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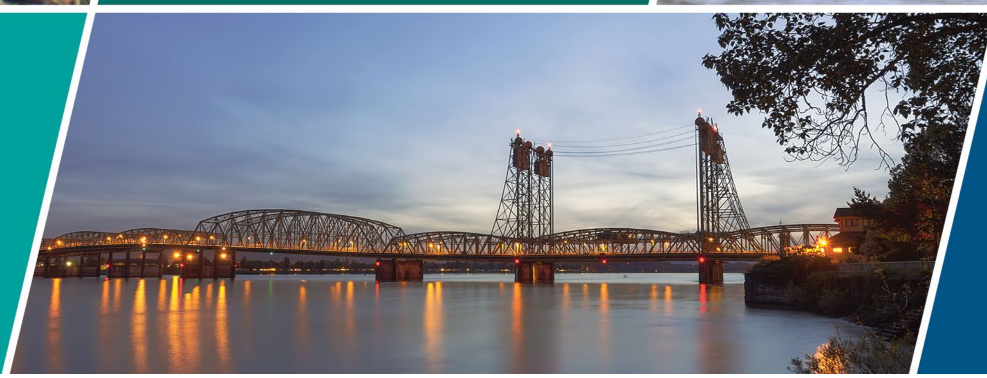

Water Quality and Hydrology Technical Report

September 2024

OREGON

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Water Quality and Hydrology Technical Report

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
BES	City of Portland Bureau of Environmental Services
BMP	best management practice
BRT	bus rapid transit
BTEX	benzene, toluene, ethylbenzene, and xylene
CAD	computer-aided design
CCC	Clark County Code
CECs	constituents of emerging concern
CESCL	certified erosion and sediment control lead
CFR	Code of Federal Regulations
cfs	cubic feet per second
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
CWA	Clean Water Act
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAHP	Federal Aid Highway Program
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration

Acronym/Abbreviation	Definition
FSCR	Flood Safe Columbia River
GIS	geographic information system
I-5	Interstate 5
IBR	Interstate Bridge Replacement
JPA	Joint Permit Application
LPA	Locally Preferred Alternative
LRT	light-rail transit
LRV	light-rail vehicle
MAX	Metropolitan Area Express
mg/L	milligrams per liter
MS4	Municipal Separate Storm Sewer System
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NGVD29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	nephelometric turbidity unit
OAR	Oregon Administrative Rules
°C	degrees Celsius
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
°F	degrees Fahrenheit
OHWM	ordinary high-water mark
ORS	Oregon Revised Statutes
OTC	Oregon Transportation Commission

Acronym/Abbreviation	Definition
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PDX	Portland International Airport
PEN 1	Peninsula Drainage District No.1
PEN 2	Peninsula Drainage District No.2
PMLS	Portland Metro Levee System
PNCD	Preliminary Navigation Clearance Determination
RM	river mile
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SOV	single-occupancy vehicle
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SR	State Route
SSA	Sole Source Aquifer
TESCP	Temporary Erosion and Sediment Control Plan
TMDL	Total Maximum Daily Load
TriMet	Tri-County Metropolitan Transportation District
TSS	total suspended solids
UFSWQD	Urban Flood Safety and Water Quality District
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMC	Vancouver Municipal Code
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife

Acronym/Abbreviation	Definition
WPCF	water pollution control facility
WSDOT	Washington State Department of Transportation
WSTC	Washington State Transportation Commission

1. PROGRAM OVERVIEW

This technical report identifies, describes, and evaluates the direct long-term, direct temporary (i.e., short-term construction), and indirect effects related to water quality and hydrology from the Interstate Bridge Replacement (IBR) Program. The construction and operation of transportation infrastructure can have effects on, and can be affected by, water quality and hydrology resources. Where possible, the Modified Locally Preferred Alternative (LPA) would be designed to avoid or minimize these effects. This report provides proposed mitigation measures for potential effects 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 (Chapter 2).
- Describe existing water quality and hydrologic conditions (Chapter 3).
- Discuss potential long-term, temporary, and indirect effects of the Modified LPA and the No-Build Alternative to water quality and hydrological resources (Chapters 4, 5, and 6).
- Provide proposed avoidance and mitigation measures to help prevent, eliminate, or minimize environmental consequences 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.
    a. 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.
    b. 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.
    a. 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.
  a. 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.
  b. 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 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.

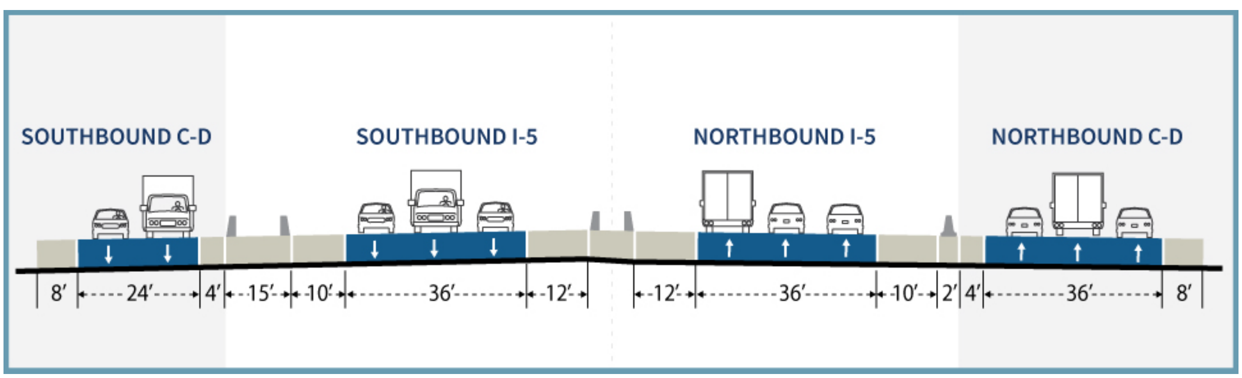
On I-5 northbound, the auxiliary lane that would begin at the on-ramp from Marine Drive would continue across the Columbia River bridge and end at the off-ramp to the C-D roadway, north of SR 14 (see Figure 1-5). The on-ramp from SR 14 westbound would join the off-ramp to the C-D roadway, forming the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

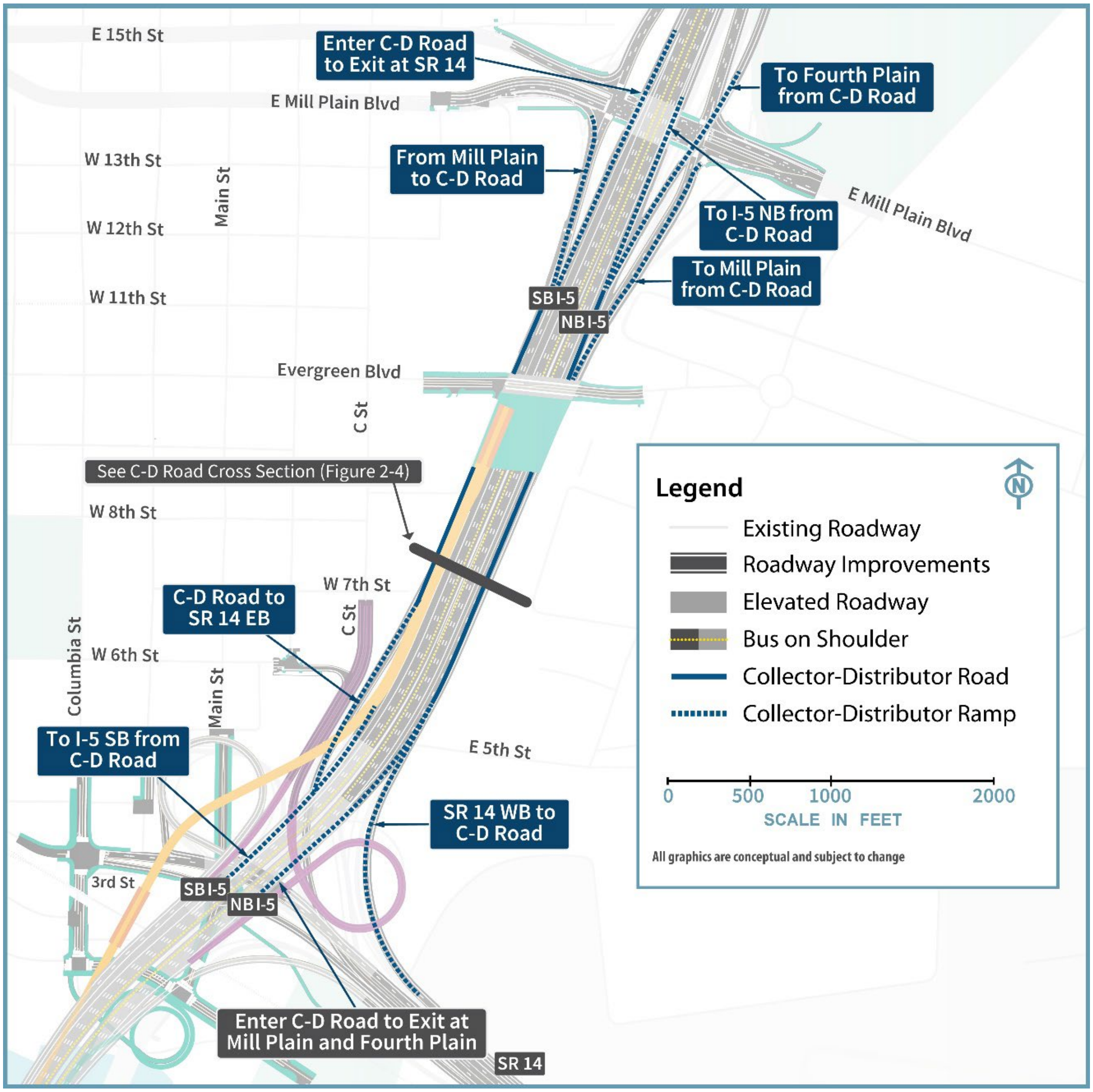
On I-5 southbound, an auxiliary lane would begin at the on-ramp from the C-D roadway and would continue across the southbound Columbia River bridge and end at the off-ramp to Marine Drive. The combined on-ramp from SR 14 westbound and C Street would merge into this auxiliary lane.

