degraded through human development, land use conversion, and introduction of invasive species and noxious weeds. In general, natural habitat for botanical resources within the study areas occurs primarily within wetlands, riparian buffers, and other protected open spaces. These habitats tend to be relatively small and isolated from each other, limiting opportunities for distribution of many native species. Invasive plants and noxious weeds are also ubiquitous throughout many of the vegetated spaces within the study areas.

3.2 Aquatic Resources

In this technical report, the term "aquatic resources" refers primarily to surface waters (rivers and streams) and the species that these habitats support (fish, marine mammals, and other aquatic organisms). Wetland resources are discussed in the IBR Program's Wetlands and Other Waters Technical Report.

3.2.1 Aquatic Habitats and Species

The study areas contain the following waterbodies: lower Columbia River, North Portland Harbor, Columbia Slough, Burnt Bridge Creek, Fairview Creek, and Pacific Coastal Waters. These resources are described below.

3.2.1.1 Columbia Slough

The Columbia Slough watershed drains over 32,000 acres of land in portions of Portland, Troutdale, Fairview, Gresham, Maywood Park, Wood Village, and Multnomah County (unincorporated areas). The Columbia Slough is a remnant of the historic system of lakes, wetlands, and channels that dominated the south floodplain of the mainstem Columbia River. Historically, Native Americans used the Columbia Slough and surrounding area for fishing, hunting, and gathering food (City of Portland 2021).

HYDROLOGY

In its current configuration, the Columbia Slough is a slow-moving, low-gradient drainage canal running nearly 19 miles from Fairview Lake in the east to the Willamette River in the west. Today, the original inlet is blocked at the upstream end and it no longer receives flows from the Columbia River. Drainage and flood control in the Columbia Slough are provided via a system of dikes, pumps, weirs, and levees (USACE 2020).

The Columbia Slough is divided into upper, middle, and lower reaches. The upper and middle reaches are highly managed with piped surface water, dikes and levees, and a system of pumps that provide watershed drainage and flood control.

The study areas include a portion of the lower Columbia Slough, which extends from the Peninsula Drainage Canal to the Willamette River, less than 1 mile south of its confluence with the Columbia River (City of Portland 2021). The lower Columbia Slough is tidally influenced and undergoes 1 to 3 feet of tidal fluctuation in its water surface daily. Water levels within the lower Columbia Slough closely correspond with the levels at the confluence of the Columbia and Willamette Rivers (USACE 2020).

WATER QUALITY

The Columbia Slough is a highly managed, low-gradient, shallow body of water that lacks significant shading and has few cold water inputs. It is generally characterized by warm water temperatures, eutrophication (excessive growth of algae and macrophytes), wide pH and dissolved oxygen fluctuations, and elevated turbidity (City of Portland 2021).

The Columbia Slough is water quality limited and is identified as an impaired water on the current Oregon 303(d) list with Total Maximum Daily Load (TMDL) listings for aquatic weeds, iron, and biological criteria (DEQ 2020).

SUBSTRATE

Benthic substrates within the lower Columbia Slough consist primarily of sand derived from alluvial deposits, though silts and other fine sediments are also prevalent (USACE 2020). The abundance of silts and fine sediments can lead to elevated turbidity.

Because the Columbia Slough is a highly managed waterbody in an urban watershed, the sediments contain elevated levels of contaminants. Heavy metals (lead, zinc, chromium, copper), toxic organic chemicals (pesticides, polyaromatic hydrocarbons [PAH]s, and polychlorinated biphenyls [PCBs]) are common contaminants.

The diversity of benthic macroinvertebrates is relatively low throughout the Columbia Slough, limiting the available food resources for other aquatic and terrestrial species. This low diversity is caused primarily by the abundance of fine sediments and impaired water quality. Polluted sediments may also be a factor (City of Portland 2021).

PHYSICAL HABITAT FEATURES

Aquatic habitat function within the Columbia Slough is limited. Development throughout the watershed has resulted in extensive habitat loss and loss of connectivity. Large woody debris is scarce because the riparian area is largely devoid of trees and the potential for future large woody debris recruitment is limited. Habitat complexity is limited, and habitat structures such as boulders and undercut banks are largely absent.

Overbank flow occurs very infrequently, and the stream is isolated from its historic floodplain. Likewise, low-energy off-channel areas (such as backwaters, ponds, and oxbows) are also scarce. However, remnant wetlands and restored wetlands do exist in the lower Columbia Slough and provide important habitat function. Smith and Bybee Lakes are accessible to fish from the main channel of the lower Columbia Slough and provide important off-channel habitat for salmonids (USACE 2020).

Riparian habitat along most portions of the Columbia Slough has been significantly impacted by urban development. Remaining areas of vegetation generally consist of narrow bands of native trees (primarily black cottonwood, Oregon ash, and bigleaf maple), shrubs (willows, red osier dogwood [*Cornus sericea*]), and common snowberry (*Symphoricarpos albus*), and extensive presence of invasive Himalayan blackberry and reed canarygrass. While riparian habitat function is impaired within the study areas, existing riparian areas provide a suite of functions, including microclimate and shade, bank stabilization and sediment control, pollution control, streamflow moderation, organic matter input, large woody debris, and wildlife travel corridors.

Several restoration efforts are ongoing in the Columbia Slough. The City of Portland's Watershed Revegetation Program and its community partners are conducting non-native species removal and native plantings in many areas along the Columbia Slough. The City of Portland Bureau of Environmental Services has conducted several restoration projects throughout the watershed since 1996 and has successfully re-established native vegetation along many parts of the Columbia Slough (City of Portland 2021).

AQUATIC SPECIES

The Columbia Slough provides habitat for many fish and wildlife species that also use the mainstem Columbia River. Approximately 26 aquatic species, including juvenile salmonids and other native and non-native fish species, freshwater shrimp, and crawfish, have been documented in the lower slough, which provides some of the only remaining off-channel and refugia habitat in the lower Willamette River area (City of Portland 2021). Anadromous fish can access the lower Columbia Slough up to an impassable levee near Northeast 18th Avenue (RM 8.3). At Smith and Bybee Lakes, a water control structure allows fish passage.

3.2.1.2 Columbia River and North Portland Harbor

The existing Interstate Bridge is located at RM 106 of the Columbia River. The study areas include the portions of the Columbia River from RM 101 to 118, as well as downstream portions to the mouth of the Columbia River (see the study area descriptions in Section 2.1). North Portland Harbor is a large side channel of the Columbia River located along the southern banks of Hayden Island. The harbor branches off the Columbia River upstream (east) of the existing bridges and flows approximately 5 miles downstream (west) before rejoining the mainstem Columbia River. I-5 crosses North Portland Harbor at approximately RM 4.

This portion of the study areas has been substantially altered from its natural condition by human disturbance, including urbanization that extends up to the shoreline, removal of streamside forests and wetlands, and degradation of riparian areas by the construction of dikes and levees and the placement of streambank armoring.

HYDROLOGY

There are more than 250 reservoirs and around 150 hydroelectric projects in the Columbia River basin, including 18 mainstem dams on the Columbia River and its main tributary, the Snake River. Consequently, the Columbia River is a highly managed waterbody that, for most of its length, resembles a series of slack-water lakes rather than its original free-flowing state. The Columbia River estuary historically received annual spring freshet flows that were on average 75% to 100% higher than current flows (ISAB 2000). Historical winter flows (October through March) were approximately 35% to 50% lower than current flows (ISAB 2000).

The second major contributor to stream flow conditions in the study areas is tidal influence from the Pacific Ocean. Although the saltwater wedge does not extend into the study areas, high-tide events affect flow and stage in the Columbia up to Bonneville Dam.

Upstream dams, levees located along shorelines, and channel modifications (e.g., armoring, reshaping) have restricted habitat-forming processes such as sediment transport and deposition, erosion, and natural flooding. In the study areas, natural landforms and constructed landforms (e.g., dikes and levees) are the dominant floodplain constrictions, while bridge footings are the subdominant floodplain constrictions. Nine bridge pier pairs associated with the existing Interstate Bridge are located below the OHWM of the Columbia River, and one bridge pier is located below the OHWM of North Portland Harbor.

WATER QUALITY

Water-quality conditions are impaired in portions of both the Columbia River and North Portland Harbor within the study areas. Refer to the IBR Program's Water Quality and Hydrology Technical Report for a more detailed description of existing water-quality conditions within the ecosystems primary study area.

The portions of the Columbia River and North Portland Harbor within the primary study area are water-quality impaired. The current Oregon 303(d) list includes listings for temperature, PCBs, PAHs, dichlorodiphenyltrichloroethane metabolites, and arsenic (DEQ 2020). The most recent approved Washington 303(d) list includes listings for temperature and PCBs (Ecology 2021). The U.S. Environmental Protection Agency (EPA) has approved TMDLs for portions of the primary study area within the Columbia River and North Portland Harbor for total dissolved gas (DEQ and Ecology 2002) dioxin (EPA 1991), and temperature (EPA 2021).

Recent studies indicate that there are high levels of chemical contaminants in the salmonid food chain in the Columbia River estuary (LCEP 2007). A report by the Lower Columbia Estuary Partnership noted widespread presence of PCBs and PAHs in the food web of the lower Columbia River (LCEP

2007). Pesticides and heavy metal contaminants have also been documented in Columbia River sediments.

Upstream municipal and industrial waste discharges within the watershed also contribute to impaired water-quality conditions in the Columbia River and North Portland Harbor. Common water-quality issues with these types of discharges include warmer water temperatures, lowered dissolved oxygen, increased nutrient loading, and increased levels of fecal coliform bacteria (LCEP 2007).

Terrestrial portions of the primary study area that drain to the Columbia River and North Portland Harbor are highly developed. Much of the terrestrial portion of the primary study area consists of a network of impervious surfaces, including I-5 and various state highways, local access roads, residential streets, parking lots, and other impervious surfaces. Pollutants commonly occurring in stormwater runoff include total suspended solids, nutrients, oil and grease, other fluids associated with automobiles, PAHs, agricultural chemicals, and dissolved metals. Dissolved metals—especially dissolved copper and zinc—are of particular concern because of their potential impact on the olfactory systems of listed fish. There is also emerging research related to 6PPD-quinone, a chemical in tires, which has been linked to mortality of salmon (particularly coho) under certain conditions (Tian et al. 2021).

Stormwater from most existing impervious surface within the primary study area drains to surface waters without formal water-quality treatment. This large amount of untreated runoff in the watershed likely contributes to a high baseline level of pollutant loading within the Columbia River and North Portland Harbor.

Portions of the Columbia River and North Portland Harbor within the primary study area are 303(d) listed for high-water temperature (DEQ 2020; Ecology 2021). In August 2021, the EPA issued a draft TMDL for addressing exceedances of various state and tribal criteria for temperature in the Columbia River and lower Snake River (EPA 2021). This TMDL documented that water temperature impairments are widespread, and primarily due to the cumulative impacts of climate change and dam impoundments. Elevated water temperatures increase the risk of disease, delay adult migration, increase the foraging rate of predators, and decrease the survival rate of smolts (NOAA Fisheries 2020a).

Sediment transport, and associated turbidity, within the mainstem Columbia River and North Portland Harbor is relatively low compared to historical conditions (Bottom et al. 2005). The series of dams and reservoirs on the Columbia and Snake Rivers have blocked natural sediment transport, with total sediment discharge into the estuary and Columbia River plume only one-third of 19th-century levels (NOAA Fisheries 2020a). These reductions in sediment transport and turbidity levels pose a risk to fish and fish habitat. Organic material in sediment is an important component of the food web. Historically, floodplain inundation provided a significant source of organic material to the aquatic system. As floodplain connectivity has been reduced over time, this input of organic material has been reduced. This has decreased the available food supply for salmonids (Bottom et al. 2005). Under certain conditions, lower turbidity levels may also pose a risk to individual fish. Decreased turbidity may lower visual cover for juvenile salmonids, making them more vulnerable to predation by birds and other fish. Low turbidity, combined with reduced spring freshets poses particularly high risks to outmigrating juvenile salmonids (Bottom et al. 2005).

SUBSTRATE

The substrate of the Columbia River within the primary study area is predominantly composed of sand, with relatively small percentages of fine sediments and organic material (DEA 2006). A bathymetric study completed in 2006 found significant scouring on the upstream side of each bridge pier, and scour channels on the downstream side (DEA 2006). The scouring ranged from approximately 10 to 15 feet deep. Bedload transport patterns were evident in the form of sandwaves, a natural feature of the river bottom that indicates the influence of the currents and that continuously moves and shifts.

The substrate in North Portland Harbor within the primary study area is predominantly composed of sand, with relatively small percentages of fine sediments and organic material. A bathymetric study completed in 2006 found deep scouring near the ends of the downstream piers of the existing North Portland Harbor bridge on the north bank, with scour holes approximately 8 to 10 feet deep (DEA 2006). Scouring around the upstream piers was approximately 3 to 7 feet deep and was more pronounced around the northern piers than the southern piers. A particularly deep area (approximately 21 feet deep) on the south side of the channel downstream of the existing bridge is indicative of a fast-moving current through the harbor.

Dredging and dredge material placement are commonly occurring activities in the lower Columbia River. Dredging is conducted on a regular basis by the USACE for maintenance of the Columbia River federal navigation channel. Once maintained at a depth of 20 feet, the channel is now dredged to an average depth of 43 feet (ISAB 2000). The USACE has also realigned the navigation channel and installed hydraulic control structures, such as in-water fills, channel constrictions, and pile dikes (ISAB 2000). Many lower Columbia River ports and industrial businesses conduct dredging for construction and maintenance of vessel berthing areas and marinas. In some areas, dredging is also conducted for sand and gravel mining purposes. These activities have modified the bathymetric profile of portions of the Columbia River and also result in periodically elevated turbidity.

PHYSICAL HABITAT FEATURES

Shallow-water habitat (defined as areas between 0 feet and -20 feet) (Columbia River Datum) is present in the primary study area on both the Oregon and Washington sides of the river and is influenced by flow and sediment input from tributaries and the mainstem river that eventually settles to form shoals and shallow flats. This shallow-water habitat is used extensively by both juvenile and adult salmonids for migrating, feeding, and holding. In general, outmigrating juveniles tend to use shallow-water habitats more extensively, whereas adult fish rely on deeper water habitats (ISAB 2000).

Within the primary study area, water depths in the Columbia River range between approximately 0 and 50 feet, with an average depth of approximately 27 feet (DEA 2006). Shallow-water habitat is present along both shorelines but is relatively more abundant along the Oregon side (Figure 3-1).

North Portland Harbor water depths within the primary study area range between approximately 0 and 20 feet; the average water depth is approximately 14 feet (DEA 2006). Within the primary study area in North Portland Harbor, all of the aquatic habitat meets the criteria to be considered shallow-water habitat (Figure 3-2).

Figure 3-1. Columbia River Water Depths

Figure 3-2. North Portland Harbor Water Depths

The extent and condition of shallow-water habitat has been greatly reduced from historical levels throughout the lower Columbia River (Bottom et al. 2005; LCFRB 2010a). As river stage has declined with the operation of the hydropower system, shallow-water habitat has concurrently decreased (Bottom et al. 2005). Dredging, diking, armoring, and other shoreline alterations have exacerbated the problem. Shoreline armoring has reduced the quality of shallow-water habitat areas by providing habitat for predaceous fish, increasing water temperatures, removing resting and holding areas for juvenile fish, and reducing primary productivity.

In-water and overwater structures in shallow-water habitat areas also affect habitat suitability in shallow-water habitats. These structures displace existing habitat, can provide habitat for predaceous fish and birds, and may interfere with juvenile migration. The existing bridge piers represent an existing impact to shallow-water habitat function in their current state. The high density of permanently moored floating homes and docks in North Portland Harbor also reduces nearshore habitat function in that location. In general, shallow-water and nearshore habitat within the primary study area is limited in extent and provides only moderate habitat function compared to that in less disturbed reaches of the river.

Riparian habitats adjacent to the Columbia River and North Portland Harbor are limited in both extent and function. Streambank armoring and development activities limit the width of the riparian area at each of the bridge locations to a narrow band of small shrubs, low-growing herbaceous vegetation, and invasive species.

Tree canopy in riparian areas within the primary study area is generally absent or sparse. Where present, typical canopy dominants include native willows (*Salix* spp.) and black cottonwood (*Populus balsamifera*) species, as well as invasive species such as tree of heaven (*Ailanthus altissima*). The understory is typically dominated by invasive species such as Himalayan blackberry (*Rubus armeniacus*) and native species such as roses (*Rosa* sp.) and willows. The herbaceous layer is typically dominated by non-native species, including English ivy (*Hedera helix*) and reed canarygrass (*Phalaris arundinacea*), but also includes a mix of native and non-native annual grasses and forbs.

Because riparian areas are limited in size within the primary study area, and are unlikely to expand within this urban setting, there is little potential for future large wood recruitment. Organic inputs through leaf litter and thermal regulation functions are generally absent due to the lack of a canopy cover. Habitat complexity is limited, although some boulders and artificial structures (such as docks and pilings) are present.

Extensive habitat restoration efforts have been, and continue to be, undertaken throughout the lower Columbia River watershed. Several various entities, including nonprofit organizations, land trusts, government agencies, electrical utilities, tribes, and private landowners, have conducted these activities. Restoration activities are being conducted at all scales, from small riparian plantings and stream enhancement projects to large-scale land acquisitions and conservation protections.

AQUATIC SPECIES

The Columbia River and North Portland Harbor provide habitat for a variety of native fish species, including Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*O. keta*), sockeye salmon (*O. nerka*), steelhead trout (*O. mykiss*), coho salmon (*O. kisutch*), Pacific eulachon (*Thaleichthys pacificus*), coastal cutthroat trout *(Oncorhynchus clarkii clarkii*), Pacific lamprey (*Entosphenus tridentatus*), white sturgeon (*Acipenser transmontanus*), green sturgeon (*Acipenser medirostris*), suckers (*Catostomus* spp.), sticklebacks (*Gasterosteus* spp.), starry flounder (*Platichthys stellatus*), sculpin (*Cottus* spp.), northern pikeminnow (*Ptychocheilus oregonensis*), shiners (*Cyprinidae*), peamouth (*Mylocheilus caurinus*), and chiselmouth (*Acrocheilus alutaceus*). There are also substantial populations of non-native invasive species such as largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), and walleye (*Sander vitreus*).

Marine mammals within the study area include Steller sea lion (*Eumetopias jubatus*), harbor seal (*Phoca vitulina*), and California sea lion (*Zalophus californianus*).

Aquatic organisms that constitute the prey base for salmonids and other fish in the lower Columbia River include invertebrates such as sand shrimp, mysids, crabs, zooplankton (e.g., daphnids, chironomid larvae), and floating insect larvae and adults. Benthic species in the Columbia River and North Portland Harbor include mussels (e.g., *Anodonta* spp.).

3.2.1.3 Burnt Bridge Creek

Burnt Bridge Creek flows through the city of Vancouver and is a direct tributary to Vancouver Lake. The Burnt Bridge Creek watershed covers 27 square miles. The stream flows approximately 13 miles through the city of Vancouver and Clark County to its outlet at Vancouver Lake, which in turn drains into the lower Columbia River via Lake River. Burnt Bridge Creek crosses I-5 within the primary study area approximately 2 miles upstream of its confluence with Vancouver Lake.

HYDROLOGY

The Burnt Bridge Creek subbasin has been heavily impacted by the disconnecting of floodplains, dredging, draining, and rerouting of flows. This subbasin is one of the most heavily urbanized in Clark County (CCC 2010). Historically, the upper portion of Burnt Bridge Creek was a series of interconnected wetlands that flowed westerly to Vancouver Lake. Currently, the stream flows for nearly half of its length in a narrow, excavated ditch. Compared to historical conditions, the modifications have increased peak flows, reduced base flows, and altered flow timing.

Stream flow from late fall through spring is driven by precipitation, while summer flow is maintained by natural groundwater inflow coupled with industrial discharge from a manufacturing facility located east of Interstate 205 (I-205). The industrial processes at the manufacturing facility extract groundwater for cooling operations and contribute a significant amount of discharge water, which helps sustain summer base flow in the creek (Herrera 2019).

WATER QUALITY

Burnt Bridge Creek is water quality limited, and the reach of the creek within the primary and secondary study areas is listed on Ecology's current 303(d) list for temperature, dissolved oxygen, fecal coliform, and pH (Ecology 2021). Water quality in Burnt Bridge Creek has been monitored extensively for more than 40 years, including a TMDL study by Ecology with 19 monitoring sites along the creek and its tributaries in 2008 through 2009. The most recent available monitoring data were collected in 2018 (Herrera 2022).

A temperature monitoring gauge at Leverich Park (gauge BBC 2.6) indicated that from June 25 to October 15, 2021, the highest annual running seven-day average of maximum temperatures exceeded 17.5 degrees Celsius (63.5 degrees Fahrenheit) approximately 86 times (Herrera 2022). These measurements indicate that temperatures in Burnt Bridge Creek exceed standards for salmonid spawning, migration, and rearing for all of the summer and over half of the year.

Between October 2020 and September 2021, dissolved oxygen levels measured at the monitoring gauge at Leverich Park were at or above the state water-quality standard of 8 milligrams per liter (mg/L) in all but one sampling event on October 20, 2020. This indicates generally acceptable dissolved oxygen conditions, with some potential impairment to salmonid habitat function during the summer months.

Fecal coliform bacteria results measured at Leverich Park between October 2020 and September 2021 exceeded the state water-quality standard for both the geometric mean (shall not exceed 100 colony-forming units [CFUs] per 100 milliliters [mL]) and the 90th percentile (shall not exceed 200 CFU/100 mL) during all base flow events. The upper reaches of the creek pass through farmland, where the use of chemical fertilizers and pesticides likely contribute chemical contamination and nutrients to the stream.

Measured pH levels in Burnt Bridge Creek at Leverich Park between October 2020 and September 2021 met the state water-quality standard (6.5 to 8.5) in all months (Herrera 2022).

SUBSTRATE

The dominant substrate within Burnt Bridge Creek is sand and silt with some small patches of heavily embedded spawning gravel in the upper reaches of the watershed; some fine gravels are present within the lower reaches. Sedimentation within Burnt Bridge Creek has been identified as an acute problem and a major limiting factor for salmonid production (CCC 2010).

PHYSICAL HABITAT FEATURES

In general, physical habitat has been substantially modified throughout Burnt Bridge Creek, and habitat function has been diminished from historic conditions. The upper reaches of the creek were historically a series of associated wetlands and marshes that were filled, ditched, and drained. In addition, most of the tributary streams have been channelized or routed underground (CCC 2010). The watershed has had significant restoration work in recent years to reconstruct side-channel wetland and floodplain areas and improve habitat.

The portion of Burnt Bridge Creek within the study areas includes a reach that flows through Arnold Park and Leverich Park, north of SR 500. In this location, the creek has a riparian canopy of mature trees and shrubs along most of its length, with dominant tree species including natives such as Douglas fir, black cottonwood, willow, and ash. The understory is dominated by non-native Himalayan blackberry, reed canarygrass, and teasel (*Dipsacus sylvestris*), but also includes native trees and shrubs, including red alder (*Alnus rubra*), red osier dogwood, and beaked hazelnut (*Corylus cornuta*). In the more open areas within Arnold Park and Leverich Park, the banks are highly eroded by regular visitor usage and mowing of herbaceous vegetation in the vicinity of the channel.

Downstream of Leverich Park, Burnt Bridge Creek passes through a series of culverts and short channelized sections as it flows north along the east side of I-5. Habitat condition and function in this portion of the creek are moderate. Where vegetated areas of open channel exist, banks are generally undercut and eroding. There is a mixed forested riparian canopy in this location, and some native understory shrubs, though reed canarygrass and Himalayan blackberry are prevalent.

Burnt Bridge Creek is conveyed under I-5 via a concrete box culvert near the northern end of the secondary study area. The portion of Burnt Bridge Creek that is downstream of I-5 within the secondary study area is characterized by low-gradient pool and marsh habitat with moderate canopy cover.

Downstream of the study areas, Burnt Bridge Creek does not include documented total barriers to fish passage, though several partial barriers do exist. The WDFW Fish Passage and Diversion Screening Inventory database documents several culverts within the primary and secondary study areas that function as partial barriers, including the I-5 culvert at milepost 3.07 (RM 1.9), which is an undersized box culvert with less than 1% slope (WDFW 2021a).

AQUATIC SPECIES

Burnt Bridge Creek provides suitable habitat for several fish SOI species, including coho salmon, Chinook salmon, and steelhead (WDFW 2021b). Lamprey (Family Petromyzontidae) have also been previously documented in Burnt Bridge Creek (PSMFC 2003); however, no data are available on distribution, abundance, timing, or extent of habitat use. Other native resident fish documented within the creek include sculpin (Family Cottidae), red-sided shiners (*Richardsonius balteatus*), sticklebacks (Family Gasterosteidae), leopard dace (*Rhinichthys falcatus*), suckers (*Catostomus* sp.), mosquitofish (*Gambusia affinis*), bullhead (*Ameiurus* sp.), and peamouth (*Mylocheilus caurinus*) (Herrera 2019).

3.2.1.4 Fairview Creek

Fairview Creek is an approximately 5-mile-long urban creek, that flows from spring-fed wetlands on the northeast side of Grant Butte in Gresham. The creek drains approximately 7,000 acres of urban watershed, flowing through the cities of Gresham and Fairview. Fairview Creek receives flow from two tributaries (No Name Creek and Clear Creek) and runoff from paved surfaces before flowing into Fairview Lake and, eventually, the Columbia River via the Columbia Slough (Multnomah County 2014; LRC 2017).

Fairview Creek receives stormwater runoff from an area of about 6.5 square miles that includes portions of the cities of Gresham, Wood Village, and Fairview. Average flow in Fairview Creek at the U.S. Geological Survey gauging station near Glisan Street, approximately 1.4 miles downstream of the Ruby Junction Maintenance Facility, was 6.39 cubic feet per second from 1992 to 1999 (Metro 2003). The 100-year floodplain for Fairview Creek is approximately 1,288 feet wide at its widest point, adjacent to the proposed expansion area for the Ruby Junction Maintenance Facility (Metro 2003).

DEQ has placed Fairview Creek on its 303(d) list for biological criteria (year-round); it also has approved TMDLs for E. coli (year-round), pH (spring/summer), and summer water temperature (DEQ 2020).

Fairview Creek has been physically altered through the construction of dikes and levees, channelization, and through historic gravel mining activity. These activities altered hydrology, increased sedimentation, and water-quality effects that had a significant impact on the physical, chemical, and biological condition of the stream (Multnomah County 2014).

In recent decades, some restoration of stream and riparian habitat function has occurred. The East Multnomah Soil and Water Conservation District, Metro, Smith Presbyterian Church, ODFW, Fairview Village, the City of Gresham, and others have conducted a variety of activities that have contributed to riparian and stream restoration in the watershed. These include land acquisitions, conservation easements, riparian planting projects, and installation of large woody debris and boulders as in stream habitat structures. Undeveloped lands have also been preserved as parks and green spaces.

Anadromous salmonids are not currently present in Fairview Creek (City of Portland 2021; PSMFC 2021). There is an impassable barrier between the lower and middle sections of the Columbia Slough, approximately 10 miles downstream of Fairview Creek. In addition, temperature regimes and other conditions within Fairview Creek limit habitat suitability for anadromous salmonids. Fairview Creek does likely provide suitable habitat for resident native and introduced fish.

3.2.1.5 Pacific Coastal Waters

The secondary study area also includes marine waters off the Pacific coast where salmonid species from the Columbia River are available as prey for SRKW. This area encompasses the whale's entire coastal range from the mouth of the Columbia River and its plume, south as far as central California, and north as far as southeast Alaska. While these marine waters would not be directly affected by the IBR Program, effects on salmon and steelhead could in turn affect the SRKW prey base that occurs within these waters. The diet of the SRKW is composed almost entirely of salmon, with adult male orcas needing approximately 325 pounds of Chinook to meet their daily prey energy requirements (SROTF 2018). Although their diet tends to vary slightly throughout the year, including smaller amounts of salmon species such as coho, chum, and steelhead, about 80% of their total diet comes from Chinook salmon (SROTF 2018). Chinook are dense in calories, the largest in size of the Pacific salmon species, and the least abundant; many populations are experiencing long-term reductions in size.

The abundance of salmon has declined significantly since the late 1800s and early 1900s due to compounded effects of harvest, impacts to habitat modifications, water-quality and water-quantity impacts, predation, and impacts to their own prey base (SROTF 2018). The Southern Resident Orca Task Force has identified impacts to prey availability—specifically, the availability of Chinook salmon—as a key threat to the recovery of the SRKW.

3.2.2 Aquatic Species of Interest

Table 3-1 presents a list of aquatic SOI that may potentially occur within the primary and/or secondary study areas. This list of aquatic SOI was developed based on data from NOAA Fisheries (NOAA Fisheries 2021), USFWS (USFWS 2021a, 2021b, 2021c), ORBIC (ORBIC 2021), ODFW (ODFW 2021a, 2021b), and WDFW (WDFW 2022, 2023) and in coordination with tribes and local, state, and federal agencies.

Table 3-1. Aquatic Species of Interest Potentially Occurring within the Study Area

Species Common Name	Species Scientific Name	ESU or DPS [a]	Federal ESA Status [b]	State Status (OR) [c]	State Status (WA) [d]	Other Special Regulatory Status [e]
Fish						
Chinook salmon	*Oncorhynchus tshawytscha*	Lower Columbia River ESU	LT; Critical Habitat	SC	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
		Upper Willamette River ESU	LT; Critical Habitat	SC	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
		Upper Columbia River Spring-Run ESU	LT; Critical Habitat	SC	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
		Snake River Spring/ Summer-Run ESU	LT; Critical Habitat	LT	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
		Snake River Fall-Run ESU	LT; Critical Habitat	LT	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
Chum salmon	*Oncorhynchus keta*	Columbia River ESU	LT; Critical Habitat	S	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
Coho salmon	*Oncorhynchus kisutch*	Lower Columbia River ESU	LT; Critical Habitat	E	Not listed; PHS	EFH; SGCN-OR; SGCN-WA

Species Common Name	Species Scientific Name	ESU or DPS [a]	Federal ESA Status [b]	State Status (OR) [c]	State Status (WA) [d]	Other Special Regulatory Status [e]
Sockeye salmon	*Oncorhynchus nerka*	Snake River ESU	LE; Critical Habitat	Not listed	Not listed; PHS	EFH
Steelhead	*Oncorhynchus mykiss*	Lower Columbia River DPS	LT; Critical Habitat	S	C; PHS	EFH; SGCN-OR; SGCN-WA
		Upper Willamette River DPS	LT; Critical Habitat	S	Not listed; PHS	EFH; SGCN-OR; SGCN-WA
		Middle Columbia River DPS	LT; Critical Habitat	S	C; PHS	EFH; SGCN-OR; SGCN-WA
		Upper Columbia River DPS	LT; Critical Habitat	S	C; PHS	EFH; SGCN-OR; SGCN-WA
		Snake River Basin DPS	LT; Critical Habitat	S	C; PHS	EFH; SGCN-OR; SGCN-WA
Coastal cutthroat trout	*Oncorhynchus clarki*	South-western Washington/ Columbia River Coastal DPS	Not listed	S	Not listed; PHS	SOC (USFWS-WA) SGCN-OR; SGCN-WA
Bull trout	*Salvelinus confluentus*	Columbia River DPS	LT; Critical Habitat	SC	C; PHS	SGCN-OR; SGCN-WA
Pacific eulachon	*Thaleichthys pacificus*	Southern DPS	LT; Critical Habitat	Not listed	Not listed; PHS	SGCN-OR; SGCN-WA
North American green sturgeon	*Acipenser medirostris*	Southern DPS	LT; Critical Habitat	SC	Not listed; PHS	SGCN-OR; SGCN-WA
White Sturgeon	*Acipenser transmontanus*	N/A	Not listed	S	Not listed; PHS	SGCN-OR; SGCN-WA

Species Common Name	Species Scientific Name	ESU or DPS [a]	Federal ESA Status [b]	State Status (OR) [c]	State Status (WA) [d]	Other Special Regulatory Status [e]
Pacific lamprey	*Entosphenus tridentata*	N/A	Not listed	S	Not listed; PHS	SOC (USFWS-WA); SOC (USFWS-OR); SGCN-OR; SGCN-WA
River lamprey	*Lampetra ayresi*	N/A	Not listed	Not listed	C; PHS	SGCN-WA
Leopard dace	*Rhinichthys falcatus*	N/A	Not listed	Not listed	C; PHS	SGCN-WA
Marine Mammals						
Killer whale	*Orcinus orca*	Southern Resident DPS	LE; Critical Habitat	Not listed	LE; PHS	MMPA; SGCN-OR; SGCN-WA
Steller sea lion	*Eumetopias jubatus*	Eastern DPS	Not listed	Not listed	Not listed; PHS	MMPA; SGCN-OR
California sea lion	*Zalophus californianus*	N/A	Not listed	Not listed	Not listed; PHS	MMPA
Harbor seal	*Phoca vitulina*	N/A	Not listed	Not listed	Not listed; PHS	MMPA; SGCN-OR
Invertebrates						
Western ridged mussel	*Gonidea angulata*	N/A	Under review	Not listed	Not listed	SGCN-OR; SGCN-WA
California floater	*Anodonta californiensis*	N/A	Not listed	Not listed	C; PHS	SGCN-OR; SGCN-WA

a DPS = distinct population segment; ESU = evolutionarily significant unit; N/A = not applicable

b ESA = Endangered Species Act; Federal status: LT = Listed Threatened, LE = Listed Endangered, Not listed = No status designated; Critical Habitat = designated critical habitat (NOAA Fisheries 2021; USFWS 2021a).

c Oregon State status: LT = Listed Threatened, S=Sensitive; SC = Sensitive Critical, Not listed = No status designated; (OCS 2016; ODFW 2021b; 2021c).

d Washington State status: C = Candidate, Not listed = No State Status; PHS = priority habitats and species (WDFW 2022, 2023).

e Other Special Regulatory Status: EFH = Essential Fish Habitat designated; SOC=Federal Species of Concern; MMPA = Marine Mammal Protection Act; SGCN-OR = Species of Greatest Conservation Need in Oregon (OCS 2016); SGCN-WA = Species of Greatest Conservation Need in Washington (WDFW 2015)

3.2.2.1 Fish

CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*)

The study areas provide habitat for five evolutionarily significant units (ESUs) of Chinook salmon: Lower Columbia River (LCR), Upper Willamette River, Upper Columbia River, Snake River spring/ summer-run, and Snake River fall-run.

Habitat use and presence varies, depending on the stock. Adult fish migrate through the study areas almost year-round. Depending on the ESU, adults enter the river between February and November and spawn in tributaries from August through December (Myers et al. 1998; LCFRB 2010b). Juvenile movement through the study areas is also variable depending on the stock. Juveniles often move into the Columbia River and estuary to overwinter (LCFRB 2010c). Overwintering and outmigrating Chinook salmon juveniles tend to occupy the nearshore habitat in the lower Columbia River. Both adult and juvenile Chinook of one or more ESUs may be present within the lower river year-round.

There is no suitable spawning habitat for Chinook salmon within the primary or secondary study area. The Columbia River and North Portland Harbor provide suitable migratory habitat for adult Chinook salmon, and suitable migratory and rearing habitat for outmigrating juveniles.

Portions of the Columbia Slough provide potentially suitable rearing, foraging, and refuge habitat for juvenile Chinook salmon. Chinook salmon are documented as occurring within the Columbia Slough to a point upstream of North Portland Road and may access areas as far upstream as NE 18th Avenue, where an earthen berm precludes passage (PSMFC 2021). Chinook salmon are not documented within Burnt Bridge Creek. However, WDFW identifies potentially accessible habitat upstream of the confluence with Vancouver Lake (WDFW 2021b).

CHUM SALMON (*ONCORHYNCHUS KETA*)

Chum salmon within the study areas are in the Columbia River ESU. The Columbia River ESU of chum salmon includes all naturally spawning populations in all river reaches accessible to chum salmon in the Columbia River downstream from Bonneville Dam (LCFRB 2010c). Historically, chum salmon were very abundant in the Columbia River. Currently, the remaining returning spawning populations represent less than 1% of historic levels. Habitat loss and degradation due to dam placement, forest practices, and urbanization are the most significant causes of decline in this ESU (LCFRB 2010a; NOAA Fisheries 2016a).

Chum salmon have a very short freshwater residency time, and they require cool, clean water and substrate for spawning. Migration to salt water occurs immediately after emerging from the gravel; therefore, freshwater rearing habitat is a lesser concern for this species. After three to five years in salt water, Columbia River chum salmon return to spawn in the fall. Spawning typically takes place in the lower mainstems of rivers, including the Columbia River, frequently in locations within the tidal zone where there is an abundance of clean gravel (NOAA Fisheries 2016a).

Spawning chum salmon in the Columbia River primarily return to areas near the mouth of Hamilton and Hardy Creeks on the Washington side, downstream of Bonneville Dam. A smaller subset of the run spawns in the mainstem, near a small spring just upstream of the I-205 bridge (approximately 7 river miles upstream of the existing Interstate Bridge) (NOAA Fisheries 2016a; PSMFC 2021).

The portions of the Columbia River and North Portland Harbor within the study areas provide a suitable migratory corridor for adult and juvenile chum salmon. Columbia River ESU chum salmon are not known or expected to occur within the Columbia Slough or Burnt Bridge Creek (PSMFC 2021; WDFW 2021b).

COHO SALMON (*ONCORHYNCHUS KISUTCH*)

Coho salmon within the study areas are within the LCR ESU. This ESU includes all-natural spawning populations in Columbia River tributaries below the Klickitat River in Washington and the Deschutes River in Oregon (including the Willamette River up to Willamette Falls) (LCFRB 2010c).

Coho salmon have one of the shortest life cycles of all anadromous salmonids. Different patterns of life history are linked to different populations. Forming large schools, juveniles rear in freshwater for one year, migrate to the ocean, and return in 5 to 20 months to spawn. Coho salmon return from the ocean to spawn during fall freshets in September and October. Spawning occurs in silt to large gravel of tributaries (LCFRB 2010c). Juvenile coho in the LCR ESU tend to rear in small tributaries, and outmigrate as smolts in the late spring of their second year (LCFRB 2010b).

The portions of the Columbia River and North Portland Harbor within the study areas provide a suitable migratory corridor for adult and juvenile coho salmon. There is no suitable spawning habitat within the mainstem Columbia River or North Portland Harbor within the study areas. Rearing habitat suitability is of limited quality and quantity within the primary study area. However, rearing juveniles may be present within the primary study area year-round. Higher-quality rearing habitat (e.g., accessible areas of small tributaries, backwater areas, and other low-velocity refugia) is present in downstream portions of the secondary study area.

Coho salmon are known to be present in the Columbia Slough and can access portions of the slough upstream to NE 18th Avenue, where an earthen levee blocks passage (City of Portland 2021). There is no documented coho salmon spawning within the Columbia Slough, and conditions are not suitable for coho spawning. Rearing juveniles may be present year-round.

Coho salmon are also known to be present within Burnt Bridge Creek. Coho salmon have been documented downstream of I-5 and are presumed to be present upstream of I-5 (WDFW 2021b). No spawning habitat is present in portions of Burnt Bridge Creek within the study areas, though rearing and outmigrating coho may be present year-round.

SOCKEYE SALMON (*ONCORHYNCHUS NERKA*)

Sockeye salmon within the study areas are within the Snake River ESU, which includes all river reaches and estuary areas presently or historically accessible to sockeye salmon in the Columbia River. The Snake River ESU of sockeye salmon is extremely close to extinction. Factors cited for the decline include overfishing, water diversion for irrigation, and obstacles to migration, including dams (LCFRB 2010c). The only extant sockeye salmon in the Snake River ESU spawn in lakes in the Stanley Basin of Idaho.

The Columbia River and North Portland Harbor provide suitable migratory habitat for adult and juvenile sockeye salmon. Adult sockeye salmon are present in the Columbia River and North Portland Harbor during upstream migration in June and July (LCFRB 2010c; NOAA Fisheries 2016b). Juveniles are present during outmigration from April to early July. There is no spawning or rearing habitat within the primary or secondary study area, though both adult and juvenile sockeye may use the mainstem and North Portland Harbor for holding and resting during their migration.

Sockeye salmon are not known or expected to occur within Burnt Bridge Creek or the Columbia Slough (PSMFC 2021; WDFW 2021b).

STEELHEAD TROUT (*ONCORHYNCHUS MYKISS*)

The study areas provide habitat for five ESUs of steelhead: LCR, Upper Willamette River, Middle Columbia River, Upper Columbia River, and Snake River ESU.

Steelhead is the most widely distributed anadromous salmonid, and habitat use and presence is variable, depending on the stock. The life-history pattern of steelhead can be complex, involving repeated spawnings and continuous reversals of freshwater to ocean phases (LCFRB 2010c). There are both summer-run and winter-run populations of steelhead. Summer-run steelhead generally return to the Columbia River between May and October and require several months in fresh water to reach sexual maturity and spawn. Spawning typically occurs between January and June (LCFRB 2010c). Winter-run steelhead return to the Columbia River between November and May as sexually mature individuals that spawn shortly after returning to fresh water (LCFRB 2010c).

There is no suitable spawning habitat for steelhead within the primary or secondary study areas. The Columbia River and North Portland Harbor provide suitable migratory habitat for adult and juvenile steelhead. Adults may be present within this portion of the action area year-round and outmigrating juveniles may be present in most months of the year (February through November). Rearing habitat suitability is of limited quality and quantity in the portions of the mainstem Columbia River and North Portland Harbor in the primary study area. Most juvenile rearing occurs in tributary streams and not in the mainstem.

Steelhead use the Columbia Slough for juvenile rearing, foraging, and refuge from high flows. They are documented as occurring within the Columbia Slough, below North Portland Road, and may potentially access areas as far upstream as NE 18th Avenue, where an earthen berm precludes passage (City of Portland 2021; PSMFC 2021). Since juveniles rear in freshwater for multiple years, rearing juvenile steelhead may be present within the Columbia Slough year-round.

Steelhead are also documented within Burnt Bridge Creek (WDFW 2021b). No suitable or documented spawning habitat is present within portions of Burnt Bridge Creek within the study areas, though rearing and/or outmigrating steelhead may be present year-round.

COASTAL CUTTHROAT TROUT (*ONCORHYNCHUS CLARKI CLARKI*)

Coastal cutthroat trout in the study areas are within the Southwestern Washington/LCR DPS. This DPS includes populations in the Columbia River and its tributaries downstream from the Klickitat River in Washington, and Fifteenmile Creek, Willamette River and its tributaries downstream from Willamette Falls, and in tributaries of Grays Harbor and Willapa Bay in Oregon.

Three general life-history forms of coastal cutthroat trout have been recognized: non-migratory, freshwater migratory, and saltwater migratory. The boundaries between these life-history forms are not rigid, and individual fish are known to move from one to another within their lifespan (Johnson et al. 1999).

The lower Columbia River region historically supported highly productive coastal cutthroat trout populations. The Southwestern Washington/LCR DPS has been proposed for listing under the federal ESA; however, it is currently not listed. It is identified as a federal species of concern, a state sensitive species in Oregon, and a Washington priority species.

Limited information is available about coastal cutthroat trout habitat use and preferences in the mainstem Columbia River. Available information indicates that their habitat use can vary depending on age, source (wild or hatchery), migratory behavior, and sexual maturity. WDFW identifies the mainstem Columbia River and North Portland Harbor as providing migratory habitat for coastal cutthroat, but do not document their presence within Burnt Bridge Creek (WDFW 2021b). Coastal cutthroat are also present in tributaries to the lower Willamette River below Willamette Falls, but are not documented as occurring within the Columbia Slough.

BULL TROUT (*SALVELINUS CONFLUENTUS*)

The study areas are located within the Coastal Recovery Unit for bull trout. Bull trout in the Coastal Recovery Unit are listed as threatened under the ESA. Bull trout are piscivorous and are the only native char species in the Columbia River system. Once widely distributed throughout the Pacific Northwest, bull trout have been reduced to approximately 44% of their historical range (LCFRB 2010c).

Bull trout require cold water and are typically found where water temperatures rarely exceed 60 degrees Fahrenheit. Besides very cold water, bull trout require stable stream channels, clean spawning gravel, complex and diverse cover, and unblocked migration routes (USFWS 2015).

There are few modern-day documented records of bull trout in the lower mainstem Columbia River. Historic records documented that bull trout (referred to as Dolly Varden at the time) were caught in fish wheels operated on the lower mainstem in the late 1800s, and historic observations have also been documented in the lower Columbia River near Jones Beach and in the fish ladder at Bonneville Dam (USFWS 2015). It is anticipated that the mainstem Columbia River will have increasing importance as key foraging and overwintering habitat for fluvial bull trout as passage improvements are made at hydroelectric facilities that currently isolate individual core areas and as populations improve in status (USFWS 2015).

There is no suitable spawning habitat for bull trout within the primary or secondary study areas. Adult bull trout could occur in the mainstem Columbia River or North Portland Harbor between approximately late March and early September. However, given the lack of documented recent sightings, their presence is not likely. Juvenile bull trout, which rear in headwater streams, are not expected to occur within the study areas at any time of the year. Bull trout are not present in Burnt Bridge Creek or the Columbia Slough.

PACIFIC EULACHON (*THALEICHTHYS PACIFICUS*)

Pacific eulachon (also commonly called smelt) are endemic to the eastern Pacific Ocean ranging from northern California to southwest Alaska and into the southeastern Bering Sea. Pacific eulachon in the lower Columbia River are part of the Southern DPS; most of the Southern DPS production occurs in the Columbia River basin (NOAA Fisheries 2017).

Adult eulachon typically enter the lower Columbia River from December to March, though a small run of eulachon can occur as early as mid-November (WDFW and ODFW 2001; NOAA Fisheries 2020a). Peak abundance typically occurs between February and March. Eggs are released and fertilized in the water column in a broadcast spawning strategy. Fertilized eggs in the water column slowly sink as they drift downstream and adhere to river substrates, typically in areas of pea-sized gravel and coarse sand (WDFW and ODFW 2001). Fertilized eggs typically require 30 to 40 days for larval development before hatching. After this incubation period, the eggs hatch and the larvae drift downstream to the estuary and into marine waters, where they generally remain for two to five years before returning to spawn as adults (NOAA Fisheries 2017, 2020a).

Adult DPS Pacific eulachon may be present within the Columbia River and North Portland Harbor from November through June, though the peak of the run occurs in February and March. Eulachon eggs and larvae may be present in the portions of the Columbia River and North Portland Harbor that are within the study areas, from approximately mid-April through August.

Pacific eulachon are not documented or expected to occur within the Columbia Slough or Burnt Bridge Creek (PSMFC 2021; WDFW 2021c).

NORTH AMERICAN GREEN STURGEON (*ACIPENSER MEDIROSTRIS*)

Green sturgeon are distributed throughout Alaska, Oregon, Washington, and California (McCabe and Tracy 1994). Green sturgeon within the Columbia River are part of the Southern DPS, which includes individuals originating from coastal and Central Valley populations south of the Eel River in California. The only known spawning populations occur in the Sacramento River; the Columbia River does not support spawning populations of green sturgeon (NOAA Fisheries 2018a).

Adults and subadults from this DPS migrate up the coast and use coastal estuaries, including the lower Columbia River, for resting and feeding during the summer. In the mid-1930s before Bonneville Dam was constructed, green sturgeon were found in the Columbia River up to the Cascades Rapids. Today, they occur upriver to Bonneville Dam but are predominantly found in the lower reach of the Columbia River. The estuaries of Willapa Bay, the Columbia River, and Grays Harbor are late summer concentration areas (NOAA Fisheries 2018a).

Green sturgeon prefer more saline environments and are not typically found in the Columbia River upstream of RM 37. Adult and subadult green sturgeon are typically present in the lower Columbia River from mid-May to mid-September, with August being the peak month (McCabe and Tracy 1994). Green sturgeon are not frequently present within the primary study area, but are present within the downstream portion of the Columbia River that is within the secondary study area between approximately mid-May and mid-September.

WHITE STURGEON (*ACIPENSER TRANSMONTANUS*)

White sturgeon is a Washington State priority species (WDFW 2022). White sturgeon are the largest of North American fishes. They occur along the Pacific slope of North America from the Aleutian Islands to Monterey, California (Lee et al. 1980). In the Columbia River, they spawn at roughly 4- to 11-year intervals, between approximately May and July (Wydoski and Whitney 1979). Larvae hatch from eggs in one to two weeks. Males may reach sexual maturity in about nine years, females in 13 to 16 years (Wydoski and Whitney 1979). White sturgeon may live over 100 years and can reach 20 feet in length and weigh over 1,800 pounds.

White sturgeon can be found at sea, usually near shore, as well as in large, cool rivers or streams. Some white sturgeon are anadromous and make extensive saltwater migrations. Many more stay primarily in estuarine waters, moving inland to freshwater to spawn. White sturgeon are bottom feeders. Young white sturgeon feed mostly on the larvae of aquatic insects, crustaceans, and mollusks. A significant portion of the diet of larger white sturgeon consists of fish.

White sturgeon are distributed throughout the lower Columbia River. Both adults and juveniles could occur within the portions of the Columbia River and North Portland Harbor that are within the study areas, primarily within deep-water portions of the Columbia River, during all months of the year.

PACIFIC LAMPREY (*ENTOSPHENUS TRIDENTATUS*)

Pacific lamprey (*Entosphenus tridentatus*, formerly *Lampetra tridentata*) were historically widespread along the West Coast of North America; however, their abundance has declined and their distribution has contracted throughout the west (USFWS 2019a). Pacific lamprey are culturally important to indigenous people throughout their range and play a vital role in the ecosystem as food for mammals, fish and birds, nutrient cycling and storage (USFWS 2019a).

As adults, Pacific lamprey return from the ocean to fresh water primarily during spring and summer months. They often spend about one year in freshwater before spawning, usually holding under large boulders or in crevices in areas with low water velocities until the following spring, when they move to spawning areas. Spawning generally occurs between March and August in gravel-bottomed streams (ODFW 2020).

After hatching, larval lamprey (ammocoetes) drift downstream and burrow into depositional areas with sand or silt substrate, and filter feed on algae, diatoms, and detritus for three to eight years, with some recent data indicating larval lamprey up to 10 years of age (ODFW 2020). Larvae frequently congregate together, often occurring in large clusters in depositional sites with fine sediments where habitats are optimal (USFWS 2019a). Metamorphosis of larval lamprey into the juvenile outmigrant form (macrophthalmia) occurs generally from July through November but varies depending on distance from salt water. Outmigration to the ocean occurs during or shortly after transformation (Beamish 1980).

The mainstem Columbia River and North Portland Harbor are used as a migration corridor for returning adult lamprey. While the mainstem Columbia River contains relatively little spawning habitat, both larvae and outmigrating juveniles have been documented (ODFW 2020). While their distribution and abundance have not been extensively studied and are not well documented (Jolley et al. 2010), it is assumed that adult, larval, and juvenile Pacific lamprey may be present within the portions of the Columbia River and North Portland Harbor within the study areas. Pacific lamprey have also been documented in Burnt Bridge Creek and Columbia Slough (CRC 2011).

RIVER LAMPREY (*LAMPETRA AYRESI*)

River lampreys are found in large river systems and nearshore marine waters from just north of Juneau, Alaska to San Francisco Bay in California. However, detailed information on their distribution and abundance is lacking (ODFW 2020). River lamprey appear to be concentrated in particular large rivers and only in the lower portions of these large rivers. The river lamprey is genetically and morphologically similar to western brook lamprey (*L. richardsoni*), which overlaps in range and is an exclusively freshwater nonparasitic form.

Life history of river lampreys is similar to that of Pacific lamprey. While their distribution and abundance are not well understood, it is presumed that adult, larval, and juvenile lamprey may be present within the portions of the Columbia River and North Portland Harbor that are within the study areas, as well as within Burnt Bridge Creek and Columbia Slough (ODFW 2020).