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

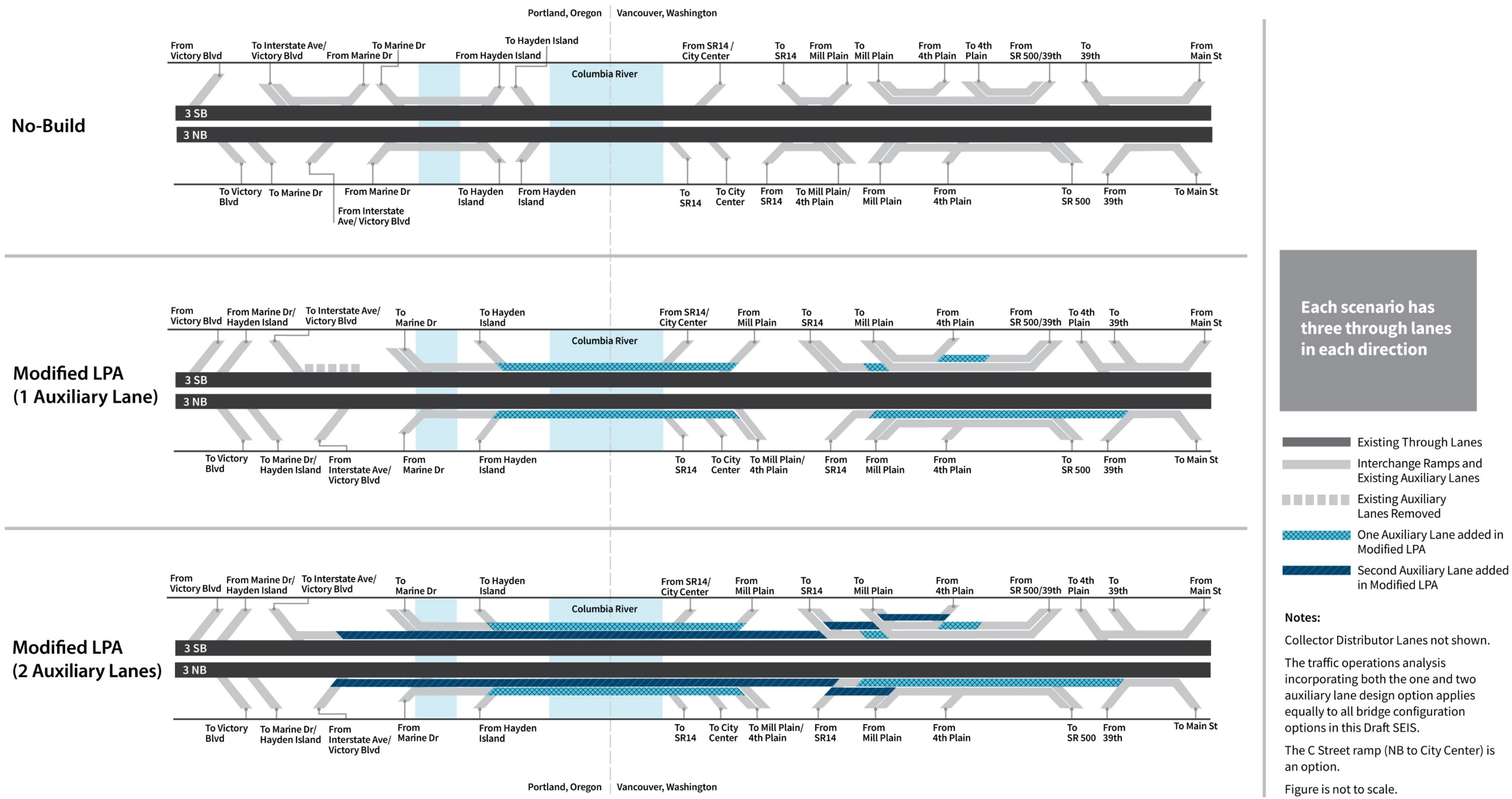
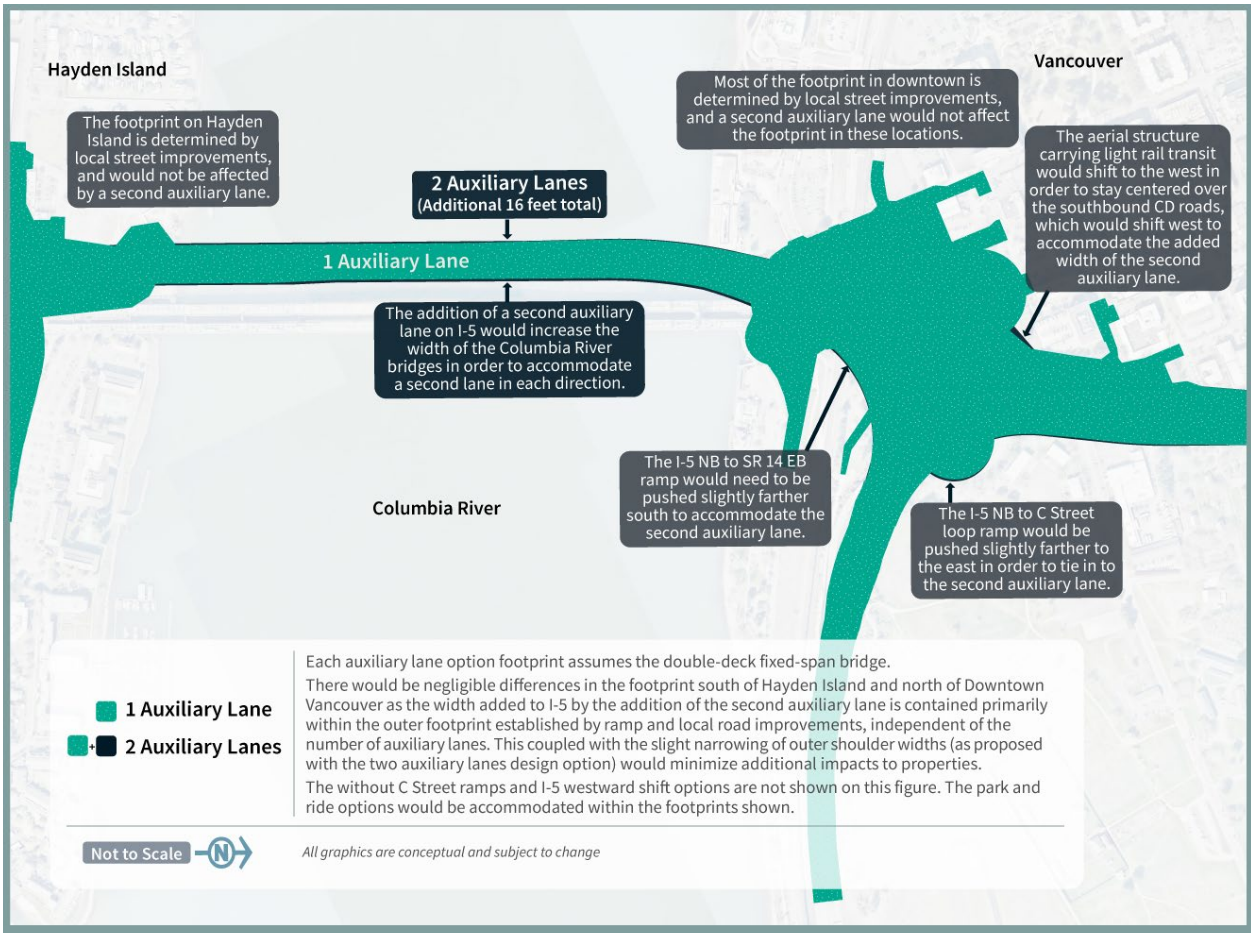


Figure 1-7. Auxiliary Lane Configuration Footprint Differences



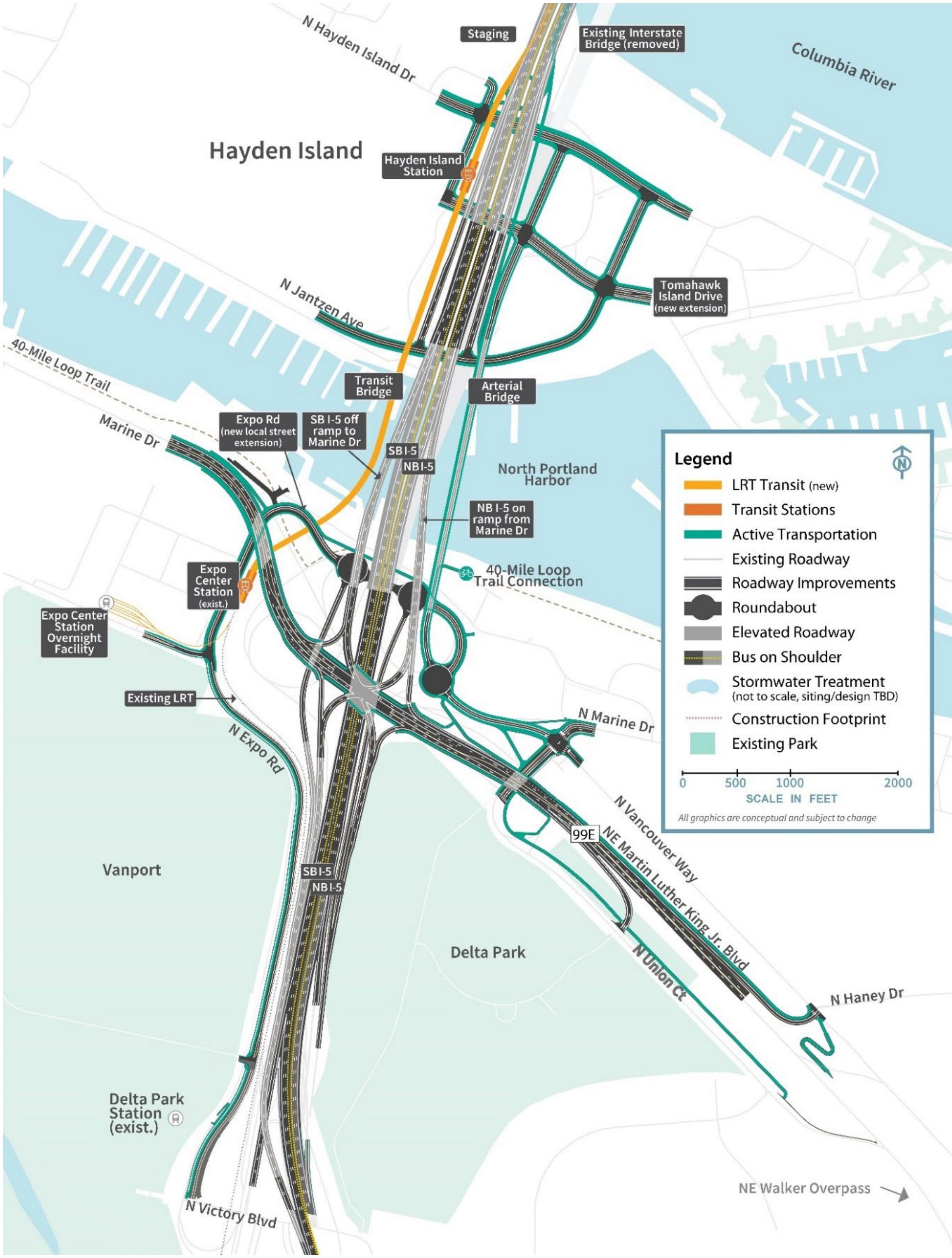
1.1.2 Portland Mainland and Hayden Island (Subarea A)

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:

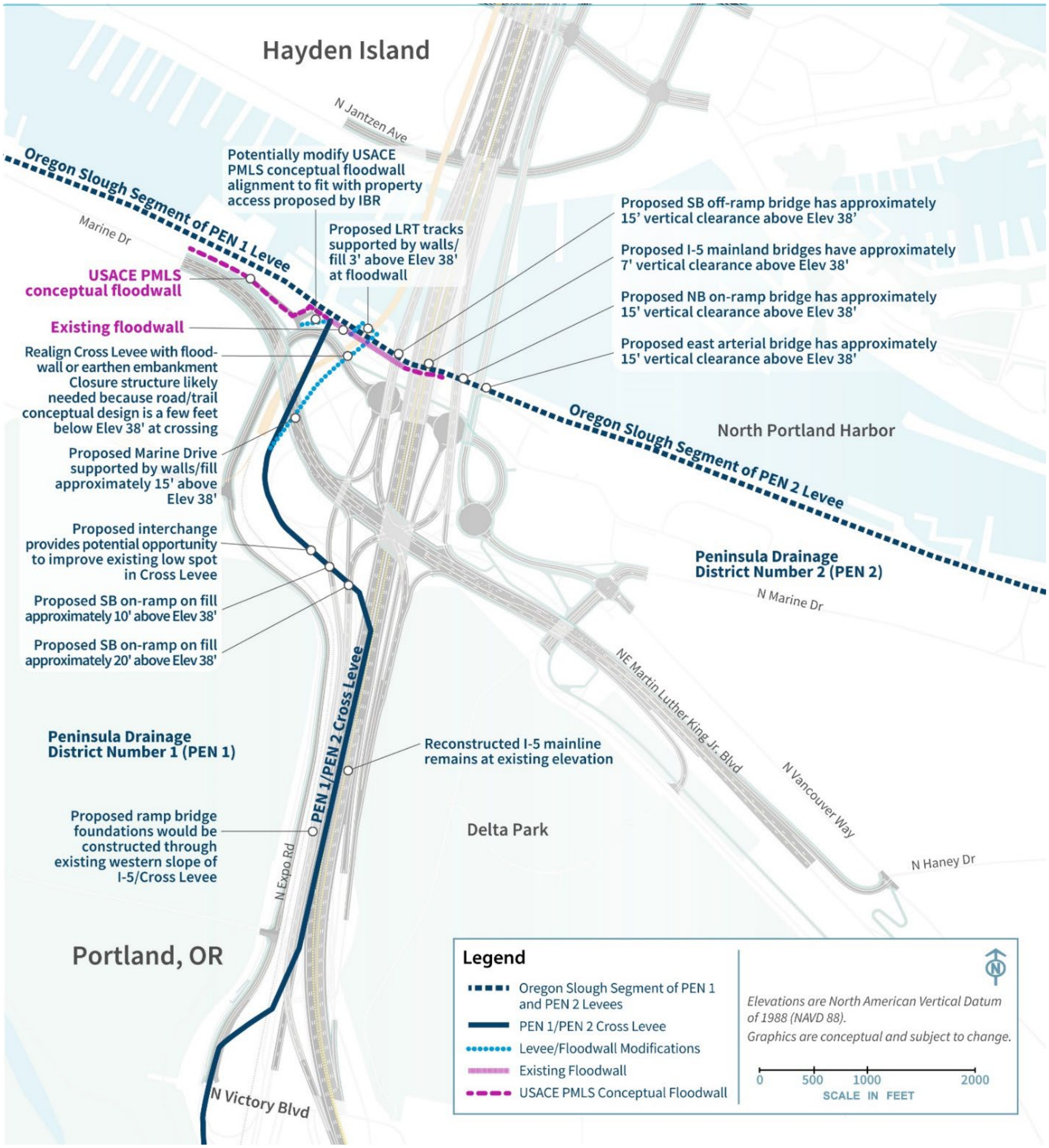
- The U.S. Army Corps of Engineers (USACE) Portland Metro Levee System (PMLS) project.
- The Flood Safe Columbia River (FSCR) program (also known as "Levee Ready Columbia").

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.

[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



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.

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.

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

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 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.

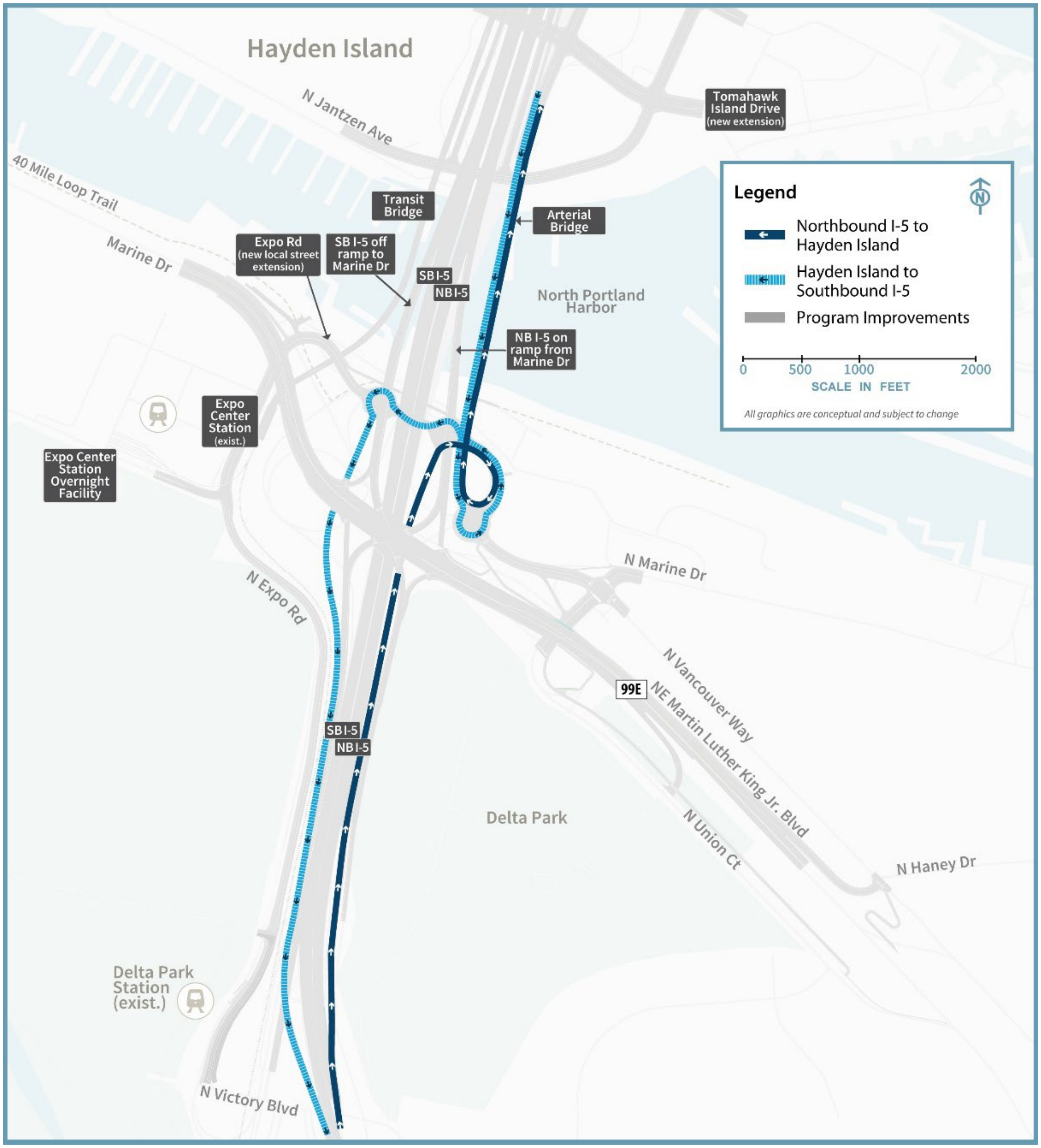
HAYDEN ISLAND INTERCHANGE AREA

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.

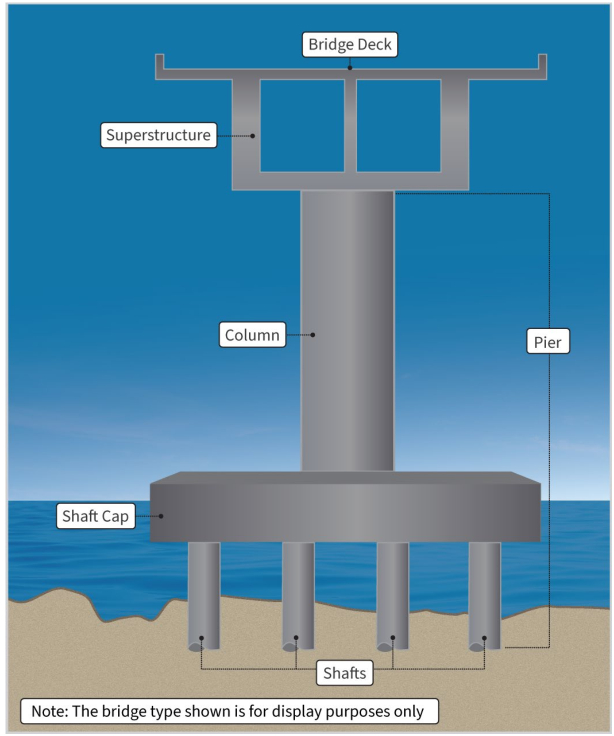
Figure 1-11. Columbia River Bridges (Subarea B)

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.

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.

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

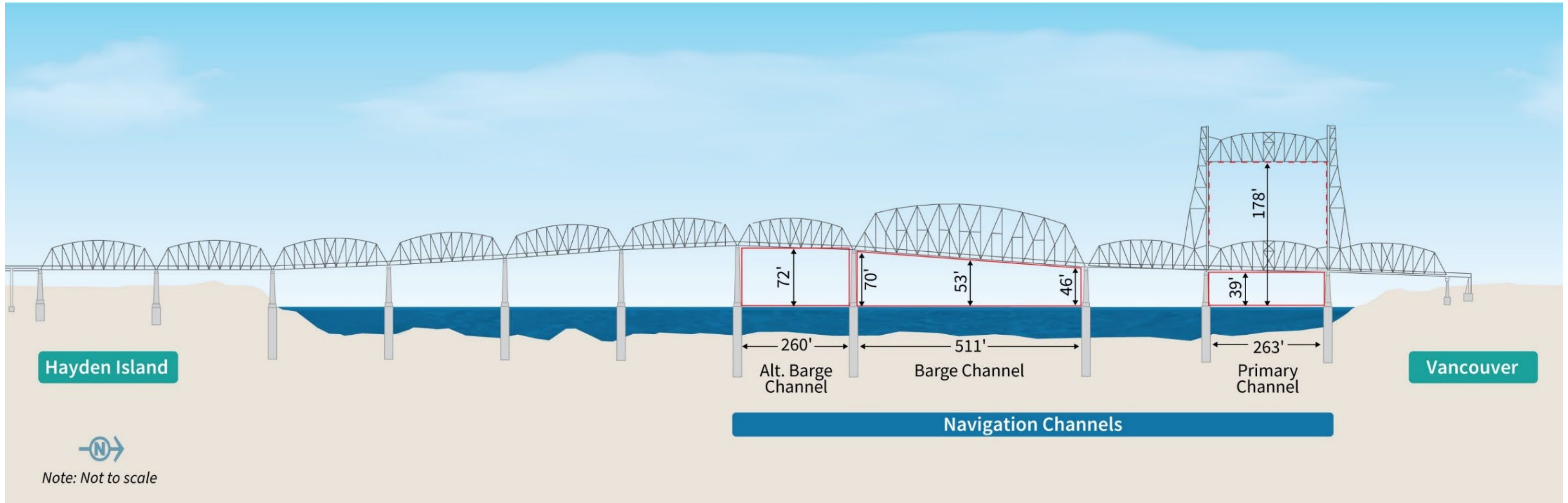
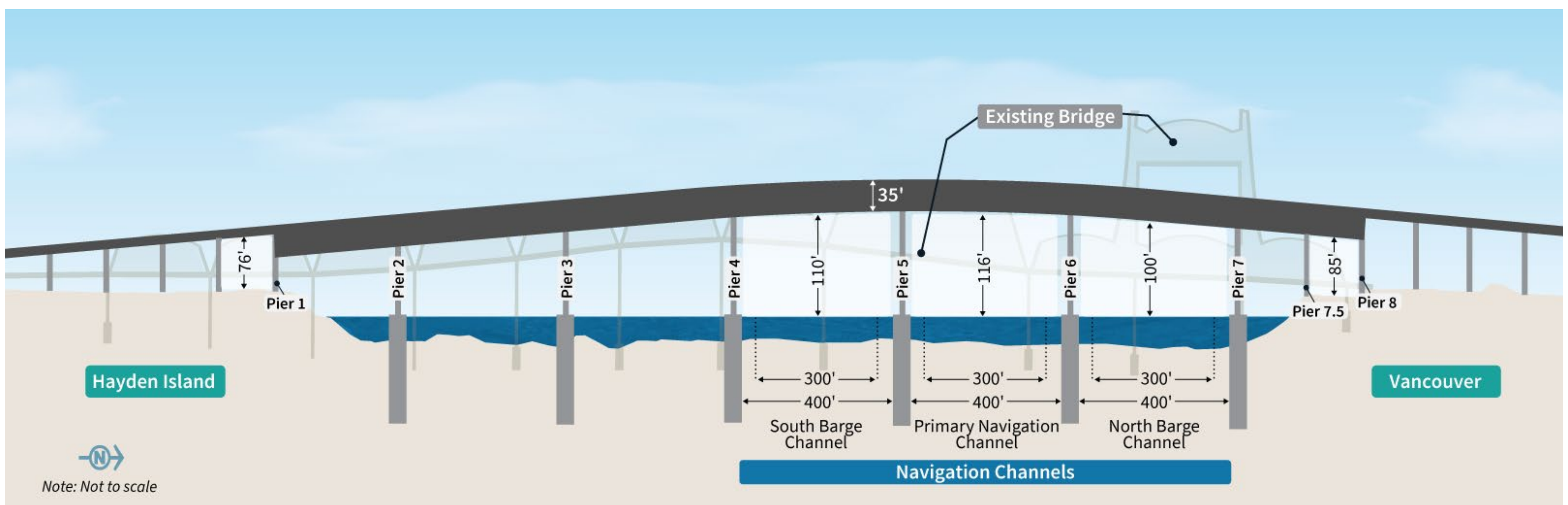


Figure 1-14. Profile and Navigation Clearances of the Proposed Modified LPA Columbia River Bridges with a Double-Deck Fixed-Span Configuration



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.

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.

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]

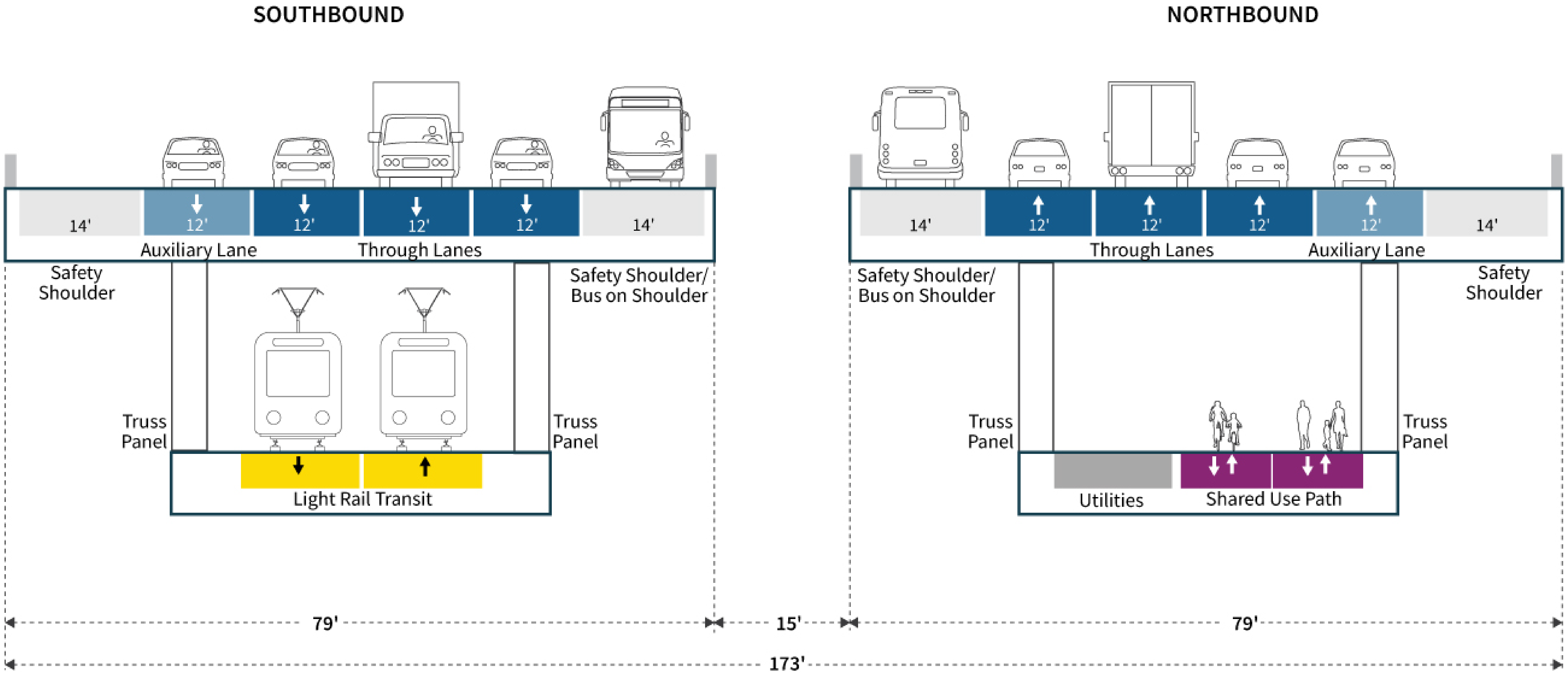
Figure 1-15. Conceptual Drawing of a Double-Deck Fixed-Span Configuration

Note: Visualization is looking southwest from Vancouver.