LEOPARD DACE (*RHINICHTHYS FALCATUS*)

Leopard dace is a Washington State candidate species and a WDFW priority species (WDFW 2022). It does not have special federal regulatory status. Leopard dace is a species of minnow endemic to the Columbia River system in Oregon, Washington, Idaho, and British Columbia and to the adjacent Fraser River system in British Columbia (Lee et al. 1980). Its habitat is thought to be similar to that of other species of dace, and includes flowing pools, gravel runs of creeks and small to medium rivers, and rocky margins of lakes. Young-of-the-year feed mostly on dipterous larvae. Yearlings begin feeding on aquatic insect larvae (e.g., *Ephemeroptera* and *Diptera*); by September, they feed mostly on terrestrial insects. Adults eat aquatic insect larvae and terrestrial insects.

Leopard dace have been documented in the mainstem Columbia River within the study areas and could be present in the portions of the Columbia River and North Portland Harbor that are within the study areas at any time of the year. The primary study area does not provide suitable spawning habitat for leopard dace, as there is no riffle habitat or suitable substrate.

3.2.2.2 Marine Mammals

SOUTHERN RESIDENT KILLER WHALE *(ORCINUS ORCA*)

SRKW was listed as endangered on February 16, 2006 (70 FR 69903). A recovery plan was completed in 2008 (NOAA Fisheries 2008). Critical habitat in inland waters of Washington for SRKW was designated on November 29, 2006 (71 FR 69054). This critical habitat designation was updated in 2021, to add six additional areas along the U.S. West Coast (86 FR 41668). In the most recent five-year status review, NOAA Fisheries evaluated information on the status of the DPS, including threats; research results and publications concluded that SRKW should remain listed as endangered.

SRKW occur in large, stable pods with memberships ranging from 10 to approximately 60 whales. The SRKW DPS consists of three distinct pods (J pod, K pod, and L pod). These pods reside for part of the year in the inland waterways of Washington State and British Columbia known as the Salish Sea (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during the late spring, summer, and fall (Carretta et al. 2023). The whales also visit outer coastal waters off Washington and Vancouver

Island, especially in the area between Grays Harbor and the Columbia River, and travel as far south as central California and as far north as southeast Alaska (Carretta et al. 2023).

The diet of the SRKW is composed almost entirely of salmon, with adult male orcas needing approximately 325 pounds of Chinook to meet their daily prey energy requirements (SROTF 2018; Hanson et al. 2021). Although their diet tends to vary slightly throughout the year, feeding on smaller amounts of salmon species such as coho, chum, and steelhead, about 80% of their total diet comes from Chinook salmon (SROTF 2018; Hanson et al. 2021).

The abundance of salmon has declined significantly since the late 1800s and early 1900s, due to compounded effects of harvest, impacts to habitat modifications, water-quality and water-quantity impacts, predation, and impacts to their own prey base (SROTF 2018). The SROTF has identified impacts to prey availability—specifically, the availability of Chinook salmon, as a key threat to the recovery of the SRKW.

The study area includes marine waters off the Pacific coast where salmonid species from the Columbia River are available as prey for SRKW. This area encompasses the whales' entire coastal range from the mouth of the Columbia River and its plume, south as far as central California, and north as far as southeast Alaska. These marine waters would not be directly affected by the IBR Program; however, effects on salmon and steelhead could, in turn, affect the prey base for the SRKW in these waters (SROTF 2018).

STELLER SEA LION (*EUMATOPIUS JUBATUS*)

Steller sea lions range along the North Pacific Rim from northern Japan to California, with centers of abundance and distribution in the Gulf of Alaska and Aleutian Islands, respectively. Two separate stocks or DPS of Steller sea lions have been recognized within U.S. waters. The Steller sea lion stock that migrates in the Columbia River is part of the Eastern DPS. The Eastern DPS of Steller sea lion was de-listed and removed from the federal ESA in 2013. However, they are protected under the MMPA and they are a Washington State priority species.

Steller sea lions are usually found in coastal waters near shore and in ocean waters over the continental shelf, approximately 35 kilometers off shore and seasonally up to several hundred kilometers off shore (Young et al. 2023). They use terrestrial rookeries and haulout locations such as beaches, rocks, jetties, reefs, floating docks, and other structures for breeding, pupping, and resting. They occur year-round at the mouth of the Columbia River and use the portion of the Columbia River within the study area as a seasonal corridor for foraging. Steller sea lions are regularly observed at Bonneville Dam, where they prey primarily on fish that congregate below the dam.

The USACE has monitored pinniped presence and salmonid predation at Bonneville Dam (RM 146) since 2002; the most recently published preliminary data come from monitoring conducted in 2019 (Tidwell et al. 2023).

Steller sea lions use the portion of the Columbia River and North Portland Harbor within the study areas as a foraging/migration corridor during seasonal feeding journeys between marine waters and Bonneville Dam. They are most frequently present during the months of January to May. There are no Steller sea lion rookeries or documented haulouts within the primary study area (Jeffries et al. 2000).

There are documented sea lion haulouts in the lower Columbia River downstream of the Cowlitz River to the mouth, and within the marine portion of the secondary study area, and Steller sea lions may haul out in these locations (Jeffries et al. 2000). The only Steller sea lions within the study area are adult males and females traveling to and from Bonneville Dam. Prior to 2002, Steller sea lions were sighted infrequently at Bonneville Dam, with fewer than 10 individuals recorded in most years. However, since 2008, the numbers of Steller sea lions documented at the dam has increased substantially (Tidwell et al. 2023).

CALIFORNIA SEA LION (*ZALOPHUS CALIFORNIANUS*)

California sea lions are found from southern Mexico to southeast Alaska. California sea lion on the West Coast are divided into three stocks, based on the locations of breeding concentrations. Individuals within the lower Columbia River are part of the U.S. stock (Carretta et al. 2023). California sea lions are not listed under the federal ESA but are protected under the MMPA, and they are a Washington State priority species. California sea lions may be present in the lower Columbia River during much of the year, except between mid-June and August, when most animals return to breeding rookeries in southern California. Peak numbers occur during the migration periods in May and September (Tidwell et al. 2023).

There are no California sea lion rookeries or documented haulouts within the primary study area (Jeffries et al. 2000). There are documented sea lion haulouts in the lower Columbia River downstream of the Cowlitz River to the mouth and within the marine portion of the secondary study area, and California sea lions may haul out in these locations (Jeffries et al. 2000). The only California sea lions within the study areas are adult males and females traveling to and from Bonneville Dam.

HARBOR SEAL (*PHOCA VITULINA*)

NOAA Fisheries defines seven “stocks” of harbor seals throughout the U.S., with three recognized along the West Coast: 1) the Washington inland stock; 2) the Oregon/Washington coastal stock; and 3) the California stock. The stock that is present in the Columbia River is the Oregon/Washington coastal stock.

Harbor seals reside year-round in the Columbia River, and they are observed relatively regularly in the study areas. They are non-migratory, but they do exhibit seasonal movement upriver to follow winter and spring runs of Pacific eulachon and outmigrating juvenile salmon. They tend to congregate to feed at the mouths of tributary rivers, including the Willamette/Columbia River confluence, during the winter months.

There are no documented harbor seal haulouts within the primary study area (Jeffries et al. 2000). There are documented harbor seal haulouts in the lower Columbia River downstream of the Cowlitz River to the mouth, and within the marine portion of the secondary study area (Jeffries et al. 2000). The only harbor seals within the study areas are adult males and females traveling to and from Bonneville Dam.

3.2.2.3 Invertebrates

WESTERN RIDGED MUSSEL (*GONIDEA ANGULATA)*

Western ridged mussel is not currently listed at the federal or state level. A petition for federal listing was filed in 2020 (Blevins et al. 2020), and the USFWS is currently conducting a federal status review. It is identified as a species of greatest conservation need in the Oregon Conservation Strategy (OCS 2016) and the Washington State Wildlife Action Plan (WDFW 2015).

The western ridged mussel is a species of freshwater mussel that historically occurred in river basins spanning portions of the western states of California, Idaho, Nevada, Oregon, and Washington and the Canadian province of British Columbia (Blevins et al. 2020). Recent research indicates that the species has experienced a significant reduction in range from its historic distribution.

Western ridged mussels, like other freshwater mussels, are filter feeders, filtering bacteria, phytoplankton and zooplankton, fungal spores, and algae from the water. The larval stage is parasitic, adhering to a host fish while metamorphosing into a juvenile clam. When metamorphosis is complete, juvenile clams fall from the host fish where they attach to gravel or rocks in clean flowing, well-aerated waters. After growing for some time, young clams are washed downstream and settle in sandy or soft, muddy bottoms in the slower waters of lakes and large rivers where they mature (Larsen et al. 1995). In many mussel beds, western ridged mussels burrow deeply into sediment—though, where sediment is coarser, they may also be only partially buried (Blevins et al. 2020).

Aquatic habitats within the study areas provide marginally suitable habitat for the western ridged mussel. While they have been documented historically within the mainstem Columbia River (Blevins et al. 2020), they have not been documented within the study areas. The substrate conditions, oxygenation, and limited hydraulic exchange of other surface waters within the study areas provide limited habitat suitability.

CALIFORNIA FLOATER (*ANODONTA CALIFORNIENSIS*)

California floater is a Washington State candidate species and a WDFW priority species (WDFW 2022).

In Washington, the California floater is a freshwater mollusk known to occur in the Columbia River system and in a few other lakes and rivers in eastern Washington. There are no recent western Washington records of live California floaters (Frest and Johannes 1993).

The California floater lives, feeds, respires, and reproduces in clean freshwater. These clams feed by filtering planktonic organisms (Larsen et al. 1995). The larval stage is parasitic, adhering to a host fish while metamorphosing into a juvenile clam. When metamorphosis is complete, juvenile clams must fall from the host fish in places where they can attach to gravel or rocks in clean, flowing, well-aerated waters. After growing for some time, young clams are washed downstream and settle in sandy or soft, muddy bottoms in the slower waters of lakes and large rivers where they mature (Larsen et al. 1995).

Aquatic habitats within the study areas provide marginally suitable habitat for California floater and other freshwater mollusks. California floater has been documented within Bybee Lake, though substrate conditions, oxygenation, and limited hydraulic exchange likely limit habitat suitability. Other surface waters within the study areas provide a similar degree of habitat suitability.

3.3 Terrestrial Resources

In this technical report, the term “terrestrial resources” refers primarily to non-aquatic habitats and the wildlife species that these habitats support (including terrestrial mammals, birds, amphibians, and reptiles).

3.3.1 Terrestrial Habitats and Species

Habitat is the area where wildlife nest, feed, roost, and raise their young. Terrestrial habitats within both the primary and secondary study areas are generally small, fragmented, and have been modified from their historic conditions. Nevertheless, these areas provide habitat for a variety of native mammals, birds, amphibians, and reptiles.

Terrestrial habitats within the study areas fall into the following broad categories, as described by Johnson and O’Neil (2001):

- Developed Habitats
    - Urban and Mixed Environs
    - Agriculture, Pasture, and Mixed Environs
- Wetland and Riparian Habitats
    - Westside Riparian – Wetlands
    - Herbaceous Wetlands
- Forest and Woodland Habitats
    - Westside Lowlands Conifer-Hardwood Forest
    - Westside Oak and Dry Douglas fir Forest and Woodlands

The approximate extent and location of these habitat types are shown on Figure 3-3 and briefly described below. Table 3-2 lists the approximate acreage of each habitat type within the study areas.

Table 3-2. Acres of Terrestrial Habitat by Classification within the Primary and Secondary Study Areas

Habitat Classification	Primary Study Area (acres)	Secondary Study Area (acres)	Total Area (acres)
Urban and Mixed Environs	396	4,518	4,914
Agriculture, Pasture, and Mixed Environs	0.3	141	141
Westside Riparian – Wetlands	17	608	625
Herbaceous Wetlands	0.3	74	74
Westside Lowlands Conifer-Hardwood Forest	1.3	122	123

Habitat Classification	Primary Study Area (acres)	Secondary Study Area (acres)	Total Area (acres)
Westside Oak and Dry Douglas Fir Forest and Woodlands	<0.1	53	53
Total	**415**	**5,516**	**5,930**

3.3.1.1 Developed Habitats

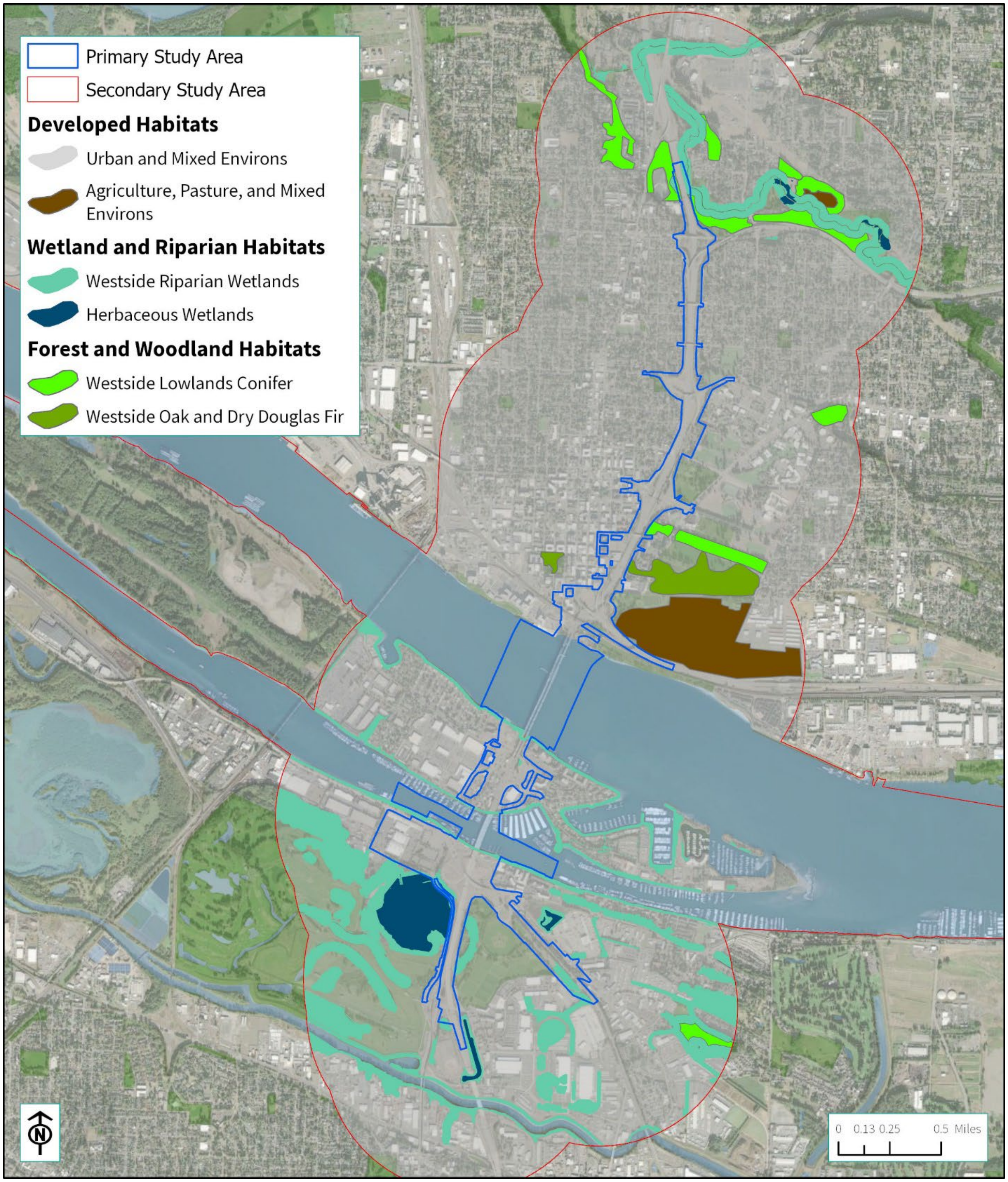
Most of the terrestrial habitat within the study areas falls into one of two “Developed Habitats” described by Johnson and O’Neil (Johnson and O’Neil 2001).

URBAN AND MIXED ENVIRONS

The predominant terrestrial habitat type within both the primary and secondary study areas is the “Urban and Mixed Environs” type. This habitat type includes areas associated with built structures and impervious surfaces such as buildings, bridges, houses, parking lots, and roads, as well as areas of heavily managed and/or maintained vegetation such as lawns, landscaped areas, vegetated stormwater facilities, and mowed/maintained portions of the highway right of way. These environs include core downtown areas, commercial areas, shopping malls, industrial areas, high-density housing, and transportation corridors (Johnson and O’Neil 2001). Examples of this habitat type within the primary study area includes much of the downtown Vancouver core, commercial and residential areas of Jantzen Beach, and industrial and commercially developed properties adjacent to North Portland Harbor and in the vicinity of Delta Park.

These habitats generally provide very little natural habitat function, though some terrestrial wildlife species have adapted to use these habitats. Bridges and other structures provide nesting and perching habitat for certain species of migratory birds. Bridges also provide potentially suitable roosting and hibernacula habitat for bats, though metal bridges do not provide suitable temperatures for bats and are not as frequently used as concrete structures. Lawns, landscaping, and other maintained vegetation provide habitat for common species that are adapted to areas of high human disturbance, particularly small mammals such as ground squirrels, rabbits, opossums, raccoons, coyotes, and various rodents and species that prey on these small mammal species. Examples of SOI associated with this habitat type include bald eagle, peregrine falcon, other migratory bird species, *Myotis* bats, Townsend’s big-eared bat, and monarch butterfly (Johnson and O’Neil 2001).

Figure 3-3. Habitat Classifications within the Primary and Secondary Study Areas



AGRICULTURE, PASTURE, AND MIXED ENVIRONS

The south end of the Fort Vancouver National Historic Site and the west end of Pearson Field is a mowed/maintained pasture that falls more closely within the “Agriculture, Pasture, and Mixed Environs” habitat type. This habitat type includes unimproved pastures, predominantly grassland sites and often abandoned fields that have little or no active management such as irrigation, fertilization, or herbicide applications (Johnson and O’Neil 2001). The “Agriculture, Pasture, and Mixed Environs” habitat type is used by a wide diversity of native species, particularly birds and small mammals. These areas also provide excellent foraging opportunities for raptors and other birds of prey. They are also prone to invasion by exotic species, due to their relatively high level of disturbance.

Examples of SOI associated with this habitat type include streaked horned lark, bald eagle, peregrine falcon, other migratory birds, *Myotis* bats, and Townsend’s big-eared bat (Johnson and O’Neil 2001).

3.3.1.2 Wetland and Riparian Habitats

Within the study areas, there are two “wetland and riparian” habitat types that provide habitat for terrestrial and avian species. Open water aquatic habitats are described in Section 3.2.

WESTSIDE RIPARIAN – WETLANDS

The “Westside Riparian – Wetlands” habitat type includes both riparian areas and freshwater wetlands that are dominated by trees or shrubs at low elevations on the west side of the Cascade Mountains. Typical dominant species include Sitka spruce, western red cedar, western hemlock, red alder, black cottonwood, Oregon ash, willows, and spirea (Johnson and O’Neil 2001).

Riparian habitats are those that are adjacent to or associated with a natural watercourse (such as a river or stream). They are transitional habitats between terrestrial and aquatic ecosystems and provide unique and important habitat functions. Narrow bands of riparian habitat are present adjacent to surface waters within the study areas, including the Columbia River, North Portland Harbor, Columbia Slough, Burnt Bridge Creek, and Fairview Creek. In general, riparian habitats within the study areas are fragmented and disturbed from their natural condition, though they do provide important habitat functions.

Wetlands are lands that are transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands are generally characterized by a predominance of hydrophytic plants, hydric soil conditions, and saturation of the upper soil profile during the growing season. Forested and shrub-dominated wetlands within the “Westside Riparian-Wetlands” habitat type are found in the Vanport complex of wetlands located south of the Expo Center.

“Westside Riparian-Wetlands” habitat type provides habitat function for a variety of wildlife that is adapted to wetlands and riparian areas within an urban environment including a variety of small mammals, amphibians, reptiles, migratory birds, waterfowl, and raptors. SOI associated with “Westside Riparian-Wetlands” habitats include the bald eagle, peregrine falcon, purple martin, willow flycatcher, other migratory birds, *Myotis* bats, Townsend’s big-eared bat, pond turtles, and painted turtles (Johnson and O’Neil 2001).

Refer to the IBR Program's Wetlands and Other Waters Technical Report for more detailed information on wetlands in the primary study area.

HERBACEOUS WETLANDS

"Herbaceous Wetlands" is another wetland habitat type that is characterized by herbaceous vegetation. These habitats include riverine floodplains, wet meadows, marshes, fens, and aquatic beds. Common dominant plant species within herbaceous wetlands include cattails, sedges, grasses, bulrushes, and a variety of native herbaceous species. Wapato (*Sagittaria latifolia*) and cattail (*Typha latifolia*), two herbaceous wetland plants with important cultural significance as traditional food, craft, and medicinal sources for several Native American tribes, have been documented within herbaceous wetlands in the study areas. Aquatic rooted plants that extend to the surface or floating aquatic plants can also be found where surface water is present year-round (Johnson and O'Neil 2001).

Within the study areas, herbaceous wetlands are located in the Vanport complex of wetlands south of the Expo Center, immediately surrounding the open water pond/wetland system east of I-5 near Delta Park, and within the closed slough east of I-5 along Whitaker Road.

Herbaceous wetlands provide many similar habitat functions as forested and shrub-dominated wetlands. In general, they provide habitat for a variety of wildlife that is adapted to wetlands and riparian areas within an urban environment including a variety of small mammals, amphibians, reptiles, migratory birds, waterfowl, and raptors. Herbaceous vegetation provides less canopy cover and structural complexity than forested or shrub-dominated wetlands. Examples of SOI associated with this habitat type include the bald eagle, peregrine falcon, purple martin, other migratory birds, *Myotis* bats, Townsend's big-eared bat, pond turtles, painted turtles, and northern red-legged frog (Johnson and O'Neil 2001).

Refer to the IBR Program's Wetlands and Other Waters Technical Report for more detailed information on wetlands in the primary study area.

3.3.1.3 Forest and Woodland Habitats

WESTSIDE LOWLANDS CONIFER – HARDWOOD FOREST

The "Westside Lowlands Conifer – Hardwood Forest" habitat type is a lowland to low montane upland forest that occurs over most of western Washington, the Coast Range of Oregon, the western slopes of the Cascades in Oregon, and around the margins of the Willamette Valley. This forest is variable in composition, and individual stands are typically characterized by one or more of the following dominant tree species: Western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), or bigleaf maple (*Acer macrophyllum*) (Johnson and O'Neil 2001).

Within the study areas, the Westside Lowlands Conifer-Hardwood Forest habitat type is limited to small, isolated patches, typically surrounded by Urban and Mixed Environs habitats, or at the upland edge of riparian habitats associated with Burnt Bridge Creek. These areas generally provide limited habitat function due to their isolated and fragmented nature. However, they do provide habitat function for urban-adapted species that are mobile, particularly migratory birds that may nest within the trees and shrubs, and raptors that may perch and use these areas for foraging in adjacent habitats. Examples of SOI associated with this habitat type include the bald eagle, peregrine falcon, other migratory birds, *Myotis* bats, and Townsend's big-eared bat (Johnson and O'Neil 2001).

WESTSIDE OAK AND DRY DOUGLAS FIR FOREST AND WOODLANDS

The "Westside Oak and Dry Douglas fir Forest and Woodlands" habitat type consists of forest or woodland dominated by evergreen conifers, deciduous broadleaf trees, evergreen broadleaf trees, or some mixture of both. This habitat typically occupies dry sites west of the Cascade Mountains. The tree composition can be variable, but frequently is dominated by Douglas fir or Oregon white oak (*Quercus garryana*). Understory can include a native shrub layer or be dominated by herbaceous vegetation and grasses.

Within the primary study area WDFW identifies two small patches of priority oak woodland habitat associated with the northern portion of Esther Short Park and the Fort Vancouver National Historic Site. These habitats are within the "Westside Oak and Dry Douglas fir Forest and Woodlands" habitat type.

These areas generally provide a similar suite of habitat functions as "Westside Lowlands Conifer – Hardwood Forest" habitats. They primarily provide habitat function for urban-adapted species that are mobile, particularly migratory birds that may nest within the trees and shrubs, and raptors that may perch and use these areas for foraging in adjacent habitats. Oak woodlands can provide some unique functions due to their relative rarity on the landscape and their different structural composition. Examples of SOI associated with this habitat type include the bald eagle, peregrine falcon, other migratory birds, *Myotis* bats, and Townsend's big-eared bat (Johnson and O'Neil 2001).

3.3.1.4 Terrestrial Habitat Connectivity and Wildlife Passage

Due to the highly urbanized nature of the primary and secondary study areas, terrestrial wildlife habitat is fragmented and passage between areas of suitable habitat is restricted. I-5 and other arterial roads serve as substantial barriers to movement for terrestrial wildlife. Underpasses, overpasses, and stream corridors serve as potential areas for wildlife passage. Due to the level of traffic, human activity, and impervious surfaces, however, underpasses and overpasses are generally unsuitable and dangerous corridors for most terrestrial species.

Areas where terrestrial wildlife could potentially travel under the existing highway structures between the east and west sides of I-5 include the Victory Boulevard/Whitaker Road area, and the Marine Drive interchange. However, the abundance of roads, traffic, and development in these areas greatly limits their suitability for wildlife passage.

The Vanport wetlands and Delta Park provide limited suitable habitat, fragmented by I-5, for small and medium-sized terrestrial species. Throughout the remainder of the study areas, wildlife corridors and passage opportunities are hindered by the density of urban structures and human disturbance.

Terrestrial wildlife passage along the banks of the Columbia River and North Portland Harbor is possible, although the riparian habitat quality is low and riparian vegetation that could provide cover is sparse. The Columbia River banks under the bridges are largely armored with riprap, sparsely vegetated, and provide poor habitat for wildlife passage. The Columbia River itself provides a travel corridor for birds and other waterfowl, as well as some terrestrial mammals that travel in water, such as river otters and beavers. Passage condition for these terrestrial species on the river is largely unimpeded by the existing bridge structures.

3.3.2 Terrestrial Species of Interest

Table 3-3 presents a list of terrestrial SOI that may occur within the study areas. This list of terrestrial SOI was developed based on data from NOAA Fisheries (NOAA Fisheries 2021), USFWS (USFWS 2021a, 2021b, 2021c), ORBIC (ORBIC 2021), ODFW (ODFW 2021a, 2021b), and WDFW (WDFW 2021c, 2023) and in coordination with tribes and local, state, and federal agencies.

Table 3-3. Terrestrial Species of Interest Potentially Occurring within the Study Areas

Species Common Name	Species Scientific Name	ESU or DPS	Federal Status [a]	State Status (OR) [b]	State Status (WA) [c]	Other Special Regulatory Status [d]
Birds						
Streaked horned lark	*Eremophila alpestris strigata*	N/A	LT; Critical Habitat	SC	LE; PHS	MBTA; SGCN-OR; SGCN-WA
Bald eagle	*Haliaeetus leucocephalus*	Continental US DPS	Not listed	Not listed	Not listed	BGEPA; MBTA; SGCN-WA
Peregrine falcon	*Falco peregrinus anatum*	N/A	Not listed	S	Not listed	MBTA; SGCN-OR; SGCN-WA
Purple martin	*Progne subis*	N/A	Not listed	SC	Not listed	MBTA; SGCN-OR; SGCN-WA
Willow flycatcher	*Empidonax traillii*	N/A	Not listed	SC	Not listed	MBTA; SGCN-OR
Common loon	*Gavia immer*	N/A	Not listed	Not listed	S; PHS	MBTA; SGCN-WA
Great blue heron	*Ardea Herodias*	N/A	Not listed	Not listed	PHS	MBTA
Other migratory birds	Multiple Species	N/A	N/A	N/A	N/A	MBTA

Species Common Name	Species Scientific Name	ESU or DPS	Federal Status [a]	State Status (OR) [b]	State Status (WA) [c]	Other Special Regulatory Status [d]
Mammals						
Columbian white-tailed deer	*Odocoileus virginianus* ssp. *Leucurus*	Columbia River DPS	LT	S	LT; PHS	SGCN-OR; SGCN-WA
Long-legged myotis	*Myotis volans*	N/A	Not listed	S	Not listed; PHS [e]	SGCN-OR
Fringed myotis	*Myotis thysanodes*	N/A	Not listed	S	Not listed; PHS [e]	SGCN-OR
Long-eared myotis	*Myotis evotis*	N/A	Not listed	Not listed	Not listed; PHS [e]	SGCN-OR
Townsend's big-eared bat	*Corynorhinus townsendii*	N/A	Not listed	SC	C; PHS	SGCN-OR; SGCN-WA
Silver-haired bat	*Lasionycteris noctivagans*	N/A	Not listed	S	Not listed; Candidate	SGCN-OR; SGCN-WA
Reptiles and Amphibians						
Western pond turtle	*Actinemys marmorata*	N/A	Not listed	S	LE; PHS	SGCN-OR; SGCN-WA
Painted turtle	*Chrysemys picta*	N/A	Not listed	SC	Not listed	SGCN-OR; SGCN-WA
Northern red-legged frog	*Rana aurora*	N/A	Not listed	S	Not listed	SGCN-OR; SGCN-WA
Insects						
Monarch butterfly	*Danaus plexippus*	N/A	C	Not listed	Not listed	N/A

a Federal ESA status: LT = Listed Threatened, LE = Listed Endangered, C = Candidate, Not listed = No status designated; Critical Habitat = designated critical habitat (NOAA Fisheries 2021; USFWS 2021a).

b Oregon State status: LT = Listed Threatened, LE = Listed Endangered, S=Sensitive, SC = Sensitive Critical, Not listed = No status designated (ODFW 2021a, 2021b).

c Washington State status: LT = Listed Threatened, LE = Listed Endangered, S=Sensitive, C=Candidate, PHS = WDFW priority habitat species; (WDFW 2022, 2023).

d Other Special Regulatory Status: SOC=Federal Species of Concern; PHS = Priority Habitats and Species; BGEPA = Bald and Golden Eagle Protection Act; MBTA = Migratory Bird Treaty Act; SGCN-OR = Species of Greatest Conservation Need in Oregon (OCS 2016); SGCN-WA = Species of Greatest Conservation Need in Washington (WDFW 2015); N/A = Not Applicable

e Roosting concentrations of *Myotis* bats are considered Priority Species by WDFW, where they occur.

Information from the USFWS identified the potential for northern spotted owl and yellow-billed cuckoo to occur within the vicinity of the study areas (USFWS 2021a, 2021b). However, data from ORBIC (2021) and WDFW (2021e) do not indicate known occurrence of these species within the primary or secondary study area, which provides limited habitat suitability for these species. Based on the lack of suitable habitat, these species are not addressed in detail in this assessment.

3.3.2.1 Birds

STREAKED HORNED LARK (*EREMOPHILA ALPESTRIS STRIGATA*)

The Southern DPS streaked horned lark is endemic to the Pacific Northwest (British Columbia, Oregon, and Washington). It is listed as threatened species under the federal ESA, endangered in Washington State, and sensitive critical in Oregon. Critical habitat has been designated under the federal ESA, none of which occurs within the study areas.

Streaked horned larks historically selected habitat in relatively flat, open areas maintained by flooding, fire, and sediment transport dynamics. The interruption of these historical processes due to flood control dams, fire suppression, and reduction of sediment transport by dams resulted in a steep decline in the extent of their historical habitat. Currently, larks are found in open areas free from visual obstructions like grasslands, prairies, wetlands, beaches, dunes, and modified or temporarily disturbed habitats (such as agricultural or grass seed fields, airports, dredged material placement sites, and gravel roads). Habitat used by larks is generally flat with substantial areas of bare ground and sparse low-stature vegetation (USFWS 2019b).

Streaked horned larks are known to both nest and winter on dredge placement sites and agricultural fields in the lower Columbia River floodplain. They have been documented near the study areas, including at the St. Johns Prairie site, which is located just southwest of Smith and Bybee Lakes, and on four different locations on Sauvie Island.

There is no suitable habitat for streaked horned lark within the primary study area and only limited potentially suitable habitat within the secondary study area. The sandy shorelines within the terrestrial portion of the secondary study area (on Hayden Island, in North Portland Harbor, and on the Columbia River shoreline in Washington) provide potentially suitable foraging habitat, but do not provide suitable nesting habitat. Habitat usage within the study areas is expected to be limited to occasional foraging by streaked horned larks passing through the vicinity.

BALD EAGLE (*HALIAEETUS LEUCOCEPHALUS*)

The bald eagle was removed from listing under the federal ESA in 1972. However, it remains under the protection of the federal BGEPA and the MBTA.

Bald eagles are closely associated with lakes and large rivers in open areas, forests, and mountains. Breeding bald eagles need large trees near open water with a relatively low level of human activity. In Washington, nearly all bald eagle nests (99%) are within 1 mile of a lake, river, or marine shoreline (Stinson et al. 2007). Perches from which nesting bald eagles forage are distributed throughout their nest territories along shorelines and prominent viewpoints. Nesting bald eagles are opportunistic foragers but feed most consistently on fish and waterfowl, which are usually associated with large, open expanses of water. In northwestern Oregon and southwestern Washington, the bald eagle breeding season lasts from January 1 to August 31. Egg-laying takes place mid-February to April, hatching in late March to May, and fledging in late May to mid-August (Isaacs and Anthony 2011).

Bald eagles are relatively common within the study areas and vicinity, using habitat along the lower Columbia River extensively. Vegetated and aquatic portions of the primary and secondary study areas provide suitable bald eagle foraging and migration habitat. No eagle nests or communal roosts are documented within the primary study area. However, there are previously documented nesting sites on Hayden Island, adjacent to the Columbia Slough, and elsewhere in the vicinity near Vancouver Lake, Smith Lake, and the Columbia River (ORBIC 2021).

PEREGRINE FALCON (*FALCO PEREGRINUS ANATUM*)

Peregrine falcon is an Oregon State sensitive species.

Peregrine falcons occur nearly worldwide. Both resident and migratory populations occur in Oregon and Washington. Breeding populations primarily occur along the outer coast, in the San Juan Islands, and in the Columbia Gorge (Hays and Milner 2004a, in Larsen et al. 2004). Nesting usually occurs on cliffs, typically 150 feet or more in height. The species will also nest on offshore islands and ledges of vegetated slopes and has also been documented nesting on man-made structures in urban areas. Eggs are laid and young are reared in small caves or on ledges. Nest sites are generally near the water. Adults remain close to the nest sites throughout the year. In the Portland area, courtship lasts from January to March, eggs are typically laid beginning in mid-March, and fledging occurs in late May through late June or July (ODOT 2003).

Peregrine falcons are regularly documented within portions of the primary and secondary study areas (ebird 2021). The Columbia River and adjacent open areas within the study areas provide suitable foraging habitat for peregrine falcons. There is also documented nesting habitat within both the primary and secondary study areas, and the Interstate Bridge itself has also been used as a nest site (ORBIC 2021).

PURPLE MARTIN (*PROGNE SUBIS*)

The purple martin is a critically sensitive species in Oregon (ODFW 2021b).

Purple martins are insectivorous, colonial nesting swallows that nest in cavities, typically in or near freshwater wetlands or ponds, or saltwater (Hays and Milner 2004b). They feed in flight on insects, with preferred foraging habitat consisting of open areas, often located near moist to wet sites, where flying insects are abundant (Hays and Milner 2004b).

The largely developed portions of the primary study area provide little habitat for purple martins, but they are occasionally observed within the secondary study areas. Forested wetland habitats associated with the Vanport wetlands, Smith and Bybee Lakes, and Burnt Bridge Creek may provide suitable nesting habitat, and these areas, as well as adjacent aquatic habitats, likely provide suitable foraging opportunities. WDFW and ORBIC data indicate that purple martin nests and regular concentrations of purple martins have been documented in the vicinity (ORBIC 2021; WDFW 2021c).

WILLOW FLYCATCHER (*EMPIDONAX TRAILLII*)

Willow flycatchers within the Willamette Valley are considered critically a sensitive population in Oregon (ODFW 2021b).

The willow flycatcher is commonly associated with low, dense shrubby vegetation, including riparian areas (especially willow thickets), shrubby wetlands, alder thickets, and dense stands of salmonberry and blackberry. Nesting and migratory habitat is almost exclusively riparian zones, typically willows.

In Washington, the willow flycatcher is a common breeding species in lower-elevation wetlands, shrub wetlands, riparian areas, and clearcuts on both sides of the Cascades. In western Oregon, its breeding range extends from sea level along the coast and interior to above 5,000 feet west of the Cascade Mountains' summit (ODFW 2021c).

The largely developed portions of the primary study area provide little habitat for willow flycatchers. Wetland and riparian habitats within the secondary study area likely provide suitable foraging opportunities for willow flycatchers, and shrub-dominated wetlands and riparian areas likely provide suitable nesting habitat. Willow flycatchers are regularly observed at the Vanport wetlands (ebird 2021).

COMMON LOON (*GAVIA IMMER*)

Common loon is a Washington State sensitive species and a priority species (WDFW 2008). In its WDFW priority species listing, WDFW considers breeding sites, migratory stopover points, and documented areas of regular concentration as priority areas (WDFW 2008).

Common loons breed in North America from the coasts of the Aleutian Islands and Bering Sea, east throughout Canada and south to the northern tier of the lower 48 states. In western North America, common loons winter along the Pacific coast from southern Alaska to Baja California. Common loons breed on large lakes in forested areas, typically those greater than approximately 30 acres in size. They typically nest on or near shorelines. Nesting also may occur within approximately 5 feet of shore on masses of emergent vegetation (Larsen et al. 2004). Their primary diet is fish, and they require a healthy fish population on which to feed.

Common loons are observed regularly on the Columbia River and within North Portland Harbor. The study areas do not likely provide suitable nesting habitat for common loons but do provide suitable wintering/migratory habitat. No breeding loons or regular concentrations have been observed within the study areas or vicinity.

GREAT BLUE HERON (*ARDEA HERODIAS)*

Great blue heron is a Washington State priority species (WDFW 2008). In its priority habitats and species listing, WDFW considers documented breeding areas to be priority areas (WDFW 2008).

Foraging, breeding, and pre-nesting habitats for the great blue heron usually are close together. Foraging habitat often is adjacent to or within a few kilometers of the nesting colony (Azerrad 2012). Prior to establishing nesting colonies, inland great blue herons gather at pre-nesting sites in habitats that include larger lakes, wetlands, and other watercourses. Nesting colonies, also frequently referred to as rookeries, are then established, typically in mature forested stands near foraging habitat. During the breeding season, herons feed in the shallow margins of various coastal and freshwater habitats, including wetland complexes, large rivers and creeks, and small lakes (Azerrad 2012).

Great blue herons are commonly observed and frequently present within wetland and riparian habitats within the primary and secondary study areas. There are no documented rookeries within the primary or secondary study areas, but active rookeries have been documented in the vicinity, and forested habitats on Hayden Island provide potentially suitable habitat for nesting.

OTHER MIGRATORY BIRDS

In addition to the SOI bird species noted above, all native birds (including both migratory and non-migratory species) are protected under the MBTA. The study areas are located within the Pacific Flyway, the major north–south route for migratory birds that extends from Patagonia to Alaska. Many species of migratory birds are present within the study areas at various times of the year. In the Portland area, over 200 regularly occurring bird species are protected under the MBTA.

Migratory birds use a variety of habitat components in both the primary and secondary study areas for nesting, roosting, and foraging. Habitat use depends on species and availability. Migratory birds may nest or roost in live trees and shrubs, in snags or cavities in dead trees, on the ground, in open gravel, or along streambanks. Many also nest in or near human-made structures, including bridges, ledges, chimneys, eaves, light poles, gravel roads, or and culverts. Swallows, for example, commonly nest on bridges and likely use the Interstate Bridge for this purpose.

3.3.2.2 Mammals

COLUMBIAN WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS* SSP. *LEUCURUS*)

The Columbia River DPS of Columbian white-tailed deer is listed as threatened under the federal ESA (USFWS 2021a). It is a state-listed sensitive species in Oregon (ODFW 2021b) and an endangered species and priority species in Washington (WDFW 2008, 2021b).

As of March 2020, an estimated 1,200 Columbian white-tailed deer inhabit areas along the lower Columbia River (WDFW 2021d). Most deer within the Columbia River DPS are included in one of four subpopulations: Washington mainland, Tenasillahe Island, Puget Island, and Oregon lowlands. Each subpopulation is geographically separated by major channels of the Columbia River. Both the Washington mainland and Tenasillahe Island subpopulations occur within the Julia Butler Hansen National Wildlife Refuge, which was established in 1972 as the Columbian White-tailed Deer National Wildlife Refuge to protect over 5,600 acres of shoreline and island habitat for the preservation of the Columbian white-tailed deer (Azerrad 2016). In 2013, the USFWS began a program to translocate Columbian white-tailed deer from the Julia Butler Hansen National Wildlife Refuge to the Ridgefield National Wildlife Refuge in Clark County.

Columbian white-tailed deer are unlikely to be present within the study areas; there are no documented sightings, and habitat suitability is limited. Columbian white-tailed deer are present on islands in the lower Columbia River, and, since they are capable of swimming, they may be occasionally present within downstream portions of the secondary study area.

MYOTIS BATS (*MYOTIS SPP.*)

Three species of *Myotis* bats (long-legged myotis, fringed myotis, and long-eared myotis) have the potential to occur within the vicinity of the study areas (ORBIC 2021; WDFW 2021c). Long-legged and fringed myotis are designated as sensitive species in Oregon. WDFW identifies roosting concentrations of all three species as priority species (WDFW 2008). While these species have unique habitat requirements, their similarities allow them to be addressed together in this section.

Myotis bats in the region occur within a wide variety of habitats. They are primarily associated with coniferous forests but also inhabit riparian forests and dry rangeland. They roost in snags and live trees with loose bark, long vertical cracks, or hollows; in cracks and crevices in rocks, stream banks, and the ground; and in caves and mines, as well as in and on buildings and bridges (Hayes and Wiles 2013).

Myotis bats likely forage within the primary and secondary study areas and may roost on structures (including the existing bridges) or trees within the primary and secondary study areas. The wetlands and aquatic habitats, including those associated with the Vanport wetlands, Smith and Bybee Lakes, and Burnt Bridge Creek, likely provide suitable foraging habitat, and adjacent forest habitats could provide roosting or maternity sites.

Bat roosting has not been formally documented within the primary study area or on the existing Interstate Bridge and North Portland Harbor bridges, but this does not mean that bats do not roost within the study areas or on these structures.

TOWNSEND'S BIG-EARED BAT (*CORYNORHINUS TOWNSENDII*)

Townsend's big-eared bats are designated a critically sensitive species in Oregon (ODFW 2021b), a Washington State candidate species, and WDFW priority species (WDFW 2008).

Townsend's big-eared bats occupy a broad range of moist and arid habitats. In Oregon and Washington, they typically occur in westside lowland conifer-hardwood forest, montane conifer forest, ponderosa pine forest and woodland, shrub-steppe, riparian habitats, and open fields. Temperatures, roost dimensions, sizes of roost openings, light quality, and extent of airflow are important factors in the selection of roosts. Hibernacula occur mainly in caves, mines, lava tubes, and occasionally in buildings (Hayes and Wiles 2013).

There are historic documented occurrences of Townsend's big-eared bat within the study areas, but no modern-day observations (ORBIC 2021). Roosting and hibernacula habitat is somewhat limited within the study area. There are no natural caves, mines, or lava tubes in the vicinity, and most buildings and structures are in regular use. The existing bridges and structures within the study areas may provide roosting habitat, and the primary and secondary study areas provide potentially suitable foraging habitat, but this species is unlikely to occur within the study areas.

Townsend's big-eared bat roosting has not been formally documented within the primary study area or on the existing Interstate Bridge and North Portland Harbor bridges, but this does not mean that bats do not roost within the study areas or on these structures.

SILVER-HAIRED BAT (*LASIONYCTERIS NOCTIVAGANS*)

Silver-haired bats are designated a critically sensitive species in Oregon (ODFW 2021b), a Washington State candidate species, and WDFW priority species (WDFW 2008).

Silver-haired bats are primarily associated with late-successional conifer forests. They use large snags and hollow trees for day, night, and maternity roosts. They may be found in other habitat types during migration (OCS 2016). There are no observations of silver-haired bats within the study areas (ORBIC 2021; WDFW 2021c). Their primary habitat (late-successional forest) is not present within the study areas or vicinity. The existing bridges and structures within the study areas may potentially provide roosting habitat, and the primary and secondary study areas provide potentially suitable foraging habitat, but this species is not expected to occur within the study area.

Silver-haired bat roosting has not been formally documented within the primary study area or on the existing Interstate Bridge and North Portland Harbor bridge, but this does not mean that these bats do not roost within the study areas or on these structures.

3.3.2.3 Reptiles and Amphibians

WESTERN POND TURTLE (*ACTINEMYS MARMORATA*)

The western pond turtle is designated a sensitive species in Oregon (ODFW 2021b), a listed endangered species in Washington, and a WDFW priority species (WDFW 2008).

Western pond turtles have been found in marshes, ponds, sloughs, and small lakes from sea level to approximately 2,500 feet. The species has also been found in altered habitats such as gravel pits, reservoirs, stock ponds, and sewage treatment plants. They use both permanent and intermittent bodies of water and have been found using a variety of substrates, including rock, gravel, sand, mud, decaying vegetation, and various combinations of these (Hallock et al. 2017).

Western pond turtles also use open, upland habitats, primarily for nesting, but also for dispersal and overwintering. Female turtles leave the water to nest sometime between late May and July. Females usually dig nests and deposit their eggs in compact, dry soil on upland sites. In aquatic habitats, these turtles winter under banks or in mud. Movement to overwintering sites occurs between September and November, and emergence from these locations occurs between March and June (Nordstrom and Milner 1997).

Aquatic (and adjacent riparian) habitats within the primary and secondary study areas provide potentially suitable habitat for western pond turtles. The Vanport wetlands and Smith and Bybee Lakes, with their connectivity to a variety of hydrologic regimes and vegetation communities, provide particularly well-suited habitat. However, western pond turtles have not recently been documented in the vicinity. There are no documented populations in Clark County, Washington, and only two documented sightings within portions of the study areas in Oregon from the 1990s (ORBIC 2021).

WESTERN PAINTED TURTLE (*CHRYSEMYS PICTA*)

The western painted turtle is designated a sensitive species in Oregon (ODFW 2021b).

In Oregon, native western painted turtles are narrowly distributed along the northern portion of the state. They are found primarily in the Columbia River basin and in the northern portion of the Willamette River Basin. They often co-occur with pond turtles in aquatic habitats in this region (Gervais et al. 2009).

Aquatic habitat for western painted turtles is typically slow-moving and shallow water, including streams, canals, sloughs, small lakes, and ponds. Terrestrial habitat is used primarily for nesting, but occasionally for overwintering and overland movements among aquatic habitats. Overwintering often takes place in shallow aquatic environments but also occurs in terrestrial habitats (Gervais et al. 2009).

Aquatic (and adjacent riparian) habitats within the primary and secondary study areas provide potentially suitable habitat for western painted turtle. Western painted turtles have been regularly observed within Smith and Bybee Lakes and the Columbia Slough (ORBIC 2021); these areas provide them with good terrestrial and aquatic habitat. Other aquatic and riparian habitats within the study areas also provide potentially suitable habitat.

NORTHERN RED-LEGGED FROG (*RANA AURORA AURORA*)

The northern red-legged frog is designated a sensitive species in Oregon (ODFW 2021b).

The native range of northern red-legged frogs extends from the southwestern coast of British Columbia south along the Pacific coast, east to the west Cascade Mountains, and south to Mendocino County in northwestern California. They live at elevations ranging from sea level to 4,680 feet. Northern red-legged frogs occur throughout western Oregon and Washington from the west Cascade Mountains to the coast.

Northern red-legged frogs are typically associated with shallow-water ponds and wetlands with emergent vegetation. For breeding, they require forested sites with exposed, still-water habitat. Breeding habitat may be seasonal or permanent, provided the water persists for at least five months. Adults and juveniles also use moist riparian and upland forests (OCS 2016).

Wetland (and adjacent riparian) habitats within the primary and secondary study areas provide potentially suitable habitat for red-legged frog. Though data from ODFW and WDFW do not indicate documented sightings (ORBIC 2021; WDFW 2021c), it is assumed that this species may occur within the study areas.

3.3.2.4 Insects

MONARCH BUTTERFLY (*DANAUS PLEXIPPUS*)

The monarch butterfly is a candidate for listing under the federal ESA (USFWS 2021a). It is not provided special state regulatory status at this time.

The monarch is a globally distributed species of butterfly that is closely associated with species of milkweed (*Asclepias* spp.). Caterpillars feed almost exclusively on milkweed, and adults require nectar from flowering plants blooming in the spring and fall to fuel migrations (OCS 2009). This species is well known for the phenomenal long-distance migrations of the North American populations. Elsewhere in the world, where temperatures are suitable and milkweed is available year-round, populations are non-migratory (USFWS 2020).

The monarch life cycle varies by geographic location. During the breeding season, monarchs lay their eggs on an obligate milkweed host plant and larvae emerge after two to five days. Larvae develop over a period of 9 to 18 days, feed on milkweed, then pupate into chrysalis before emerging 6 to 14 days later as an adult butterfly. Multiple generations of monarchs are typically produced during a single breeding season, with most of these-non-migratory adult butterflies living approximately two to five weeks (USFWS 2020).

In western North America, adult monarchs begin migrating south to overwintering sites in the fall. This migration can take monarchs distances of over 1,500 miles and can last over two months. Migratory individuals in western North America generally fly south and west to overwintering areas along the central and southern California coast and into northern Baja California in Mexico (USFWS 2020).

There is little data on monarch butterfly presence or distribution within the study areas. ODFW and WDFW do not maintain records of monarch butterfly presence in the ORBIC or WDFW priority species databases. However, the study areas are within the summer breeding range of monarch butterflies, and they may be present in certain years. Milkweed is not common within the primary or secondary study area, and there is little suitable breeding habitat for monarchs.

3.4 Botanical Resources

3.4.1 Botanical Resources Overview

This assessment of botanical resources evaluates only the primary study area; botanical resources within the secondary study area would not be affected. This section describes the botanical SOI and noxious weeds that may occur within the primary study area.

The primary study area provides suitable habitat for a variety of botanical resources. These include common species that are widely distributed within the region, botanical SOI that are rare or have other special regulatory status, and noxious weeds. A discussion of the common plant species that occur within each terrestrial habitat within the primary study area is provided in the habitat descriptions in Section 3.4.2.

3.4.2 Botanical Species of Interest

Table 3-4 presents a list of botanical SOI that may occur within the primary study area. This list of botanical SOI was developed based on data from USFWS (USFWS 2021a, 2021b, 2021c), ORBIC (ORBIC 2021), and WNHP (WNHP 2021) and in coordination with tribes and local, state, and federal agencies.