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.

[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



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.

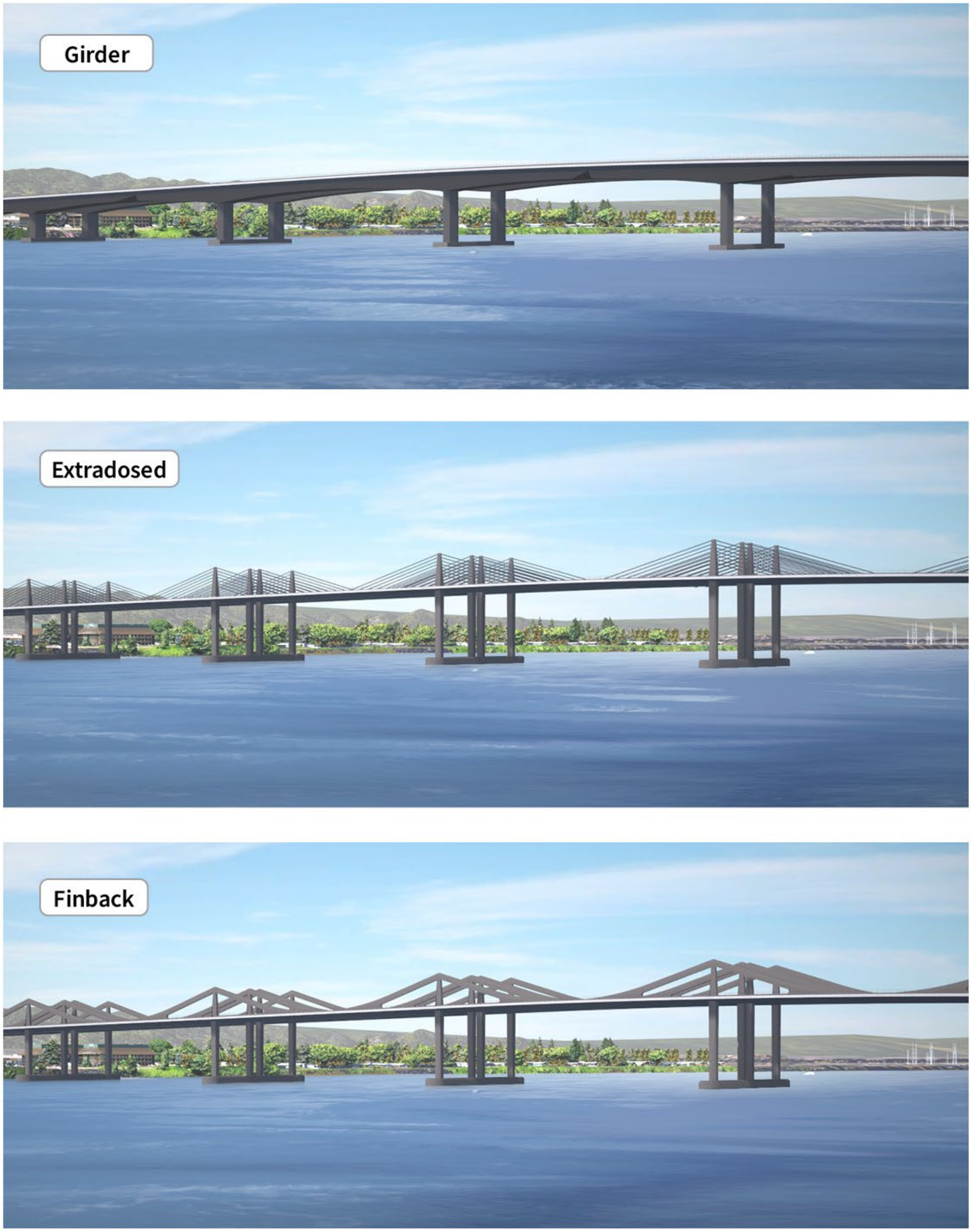
This configuration would provide 116 feet of vertical navigation clearance for river traffic using the primary navigation channel and 400 feet of horizontal navigation clearance at the primary navigation channel, as well as barge channels. This bridge height would not impede takeoffs and landings by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

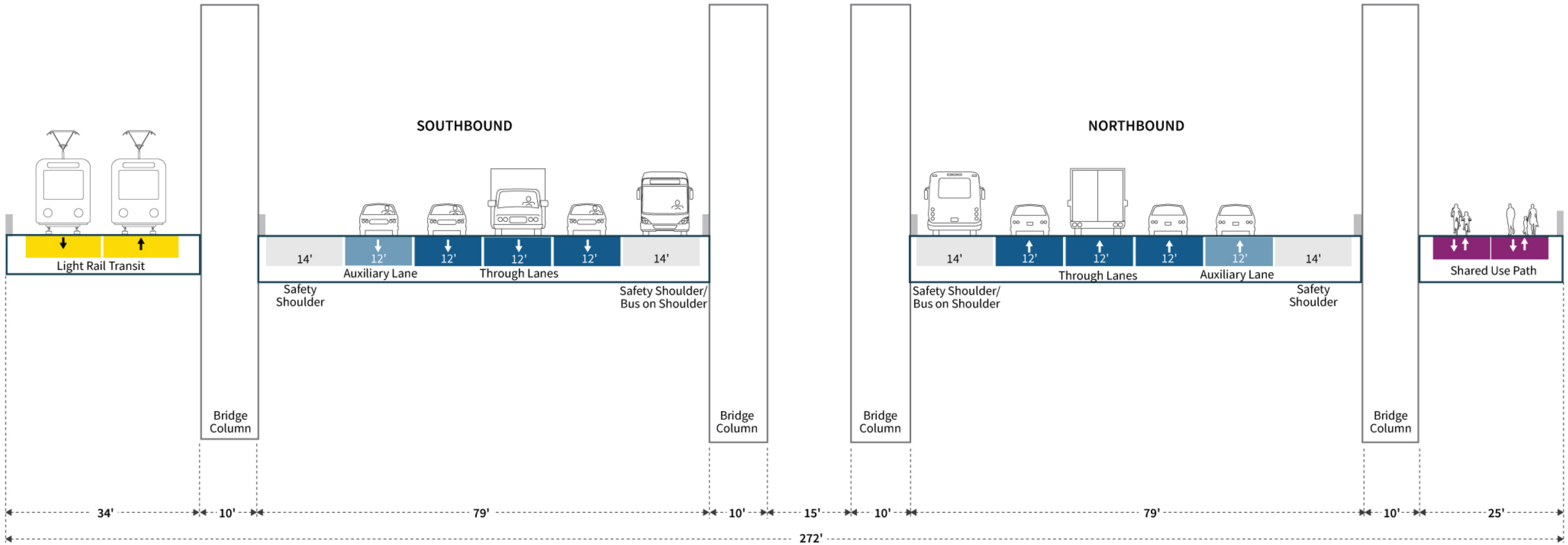
This bridge configuration would have a 3% maximum grade on both the Oregon and Washington sides of the bridge.

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.

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.

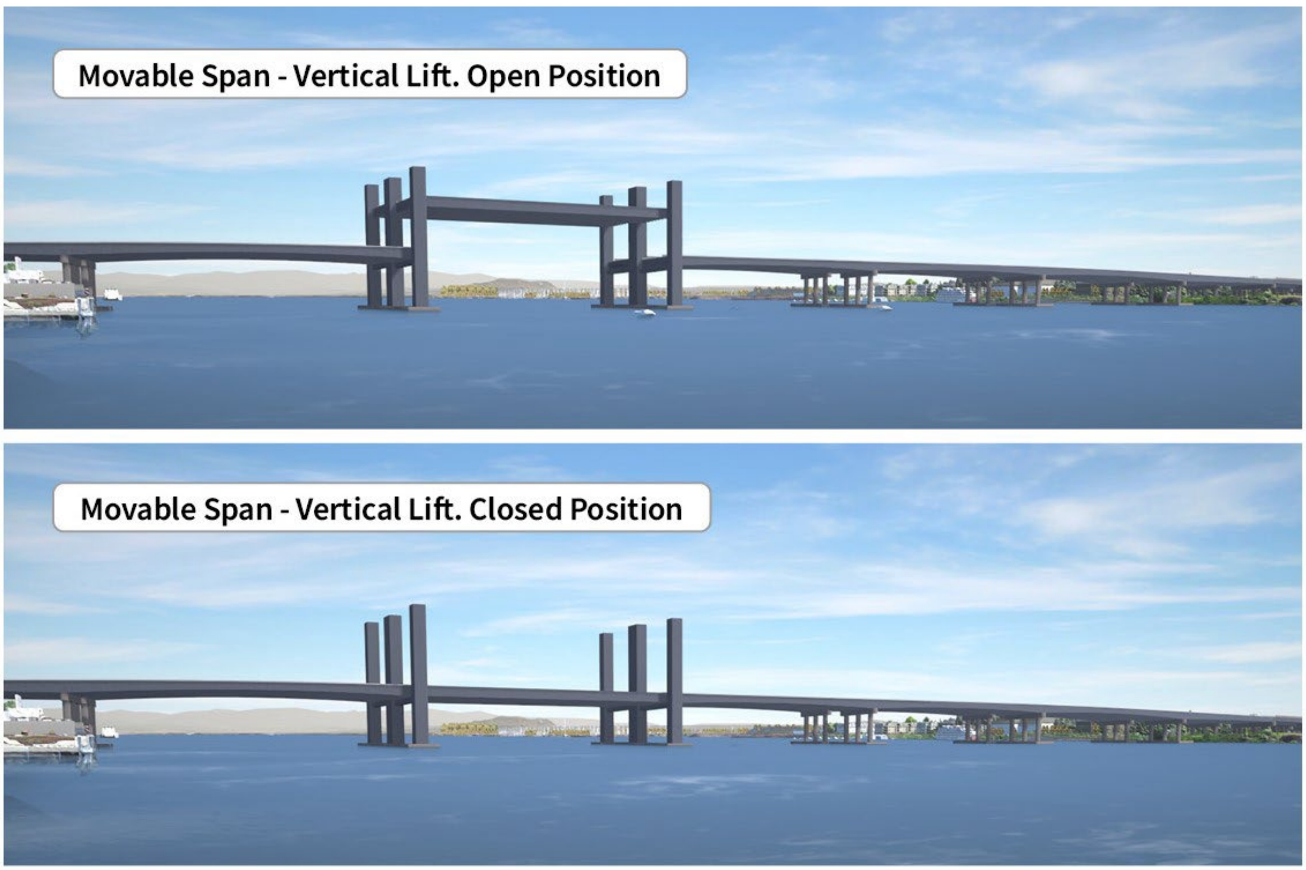
The vertical lift-span towers would be approximately 243 feet high; this is shorter than the existing lift-span towers, which are 247 feet high. This height of the vertical lift-span towers would not impede takeoffs and landings by aircraft using Portland International Airport. At Pearson Field, the 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.

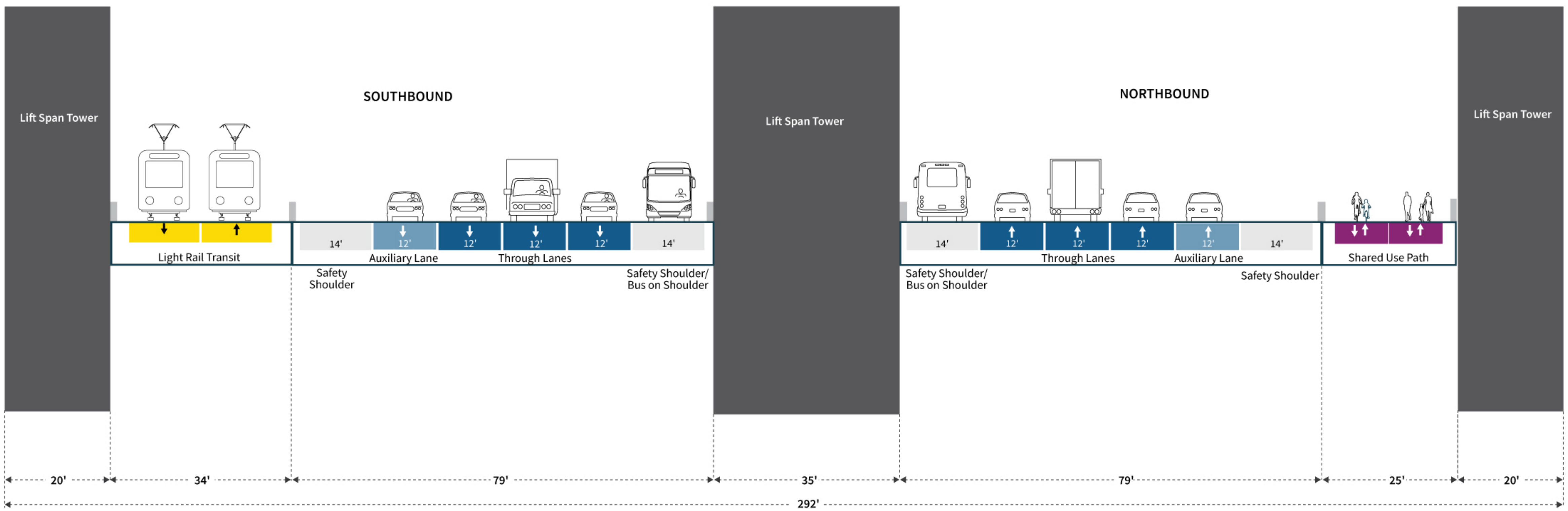
Figure 1-19. Conceptual Drawings of Single-Level Movable-Span Configurations in the Closed and Open Positions