Table 3-4. Botanical Species of Interest Potentially Occurring within the Primary Study Area

Species Common Name	Species Scientific Name	Federal Status [a]	State Status (OR) [b]	State Status (WA) [c]	Habitat Suitability in Primary Study Area	Typical Flowering Window [d]
Vascular Plants						
Golden paintbrush	*Castilleja levisecta*	T	E	T	Low – Agriculture, Pasture and Mixed Environs	April–June
Kincaid's lupine	*Lupinus oreganus*	T	T	T	Low – Agriculture, Pasture and Mixed Environs	April–June
Nelson's checker-mallow	*Sidalcea nelsoniana*	T	T	E	Low – Agriculture, Pasture and Mixed Environs	Late May–July
Willamette Daisy	*Erigeron decumbens*	E	E	Not listed	Low – Agriculture, Pasture and Mixed Environs	June–July
Tall bugbane	*Actaea elata* var. *elata*	Not listed	Not listed	S	Low – Westside Riparian – Wetlands and Westside Lowlands Conifer – Hardwood Forest	May–August
Small-flowered trillium	*Trillium albidum ssp. Parviflorum*	Not listed	Not listed	S	Low – Westside Riparian – Wetlands and Westside Lowlands Conifer – Hardwood Forest	March–May
Western ladies-tresses	*Spiranthes porrifolia*	Not listed	Not listed	S	Low – Herbaceous Wetlands and Westside Riparian – Wetlands	May–August
Columbia cress	*Rorippa columbiae*	Not Listed	C	T	Low – Herbaceous Wetlands and Westside Riparian – Wetlands	April–October

a Federal Endangered Species Act status: T = Threatened, E = Endangered, P = Proposed, C = Candidate, SOC = Species of Concern, Not listed = No status designated (USFWS 2021a).

b Oregon State status: T = Threatened, E = Endangered, S=Sensitive, SC = Sensitive Critical, Not listed = No status designated (ORBIC 2021).

c Washington State status: T = Threatened, E = Endangered, S=Sensitive, C=Candidate, PHS = priority habitat and species (WNHP 2021).

d USFWS 2010; ODA 2021; WNHP 2021

In addition to the species identified in Table 3-4, data from ORBIC and WNHP identify several SOI documented in the primary study area from historical records, but that are not known or expected to occur. These species are bristly sedge (*Carex comosa*), moss grass (*Coleanthis subtilis*), yellow lovegrass (*Eragrostis lutescens*), water howellia (*Howellia aquatilis*), hairy water-fern (*Marsilea vestita*), toothcup (*Rotala ramosior*), pale bulrush (*Scirpus pallidus*), Oregon Sullivantia (*Sullivantia oregana*), golden alexanders (*Zizia aptera*), western yellow oxalis (*Oxalis suksdorfii*), branching montia (*Montia diffusa*), and Gray's broomrape (*Aphyllon californicum* ssp.*grayanum*) (ORBIC 2021; WNHP 2021).

3.4.2.1 Vascular Plants

GOLDEN PAINTBRUSH (*CASTILLEJA LEVISECTA*)

Golden paintbrush is listed as threatened under the federal ESA (USFWS 2021a), as endangered in Oregon (ORBIC 2021), and as threatened in the state of Washington (WNHP 2021).

This species historically occurred in open grasslands in the Puget Trough and Willamette Valley. It is now believed to be extirpated in Oregon, its current range restricted to 11 known extant occurrences in the Puget Trough of Washington and British Columbia.

The preferred substrate is generally composed of glacial outwash or depositional material. The species prefers sun and can tolerate partial shade but will not tolerate a closed canopy. The most common associate species, depending on the site, are Idaho fescue (*Festuca idahoensis*) or red fescue (*Festuca rubra*). Many weedy species also occur as associated species, as most of these areas have suffered from past disturbances (WNHP 2021). Golden paintbrush flowers from approximately April to June (USFWS 2010).

The primary study area provides only limited suitable habitat for golden paintbrush. Patches of "Agriculture, Pasture and Mixed Environs" habitat type are generally dominated by grasses and herbaceous vegetation and mimic the remnant prairie habitats that golden paintbrush requires. However, these areas are generally heavily disturbed and are regularly mowed and maintained, and habitat suitability is limited. There are no documented occurrences of golden paintbrush within the primary study area or vicinity.

KINCAID'S LUPINE (*LUPINUS OREGANUS)*

Kincaid's lupine is listed as threatened under the federal ESA (USFWS 2021a) and as threatened in Oregon (ORBIC 2021) and Washington (WNHP 2021).

Kincaid's lupine occurs in wet prairie, upland prairie, and oak/savannah habitats, which were once widely distributed in western Oregon and Washington. Its current range extends from Lewis County, Washington, in the north and south to the foothills of Douglas County, Oregon. However, most of the known and historical populations are found in the Willamette Valley (USFWS 2010). Kincaid's lupine flowers from approximately April through June (USFWS 2010).

The primary study area provides only limited suitable habitat for Kincaid's lupine. Patches of "Agriculture, Pasture and Mixed Environs" habitat type are generally dominated by grasses and herbaceous vegetation and mimic the remnant prairie habitats that Kincaid's lupine requires. However, these areas are generally heavily disturbed and are regularly mowed and maintained, and habitat suitability is limited. There are no documented occurrences of Kincaid's lupine within the primary study area or vicinity.

NELSON'S CHECKERMALLOW (*SIDALCEA OREGANA)*

Nelson's checkermallow is listed as threatened under the federal ESA (USFWS 2021a), threatened in Oregon (ORBIC 2021), and endangered in the state of Washington (WNHP 2021).

Nelson's checkermallow is typically found in open prairie remnants along the margins of streams, sloughs, ditches, roadsides, fence rows, and drainage swales and in fallow fields. Occasionally, the species occurs in the understory, at the edges of ash woodlands, or among woody shrubs (USFWS 2010). The majority of extant populations occur in Oregon, with many concentrated near the cities of Corvallis and Salem. Only two populations are known to occur in Washington. Nelson's checkermallow flowers from approximately late May to early July (USFWS 2010).

The primary study area provides only limited suitable habitat for Nelson's checkermallow. Patches of "Agriculture, Pasture and Mixed Environs" habitat type are generally dominated by grasses and herbaceous vegetation and mimic the remnant prairie habitats that Nelson's checkermallow requires. However, these areas are generally heavily disturbed and are regularly mowed and maintained, and habitat suitability is limited. There are no documented occurrences within the primary study area or vicinity.

WILLAMETTE DAISY (*ERIGERON DECUMBENS*)

Willamette daisy is listed as endangered under the federal ESA (USFWS 2021a) and as endangered in Oregon (ORBIC 2021).

Willamette daisy typically occurs where woody cover is nearly absent and where herbaceous vegetation is low in stature. It occurs in both wet prairie grasslands and drier upland prairie sites. The wet prairie grassland community is typically dominated by tufted hairgrass (*Deschampsia caespitosa*), California oatgrass (*Danthonia californica*), and a number of Willamette Valley endemic forbs. On drier upland prairie sites, associated species commonly include hall's aster (*Symphotrichum hallii*), Roemer's fescue (*Festuca idahoensis* ssp. *Roemeri*) and poison-oak (*Toxicodendron diversilobum*) (USFWS 2010).

Willamette daisy is known only from the Willamette Valley in northwestern Oregon. Though once found throughout the valley, the species is now restricted to scattered habitat remnants. It is not known to occur in Washington. Willamette daisy flowers from approximately June to early July (USFWS 2010).

The primary study area does not provide suitable habitat for Willamette daisy. Neither the wetland nor the upland prairie or grassland habitat types exhibit the specific species associations or conditions that are present where Willamette daisies are found. There are no documented occurrences within the primary study area or vicinity.

TALL BUGBANE (*ACTAEA ELATA VAR ELATA*)

Tall bugbane is listed as a sensitive species in Washington (WNHP 2021).

Tall bugbane is a tall understory plant of lowland forests. In Washington, it occurs in the Western Cascades, Puget Trough, Olympic Peninsula, and Southwest Washington physiographic provinces

(WNHP 2021). The species grows in or along the margins of mixed, mature or old growth stands of mesic coniferous forest, or mixed coniferous-deciduous forest. Associated species include Douglas fir, western red cedar, bigleaf maple, red alder, vine maple (*Acer circinatum*), oceanspray (*Holodiscus discolor*), hazelnut (*Corylus cornuta*), sword fern (*Polystichum munitum*), and snowberry (*Symphoricarpos albus*). Tall bugbane flowers from approximately May to August (WNHP 2021).

The primary study area provides limited potentially suitable habitat for tall bugbane. Patches of "Westside Riparian – Wetlands" and "Westside Lowlands Conifer – Hardwood Forest" habitat have plant species associations that are similar to those required by tall bugbane. The areas of greatest potential habitat suitability are the riparian forested areas associated with Burnt Bridge Creek and forested riparian fringe around the Vanport wetlands. There are no documented occurrences of tall bugbane within the primary study area or vicinity.

SMALL-FLOWERED TRILLIUM (*TRILLIUM ALBIDUM* SSP. *PARVIFLORUM*)

Small-flowered trillium is listed as a sensitive species in Washington (WNHP 2021).

Small-flowered trillium is a regional endemic, occurring from Pierce and Thurston Counties southward into Lewis and Clark Counties, Washington, and into the Willamette Valley, Oregon. It is an uncommon species of very local distribution with few, widely scattered populations (WNHP 2021). It occurs in association with moist areas dominated by hardwoods, most commonly Oregon ash but sometimes red alder or Oregon white oak. Many known sites are within the upland edge of riparian zones that may undergo periodic winter flooding.

The primary study area provides limited potentially suitable habitat for small-flowered trillium. Some small patches of "Westside Riparian – Wetlands" and "Westside Lowlands Conifer – Hardwood Forest" habitat types have hydrologic conditions and plant species associations that are similar to those required by small-flowered trillium. The areas of greatest potential habitat suitability are the riparian forested areas associated with Burnt Bridge Creek and forested riparian fringe around the Vanport wetlands. Small-flowered trillium flowers from approximately March to May (WNHP 2021).

There are no documented occurrences of small-flowered trillium within the primary study area or vicinity.

WESTERN LADIES-TRESSES (*SPIRANTHES PORRIFOLIA)*

Western ladies-tresses is listed as a sensitive species in Washington (WNHP 2021).

Western ladies-tresses occurs sporadically from southern Washington to southern California. Its habitat includes wet meadows, areas adjacent to streams, bogs, and seepage slopes (WNHP 2021). Associated species include a variety of sedges (*Carex* spp.), white brodiaea (*Triteleia hyacinthina*), and yellow monkeyflower (*Erythranthe guttata*) (WNHP 2021). Western ladies-tresses has been previously documented in the Vancouver Lake lowlands, but there are no currently documented extant populations within the primary study area (WNHP 2021). Western ladies-tresses flowers from approximately May to August (WNHP 2021).

The primary study area provides limited potentially suitable habitat for western ladies-tresses. Some patches of the "Herbaceous Wetlands" and "Westside Riparian – Wetlands" habitat types provide hydrologic conditions and have plant species associations that are similar to those required by western ladies-tresses. The areas of greatest potential habitat suitability are the herbaceous and riparian wetland habitats associated with Burnt Bridge Creek and the Vanport wetlands.

There are no documented occurrences of western ladies-tresses within the primary study area or vicinity.

COLUMBIA CRESS (*RORIPPA COLUMBIAEA*)

Columbia cress is listed as a candidate species in Oregon (ORBIC 2021) and a threatened species in Washington (WNHP 2021).

Columbia cress occurs along riverbanks, internally drained lakes with extended periods of dryness, wet meadows, and ditches. All known sites are inundated for at least part of the year. The species is adapted to periodic flooding and unstable substrates; prior to the construction of hydroelectric dams, its habitat was scoured most years by spring floods. Soil types include clay, sand, gravel, sandy silt, cobblestones, and rocks. All sites in Washington occur along the Columbia River, in the lowest vegetated riparian zone. The nearest documented site in Washington is in Skamania County, below Bonneville Dam (WNHP 2021). On the Oregon side of the river, Columbia cress has been documented within portions of North Portland Harbor in the vicinity of the secondary study area (ORBIC 2021). Columbia cress flowers from approximately April to October (WNHP 2021).

The primary study area provides limited potentially suitable habitat for Columbia cress. Areas within the "Westside Riparian – Wetlands" habitat that are adjacent to the Columbia River, North Portland Harbor, and Columbia Slough provide conditions that are potentially suitable for Columbia cress.

3.4.2.2 Botanical Species of Interest Summary

In general, habitat suitability for the botanical SOI identified in Table 3-4 is extremely limited due to the degree of development, impervious surface, habitat fragmentation, and presence of invasive species. Areas of natural habitat that remain within the primary study area are limited both in extent and condition. The highest quality habitats for botanical SOI are prairie-like habitats near Fort Vancouver and the Pearson Airfield, and wetland and riparian habitats associated with Burnt Bridge Creek and the Vanport wetlands. Due to the lack of suitable habitat, species-specific botanical surveys were not conducted for botanical SOI. However, no botanical SOI have been documented within the primary study area, and, due to the limited habitat suitability, their presence is unlikely.

3.4.3 Noxious Weeds

Noxious weeds are defined at the state level by the Oregon State Weed Board (OSWB) and the Washington State Noxious Weed Control Board (WNWCB). The OSWB defines noxious weeds as terrestrial, aquatic, or marine plants that represent the greatest public menace and are a top priority for action by weed control programs. The WNWCB has a similar definition, which classifies noxious species as invasive, non-native plants that are so aggressive they harm local ecosystems or disrupt agricultural production. Both the OSWB and the WNWCB maintain noxious weed lists for the state with various management classifications.

The OSWB establishes three classifications of noxious weeds: A-listed, B-listed, and T-designated.

- **A-listed:** Weeds of known economic importance that occur in the state in small enough infestations to make eradication or containment possible, or that are not known to occur, but their presence in neighboring states makes future occurrence in Oregon seem imminent. Infestations of A-listed weeds are subject to eradication or intensive control when and where found.
- **B-listed:** Weeds of economic importance that are regionally abundant but may have limited distribution in some counties. The OSWB may recommend limited to intensive control at the state, county, or regional level as determined on a site-specific, case-by-case basis. Where implementation of a fully integrated statewide management plan is not feasible, biological control (when available) shall be the primary control method.
- **T-designated**: Weed species that are selected and will be the focus for prevention and control by the Noxious Weed Control Program. Action against these weeds will receive priority. T-designated noxious weeds are determined by the OSWB and directs the Oregon Department of Agriculture (ODA) to develop and implement a statewide management plan. T-designated noxious weeds may be species selected from either the A or B list.

The WNWCB establishes three classifications of noxious weeds: Class A, Class B, and Class C.

- **Class A:** Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication of all Class A plants is required by law.
- **Class B:** Non-native species presently limited to portions of the state. Species are designated for required control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal. County Noxious Weed Control Boards identify the species designated for control for their county.
- **Class C**: Noxious weeds that are typically widespread in Washington or are of special interest to the state's agricultural industry. The Class C status allows county weed boards to require control if locally desired, or they may choose to provide education or technical consultation.

Table 3-5 identifies 14 species of noxious weeds that are known or expected to occur within the primary study area.

No OSWB A-listed or WNWCB Class A noxious weeds (i.e., those requiring eradication) are known or expected to occur within the primary study area. Twelve species are identified as noxious species on both the OSWB and WNWCB species lists, while two additional species are only listed as noxious species by the WNWCB.

Table 3-5. Noxious Weed Species Occurring within the Primary Study Area

Botanical Name	Common Name	OSWB Status	WNWCB Status
Centaurea × gerstlaueri (Centaurea pratensis)	Meadow knapweed	B-listed	Class B
Cirsium arvense	Canada thistle	B-listed	Class C
Cirsium vulgare	Bull thistle	B-listed	Class C
Clematis vitalba	Old man's beard	B-listed	Class C
Conium maculatum	Poison hemlock	B-listed	Class B
Convolvulus arvensis	Field bindweed	B-listed	Class C
Cytisus scoparius	Scotch broom	B-listed	Class B
Daucus carota	Wild carrot	N/A	Class C
Geranium robertianum	Herb-Robert's	Class B	Class B
Hedera helix	English ivy	B-listed	Class C
Hypericum perforatum	St. John's wort	B-listed	Class C
Phalaris arundinacea	Reed canarygrass or Ribbongrass	B-listed	Class C
Fallopia japonica	Japanese knotweed	B-listed	Class B
Rubus armeniacus	Himalayan blackberry	B-listed	Class C
Senecio jacobaea	Tansy ragwort	B-listed	Class B

N/A = Not Applicable – Species does not have a listing status by either OSWB or WNWCB.

OSWB = Oregon State Weed Control Board; WNWCB = Washington State Noxious Weed Control Board

In general, noxious weeds are distributed throughout vegetated portions of the study areas. In particular, noxious weeds can proliferate in areas that are highly disturbed (including the Washington State Department of Transportation [WSDOT] and Oregon Department of Transportation [ODOT] rights of way) despite regular mowing and maintenance.

3.5 Federal, State, and Local Habitat Designations

Federal, state, and local regulatory frameworks provide habitat designations for a number of ecosystem resources within the study areas. A summary of these designations is provided in Table 3-6. Note that many of these designated areas overlap. For example, open water habitats within the Columbia River are designated critical habitat for several fish SOI, EFH for Pacific salmon, a WDFW priority habitat, a Fish and Wildlife Habitat Conservation area in the City of Vancouver, and a Portland environmental zone (ezone). Refer to Chapter 8 for a discussion of the regulatory permits and approvals that may be associated with these various resource designations.

Table 3-6. Federal, State, and Local Habitat Designations within the Study Areas

Agency	Limits of Jurisdiction	Resource Designation	Description
Federal			
NOAA Fisheries and USFWS	U.S.	Critical Habitat for ESA-listed species	Specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection.
NOAA Fisheries	U.S.	EHF	Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. EFH has been designated for three categories of fish: Pacific salmon, groundfish, and coastal pelagic species.
Oregon			
Oregon DSL and ODFW	Oregon – Statewide	Habitats of Conservation Concern	Habitats of conservation concern within Oregon that provide important benefits to OCS Strategy Species. Eleven Strategy Habitats have been designated.
City of Portland	City of Portland	Environmental Overlay Zones	Establishes Environmental Protection zones and Environmental Conservation zones in Portland to protect important natural resource areas.
Metro	Multnomah, Clackamas, and Washington Counties	Habitat Conservation Areas	Classifies regionally significant fish and wildlife habitat as Habitat Conservation Areas. Separate categories exist for Riparian and Upland Wildlife habitats.
Washington			
WDFW	Washington - Statewide	Priority Habitats	Specifically designated habitat types that have been determined to have unique or significant value. WDFW has designated a total of 20 Priority Habitats within the state, including 11 Terrestrial Priority Habitat types, 5 Aquatic Habitat Types, and 4 Priority Habitat Features.
Ecology	Washington - Statewide	Shoreline Management Areas	The Shoreline Management Act defines certain waterbodies as “Shorelines of the State,” and local jurisdictions establish shoreline management areas in which development activities are regulated.

Agency	Limits of Jurisdiction	Resource Designation	Description
City of Vancouver	City of Vancouver	Critical Areas Ordinance – Fish and Wildlife Habitat Conservation Areas	Five categories of "Critical Areas" are defined in the city of Vancouver. This section addresses fish and wildlife habitat conservation areas.

DSL = Department of State Lands; EFH = Essential Fish Habitat; ESA = Endangered Species Act; NOAA Fisheries = North American Oceanic and Atmospheric Administration Fisheries Service; ODFW = Oregon Department of Fish and Wildlife; USFWS = U.S. Fish and Wildlife Service; WDFW = Washington Department of Fish and Wildlife

3.5.1 Federal

3.5.1.1 Designated Critical Habitat for Endangered Species Act–Listed Species

Critical habitat is defined for ESA-listed species to include the following:

- Specific areas within the geographical area occupied by the species at the time of listing that contain physical or biological features essential to conservation of the species and that may require special management considerations or protection; and
- Specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

Critical habitat is designated by NOAA Fisheries and USFWS for species under their respective jurisdictions. When a species is listed under the ESA, NOAA Fisheries and USFWS are required to determine whether there are areas that meet the definition of critical habitat. Once critical habitat is designated, other federal agencies consult with NOAA Fisheries to ensure that actions they fund, authorize, or undertake are not likely to destroy or adversely modify the critical habitat.

Surface waters within the study areas have been designated critical habitat for one or more species. The mainstem Columbia River and North Portland Harbor provide designated critical habitat for ESA-listed populations of Chinook salmon, chum salmon, coho salmon, steelhead trout, sockeye salmon, bull trout, and eulachon. Portions of the Columbia Slough that are within the secondary study area are designated critical habitat for ESA-listed coho salmon, and portions downstream of the Columbia Slough that are outside of the study areas are designated critical habitat for ESA-listed Chinook salmon and steelhead. Burnt Bridge Creek is designated critical habitat for coho salmon.

3.5.1.2 Essential Fish Habitat

NOAA Fisheries designates certain waters as EFH, under the Magnuson-Stevens Act. Under this act, EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH has been designated for three categories of fish: Pacific salmon, groundfish, and coastal pelagic species. Federal agencies must consult with NOAA Fisheries on all proposed actions authorized, funded, or carried out by the agency that may adversely affect EFH.

All portions of the Columbia River and North Portland Harbor, the Columbia Slough, and Burnt Bridge Creek that are within the primary and secondary study areas are designated as EFH for Pacific salmon. In addition, the mainstem Columbia River and North Portland Harbor are designated EFH for groundfish, and portions of the secondary study area near the mouth of the Columbia River and areas within the SRKW whale prey base are designated EFH for coastal pelagic species.

3.5.2 Oregon

3.5.2.1 Essential Salmonid Habitat

The Oregon DSL has designated certain waters in Oregon as ESH. The designation is based on scientific data from ODFW and identifies areas that are critical for salmonids to thrive. DSL considers potential impacts to ESH in their removal-fill permitting process. The ESH designation map was recently updated on May 14, 2021 (DSL 2021).

None of the surface waters within the primary or secondary study areas are designated ESH; designated ESH is in the vicinity. The waters of the Willamette River are designated ESH to the point of confluence with the Columbia River. The lower reaches of the Columbia Slough (downstream of Moore Island) are also designated ESH. This includes Smith and Bybee Lakes and their associated side channels and tributaries.

3.5.2.2 Aquatic Resources of Special Concern

The DSL identifies some waters of the state as ARSC because these waters provide functions, values, and habitats that are limited in quantity, either because they are naturally rare or because they have been disproportionately lost due to prior impacts. ARSCs are defined in OAR 141-085-0510, and include “alkali wetlands and lakes, bogs, cold water habitat, fens, hot springs, interdunal wetlands, kelp beds, mature forested wetlands, native eelgrass beds, off-channel habitats (alcoves and side channels), ultramafic soil wetlands, vernal pools, wet prairies, wooded tidal wetlands, and others as defined by the Department.”

The waters of North Portland Harbor could be considered an ARSC, as it is a side channel of the Columbia River mainstem. There are no other ARSCs within the primary study area. Within the portion of the secondary study area that is downstream of the Willamette River confluence to the mouth of the Columbia River, there are multiple side channels and alcoves, as well as pockets of cold water habitat that would be considered ARSCs.

3.5.2.3 City of Portland Environmental Overlay Zones

The City of Portland has established two types of environmental overlay zones (Environmental Protection zones and Environmental Conservation zones) to protect important natural resource areas.[12] These ezones are defined in Chapter 33.430 of Portland’s Municipal Code. Their purpose is to

[12] The City of Portland is updating its ezones in this location as a part of the Columbia Corridor and Industrial Lands Ezones Project. The ezones shown on Figure 3-6 are draft and subject to change. Final updates are

regulate development activities within defined areas that provide significant resources and functional values, as well as within established transition areas that buffer the resource areas from surrounding pressures.

Environmental Protection zones provide the highest level of protection for resource areas deemed highly valuable through a detailed inventory and economic, social, environmental, and energy analysis. Development is largely prevented in these areas. Environmental Conservation zones are also considered valuable but can be protected while allowing “environmentally sensitive urban development,” per Chapter 33.430.

The application of the ezones is limited to areas that have undergone a thorough inventory of resources and functional value, in addition to an economic, social, environmental, and energy analysis. Environmental zoning applies to all development and site disturbance activities.

Most of the aquatic, wetland, and riparian habitats within the study areas are within an Environmental Conservation zone. No portion of the primary or secondary study areas is designated as an Environmental Protection zone. The approximate extent of City of Portland ezones within the study areas is shown on Figure 3-4.

3.5.2.4 City of Portland – Riparian Corridors and Wildlife Habitat

Metro adopted Title 13 of the Urban Growth Management Functional Plan in September 2005. Title 13 establishes baseline requirements to protect, conserve and restore the region’s significant riparian corridors and wildlife habitat resources, which are collectively referred to as Habitat Conservation Areas. These Habitat Conservation Areas include rivers, streams, wetlands, and adjacent resource areas, as well as upland wildlife habitat patches and habitats of concern.

Metro-area cities and counties were required to demonstrate substantial compliance with Title 13 by January 2009. In 2012, the City of Portland prepared a Natural Resource Inventory Update that demonstrated compliance with Title 13. Portland’s Natural Resource Inventory, like the Title 13 inventory, focuses on riparian corridors and wildlife habitat (City of Portland 2012).[13] Portland’s model assigns scores of high, medium, or low to mapped habitat patches and also establishes a combined riparian/wildlife habitat ranking that categorizes habitat patches as providing high, medium, or low relative function. Portland also identifies certain habitats as Special Habitat Areas (SHAs), comparable to Metro’s Title 13 Habitats of Concern.

The approximate extent of areas designated as riparian corridors and wildlife habitat within the study areas, and their relative (high, medium, low) combined values are shown on Figure 3-5. Areas identified as SHAs are also identified on Figure 3-5.

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expected to be adopted by early 2024. For more information, see www.portland.gov/bps/planning/environ-planning/industrial-ezones

[13] The City of Portland will be updating their Natural Resources Inventory in this location in early 2023, as a part of the Columbia Corridor and Industrial Lands Ezones Project. The Natural Resource Inventory zones shown on Figure 3-5 are draft and subject to change. Final updates are expected to be adopted by early 2024.
For more information, see www.portland.gov/bps/planning/environ-planning/industrial-ezones

Figure 3-4. Oregon - City of Portland Environmental Overlay Zones

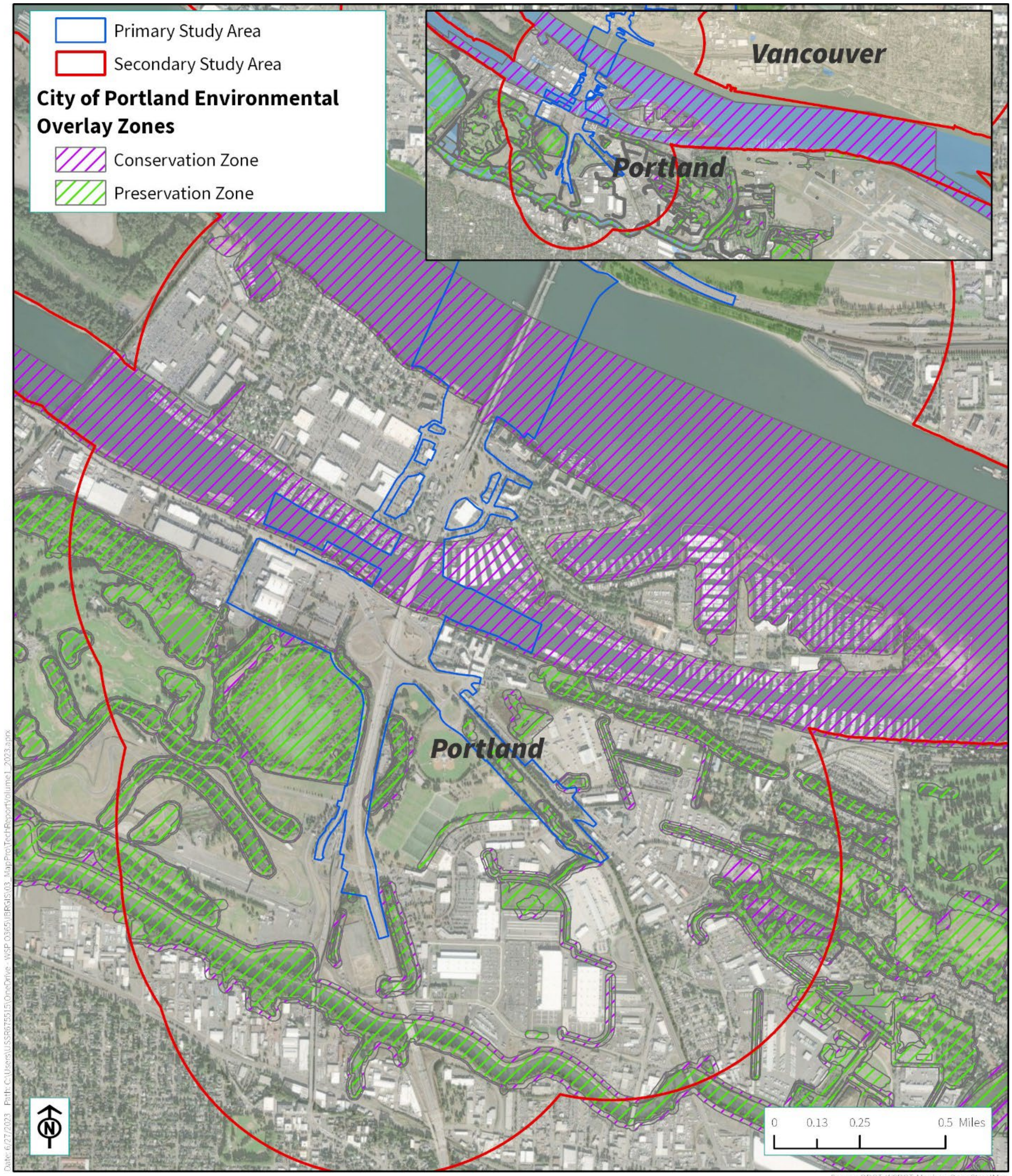
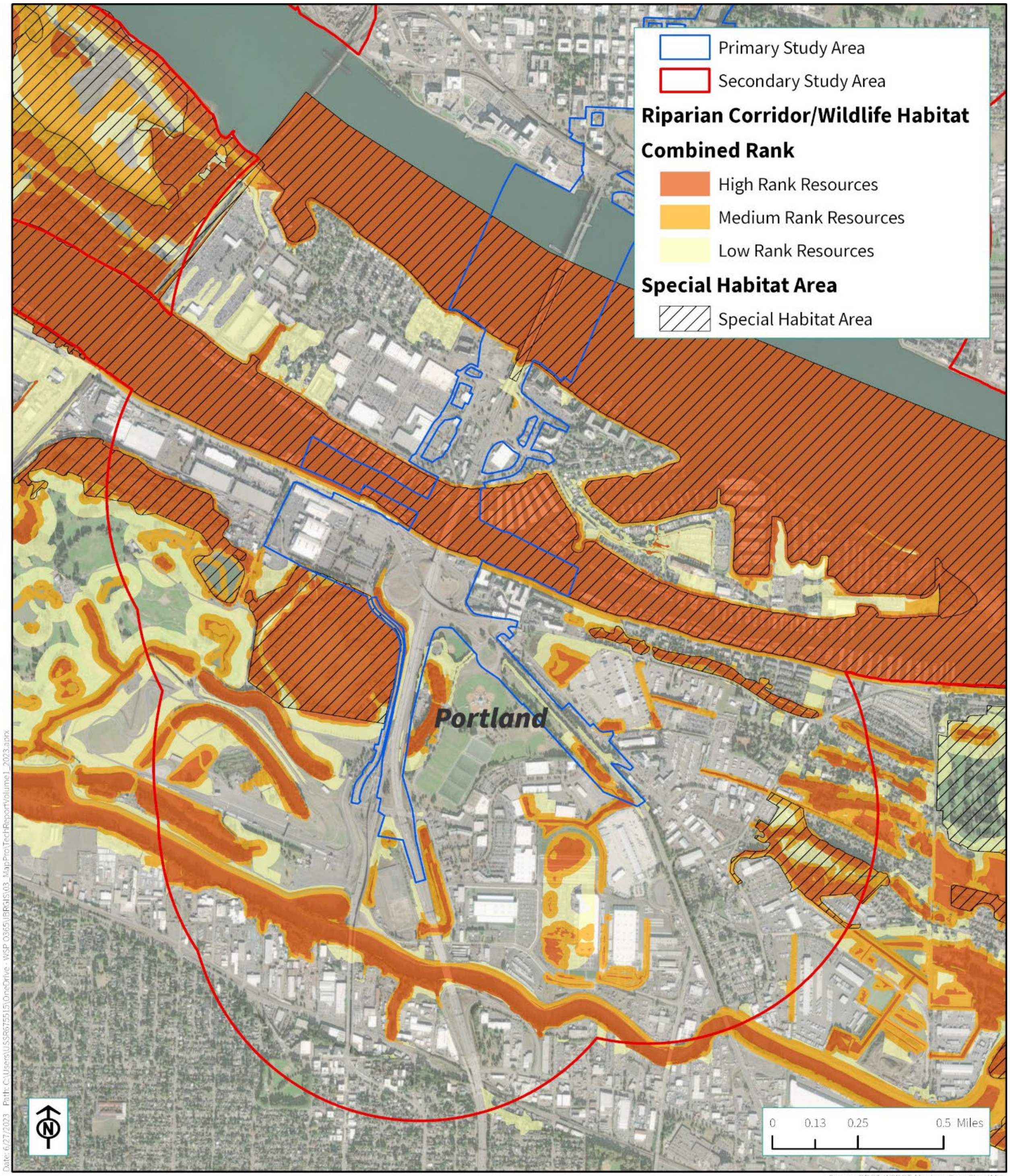


Figure 3-5. Oregon – City of Portland Natural Resource Inventory



Source: ODOT, WSDOT, Mapbox, OpenStreetMap

3.5.2.5 City of Gresham

The City of Gresham inventoried wetlands, riparian areas, and upland areas in the fall of 1987. The findings of this survey are summarized by the Inventory of Significant Natural Resources and Open Spaces that was adopted by the City of Gresham as an appendix to the Community Development Plan (City of Gresham 2005). This survey was oriented primarily toward wildlife habitat values of lowland and upland natural areas within Gresham. Forty-five sites having potential significance as natural resource areas were identified and include wetlands, riparian corridors, upland areas, and greenways. Among these sites, two sites along Fairview Creek were identified as riparian resources: Fairview Creek at SE Burnside Street and Fairview Creek at SE Division Street (City of Gresham 2005). Both sites are within the 100-year floodplain of Fairview Creek and are in close proximity to the Ruby Junction Maintenance Facility.

In 2021 the City of Gresham updated its municipal code with an updated Natural Resources Overlay (City of Gresham 2021). In 2019, the City of Gresham updated its Municipal Code with an updated floodplain overlay (City of Gresham 2019). According to City of Gresham code, within the floodplain overlay district of Fairview Creek, proposed developments need to comply with the guidelines in the code and would need to be accompanied by documentation demonstrating that the proposed activities would not affect floodplain function (City of Gresham 2019).

3.5.3 Washington

3.5.3.1 WDFW Priority Habitats

WDFW is responsible for protecting fish and wildlife species in the state of Washington. To address the protection of these habitats, WDFW publishes a Priority Habitats and Species List that identifies habitats and species that should be a priority for management and conservation. This list is largely created to inform the management and conservation efforts of landowners, agencies, governments, and members of the public who, according to WDFW, “have a shared responsibility to protect and maintain these resources” (WDFW 2008).

WDFW defines priority habitats as those specific habitat types that have been determined to have unique or significant value. An area identified and mapped as priority habitat has one or more of the following attributes:

- Comparatively high fish and wildlife density
- Comparatively high fish and wildlife species diversity
- Important fish and wildlife breeding habitat
- Important fish and wildlife seasonal ranges
- Important fish and wildlife movement corridors
- Limited availability
- High vulnerability to habitat alteration
- Unique or dependent species

Washington identifies 20 different types of priority habitats: 11 Terrestrial Priority Habitat types, five Aquatic Habitat Types, and four Priority Habitat Features. Of these, five habitat types occur within the study areas: instream, riparian areas, wetlands, biodiversity areas and corridors, and oak woodlands. The approximate location and extent of these priority habitats are shown on Figure 3-6.

3.5.3.2 Shoreline Management Areas – Ecology

The Shoreline Management Act defines certain waterbodies as "Shorelines of the State" and directs local jurisdictions to establish Shoreline Master Programs (SMPs), which identify these shorelines within their jurisdictions and establish shoreline management areas where development activities are regulated to protect important shoreline functions, including habitat functions.

The City of Vancouver's SMP defines the limits of shoreline jurisdiction as including areas 200 feet in all directions as measured on a horizontal plane from the OHWM; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters.

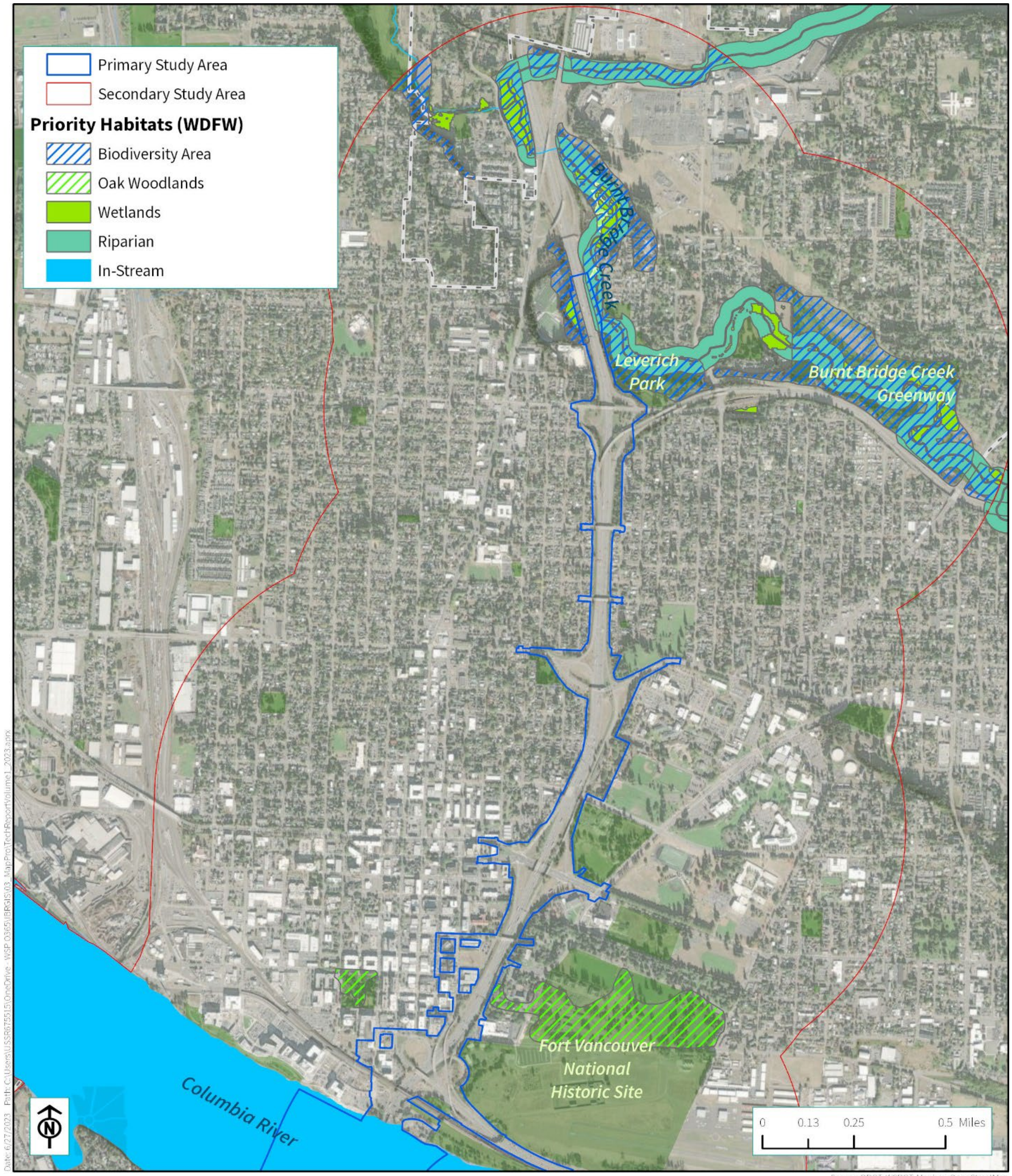
Within the study areas there are shoreline management areas associated with the Columbia River and Burnt Bridge Creek. The approximate location and extent of these shoreline management areas are shown on Figure 3-7.

3.5.3.3 Critical Areas – City of Vancouver

The Growth Management Act requires all cities and counties in Washington to adopt regulations protecting "critical areas" to preserve the natural environment, wildlife habitats, and sources of fresh drinking water. Critical area regulations also encourage public safety by limiting development in areas prone to natural hazards like floods and landslides.

Five categories of critical areas are defined under the Growth Management Act (RCW 36.70A.030(5)): wetlands, fish and wildlife habitat conservation areas (FHWCAs), geologically hazardous areas, frequently flooded areas, and critical aquifer recharge areas. This section pertains specifically to FHWCAs, and a discussion of wetlands and wetland buffers can be found in the Wetlands and Other Waters Technical Report.

Figure 3-6. Washington – Priority Habitats



The City of Vancouver has a Critical Areas Ordinances that defines and regulates development activities within FHWCAs. The definition of FHWCAs is the same in both jurisdictions and is used to characterize:

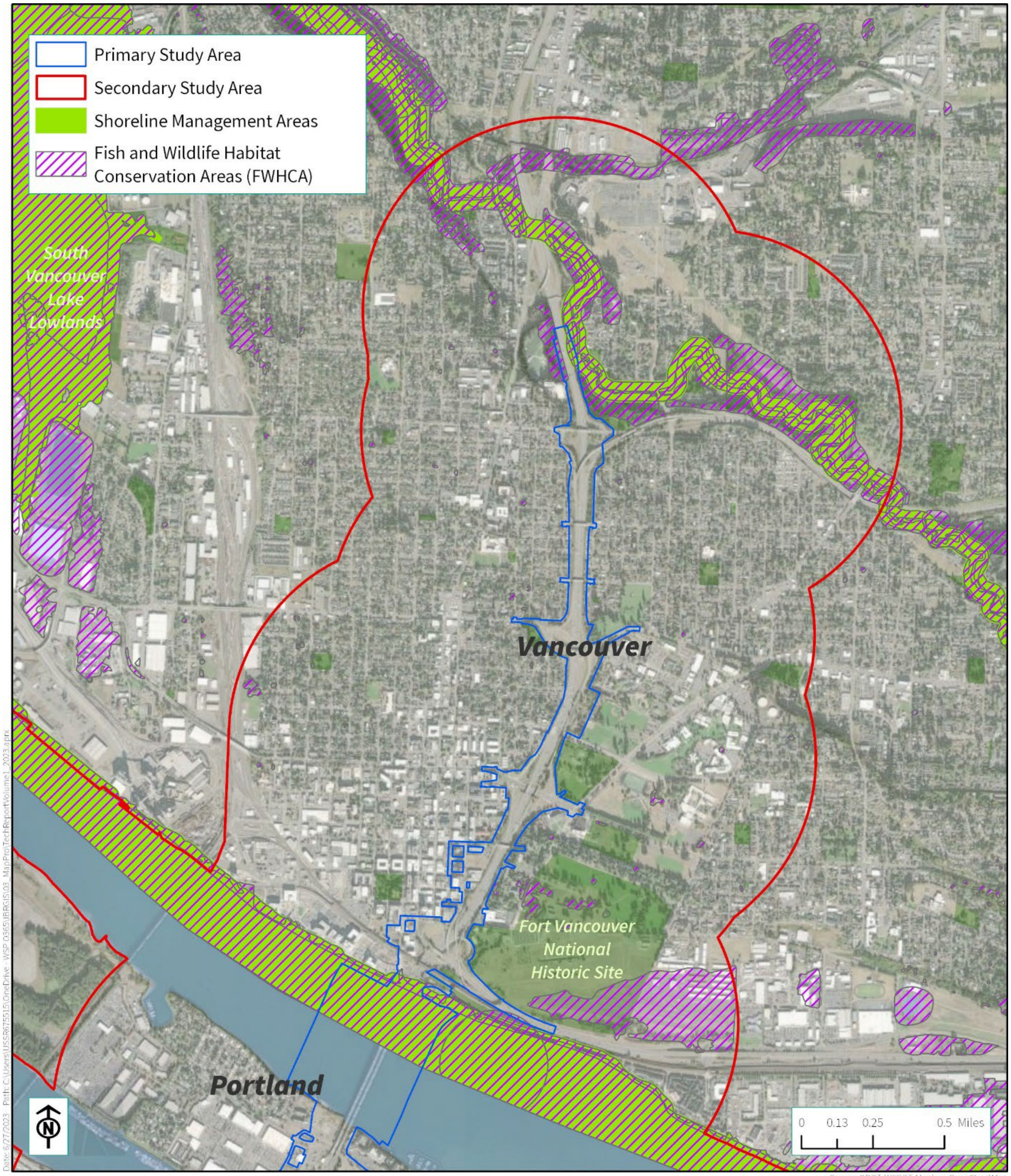
- Habitat used by any life stage of federally designated endangered, threatened, or sensitive species.
- Priority habitats and areas associated with priority species as defined by WDFW.
- Waterbodies, including lakes, streams, rivers, and naturally occurring ponds.
- Habitats of local importance—areas designated by the City to be of local significance that are not designated as state priority habitats.
- Riparian management areas and riparian buffers. These regulated areas include the land from the OHWM to a specified distance (ranging from 0 to 75 feet, depending on the stream type and land use intensity) as measured horizontally in each direction.

The Critical Areas Ordinances require that development activities within these FHWCAs avoid and minimize impacts to the extent practicable and result in no net loss of function.

Areas that meet the criteria for FHWCAs within the study areas are shown on Figure 3-7. Aquatic habitats within the Columbia River and Burnt Bridge Creek are FHWCAs due to their use by ESA-listed fish. WDFW priority habitats (discussed in Section 3.5.3.1) are also FHWCAs.

In addition, areas within approximately 175 feet of the Columbia River and Burnt Bridge Creek in Washington are within the designated riparian management area and riparian buffers established for these waterbodies, except where the buffers are isolated by existing impervious surfaces.

Figure 3-7. Washington - Fish and Wildlife Habitat Conservation and Shoreline Management Areas



4. LONG-TERM EFFECTS

This section describes the long-term effects on ecosystems (aquatic, terrestrial, and botanical resources) expected to result from the operation and maintenance of the No-Build Alternative and the infrastructure built, operated, and maintained with the Modified LPA. Long-term effects are those that would persist on a permanent basis and have been assessed based on the current understanding of the natural and built environments.

Long-term effects on aquatic habitats and species include permanent changes to aquatic habitat from proposed in-water structures, hydraulic shadowing from proposed permanent bridge foundations, water quality associated with stormwater runoff from impervious surfaces, permanent overwater lighting, and avian predation. Long-term effects on terrestrial habitats and species (including botanical species) include removal of sensitive terrestrial habitats or terrestrial wildlife passage.

As described in Chapter 2, several design options are being evaluated as part of the Modified LPA. Where impacts would differ associated with a design option, a comparison of the impacts associated with each design option is provided in Section 4.2.4. The with or without C-Street ramp option, I-5 mainline westward shift or centered option, and the park-and-ride site options evaluated as part of the Modified LPA would not result in different levels or types of long-term effects to ecosystem resources and are, therefore, not specifically addressed further.

As described in Chapter 2, the construction activities associated with the Modified LPA would likely require both temporary and permanent modifications to portions of the Portland Metro Levee System, which is a system of federal flood control levees located along the south bank of the Columbia River/North Portland Harbor within the primary study area. Such modifications may include activities to restore temporarily disturbed portions of the levees, permanent modifications where proposed infrastructure would intersect with the existing levees, or where access to the levees would change as a result of reconfiguration of the roadways. Modifications may also include improvements to existing levee function, if such improvements are requested or required. Modifications or improvements would also be coordinated with the USACE and Urban Flood Safety & Water Quality District (UFSWQD) Joint Contracting Authority for consistency with the planned future condition of the levees. The assessment of long-term effects to ecosystem resources associated with Modified LPA presented below includes those associated with potential modifications to the federal levee system.

Chapter 7 identifies potential mitigation measures that could be implemented to avoid, minimize, and mitigate long-term effects on aquatic, terrestrial, and botanical resources. Chapter 8 identifies applicable federal, state, and local regulations that would be applicable to the construction and operation of the Modified LPA.

4.1 No-Build Alternative

Under the No-Build Alternative, there would be no replacement of the existing Interstate Bridges over the Columbia River and North Portland Harbor, no removal of the existing Interstate Bridge, and none of the other proposed roadway, transit, or stormwater improvements associated with the Modified LPA.

Stormwater from impervious surfaces associated with the existing Interstate Bridges over the Columbia River and North Portland Harbor and roadways within the primary study area would continue to enter surface waters largely untreated, and water quality would continue to be impaired.

The existing Interstate Bridges and roadways would continue to require regular, intermittent maintenance activities, which have the potential to disturb aquatic and terrestrial species and habitats. Potential impacts from maintenance activities include temporarily impaired water quality, temporary underwater and/or terrestrial noise, and temporary vegetation impacts.

Regular and intermittent maintenance activities would continue to be required, which has the potential to result in long-term impacts to aquatic and terrestrial species and habitats, including potential impacts to birds nesting on the existing Interstate Bridge. Activities with the potential to impact nesting migratory birds, such as nest removal, would be conducted consistent with the provisions of the MBTA. The MBTA requires that nests of migratory birds be removed only at times when nests are inactive. Active nests (those with live eggs and/or viable chicks) are to be left undisturbed until they are no longer active.

Typical construction best management practices (BMPs) would likely be implemented during maintenance activities to minimize impacts to fish and wildlife species and habitats.

If a catastrophic event occurred, such as a major earthquake, that resulted in the existing Interstate Bridges over the Columbia River failing or collapsing, it could affect fish and wildlife species both in the immediate vicinity of the bridges and in aquatic habitats both upstream and downstream. Fish and wildlife in the immediate vicinity of the Interstate Bridges at the time of the event could be directly affected by falling debris and injured or killed if struck. Fallen debris would diminish habitat suitability at the site by displacing benthic habitat. Fallen debris from the Interstate Bridges could also contribute chemical contaminants to the water and result in reductions in water quality that could affect aquatic species and habitats both upstream and downstream of the bridge.

4.2 Modified Locally Preferred Alternative

4.2.1 Aquatic Resources

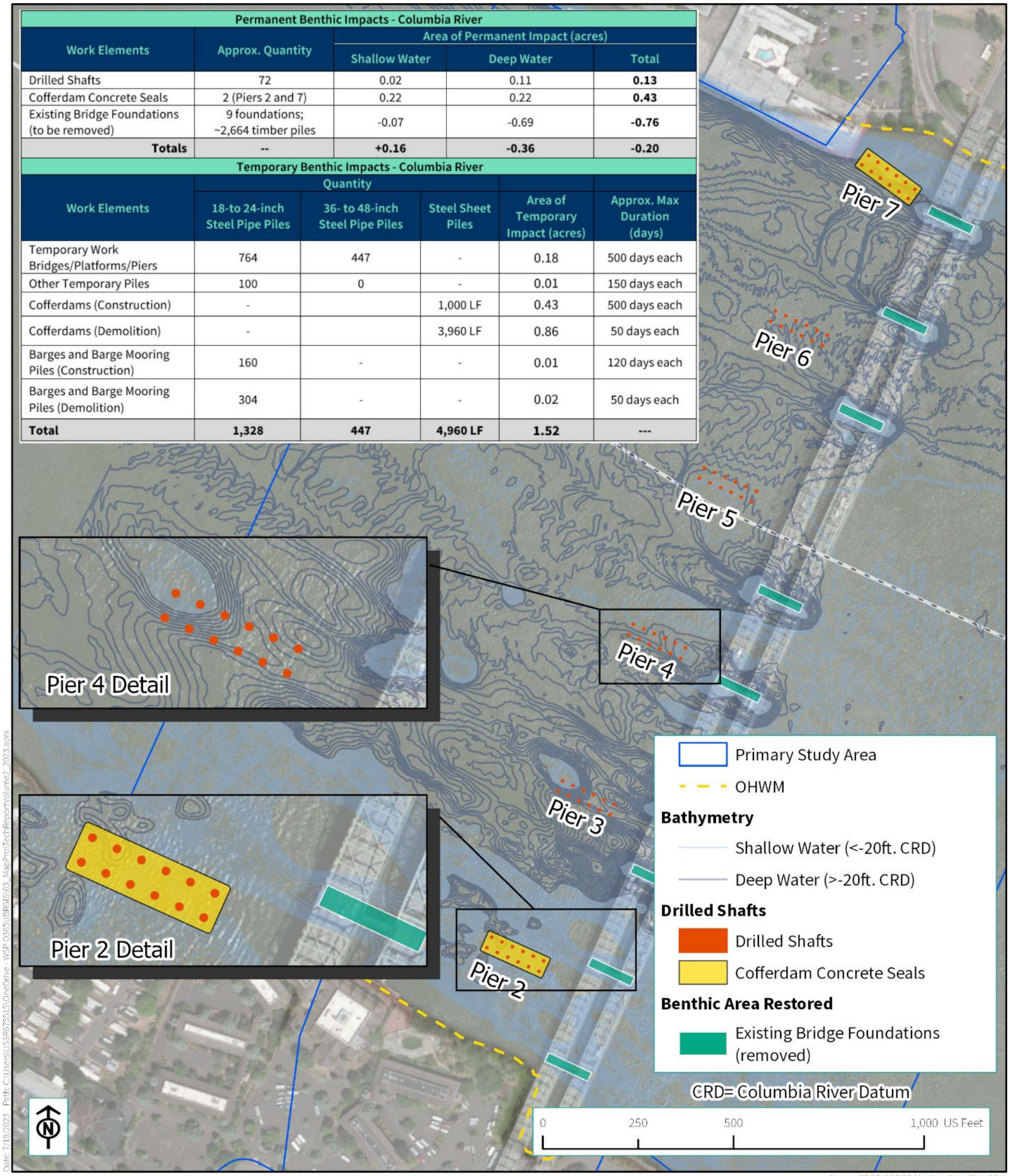
4.2.1.1 Permanent Impacts to Sensitive Aquatic Habitat

The Modified LPA would result in direct permanent impacts to sensitive aquatic habitats associated with physical changes in the benthic and overwater footprint of the replacement bridges over the Columbia River and North Portland Harbor and from the removal of the existing bridges. Table 4-1 summarizes the unavoidable permanent aquatic habitat impacts associated with the Modified LPA. Figure 4-1 through Figure 4-4 identify the areas where long-term impacts to sensitive aquatic habitats are likely to occur in the Columbia River and North Portland Harbor as a result of the Modified LPA. These effects are discussed below.