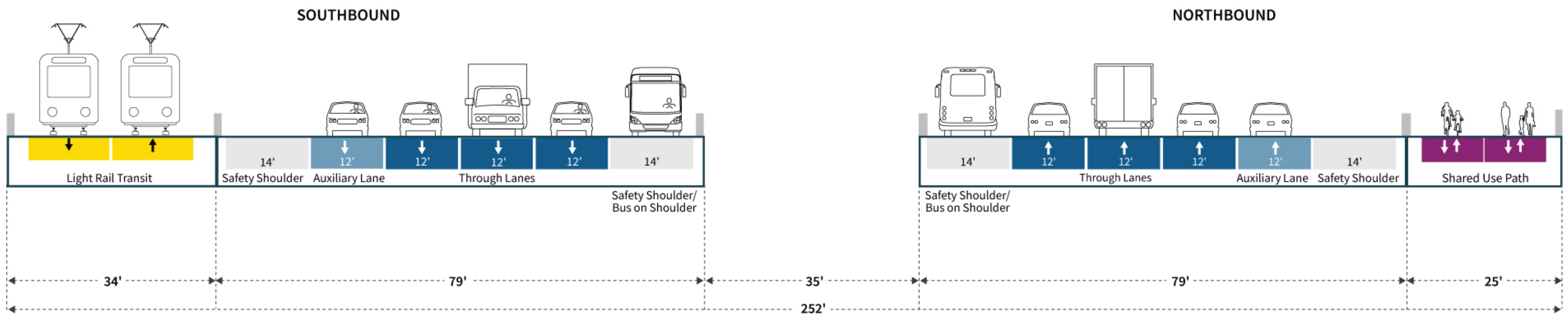
Note: Visualizations are for illustrative purposes only. They do not reflect property impacts or represent final design. Visualization is looking southeast (upstream) from Vancouver.

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

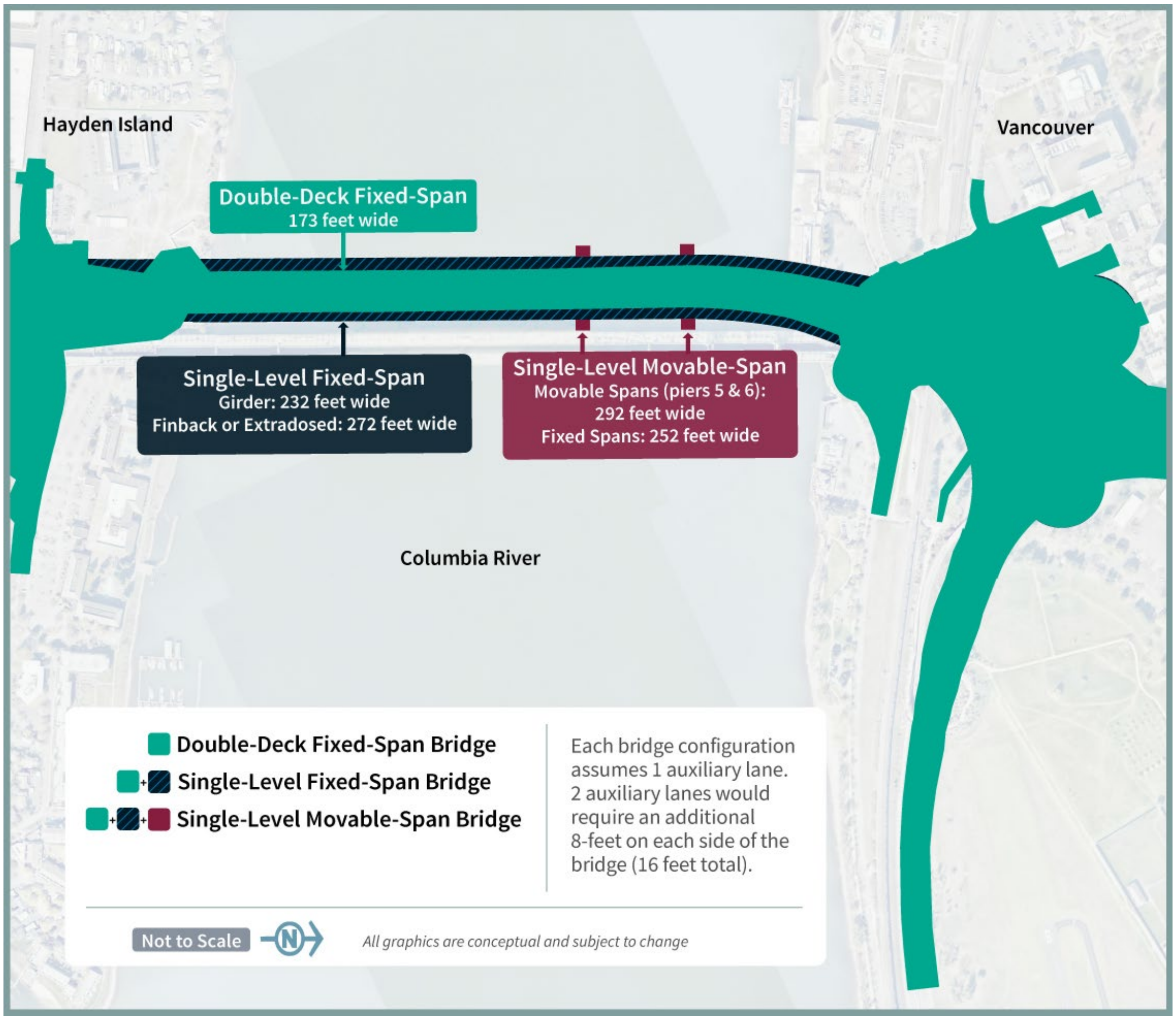
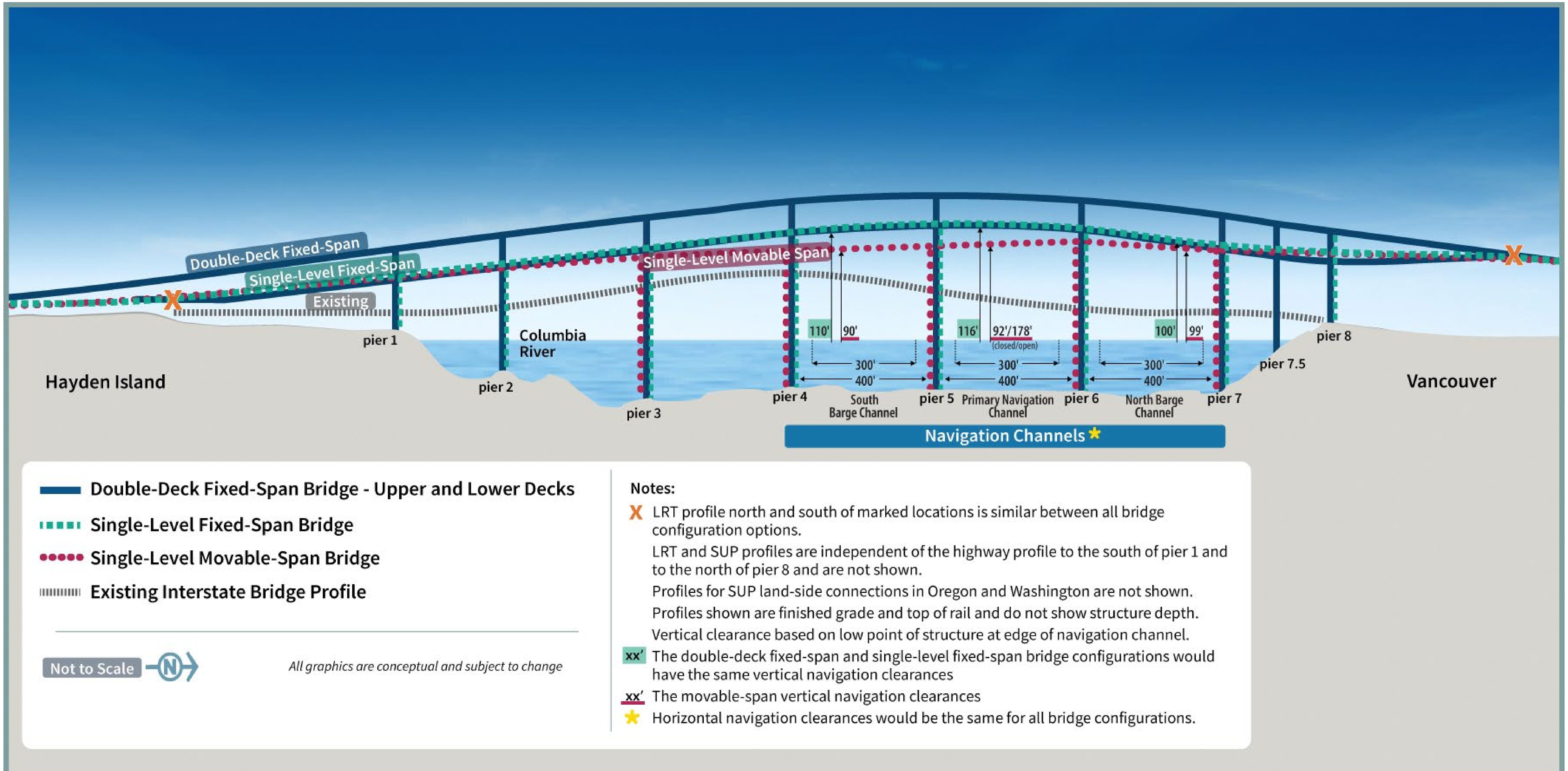


Figure 1-22. Bridge Configuration Profile Comparison



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.

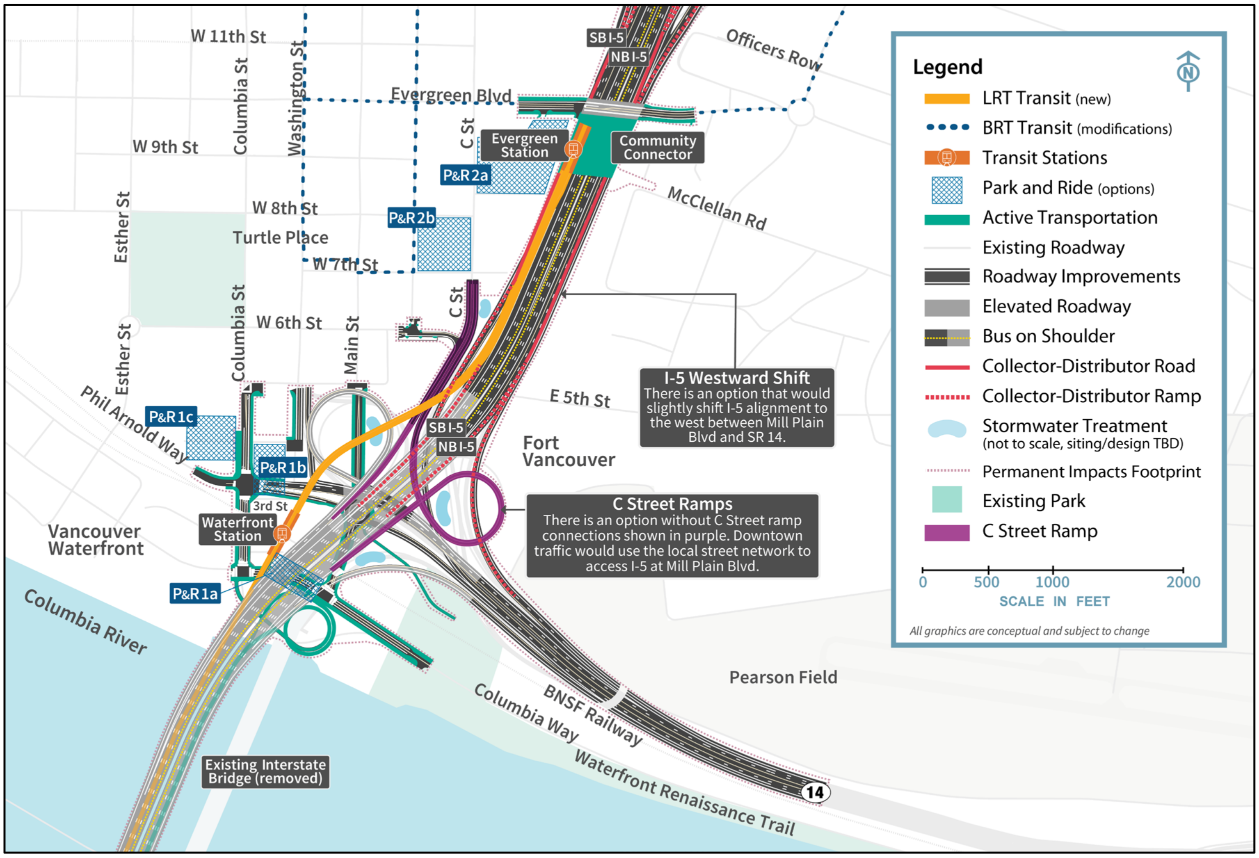
Main Street would be extended between 5th Street and Columbia Way. Vehicles traveling from downtown Vancouver to access SR 14 eastbound would use the new extension of Main Street to the roundabout underneath I-5. If coming from the west or south (waterfront) in downtown Vancouver, vehicles would use 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.