Table 4-1. Permanent Benthic Habitat and Overwater Shading Aquatic Impacts Summary

Water Body	Impact Type	Impact from New Bridges (Shallow Water) (acres)	Restored Area from Removal of Existing Bridges (Shallow Water) (acres)	Net Change (Shallow Water) (acres)	Impact from New Bridges (Deep Water) (acres)	Restored Area from Removal of Existing Bridges (Deep Water) (acres)	Net Change (Deep Water) (acres)	Total Net Change
Columbia River	Benthic Habitat Impact	0.24	-0.07	+0.17	0.33	-0.69	-0.36	**-0.19**
	Overwater Shading (Water Surface)	+0.15	0	+0.15	+0.89	0	+0.89	**+1.04**
	Overwater Shading (Elevated Deck)	+1.44	-0.64	+0.80	+9.73	-6.44	+3.29	**+4.09**
North Portland Harbor	Benthic Habitat Impact	0.34	-0.28	+0.06	0	0	0	**+0.06**
	Overwater Shading (Water Surface)	0	0	0	0	0	0	**0**
	Overwater Shading (Elevated Deck)	+8.70	-4.57	+4.13	0	0	0	**+4.13**
Totals	Benthic Habitat Impact	+0.58	-0.35	**+0.23**	0.33	-0.69	**-0.36**	**-0.13**
	Overwater Shading (Water Surface)	+0.15	0	**+0.15**	+0.89	0	**+0.89**	**+1.04**
	Overwater Shading (Elevated Deck)	+10.14	-5.21	**+4.93**	9.73	-6.44	**3.29**	**+8.22**

Figure 4-1. Benthic Habitat Impacts – Columbia River



Permanent Benthic Impacts - Columbia River

Work Elements	Approx. Quantity	Area of Permanent Impact (acres)		
		Shallow Water	Deep Water	Total
Drilled Shafts	72	0.02	0.11	**0.13**
Cofferdam Concrete Seals	2 (Piers 2 and 7)	0.22	0.22	**0.43**
Existing Bridge Foundations (to be removed)	9 foundations; ~2,664 timber piles	-0.07	-0.69	**-0.76**
Totals	**--**	**+0.16**	**-0.36**	**-0.20**

Temporary Benthic Impacts - Columbia River

Work Elements	Quantity			Area of Temporary Impact (acres)	Approx. Max Duration (days)
	18-to 24-inch Steel Pipe Piles	36- to 48-inch Steel Pipe Piles	Steel Sheet Piles		
Temporary Work Bridges/Platforms/Piers	764	447	-	0.18	500 days each
Other Temporary Piles	100	0	-	0.01	150 days each
Cofferdams (Construction)	-		1,000 LF	0.43	500 days each
Cofferdams (Demolition)	-		3,960 LF	0.86	50 days each
Barges and Barge Mooring Piles (Construction)	160	-	-	0.01	120 days each
Barges and Barge Mooring Piles (Demolition)	304	-	-	0.02	50 days each
Total	**1,328**	**447**	**4,960 LF**	**1.52**	**---**

Figure 4-2. Benthic Habitat Impacts – North Portland Harbor

Permanent Benthic Impacts – North Portland Harbor

Work Elements	Approx. Quantity	Area of Permanent Impact (acres)		
		Shallow Water	Deep Water	Total
Drilled Shafts	52	0.09	0.00	0.09
Isolation Casing Seals	52	0.25	0.00	0.25
Existing Bridge Foundations (to be removed)	18	-0.28	0.00	-0.28
Totals	--	**+0.06**	**0.00**	**+0.06**

Temporary Benthic Impacts - North Portland Harbor

Work Elements	Quantity			Area of Temporary Impact (acres)	Approx. Max Duration (days)
	18-to 24-inch Steel Pipe Piles	36- to 48-inch Steel Pipe Piles	19-foot Isolation Casings		
Temporary Work Bridges/Platforms/Piers	912	208	-	0.13	850 days each
Other Temporary Piles	100	-	-	0.01	150 days each
Drilled Shaft Isolation Casings	0	0	52	0.24	50 days each
Barges and Barge Mooring Piles (Construction)	216	-	-	0.02	50 days each
Barges and Barge Mooring Piles (Demolition)	100	-	-	0.01	50 days each
Total	**1,328**	**208**	**52**	**0.40**	**---**

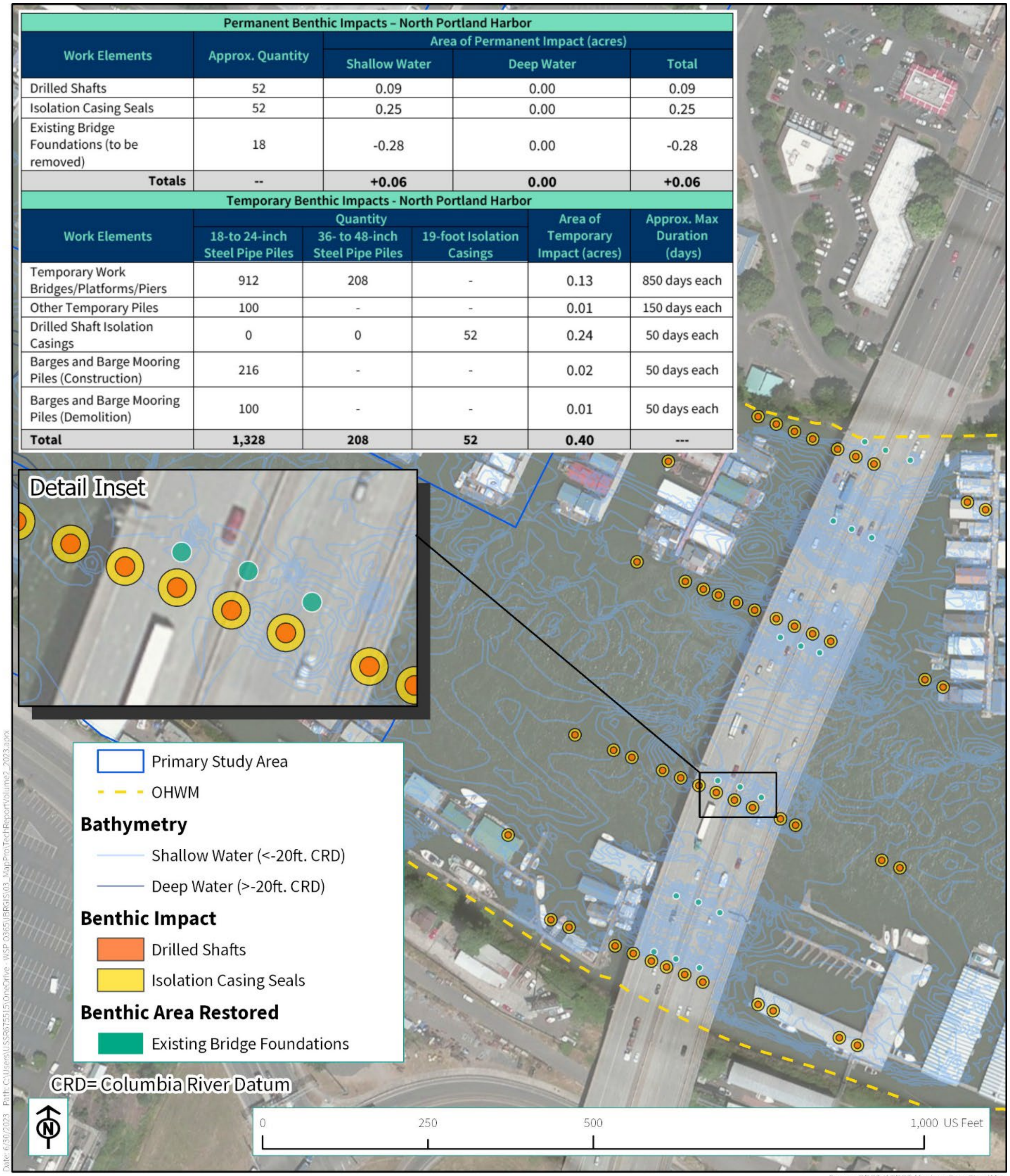


Figure 4-3. Overwater Shading – Columbia River

Overwater Shading - Columbia River			
Work Elements	Area of Permanent Impact (acres)		
	Shallow Water	Deep Water	Total
Water Surface-Level Shading			
Shaft Caps (Single Level, Movable Span)	0.15	0.89	**+1.04**
Elevated Bridge Deck			
Proposed Bridge Deck (Single Level, 2 Auxiliary Lanes)	1.44	9.73	**11.17**
Existing Bridge Deck (to be removed)	-0.64	-6.44	**-7.08**
Bridge Deck Subtotal	**+0.80**	**+3.29**	**+4.09**

Temporary Overwater Shading - Columbia River		
Work Elements	Area of Temporary Overwater Shading (acres)	Approx. Max Duration (days)
Temporary Work Bridges/Platforms/Piers	4.23	500 days each
Suspended Shaft Cap Isolation System	0.25	120 days each
Barges and Barge Mooring Piles (Construction)	2.75	120 days each
Barges and Barge Mooring Piles (Demolition)	0.65	50 days each
Total	**7.89**	---

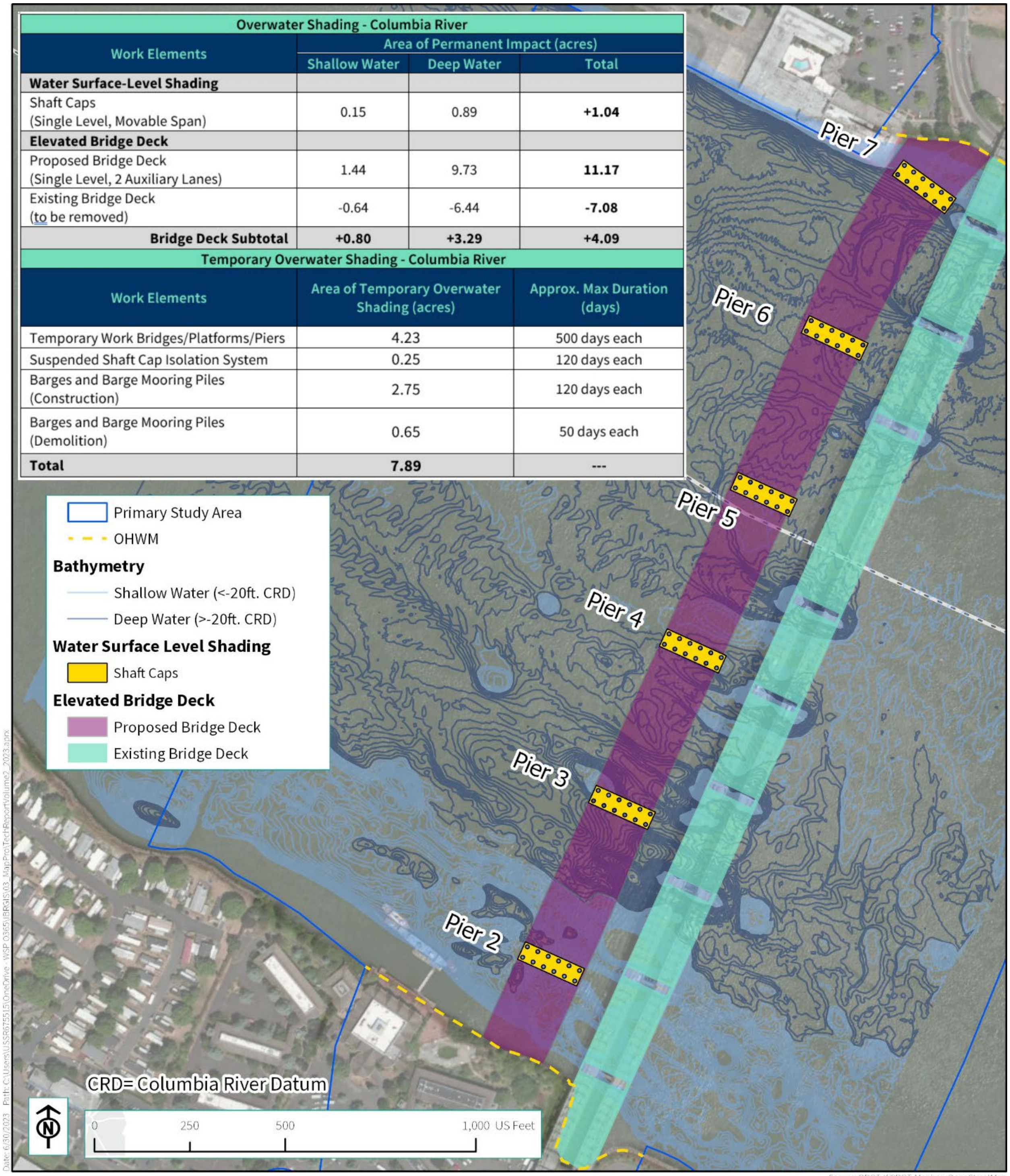
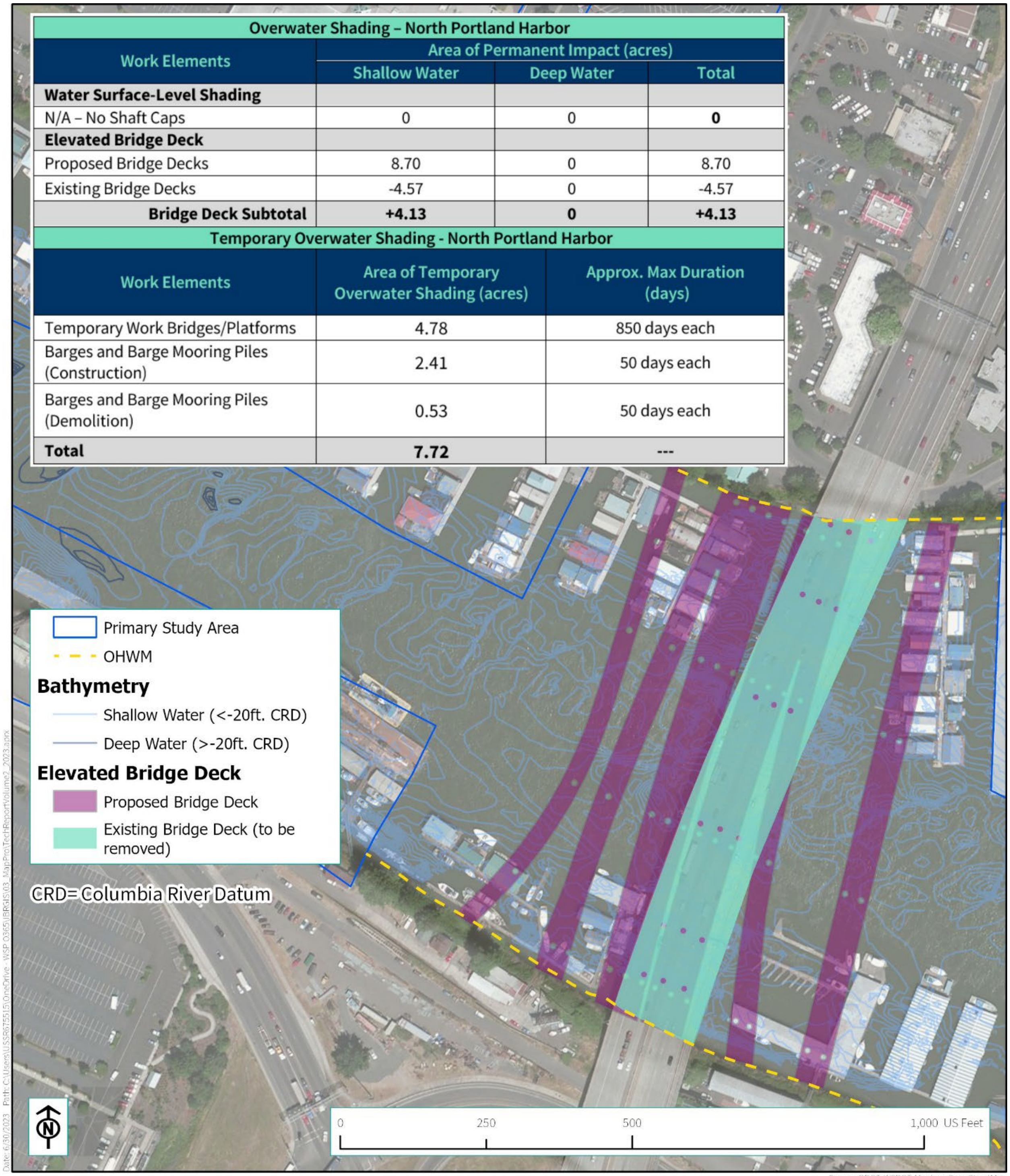


Figure 4-4. Overwater Shading – North Portland Harbor



Overwater Shading – North Portland Harbor			
Work Elements	Area of Permanent Impact (acres)		
	Shallow Water	Deep Water	Total
Water Surface-Level Shading			
N/A – No Shaft Caps	0	0	**0**
Elevated Bridge Deck			
Proposed Bridge Decks	8.70	0	8.70
Existing Bridge Decks	-4.57	0	-4.57
Bridge Deck Subtotal	**+4.13**	**0**	**+4.13**

Temporary Overwater Shading - North Portland Harbor		
Work Elements	Area of Temporary Overwater Shading (acres)	Approx. Max Duration (days)
Temporary Work Bridges/Platforms	4.78	850 days each
Barges and Barge Mooring Piles (Construction)	2.41	50 days each
Barges and Barge Mooring Piles (Demolition)	0.53	50 days each
Total	**7.72**	---

Source: ODOT, WSDOT, Mapbox, OpenStreetMap

BENTHIC HABITAT IMPACTS

The Modified LPA would result in new in-water structures that would displace benthic (river bottom) habitat within the Columbia River and North Portland Harbor, as well as the removal of existing in-water structures that would restore areas of benthic habitat. The foundation footprints for the replacement bridges under the Modified LPA would represent a loss of physical benthic substrate for species that rely on aquatic habitats within the primary study area. The extent of the loss of aquatic habitat function is tempered by the relatively low level of existing aquatic habitat function that is currently provided by the benthic habitats at the locations that would be disturbed. It is important to note that the existing Interstate Bridge would remain in place during construction of the new Columbia River bridges; once the new bridges have been constructed, the existing bridge would be demolished.

The foundations for the Modified LPA would be supported on 10-foot-diameter drilled shafts. The replacement bridges would require the installation of approximately 124 shafts (72 in the Columbia River and 52 in North Portland Harbor) that would displace approximately 0.32 acres of benthic habitat (0.13 acres in the Columbia River and 0.19 acres in North Portland Harbor).

The foundations for Piers 2 and 7 for the Columbia River bridges would be constructed within sheet pile cofferdams, which have a permanent concrete seal at the base to allow these to be dewatered for construction. Similarly, the drilled shafts for the North Portland Harbor bridges would be constructed within 19-foot-diameter isolation casings, which would have a similar permanent concrete seal. These concrete seals would also represent permanent benthic impacts, as they would remain in place when the temporary structures are removed. These concrete seals would displace approximately 0.69 acres of benthic habitat (0.44 acres in the Columbia River and 0.25 acres in North Portland Harbor).

The existing Interstate Bridge and North Portland Harbor bridges would be removed once the replacement bridges are in place. The existing Interstate Bridge is founded on a total of nine in-water piers, which consist of concrete piers supported on a network of timber piles. It is estimated that there are approximately 2,664 timber piles supporting the in-water foundations; the foundations currently displace a total of approximately 0.76 acres of existing benthic habitat. The existing North Portland Harbor bridge is founded on a total of six existing in-water piers, each supported by a network of steel piles and a concrete pile cap that is located at the benthic surface of the riverbed. These structures currently displace a total of approximately 0.28 acres of existing benthic habitat.

Together, the existing bridges over the Columbia River and North Portland Harbor currently displace approximately 1.04 acres of benthic habitat. The proposed replacement bridges would displace only approximately 0.91 acres of benthic habitat. As such, the Modified LPA would result in a net restoration of approximately 0.13 acres of benthic habitat in total—a net impact of approximately 23 acres of shallow-water habitat and a net restoration of approximately 0.36 acres of deep-water habitat.

Permanent benthic habitat loss directly impacts species that rely on aquatic habitats. Benthic habitat loss can affect primary productivity, as it eliminates substrate that aquatic vegetation and benthic microorganisms can occupy. Structures that occupy benthic habitat can also represent impediments to foraging and migration.

Shallow water is of particular importance in the life history of anadromous salmonids for migration, feeding, holding, rearing, and predator avoidance (Simenstad et al. 1982). LCR Chinook and Columbia River chum migrate as subyearlings and are particularly dependent on nearshore, shallow-water areas during outmigration (Bottom et al. 2005). However, these species can and do occupy other parts of the channel. While these fish are highly dependent on shallow water and are most likely to occur there, they do not occur exclusively in the nearshore and may potentially be present across the entire cross section of the channel (Bottom et al. 2005).

Other juvenile salmonids outmigrate after they reach the yearling stage or older. These species are frequently found in both deep and shallow-water habitats, indicating that these individuals do not show preferential use of a particular water depth (Bottom et al. 2005), though they may seek out these areas for resting or as flow refugia during high velocity events. Fish that migrate as yearlings or older tend to move quickly and occupy deeper water habitats, but all use the nearshore to some extent during their outmigration (Bottom et al. 2005; Carter et al. 2009). These juveniles may alternate active migration in deeper water interspersed with periods of holding and resting in shallow-water and/or low-velocity areas (Bottom et al. 2005).

Adult salmonids generally migrate within deeper water habitats near the mid-channel. While they may occur in shallow-water habitat, they are not particularly dependent on it. They may seek out shallow-water areas for resting or as flow refugia during upstream migration (Bottom et al. 2005).

Changes to benthic habitats would represent a change in the physical habitat for both adult and juvenile salmonids. The extent of the effect would be minor, given the small area that would be affected and the net area that would be restored.

Bull trout subadults and adults may be present within the study areas during migration and holding. However, bull trout are not known or expected to occur frequently in this portion of the Columbia River, and effects on bull trout from changes to benthic habitat (new pier locations) and overwater shading would be insignificant.

Adult green sturgeon are similarly not known or expected to occur frequently in this portion of the Columbia River, and effects on green sturgeon from changes to benthic habitat would be insignificant.

White sturgeon, Pacific eulachon, Pacific lamprey, and river lamprey are all known to use both shallow and deep-water habitat in the Columbia River within the study areas. White sturgeon are more closely associated with deep-water habitats but use shallow-water habitats during periods of high activity. Changes to benthic habitats would represent a change in the physical benthic substrate for these species. The extent of the effect would be minor, given the small area that would be affected and the net area that would be restored.

Native resident fish such as sculpins, threespine sticklebacks, dace, and suckers spend the majority of their life cycle in shallow-water habitat, using emergent vegetation for cover, spawning, and foraging. Because their life-history requirements include the use of emergent vegetation and other types of cover (e.g., rocks and overhanging trees), their distribution even within shallow-water areas is relatively limited to depths of only a few feet where emergent vegetation is present. These fish species typically forage on prey items (e.g., benthic invertebrates, algae, and detritus) that also depend on emergent vegetation, or at least are present at depths at which primary productivity is high. These species may migrate locally among habitat areas in the study area in response to seasonal flows, water temperatures, life stage, and temporal cycles (e.g., moving between various depths according to time of day). Changes to benthic habitats would represent a change in the physical habitat for these resident fish. The extent of the effect would be minor, given the small area that would be affected and the area that would be restored.

Changes to benthic habitats would not affect habitat suitability for Steller sea lion, California sea lion, and harbor seal. These species transit the Columbia River within the study areas but are not closely associated with benthic habitats.

Changes to benthic habitats would represent a change in the physical habitat for freshwater invertebrates within the study areas. The extent of the effect would be minor, given the small area that would be affected and the net area that would be restored, the unlikely presence of these species, and the low degree of habitat suitability within the Columbia River and North Portland Harbor.

OVERWATER SHADING

The Modified LPA would result in new overwater structures that would cast shading on the water surface within the Columbia River and North Portland Harbor, as well as the removal of existing structures that would remove sources of overwater shading.

Water Surface-Level Shading

The permanent overwater structures that are expected to have potential effects on aquatic habitat function for ESA-listed species are the shaft caps for the Columbia River bridges, which are located at the water's surface. For the Modified LPA, these shaft caps would result in approximately 1.04 acres of new solid overwater coverage, approximately 0.15 acres of which would be located in shallow water habitats and approximately 0.89 acres would be over deep-water areas. The North Portland Harbor bridges would not have shaft caps at the water's surface.

Elevated Bridge Decks

The replacement bridges would also result in new overwater shading from the elevated bridge decks and removal of elevated shading from the existing bridge decks; however, the height of the deck limits the effect on aquatic habitat function as described in the sections below.

The Columbia River bridges would represent approximately 11.17 acres of new elevated overwater coverage, and the removal of the existing Interstate Bridge would remove approximately 7.08 acres of existing overwater coverage. The new North Portland Harbor bridges would represent approximately

8.70 acres of new elevated overwater coverage, and the removal of the existing North Portland Harbor bridge would remove approximately 4.57 acres of existing overwater coverage.

In total, the Modified LPA would result in a net increase of up to approximately 8.22 acres of elevated overwater coverage.

The primary effects on aquatic habitat function associated with shading from overwater structures are the potential for: 1) effects on aquatic vegetation and reduced primary productivity and 2) reduced habitat suitability for aquatic species, particularly juvenile salmonids (Nightingale and Simenstad 2001). At the location of the proposed new bridges, there is limited aquatic vegetation along the shoreline of the Columbia River and effects on aquatic vegetation, if any, would be minimal.

Overwater shading affects aquatic habitat suitability for fish, in particular for migrating and rearing juvenile salmonids. Juvenile salmonids rely on nearshore habitats during migration and rearing, and nearshore shading can affect patterns of movement and can also provide habitat for both native and non-native predatory fish species such as northern pikeminnow, largemouth bass, smallmouth bass, black crappie, white crappie, and walleye.

Several factors can reduce the potential effects associated with overwater shading to aquatic habitat function that could otherwise occur. These include the height of the structure, the orientation of the structure, the density of the piling, and the piling material and reflectivity (Nightingale and Simenstad 2001).

Increased structure height diminishes the intensity of shading by providing a greater distance for light to diffuse and refract around the bridge deck surface. The existing and proposed bridge spans in the Columbia River are more than 30 feet above the water surface and are therefore not likely to create dense shade on the water surface. For this reason, shade cast by the Modified LPA's bridge structures over the Columbia River is unlikely to affect aquatic habitat function. The Columbia River bridges under the Modified LPA are oriented roughly north–south, so the shadows they cast would be constantly moving throughout the day and the shape and intensity of shading would not be a solid dark area but a more diffuse irregular shape. This reduces the extent of the functional impact of the shading.

Juvenile and subyearling salmonids are highly dependent on shallow-water habitats, may stray or be carried into deeper water while avoiding densely shaded areas, and may be subject to effects on migration timing or predation exposure. Adult salmonids and larger juveniles of the yearling age class commonly use deep-water habitat during migration and are less susceptible to these effects. While the shaft caps of the proposed Columbia River bridges would represent a source of new overwater shading, the shaded area would be small relative to the amount of available habitat in the vicinity. Salmonids of all age classes would have access to suitable habitats outside the shaded areas and would be able to avoid the densely shaded areas under the shaft caps with no appreciable effect on migration or predation risk. Nighttime migration would be unaffected.

Overwater shading is not known or expected to measurably or significantly affect habitat suitability for other fish species in the lower Columbia River. Effects on bull trout would be minimal, as they are not known or expected to occur within the primary study area, and the only life stages that would potentially be present would be migrating adults and subadults. Green sturgeon and white sturgeon are typically closely associated with deep-water portions of the Columbia River where shading is not a concern. Migrating adult eulachon could be affected by shading in the same ways that juvenile salmonids are, though this effect has not been formally documented. Larval eulachon do not have volitional movement and are therefore not likely affected by overwater shading. Pacific and river lamprey are not known or expected to be affected by overwater shading. Adult, juvenile, and larval lamprey migrate primarily at night.

Marine mammals and aquatic invertebrates that use the aquatic habitats within the study areas would not be affected by overwater shading associated with the Modified LPA.

FLOODPLAIN FILL

New fill placement within the floodplain can affect aquatic habitat suitability by affecting peak and base flow conditions and by altering hydrodynamic conditions such as scour. The Modified LPA's location on the Columbia River, where flows are regulated in part by upstream dams, makes these potential effects less pronounced.

The 100-year floodplain elevation within is at approximately +32 feet North American Vertical Datum of 1988. The extent of functional floodplain habitat below this elevation within the area that would be disturbed by the Modified LPA is relatively limited given the degree of streambank armoring on both sides of the Columbia River. In addition, most of the land south of North Portland Harbor is isolated from the active floodplain by an existing system of levees.

ODOT's Federal-Aid Highway Program (FAHP) Biological Opinion (BO) establishes fluvial performance standards for bridge replacement projects seeking coverage under that programmatic consultation. While these standards do not specifically apply to the Modified LPA, they are applicable guiding principles for avoiding impacts to floodplain function. The FAHP BO fluvial performance standards are based in part on the concept of maintaining the physical and biological processes associated with a "functional floodplain." The FAHP BO defines the functional floodplain for constrained river channels such as coinciding with the flood-prone area but notes also that the functional floodplain may be reduced by the presence of natural constrictions, flow regulation, or encroachment of built infrastructure.

The Modified LPA would require both removal and placement of material below the 100-year floodplain elevation. While specific volumes have not yet been calculated, it is anticipated that the net change to habitat function would be insignificant. In 2024, the City of Portland updated its building code and zoning code that apply to development within floodplains. The updates are intended in part to bring the City's code into compliance with the recommendations of the 2016 Federal Emergency Management Agency (FEMA) National Flood Insurance Program BO that was issued by NOAA Fisheries in 2016. The City of Vancouver also regulates fill placement within the floodplain and would require demonstration of no net-rise through their local environmental approval process. Pursuant to Executive Order 11988, a Location Hydraulic Study would be conducted to evaluate potential impacts to the floodplain, and to document the impacts, mitigation measures, alternatives, and findings following the provisions of 23 Code of Federal Regulations 650A.

The Modified LPA would also require both removal and placement of material within the functional floodplain. Specific quantities have only been estimated at this time and would depend substantially on final design and permitting details. It is estimated that the Modified LPA would result in a net increase of approximately 55,000 cubic yards of material within the functional floodplain. Most of this net increase would be the result of the pile shaft caps in the Columbia River bridge, which would be approximately 20 feet thick, and most of which would be below the OHWM elevation. Despite this increase, the Modified LPA would fully comply with applicable requirements to maintain floodplain function as described above and would maintain floodplain function and hydrologic processes at the site.

Given the limited extent of functional floodplain within the area that would be disturbed by the Modified LPA, and the regulatory requirements to balance cut and fill within the floodplain and to maintain or improve floodplain function, the effects on floodplain function from the Modified LPA are expected to be minimal.

4.2.1.2 Hydraulic Shadowing

Hydraulic shadowing may affect habitat suitability for some species of fish by creating low-velocity eddies that have the potential to increase exposure to predation by both native and non-native predatory fish species (e.g. northern pikeminnow, largemouth bass, smallmouth bass, black crappie, white crappie, and walleye) or piscivorous birds. Hydraulic shadowing can also potentially interfere with fish movement patterns and may alter sediment transport.

A detailed assessment of the hydraulic shadow associated with the existing and replacement bridges was conducted for the CRC project (DEA 2006). Given the similarity of the design of the in-water foundations for the replacement bridges, the effects on aquatic habitat function associated with hydraulic shadowing are assumed to be similar to those modeled and described for the CRC project.

The analysis conducted for the CRC project was based on flow velocities during a 100-year flood event. During a 100-year flood event, the analysis indicated that typical (unshadowed) flows in the mainstem and North Portland Harbor would be approximately 5 feet per second (fps). The hydraulic shadow associated with the existing Columbia River bridges extends between 200 to 1,100 feet downstream of the existing piers, with velocities in the shadow ranging from 0 to 3 fps. It was estimated that the hydraulic shadow associated with the piers for the replacement Columbia River bridges under similar events would extend up to approximately 1,600 feet downstream of each pier, with velocities in the shadow remaining in the 0 to 3 fps range. However, due to the reduction in the total number of piers in the water, there would also be more unaffected area between piers.

The hydraulic footprint was not modeled for the existing North Portland Harbor bridge (DEA 2006). However, it was concluded that the hydraulic shadow would likely increase in length given the increase in the number of shafts and the width of the proposed supporting piers. It was estimated that the hydraulic shadow of the completed North Portland Harbor bridges would extend up to approximately 400 feet downstream of each pier, with velocities in the shadow ranging from 0 to 2 fps.

Aquatic species and their life stages that may be affected by an increase in hydraulic shadowing from the replacement bridges with the Modified LPA include juvenile salmonids, adult and juvenile Pacific eulachon, adult and juvenile Pacific lamprey and river lamprey, and all life stages of other native resident fish. In general, hydraulic shadowing and resulting low-velocity areas have the potential to delay outmigration or otherwise affect patterns of movement for some species of fish. These delays can increase exposure to factors that may decrease survival including predation, disease, poor water quality, and thermal stress. Migration timing delays may also deplete energy reserves and disrupt arrival times in the lower estuary. The latter may cause salmonids or other species to arrive in the estuary when predation levels are high and/or prey species are limited. The extent of the effect may be reduced in the Columbia River, due to the reduction in the total number of piers in the water, and likely increased within North Portland Harbor, due to the increase in the total number of piers.

Although the size of the hydraulic shadow would increase, the net effect of the change would be insignificant. The range of velocities found in the hydraulic shadow is within the range which fish encounter in the natural environment. Therefore, no species or life stages are expected to become trapped or significantly delayed by the hydraulic shadow. Additionally, none are likely to be directed toward or away from shallow-water habitat because the structures neither pose a complete physical blockage to the shallow-water habitat, produce water velocities low enough to trap fish, nor produce velocities high enough to direct fish into deeper water. While it is possible that some individuals may be subject to increased exposure to predation as a result of the increase in hydraulic shadowing associated with the replacement bridges under the Modified LPA, is anticipated that the net effect of the change would be insignificant given the relatively small area that would be affected by the change.

The change in the hydraulic shadow from the replacement bridges with the Modified LPA is not expected to increase predation on adult salmon and steelhead, adult or subadult bull trout, green sturgeon, or white sturgeon. These species and life stages are generally of sufficient size to be unaffected by the slight change in hydraulic conditions within the hydraulic shadow, and predation on fish of these size classes is rare. Additionally, because of the extremely low numbers of bull trout and green sturgeon in the study area, exposure risk to this effect is discountable for these two species.

Increased hydraulic shadowing may also benefit salmonids by creating areas of velocity refugia for both adults and juveniles during periods of high flow. Velocity refugia allow fish to rest and replenish energy reserves. Without such resting areas, migrating adults use larger amounts of energy, posing risks for spawning success (Brown and Geist 2002). Again, given the relatively small area that would be affected by the change in hydraulics, the extent to which this change would benefit habitat suitability for aquatic species is probably slight and therefore insignificant.

4.2.1.3 Stormwater Effects on Water Quality and Water Quantity

Stormwater runoff from roads conveys pollutants to surface waterbodies, sometimes at concentrations that are toxic to fish (Spence et al. 1996). Stormwater runoff from roads is known to contain pollutants such as hydrocarbons and metals, which could reach aquatic systems and degrade water quality. The primary pollutants of concern to aquatic species and habitats have historically been heavy metals (zinc and copper) and total suspended solids (turbidity).

Stormwater can also deliver other pollutants that accumulate on roadway surfaces. These can include petroleum hydrocarbons, excess nutrients, pesticides, and other trace pollutants. These pollutants can be toxic to fish even at very low concentrations. Additionally, current research indicates that adult and juvenile coho salmon are particularly vulnerable to lethal effects of exposure to a chemical known as 6PPD-q, which is a chemical derivative of 6PPD, an organic chemical that is widely used as an antiozonant and antioxidant in rubber tires (Ecology 2022a; Lo et al. 2023). Related research from

Canada suggests that Chinook salmon and steelhead could potentially be negatively affected by 6PPD-q (Brinkmann et al. 2022).

Many stormwater pollutants are persistent in the aquatic environment, travel long distances in solution or adsorbed onto suspended sediments, and may become remobilized or re-enter solution as they move through the system. They may also persist in streambed substrates and be mobilized during high-flow events. Some of these pollutants may also persist and accumulate in the tissues of aquatic species, either directly or via biomagnification. For this reason, effects associated with stormwater pollutants in riverine systems have the potential to affect aquatic species and habitats not only where they enter the surface waters but also downstream.

Stormwater-delivered pollutants can affect the physiological or behavioral performance of fish and other aquatic species in ways that range from reduced growth and reproduction, reduced migratory success, and direct mortality at sufficient concentrations. The likelihood and extent of effects on fish and other aquatic species from the discharge of roadway pollutants to surface waters can vary spatially and temporally, and are dependent upon external variables such as background water-quality conditions, life stage of the fish, duration of exposure, concentration and relative toxicity of the pollutants, and concurrent discharges and/or background levels of other contaminants.

Most of the stormwater runoff from existing contributing impervious area (CIA) within the primary study area is currently untreated. At present, approximately 19.2 acres out of the 177.6 acres of existing CIA receives water quality treatment or is infiltrated. Stormwater from the existing Columbia River and North Portland Harbor bridges currently passes directly to the aquatic environment untreated. Similarly, contaminants from vehicles using these existing bridges (fuel, oil, lubricants, trace heavy metals from brake pads, etc.) currently pass directly to the aquatic environment, uncaptured and untreated.

Stormwater from post-project CIA associated with the Modified LPA would be treated to current stormwater treatment standards. Construction of the Modified LPA would add approximately 29.6 acres of CIA, resulting in a post-project net total of 207.2 acres of CIA. Runoff from 100% of the post-project CIA would be treated or infiltrated.

The addition of 29.6 acres of CIA may reduce natural infiltration rates and increase stormwater pollutants loads of suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear from brake pads, bearings, metal plating, and engine parts. However, untreated impervious surface area would be reduced by approximately 156.4 acres.

Table 4-2 provides a summary of changes in CIA and stormwater treatment associated with the Modified LPA.

Table 4-2. Changes in Impervious Area and Stormwater Treatment associated with the Modified LPA

CIA	No-Build Alternative (acres)	Modified LPA (acres)	Net Change (acres)
Treated	0.0	189.7	**+189.7**
Infiltrated	21.2	17.5	**-3.7**
Untreated	156.4	0	**-156.4**
Totals	**177.6**	**207.2**	**+29.6**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

Stormwater treatment associated with the Modified LPA would be consistent with the ODOT Hydraulics Design Manual (ODOT 2014). While a detailed stormwater treatment design has not yet been developed for the replacement bridge, the stormwater treatment provided under the Modified LPA would, at minimum, provide treatment for all CIAs and would meet the treatment standards established by the federal, state, and/or local agencies with jurisdiction.

The preliminary stormwater treatment design for the Modified LPA assumes that water quality treatment would be provided primarily through bioretention facilities. These treatment BMPs would sequester pollutants before treated stormwater is ultimately infiltrated or discharged to a surface waterbody. It is important to note that even treated stormwater contains some level of pollutants. Treatment BMPs are not 100% efficient and would not completely eliminate discharges of pollutants to receiving waterbodies. Also, BMPs are sized to accommodate a design storm and events that exceed that design storm would result in treatment BMPs being unable to treat all stormwater that passes through.

In addition to the proposed water quality treatment, flow control treatment would be provided for runoff that discharges to Burnt Bridge Creek. The Columbia River, North Portland Harbor, and the Columbia Slough are exempt from requirements for flow control treatment. This means that stormwater from impervious surfaces that drain to these waterbodies would not require formal flow control treatment. However, the bioretention BMPs would likely still provide some degree of flow control function.

COLUMBIA SLOUGH

Table 4-3 summarizes the changes in impervious area and proposed stormwater scenario associated with the portion of the Modified LPA that drains to the Columbia Slough watershed. Currently, stormwater runoff from approximately 35.5 acres of existing CIA within the primary study area in this watershed receives no water quality treatment, and approximately 3.0 acres of existing CIA is infiltrated.

The Modified LPA would result in approximately 2.2 acres of net new CIA in this watershed. Stormwater from all 40.7 acres of post-project CIA within this watershed would be treated prior to being released to surface waters.

Table 4-3. Changes in Impervious Area and Stormwater Treatment Associated with the Modified LPA – Columbia Slough

CIA	No-Build Alternative (acres)	Modified LPA (acres)	Net Change (acres)
Treated	0	40.7	**40.7**
Infiltrated	3.0	0	**-3.0**
Untreated	35.5	0	**-35.5**
Totals	**38.5**	**40.7**	**+2.2**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

Addition of impervious surface to this stormwater drainage area would have no effect on flows in the Columbia Slough. The Columbia Slough is a flow control-exempt waterbody, meaning that addition of impervious surface in this area is not expected to degrade the flow regime and, therefore, the stormwater treatment facilities in this drainage area do not require flow control. Discharges to the Columbia Slough are regulated by a UFSWQD pump system designed to handle up to the 100-year event. Because the pumps regulate flows between the outfalls and the Columbia Slough, additional runoff from these areas would not affect flows during the large majority of events and the inclusion of flow control in treatment facilities would be redundant.

FAIRVIEW CREEK

Table 4-4 summarizes the changes in impervious area and proposed stormwater scenario associated with the portion of the Modified LPA that drains to the Fairview Creek watershed. Currently, stormwater runoff from all approximately 5.3 acres of the existing CIA within the primary study area in this watershed is infiltrated.

The Modified LPA would increase the total impervious surface area by 1.5 acres compared to the No-Build Alternative. Stormwater from all 6.8 acres of post-project CIA within this watershed would be infiltrated.

Table 4-4. Changes in Impervious Area and Stormwater Treatment Associated with the Modified LPA – Fairview Creek

CIA	No-Build Alternative (acres)	Modified LPA (acres)	Net Change (acres)
Treated	0.0	0.0	0.0
Infiltrated	7.3	6.8	-0.5
Untreated	0.0	0.0	0.0
Totals	**7.3**	**6.8**	**-0.5**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

Because the City of Gresham's requirements for stormwater treatment and flow control must be met for this portion of the Modified LPA, runoff from all CIA within the expansion area would be infiltrated. The infiltration techniques would comply with the City of Gresham's stormwater management requirements and would protect and/or improve the quality and quantity of existing groundwater flows. There would be no discharge to any surface waterbody, even during events that exceed the design storm. During such events, stormwater would pond in a nearby field and would infiltrate. Because there would be no discharge to a surface waterbody, this element of the Modified LPA would have no effect on aquatic habitats or on the water quality of Fairview Creek.

COLUMBIA RIVER AND NORTH PORTLAND HARBOR

Table 4-5 summarizes the changes in impervious area and proposed stormwater scenario associated with the portion of the Modified LPA that drains to North Portland Harbor and to the portion of the Columbia River in Oregon. Currently, no water quality treatment is provided for approximately 45.8 acres of existing CIA within the primary study area in this watershed.

The Modified LPA would result in approximately 5.8 acres of net new CIA in this watershed. Stormwater from all 51.6 acres of post-project CIA within this watershed would be treated prior to being released to surface waters.

Table 4-5. Changes in Impervious Area and Stormwater Treatment associated with the Modified LPA – Columbia River and North Portland Harbor (Oregon)

CIA	No-Build Alternative (acres)	Modified LPA (acres)	Net Change (acres)
Treated	0.0	51.6	51.6
Infiltrated	0.0	0.0	0.0
Untreated	45.8	0.0	-45.8
Totals	**45.8**	**51.6**	**5.8**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

Table 4-6 summarizes the changes in impervious area and proposed stormwater scenario associated with the portion of the Modified LPA that drains to the Columbia River in Washington. Currently, stormwater runoff from approximately 73.4 acres of existing CIA within the primary study area in this watershed receives no water quality treatment, and approximately 3.0 acres of existing CIA is infiltrated.

The Modified LPA would result in approximately 21.0 acres of net new CIA in this watershed. Stormwater from all 97.4 acres of post-project CIA within this watershed would be treated prior to being released to surface waters.

Table 4-6. Changes in Impervious Area and Stormwater Treatment associated with the Modified LPA – Columbia River (Washington)

CIA (acres)	Existing Conditions (No-Build Alternative)	Modified LPA	Net Change
Treated	0	97.4	**+97.4**
Infiltrated	3.0	0	**-3.0**
Untreated	73.4	0	**-73.4**
Totals	**76.4**	**97.4**	**21.0**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

BURNT BRIDGE CREEK

Table 4-7 summarizes the changes in impervious area and proposed stormwater scenario associated with the portion of the Modified LPA that drains to the Burnt Bridge Creek watershed. Currently, stormwater runoff from approximately 1.7 acres of existing CIA within the primary study area in this watershed receives no water quality treatment, and approximately 7.9 acres of existing CIA is infiltrated.

The Modified LPA would result in approximately 1.1 acres of net new CIA in this watershed. Stormwater from all 10.7 acres of post-project CIA within this watershed would be infiltrated, which would also provide flow control treatment for this CIA. As such, the addition of impervious surface to this stormwater drainage area would have no effect on flows in Burnt Bridge Creek.

Table 4-7. Changes in Impervious Area and Stormwater Treatment associated with the Modified LPA – Burnt Bridge Creek

CIA	No-Build Alternative (acres)	Modified LPA (acres)	Net Change (acres)
Treated	0	0	**0**
Infiltrated	7.9	10.7	**2.8**
Untreated	1.7	0	**-1.7**
Totals	**9.6**	**10.7**	**1.1**

CIA = contributing impervious area; LPA = Locally Preferred Alternative

EFFECTS SUMMARY

Because many stormwater pollutants can persist in the aquatic environment and can be mobilized downstream, the area that could be affected by stormwater from the Modified LPA includes the mainstem of the Columbia River and North Portland Harbor from the location of the bridge downstream to the mouth. It also includes portions of Burnt Bridge Creek and Columbia Slough downstream of stormwater outfalls proposed with the Modified LPA. Because stormwater-related effects would occur year-round basis, all species and life stages of fish and other aquatic species that use the habitats within these waterbodies would be exposed to the stormwater effects.

As described above, the Modified LPA would provide a high level of water quality treatment and would be expected to result in a net beneficial effect on water quality. The Modified LPA would add approximately 29.6 acres of CIA but would treat or infiltrate 207.2 acres of CIA, including 156.4 acres of existing CIA that is currently untreated. This represents treatment of approximately seven times the area of net new CIA associated with the Modified LPA.

Runoff from 100% of the post-project CIA would be treated or infiltrated. It is assumed that water quality treatment would be provided, where space allows, using bioretention facilities. Where space is not available for bioretention treatment, either biofiltration swales or compost-amended vegetated filter strips would most likely be used.

One reason for prioritizing the use of biofiltration BMPs is their effectiveness at reducing levels of 6PPD-q in stormwater. Ecology funded a literature review on the effectiveness of stormwater treatment BMPs to reduce levels of tire-derived chemicals including 6PPD-q (Ecology 2022b). The published findings of this study (Ecology 2022b) indicated that the flow and treatment BMPs that provide the highest levels of reduction in 6PPD and 6PPD-q are:

- Dispersion BMPs.
- Infiltration BMPs.
- Biofiltration BMPs that use bioretention soil media or compost (where the underlying soils meet soil suitability criteria).
- Other BMPs that provide the treatment process sorption.

The literature review also notes the importance of source control (design considerations that separate a source of pollutants from stormwater). Even treated stormwater contains some level of pollutants. Treatment BMPs are not 100% efficient and would not completely eliminate discharges of pollutants to receiving waterbodies. Also, BMPs are sized to accommodate a design storm, and events that exceed that design storm would result in treatment BMPs being unable to treat all stormwater that passes through.

Quantifying the extent of the impact or benefit to aquatic habitat function that would be provided by the proposed stormwater treatment is difficult. The Modified LPA would create new impervious surface that would represent a new source of stormwater pollutants but would provide substantial water quality treatment for new, existing, and rebuilt impervious surfaces. The existing bridges would also be removed, which would remove a potentially significant source of direct discharge of stormwater pollutants from the system. For these reasons, the proposed stormwater treatment scenario could result in a net benefit to water quality in the action area.

During storm events that exceed the design storm for the treatment BMPs, fish and other aquatic species in the primary study area will continue to be exposed to pollutants in untreated stormwater, but because of the significant increase in the level of treatment proposed for existing impervious surfaces, the total exposure level is expected to be less than is currently experienced.

Salmon and steelhead, bull trout, green sturgeon, white sturgeon, eulachon, Pacific and river lamprey, and other native resident fish (e.g., sculpins, threespine sticklebacks, suckers, and dace) could be exposed to elevated levels of stormwater pollutants during storm events that exceed the design storm. During such events, pollutants in stormwater would dilute quickly to levels below background conditions, due to the volumes of water present. Therefore, only fish that were present within a few feet of a given outfall during such an event would experience elevated pollutant concentrations. The potential for such exposure is low, though individual fish could be affected.

Bull trout and green sturgeon are less likely to be exposed to pollutants from stormwater in the Columbia River and North Portland Harbor as they are not typically present in the vicinity of stormwater outfalls associated with the Modified LPA. They would, however, be exposed to pollutants that are delivered to the system from stormwater associated with the Modified LPA. The extent of this exposure, given the level of proposed treatment, would be reduced as a result of the Modified LPA.

Steller sea lion, California sea lion, and harbor seal would be present within portions of the Columbia River and North Portland Harbor that would be affected by stormwater runoff associated with the Modified LPA. However, these species are not known or expected to be affected by stormwater pollutants in the same way as fish. These marine mammals use the Columbia River and North Portland Harbor as migratory and foraging corridors and the net beneficial effect on stormwater associated with the Modified LPA would likely result in an improved condition for migrating and foraging marine mammals.

Aquatic invertebrates, including freshwater mussels, would also likely benefit from a net improvement in water quality from the Modified LPA. Individuals could be exposed to elevated levels of stormwater pollutants during storm events that exceed the design storm. During such events, pollutants in stormwater would dilute quickly to levels below background conditions, due to the volumes of water present. Therefore, only individual invertebrates that were present within a few feet of a given outfall during such an event would experience elevated pollutant concentrations.

4.2.1.4 Permanent Overwater Lighting

The literature regarding effects of artificial lighting overwater on aquatic habitat function for salmonids is extensive, but also somewhat inconclusive.

Artificial light sources associated with overwater structures or construction activities have been shown to attract fish and can result in effects associated with delayed migration (Celedonia et al. 2008; Collis et al. 1995). Juvenile salmon have been documented as being attracted to work lights and have also been observed congregating at night near streetlights on floating bridges. Artificial lights can also create sharp boundaries between dark and light areas under water, which in turn, can cause juvenile fish to become disoriented and avoid these areas of sharp light-dark contrast.

Artificial overwater light sources may also provide an advantage to predators such as smallmouth bass, largemouth bass, and northern pikeminnow. If an overwater light source causes juvenile salmonids to congregate, this can improve the ability of predatory species to successfully prey on them. However, it has also been documented that artificial lights may improve prey detection and predator avoidance in some circumstances (Tabor et al. 1998).

The permanent lighting for the Columbia River bridges with the Modified LPA have not yet been designed but is not expected to result in an increase in the amount of light on the water's surface. The existing bridges are lit at night consistent with regulatory and safety requirements. Permanent lighting for the bridge decks would use directional lighting with shielded luminaries to control glare and to direct light onto the bridge deck to the extent practicable. The solid nature of the bridge deck would reduce the amount of light that illuminates the water's surface. The Columbia River bridges would require some lighting for navigation, comparable to the existing bridges. These lights are typically small and dim and are not a source of a high level of lighting.

Species and life stages of aquatic species that may be affected by a change in the permanent overwater lighting under the Modified LPA include adult and juvenile salmon, steelhead, bull trout, Pacific eulachon, Pacific lamprey, river lamprey, and other native resident fish. Green and white sturgeon are not particularly subject to effects of overwater lighting, given their preference for deep-water habitats.

4.2.1.5 Permanent Changes to Avian Predation Pressure

The Columbia River and North Portland Harbor bridges associated with the Modified LPA may have an effect on avian predation in the vicinity of these bridges.

Avian predation of juvenile salmonids is documented as a limiting factor for salmon recovery in the Columbia River basin (LCFRB 2010a). Other species that are likely subject to predation include adult and juvenile Pacific eulachon, and adult and juvenile lamprey. Green and white sturgeon are not particularly subject to avian predation, given their size and preference for deep-water habitats.

Caspian terns, double-crested cormorants, and various gull species are the principal avian predators in the lower Columbia River. The existing Columbia River and North Portland Harbor bridges currently provide perching opportunity for piscivorous birds, though extensive use by terns, cormorants, or other piscivorous birds has not been documented.

The Columbia River and North Portland Harbor bridges associated with the Modified LPA would also provide perching opportunity for piscivorous birds, but it is expected to be comparable to or less than the perching habitat that is available on the existing bridge. The steel superstructure of the existing Interstate Bridges that is located above the bridge deck offers greater opportunities for birds to perch undisturbed. The new Columbia River bridges would likely provide relatively fewer overhead perching opportunities. However, this would depend in part on the final design of the superstructure. Perching opportunity on the replacement North Portland Harbor bridges would be comparable to that associated with the existing North Portland Harbor bridge, though it could be slightly higher given the increase in the total number of structures.

4.2.2 Terrestrial Resources

4.2.2.1 Permanent Impacts to Sensitive Terrestrial Habitats

The Modified LPA would result in the loss of small quantities of sensitive terrestrial habitats. Temporary impacts to these resources are described in Section 5.1.2.1. Table 4-8 summarizes the permanent impacts that would occur to these resources.

Table 4-8. Permanent Impacts to Sensitive Terrestrial Habitats

Permanent Terrestrial Habitat Impacts	Permanent Loss of Sensitive Terrestrial Habitat (acres)
Oregon	
“High” combined riparian/wildlife value habitats	1.12
“Medium” combined riparian/wildlife value habitats	6.20
Wetlands	0.58
Wetland Buffers	7.39
Washington	
Riparian Buffers	0.79
Biodiversity Areas	0.15
Oak Woodlands	<0.01
Wetlands	0
Wetland Buffers	0.06

SENSITIVE TERRESTRIAL HABITATS IN OREGON

In Oregon, sensitive terrestrial habitats include riparian and wildlife habitats designated as having either “high” and “medium” combined values in the City of Portland’s Natural Resources Inventory (NRI), and wetland habitats. These habitats are regulated where they occur within the City’s ezones.

In Oregon, the Modified LPA would result in a permanent loss of approximately 7.32 acres of terrestrial habitats identified as having a “high” or “medium” combined wildlife/riparian value in Portland’s NRI. Approximately 1.12 acres of these are categorized as “high” combined value, and approximately 6.20 acres are characterized as having a “medium” combined value. These impacts would occur primarily within disturbed terrestrial riparian habitats on the shorelines of Hayden Island, on the south shoreline of North Portland Harbor, near the Vanport wetlands, and in a partially forested area south of NE Martin Luther King Jr. Boulevard.

However, it is worth noting that in some locations Portland’s NRI designations extend into paved areas, riprap, and other areas that provide limited riparian or wildlife habitat function. The City is in the process of updating and refining the NRI based on field verification, and updated NRI and Ezone mapping is expected to be published in 2023.

The Modified LPA would also result in approximately 0.58 acres of permanent wetland impacts, and approximately 7.39 acres of wetland buffer impacts in Oregon. Wetlands and wetland buffers within the primary study area are generally located within areas designated as having “high” or “medium” wildlife/riparian value in Portland’s NRI (the designations overlap and are not cumulative). Additional detail regarding wetlands can be found in the IBR Program's Wetlands and Other Waters Technical Report.

The Modified LPA would likely require the removal of trees. Tree removal can affect water temperature, reduce habitat complexity, and lessen the potential for large woody debris (an important component of fish habitat) to accumulate in a watershed over the long term. Riparian areas adjacent to the Columbia River and North Portland Harbor in Oregon are armored with riprap, and provide little riparian function. The Modified LPA would likely require removal of some trees that have established along the riprapped banks. Some tree removal would also be required in other areas mapped as having "high" or "medium" combined wildlife/riparian value in Portland's NRI. Trees in these areas are primarily associated with wetlands and adjacent buffer areas and are not directly associated with a surface water. Any tree removal would be conducted consistent with the City's Title 11 Tree Ordinance.

The Modified LPA would avoid and minimize impacts to riparian areas and other sensitive terrestrial habitats in Oregon consistent with federal, state, and local regulations. Compensatory mitigation would be provided for unavoidable impacts. It is anticipated that the net result would be a net benefit to riparian and terrestrial habitat function in the long term.

Figure 4-5 identifies the areas where the Modified LPA would result in a reduction of sensitive terrestrial habitats in Oregon.

SENSITIVE TERRESTRIAL HABITATS IN WASHINGTON STATE

In Washington State, sensitive terrestrial habitats include those identified by WDFW as Priority Habitats. These include City of Vancouver riparian buffers, biodiversity areas, oak woodlands, wetlands, and wetland buffers.

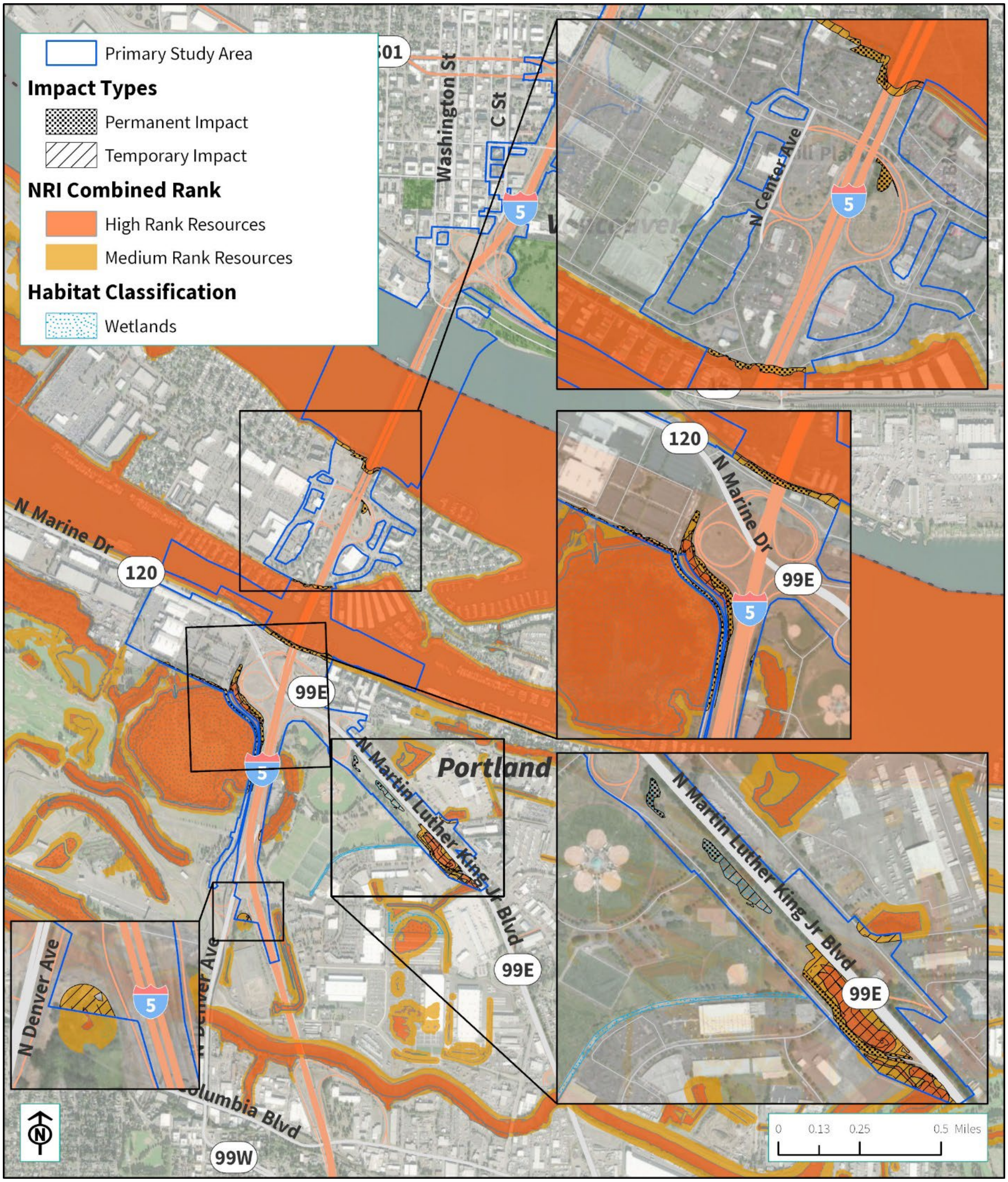
Permanent impacts to sensitive terrestrial habitats in Washington as a result of the Modified LPA would be minimal, as they would occur largely within a developed transportation corridor and the Modified LPA avoids encroaching into sensitive resources, to the extent practicable.

The Modified LPA would result in permanent impacts to approximately 0.79 acres of riparian buffers, approximately 0.15 acres of a designated biodiversity area, and approximately 0.06 acres of wetland buffer (these habitat designations overlap and are not cumulative). Most of this reduction would occur within terrestrial riparian habitat associated with Burnt Bridge Creek, north of SR 500.

Over the long term, a loss of riparian vegetation can reduce habitat complexity, affect water temperature, and reduce the potential for large woody debris recruitment in a watershed. However, the affected terrestrial habitats in the Burnt Bridge Creek location provide only moderate habitat function in their current state, as they are fragmented, and located immediately adjacent to I-5. Given the small amount of vegetation removal, and the area affected relative to the amount of comparable habitat in the vicinity, riparian vegetation removal is not expected to significantly affect habitat function for terrestrial resources.

I-5 shoulder. No oak trees or vegetation would be removed within this location, and there would be no loss of oak woodland habitat function in this location.

Figure 4-5. Long-Term Reduction to Sensitive Terrestrial Habitats in Oregon



The Modified LPA would result in permanent impacts to an area less than 0.01 acres in size that is mapped as priority oak woodland habitat. However, this is likely the result of a mapping error in the oak woodland habitat designation. The area that would be affected is currently a paved portion of the

The Modified LPA would not result in any permanent wetland impacts in Washington and would permanently impact approximately 0.06 acres of wetland buffer. Additional details regarding wetlands and wetland buffers can be found in the Wetlands and Other Waters Technical Report.

The Modified LPA would avoid and minimize impacts to riparian areas and other sensitive habitats in Washington consistent with federal, state, and local regulations. Compensatory mitigation would be provided for unavoidable impacts. It is anticipated that the net result would be a net benefit to riparian and terrestrial habitat function in the long term.

Figure 4-6 identifies the areas where the Modified LPA would result in a reduction of sensitive terrestrial habitats in Washington State.

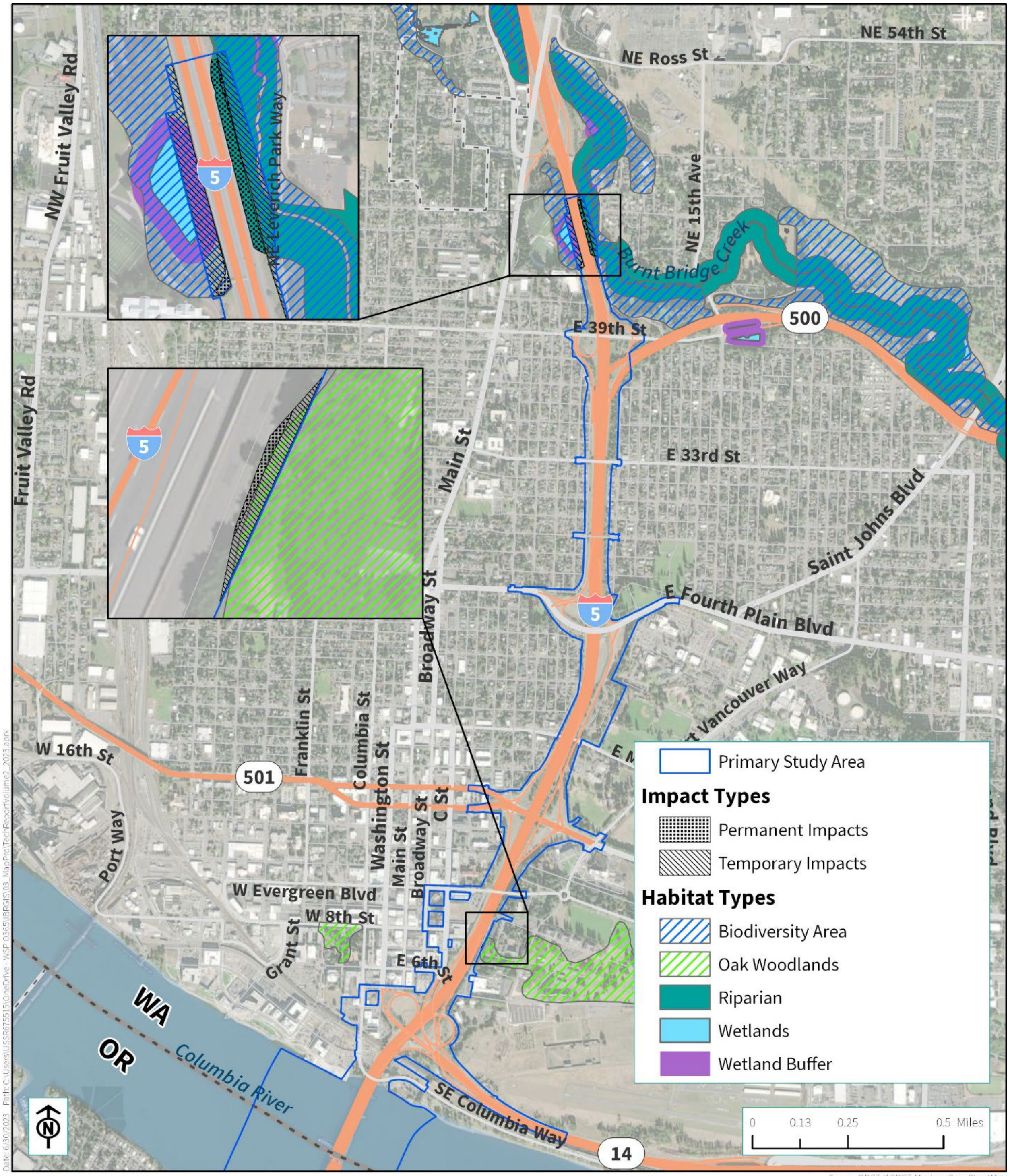
NESTING BIRD AND ROOSTING BAT HABITAT STRUCTURES

The Modified LPA would require the removal of both natural features and human-made structures that provide documented or potentially suitable habitat for nesting birds and roosting bats.

Activities with the potential to disturb nesting migratory birds, such as nest removal, would be conducted consistent with the provisions of the MBTA. The MBTA requires that nests of migratory birds be removed only at times when nests are inactive. Active nests (those with live eggs and/or viable chicks) are to be left undisturbed until they are no longer active. Compliance with the provisions of the MBTA would avoid disturbance of migratory birds during nest removal. However, the loss of a specific nesting structure could be significant, particularly if similar replacement structures are not available.

The existing Interstate Bridges has been the site of a peregrine falcon nest site since 2001 (ORBIC 2021). There is also documented nesting habitat within both the primary and secondary study areas (ORBIC 2021). Removal of the existing Interstate Bridge would represent the loss of a suitable nesting structure and, while there are likely alternate nesting sites in the vicinity, could appreciably disrupt peregrine breeding, foraging, and/or nesting activity. Peregrines using the existing Interstate Bridge would be forced to find alternative nesting structures in the area or would be likely to move out of the area. Providing an alternate nesting structure, either on the Columbia River bridges or within the vicinity, would greatly reduce the potential nesting impact.

Figure 4-6. Long-Term Reduction of Sensitive Terrestrial Habitats in Washington State



4.2.2.2 Permanent Impacts to Terrestrial Wildlife Passage

Given the highly developed character of the study areas, terrestrial wildlife passage is already severely limited. The existing shoreline and riparian areas provide limited suitable passage for terrestrial species, though these areas are narrow and provide little habitat function. Landside piers for the new Columbia River bridges may further obstruct movement along the shoreline. However, the removal of the existing landside bridge piers would likely offset the functional effect on terrestrial wildlife passage. Options for improving wildlife passage are limited given the developed nature of the corridor; however, impact minimization measures, including design efforts to avoid impacts to riparian habitat would likely maintain or improve terrestrial wildlife passage in the long term (see Chapter 7).

4.2.3 Botanical Resources

Permanent removal of vegetation is described in Section 4.2.2. The extent of permanent vegetation removal associated with the Modified LPA is expected to be relatively minor and to occur primarily within disturbed areas adjacent to existing roadway infrastructure. The Modified LPA would permanently impact native vegetation within a few relatively small areas of functioning riparian and wetland habitats. The impact would be avoided and minimized to the extent practicable, consistent with applicable federal, state, and local regulations, and compensatory mitigation would be conducted to offset the net loss in habitat function. The net result is expected to be an increase in the quality of habitat for botanical resources. There are no SOI botanical species known or expected to occur within the areas that would be permanently disturbed, and therefore the Modified LPA is not expected to remove or reduce botanical SOI.

4.2.4 Design Options

In general, the Modified LPA's design options would result in the same types of effects on ecosystems. However, some design options would result in effects that would differ in terms of quantity or intensity of the effect. The subsections below describe and compare the permanent impacts that would occur under the design options.

4.2.4.1 Two Auxiliary Lanes

The Modified LPA with two auxiliary lanes would have long-term effects similar to those of the Modified LPA with one auxiliary lane, except for an approximately 3.9-acre (2.3%) increase in elevated overwater shading and CIA compared to the Modified LPA. However, as with the Modified LPA, the height of the elevated overwater shading limits the extent of the effect on habitat function. Also, because treatment would be provided for all post-project CIA, the net effect on water quality and aquatic habitat would be similar to the Modified LPA, resulting in a substantial net improvement compared to the No-Build Alternative.

4.2.4.2 Single-Level Fixed-Span Bridge Configuration

The Modified LPA with the single-level fixed-span configuration would have long-term effects similar to those of the Modified LPA with the double-deck fixed-span configuration, except that it would:

- Require larger foundations with more drilled shafts. This bridge configuration would require 96 drilled shafts (24 more than the Modified LPA). This would result in a net benthic impact of 1.07 acres (approximately 0.16 acres larger than the Modified LPA)., and a 0.03-acre net reduction in benthic habitat (compared to the net 0.13-acre increase in habitat in the Modified LPA).
- Require larger shaft caps. The shaft caps for the single-level fixed-span configuration would result in an increase of approximately 1.41 acres of shading at the Columbia River water surface (approximately 0.37 acres more than under the Modified LPA).
- Be approximately 15.43 acres in size, an increase of approximately 4 acres compared to the Modified LPA. However, the increase would not likely result in substantial effects, as the shading from the elevated bridge decks would not have significant effects on habitat function.
- Increase the CIA by 32.9 acres (an increase of approximately 3.3 acres compared to the double-deck configuration) due to the slightly different configuration and dimensions of the bridges and interchanges. However, the same level of treatment would be provided, and the net effect on water quality and aquatic habitat would be similar to the Modified LPA, resulting in a substantial net improvement compared to the No-Build Alternative.

4.2.4.3 Single-Level Movable-Span Configuration

The Modified LPA with the single-level movable-span configuration would have long-term effects similar to those of the Modified LPA with the double-deck fixed-span configuration, except that it would:

- Require larger foundations with more drilled shafts. The single-level vertical lift span configuration would require 108 drilled shafts (36 more drilled shafts than the Modified LPA). This would result in a total benthic impact of 1.11 acres (approximately 0.20 acres larger than the Modified LPA), and a 0.07-acre net reduction in benthic habitat (compared to the net 0.13 acre increase in habitat in the Modified LPA).
- Require larger shaft caps. The shaft caps for the single-level movable-span configuration would result in increased shading at the Columbia River water surface. The shaft caps for the movable-span configuration would result in an increase of approximately 1.58 acres of shading at the Columbia River water surface.
- Be approximately 16.18 acres in size, an increase of approximately 5 acres compared to the Modified LPA. However, the increase would not likely result in substantial effects, as the shading from the elevated bridge decks would not have significant effects on habitat function.
- Increase the CIA by 32.9 acres (an increase of approximately 3.3 acres compared to the double-deck configuration) due to the slightly different configuration and dimensions of the bridges and interchanges. However, the same level of treatment would be provided, and the net effect on water quality and aquatic habitat would be similar to the Modified LPA, resulting in a substantial net improvement compared to the No-Build Alternative.

4.2.4.4 State Route 14 Interchange without Interstate 5 C Street Ramps

The design option that would construct the SR 14 interchange without the I-5 C Street ramps would not result in different long-term effects on ecosystem resources from those identified for the Modified LPA with the C Street ramps. This design option would have a slightly smaller footprint, which would reduce the amount of post-project CIA. However, because stormwater from all post-project CIA would be treated, the stormwater-related effects associated with this option would be identical to those identified for the Modified LPA.

4.2.4.5 Interstate 5 Mainline Westward Shift

The design option that would shift a portion of the I-5 mainline westward in Vancouver would not result in different long-term effects on ecosystem resources from those identified for the Modified LPA with the centered I-5 mainline because there is no functional habitat within the area to which the I-5 mainline would be shifted.

4.2.4.6 Park and Rides

The design options for potential alternate locations for park and rides in downtown Vancouver would not result in any long-term effects on ecosystem resources that would differ from those identified for the Modified LPA. Small differences (increases or decreases) could occur between the design option sites in the amount of new impervious surfaces, such as in areas where the park-and-ride locations are currently unpaved. However, since stormwater from all post-project CIAs would be treated, the stormwater-related effects associated with the park-and-ride design options would be identical to those identified for the Modified LPA.

5. TEMPORARY EFFECTS

This section describes the temporary effects on ecosystems for aquatic, terrestrial, and botanical resources, including potential modifications to the Portland Metro Levee System. Short-term effects are those that would occur during construction, which would cease once construction is complete. These potential effects are assessed based on the current understanding of the condition of the natural and built environments.

Temporary effects on aquatic habitats and species include temporary displacement of aquatic habitat from temporary work structures, work area isolation and fish salvage, temporary water-quality impairment, temporary overwater lighting, hydroacoustic impacts, and disturbance or displacement of individuals. Temporary effects on terrestrial habitats and species (including botanical species) include temporary displacement of sensitive terrestrial habitats, in-air acoustic impacts, obstacles to terrestrial wildlife passage, and disturbance or displacement of individuals.

Certain design options that are being evaluated as part of the Modified LPA (the C-Street ramp options, I-5 mainline westward shift options, and the two park-and-ride site options) would not result in different levels or types of short-term effects to ecosystem resources, and these design options are not specifically addressed further in this section.

Chapter 7 identifies potential mitigation measures that could be implemented to avoid, minimize, and mitigate temporary impacts to aquatic, terrestrial, and botanical resources. Chapter 8 identifies applicable federal, state, and local regulations that would be applicable to the construction and operation of the Modified LPA.

5.1 Modified LPA

5.1.1 Aquatic Resources

In-water construction activities related to construction of the new bridges and demolition of the existing bridges within the Columbia River and North Portland Harbor could temporarily affect aquatic species and their habitats. To minimize impacts to aquatic species and their habitats, certain work below the OHWM of the Columbia River and North Portland Harbor would be restricted to defined timing restrictions, referred to here as the in-water work window (IWWW). The USACE, NOAA Fisheries, USFWS, ODFW, and WDFW all can recommend and/or require restrictions on the timing of in-water work during their regulatory review processes. The following agencies have published regulatory guidance regarding the preferred timing for in-water work to minimize impacts to aquatic species on the reach of the Columbia River at the project site:

- USACE: November 1 to February 28 (USACE 2010)
- WDFW: July 16 to February 28 (WDFW 2018)
- ODFW: November 1 to February 28 (ODFW 2022)

These published IWWWs are considered regulatory guidance, created to assist project proponents in minimizing potential impacts to fish, wildlife, and habitat resources. On a project-by-project basis, it may be determined that it is appropriate to perform in-water work outside of the work windows indicated in these guidelines. In practice, for projects on the Columbia River where both ODFW and WDFW have review authority, an IWWW is typically negotiated among the agencies early in a project's permitting phase.

Because of the amount of in-water work involved, and the logistical complexity of construction, adhering strictly to the published IWWW guidelines would more than double the anticipated construction timeline of the Modified LPA. This schedule was determined to be undesirable from both a cost standpoint and for the impacts associated with a longer construction duration requiring multiple seasons of in-water work.

Between 2005 and 2011, a set of project-specific in-water work timing restrictions were developed for the CRC LPA through extensive coordination with regulatory agencies, tribal partners, and other interested parties. These work timing restrictions were reviewed with agencies, tribes, and other interested parties in several meetings between 2022 and 2023 to inform planning for the Modified LPA. Based on the outcome of these discussions, it was concluded that the timing restrictions developed for the CRC LPA were likely also the preferred windows to apply to construction of the Modified LPA.

To establish appropriate assumptions regarding timing restrictions for the construction of the Modified LPA, several meetings were conducted between representatives from the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), NOAA Fisheries, ODFW, WDFW, and consulting tribes. The purpose of these meetings was to refine the prior assumptions around the in-water construction elements, construction schedule, and in-water work timing, to establish an IWWW for consultation purposes and to define which activities would be restricted to the IWWW. Based on the outcome of these discussions, it was determined that the IWWW timing assumptions that were developed for the CRC project would be applicable to the Modified LPA as well.

Therefore, for this evaluation of impacts associated with the Modified LPA, the following IWWW restrictions have been established:

- **Impact pile driving** would be confined to **September 15 through April 15** of each year. This was confirmed as the most biologically defensible window for the Modified LPA, as it allows for an expedited construction schedule that minimizes the number of in-water work seasons, while still avoiding sensitive periods for aquatic SOI to the greatest extent practicable.
- **In-water debris removal with a bucket dredge** would be confined to **November 1 and February 28** of each year. This is the standard published work window for this reach of the Columbia River and would appropriately avoid impacts to aquatic SOI. However, limited, diver-assisted removal of specific individual pieces of debris or large riprap necessary to place a drilled shaft may be conducted at any time of year.

The following in-water and overwater construction activities would not be restricted to an IWWW and may be conducted year-round, provided they are conducted consistent with the BMPs described in Section 7 of this document and in compliance with all applicable permit conditions:

- Pile installation with a vibratory hammer.
- Pile removal with a vibratory hammer or by direct pulling.

- Sheet pile installation via vibratory or other non-impact methods.
- Sheet pile removal via vibratory hammer or by direct pulling.
- Drilled shaft casing installation via vibratory hammer or oscillator.
- Wire saw/diamond wire cutting to demolish and remove existing piers.
- Operation of barges and other water-based construction vessels (small skiffs, etc.), including movement, anchoring, and repositioning.
- Work conducted below the OHWM elevation but in isolated and/or dewatered conditions, or above the wetted channel. Such activities include (but are not limited to) fish salvage activities, work within drilled shaft casings (excavation, reinforcement, concrete placement), construction of formwork and concrete placement for cast-in place concrete work, and demolition work within cofferdams.
- Work conducted waterward of OHWM, but above the OHWM elevation (overwater work). Such activities include (but are not limited to) installation of superstructure elements of the bridge, cast-in-place concrete work, and overwater demolition activities.

The timing of in-water work would ultimately occur in compliance with the terms and conditions of the regulatory permits obtained for the Modified LPA.

5.1.1.1 Temporary Impacts to Sensitive Aquatic Habitat

The Modified LPA would result in temporary impacts to sensitive aquatic habitats associated with the physical benthic and overwater footprint of several temporary in-water and overwater structures. These structures would include a variety of temporary work platforms, bridges and piers, temporary isolation systems, cofferdams, casings, barges, and temporary piles associated with these structures.

Temporary work structures would be designed by the contractor after a contract is awarded, but prior to construction. For this reason, the exact size, quantity, type, and configuration of temporary work structures are not known with certainty.

Table 5-1 summarizes the temporary aquatic habitat impacts associated with construction of the Modified LPA, and Figure 5-1 and Figure 5-2 provide a conceptual graphic overview. These effects are discussed in detail in the subsections below.

Table 5-1. Temporary Aquatic Habitat Impacts Summary

Work Area	Temporary In-Water and Overwater Work Elements	Work Platforms/ Bridges/Piers and Associated Piles	Other Temporary Piles	Suspended Shaft Cap Isolation System	Sheet Pile Cofferdams (Construction)	Sheet Pile Cofferdams (Demolition)	Drilled Shaft Isolation Casings	Barges and Barge Mooring Piles (Construction)	Barges and Barge Mooring Piles (Demolition)	Total
Columbia River	Approximate Quantity	764 (24-inch) 447 (48-inch)	100 (24-inch)	4	2	9	–	12 barges; 160 (24-inch)	6 barges; 304 (24-inch) piles	**1,328 (24-inch) 447 (48-inch)**
	Temporary Benthic Impact (acres)	0.18	0.01	0	0.44	0.86	–	0.01	0.01	**1.52**
	Temporary Overwater Shading (acres)	4.23	0	0.25	0	0	–	2.75	0.65	**7.89**
	Approximate Maximum Duration (days)	500 days each	150 days each	120 days each	500 days each	50 days each	–	120 days each	50 days each	**–**
North Portland Harbor	Approximate Quantity	912 (24-inch) 208 (48-inch)	100 (24-inch)	–	–	–	52	6 barges; 216 (24-inch) mooring piles	6 barges; 100 (24-inch) piles	**1,328 (24-inch) 208 (48-inch)**
	Temporary Benthic Impact (acres)	0.13	0.01	–	–	–	0.24	0.02	0.01	**0.40**
	Temporary Overwater Shading (acres)	4.78	0	–	–	–	0	2.41	0.53	**7.72**
	Approximate Maximum Duration (days)	850 days each	150 days each	–	–	–	50 days each	50 days each	50 days each	**–**

Figure 5-1. Temporary Work Structures – Columbia River

Figure 5-2. Temporary Work Structures – North Portland Harbor

TEMPORARY WORK PLATFORMS, BRIDGES, AND PIERS[14]

Construction of the Columbia River and North Portland Harbor bridges would require a combination of temporary work bridges, platforms, and piers. For purposes of this discussion, work bridges are structures that have a point of connection with, and that can be accessed from, the adjacent land, whereas work platforms and piers are stand-alone structures.

Temporary work bridges, platforms, and piers would be supported by a combination of 24-inch and 48-inch-diameter hollow, steel pipe piles (pile installation and removal is described in Section 5.1.1.5). Each temporary structure would be fully removed prior to project completion. Bridge decking would be removed using appropriate containment measures, and temporary piles would be removed with a vibratory hammer or via direct pulling.

To further reduce the potential for impacts to ESA-listed species or critical habitats, installation and removal of all temporary work bridges, platforms, and piers would be conducted consistent with the impact minimization BMPs described in Section 4 and the permits that would ultimately be issued for construction.

Columbia River

Temporary work bridges would be constructed at nearshore pier complexes 2 and 7. The Pier 2 temporary work bridge would measure approximately 0.52 acres in size and would require a total of approximately 100 24-inch-diameter piles and 54 48-inch-diameter piles. The Pier 7 temporary work bridge would measure approximately 0.38 acres in size and would require a total of approximately 73 24-inch-diameter piles and 40 48-inch-diameter piles.

Temporary work platforms would be installed at the locations of Piers 3 through 6 to support the construction of the foundations for those piers. The temporary platforms would be used for the installation of the drilled shafts and would also support the suspended shaft cap isolation system and construction of the shaft caps at these piers. The temporary work platforms at Piers 3 and 4 would each measure approximately 0.63 acres in size and would be supported by approximately 120 24-inch-diameter steel pipe piles and 65 48-inch-diameter steel pipe piles. The temporary platforms at Piers 5 and 6 would each be approximately 0.92 acres square feet in size and would be supported by approximately 175 24-inch-diameter piles and 95 48-inch-diameter piles.

Additionally, two new temporary piers would be constructed near upland Piers 1 and 8 to facilitate construction of the spans between Piers 1 and 2 and Piers 7 and 8. Each of these temporary piers would measure approximately 0.11 acres in size and would require a total of approximately 16 48-inch-diameter piles.

In total the temporary work bridges, platforms, and piers for construction of the Columbia River bridge would require up to 764 24-inch-diameter piles and approximately 447 48-inch-diameter piles. These structures would temporarily displace approximately 0.18 acres of benthic habitat and would temporarily shade approximately 4.23 acres of water surface within the Columbia River. However, not

[14] The temporary in-water and overwater work areas have been estimated for the Modified LPA based on the analysis conducted for the CRC project.

all of these temporary structures would be in place at the same time, as construction would progress in a sequenced fashion and temporary work structures would be removed prior to project completion.

North Portland Harbor

Within North Portland Harbor, a total of eight temporary work bridges of various sizes would be required to install the drilled shafts and construct the bridges. These temporary work bridges would be supported by a combination of 24-inch and 48-inch-diameter steel pipe piles. In total each work bridge would be approximately 0.53 acres in size (on average) and would be supported by approximately 80 24-inch-diameter steel pipe piles and 23 48-inch piles.

In total, approximately 912 24-inch-diameter piles and 208 48-inch-diameter piles would be required for the temporary work bridges in North Portland Harbor. These structures would temporarily displace approximately 0.13 acres of benthic habitat and temporarily shade approximately 4.78 acres of water surface within North Portland Harbor. However, only two of these temporary work bridges would typically be in place at any one time, though a contractor could potentially install a greater number of work bridges. For purposes of this analysis, it is assumed that no more than approximately 100,000 square feet of temporary work bridge would be installed at any given time. The piles that would be necessary to support the temporary platforms, bridges, and piers would be installed using a combination of vibratory and impact hammer. A detailed discussion of pile driving and associated impacts is provided in Section 5.1.1.5.

Temporary work platforms and bridges would be fully removed prior to project completion, which would result in the full restoration of function to the temporarily affected areas.

To further reduce the potential for impacts to aquatic ecosystem resources, installation and removal of the temporary work bridges would be conducted consistent with the impact minimization BMPs described in Section 7.2. These include the implementation of a Spill Prevention, Control, and Countermeasures (SPCC) plan and Pollution Control Plan (PCP) that would specify the means and methods employed to prevent the introduction of debris or contaminants into the water during installation and removal, as well as while they are present. The work bridges would be designed and installed so the bridge deck would not be inundated during high-water events and containment would be provided consistent with the requirements of the permits that are ultimately issued for the project, including the 401 Water Quality Certifications.

SUSPENDED SHAFT CAP ISOLATION SYSTEM

The shaft caps for the foundations of Piers 3 through 6 of the Columbia River bridges would be constructed using a suspended shaft cap isolation system. The use of this system avoids the need for cofferdams and permanent concrete seals on the bottom of the riverbed at Piers 3 through 6. The suspended shaft cap isolation system would be constructed on top of the permanent drilled shafts for each pier.

Precast concrete sections would be placed over each drilled shaft above the water line, suspended by a steel frame that is in turn supported by the shaft casing. The precast segments would be linked together, and watertight forms would be constructed to allow the sides and concrete floor of the shaft cap to be cast in place. Once this is complete and the concrete has cured, the temporary formwork would be removed. The whole, watertight assembly would then be lowered into place, and the rest of the concrete shaft cap would be constructed and cast in place.

The suspended shaft cap isolation system would rest on the permanent drilled shafts and would not displace any benthic habitat. The system would extend approximately 4 feet beyond the edge of each shaft cap, which would result in approximately 0.25 acres of temporary water surface shading within the Columbia River.

SHEET PILE COFFERDAMS

Sheet pile cofferdams would likely be used to isolate certain in-water work areas from active flow during construction. It is assumed that two cofferdams would be required for the construction of nearshore Piers 2 and 7 in the Columbia River. The shallow water depth at these piers renders other methodologies less feasible. Sheet pile cofferdams may also be required during demolition of the nine existing bridge piers, though this activity may also be conducted with a wire saw without a cofferdam.

The two cofferdams used during construction of Piers 2 and 7 in the Columbia River would temporarily affect a combined area of approximately 0.44 acres of benthic habitat. These two cofferdams would be constructed of steel sheet piles, which would be installed and removed with a vibratory hammer operated from temporary work bridges or barges. Once sheet piles are installed, a permanent concrete seal would be installed at the base of each cofferdam, and they would be dewatered (dewatering and fish salvage activities are described in Section 5.1.1.2). Once construction of the pier is complete, sheet piles would be removed with a vibratory hammer, but the concrete seals would remain.

Up to nine additional cofferdams may be installed in the Columbia River during demolition of the existing Interstate Bridge piers 2 through 10. Each cofferdam would measure approximately 175 feet by 45 feet, and in total, these temporary sheet pile cofferdams would temporarily displace approximately 0.86 acres of benthic habitat.

Not all cofferdams would be installed at once, though it is possible that a contractor may have more than one demolition cofferdam in place at one time.

Sheet pile cofferdams would not be required for construction or demolition activities in North Portland Harbor. Installation of drilled shafts in North Portland Harbor would be conducted within temporary isolation casings rather than sheet pile cofferdams. Removal of existing foundations in North Portland Harbor are expected to be able to be conducted via wiresaw at the mudline and would not require sheet pile cofferdams.

DRILLED SHAFT ISOLATION CASINGS

Temporary 19-foot-diameter hollow steel casings would be installed within North Portland Harbor to isolate in-water work areas in which the permanent drilled shafts for the bridge foundations can be constructed. These casings would be required in North Portland Harbor due to the specific design requirements of these drilled shafts and the way they would attach to the columns. This same constraint is not applicable to the Columbia River bridges, and for this reason, drilled shaft isolation casings would not be required for installation of the drilled shafts for the Columbia River bridges.

These temporary casings would be screened at the bottom to avoid fish entrapment, then placed on the river bottom and then either pushed into the substrate approximately 2 to 4 feet with weighted equipment, or vibrated into place. Once installed, a permanent concrete seal would be cast in place at the base, which would allow them to be dewatered (see Section 5.1.1.2).

A total of 52 temporary drilled shaft isolation casings would be required in North Portland Harbor (one for each drilled shaft). Each of these temporary isolation casings would be approximately 19 feet in diameter (<0.01 acres in size). In total, the drilled shaft isolation casings would temporarily displace an area approximately 0.24 acres in size within North Portland Harbor. However, not all isolation casings would be installed at a single time. A contractor may have up to 36 of these casings in place at one time. It is further estimated that each isolation casing would be in place for approximately 50 days each.

Drilled shaft isolation casings would not be required for installation of the drilled shafts for the Columbia River bridges.

BARGES AND BARGE MOORING PILES

Barges would be used as platforms to conduct work activities within the Columbia River and to haul materials and equipment to and from the work site. Barge mooring piles would be installed and removed with a vibratory hammer. A detailed discussion of pile driving and associated impacts is provided in Section 5.1.1.5.

Although multiple barges would be in use over the course of construction, there would be a limited number of stationary barges in place at one time. During construction in the Columbia River, there would likely be a maximum of 12 stationary barges operating in the Columbia River at one time, casting no more than 2.75 acres of overwater shading at once. Because of wind, current, and wave action, temporary mooring piles would likely be installed for some of these barges to anchor in place. Some barges would be able to moor to temporary bridges or platforms and may not need additional mooring piles. It is estimated that up to 160 temporary mooring piles (18- to 24-inch-diameter steel pipe piles) would be installed within the Columbia River and that a given barge would be present in a given location for up to approximately 120 days each, on average.

Barges and temporary barge mooring piles would also be required for the demolition of the existing structures in the Columbia River. It is anticipated that demolition of the existing bridges would require up to six stationary barges at one time, with a maximum overwater footprint of approximately 0.65 acres at once. Since there would not be any temporary work bridges or platforms to moor to, these barges for demolition may require more mooring piles than those that are used for construction. It is estimated that up to 304 temporary mooring piles (18- to 24-inch-diameter steel pipe piles) would be used to anchor and support the work and material barges necessary for demolition, temporarily displacing approximately 0.01 acres of benthic substrate. These barges would be in place for up to approximately 50 days each.

Construction within North Portland Harbor would most likely occur from temporary platforms and bridges, and barges are not expected to be necessary for construction or demolition within North Portland Harbor. However, a contractor may elect to use barges for some activities, and barges may be used for delivery and/or staging of materials. It is anticipated that up to nine barges may be present at a given time within North Portland Harbor, with a maximum shade footprint of approximately 2.41 acres at any one time. It is estimated that up to 216 temporary mooring piles (18- to 24-inch-diameter steel pipe piles) would be used to anchor and support these barges, temporarily displacing approximately 0.02 acres of benthic substrate. These barges would be in place for up to approximately 50 days each.

A contractor could also elect to use barges during demolition of the bridges in North Portland Harbor. It is estimated that, if this is the case, up to six barges may be present at a given time, with a maximum shade footprint of approximately 0.53 acres at any one time. It is estimated that up to 100 temporary mooring piles (18- to 24-inch-diameter steel pipe piles) would be used to anchor and support these barges, temporarily displacing approximately 0.01 acres of benthic substrate. These barges would be in place for up to approximately 50 days each.

OTHER TEMPORARY PILES

Additional temporary piles (in addition to those associated with temporary work bridges, platforms, and piers) would likely be necessary throughout construction for a variety of purposes, including supporting falsework and formwork, pile templates, and reaction piles, or for other purposes. Temporary piles would likely be 24-inch-diameter, open-ended steel pipes. These would be non-load-bearing piles installed and removed solely with a vibratory pile driver. Temporary piles would be removed prior to project completion.

Approximately 200 such temporary piles may be required over the duration of construction, split approximately evenly between the Columbia River and the North Portland Harbor. These piles would temporarily displace approximately 0.02 acres of benthic habitat.

EFFECTS DISCUSSION

Temporary benthic habitat impacts (from temporary pilings and cofferdams) would represent a loss of physical benthic substrate for species that rely on aquatic habitats. Temporary overwater shading impacts (from temporary work bridges, platforms, piers, and barges) would temporarily affect habitat function for species that rely on aquatic habitats. The effect on aquatic habitats and species would be comparable to those associated with long-term effects as described in Section 4.2.1.1 but would be of shorter duration, and the habitat function would be fully restored once the temporary structure is removed.

Temporary benthic habitat impacts and overwater shading would occur at various times throughout construction and demolition. For this reason, all species and life stages of salmon and steelhead that are present within the Columbia River and North Portland Harbor could be exposed to these effects. Temporary impacts to benthic habitat and overwater shading associated with temporary work structures would affect foraging and migration habitat suitability within the study area for both adult and outmigrating juvenile salmon and steelhead. However, the extent of the effect on function would be limited, given that the impacted habitat is not of particularly high quality or rarity, and there is abundant similar habitat immediately adjacent along the shorelines of the river upstream and downstream of the proposed bridge locations. The impacted habitat represents only a small fraction of the remaining habitat available for miles in either direction. In addition, only a portion of the total quantity of temporary structures would be installed at any one time. The temporary structures that would be required in the Columbia River would occupy a small portion of the available habitat at any one time.

The relatively more constrained channel width in North Portland Harbor means that the proposed work bridges would potentially occupy a relatively larger percentage of the available habitat. However, as with the Columbia River structures, not all the work bridges would be installed at the same time, and work bridges would be added and removed as construction of the bridges in North Portland Harbor proceeds.

Bull trout subadults and adults may be present in the study area during migration and holding. However, bull trout are not known or expected to occur frequently in this portion of the Columbia River, and effects on bull trout from benthic habitat impacts and overwater shading would be insignificant.

Adult green sturgeon are similarly not known or expected to occur frequently in this portion of the Columbia River, and effects on green sturgeon from temporary benthic habitat impacts and temporary overwater shading would be insignificant.

White sturgeon, Pacific eulachon, Pacific lamprey, and river lamprey are all known to use both shallow and deep-water habitat in the Columbia River within the study area. White sturgeon are more closely associated with deep-water habitats but use shallow-water habitats during periods of high activity. Temporary impacts to benthic habitats would represent a temporary loss of physical benthic substrate for these species. Larval lamprey, which reside in the benthic substrates, could be killed, injured, or displaced during installation of temporary structures.

Native resident fish such as sculpins, threespine sticklebacks, dace, and suckers spend the majority of their life cycles in shallow-water habitat, using emergent vegetation for cover, spawning, and foraging. Because their life-history requirements include the use of emergent vegetation and other types of cover (e.g., rocks and overhanging trees), their distribution even within shallow-water areas is relatively limited to depths of only a few feet where emergent vegetation is present. These fish species typically forage on prey items (e.g., benthic invertebrates, algae, and detritus) that also depend on emergent vegetation, or at least are present at depths at which primary productivity is high. These species may migrate locally among habitat areas in the study area in response to seasonal flows, water temperatures, life stage, and temporal cycles (e.g., moving between various depths according to time of day). Temporary impacts to benthic habitats would represent a temporary loss of physical habitat for native resident fish within the primary study area. However, the extent of the effect on function would be limited, given that the impacted habitat is not of particularly high quality or rarity, and there is abundant similar habitat immediately adjacent along the shorelines of the river upstream and downstream of the proposed bridge locations. The impacted habitat represents only a small fraction of the remaining habitat available for miles in either direction.

Temporary benthic habitat impacts and temporary overwater shading would not affect habitat suitability for Steller sea lion, California sea lion, or harbor seal. These species transit the Columbia River within the study area but are not closely associated with benthic habitats.

Temporary impacts to benthic habitats would represent a temporary loss of physical habitat for freshwater invertebrates within the primary study area. The extent of the effect would be minor, given the small size of the impact, the unlikely presence of these species, and the low degree of habitat suitability within the Columbia River and North Portland Harbor. Temporary overwater shading would not affect habitat suitability for freshwater invertebrates.

As described above, habitat function would be fully restored once a given temporary structure is removed.

5.1.1.2 Work Area Isolation and Fish Salvage

As described in Section 5.1.2.1, certain in-water work activities would be isolated from the active flow of the Columbia River and North Portland Harbor to reduce potential effects on fish and aquatic habitats. Areas that would be isolated in this manner include drilled shaft isolation casings and temporary sheet pile cofferdams. Sheet pile cofferdams for construction of Piers 2 and 7, and the drilled shaft isolation casings in North Portland Harbor would be dewatered to provide a work area for construction. Sheet pile cofferdams for demolition of the existing Columbia River bridges (if used), would not be dewatered, as their primary purpose would be to contain sediment and debris and dry work conditions would not be required for demolition activities. Isolation of in-water work areas would temporarily disturb benthic habitats and would temporarily limit access to these areas for fish.

Cofferdams and drilled shaft isolation casings would be installed in a manner that minimizes the potential for fish entrapment. Sheet piles would be installed from upstream to downstream and would be lowered slowly until contact with the substrate. Drilled shaft isolation casings would be screened at the bottom to minimize potential for fish entrapment during installation.

Installation of drilled shaft casings and cofferdams is likely to generate low-level noise and visual disturbance, and many fish would actively avoid the work area during the construction of cofferdams. Nevertheless, it is likely that some fish may become trapped within the isolated work area and need to be manually removed.

Fish salvage would be conducted both during and after the installation of the sheet pile cofferdams to remove fish from within the isolated work area. Since the drilled shaft isolation casings would be screened prior to installation, fish salvage would not be required within these structures prior to dewatering.

To minimize the potential for effects on fish or other aquatic organisms, all fish salvage work would be conducted consistent with the best practices established in the BO for ODOT’s FAHP consultation. A fish biologist with the experience and competence to ensure the safe capture, handling, and release of all fish would supervise all fish capture and release. To minimize take, efforts would be made to capture fish known or likely to be present in an in-water isolated work area using methods that are effective, minimize fish handling, and minimize the potential for injury. Attempts to seine and/or net fish, or the use of minnow traps, shall precede the use of electrofishing equipment. Isolation structures would be designed and installed consistent with the ODOT Hydraulics Manual, which establishes criteria to avoid these structures being overtopped during high-water events.

If electrofishing must be used, it would be conducted consistent with the 2000 NOAA Fisheries *Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act*, or most recent version (NOAA Fisheries 2000).

Despite employing BMPs to minimize impacts, the salvage operation would involve capture, direct handling, and transporting of fish. Therefore, there is a reasonable risk that the operation may harass, injure, or kill individual fish. Similarly, if a fish remains trapped in an isolated work area during construction, mortality is likely.

Because fish salvage activities may take place year-round, all species and life stages of fish that are present in the Columbia River and North Portland Harbor may be exposed to this effect. This includes capture and handling of juvenile salmonids, as well as potential entrainment of eggs or larval stages of Pacific eulachon, Pacific lamprey, or river lamprey.

Adult seals and sea lions are likely to be in the Columbia River during installation and removal of cofferdams. However, these species would avoid the area and would not be subject to handling or disturbance during fish salvage operations. Work area isolation and fish salvage activities associated with the construction of the Modified LPA are not likely to significantly impact marine mammals.

5.1.1.3 Temporary Impacts to Water Quality

Water quality can be temporarily affected during both in-water and upland construction activities in a number of ways. Contamination could occur through the accidental release of construction materials or wastes. In-water work activities could disturb sediment and generate turbidity directly in waterways. Upland ground-disturbing activities could lead to erosion, also causing turbidity in adjacent waterbodies. Several BMPs (described in Section 7.2) would be implemented during in-water and upland construction activities to avoid and minimize temporary impacts to water quality, to the extent practicable.

TEMPORARILY ELEVATED TURBIDITY

Construction of the Modified LPA would likely result in temporary, localized turbidity during in-water work in the Columbia River and North Portland Harbor. Activities associated with the construction of the Modified LPA that have the potential to disturb sediment and temporarily elevate turbidity levels within the primary study area include pile installation and removal, drilled shaft casing installation and removal, upland ground improvements, cofferdam installation and removal, and barge operations, including movement, anchoring, and spudding. These activities could disturb sediments and temporarily elevate turbidity levels above background conditions within the primary study area.