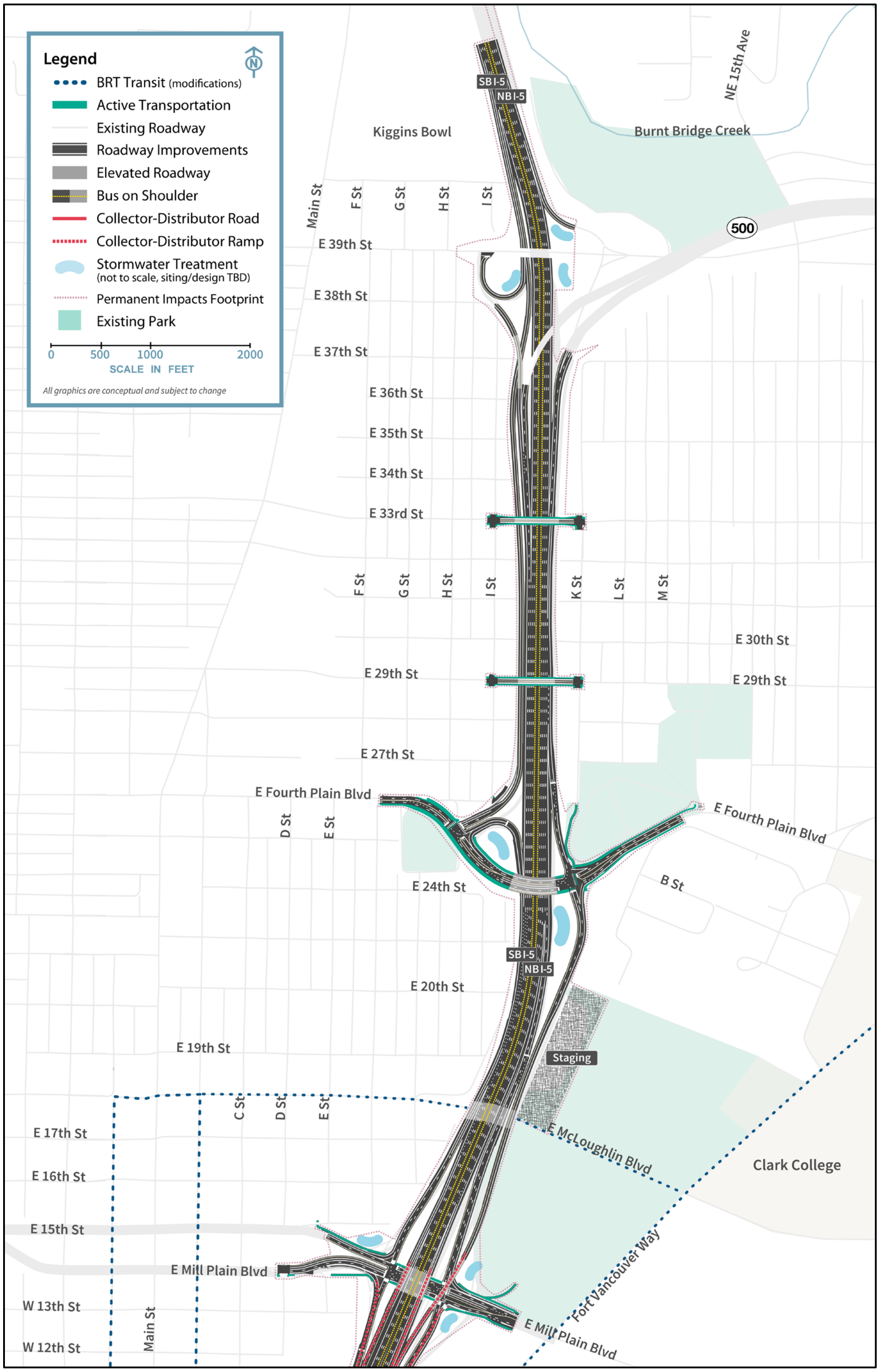
MILL PLAIN BOULEVARD INTERCHANGE

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.

Figure 1-24. Upper Vancouver (Subarea D)



BRT = bus rapid transit; TBD = to be determined

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.

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.

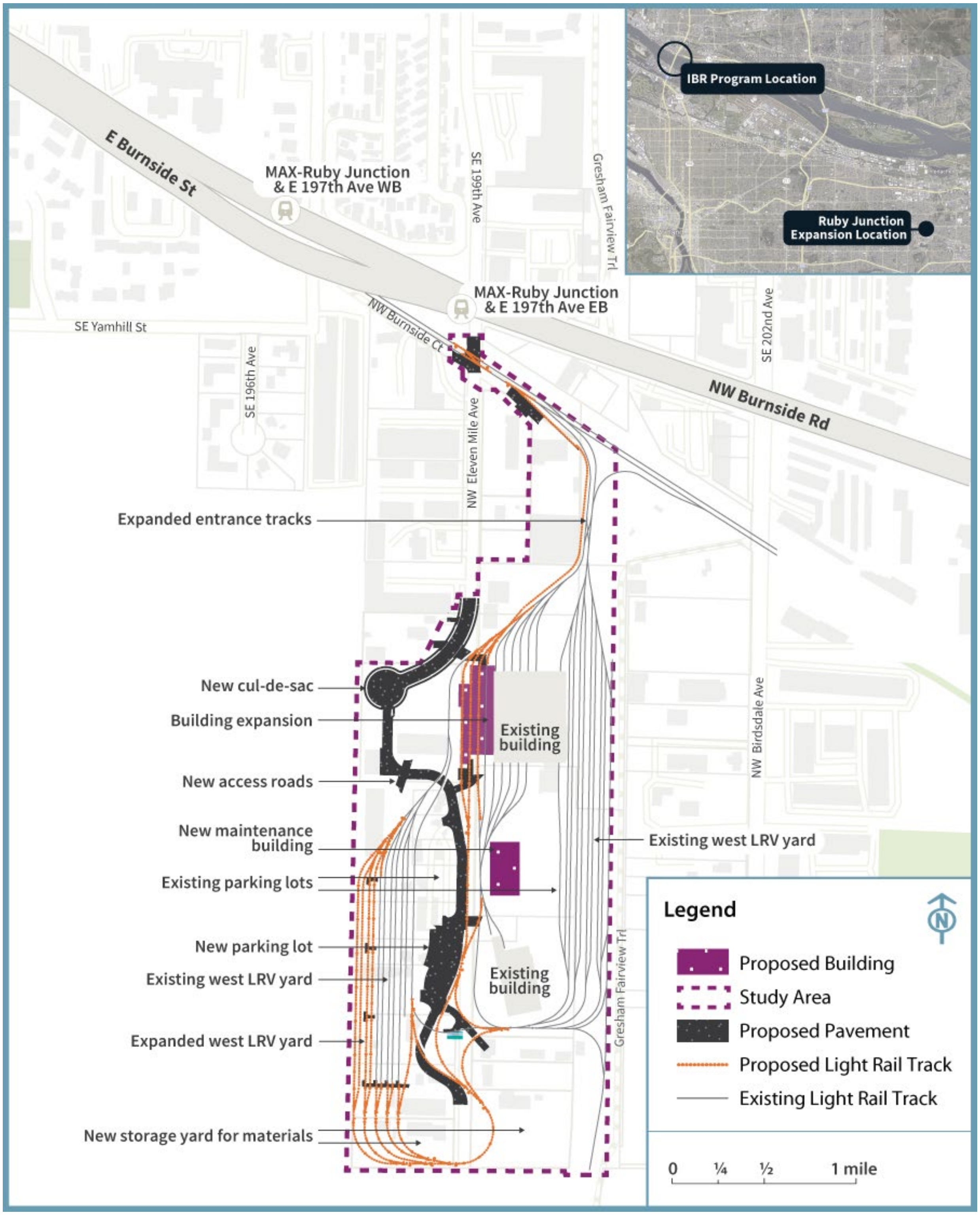
The existing LRV storage yard, west of Eleven Mile Avenue, would be expanded to the west to accommodate additional storage tracks and a runaround track (a track constructed to bypass congestion in the maintenance yard). This expansion would require partial demolition of an existing TriMet building (just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

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.

Figure 1-25. Ruby Junction Maintenance Facility Study Area



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

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.

Bus Route	Existing Route	Changes with Modified LPA
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.
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).

> **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.

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.

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.
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).

Component	Estimated Duration	Notes
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 Water Quality and Hydrology Technical Report to:

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

The methods and analysis comply with NEPA and relevant federal, state, and local laws, and builds on those developed for the CRC project. The methods used for this analysis have been updated for the IBR Program as follows:

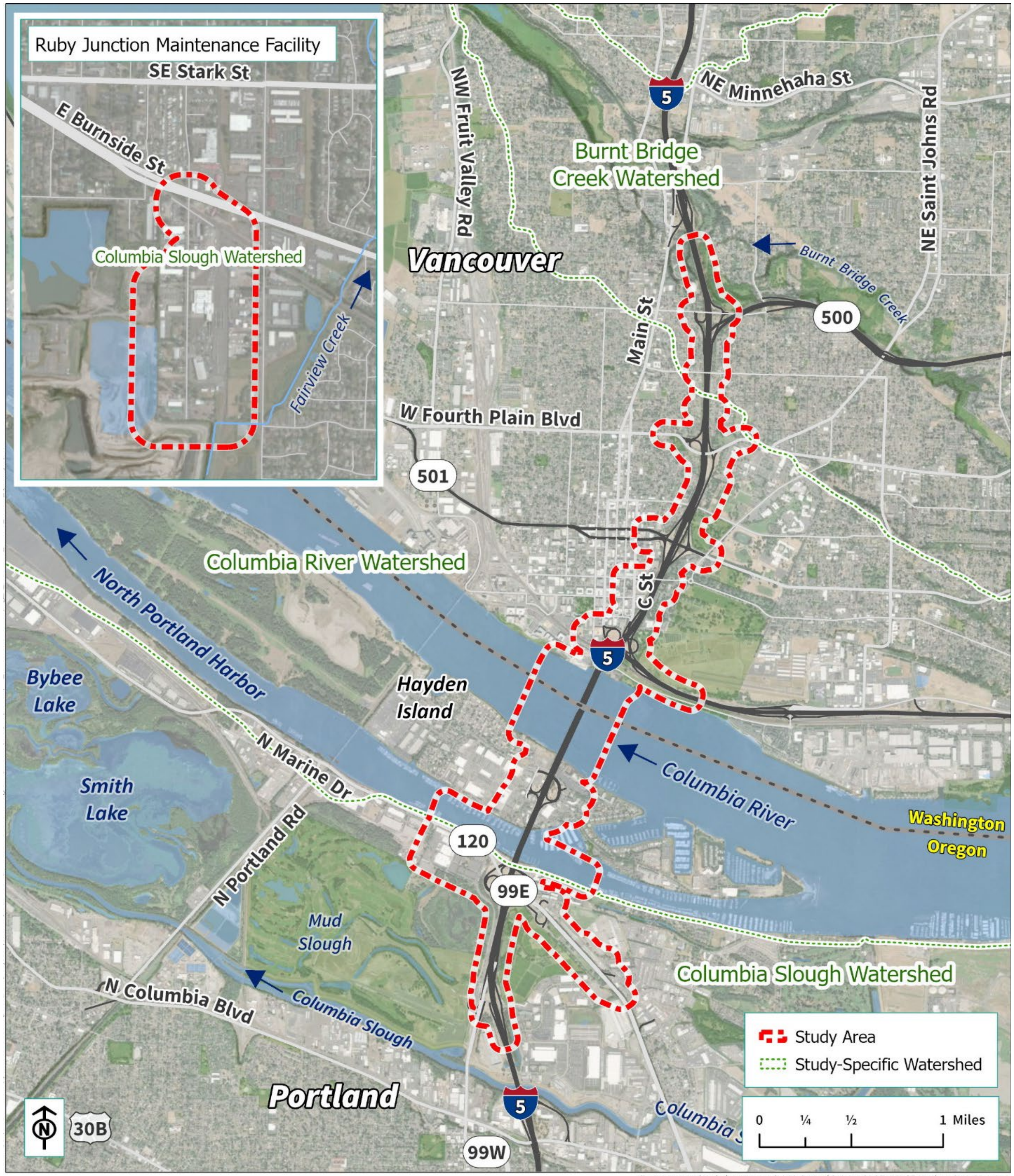
- Changes to federal or state regulation dates/citations.
- Changes in permitting processes, most notably for the Clean Water Act (CWA) Section 401 Water Quality Certification and Section 402 National Pollutant Discharge Elimination System (NPDES).
- Updates to 303(d)-listed impaired waters.
- Changes to climate predictions and modeling tools.
- Changes to constituents of emerging concern, including 6PPD-quinone.
- Addition, removal, and updating of data sources as appropriate.

2.1 Study Area

The study area for the Modified LPA includes 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 area around the Tri-County Metropolitan Transportation District's (TriMet's) existing Ruby Junction Maintenance Facility in Gresham, Oregon. Physical changes associated with the Modified LPA would occur in this area. The study area includes temporary construction easements that would be established directly adjacent to the proposed construction areas and the potential locations of larger staging areas and casting yards.