BMPs would be implemented to minimize the extent and duration of turbidity. These BMPs include implementation of a Temporary Erosion and Sediment Control Plan (TESCP), a Water Quality Protection and Monitoring Plan (WQPMP), and others as outlined in Section 7.2. These BMPs would require that the amount and extent of turbidity would meet the terms and conditions of water quality permits that would ultimately be issued—in particular, the Section 401 Water Quality Certifications that would be obtained from DEQ and Ecology. These certifications typically establish a temporary mixing zone for turbidity within which turbidity may temporarily exceed ambient background levels. Typically, the 401 Water Quality Certifications would require regular water-quality monitoring in accordance with a WQPMP to document that the construction activities are consistent with the permits.

Most of the construction activities described in this section are not expected to generate large amounts of turbidity and are expected to dissipate to background levels more quickly than the anticipated mixing zone. Installation of piles, drilled shafts, and cofferdam piles disturb relatively small amounts of material, and the potential for generating turbidity is greatly reduced. The Columbia River is a large waterbody that provides for increased dilution and reduces the size of the potential mixing zone. Additionally, the dominant substrate at the location of the replacement Interstate Bridge is sand, which settles in relatively short distances compared to finer sediments.

Activities conducted within cofferdams or other isolated work areas (excavation of material from within drilled shaft casings) would introduce only minimal amounts of sediment into the water. There is a potential for a pulse of turbid water when cofferdams are removed and this turbidity would be managed consistent with the TESCP and permit conditions of the 401 Water Quality Certifications that would be issued for the Modified LPA. Water would be allowed to settle before removing cofferdams to minimize the turbidity plume, and turbidity would not be allowed to exceed the levels, distance, or duration specified in the permits for the activity.

Barges operating in shallow water have the potential to temporarily elevate turbidity. Barge propellers may produce turbulence that causes sediments to become suspended. Additionally, tugboats that position barges may also have propellers that generate suspended sediment. Once anchored, barges would be stationary while a given work element is being completed, and therefore have little potential to produce turbidity until moved again. Barges would be moved and repositioned multiple times in the course of construction and demolition. While the specific timing of turbidity associated with barge operation is not known, the extent and duration of temporary turbidity would not be allowed to exceed the levels, distance, or duration specified in the permits for the activity. Construction barges would not be allowed to ground out.

Upland ground-disturbing activities (including clearing, grubbing, and excavation) have the potential to cause erosion, which in turn may introduce sediment into adjacent waterbodies. However, given the TESCP that would be implemented, it is not likely that upland construction would cause turbidity in the Columbia River. The TESCP would establish BMPs and inspection protocols and outline contingency plans that would be implemented in the event of failure.

It is important to note that natural currents and flow patterns in the Columbia River routinely disturb sediments. Flow volumes and currents are affected by precipitation, as well as upstream and downstream water management at dams. High-volume flow events can result in hydraulic forces that resuspend benthic sediments, temporarily elevating turbidity locally. Additionally, the volume of flow through the study area would help minimize the intensity and duration of temporary episodic increases in sediment suspension or turbidity. In-water work activities would adhere to the proposed impact minimization measures described in Section 7.2.

CHEMICAL AND/OR DEBRIS CONTAMINATION

Construction of the Modified LPA has the potential to result in chemical and/or debris contamination of surface waters. The following activities have the potential to result in chemical or debris contamination:

- Overwater construction and demolition work creates the potential for construction debris to enter surface waters.
- Water may encounter uncured concrete, creating a potential pathway for contaminants or elevated pH into surface waters.
- Construction of the Modified LPA would require the use of various fuels, hydraulic fluids, lubricants, and other chemicals. Use and storage of these materials have the potential to result in leaks or spills of material into surface waters.
- Demolition of the existing bridges would occur both in and over the water and could release contaminants such as concrete debris, concrete dust, creosote, and lead-based paint and/or asbestos on elements of the superstructure.
- Upland ground improvements will mix and inject cementitious materials into underlying substrates to improve stability and loading potential in targeted locations within the project site, which has the potential to affect groundwater movement, and to introduce contaminants or elevated pH into groundwater or nearby surface waters. Ground improvements can also entrap contaminants and can limit the movement of contaminants in soil into groundwater or adjacent surface waters.

Although there are several sources of chemical contaminants, there is a low risk that chemicals would actually enter ground or surface waters. The contractor would be required to provide and implement avoidance and minimization measures, including an SPCC plan and PCP (see Section 7.2). The SPCC plan and PCP would specify the required BMPs and spill containment measures, as well as the means and methods of implementation. The contractor would also be required to prepare a WQPMP to satisfy the monitoring and reporting requirements of the 401 Water Quality Certifications that are ultimately issued for the project. The WQPMP will identify the timing and methodology for water-quality sampling during construction of the Modified LPA, as well as methods of implementation and reporting. All work would also be conducted consistent with the requirements of the permits that are ultimately issued, including the 401 Water Quality Certifications and construction stormwater permits. For these reasons, the potential for effects on fish and wildlife resources associated with chemical or debris contamination is low.

WATER QUALITY EFFECTS DURING UPLAND GROUND IMPROVEMENTS

An upland ground improvement program would be implemented as part of the Modified LPA to protect the bridge structures from earthquake-induced liquefaction. Ground improvement is a common means to densify or otherwise strengthen weak soil so that it becomes sufficiently resistant to excessive settlement and horizontal movement.

There are several methods that could potentially be used to conduct upland ground improvements, including, but not limited to, deep soil mixing, jet grouting, and stone columns. Deep soil mixing and jet grouting are the most likely applications. These activities would all be performed from the ground surface. The process generally involves drilling augers or inserting probes to specified depths on a regular grid pattern. Cementitious materials and/or aggregate is then mixed into the soils as the auger or probe is withdrawn.

A ground improvement test program would be conducted prior to contractor procurement to confirm the method and efficacy of upland ground improvements. It is assumed that upland ground improvements in the form of deep soil mixing and jet grouting would be conducted within an approximately 188,000-square-foot area in specific upland locations along the north and south shorelines of North Portland Harbor in and on a portion of the northern shoreline of Hayden Island. The approximate area defining the limits of these activities are shown on Figure 5-3. These activities would extend to a depth approximately 90 feet below ground surface, though actual final depths would be informed by the results of the ground improvement study.

The sequencing and duration of upland ground improvement activities would be dependent on several factors including overall project sequencing, access, and the availability of equipment. It is estimated that the ground improvement program would require approximately one year to complete.

Upland ground improvement activities would be conducted consistent with the BMPs established in this technical report (including consistency with the TESCP, PCP, and SPCC plan) and consistent with conditions of permits issued for the Modified LPA. A WQPMP would also be required to satisfy the monitoring and reporting requirements of the regulatory permits that would be required for the project. The WQPMP would identify the timing and methodology for water-quality sampling during construction of the Modified LPA, including during any upland ground improvement activities.

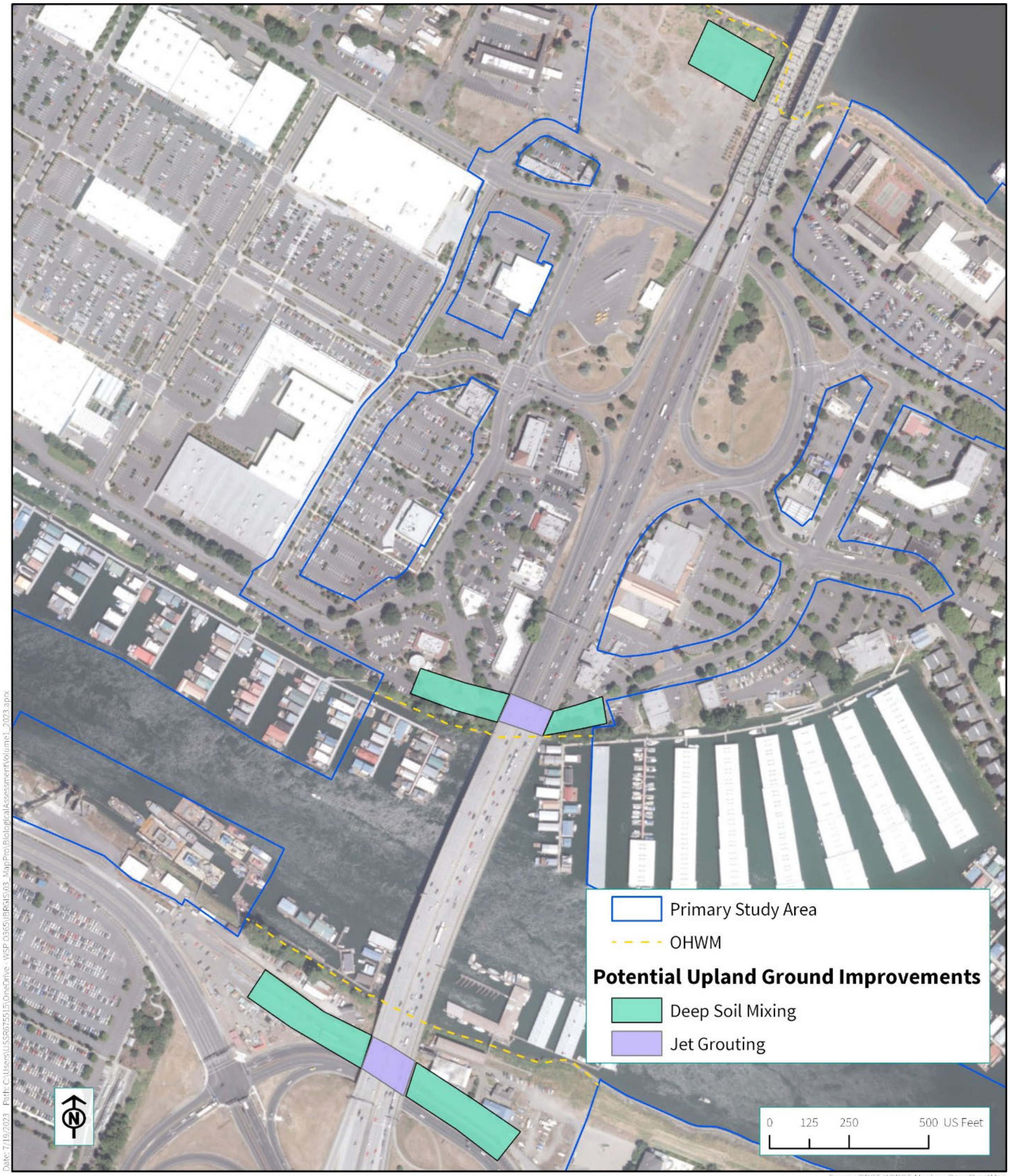
EFFECTS DISCUSSION

The assumptions presented in this document regarding anticipated turbidity concentrations that could be generated are based in part upon a literature review that was conducted for the CRC project in 2011 (Parametrix 2010). That analysis concluded that activities, such as installation and removal of piles, drilled shaft casings, and cofferdams, were likely to generate turbidity between approximately 50 and 150 mg/L, with maximum potential concentrations of 700 to 1,100 mg/L.

As described below, there are several mechanisms by which suspended sediment and elevated turbidity can potentially affect fish, including increased potential for gill tissue damage, physiological stress, behavioral changes, and direct mortality.

Elevated turbidity levels, at sufficient concentration, can result in mortality of juvenile and even adult salmon, steelhead, and bull trout (NOAA Fisheries 2002). Turbidity levels associated with the construction of the Modified LPA are not expected to reach levels that would cause mortality in fish. The highest sediment concentrations expected to occur (1,100 mg/L) would be well below levels known to kill fish (6,000 mg/L). Direct mortality of fish from temporarily elevated turbidity levels is not expected to occur.

Figure 5-3. Potential Upland Ground Improvements



Suspended sediment can clog fish gills, thereby decreasing their capacity for oxygen exchange. The nature of the sediment particle, as well as the concentration, water temperature, duration of exposure, age, and species all affect salmonid response to suspended sediment. Gill tissue damage occurs at suspended sediment concentrations of approximately 3,000 mg/L, which is greater than the maximum levels that are expected from the construction of the Modified LPA (NOAA Fisheries 2002). However, when the filaments of salmonid gills are clogged with sediment, fish attempt to expunge the sediment by opening and closing their gills excessively, in a physiological process known as "coughing." In response to the irritation, the gills may secrete a protective layer of mucus. Although this may interfere with respiration, it is not a lethal effect. This phenomenon has been observed at concentrations between 30 mg/L and 60 mg/L, so it is possible that fish within the vicinity of the replacement bridges during construction could be exposed to levels of turbidity that could elicit a coughing response.

Suspended sediments have been shown to cause physiological stress in adult and juvenile salmon, steelhead, and bull trout, but typically only when exposed to high levels for long durations (NOAA Fisheries 2002). Generally, stress is produced by prolonged exposure to high levels of suspended sediments. Because periods of elevated turbidity associated with the Modified LPA would be short-term in nature, and fish are not confined to the immediate project vicinity, prolonged exposure would not occur.

Behavioral responses to elevated levels of suspended sediment include feeding disruption and changes in migratory behavior. Fish that are exposed to elevated levels of turbidity may modify feeding and/or migratory behavior to avoid areas of high concentration. It is likely that fish present within the portion of the primary and secondary study area in which turbidity levels could potentially be elevated during construction could be exposed to levels of turbidity that could elicit a behavioral response. The geographic extent and duration of potential increases in turbidity are expected to be limited and short term, and the conservation and impact minimization measures that would be implemented would be sufficient to minimize effects.

Elevated turbidity can also have direct effects on aquatic habitat function. Mobilized sediment can settle in spawning gravels and, at high concentrations, can bury or smother eggs and reduce spawning habitat suitability. However, there are no spawning gravels within the portion of the primary study area in which turbidity could be elevated during construction, and benthic substrates are uniformly composed of primarily coarse-grained sands. Re-settling of mobilized sediment would not result in effects on habitat function. Aquatic habitat, including designated critical habitats within the primary study area, also may experience temporarily increased levels of turbidity during construction. The geographic extent and duration of potential short-term increases in sedimentation or turbidity would be limited and are not expected to measurably exceed typical ambient conditions.

Increased levels of turbidity could have temporary negative impacts on habitat for fish and other aquatic species and, if fish species are present within the portion of the primary and secondary study area where turbidity levels could potentially be elevated during the time of construction, could affect them directly.

As discussed above, turbidity levels associated with construction of the Modified LPA are not expected to reach levels that would result in direct mortality or gill damage to fish. However, turbidity would likely reach levels that could cause a coughing response. Actual exposure to these levels is expected to be minimal, however, as regulatory permits would require a restricted mixing zone in which turbidity can be elevated. Additionally, because of the large size and the high dilution capacity of the Columbia River, there are abundant accessible areas of turbidity refugia in the vicinity, and it is not anticipated that fish would become trapped in turbid water. The turbidity would be localized and would not cause a complete barrier to movement.

The construction of the Modified LPA would result in turbidity concentrations that could result in physiological stress in fish, but the duration of exposure is not expected to be of sufficient duration to elicit a physiological response.

It is likely that turbidity generated during construction and demolition activities would result in some behavioral responses, including temporary avoidance and reduced foraging abilities, as these responses have been documented at very low turbidity levels. Certain turbidity-generating activities (such as pile removal and barge operation) may be conducted on a year-round basis. For this reason, all species and life stages of fish that are present within the portions of the Columbia River and North Portland Harbor where turbidity could potentially be elevated during construction could be exposed to elevated levels of turbidity that could result in behavioral responses. The geographic extent and duration of potential increases in turbidity are expected to be limited and short term, and the conservation and impact minimization measures that would be implemented would be sufficient to minimize effects.

5.1.1.4 Temporary Overwater Lighting

Temporary overwater lighting would be required throughout construction and demolition to provide adequate lighting for barges, work platforms/bridges, construction of the replacement bridge decks, and demolition of the existing structures. Temporary lighting would be needed for all phases of construction and would be relatively uniformly distributed throughout the entire construction period.

The effects of permanent overwater lighting on aquatic habitats and species are described in Section 4.2.1.4. The effects of temporary lighting would be comparable to those associated with permanent lighting, except the lighting would likely be more intense and closer to the water surface. Barges and temporary in-water structures would cast light at the water surface during construction and demolition activities in the Columbia River. However, the overall intensity of this effect would be low as conservation measures would be implemented to minimize the effects of lighting on fish, including the use of directional lighting with shielded luminaries to the extent practicable, to control glare and direct light onto work areas instead of surface waters.

Temporary lighting may occur during all months of the year, and therefore all species and life stages of fish and aquatic species within the primary study area could be exposed to temporary effects of overwater lighting.

Temporary overwater lighting associated with temporary work structures may affect migratory movement and/or increase predation pressure within the study area for both adult and outmigrating juvenile salmon, steelhead, and bull trout. However, while lighting may prompt fish to either avoid or congregate within illuminated areas, it would not constitute a complete barrier to migrating juvenile fish. Migrating juvenile salmonids that congregate under light sources could be exposed to an increased risk of predation than they are currently. Pacific eulachon, Pacific lamprey, river lamprey, and other native resident fish could be similarly temporarily affected.

Overwater lighting is not known to affect green or white sturgeon, given their preference for deep-water habitats. Similarly, seals and sea lions are not known or expected to be significantly affected by temporary overwater lighting.

5.1.1.5 Temporary Underwater Noise During Construction

Temporarily elevated underwater noise has the potential to affect aquatic species in several ways. The effects can range from the alteration of behavior to physical injury or mortality, depending on the intensity and characteristics of the sound, the distance from the noise source, the location in the water column, and other factors. The primary sources of underwater noise associated with the Modified LPA are impact pile driving, vibratory pile driving and drilled shaft oscillation, and noise from vessels.

The Modified LPA has been designed to minimize the likelihood of impacts resulting from pile installation activities. Pile installation would be performed to the greatest extent possible using a vibratory hammer, though piles may need to be driven to final tip elevation or proofed, as necessary, with an impact hammer. Proofing is the process of striking piles with an impact hammer to verify their load-bearing capacity.

A bubble curtain or similarly effective noise attenuation device would be implemented during all in-water impact pile driving. These devices, when installed and operated properly, can conservatively be expected to provide at least 5 decibels (dB) of noise attenuation (Caltrans 2020), and the NOAA Fisheries Office of Protected Resources uses a 7 dB reduction as a general standard during bubble curtain application. For purposes of this analysis, a minimum 7dB reduction has been assumed for all impact pile strikes, except for those necessary for testing the attenuation system. A hydroacoustic monitoring plan would be implemented during impact pile driving to confirm the level of attenuation provided.

Impact Pile Driving

Impact pile driving would occur during installation of temporary in-water work structures in the Columbia River and North Portland Harbor. These structures include temporary work bridges, work platforms, and work piers, as well as temporary mooring piles for barges, and other temporary piles. See Section 5.1.1.1 for a description of the temporary structures (including temporary piles) that are anticipated to be required for the construction of the Modified LPA.

Temporary piles are expected to be steel pipe piles and would fall into two size classes: 18 to 24 inches and 36 to 48 inches in diameter. Because larger-diameter piles generally generate greater levels of underwater sound pressure, this analysis conservatively assumes that all piles within each category would be of the larger diameter (24 inches and 48 inches, respectively).

Impact pile installation of the 36- to 48-inch steel pipe piles has the potential to generate temporary underwater noise levels of approximately 214 peak decibels (dB_{PEAK}), 201 decibels root mean square (dB_{RMS}), and 184 decibels sound exposure level (dB_{SEL}) (measured at a distance of 33 feet or 10 meters from the pile) prior to any attenuation (DEA 2011). Installation of 18- to 24-inch-diameter steel pipe piles would generate noise levels of approximately 205 dB_{PEAK}, 190 dB_{RMS}, and 175 dB_{SEL} (measured at a distance of 33 feet, or 10 meters, from the pile) prior to attenuation.

During construction, up to two impact pile drivers may operate simultaneously near one another. Due to the principle of decibel addition, this could potentially result in greater noise levels than those that would be generated by a single pile driver. However, an analysis of pile-driving noise conducted for the CRC project demonstrated that pile strikes from two impact pile drivers would need to be synchronous (within 0.0 and approximately 0.1 seconds apart) to produce higher noise levels than a single pile driver operating alone and found that this level of synchronicity is highly unlikely, and not reasonably certain to occur. The analysis in this document, therefore, assumes that the operation of two impact pile drivers simultaneously would not generate underwear noise levels that are greater than those associated with a single pile driver.

It is estimated that a total of approximately 3,200 temporary piles would be installed and removed during the multi-year construction of the Columbia River and North Portland Harbor bridges. These piles would be staged throughout the in-water construction and demolition periods, and it is assumed that 100 to 400 piles may be in the water at a given time.

An average of six temporary, load-bearing piles could be installed per day using one or two impact drivers. It is estimated that some amount of impact pile driving in the Columbia River or North Portland Harbor would occur on approximately 735 days over the course of the approximately nine seasons of in-water work to construct the new bridges and demolish the existing bridges.

It is estimated that up to approximately 300 impact strikes may be required to finish driving and/or proofing a given pile. This number of strikes would require a maximum of approximately 30 to 45 minutes of impact hammer activity. It is further estimated that two to three piles per day may be installed and/or proofed with an impact hammer, with an estimated total maximum number of 900 impact strikes per day if a single impact pile driver is in operation, or up to 1,800 impact strikes per day if two pile-driving rigs are operated concurrently. It is important to note that actual pile production rates would vary, and a typical day would likely have fewer strikes.

As described previously, a bubble curtain or similarly effective noise attenuation device would be implemented during all in-water impact pile driving, and a hydroacoustic monitoring plan would be implemented during impact pile driving to confirm the level of attenuation provided. This monitoring program would require some unattenuated pile strikes to be able to confirm the amount of attenuation provided by the system. It is estimated that up to 75 unattenuated strikes may be required, approximately one day per week, to accomplish this testing. Testing would occur on up to approximately 40 days total over the course of construction and, on each day of testing, unattenuated pile strikes would occur over a period of less than 10 minutes.

Vibratory Pile Driving and Drilled Shaft Oscillation

Installation of temporary piles would be conducted with a vibratory hammer to the extent practicable, to minimize impacts associated with underwater noise. Drilled shaft casings would be installed with either an oscillator or a vibratory hammer. In addition, installation and removal of steel sheet piles for cofferdams would also be conducted with a vibratory hammer. These vibratory driving activities are proposed to occur year-round and without the use of an attenuation device.

Vessel Noise

Various types of vessels, including barges, tug boats, and small craft, would be present during construction. These vessels would move and operate within the Columbia River and North Portland Harbor on a year-round basis. Such vessels already use this portion of the study area in relatively high numbers; therefore, the vessels to be used in the construction of the Modified LPA do not represent a new noise source, only a potential increase in the frequency and duration of this type of activity.

While underwater noise from construction-related vessels may exceed background levels, it is not likely to be significantly louder than background noise levels. Background hydroacoustic data collected as part of the CRC test pile program in 2010 measured ambient background underwater noise levels between 111 and 118 dB_{RMS}, and maximum levels between 145 and 157 dB_{RMS} (DEA 2011).

There are very few controlled tests or repeatable observations related to the reactions of pinnipeds to vessel noise. However, Richardson et al. (1995) reviewed the literature on reactions of pinnipeds to vessels, concluding overall that seals and sea lions showed high tolerance to vessel noise. One study showed that, in water, sea lions tolerated frequent approach of vessels at close range, sometimes even congregating around fishing vessels. Because the study area is heavily traveled by commercial and recreational craft, it seems likely that seals and sea lions that transit the study area are already habituated to vessel noise. Thus, the additional vessels that would be present during construction of the Modified LPA would likely not have an effect on seals or sea lions.

EFFECTS ON FISH

Hydroacoustic Impacts to Fish from Impact Pile Driving

The current NOAA Fisheries hydroacoustic noise thresholds for injury and disturbance to fish are as follows (FHWG 2008):

- Peak pressure of 206 dB_{PEAK}
- Cumulative sound exposure level (SEL) of 187 dB_{SEL} for fish greater than or equal to 2 grams (g)
- Cumulative SEL of 183 dB_{SEL} for fish less than 2 g

Current NOAA Fisheries thresholds for disturbance to fish are represented as an average pressure or root mean square (RMS). The threshold for behavioral disturbance is 150 RMS decibels referenced to 1 micropascal (dB_{RMS} re: 1 µPa) (FHWG 2008). The areas within the primary and secondary study area that experience sound pressure levels exceeding the peak and cumulative SELs for injury are referred to as the “injury” zone, while those areas exceeding 150 dB_{RMS} re: 1 µPa for disturbance are referred to as the “behavioral effect” zone.

Underwater noise above the injury thresholds may cause a range of lethal and sublethal injuries to fish. These include barotrauma, which can result in ruptured swim bladders or other internal organs and can also result in the formation of gas bubbles in tissue, causing inflammation, cellular damage, and blockage or rupture of blood vessels. These injuries may lead to immediate or delayed mortality.

Elevated underwater sound can also result in hearing loss in fish. Such hearing loss may be temporary and reversible (temporary threshold shift [TTS]), or permanent (permanent threshold shift [PTS]). TTS is the result of fatigue of the hair cells in the inner ear and is not permanent tissue damage. PTS results from the irreversible damage of sensory hair cells in the inner ear. TTS and PTS may result in a general decrease in fitness, foraging success, ability to avoid predators, and ability to communicate. Thus, even if TTS or PTS does not directly result in death, it can result in delayed mortality.

Noise generated from construction of the Modified LPA above the 150 db_{RMS} behavioral noise level may cause behavioral changes in fish. These can include relatively immeasurable effects or minor effects, such as startling, momentary disruption in feeding, or avoidance of the study area. Depending on timing of the work, site conditions, amount of habitat affected, and duration, behavioral effects may be significant, with consequences for survival and reproduction. For example, avoidance of the study area could presumably cause delays in feeding or migration that could in turn affect spawning or outmigration success.

Table 5-2 summarizes the modeled distances within which noise from impact pile driving is expected to exceed established peak and cumulative injury thresholds for fish, as well as the established behavioral noise levels. These include the modeled distances for impact pile driving occurring both with and without the use of an attenuation device for comparison. The calculations assume that the noise attenuation device would achieve a 7 dB noise reduction at the source. Graphical representations for the modeled distances to the thresholds are provided in Figure 5-4 through Figure 5-13.

Impact pile driving would result in effects on fish that may range from behavioral disturbance to mortality, depending on the size of the fish, duration of exposure to sound pressure, proximity to the strike site, size of the pile, and the accumulated number of strikes in a given day of pile driving.

Actual exposure to noise that could result in injury would be relatively limited, restricted to the periods when impact pile driving is occurring (mid-September through mid-April) during each year of the nine in-water work seasons. Impact pile driving within the Columbia River could be conducted on a total of approximately 170 days over the course of construction and would occur for approximately 45 minutes per day on days that impact pile driving occurs. Impact pile driving within North Portland Harbor could be conducted on a total of approximately 565 days over the course of construction and would occur for approximately 23 minutes per day on days that impact pile driving occurs.

Given the nature and anticipated use of the habitat, most fish are expected to be moving through the portion of the study areas where injury and behavioral noise levels could be temporarily exceeded during impact pile driving. For this reason, most fish are not expected to be exposed to the accumulated sound from all strikes in a day. However, it is possible that some fish in the vicinity could be exposed to levels of cumulative underwater noise that exceed the injury threshold.

While the IWWW avoids the peak timing of the runs for adult and juvenile salmon and steelhead, a portion of the run for all ESU/DPS may occur within some portion of the IWWW. Adult and/or juvenile salmon and steelhead that are present within the areas identified in Table 5-2 during impact pile-driving activity could be exposed to levels of underwater noise that could result in injury or disturbance.

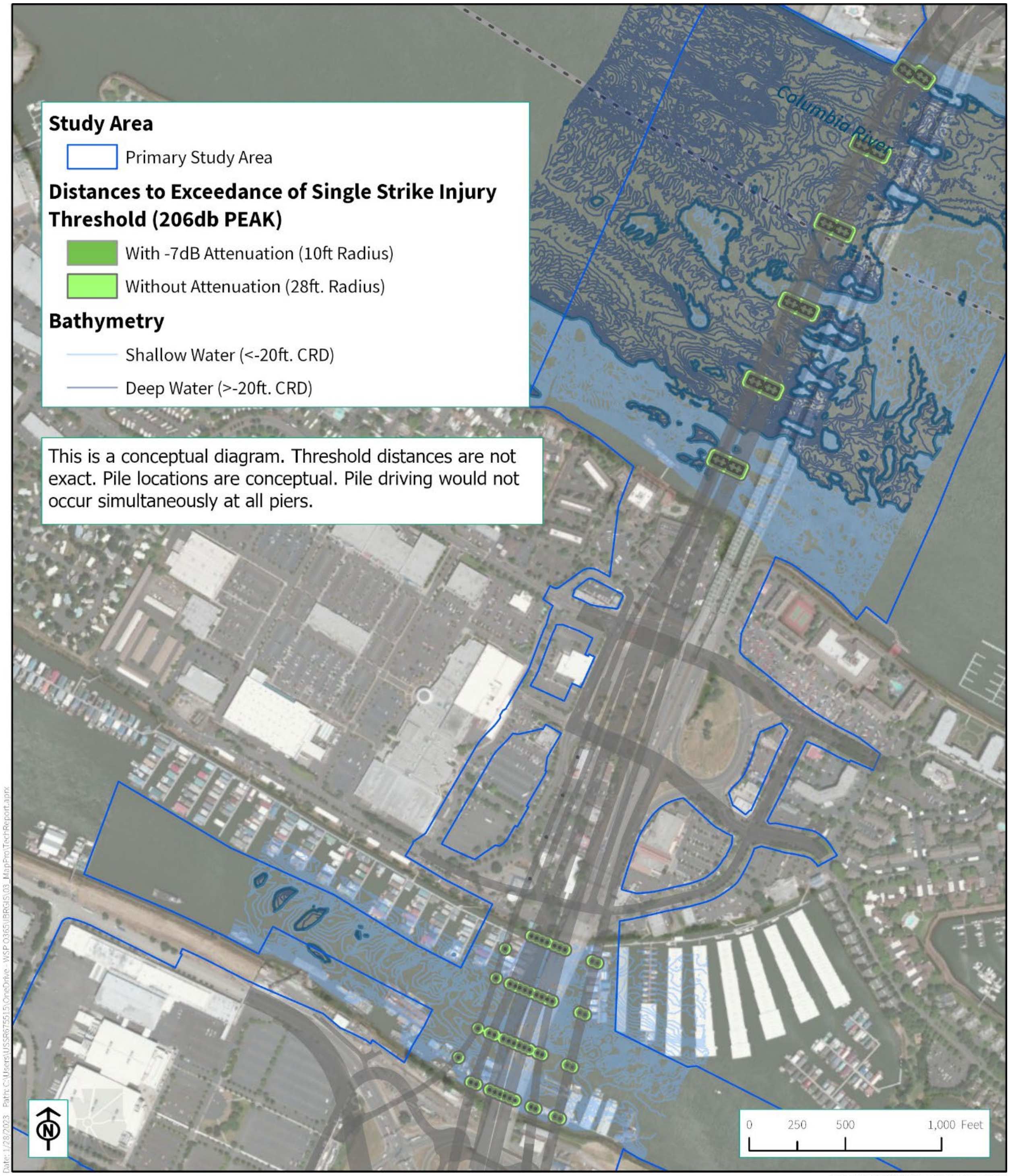
Table 5-2. Distances to Established Thresholds for Fish During Impact Pile Driving

Number of Pile Drivers	Pile Type and Dimensions	Source Decibel Levels	Max. Strikes Per Day	Distance to Single Strike Peak Injury Threshold (206 dB_{PEAK})	Distance to Cumulative Injury Threshold for Fish >2g (187 dB_{SEL})	Distance to Cumulative Injury Threshold for Fish <2g (183 dB_{SEL})	Distance to Behavioral Noise Level for Fish (150 dB_{RMS})
Without Noise Attenuation Device							
Single Impact Pile Driver	24-inch Steel	205 dB_{PEAK} 175 dB_{SEL} 190 dB_{RMS}	75	28 feet (9 meters)	92 feet (28 meters)	171 feet (52 meters)	15,228 feet (4,642 meters)
	48-inch Steel	214 dB_{PEAK} 184 dB_{SEL} 201 dB_{RMS}	75	112 feet (34 meters)	368 feet (112 meters)	680 feet (207 meters)	82,411 feet (25,119 meters)
With Noise Attenuation Device (-7dB)							
Single Impact Pile Driver	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 183 dB_{RMS}	900	10 feet (3 meters)	164 feet (50 meters)	305 feet (93 meters)	5,200 feet (1,585 meters)
	48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 194 dB_{RMS}	900	39 feet (12 meters)	660 feet (201 meters)	1,217 feet (371 meters)	28,140 feet (8,577 meters)
Two Impact Pile Drivers	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 183 dB_{RMS}	1,800	10 feet (3 meters)	262 feet (80 meters)	486 feet (148 meters)	5,200 feet (1,585 meters)
	48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 194 dB_{RMS}	1,800	39 feet (12 meters)	1,047 feet (319 meters)	1,932 feet (589 meters)	28,140 feet (8,577 meters)

dB = decibels; dB_{PEAK} = peak decibels; dB_{RMS} = decibels root mean square; dB_{SEL} = decibels sound equivalent level; g = grams; Max = maximum

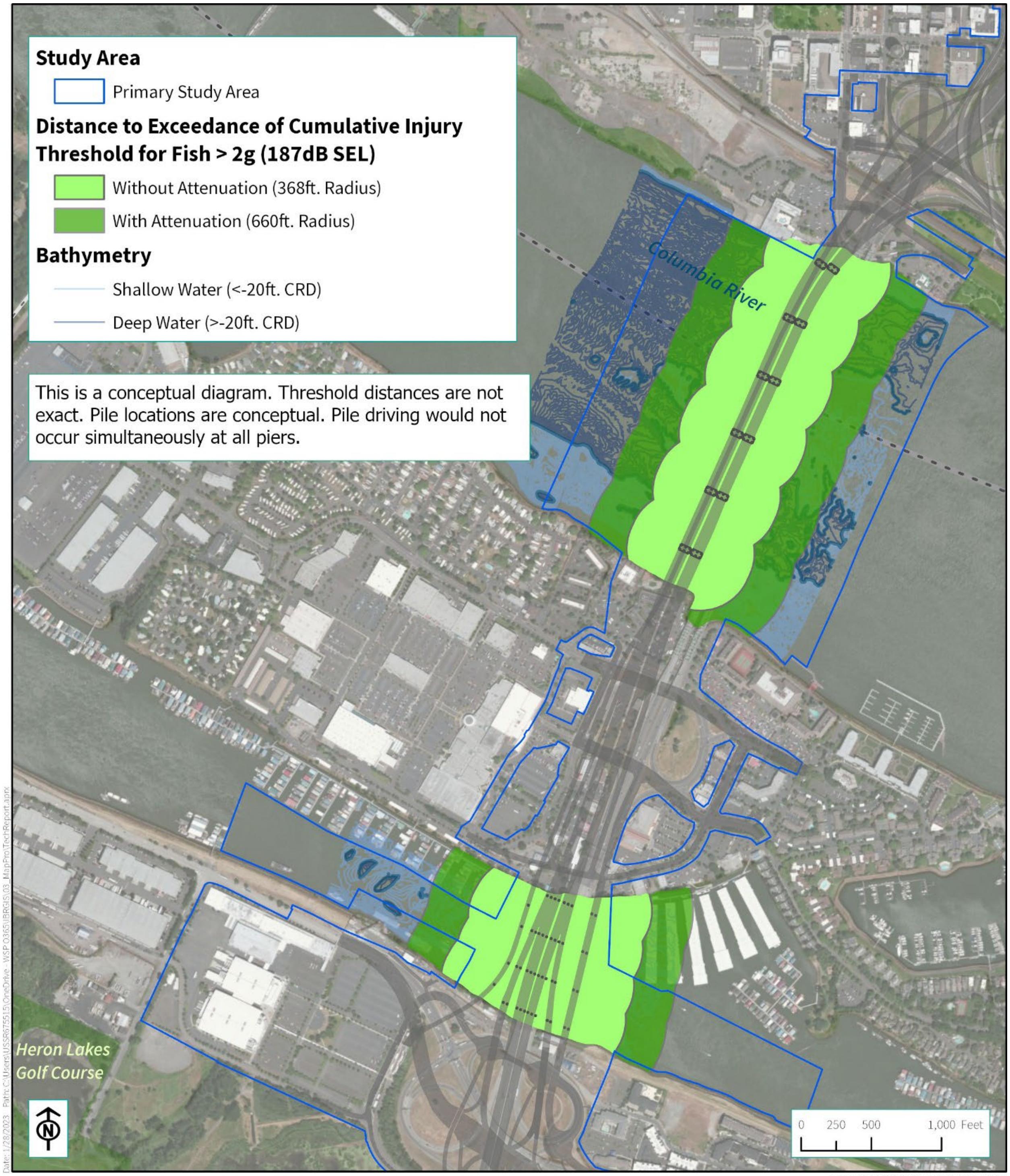
Figure 5-4. Distance to 206 dB_{Peak} Injury Threshold for Fish During Impact Pile Driving – 36- to 48-inch Pile

Figure 5-5. Distance to 206 dB_{Peak} Injury Threshold for Fish during Impact Pile Driving – 18- to 24-inch Pile



Source: ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 5-6. Distance to 187 dB_{SEL} Cumulative Injury Threshold for Fish >2 g during Impact Pile Driving – 36- to 48-inch Pile, Single Pile Driver



Source: ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 5-7. Distance to 187 dB_{SEL} Cumulative Injury Threshold for Fish >2 g during Impact Pile Driving – 18- to 24-inch Pile, Single Pile Driver

Source: ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 5-8. Distance to 187 dB_{SEL} Cumulative Injury Threshold for Fish >2 g during Impact Pile Driving – All Pile Sizes, Multiple Pile Drivers

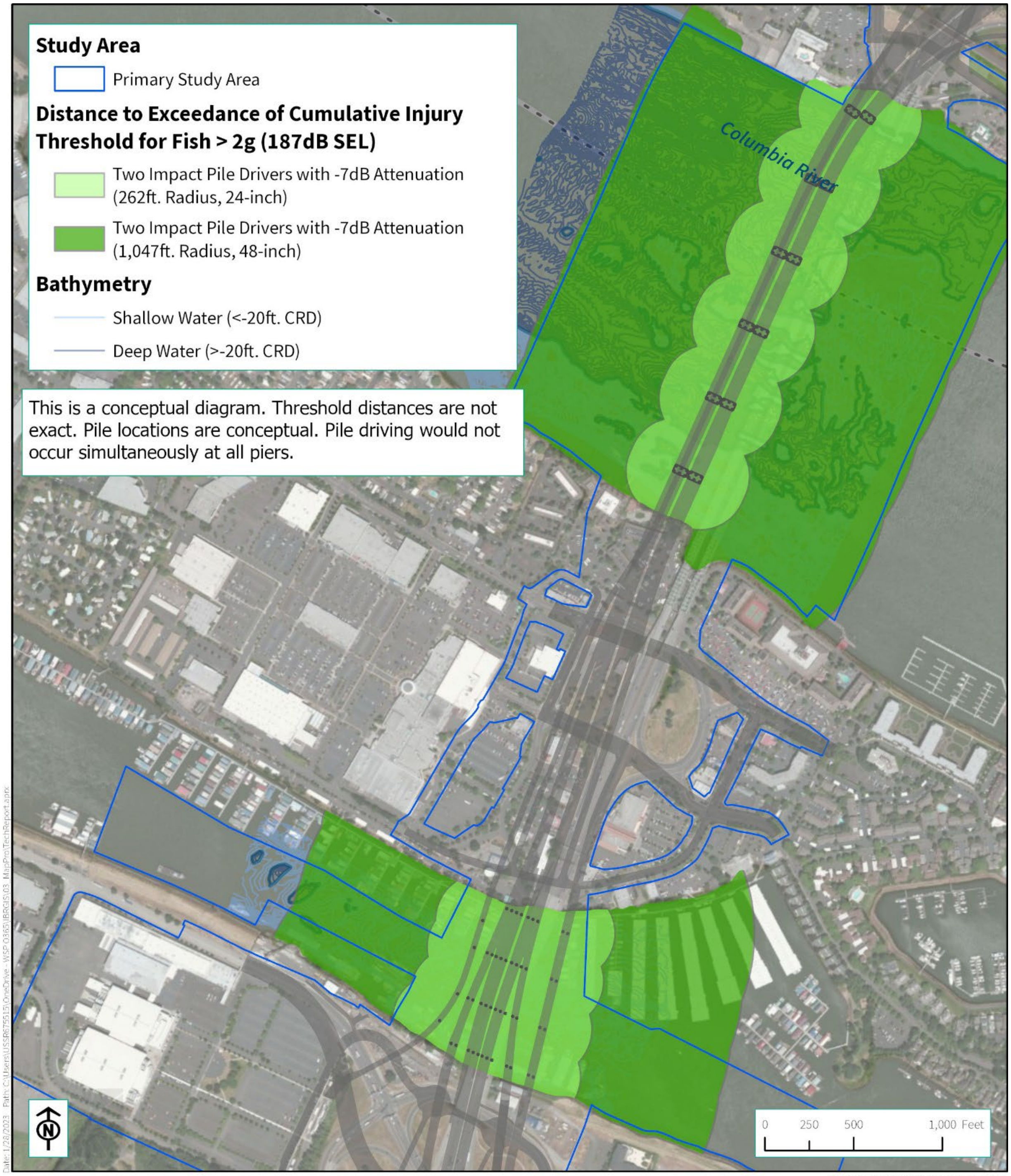
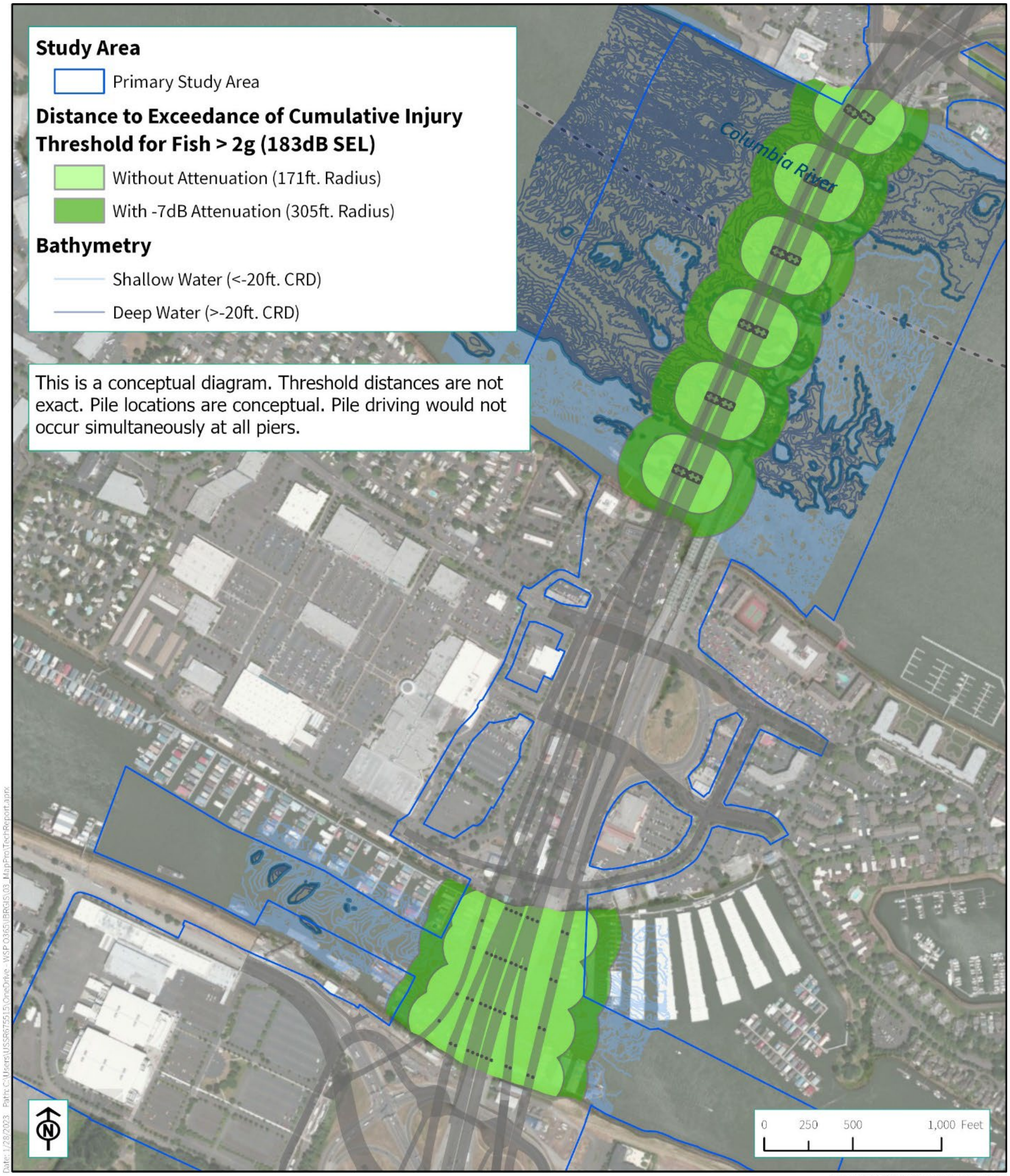


Figure 5-9. Distance to 183 dB_{SEL} Cumulative Injury Threshold for Fish <2 g During Impact Pile Driving – 36- to 48-inch Pile, Single Pile Driver

Figure 5-10. Distance to 183 dB_{SEL} Cumulative Injury Threshold for Fish <2 g during Impact Pile Driving – 18- to 24-inch Pile, Single Pile Driver



Source: ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 5-11. Distance to 183 dB_{SEL} Cumulative Injury Threshold for Fish <2 g during Impact Pile Driving – All Pile Sizes, Multiple Pile Drivers

Figure 5-12. Distance to 150 dB_{RMS} Disturbance Thresholds during Impact Pile Driving – 36- to 48-inch Pile

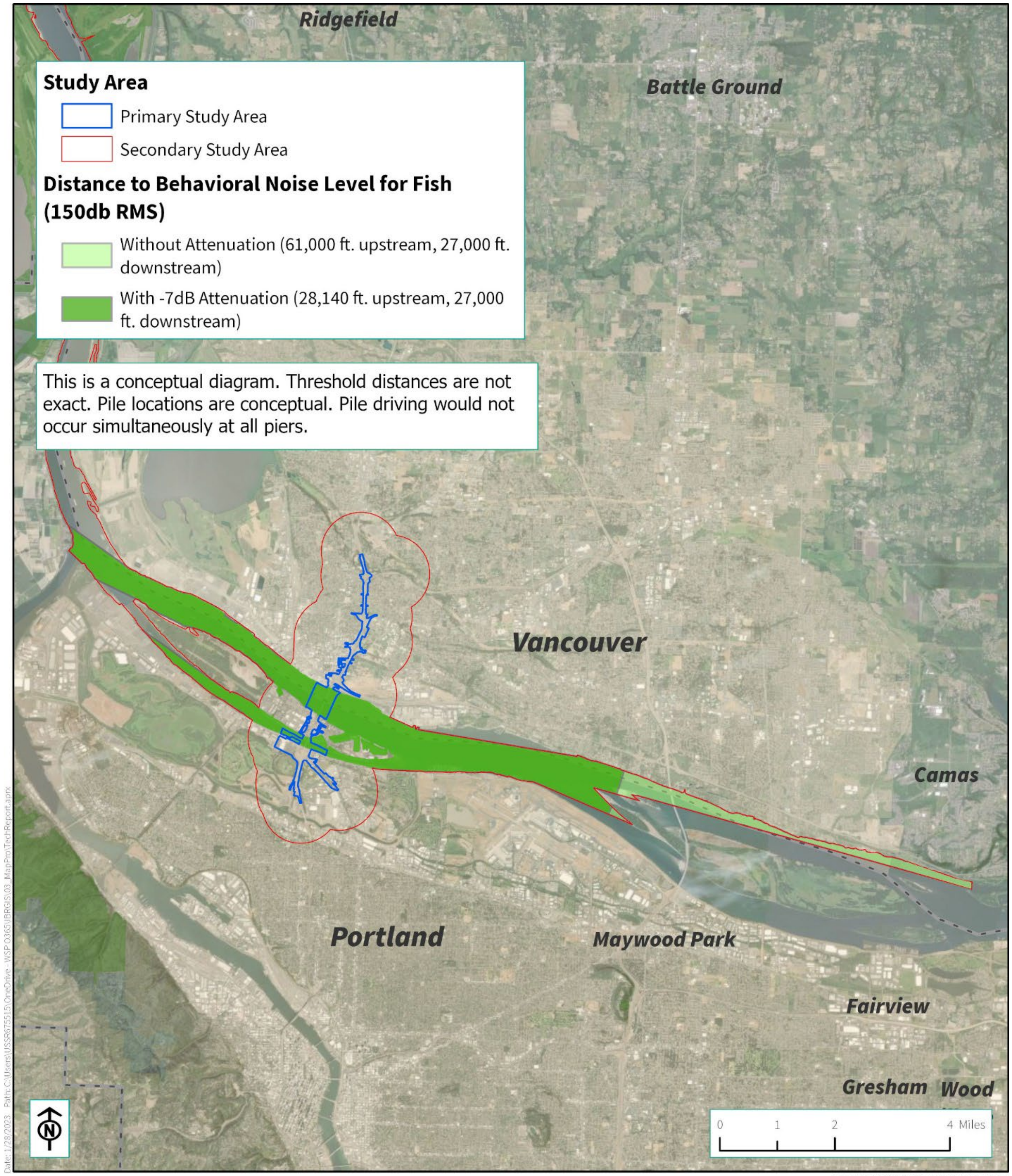
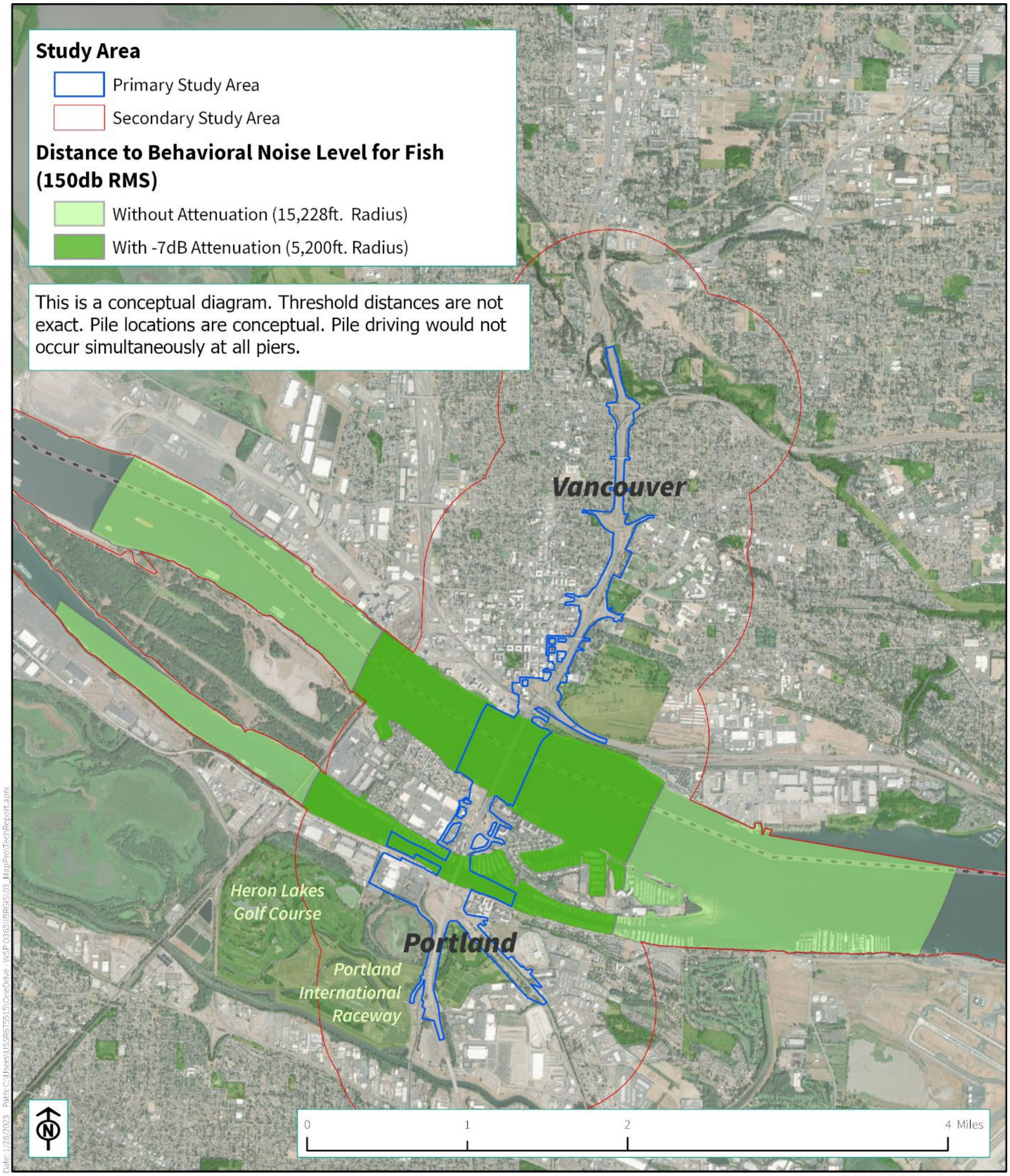


Figure 5-13. Distance to 150 dB_{RMS} Disturbance Thresholds during Impact Pile Driving – 18- to 24-inch Pile



Fish with swim bladders, including salmon, steelhead, and sturgeon, are particularly sensitive to underwater impulsive sounds (Hastings and Popper 2005). Pacific eulachon, Pacific lamprey, and river lamprey do not have swim bladders and may be less susceptible to injury associated with elevated underwater noise levels (Caltrans 2020). However, they are likely still susceptible to general pressure wave injuries, and damage to the auditory system and elevated levels of underwater noise may also result in temporary behavioral effects on these species.

In summary, all species and life stages of salmon, steelhead, eulachon, lamprey, green sturgeon, white sturgeon, and other resident fish are likely to be subject to potential injury and disturbance effects as salmon and steelhead if present during impact pile driving.

Bull trout are not expected to be present in the area where construction-related underwater noise could occur, and this element of construction of the Modified LPA is not likely to appreciably impact green sturgeon or bull trout.

Hydroacoustic Impacts to Fish from Vibratory Pile Driving and Drilled Shaft Oscillation

Currently, there are no established injury thresholds for noise levels generated during vibratory pile driving or drilled shaft oscillation that are likely to cause injury or behavioral disturbance to fish.

The maximum anticipated underwater sound pressure levels generated during vibratory pile driving are estimated to be approximately 185 dB_{PEAK} and 175 dB_{RMS} for piles of all size classes (Caltrans 2020). For a conservative estimate of potential underwater noise generation, it is assumed that underwater noise levels during oscillation would similarly not exceed 185 dB_{PEAK} and 175 $dB_{RMS.}$ However, underwater sound pressure levels associated with oscillation of drilled shaft casings are generally lower than those associated with vibratory pile driving (HDR 2011).

It is conservatively estimated that vibratory pile driving, pile removal, and drilled shaft oscillation activity could result in temporarily elevated underwater noise throughout the portion of the secondary study area that is approximately 5.5 miles downstream and 12.5 miles upstream.

Vibratory pile driving and removal would be required for aspects of both construction and demolition and, as such, could be conducted throughout the in-water construction period. It is further estimated that some amount of vibratory pile driving, pile removal, or drilled shaft oscillation could be conducted seven days per week, and year-round throughout the in-water construction period. It is estimated that up to 5 hours of vibratory pile driving, pile removal, and drilled shaft oscillation could be conducted on a given day.

Vibratory pile installation and removal has the potential to result in behavioral responses that could include temporary avoidance of the area, changes in migratory routes, predator avoidance, or interruption of reproduction. While these behavioral responses could potentially affect some individuals, these disturbance-level effects will not be expected to rise to the level of adverse effect.

All of the species and life stages of salmon, steelhead, eulachon, lamprey, green sturgeon, white sturgeon, and other resident fish that use aquatic habitats within the Columbia River and North Portland Harbor could be exposed to these effects when they are present in the portion of the primary and secondary study areas where underwater noise would be elevated. Adult and/or juvenile fish that are present within the area where underwater noise would be temporarily elevated during vibratory pile driving, pile removal, and drilled shaft oscillation may also be exposed to levels of underwater noise that could result in behavioral disturbance. However, this activity is unlikely to injure fish and is not expected to significantly interfere with behaviors such as migration, rearing, or foraging. Thus, vibratory pile driving, pile removal, and drilled shaft oscillation are not likely to adversely affect these species.

Due to the extremely limited numbers of green sturgeon and bull trout in the portion of the primary and secondary study areas where underwater noise would be elevated, risk of exposure is discountable. Thus, this element of construction of the Modified LPA is not likely to appreciably impact green sturgeon or bull trout.

EFFECTS ON MARINE MAMMALS

The MMPA categorizes harassment of marine mammals according to two categories: Level A harassment (harassment resulting in injury or direct mortality) and Level B harassment (harassment resulting in disturbance, but not rising to the level of injury or mortality).

Temporarily elevated underwater and in-air noise during vibratory and impact pile installation, vibratory pile removal, installation of drilled shaft casings with an oscillator, and removal of existing concrete bridge foundations with a wiresaw has the potential to result in Level A and Level B harassment of marine mammals that may be present during construction.

Table 5-3 and Table 5-4 show the disturbance and injury thresholds that NOAA Fisheries has established for Levels A and B harassment for underwater noise.

Table 5-3. Level A Harassment Threshold Decibel Levels for Underwater Noise

Marine Mammal Hearing Group	Impulsive Sounds	Non-impulsive Sounds
Phocid Pinnipeds (PW) (Underwater)	223 dBpk 183 dBLe	195 dBpk
Otariid Pinnipeds (OW) (Underwater)	230 dBpk 185 dBLe	199 dBpk

Key: dBpk = peak noise level; dBLe = cumulative noise level averaged over a 24-hour period

Table 5-4. Level B Harassment Threshold Decibel Levels for Underwater Noise

Source Type	Threshold
Behavioral disruption for non-explosive impulsive or intermittent noise (e.g., impact pile driving)	160 dB_{RMS}
Behavioral disruption for continuous noise (e.g., vibratory pile driving)	120 dB_{RMS}

Note: Underwater decibel levels are based on root mean square (RMS) levels, referenced to 1 micropascal (re: 1 µPa).

Key: dB_{RMS} = decibels root mean square

Attenuation to NOAA Thresholds for Marine Mammal Harassment

Level A Harassment Isopleths

Level A harassment of marine mammals associated with underwater noise can occur either through peak sound pressures or through accumulated sound pressure.

In 2018, NOAA published the *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (2018 Guidance) (NOAA Fisheries 2018b), which establishes methodologies for calculating attenuation to the peak and cumulative Level A thresholds for marine mammals.

The 2018 NOAA guidance includes a spreadsheet that uses simplified weighting factor adjustments to calculate the distances to the cumulative sound exposure levels for a given pile size and type (NOAA Fisheries 2018b). The calculations are based upon the source sound level, the number of pile strikes over a given duration, and the propagation properties of the surrounding waters.

In May 2024, NOAA published a draft update to the 2018 Guidance entitled *2024 Update to: 2 Technical Guidance for Assessing the Effects of 3 Anthropogenic Sound on Marine Mammal Hearing 4 (Version 3.0)* (NOAA Fisheries 2024a). This document was published for a 45-day public comment period. NOAA anticipates that the Updated Technical Guidance document will be finalized in summer 2024, and that there will not likely be substantive changes to the thresholds or calculator that were provided in the public review draft (pers comm. Cara Hotchkin, July 2024). For this reason, the noise attenuation calculations, thresholds, and references to the Technical Guidance presented in this document reflect the updates in, and are consistent with, the Draft 2024 Updated Technical Guidance.

For the Modified LPA, the principles in the Draft 2024 Updated Technical Guidance (NOAA Fisheries 2024b) has been applied based on the following assumptions.

- The following source decibel levels were used to calculate cumulative sound pressure exposure for scenarios where only a single pile driver, oscillator, or wiresaw is in operation.
  - ➢ Impact Pile Driving (Installation):
    a. 48-inch steel pipe pile: 214 dB_{PEAK}; 201 dB_{RMS}; 184 dB_{SEL} (measured at 10 meters, before attenuation)
    b. 24-inch steel pipe pile: 205 dB_{PEAK}; 190 dB_{RMS}; 175 dB_{SEL} (measured at 10 meters, before attenuation)
  - ➢ Vibratory Pile Driving (Installation and Removal):
    a. 48-inch and 24-inch steel pipe piles, and steel sheet piles: 175 dB_{RMS} (measured at 5 meters, without attenuation) (Caltrans 2020)
  - ➢ 10-foot-diameter drilled shaft casings (oscillation): 143.8 dB_{RMS}; (measured at 10 meters, without attenuation) (NOAA Fisheries 2022)
  - ➢ Removal of existing concrete foundations (wiresaw): 155.6 dB_{RMS}; (measured at 10 meters, without attenuation) (US Navy 2017)
- The following adjustments were made for scenarios where two pile drivers are in operation simultaneously, consistent with NOAAs draft Simultaneous Source Guidance (NOAA Fisheries 2024a):

- Two Impact Pile Drivers (Installation)
  - Two 48-inch steel pipe piles: 207 dB_{PEAK}; 197 dB_{RMS}; 177 dB_{SEL} (measured at 10 meters, with -7dB attenuation)
  - One 48-inch and one 24-inch steel pipe pile: 207 dB_{PEAK}; 197 dB_{RMS}; 177 dB_{SEL} (measured at 10 meters, with -7dB attenuation)
  - Two 24-inch steel pipe piles: 198 dB_{PEAK}; 186 dB_{RMS}; 168 dB_{SEL} (measured at 10 meters, with -7dB attenuation)
- Propagation of underwater noise through the water column was assumed to adhere to the practical spreading loss model (15*logR where R=the distance at which source decibel levels were calculated).

It is important to note that NOAA acknowledges that the User Spreadsheet that was developed for the 2024 Updated Technical Guidance relies on multiple conservative assumptions and, therefore, is expected to typically result in higher estimates of instances of potential injury. For example, the calculations in the User Spreadsheet were developed based on a conservative assumption that marine mammals are stationary during a given activity. However, seals and sea lions in this reach of the mainstem Columbia River are typically moving through the area, and are unlikely to be exposed to the entire duration of a given activity.

The noise attenuation calculations are summarized in Table 5-5 and shown graphically in Figure 5-14 through Figure 5-20.

Table 5-5. Summary of Attenuation to Level A Isopleths by Activity

Activity and Quantity	Attenuation Device (Y/N)	Type and Size	Source Decibel Levels	Max. Strikes Per Day	Level A (Peak) Isopleth	Level A (Cumulative) Isopleth
Impact Pile Driving (Installation)						
Single Impact Pile Driver	None (for Hydroacoustic Testing Purposes Only)	24-inch Steel	205 dB_{PEAK} 175 dB_{SEL} 190 dB_{RMS}	75	N/A	151 feet (46 meters)
		48-inch Steel	214 dB_{PEAK} 184 dB_{SEL} 201 dB_{RMS}	75	8.2 feet (2.5 meters)	601 feet (183.3 meters)
Single Impact Pile Driver	Bubble Curtain (-7 dB attenuation)	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 183 dB_{RMS}	900	N/A	270 feet (82.4 meters)
		48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 194 dB_{RMS}	900	N/A	1,076 feet (328 meters)
Two Impact Pile Drivers	Bubble Curtain (-7 dB attenuation)	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 186 dB_{RMS}	1,800	N/A	430 feet (130.8 meters)
		48-inch Steel Or 24- and 48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 197 dB_{RMS}	1,800	N/A	1,708 feet (520.7 meters)
Vibratory Pile Driving (Installation and Removal)						
Single Vibratory Pile Driver	None	24- and 48-inch steel pipe piles; steel sheet piles	175 dB_{RMS}	N/A – 600 minutes per day	N/A	775 feet (236.3 meters)
Two Vibratory Pile Drivers	None	24- and 48-inch steel pipe piles; steel sheet piles	178 dB_{RMS}	N/A – 600 minutes per day	N/A	1,229 feet (374.5 meters)
Drilled Shaft Casing Installation (Oscillator)						
Single Oscillator	None	10-foot-diameter steel casings	143.8 dB_{RMS}	N/A – 1,080 minutes per day	N/A	19 feet (5.8 meters)
Bridge Foundation Removal (Wiresaw)						
Single Wiresaw	None	Existing concrete bridge foundations (size variable)	155.6 dB_{RMS}	N/A – 720 minutes per day	N/A	89 feet (27.2 meters)

Key: dB_{PEAK} = peak decibels; dB_{RMS} = decibels root mean square; dB_{SEL} = decibels sound equivalent level; N/A = not applicable

Level B Harassment Isopleths

NOAA Fisheries has established 160 dB_{RMS} as the Level B harassment threshold for marine mammals during impact pile driving, and 120 dB_{RMS} as the Level B harassment threshold for marine mammals during vibratory pile driving and removal.

The distances to the Level B isopleths associated with underwater noise were established using the practical spreading loss model. This model, currently recognized by both the USFWS and NOAA Fisheries as the best method to determine underwater noise attenuation rates, assumes a 4.5-decibel (dB) reduction per doubling of distance (WSDOT 2024). The baseline underwater noise level in the portion of the Columbia River that is within the action area is conservatively assumed to be approximately 120 dB_{RMS} (WSDOT 2024), although actual background underwater noise levels may be higher, given the amount of vessel activity.

The practical spreading loss model (see above) uses the following equation to model underwater noise attenuation.

$$TL = 15 \log(R1/R2) + \alpha R$$

Solving this equation for R1, calculates the distance at which construction noise would attenuate to the established threshold distances.

$$R1 = (10^{(TL/15)})(R2)$$

The variables are defined as follows.

- TL = Transmission loss (known noise level - threshold noise level)
- R1 = The distance at which noise attenuates
- R2 = Range of the known noise level (10 meters [33 feet] in this case)
- αR = Linear absorption rate (WSDOT currently recommends that this factor not be used for modeling purposes, so it was not included in the analysis.)

The following equations show the modeled attenuation distances to the Level B isopleths by activity:

- One Impact Pile Driver (Unattenuated)
  - 24-inch Pile: 190 dB_{RMS} = (10([190-160]/15))(10) = 1,000 meters (3,280 feet)
  - 48-inch Pile: 201 dB_{RMS} = (10([201-160]/15))(10) = 5,412 meters (17,750 feet)
- One Impact Pile Driver (-7dB Attenuation)
  - 24-inch Pile: 183 dB_{RMS} = (10([183-160]/15))(10) = 341 meters (1,120 feet)
  - 48-inch Pile: 194 dB_{RMS} = (10([194-160]/15))(10) = 1,848 meters (6,061 feet)
- Two Impact Pile Drivers (-7dB Attenuation)
  - 24-inch Pile: 186 dB_{RMS} = (10([186-160]/15))(10) = 541 meters (1,775 feet)
  - 48-inch Pile: 197 dB_{RMS} = (10([197-160]/15))(10) = 2,929 meters (9,606 feet)
- One Vibratory Pile Driver:
  - 24- and 48-inch Piles: 175 dB_{RMS} = (10([175-160]/15))(10) = 46,414 meters (152,244 feet)
- Two Vibratory Pile Drivers:
  - 24- and 48-inch Piles: 178 dB_{RMS} = (10([178-160]/15))(10) = 73,564 meters (241,291 feet)
- Drilled Shaft Casing Installation (Oscillator)
  - 10-foot steel casing: 143.8 dB_{RMS} = (10([143.8-120]/15))(10) = 386 meters (1,266 feet)

- Bridge Foundation Removal (Wiresaw)
  - Existing Foundations: 155.6 dB_{RMS} = (10([155.6-120]/15))(10) = 2,362 meters (7,748 feet)

The noise attenuation calculations are summarized in Table 5-6 and shown graphically in Figure 5-14 through Figure 5-20.

Table 5-6. Summary of Attenuation to Level B Isopleths by Activity

Activity and Quantity	Attenuation Device (Y/N)	Type and Size	Source Decibel Levels	Max. Strikes Per Day	Distance to Level B Isopleth for Underwater Noise
Impact Pile Driving (Installation)					
Single Impact Pile Driver	None (For Hydroacoustic Testing Purposes Only)	24-inch teel	205 dB_{PEAK} 175 dB_{SEL} 190 dB_{RMS}	75	3,280 feet (1,000 meters)
		48-inch Steel	214 dB_{PEAK} 184 dB_{SEL} 201 dB_{RMS}	75	17,750 feet (5,412 meters)
Single Impact Pile Driver	Bubble Curtain (-7 dB attenuation)	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 183 dB_{RMS}	900	1,120 feet (341 meters)
		48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 194 dB_{RMS}	900	6,061 feet (1,848 meters)
Two Impact Pile Drivers	Bubble Curtain (-7 dB attenuation)	24-inch Steel	198 dB_{PEAK} 168 dB_{SEL} 186 dB_{RMS}	1,800	1,775 feet (541 meters)
		48-inch Steel or 24- and 48-inch Steel	207 dB_{PEAK} 177 dB_{SEL} 197 dB_{RMS}	1,800	9,606 feet (2,929 meters)
Vibratory Pile Driving (Installation and Removal)					
One Vibratory Pile Driver	None	24 and 48-inch Steel Pipe Piles; Steel Sheet Piles	175 dB_{RMS}	N/A – 600 minutes per day	152,244 feet (46,414 meters)
Two Vibratory Pile Drivers	None	24 and 48-inch Steel Pipe Piles; Steel Sheet Piles	178 dB_{RMS}	N/A – 600 minutes per day	241,291 feet (73,564 meters)
Drilled Shaft Casing Installation (Oscillator)					
One Oscillator	None		143.8 dB_{RMS}	N/A – 1,080 minutes per day	1,266 feet (386 meters)

Activity and Quantity	Attenuation Device (Y/N)	Type and Size	Source Decibel Levels	Max. Strikes Per Day	Distance to Level B Isopleth for Underwater Noise
		10-foot-diameter steel casings			
Bridge Foundation Removal (Wiresaw)					
One Wiresaw	None	Existing concrete bridge foundations (size variable)	155.6 dB_{RMS}	N/A – 720 minutes per day	7,748 feet (2,362 meters)

Key: dB_{PEAK} = peak decibels; dB_{RMS} = decibels root mean square; dB_{SEL} = decibels sound equivalent level; N/A = not applicable

Figure 5-14. Level A and B Underwater Isopleths During Impact Pile Driving - One Pile Driver; No Attenuation

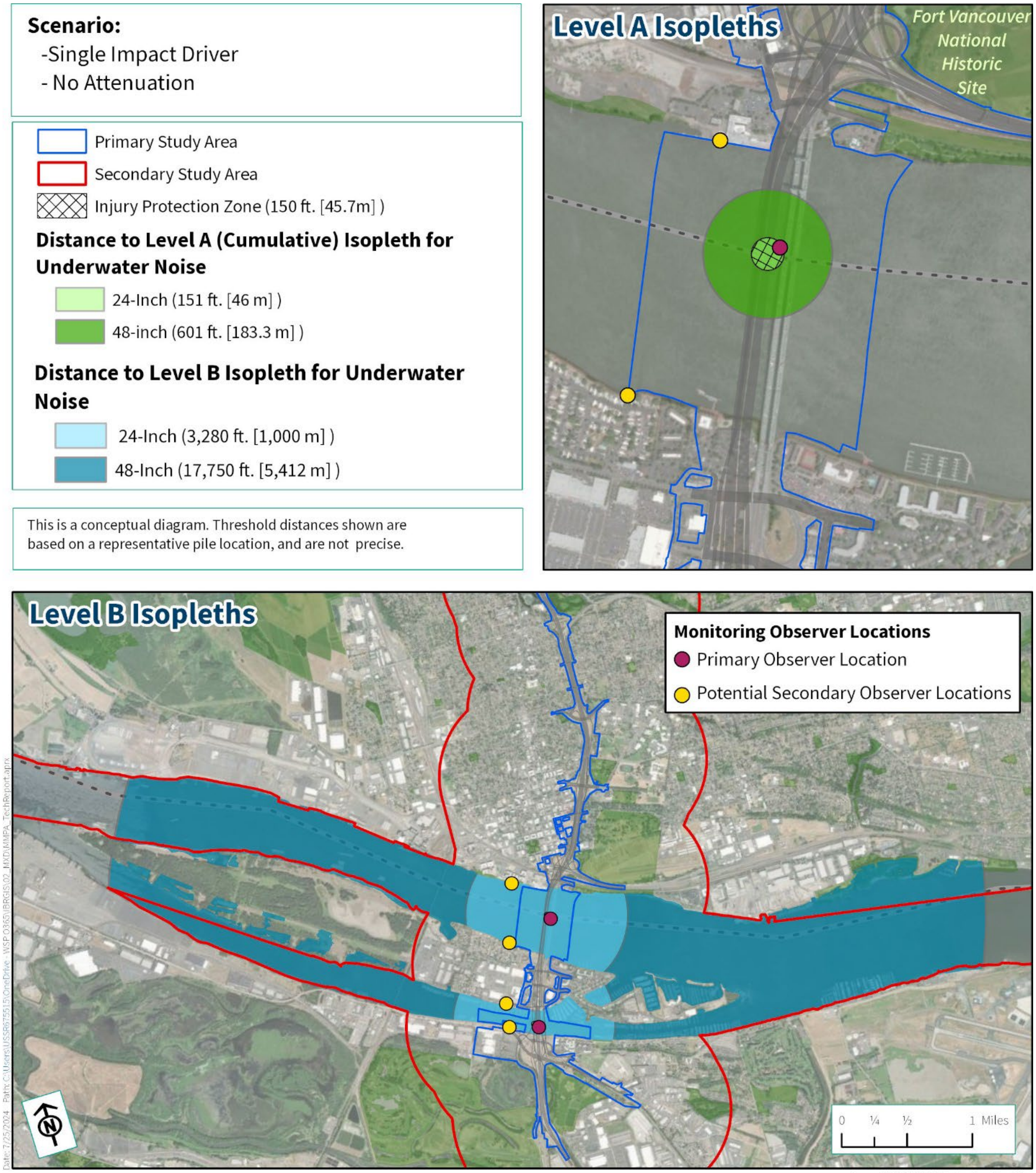


Figure 5-15. Level A and B Underwater Isopleths During Impact Pile Driving - One Pile Driver; With Bubble Curtain

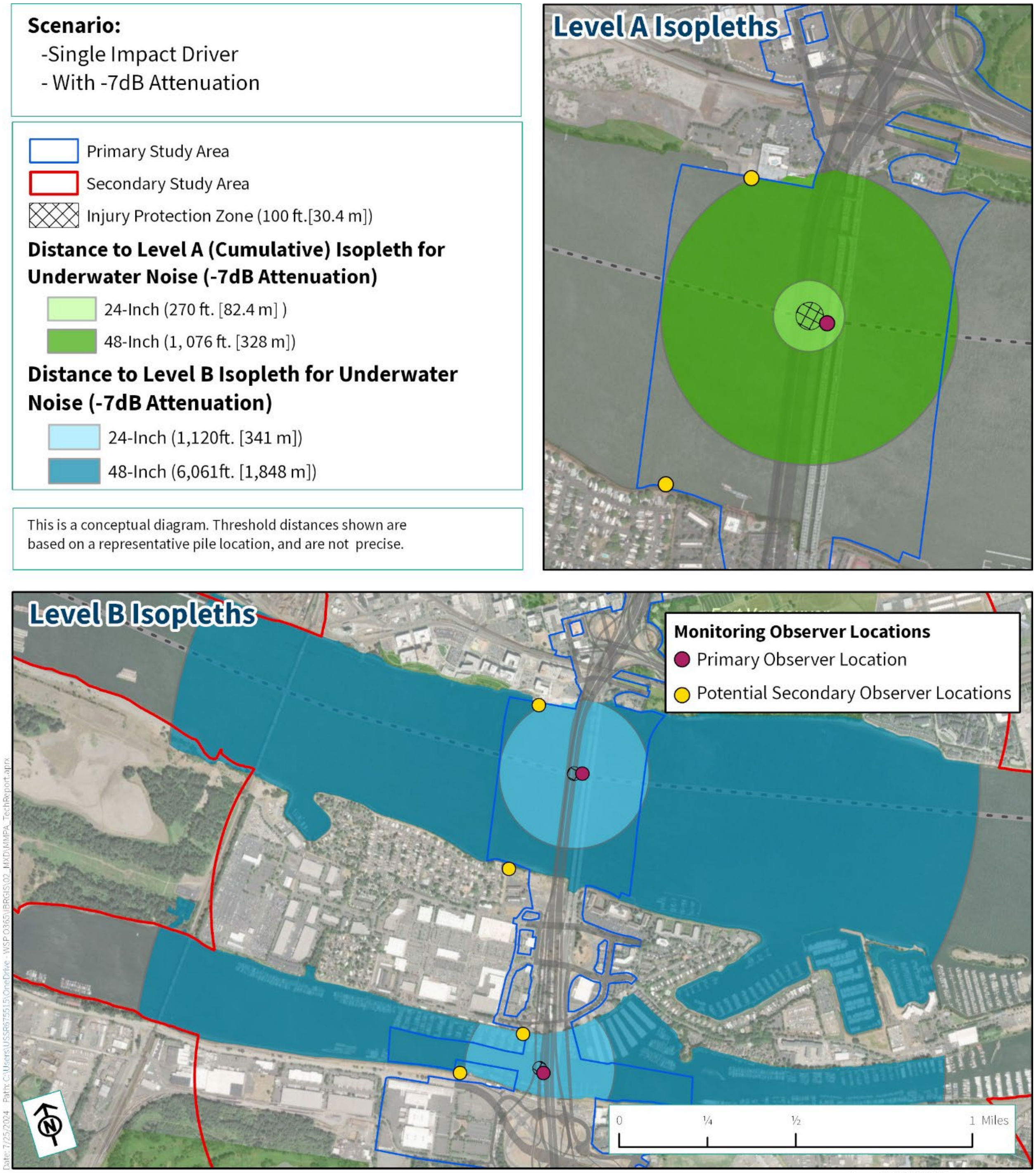


Figure 5-16. Level A and B Underwater Isopleths During Impact Pile Driving - Two Pile Drivers; With Bubble Curtain

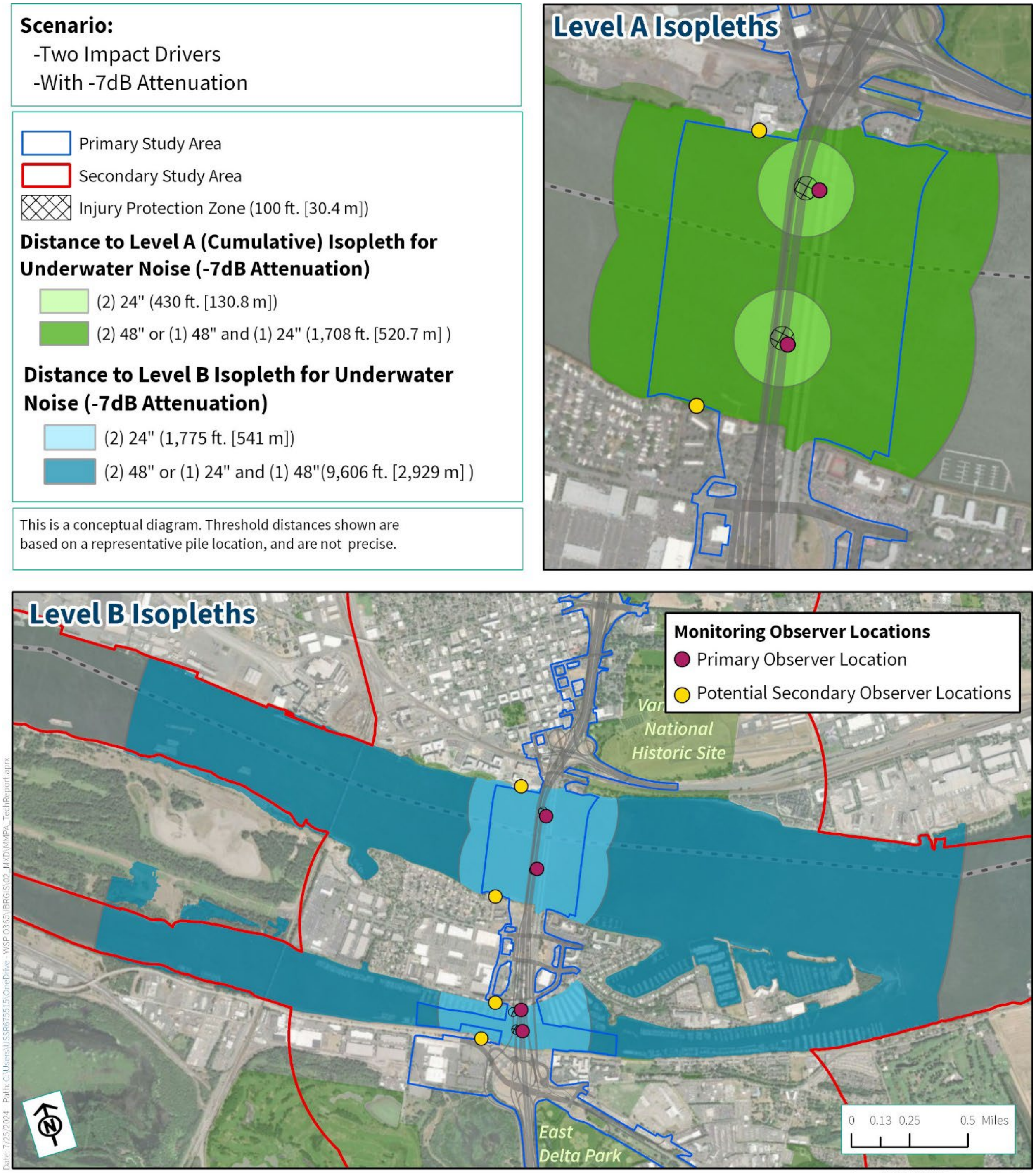


Figure 5-17. Level A and B Underwater Isopleths During Vibratory Pile Driving - One Pile Driver

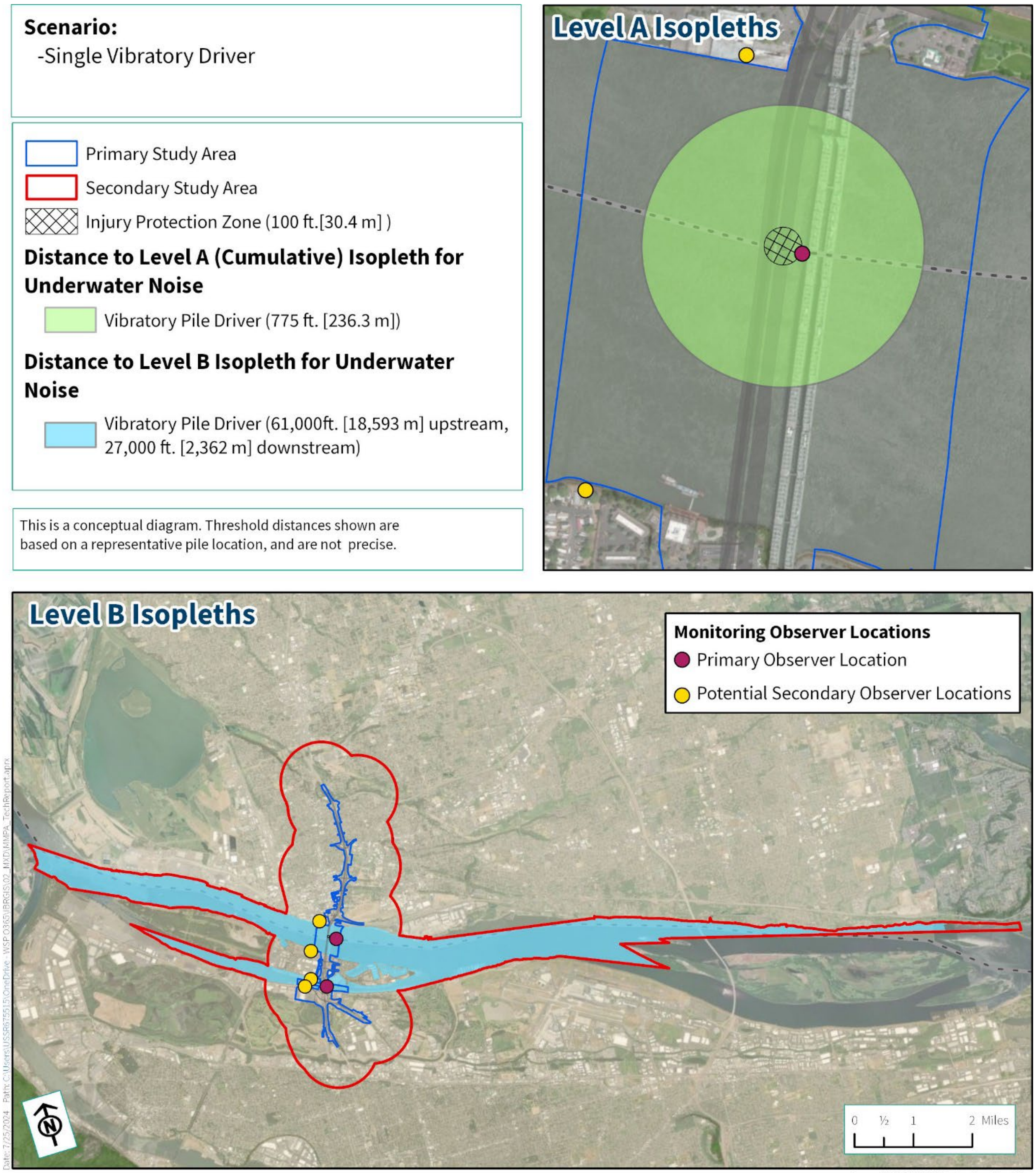


Figure 5-18. Level A and B Underwater Isopleths During Vibratory Pile Driving - Two Pile Drivers

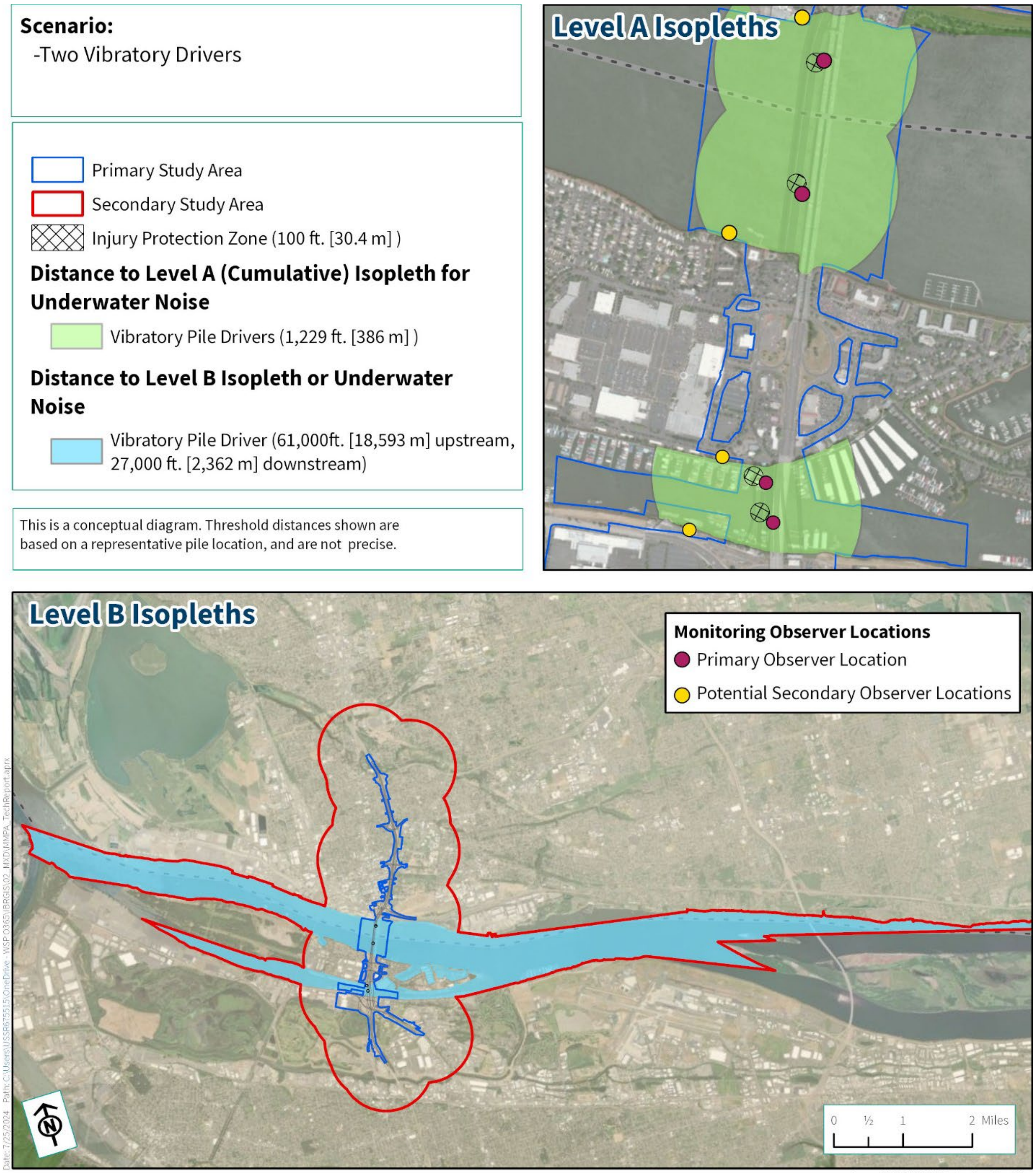


Figure 5-19. Level A and B Underwater Isopleths During Drilled Shaft Casing Installation Via Oscillator

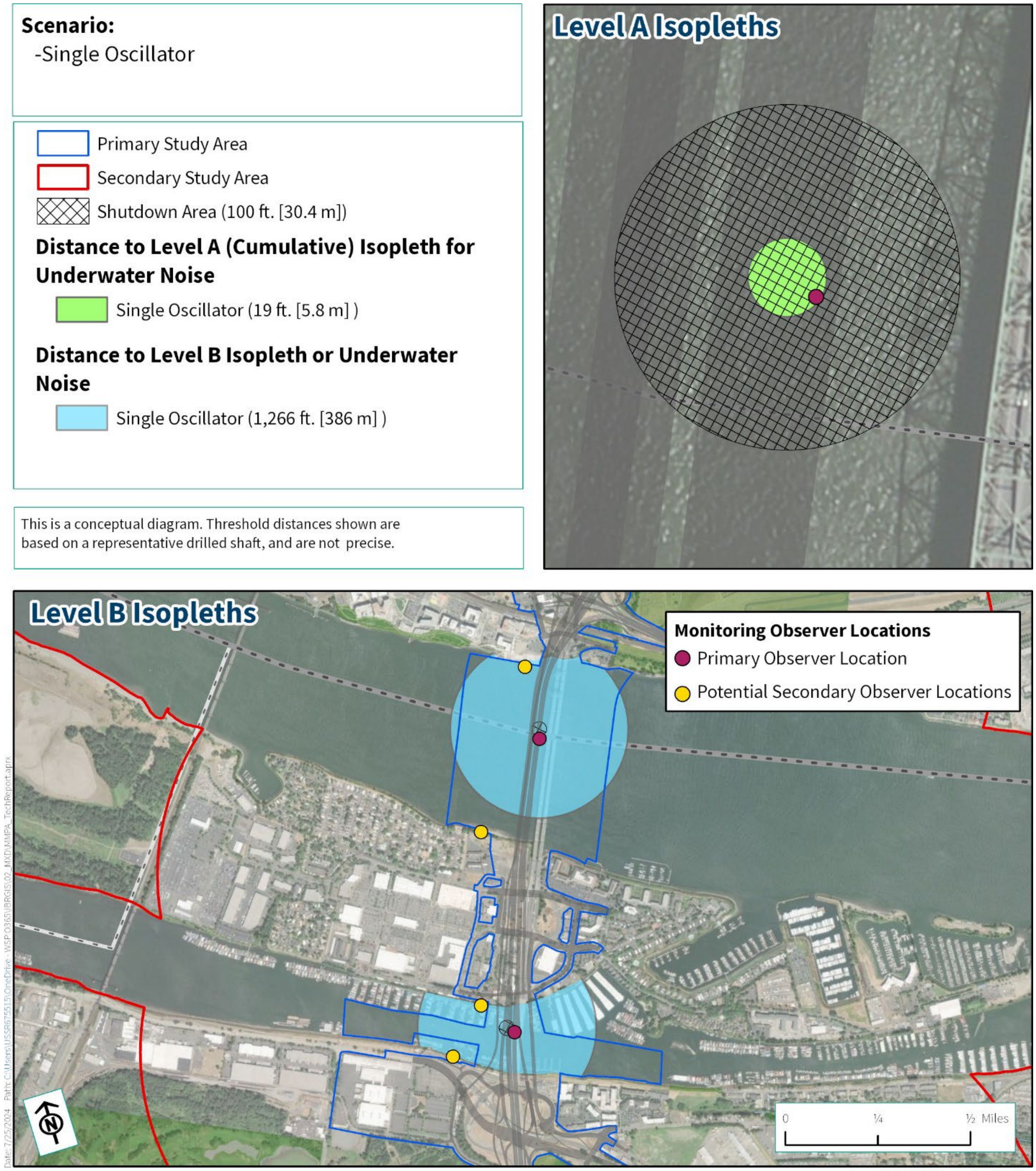
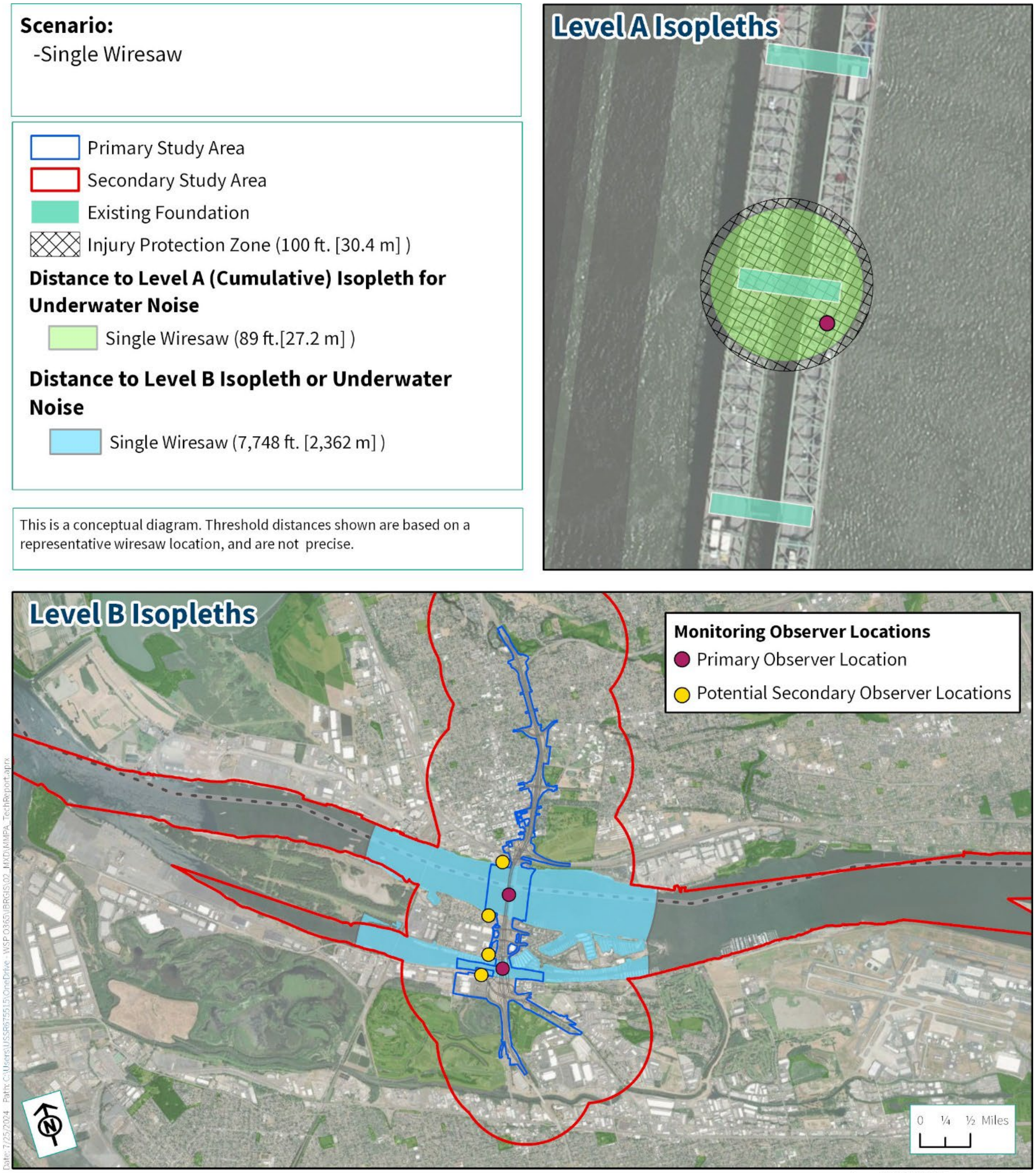


Figure 5-20. Level A and B Underwater Isopleths During Foundation Removal Via Wiresaw



Effects Discussion

Construction of the Modified LPA would result in temporarily elevated underwater noise during certain activities (specifically, pile installation and removal, installation of drilled shaft casings with an oscillator, and operation of a wiresaw) that have the potential to result in incidental harassment of marine mammals as defined under the MMPA. Appropriate authorization would be secured in the form of a Letter of Authorization (LOA), prior to conducting these activities.

The best source of current density data for California sea lion and Steller sea lion within the Columbia River is the most recent USACE report on pinniped presence and salmonid predation at Bonneville Dam, which reports data from pinniped monitoring conducted in 2022 (Tidwell et al. 2023). This document likely provides an accurate estimate of the number of sea lions that transit the primary study area in a given year, as each sea lion is likely traveling to or from Bonneville Dam and, therefore, captured in the annual counts. Each animal counted at the dam would transit the primary study area twice in a given season.

However, the USACE Bonneville Dam monitoring data likely underestimates the density of harbor seals that transit the primary study area. Harbor seals are relatively more common in the lower reaches of the river but are only occasionally observed as far upriver as Bonneville Dam. For this reason, estimated harbor seal density is based on density data presented in a recent Incidental Harassment Authorization (IHA) issued for the Port of Kalama (85 FR 76527), which presented a conservative average density developed from anecdotal reports of harbor seal densities observed near the mouths of the Cowlitz and Kalama rivers in a typical year (NOAA Fisheries 2017; 85 FR 76527).

The estimated number of exposures to noise that would result in Level A and Level B harassment, by species, is summarized in Table 5-7.

Table 5-7. Level A and B Marine Mammal Harassment Summary

Species	Level A Take Request		Level B Take Request	
	Per Year	Total (5 years)	Per Year	Total (5 years)
Harbor Seal	36	180	1,095	5,477
California Sea Lion	6	30	181	904
Steller Sea Lion	9	45	276	1,382

There are no pinniped haulouts or breeding sites in areas likely to be exposed to elevated noise. The nearest known sea lion haulout is located approximately 32 miles upstream of the primary study area, and the nearest sea lion breeding site is located more than 200 miles from the study area (Jeffries et al. 2000). The nearest known harbor seal haulout is located at Carroll Slough at the confluence of the Cowlitz and Columbia Rivers, approximately 45 miles downstream of the primary study area. Therefore, elevated noise levels would have no effect on individuals at breeding or haulout sites.

The effects of elevated underwater noise on marine mammals are dependent on several factors, including the species, size of the animal, proximity to the source; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the distance between the source and the receptor; and the sound propagation properties of the environment. Potential effects to individuals can range from relatively minor behavioral effects such as avoidance or behavioral modifications, to physiological effects that can either be permanent or temporary and can include effects to internal organs or the auditory system. In extreme cases, mortality can occur.

A marine mammal monitoring plan would be developed and implemented during vibratory and impact pile installation, vibratory pile removal, installation of drilled shaft casings with an oscillator, and removal of existing concrete bridge foundations with a wiresaw. The purpose of the plan would be to reduce the potential for and extent of any unavoidable Level A harassment, and to document and quantify the number of Level B takes.

In order to avoid exposing marine mammals to levels of underwater noise that could result in mortality or serious injury, and to reduce the extent of unavoidable Level A take associated with auditory injury, Injury Protection Zones would be implemented during all impact pile driving, vibratory pile driving and removal, installation of drilled shafts with an oscillator, and operation of an underwater wiresaw. A 150-foot [45.7-meter] Injury Protection Zone would be established during impact pile driving conducted without a bubble curtain, and a 100-foot (30.4-meter) Injury Protection Zone would be established during all other activities identified in Table 5-5, in which underwater noise could potentially be elevated to levels that could result in Level A take. The sound generated from these activities would not result in mortality or serious injury to marine mammals because the areas where these types of effects could potentially occur are small, would be fully monitored, and the activity would be shut down if marine mammals are present within these zones.

However, it is not possible to completely avoid all potential for harassment, and some seals and sea lions may be exposed to underwater noise that could result in level A and/or B harassment. Marine mammals that are exposed (harassed) may temporarily change their normal behavior patterns (i.e., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Exposures to Level B harassment would likely have only a minor effect on individuals and no effect on the population. Those marine mammals that are exposed to levels of noise resulting in Level A harassment could experience permanent changes in hearing thresholds.

5.1.1.6 Temporary Changes to Avian Predation Pressure

Temporary in-water and overwater structures associated with the construction of the Modified LPA may have an effect on avian predation within portions of the primary study area. Such structures may include the temporary work platforms/bridges, tower cranes, oscillator support platforms, barges, and cofferdams.

The effect on aquatic habitats and species associated with temporary changes to avian predation would be comparable to those associated with long-term effects described in Section 4.2.1.5 but would be of shorter duration, and function would be fully restored once a given temporary structure is removed.

The temporary overwater structures associated with the construction of the Modified LPA are not likely to attract large concentrations of avian predators as do such features as nesting islands, impoundments, or tailraces. Nevertheless, because avian predators are known to congregate on overwater structures, and because construction of the Modified LPA would increase the number of available perches, it is possible that the avian predation rates could increase to some extent within the primary study area. Specifically, the work platforms/bridges, tower cranes, oscillator support platforms, and barges would temporarily increase the number of perches available in the Columbia River and North Portland Harbor. Presumably, avian predation may occur during the overlap of times when 1) temporary overwater structures are present in the primary study area, and 2) juvenile fish are present in the primary study area; however, it is impossible to quantify how many individual fish would be affected.

5.1.2 Terrestrial Resources

5.1.2.1 Temporary Impacts to Terrestrial Habitats

Construction activities associated with the Modified LPA would result in temporary impacts to terrestrial habitats. Table 5-8 summarizes the temporary impacts that would occur to these resources. For purposes of this analysis, temporary impacts include areas that may be physically disturbed during construction but would be fully restored once construction is complete.

Table 5-8. Temporary Impacts to Sensitive Terrestrial Habitats

Temporary Terrestrial Habitat Impacts	Temporary Impacts to Sensitive Terrestrial Habitat (acres)
Oregon	
“High” combined riparian/wildlife value habitats	4.6
“Medium” combined riparian/wildlife value habitats	5.7
Wetlands	2.56
Wetland Buffers	7.11
Washington	
Riparian Buffers	1.15
Biodiversity Areas	2.87
Oak Woodlands	0.03
Wetlands	0
Wetland Buffers	1.19

SENSITIVE TERRESTRIAL HABITATS IN OREGON

In Oregon, sensitive terrestrial habitats include those identified in the City of Portland’s NRI as Riparian Corridors and Wildlife Habitats and areas identified within City of Portland ezones. These include a variety of sensitive riparian and wetland habitats.