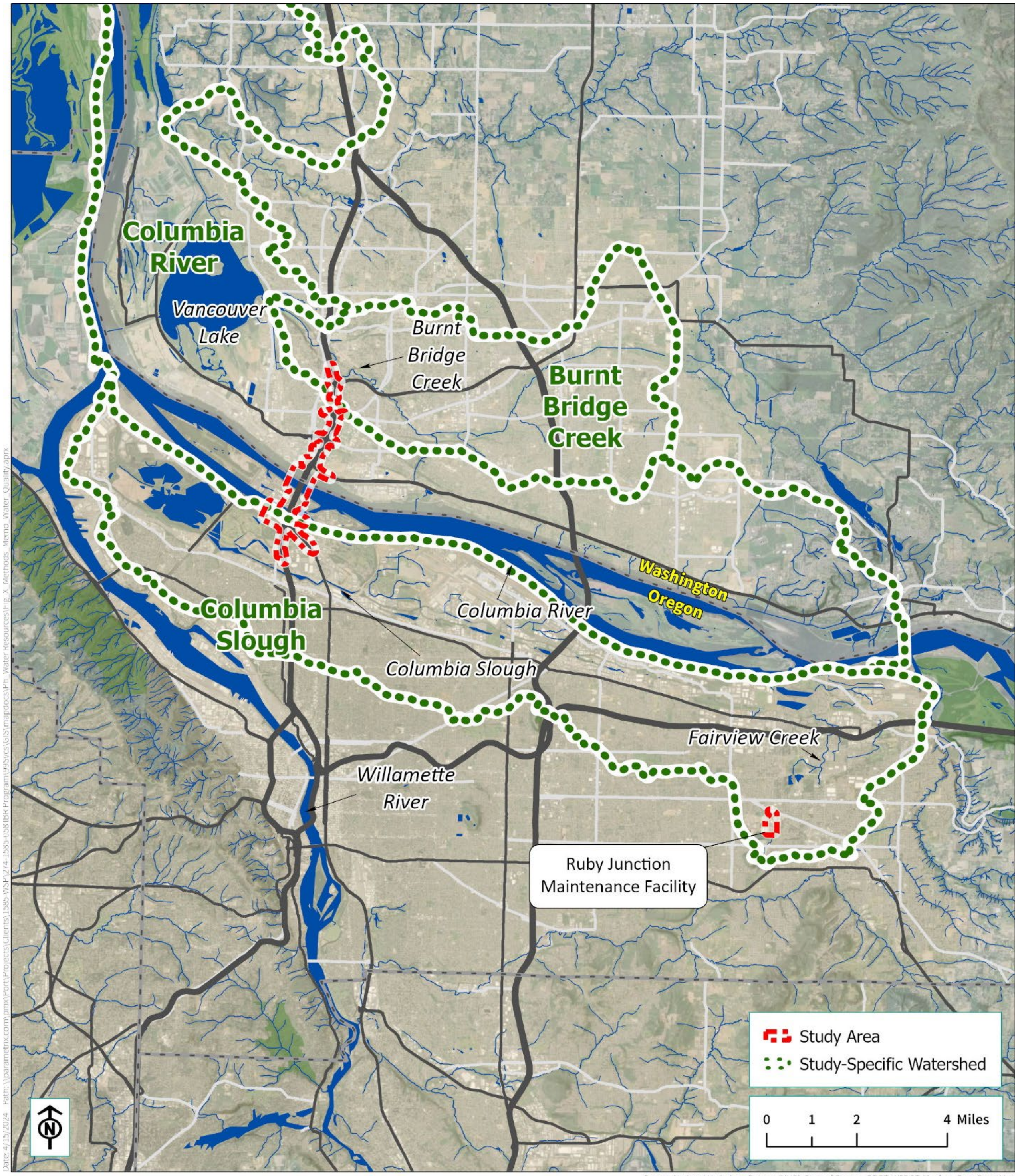
This evaluation additionally considers the watersheds (or portions of watersheds) and impervious areas that have hydrologic connectivity with the study area. Figure 2-1 shows the study area and watersheds. Figure 2-2 shows the full extent of the study watersheds.

Figure 2-1. Water Quality and Hydrology Study Area and Study-Specific Watersheds



Source: National Hydrology Dataset (NHD), State of Oregon, ODOT, WSDOT, Mapbox, OpenStreetMap

Figure 2-2. Full Extent of Study-Specific Watersheds



Source: National Hydrology Dataset (NHD), State of Oregon, ODOT, WSDOT, Mapbox, OpenStreetMap

2.1.1 Contributing Watersheds

Study-specific watersheds (or portions of watersheds) are used as the fundamental geographic area for the evaluation of the Modified LPA (see Figure 2-1 and Figure 2-2). Waterbodies and their associated watersheds in the study area have different levels of water quality, designated uses, and management scenarios.

Waterbodies and their contributing watersheds have been delineated using geographic information system (GIS) data, Google Earth Pro, information from local governments, field surveys, the Washington State Department of Ecology (Ecology) Watershed Planning Program, local drainage districts, and the Columbia Slough Watershed Council.

The watersheds that would be directly affected by construction of, and stormwater runoff generated by, the Modified LPA in the study area are the Columbia Slough, the Columbia River, Burnt Bridge Creek, and Fairview Creek. Within the study area, the Columbia River includes North Portland Harbor, Hayden Island, and the north portion of the river corridor that lies within Vancouver and drains directly to the Columbia River.

2.1.2 Contributing Impervious Area

For the Modified LPA, impervious areas that would require stormwater management in both Oregon and Washington would comply with the requirements established in the programmatic Endangered Species Act (ESA) Section 7 and Magnuson Stevens Act consultations with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) for the State of Oregon Federal Aid Highway Program (FAHP). Based on these consultations, stormwater treatment would be required for all contributing impervious area (CIA). The CIA is defined as all impervious areas created by the Modified LPA (including new and rebuilt or replaced impervious surfaces) and contiguous existing impervious areas that contribute stormwater runoff to the Program's CIA. The CIA does not include impervious areas outside of the Modified LPA's construction footprint that would flow through to outfalls that would not be modified.

2.2 Relevant Laws and Regulations

The following sections list and briefly describe applicable federal, state, and local laws and regulations protecting the condition of waterbodies and floodplains, as well as permitting activities related to water quality and stormwater conveyance.

2.2.1 Federal

2.2.1.1 Clean Water Act, 1977 as Amended, 33 USC 1251-1376

The CWA requires states to set water quality standards for all contaminants in surface waters based on the "beneficial" or "designated" uses for the waterbody and makes it unlawful for a person to discharge a pollutant from a point source into navigable waters unless a permit was obtained under its provisions. It also recognizes the need to address the problems posed by nonpoint source pollution. The permitting processes within the purview of the CWA are summarized below.

SECTION 402 NPDES PERMITS

The U.S. Environmental Protection Agency (EPA) requires NPDES permits for industrial sites and construction activities, as well as for certain sizes of municipalities that discharge stormwater into waterways. In Oregon, these permits are administered through the Oregon Department of Environmental Quality (DEQ). In Washington, these permits are administered through Ecology. Since these permits are administered by state regulatory agencies, their applicability is discussed individually under state regulations in Section 2.2.2.

SECTION 303(D) IMPAIRED WATERS AND TOTAL MAXIMUM DAILY LOADS (TMDLS)

Section 303(d) requires states and territories to issue water quality status reports every two years. These reports identify water quality trends, prioritize polluted waters, and target waters for TMDL development. TMDLs identify the pollutant load reductions that are necessary from point and nonpoint sources and guide implementation work by federal, state, tribal, territorial, and local water quality protection programs. In Oregon and Washington, DEQ and Ecology develop 303(d) lists for approval by the EPA.

SECTION 404 FOR PERMITTING DISCHARGES OF DREDGE OR FILL MATERIAL

Section 404 requires a permit to be issued by the USACE for activities involving the discharge of dredge or fill material into waters of the U.S., including wetlands. This permit would be required for work associated with the Modified LPA that would occur within a jurisdictional wetland or below the ordinary high-water mark (OHWM) of the waterbodies within the study area. The IBR Program Wetlands and Other Waters Technical Report discusses the wetland and OHWM determination process in more detail.

SECTION 401 WATER QUALITY CERTIFICATION

Section 401 requires an applicant for a federal license, or a Section 404 permit applicant planning to conduct an activity that may result in a discharge to waters of the state or U.S., to obtain a certification that the activity complies with state water quality requirements and standards. Applicants must submit a pre-filing meeting request to the certifying state agency at least one month prior to submitting the Section 404 application to the USACE. After the Section 404 application is submitted, the application is then forwarded to the certifying state agency by the USACE. The state agency then certifies whether the project meets state water quality standards and does not endanger waters of the state/U.S. or wetlands and forwards the application to the EPA for review. Comments on the Section 404 application would be addressed by the applicant. Upon completion of EPA’s review, these certifications are issued by the DEQ in Oregon and Ecology in Washington.

2.2.1.2 Endangered Species Act of 1973 and Amendments; 16 USC §1531 et. seq.

The ESA provides a framework to conserve and protect endangered and threatened species and their habitats from effects such as those related to stormwater (e.g., water quality and hydromodification).

2.2.1.3 Fish and Wildlife Coordination Act of 1934 and Amendments, 16 USC §661 et. seq.

The Fish and Wildlife Coordination Act protects fish and wildlife when federal actions result in the control or modification of a natural stream or body of water.

2.2.1.4 Safe Drinking Water Act. 1974, as amended, 42 USC 300f

The Safe Drinking Water Act (SDWA) requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. The SDWA authorizes the EPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants. State drinking water programs provide direct oversight of water systems. Both Washington and Oregon implement the SDWA within their jurisdictions. For the Modified LPA, this law would only apply if infiltration basins or underground injection control measures were incorporated into the Program design.

2.2.1.5 U.S. Code of Federal Regulations (CFR), Title 33, Section 208.10

This section of Title 33 of the CFR details how the USACE and its local partners (in this case, the Urban Flood Safety and Water Quality District [UFSWQD] and Peninsula Drainage Districts #1 and #2) must maintain levees and floodwalls. The mandate includes regular inspections to look for encroachments on the levee or its right of way, such as fences, patios, and pools; the growth of shrubs and trees whose root systems could damage the system's integrity; signs of seepage or sand boils; subsidence; animal burrows; and the accumulation of trash or debris.

The regulations state that no improvement shall be passed over, under, or through the walls, levees, improved channels, or floodways, nor shall any excavation or construction be permitted within the limits of the project right of way. In addition, no changes shall be made in any feature of the works without prior determination by the District Engineer of the Department of the Army or their authorized representative. This is so that any improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations that may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice.

Further, the USACE Flood Control Operations and Maintenance Policies, Regulation 1130-2-530 states: "Projects that protect urban areas or ones where failure would be catastrophic and result in loss of life should be inspected annually." It also instructs USACE personnel to report non-federal sponsors who are not complying with the regulations.

2.2.2 State

The following state water quality regulations apply to the IBR Program.

2.2.2.1 Washington

WASHINGTON ADMINISTRATIVE CODE (WAC). 2019. "WATER QUALITY STANDARDS FOR SURFACE WATERS OF THE STATE OF WASHINGTON." WAC 173-201A

This code establishes water quality standards for surface waters of the state of Washington consistent with public health and the propagation and protection of fish, shellfish, and wildlife. All surface waters are protected by narrative criteria, designated uses, and an antidegradation policy.

WAC. 2002. "NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM PERMIT PROGRAM (DEPARTMENT OF ECOLOGY)." WAC 173-220

This code establishes a state individual permit program, applicable to the discharge of pollutants and other wastes and materials to the surface waters of the state. This program operates under state laws as part of the NPDES program created by the CWA. Ecology issues and enforces NPDES permits and authorizes Section 401 water quality certifications in the state of Washington.

In Washington, a Joint Aquatic Resource Permits Application is submitted to both USACE and Ecology. Ecology reviews the permit application for 401 water quality certification.

Ecology (2019) has developed guidance for stormwater management in western Washington.

WAC. 2002. "WASTE DISCHARGE GENERAL PERMIT PROGRAM (DEPARTMENT OF ECOLOGY)." WAC 173-226

This code establishes a state general permit program applicable to the discharge of pollutants, wastes, and other materials to waters of the state. Permits issued are designed to satisfy the requirements for discharge permits under the CWA.

WAC. 2021. "DEPARTMENT OF TRANSPORTATION." WAC 468

The Washington State Department of Transportation (WSDOT) has developed its own guidance to determine when to include stormwater treatment and detention for its projects. WSDOT requires certain minimum levels of mitigation based on the size and region of the project.

WSDOT has a NPDES Construction General Stormwater Permit to cover all WSDOT construction activities disturbing more than 1 acre. Under the conditions of this permit, WSDOT must submit to Ecology a Notice of Intent to discharge stormwater associated with construction activities and to meet stormwater pollution prevention requirements. Approved methods of erosion and sediment control are provided in WSDOT's Highway Runoff Manual (WSDOT 2019).

WAC. 2022. "HYDRAULIC CODE RULES." WAC 220-660

The Washington Department of Fish and Wildlife (WDFW) requires a hydraulic project approval for "construction or performance of work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state." The permit application allows WDFW to review proposed work and ensure it is performed in a way that protects fish and their aquatic environments, including water quality.