Temporary disturbance to sensitive terrestrial habitats in Oregon would be relatively small, as construction of the Modified LPA would largely occur within developed transportation corridors and the design would avoid encroachment into sensitive resources to the extent practicable.

Construction of the Modified LPA would result in temporary impacts to approximately 2.56 acres of wetland, 7.11 acres of wetland buffer, and approximately 10.3 acres of habitat identified as having a “high” or “medium” combined wildlife/riparian value in Portland’s NRI, and approximately 2.56 acres of wetland in Oregon (these habitat designations overlap and are not cumulative). These impacts would occur primarily within disturbed terrestrial riparian habitats on the shorelines of Hayden Island, on the south shoreline of North Portland Harbor, near the Vanport wetlands, and in a partially forested area south of NE Martin Luther King Jr. Boulevard.

It is worth noting that these designations in Portland’s NRI extend in some locations into paved areas, riprap, and other areas that do not currently provide a riparian habitat function.

Construction of the Modified LPA would include revegetating temporarily disturbed riparian areas and other sensitive habitats in Oregon consistent with federal, state, and local regulations, and there would be no net loss of riparian or terrestrial habitat function in the long term. Figure 4-5 (see Section 4.2.2.1) illustrates the acreage and locations of disturbance to sensitive terrestrial habitats that are likely to occur in Oregon from construction of the Modified LPA.

SENSITIVE TERRESTRIAL HABITATS IN WASHINGTON STATE

Temporary disturbance of sensitive terrestrial habitats in Washington would be relatively small, as the Modified LPA would occur largely within developed transportation corridors and the design would avoid encroachment into sensitive resources to the extent practicable.

The Modified LPA would result in temporary impacts to approximately 1.15 acres of riparian buffers, approximately 2.87 acres of a designated biodiversity area, approximately 0.03 acres of priority oak woodland habitat and approximately 1.19 acres of wetland buffer in Washington. (These habitat designations overlap and are not cumulative.) Additional detail regarding wetlands and wetland buffers can be found in the Wetlands and Other Waters Technical Report.

These temporarily disturbed areas would primarily occur within terrestrial riparian habitat associated with Burnt Bridge Creek, north of SR 500. The affected riparian vegetation in this location provides only moderate habitat function in its current state, as it is located immediately adjacent to I-5.

Construction of the Modified LPA would also temporarily disturb approximately 0.03 acres of a priority oak woodland habitat adjacent to I-5. However, the only area affected would be a grassy shoulder adjacent to I-5. No mature oak trees would be affected, and the extent of the impact would be insignificant.

Construction of the Modified LPA would include revegetating temporarily disturbed riparian areas and other sensitive habitats in Washington consistent with federal, state, and local regulations, and the net result would no net loss of riparian or terrestrial habitat function in the long term. Figure 4-6 (see Section 4.2.2.1) illustrates the acreage and locations of disturbed sensitive terrestrial habitats that are likely to occur in Washington State from construction of the Modified LPA.

TEMPORARY IMPACTS FROM CONSTRUCTION ACCESS AND STAGING

Work would likely begin with the contractor mobilizing materials, equipment, and labor to the site. The contractor would most likely mobilize materials and equipment to the site via rail, barges, and trucks. The contractor would install erosion control measures (silt fences, etc.), debris containment devices (i.e., floating debris booms) and other BMPs consistent with an SPCC, PCP, and TESCP. Clearing and grubbing limits would be established in the field prior to vegetation clearing. Federal, state, and local permits may include additional specific regulatory requirements regarding mobilization and site preparation, and contract specifications would dictate that all such activities be conducted consistent with these permit requirements.

Materials and equipment arriving by truck or rail would be unloaded and staged either within the limits of the project site or in approved off-site locations. The larger construction materials would arrive at the site by barge. Materials and equipment delivered by barge may be offloaded to upland staging areas or may be temporarily staged on barges.

Staging of equipment and materials would occur in many locations within the project site throughout construction, generally within existing or newly purchased right of way or on nearby vacant parcels. At least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate.

Two potential major staging areas have been identified and are shown on Figure 5-21. The first site is the vacant 5.6-acre former Thunderbird Hotel site on Hayden Island. The second is a former rest-area site east of I-5 and north of McLoughlin that is currently used as auxiliary parking for the Clark College Athletic Annex. Other staging locations would be established by the contractor during permitting and construction, and appropriate compliance documentation, approvals, permits and access easements would be acquired at that time. Key considerations for staging sites include: 1) size and capacity to provide for heavy machinery and material storage; 2) waterfront access for barges (either a slip or a dock capable of handling heavy equipment and material); and 3) roadway or rail access for landside transportation of materials by truck or train.

A casting or staging yard could also be required for construction of the overwater bridges if a precast concrete segmental bridge design is used. If such a casting yard is required, it would require access to the river for barges including either a slip or a dock capable of handling heavy equipment and material; a large area suitable for a concrete batch plant and associated heavy machinery and equipment; and access to a highway or railway for delivery of materials. Such a site would likely be between approximately 50 and 100 acres in size. As with the staging sites, casting yards would be identified during the design process or by the contractor, and would be subject to the same contract and permit requirements to implement the BMPs described in this document unless more stringent permitting requirements and conditions are required at the time of identification.

All material staging, equipment staging areas, equipment fueling areas, and casting yards would be contained and located outside of environmentally and culturally sensitive areas. To the extent practicable, these sites would be located in upland locations, on areas that are already or have been previously disturbed. These activities would be conducted consistent with the impact minimization BMPs described in Section 7.2. Construction of the Modified LPA would also include revegetating temporarily disturbed areas consistent with federal, state, and local regulations, and the net result would no net loss of habitat function in the long term.

5.1.2.2 Temporary Terrestrial Noise During Construction

Terrestrial noise during impact pile-driving activity could be elevated above background levels within approximately 3,200 feet of proposed pile-driving activities. Peak terrestrial noise generated during impact pile installation has been estimated to be approximately 110 dB, measured at 50 feet (FTA 2006).

Temporarily elevated noise can result in a range of potential wildlife reactions, which can include altered vocal behavior, changes in vigilance and foraging behavior, and changes in body condition. These responses could in turn result in increased energy expenditure or movement into less desirable locations with potentially greater exposure to predation.

To avoid impacts to migratory birds, all activities would be conducted consistent with the MBTA. Peregrine falcons are known to use the existing Interstate Bridges and would be directly impacted by noise disturbance if construction activities occurred during nesting and fledging season.

Effects on Marine Mammals

NOAA has established Level A (auditory injury) thresholds and Level B (disturbance) thresholds for pinnipeds resulting from in-air noise, as shown in Table 5-9 and Table 5-10.

Table 5-9. Level A Harassment Threshold Decibel Levels for In-Air Noise

Marine Mammal Hearing Group	Impulsive Sounds	Non-impulsive Sounds
Phocid Pinnipeds (PW) (Underwater)	162 dBpk 140 dBLe	154 dBpk
Otariid Pinnipeds (OW) (Underwater)	177 dBpk 163 dBLe	177 dBpk

Note: In-air decibel levels are based on root mean square (RMS) levels, referenced to 20 micropascals (re: 20 µPa).

Key: dBpk - peak noise level; dBLe - cumulative noise level averaged over a 24-hour period

Table 5-10. Level B Harassment Threshold Decibel Levels for In-Air Noise

Marine Mammal Hearing Group	Threshold
Harbor seals (Underwater)	90 dB_{RMS}
All Other Pinnipeds (Underwater)	100 dB_{RMS}

Note: In-air decibel levels are based on root mean square (RMS) levels, referenced to 20 micropascals (re: 20 µPa).

Key: dB_{RMS} = decibels root mean square

Since in-air noise generated during construction activities is not expected to exceed the Level A threshold levels of in-air noise in Table 5-9. For this reason, construction activities are not expected to generate levels of in-air noise that would result in Level A injury of marine mammals.

The following equation was used to determine the distance in-air noise would travel before it attenuates to the NOAA thresholds for Level B in-air disturbance of pinnipeds.

$$D = D_o * 10((\text{Construction Noise} - \text{Ambient Sound Level in dBA})/\alpha)$$

The variables are defined as follows.

- D = The distance from the noise source at which attenuation will occur
- Do = The reference measurement distance (15.24 meters [50 feet] in this case)
- α = 20 (for hard ground/open water). This value assumes a 6.0 dBA reduction per doubling distance.

The following equations show the modeled in-air noise attenuation distances to the Level B isopleths shown in Table 5-10.

- 90 dBA = 15.24*10([110-90]/25) = 96 meters (315 feet)
- 100 dBA = 15.24*10([110-100]/25) = 38 meters (126 feet)

The analysis shows that in-air noise during impact and vibratory pile driving and drilled shaft installation would attenuate to the phocid (harbor seal) threshold (90 dB) at a distance of approximately 315 feet, and to the otariid (sea lion) threshold (100 dB) at a distance of approximately 126 feet.

For purposes of making conservative estimate of the potential extent of exposure, a distance of 400 feet (121.9 meters) has been established as the in-air Level B isopleth for purposes of this assessment (Figure 5-22). Appropriate authorization under the Marine Mammal Protection Act would be secured in the form of a Letter of Authorization prior to conducting any activities that would result in harassment of marine mammals. A marine mammal monitoring plan would also be developed and implemented to avoid and minimize the extent of unavoidable harassment of marine mammals during construction.

Figure 5-21. Potential Major Staging Areas

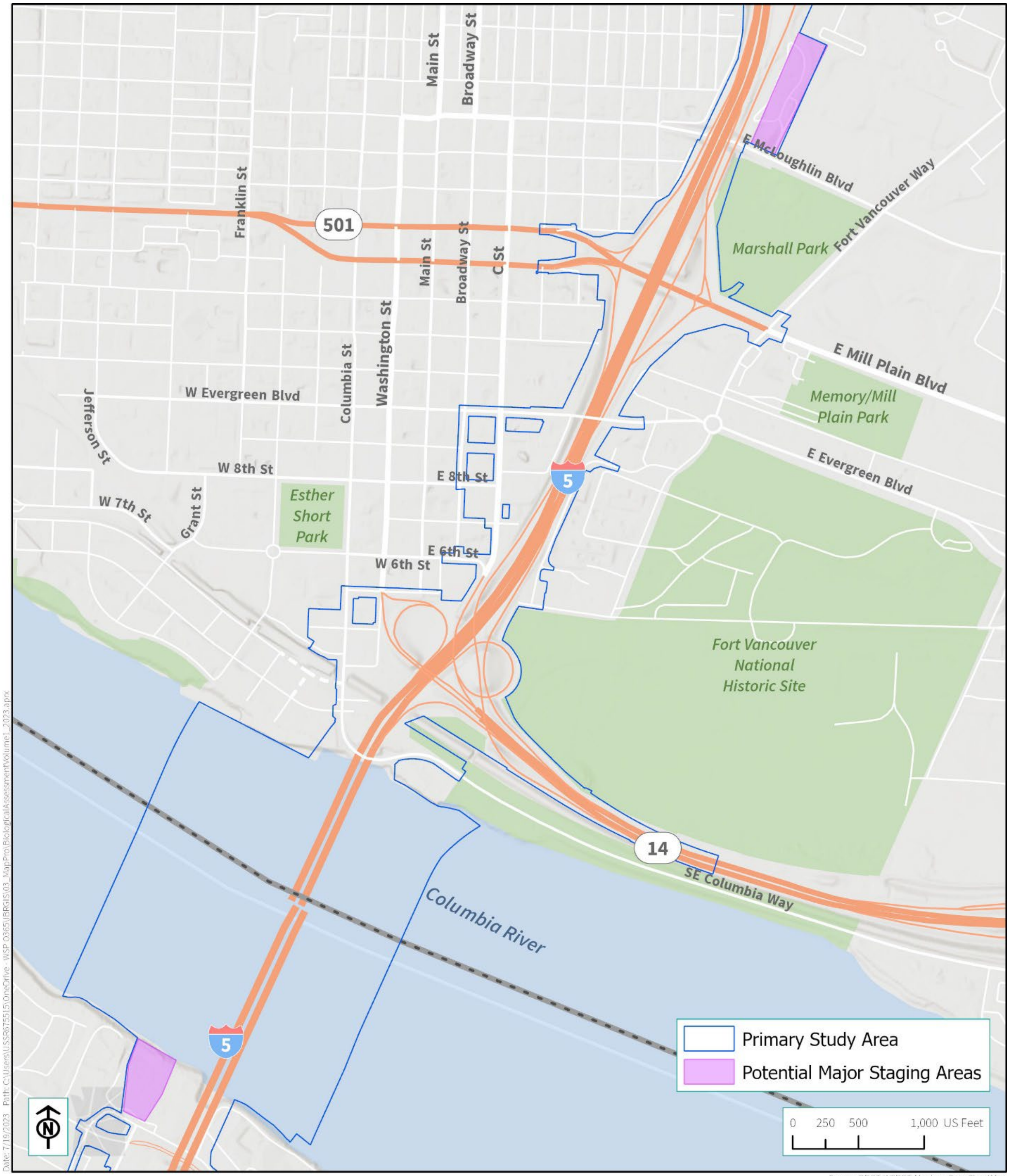


Figure 5-22. Level B In-air Isopleths: All Activities

5.1.2.3 Temporary Disturbance of Individuals

Individual terrestrial species, including both SOI and common species, could be directly disturbed during construction if present in the vicinity. This type of disturbance could affect movement, breeding, foraging, and dispersal.

Construction activities conducted during nesting season for migratory birds could cause disturbance that could reduce nesting success. Although the existing Interstate Bridge does not provide ideal roosting habitat for bats, several bat species that may pass near and use them for temporary roosting could be affected by construction disturbance. Short-term effects on raccoons, bats, reptiles, and other terrestrial wildlife could also result from temporary vegetation clearing.

5.1.2.4 Temporary Impacts to Terrestrial Wildlife Passage

Given the highly developed character of the study areas, terrestrial wildlife passage is already severely limited. Wildlife passage may be temporarily further impaired during construction due to the presence of construction equipment and human activity. Potential effects on wildlife could include altered behavior to avoid construction activities (e.g., moving through more developed areas) and could increase the risks of human/wildlife conflicts and wildlife mortality.

5.1.3 Botanical Resources

Temporary impacts to vegetation are described in Section 5.1.2.1. The extent of temporary vegetation impacts associated with construction of the Modified LPA are expected to be relatively minor and to occur primarily within disturbed areas adjacent to existing roadway infrastructure. The Modified LPA would temporarily impact native vegetation within a few relatively small areas of functioning riparian and wetland habitats. These impacts would be avoided and minimized to the extent practicable through project design, consistent with applicable federal, state, and local regulations. In addition, compensatory mitigation would offset the net loss in habitat function. There are no SOI botanical species known or expected to occur within the areas that would be temporarily disturbed. Therefore, botanical SOI are not expected to be impacted by construction of the Modified LPA.

5.1.4 Design Options

In general, the design options for the Modified LPA (see Chapter 1) would result in the same types of effects on ecosystems as the Modified LPA. However, some design options would result in effects that would differ in terms of quantity or intensity of the effect. The subsections below describe the temporary impacts that would occur under the design options, including a relative comparison to the impacts that would occur under the Modified LPA configuration.

5.1.4.1 Two Auxiliary Lanes

The Modified LPA with the two auxiliary lane design option would have the same temporary impacts as the Modified LPA with one auxiliary lane.

5.1.4.2 Single-Level Fixed-Span Configuration

The temporary effects of the Modified LPA with the single-level fixed-span configuration would be similar to those of the Modified LPA with the double-deck fixed-span configuration, except it would have slightly more benthic in-water area temporarily displaced within cofferdams. The amount of increased temporary displacement would be approximately 0.42 acres. This would represent an increase in the amount of impacts but would not result in effects that are different in type or intensity from the Modified LPA with the double-deck fixed-span configuration.

5.1.4.3 Single-Level Movable-Span Configuration

The temporary effects of the Modified LPA with the single-level movable-span configuration would be similar to those of the Modified LPA with the double-deck fixed-span configuration except that it would have slightly more benthic in-water area temporarily displaced within cofferdams. The amount of increased temporary displacement would be approximately 0.42 acres. This would represent an increase in the amount of the impacts but would not result in effects that are different in type or intensity from the Modified LPA with the double-deck fixed-span configuration.

5.1.4.4 State Route 14 Interchange without Interstate 5 C Street Ramps

The design option that would construct the SR 14 interchange without the I-5 C Street ramps would not result in short-term effects on ecosystem resources that would differ from those identified for the Modified LPA with the C Street ramps at the SR 14 interchange.

5.1.4.5 Interstate Mainline Westward Shift

The design option that would shift a portion of the I-5 mainline westward in Vancouver would not result in short-term effects on ecosystem resources that would differ from those identified for the Modified LPA with the centered I-5 mainline.

5.1.4.6 Park and Rides

The design options for park-and-ride sites in downtown Vancouver would not result in short-term effects on ecosystem resources that would differ from those identified for the Modified LPA.

6. INDIRECT EFFECTS

Indirect impacts include those that are not a direct result of a project but would occur later in time or farther in distance as a result of a project.

6.1 No-Build Alternative

No indirect effects are anticipated from the No-Build Alternative.

6.2 Modified LPA

6.2.1 Changes in Land Use

An extensive body of research provides insight into the complex relationship between transportation infrastructure and land use. Different types of transportation system changes can have different types and degrees of effects on land use. For example, some types of roadway improvement projects can reduce travel times between points and improve access to developable areas further from the urban center, shifting a portion of future growth to the periphery and encouraging automobile-oriented development (Tidd et al. 2013). Other types of roadway improvements do not have this effect. Similarly, some transit projects can lead to increased development density around transit stations, while others do not. Integration of regional transportation planning with local land use planning can help to coordinate the nature and pattern of land development with available transportation services (NCHRP 1999). Effective local plans and policies of the types that exist in Oregon and Washington have been shown to control potential unplanned growth and land use changes resulting from transportation investments (CH2M Hill 2006).

Because the IBR Program is a multimodal project, it has the potential to promote both automobile-oriented and transit-oriented development. In general, automobile-oriented development tends to occur at relatively low densities around the urban periphery; while local and regional land use plans allow some of this type of development, they generally attempt to limit it because it is considered an inefficient method of accommodating population and employment growth and results in relatively higher costs, higher environmental impacts, and a greater consumption of land.

In contrast, transit-oriented development is often higher density, in an already urbanized area, and typically a more efficient method of accommodating future growth. Concentrating growth may help protect listed species and their habitat from habitat loss or conversion. However, other potential effects, such as vehicle-generated stormwater contaminants, may worsen with increased traffic densities in growing urban areas without proper environmental protections. The Modified LPA may encourage redevelopment adjacent to or near proposed light-rail stations in downtown Vancouver and on Hayden Island. Because these areas are already within a highly developed corridor adjacent to the interstate, habitat for terrestrial species is of limited quantity and quality, and impacts to terrestrial species would be minimal. Impacts to aquatic habitats associated with redevelopment activities could result from fill placement within wetlands or waterbodies, or from stormwater runoff from new impervious surfaces.

Applicable federal, state, and local environmental regulations would minimize impacts from any such redevelopment activities. Local regulations require the avoidance and minimization of impacts to sensitive resources including shorelines, wetlands, and riparian habitats. For activities that require fill within wetlands or waterbodies, federal laws such as the Clean Water Act, the Rivers and Harbors Act, and the ESA require analysis and approval by federal agencies to ensure that impacts are avoided, minimized, and compensated for. Likewise, State agencies, including WDFW, ODFW, DSL, and Ecology, have policies and regulatory frameworks in place that require avoidance, minimization, and compensation. State land use laws and local land use code requirements would minimize the potential for unplanned growth and land use changes by requiring all development to be consistent with existing comprehensive plans and zoning regulations.

The Modified LPA also has the potential to affect how traffic moves through the action area. The tolling program that would likely be implemented for the replacement bridge crossing could cause some drivers to seek an alternate crossing at the I-205 bridge. If enough vehicles were to divert to an alternate route, this could result in effects such as increased stormwater pollutant loads in areas where vehicle traffic increases occur.

A regional travel demand model was run for both the No-Build Alternative and for the Modified LPA. The model considered background assumptions that included highway, transit, and tolling changes, all of which would have the potential to impact overall travel demand and traffic patterns regionally, including crossings on both I-5 and I-205 between the Portland area and Clark County in Washington.

Table 6-1 highlights the anticipated overall change in vehicle crossings for both I-5 and I-205, as well as overall totals, which are expected to be lower than the no-build scenario by approximately 3% on an average weekday. The model indicates that the Modified LPA would likely result in an approximately 2% shift in the relative distribution of crossings at the I-205 bridge. This relatively minor increase would not result in any measurable or significant effects on ecosystem resources.

Results of the regional travel demand model indicate a likely increase in the transit mode share, as a result both of the improved transit investment as part of the program and of the introduction of variable rate tolling on the I-5 bridge. This is expected to result in a corresponding decrease in the relative amount of vehicle traffic compared to the no-build scenario. The net reduction in vehicular traffic and increase in transit mode share results in an overall lower amount of vehicle miles traveled on an average weekday in the Portland Metropolitan region. The overall reduction is close to 93,000 miles reduced per weekday, which is approximately 1% change from the No-Build Alternative.

Table 6-1. 2045 Forecast Average Weekday Daily Traffic Volumes

Location	Existing AWDT	2045 No-Build AWDT [a]	2045 Modified LPA AWDT [b]
Total River Crossing	313,000	400,000 (+28%)	389,000 (-3%)
Interstate Bridge	143,400	180,000 (+26%)	175,000 (-3%)
I-205 Bridge	169,600	220,000 (+30%)	214,000 (-3%)

Source: ODOT/WSDOT, Metro/RTC Regional Travel Demand Model, IBR Analysis 2022

a Percentages reflect change from existing 2019 conditions.

b Percentages reflect change from 2045 No-Build Alternative.

AWDT = average weekday daily traffic

In summary, because the Modified LPA is expected to encourage more compact development and/or redevelopment within existing urban areas that have limited terrestrial resources and habitat, it is likely to reduce the potential loss of habitat and impervious surface throughout the region. By concentrating future regional population and employment growth in North Portland and downtown Vancouver, the Modified LPA should reduce development pressure in outlying areas that is more likely to result in loss of previously undisturbed habitat and incur a greater development footprint to accommodate this growth. Any redevelopment or development activities that are increased as an effect of the Modified LPA would be required to be conducted in compliance with the laws and regulations described above, and as such, any indirect changes in land use patterns are not expected to result in indirect effects on ecosystem resources.

6.2.2 Effects on Prey Base for Southern Resident Killer Whales

Salmon and steelhead are a critical dietary component for SRKW. The Columbia River and North Portland Harbor provide migration and foraging habitat for habitat for juvenile and adult salmon and steelhead, as well as some limited rearing habitat for juvenile salmon and steelhead. Effects on these species have the potential to affect the prey base for SRKW.

Impacts to salmon, steelhead and other aquatic species are documented and described in Chapters 4 and 5. Construction of the Modified LPA would be conducted consistent with federal, state, and local regulatory requirements, and consistent with the BMPs and minimization measures outlined in Chapter 7. Given the large numbers of fish in the Columbia River, the short-term nature of effects on individual fish, and the long-term beneficial effects on fish habitat that are anticipated to occur as a result of mitigation and conservation measures, construction of the Modified LPA would not be expected to have measurable effects on the distribution or abundance of potential prey species for SRKW.

6.2.3 Federal Navigation Channel Dredging

Portions of the Columbia River mainstem are designated and maintained for navigation as part of the Columbia and Lower Willamette and Vancouver to The Dalles Federal Navigation Channel projects by USACE. Within the vicinity of the Interstate Bridge, there are four federally authorized navigation projects on the Columbia River: three federally authorized navigation channels that pass beneath the Interstate Bridge (the primary navigation channel, barge channel, and alternate barge channel) and the federally authorized Upper Vancouver Turning Basin located immediately downstream of the Interstate Bridge. This turning basin has historically provided a turning location for deep-draft ships navigating up to, but not beyond, the Interstate Bridge. There is no federally authorized navigation channel within North Portland Harbor in the vicinity of the Interstate Bridge.

The federal navigation projects would be maintained with the IBR Program. However, the primary navigation channel would be swapped with the existing barge channel (which would become the north barge channel), which would move the primary navigation channel closer to the center of the river than it is currently. No changes are proposed to authorized or maintained channel depths, and no dredging is proposed or reasonably certain to occur as a result of the Modified LPA. The existing bathymetry at the location of the proposed channels provides sufficient depth (between 10 and 29 feet in depth, as shown in Figure 3-1). Activities associated with the proposed action to accommodate the reconfiguration of these channels would likely include the relocation of one or more navigation markers. These markers are floating buoys that are attached to concrete or steel anchors. Work activities associated with relocating the navigation markers would consist of picking up the buoy and anchor, placing them temporarily on a barge or small vessel, and redeploying the buoy and anchor in the desired location. Therefore, the reconfiguration of the navigation channels that would occur under the Modified LPA is not expected to result in adverse indirect effects on ecosystem resources.

7. PROPOSED MITIGATION FOR ADVERSE EFFECTS

The design of the proposed Columbia River bridges has been modified to avoid and minimize impacts. Examples of these modifications include reducing the number of in-water piers, timing restrictions on in-water work, enhancement of the proposed stormwater treatment to exceed regulatory minimums, and configuration changes to avoid and minimize impacts to sensitive aquatic and terrestrial habitats. It is anticipated that the Biological Opinion that will be issued by the National Marine Fisheries Service (NMFS) would include additional conservation measures (reasonable and prudent measures) and terms and conditions that are necessary and appropriate to minimize the effects from the incidental take of listed fish.

Construction methods have also been refined to avoid long-term impacts, such as developing an alternative shaft cap isolation system for four of the Columbia River Bridge piers, which would avoid the need for cofferdams and concrete seals in these locations.

7.1 Long-Term Effects

7.1.1 Regulatory Requirements

- Provide stormwater quality and quantity treatment that meets or exceeds applicable regulatory requirements for all post-project CIA.

7.1.2 Program-Specific Mitigation

- Avoid and minimize long-term impacts to ecosystem resources in final design to the extent practicable.
- Provide compensatory mitigation for unavoidable impacts to ecosystem resources, consistent with applicable federal, state, and local regulatory requirements.
- Prepare a compensatory mitigation plan that satisfies applicable federal, state, and local regulatory requirements, and that demonstrates no net loss of function of ecosystem resources.
- Provide an alternate nesting structure, either on the new Columbia River bridges or within the vicinity, to offset removal of an existing peregrine falcon nest from demolition of the existing Interstate Bridge.

7.2 Temporary Effects

7.2.1 Regulatory Requirements

The following impact avoidance and minimization measures would be implemented as regulatory requirements to avoid and minimize potential effects on ecosystem resources.

7.2.1.1 General Measures and Conditions

- Perform all work according to the requirements and conditions of the regulatory permits that are issued for the Modified LPA.

- Require contractor to prepare a WQPMP to satisfy the monitoring and reporting requirements of the 401 Water Quality Certifications that are ultimately issued for the project. The WQPMP would be provided to NOAA Fisheries for review and approval prior to implementation. The WQPMP would identify the timing and methodology for water-quality sampling during construction of the Modified LPA, as well as methods of implementation and reporting. If, in the future, a standard water-quality monitoring plan is adopted by ODOT and/or WSDOT, this plan, with the agreement of NOAA Fisheries may replace the contractor plan.
- In compliance with ODOT and WSDOT policy and construction administration practice in Oregon and Washington, have one or more Department of Transportation inspectors on site during construction. The role of the inspector(s) would be to monitor compliance with contract and permit requirements.
- If in-water dredging is required outside of a cofferdam, use a clamshell bucket. Dredging and handling and disposal of dredged materials shall be conducted consistent with the requirements and conditions of the regulatory permits issued for the Modified LPA.
- Prohibit work barges from grounding out.
- Dispose of excess or waste materials in an appropriate manner consistent with applicable local, state, and federal regulations, do not dispose of or abandon waterward of the OHWM or allow to enter waters of the state.
- All pumps must employ a fish screen that meets the following specifications:
  - An automated cleaning device with a minimum effective surface area of 2.5 square feet per cubic foot per second and a nominal maximum approach velocity of 0.4 feet per second, or no automated cleaning device, a minimum effective surface area of 1 square foot per cubic foot per second and a nominal maximum approach rate of 0.2 feet per second; and
  - A round or square screen mesh that is no larger than 0.094 inches (2.38 millimeters [mm]) in the narrow dimension, or any other shape that is no larger than 0.069 inches (1.75 mm) in the narrow dimension; and
  - Each fish screen must be installed, operated, and maintained according to NOAA Fisheries fish screen criteria.

7.2.1.2 Spill Prevention/Pollution Control Measures

- Require contractor to prepare an SPCC plan and PCP prior to beginning construction. These plans would be provided to NOAA Fisheries for review and approval. The SPCC plan and PCP would identify the appropriate spill containment materials; as well as the means and methods of implementation, response, and reporting. All elements of the SPCC plan and PCP would be available at the project site at all times. For additional detail, consult ODOT Standard Specification 00290.00 to 00290.90.
- Require contractor to designate at least one employee as the erosion and spill control (ESC) lead. The ESC lead would be responsible for the implementation of the SPCC plan and PCP.
- Maintain applicable spill response equipment and material designated in the SPCC plan and PCP at the job site.

- With the exception of barges and stationary large equipment (cranes, oscillators) operating from barges or work platforms, fuel and maintain equipment at least 150 feet from the OHWM of any waterbody using secondary containment to minimize potential for spills or leaks entering the waterway.
- Clean and inspect all equipment to be used for construction activities prior to arriving at the project site, to ensure no potentially hazardous materials are exposed, no leaks are present, free of noxious weeds, and the equipment is functioning properly. Daily inspection and cleanup procedures would be identified.
- Should a leak be detected on heavy equipment used for the project, immediately remove the equipment from the area, and do not use again until adequately repaired. Where off-site repair is not practicable, the SPCC plan and PCP would document measures to be implemented to prevent and/or contain accidental spills in the work/repair area to ensure no contaminants escape containment to surface waters and cause a violation of applicable water-quality standards.
- Operate construction equipment from on top of floating barges, from the decks of temporary work bridges and platforms, the decks of the existing or replacement bridges, or from portions of the streambank above the OHWM. Barges and support vessels would be operated in the water.
- Provide suitable containment measures for all equipment (including barges, work decks, stationary power equipment, and storage facilities) in the SPCC plan and PCP to prevent and/or contain accidental spills to ensure no contaminants escape containment to surface waters and cause a violation of applicable water-quality standards.
- Design and install temporary work bridges and platforms, cofferdams, and drilled shaft isolation casings consistent with the ODOT Hydraulics Manual, which establishes criteria to avoid these structures being overtopped during high-water events.
- Process water generated on site from construction, demolition or washing activities would be contained and treated to meet applicable water-quality standards before entering or reentering surface waters.
- Do not conduct paving, chip sealing, or stripe painting activities during periods of rain or wet weather.
- In the SPCC plan and PCP, establish a concrete truck chute cleanout area to properly contain wet concrete as part of ODOT Standard Specification 00290.30(a).

7.2.1.3 Site Erosion/Sediment Control Measures

- Require contractor to prepare and implement an TESCP to minimize impacts associated with clearing, vegetation removal, grading, filling, compaction, or excavation. The BMPs identified in the TESCP would be used to control sediments from all vegetation removal or ground-disturbing activities. Additional temporary control measures may be required beyond those described in the TESCP if it appears pollution or erosion may result from weather, nature of the materials or progress on the work. For additional detail, consult ODOT Standard Specifications 00280.00 to 00280.90.

- As part of the TESCP, delineate clearing limits with orange barrier fencing wherever clearing is proposed in or adjacent to a stream/wetland or its buffer and install perimeter protection/silt fence as needed to protect surface waters and other critical areas. Location would be specified in the field, based upon site conditions and the TESCP. For additional silt fence detail, consult ODOT Standard Specification 00280.16(c).
- Require contractor to designate at least one employee as the ESC lead. The ESC lead would be responsible for the implementation of the SPCC plan and PCP, and would also be responsible for ensuring compliance with all local, state, and federal erosion and sediment control requirements.
- All TESCP measures would be inspected and maintained as required by applicable permit requirements. Contractor would also conduct maintenance and repair of TESCP measures as described in ODOT Standard Specifications 00280.60 to 00280.70.
- For landward construction and demolition, locate project staging and material storage areas a minimum of 150 feet from surface waters, in currently developed areas such as parking lots or managed fields, unless a site visit by an ODOT/WSDOT biologist determines (and an ODOT/NOAA Fisheries liaison confirms) that the topographic features or other site characteristics allow for site use closer to the edge of surface waters.
- Complete excavation activities under dry or dewatered conditions where practicable. All surface water flowing toward the excavation would be diverted through utilization of cofferdams and/or berms. Cofferdams and berms must be constructed of sandbags, clean rock, steel sheeting, or other non-erodible material.
- Limit bank shaping to the extent as shown on the approved grading plans. Minor adjustments made in the field would occur only after engineer's review and approval.
- Install bio-degradable erosion control blankets on areas of ground-disturbing activities on steep slopes (1V:3H or steeper) that are susceptible to erosion and within 150 feet of surface waters. Areas of ground-disturbing activities that do not fit the above criteria would implement erosion control measures as identified in the approved TESCP. For additional erosion control blanket detail, consult ODOT Standard Specification 00280.14I.
- Cover erodible materials (material capable of being displaced and transported by rain, wind or surface water runoff) temporarily stored or stockpiled for use in project activities to prevent sediments from being washed from the storage area to surface waters. Temporary storage or stockpiles must follow measures as described in ODOT Standard Specification 00280.42.
- Stabilize all exposed soils as directed in measures prescribed in the TESCP. Hydro-seed all bare soil areas following grading activities and revegetate all temporarily disturbed areas with native vegetation indigenous to the location. For additional detail, consult ODOT Standard Specifications 01030.00 to 01030.90.
- Where site conditions support vegetative growth, plant native vegetation indigenous to the location in areas temporarily disturbed by construction activities. Revegetation of construction easements and other areas would occur after the project is completed. Trees would be planted when consistent with highway safety standards. Riparian vegetation would be replanted with species native to geographic region. Planted vegetation would be

maintained and monitored to meet regulatory permit requirements. For additional detail, consult ODOT Standard Specifications 01040.00 to 01040.90.

7.2.1.4 Pile Installation and Removal Best Management Practices

- Use a vibratory hammer to drive steel piles to the maximum extent practicable, to minimize noise levels.
- Conduct impact pile driving below the OHWM between September 15 and April 15. Vibratory pile installation and removal (as well as certain other in-water construction activities) may occur on a year-round basis, provided they are conducted in compliance with all regulatory approvals.
- No more than two impact pile drivers would be operated simultaneously within the same waterbody channel.
- Employ a bubble curtain or other similarly effective noise attenuation device during all impact pile driving conducted in water depths greater than 0.67 meters (2 feet).
- Develop and implement a hydroacoustic monitoring plan, based on the template developed by the Fisheries Hydroacoustic Working Group, in coordination with FHWA and FTA to confirm the effectiveness of the noise attenuation devices and that predicted noise levels adequately capture the area of the potential onset of injury. The plan would be provided to NOAA Fisheries for review and approval prior to any impact pile-driving activity commencing.
- Prepare a marine mammal monitoring plan, including establishing injury protection zones for marine mammals.
- Install cones or other anti-perching devices on open-ended pipe piles to discourage perching by piscivorous birds.
- Remove temporary piles with a vibratory hammer, or by direct pulling, and prohibit intentionally breaking by twisting or bending.
- In the event a temporary pile cannot be removed, cut or press the pile 3 feet below the mudline. At locations where hazardous materials are present or adjacent to utilities, temporary piles may be cut off at the mud line with underwater torches, if such activity would not conflict with navigation elements.

7.2.1.5 Work Area Isolation and Fish Salvage Best Management Practices

- Develop a Temporary Water Management Plan, consistent with the requirements of ODOT Special Provision Section 00245.03, and provided to NOAA Fisheries for review and approval prior to any work area isolation of fish salvage activities.
- Install cofferdams and isolation casings in a manner that minimizes fish entrapment. Sheet piles would be installed from upstream to downstream, lowering the sheet piles slowly until contact with the substrate.
- Screen drilled shaft isolation casings at the bottom, to minimize potential for fish entrapment during installation. Screen shall have maximum openings of approximately 3/32 inch (2.38 mm) measured on a diagonal (NOAA Fisheries 2022).

- Conduct fish salvage according to the best practices established in the BO for ODOT's Federal-Aid Highway Programmatic consultation.
- Have a qualified fishery biologist[15] conduct and supervise fish capture and release activity to minimize risk of injury to fish.
- Prepare a fish salvage report and submit to NOAA Fisheries, USFWS, ODFW, and WDFW following project completion.
- Make a reasonable effort to capture ESA-listed fish known or likely to be present in an in-water isolated work area using methods that minimize the risk of injury. Attempts to seine and/or net fish would precede the use of electrofishing equipment.
- If electrofishing must be used, conduct consistent with NOAA Fisheries "Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act" (NOAA Fisheries 2000), or most recent version.

7.2.1.6 Work Area Lighting Best Management Practices

- Conduct construction activities consistent with local, state and federal permit restrictions for allowable work hours. If work occurs at night, temporary lighting may be required to provide better visibility for driver and worker safety. If temporary lighting is required, contractor would use directional lighting with shielded luminaries to control glare and direct light onto work area, not surface waters.

7.2.2 Program-Specific Mitigation

- Avoid and minimize short-term impacts to ecosystem resources in final design to the extent practicable.
- Restore temporarily disturbed terrestrial habitats consistent with applicable regulatory requirements.
- Provide compensatory mitigation for unavoidable impacts to ecosystem resources, consistent with applicable federal, state, and local regulatory requirements.
- Conduct activities with the potential to impact nesting migratory birds, such as nest removal, consistent with the provisions of the MBTA, which requires nests of migratory birds to be removed only at times when nests are inactive.

[15] The qualified biologist shall have a bachelor's degree in biology, fisheries or equivalent, and have a minimum of 2 years of experience identifying northwest fish and aquatic species. If electrofishing is required, the lead biologist shall be competent with electrofishing procedures and have completed at least 100 hours of fish salvage following NOAA Fisheries, USFWS, ODFW, and/or WDFW fish salvage/fish removal protocols.

8. PERMITS AND APPROVALS

8.1 Federal Permits

In addition to the federal NEPA process that this technical report was developed to support, the Modified LPA would be subject to the following federal regulations relevant to protecting aquatic, terrestrial, and botanical resources.

8.1.1 Endangered Species Act

Under Section 7 of the ESA, a federal agency that permits, funds, carries out, or otherwise authorizes an action is required to ensure that the action would not jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. To satisfy this requirement, lead federal agencies conduct consultation with NOAA Fisheries and/or USFWS under Section 7 of the ESA.

Projects that are “not likely to adversely affect” listed species or designated critical habitats undergo informal consultation. Projects that are “likely to adversely affect” one or more listed species or designated critical habitats undergo formal consultations.

The IBR Program is coordinating closely with NOAA Fisheries and the USFWS. A Biological Assessment has been prepared to analyze the effects on listed species and designated critical habitats. The Biological Assessment was submitted to both NOAA Fisheries and USFWS on September 25, 2023 for purposes of consultation under Section 7 of the ESA. The consultation with NOAA Fisheries is a formal consultation, and NOAA Fisheries is expected to issue their final BO in September 2024. The consultation with USFWS is proceeding as an informal consultation, and it is expected that the USFWS would issue a Letter of Concurrence by September 2024.

8.1.2 Migratory Bird Treaty Act

The MBTA regulates the unauthorized taking of migratory bird eggs, young, or adults. The MBTA prohibits the disturbance of active nests (i.e., those with eggs or young) without a permit from the USFWS. The breeding season in the study area is approximately March through August, though many species of birds may nest outside of this period.

Construction of the Modified LPA would need to be conducted in compliance with the MBTA, either by scheduling construction and vegetation removal activities such that active nests can be avoided, or by obtaining a permit to remove active nests.

8.1.3 Bald and Golden Eagle Protection Act

Administered by the USFWS, the BGEPA provides for the protection of the bald eagle (*Haliaeetus leucocephalus*) and the golden eagle (*Aquila chrysaetos*) by prohibiting, except under certain specified conditions, the taking, possession and commerce of such birds. Golden eagles are not likely to occur within the study areas.

The BGEPA prohibits unregulated take and makes it illegal to kill, wound, pursue, shoot, shoot at, poison, capture, trap, collect, molest, or disturb bald or golden eagles. If such disturbance is unavoidable, a permit is required under the act. Bald or golden eagle incidental take permitted under the BGEPA does not need a separate authorization under the MBTA.

There are no documented bald eagle nests within 0.5 miles of the replacement bridge site, and a BGEPA permit is not expected to be necessary.

8.1.4 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Act affords protection to EFH for three cohorts of commercially important fish species: Pacific salmon, groundfish, and coastal pelagic species. As with the ESA, federal agencies are required to consult with NOAA Fisheries regarding actions that may adversely modify EFH. This consultation typically occurs in conjunction with the Section 7 ESA consultation process. Impacts to EFH would be analyzed in the biological assessment, and NOAA Fisheries would issue their findings in the BO.

8.1.5 Marine Mammal Protection Act

The MMPA is administered by NOAA Fisheries Office of Protected Resources and provides for the protection of marine mammals by prohibiting, except under certain specified conditions, the taking, possession, and commercial use of such mammals. Under the MMPA, “take” means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill a marine mammal. NOAA Fisheries can authorize incidental take under the MMPA through either an Incidental Harassment Authorization or a Letter of Authorization. An Incidental Harassment Authorization is typically issued for projects involving take that would not result in injury or are of short duration, while a Letter of Authorization is typically used for projects with more significant potential impacts or those that may require multiple years of construction.

It is anticipated that either a Letter of Authorization or multiple Incidental Harassment Authorizations would be required for pile-driving activities associated with the construction of the Modified LPA. These permits would be applied for approximately 12 to 18 months prior to the start of construction.

8.1.6 Clean Water Act/Rivers and Harbors Act

Discharge of fill within waters of the U.S. (which include certain wetlands and surface waters) is regulated under Section 404 of the Clean Water Act. Section 404 is administered by the USACE. The appropriate state agency must also certify that the activity meets state water-quality standards under Section 401. These Section 401 certifications are issued by DEQ in Oregon and by Ecology in Washington. Section 10 of the Rivers and Harbors Act regulates activities within navigable waterways.

The construction of the Modified LPA would require both work within navigable waterways and fill placement within waters of the U.S. Therefore, a Section 10/404 permit with the USACE would be required. Additional detail regarding wetlands can be found in the Wetlands and Other Waters Technical Report.

8.1.7 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act authorizes the Secretaries of Agriculture and Commerce to provide assistance to, and cooperate with, federal and state agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.

8.2 State Permits

8.2.1 Oregon

Construction of the Modified LPA would be subject to the following Oregon State regulations relevant to protecting aquatic, terrestrial, and botanical resources.

8.2.1.1 Oregon Endangered Species Act

The Oregon ESA applies to actions of state agencies on state-owned or leased lands. ODFW is responsible for fish and wildlife protected under the Oregon ESA, and the ODA is responsible for listed plants. ODFW or ODA may issue a permit to any person for the incidental take of a state-listed threatened or endangered species if it determines that such take would not adversely impact the long-term conservation of the species or its habitat. The issuing department may issue the permit under such terms, conditions, and time periods necessary to minimize the impact on the species or its habitat.

A permit under the Oregon ESA would only be require for incidental take of state-listed species that are not covered under the federal ESA. It is not anticipated that an Oregon ESA permit would be required for the construction of the Modified LPA.

8.2.1.2 Fish Passage, Fishways, Screen Devices, and Hatcheries near Dams

Oregon's fish passage law has several triggers that initiate compliance requirements. All new culverts, bridges, and dams must meet the current ODFW guidelines for fish passage. If passage is not possible, the law allows waivers or exemptions to be approved by the ODFW fish passage coordinator or the Oregon Fish and Wildlife Commission, depending on the amount of habitat that would be removed from fish usage. Waivers allow for fish passage to be accomplished off site, but still within the watershed if a net benefit to fish is shown. Exemptions allow applicants not to provide passage at the specific site, but passage could be required in the future if watershed conditions change.

It is anticipated that the Modified LPA would meet all applicable fish passage criteria for the State of Oregon, and that waivers or exemptions would not be required. A fish passage plan would be submitted to ODFW for review and approval.

8.2.1.3 State Planning Goal 5/Metro Title 13

In the 1970s, Oregon established a set of 19 Statewide Planning Goals as part of a strong program for land use planning. Goal 5 establishes standards for protecting natural resources, open spaces, and scenic and historic areas.

Metro adopted Title 13 of the Urban Growth Management Functional plan to satisfy Goal 5 planning goals. Title 13 establishes baseline requirements to protect, conserve, and restore the region’s significant riparian corridors and wildlife habitat resources which are collectively referred to as Habitat Conservation Areas. These Habitat Conservation Areas include rivers, streams, wetlands, and adjacent resource areas, as well as upland wildlife habitat patches and habitats of concern. Metro requires area cities and counties to demonstrate compliance with Title 13.

In 2012, the City of Portland prepared an NRI update that demonstrated compliance with Title 13. The City’s NRI, like the Title 13 inventory, focuses on riparian corridors and wildlife habitat. Portland’s model assigns scores of high, medium, or low to mapped habitat patches, then establishes a combined riparian/wildlife habitat ranking that categorizes habitat patches as providing high, medium, or low relative function. Portland also identifies certain habitats as SHAs, the comparable equivalent to Metro’s Title 13 Habitats of Concern.

8.2.1.4 Oregon’s Removal-Fill Law

Impacts to jurisdictional wetlands or other waters of the state (e.g., fill or removal activities below the bankfull stage or the line of non-aquatic vegetation, whichever is higher) require a removal-fill permit from DSL. This permit is typically obtained in conjunction with Section 404/401 approvals via the preparation of a joint permit application. Additional detail regarding wetlands can be found in the Wetlands and Other Waters Technical Report.

8.2.1.5 Wildlife Policy

It is the State of Oregon’s policy that wildlife be managed to prevent serious depletion of an indigenous species. An in-water blasting permit is required from ODFW if the project alternatives include in-water blasting. This permit is required if explosives are used when removing an obstruction in a water of the state; in constructing foundations for dams, bridges, or other structures; or in carrying on trade or business. ODFW issues in-water blasting permits only if they contain conditions for preventing injury to fish and wildlife and their habitat.

No in-water blasting is expected to be necessary for the Modified LPA; therefore, no permit is likely to be required under this policy.

8.2.1.6 Section 401 Clean Water Act Certification

As described in Section 8.1.6, state agencies must issue a Section 401 certification in conjunction with a federal Section 404 permit for impacts to wetlands and jurisdictional waters. The 401 Certification in Oregon would be coordinated with, and issued by, DEQ.

8.2.2 Washington

Construction of the Modified LPA would be subject to the following Washington State regulations relevant to protecting aquatic, terrestrial, and botanical resources.

8.2.2.1 State Environmental Policy Act

The State Environmental Policy Act (SEPA) requires all governmental agencies to consider the environmental impacts of a proposed action before making decisions. An environmental impact statement (EIS) must be prepared for all proposals that would result in probable significant adverse impacts on the quality of the environment. For actions where a NEPA EIS is being prepared, the SEPA lead agency may approve an EIS prepared under NEPA to fulfill the SEPA evaluation requirement. This would be the case for the Modified LPA; a separate SEPA EIS would not be prepared.

8.2.2.2 Washington Hydraulic Project Approval

WDFW administers impacts to fish and wildlife resources through Washington's Hydraulic Code Rules, which are defined in WAC 220-660-080. The Hydraulic Code establishes a requirement of a Hydraulic Project Approval for projects that affect fish and aquatic habitats. A Hydraulic Project Approval would be required for the construction of the Modified LPA, and this application would be coordinated with WDFW.

8.2.2.3 Clean Water Act Certification

As described in Section 8.1.6, state agencies must issue a Section 401 certification in conjunction with a federal Section 404 permit for impacts to wetlands and jurisdictional waters. The 401 Certification in Washington would be coordinated with, and issued by, Ecology.

8.3 Local Permits

8.3.1 Oregon

Construction of the Modified LPA would be subject to the following Oregon local regulations relevant to protecting aquatic, terrestrial, and botanical resources.

8.3.1.1 City of Portland Environmental Review

The City of Portland regulates development activities within sensitive habitats through its environmental review process. Portland has established Environmental Protection zones and Environmental Conservation zones that provide habitat protection and regulation, in addition to location-specific management plans that establish regulations that supersede or supplement the environmental zone regulations. Environmental review is overseen by the City of Portland Land Use Review process.

The environmental review process requires the applicant to explore development and construction methods that first avoids impacts to natural resources and then minimizes those impacts if they cannot be avoided. Impacts to resources and functional values as identified for protection by the City must be adequately compensated for consistent with Zoning Code Section 33.430.350.A.4.

Construction of the Modified LPA would require an environmental review, and this application would be coordinated with the City of Portland.

8.3.1.2 City of Portland Floodplain Review

The City of Portland is a participant in the National Flood Insurance Program and regulates development in special flood hazard areas through CPC Title 24.50, which is based on FEMA regulations. The City reviews projects for compliance with these flood hazard regulations through both building permit and land use reviews. The City has worked with FEMA, NOAA Fisheries, and other jurisdictions to facilitate changes to align city land use and building regulations with the federal ESA. The City's revised Floodplain Development Code increases flood storage compensation requirements for certain flood hazard areas.

Construction of the Modified LPA would require a land use review, and would need to demonstrate consistency with flood hazard regulations in effect at the time of application. This application would be coordinated with the City of Portland.

8.3.1.3 City of Portland Tree Ordinance

A permit to cut trees on private or public property within the study area may be required from the City of Portland. Urban Forestry also regulates the cutting and planting of trees on public property, including street trees located on the public right of way. Permits are required to plant, prune, remove, or cut the roots of any tree located on public property.

8.3.1.4 City of Gresham Floodplain Overlay District

In 2019, the City of Gresham updated its Municipal Code with an updated floodplain overlay (City of Gresham 2019). Activities within the Natural Resource Overlay or Floodplain Overlay Districts of the city of Gresham would need to comply with the applicable sections of Gresham's municipal code that apply to these districts. The Natural Resource Overlay code establishes requirements to avoid and minimize impacts to the extent practicable, and to provide compensatory mitigation for unavoidable impacts. Activities within the floodplain overlay would need to be accompanied by documentation demonstrating that the proposed activities would not affect floodplain function (City of Gresham 2019).

8.3.2 Washington

Construction of the Modified LPA would be subject to the following Washington local regulations relevant to protecting aquatic, terrestrial, and botanical resources.

8.3.2.1 Critical Areas Ordinances

The City of Vancouver has established a Critical Areas Ordinances that regulates development within sensitive habitat resources, including wetlands, FHWCAs, floodplains, aquifer recharge areas, and geologic hazard areas.

A Critical Areas Permit would be required for impacts to designated critical areas or their buffers. A Critical Areas Report would be required. This application and review would be coordinated with the City of Vancouver for affected resources within their jurisdiction.

8.3.2.2 Shoreline Management Program

The Shoreline Management Act defines certain waterbodies as “Shorelines of the State” and directs local jurisdictions to establish SMPs, which identify these shorelines within their jurisdictions and establish shoreline management areas in which development activities are regulated to protect important shoreline functions, including habitat functions.

The City of Vancouver’s SMP defines the limits of shoreline jurisdiction as including areas 200 feet in all directions as measured on a horizontal plane from the OHWM; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters.

A Substantial Development Permit would be required for activities occurring within areas regulated by the City of Vancouver’s SMP. This application and review would be coordinated with the City of Vancouver for affected resources within their jurisdiction.

8.3.2.3 Tree Conservation Ordinance

The City of Vancouver’s Tree Conservation ordinance regulates the removal of trees on public or private property. If construction of the Modified LPA would require removal of one or more trees, a Tree Permit would likely be required and coordinated with the City of Vancouver. Tree mitigation required by the city through this process would focus on native and climate adaptive plant material.

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