2.2.2.2 Oregon

OREGON REVISED STATUTES (ORS). 2019. "WATER QUALITY." ORS 468B

This statute sets effluent limitations, describes the implementation of the CWA, and sets permit requirements. It prohibits any person from causing pollution of any waters of the state or placing or causing to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means. The statute also prohibits the discharge of any wastes into waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission.

OREGON ADMINISTRATIVE RULES (OAR). 2017. "DEPARTMENT OF ENVIRONMENTAL QUALITY: REGULATIONS PERTAINING TO NPDES AND WATER POLLUTION CONTROL FACILITIES (WPCF) PERMITS." OAR 340-045-0005 TO 340-045-0080

In Oregon, the DEQ issues and enforces NPDES and WPCF permits. For the Modified LPA, a permit would be required for: (1) the construction, installation, or operation of any activity that would increase the discharge of wastes into the waters of the state or would otherwise unlawfully alter the physical, chemical, or biological properties of any waters of the state; (2) an increase in volume or strength of any wastes in excess of the discharges authorized under an existing permit; and (3) the construction or use of any new outlet for the discharge of any wastes into the waters of the state.

STATE ISSUANCE, MONITORING, AND ENFORCEMENT OF SECTION 401 WATER QUALITY CERTIFICATION

In Oregon, for the Modified LPA a pre-filing meeting request to the DEQ would be required at least one month prior to the submittal of a Joint Permit Application (JPA). Then the JPA is submitted to the Oregon Department of State Lands (DSL), the USACE (Portland District Office), and the DEQ. The DEQ reviews the project for 401 water quality certification and forwards the JPA to the EPA for review. Frequently, applicants are required to incorporate protective measures into their construction and operational plans, such as bank stabilization, treatment of stormwater runoff, spill protection, and fish and wildlife protection. The DEQ water quality certification process requires a Land Use Compatibility Statement signed by the local government land use authority to ensure that permits affecting land use are compatible with local government comprehensive plans.

WATER QUALITY MITIGATION. PD-05. 2006. OREGON DEPARTMENT OF TRANSPORTATION (ODOT). PROJECT DELIVERY LEADERSHIP TEAM

ODOT has developed its own guidance in its PD-05 Operational Notice that determines the need for stormwater treatment and detention on its projects and the appropriate level of mitigation. ODOT is in the process of updating the PD-05 Operational Notice.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) INDIVIDUAL PERMIT. 2020. ODOT

ODOT is an MS4 individual permit holder (2021). This permit prescribes all stormwater and allowable non-stormwater dischargers from the MS4 associated with ODOT-owned and/or operated roads, water quality facilities, maintenance yards, rest areas, and other facilities located within highway right of way.

1200-CA CONSTRUCTION STORMWATER PERMIT

ODOT has a NPDES General Construction 1200-CA Stormwater Permit for ODOT construction activities on sites covering more than 1 acre. This permit requires a Temporary Erosion and Sediment Control Plan (TESCP). Approved methods of erosion and sediment control are given in ODOT's Erosion and Sediment Control Manual.

OREGON'S STATEWIDE PLANNING GOALS AND GUIDELINES. 2016. OAR 660-015-0000

In Oregon, Goal 6 instructs local governments to consider protection of air, water, and land resources from pollution and pollutants when developing comprehensive plans. The relevant pollutants considered include (but are not limited to) solid waste, water waste, and thermal pollution. The goal asks cities and counties to designate areas suitable for use in controlling pollution. It calls on them to use a variety of market, zoning, and management tools in creating these outcomes.

2.2.3 Regional and Local

2.2.3.1 Clark County, Washington

CLARK COUNTY CODE (CCC). 2015. "STORMWATER AND EROSION CONTROL." CCC 40.386

Clark County uses the WSDOT (2019) Highway Runoff Manual for publicly funded linear transportation projects guidance on minimum design requirements and best management practices (BMPs), except for the use of the infeasibility criteria used for low impact development selection (WSDOT 2019). Clark County, through WSDOT's manual, requires stormwater mitigation for any development that results in an increase in impervious area of 5,000 square feet or more in a rural area or 2,000 square feet or more in an urban area.

CLARK COUNTY CODE. 2022, "FLOOD HAZARD AREAS." CCC 40.420

Clark County Flood Hazard Area code provides construction standards and outlines flood hazard permit requirements for construction or development within special flood hazard areas. Special flood hazard areas, as defined in the chapter, include land area subject to a 1% or greater chance of flooding in any given year.

2.2.3.2 City of Vancouver

VANCOUVER MUNICIPAL CODE (VMC). 2012. "STORMWATER MANAGEMENT." VMC 14.09

The City of Vancouver implements its own NPDES permit, as issued by Ecology. Vancouver defers to Ecology's Stormwater Management Manual for Western Washington (Ecology 2019) for guidance but requires stormwater mitigation for any development that increases the impervious area by more than 2,500 square feet.

VMC. 2009. "EROSION CONTROL." VMC 14.24

This code establishes regulations to minimize erosion from land development and land-disturbing activities.

VMC. 2016. "STORMWATER CONTROL." VMC 14.25

This code establishes standards for stormwater runoff.

VMC. 2016. "WATER RESOURCES PROTECTION." VMC 14.26

This code establishes allowable and prohibited discharges and BMPs for protecting stormwater, surface water, and groundwater quality.

VMC. 2005. "CRITICAL AREAS PROTECTION." VMC 20.740.120 (2020) AND 130 (2007)

This code regulates construction in floodways, floodplains, and severe erosion hazard areas. A critical areas report and permit are required.

2.2.3.3 Multnomah County, Oregon

MULTNOMAH COUNTY TRANSPORTATION SYSTEM PLAN (2016), POLICY 20: ENVIRONMENT

This policy avoids and minimizes impacts to the natural environment and fish and wildlife habitat when applying roadway design standards.

2.2.3.4 City of Portland

CITY OF PORTLAND PUBLIC IMPROVEMENTS CODE TITLE 17 PUBLIC IMPROVEMENTS, CHAPTER 17.38 DRAINAGE AND WATER QUALITY

This code provides for the effective management of stormwater, groundwater, and drainage and the protection and improvement water quality in Portland.

OREGON DEQ, NPDES MS4 PERMIT NO. 101314 (202)

This permit prescribes all stormwater and allowable non-stormwater dischargers from the MS4 within the city of Portland urban services boundary to surface waters of the state.

CITY OF PORTLAND ENVIRONMENTAL SERVICES EROSION CONTROL

In its 2021 Erosion Control Manual, the City of Portland provides guidance for temporary and permanent erosion prevention, sediment control, and control of other development activities.

CITY OF PORTLAND ADMINISTRATIVE RULE ENB-4.01, STORMWATER MANAGEMENT MANUAL (2020)

The City of Portland developed a stormwater management manual to implement its municipal NPDES permit. Portland requires stormwater mitigation for any development that develops or redevelops 500 square feet or more of impervious surface. Projects that meet this threshold are required to comply with stormwater management requirements for the new or redeveloped impervious area, unless specifically exempt.

CITY OF PORTLAND CODE (CPC). 2004. "STORMWATER MANAGEMENT." CPC 33.653

The CPC provides for placement of stormwater facilities, standards, and criteria for on-site facilities. The code lists approval criteria to ensure the development of a feasible stormwater system with adequate capacity.

CPC "EROSION AND SEDIMENT CONTROL REGULATIONS." CPC 10. 2019 UPDATE

This title provides requirements for development and construction-related activities to control the creation of sediment and to prevent the occurrence of erosion at the source during construction and development. Specific to water quality, these regulations seek to reduce the sediment and pollutants contained in erosion caused by construction and development and to reduce the amount of sediment and pollutants entering storm drainage systems and surface waters from all ground-disturbing activity.

CPC. "FLOOD HAZARD AREAS." CPC 24.50 (AMENDED 2008)

This title outlines restrictions or prohibitions of activities that cause increased flood heights or velocities within Portland. Permitting requirements to ensure development or building sites will be reasonably safe from flooding are provided.

CPC. "PORTLAND ENVIRONMENTAL ZONES." CPC 33.430 (MARCH 2021)

This title establishes environmental zones to protect resources and functional values that have been identified by Portland as providing benefits to the public. The environmental regulations encourage flexibility and innovation in site planning and provide for development that is carefully designed to be sensitive to the site's protected resources.

2.3 Effects Guidelines

The following describes how impacts to water quality and hydrology were evaluated. The IBR Program team will coordinate with federal, state, and local resource agencies to determine impacts to water quality and hydrology. Generally, impacts are identified if the Modified LPA:

1. Would violate a NPDES permit for stormwater discharges.
2. Is likely to contaminate surface or ground waters that would result in an exceedance of federal, state, or local water quality standards.
3. Is noncompliant with an approved Water Quality Management Plan or TMDL.
4. Would become flooded or induce flooding as a result of stormwater increases or floodplain constriction.

Potential cumulative effects from the Modified LPA are addressed in the IBR Cumulative Effects Technical Report.

2.4 Data Collection Methods

The following methods and data sources were used to identify existing conditions and provide the required information for analysis of the Modified LPA.

1. Reviewed the following studies and plans from local, state, and federal agencies:
    - Burnt Bridge Creek Ambient Water Quality Data Trend Analysis (Herrera 2017).
    - Streamflow Summary for Burnt Bridge Creek, Clark County, 2008 (Ecology 2010).
    - Burnt Bridge Creek Regional Wetland Bank and Greenway Trails Project Biological Evaluation (PBS 2003).
    - Burnt Bridge Creek Watershed Fecal Coliform Bacteria, Temperature, Dissolved Oxygen, and pH Source Assessment Report (Ecology 2020).
    - Surface Water/Groundwater Interactions and Near-Stream Groundwater Quality along Burnt Bridge Creek, Clark County (Ecology 2012).
    - Integrated Scientific Assessment Report, Vancouver Watershed Health Assessment (Herrera and PGG 2019).
    - Burnt Bridge Creek Ambient Water Quality Monitoring Program, 2017 Trend Analysis Report (Herrera 2018).
    - Burnt Bridge Creek Ambient Water Quality Monitoring – Quality Assurance Plan (Herrera 2011).
    - Comprehensive Conservation and Management Plan for the Lower Columbia River (LCEP 2011).
    - Columbia Slough Fish Advisory (OHA 2019).
    - The Columbia Slough (Wells 1997).
    - Multnomah County 2014 TMDL Implementation Plan for the Tualatin, Lower Willamette, and Sandy River Basins (Multnomah County 2014).
    - Columbia Slough TMDL (DEQ 1998).
    - 2020–2021 Columbia Slough Sediment Program Annual Report (BES and DEQ 2022).
    - Columbia Slough Sediment Study (DEQ 2012).
    - Lower Columbia Slough Refugia Project (BES 2015).
    - Portland Plan: Watershed Health (BES 2011).
    - Columbia Slough Report Card (BES 2019).
    - Environmental Contaminants and their Effects on Fish in the Columbia River Basin (Hinck et al. 2004).
    - Columbia River Basin National Stream Quality Accounting Network Program (Kelly and Hooper 2004).
    - 2022 Stormwater Management Plan, City of Vancouver (2022).
    - Lower Columbia River and Estuary Ecosystem Monitoring: Water Quality and Salmon Sampling Report (LCEP 2007).

- Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (LCFRB 2010).
- Columbia River Cold Water Refuges Plan (EPA 2021a).
- Columbia and Lower Snake Rivers Temperature Total Maximum Daily Load (EPA 2021b).
- TMDL for Mercury in the Willamette Basin, Oregon (EPA 2021c).
- Water Quality of the Lower Columbia River Basin: Analysis of Current and Historical Water-Quality Data through 1994 (Fuhrer et al. 1996).
- Total Dissolved Gas TMDL for the Lower Columbia River (DEQ and Ecology 2002).
- Modification of State's Total Dissolved Gas Water Quality Standard (DEQ 2020).
- TMDL for 2,3,7,8-TCDD (Dioxin) in the Columbia River Basin (EPA 1991).
- Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW 2010).
- City of Portland Watershed Management Plan (BES 2005).
- Portland Water Bureau Water Management and Conservation Plan (PWB 2020).
- Lower Columbia River Bi-State Water Quality Program, The Health of the River 1990–1996 Integrated Technical Report (Tetra Tech 1996).
- Water Quality Data, Columbia River Estuary, 2004–2005 (Morace 2006).
- Willamette Basin Rivers and Streams Assessment (DEQ 2009).
- Washington State's Water Quality Assessment and 303(d) list (Ecology 2022).
- Oregon's 2022 Integrated Report, 303(d) and Impaired Waters List (DEQ 2022).

2. Reviewed the following maps and GIS data, including those showing topography, soils, and floodplains:
    - *Infrastructure:* This information was used to develop impervious area estimates and evaluate runoff potential from the Modified LPA.
    - *Topography:* Topographic maps were used to delineate drainages in areas where as-built and infrastructure records providing drainage information were not available.
    - *Flood Insurance Rate Maps, Floodway Maps, and Flood Insurance Study Reports:* This information was used to identify 100-year floodplains and floodways located in the Program's study area.
    - *Land use maps:* The Program team coordinated with land use map reviews conducted as part of the land use technical report to obtain necessary information regarding land use in each of the study area watersheds.
3. Reviewed available water quality characterization studies, Section 303(d) listings, TMDLs, municipal water quality management plans and regulations, and other water quality, water quantity, and floodplains data to determine if streams located in the study area would be affected directly or indirectly by the Modified LPA. Specific data reviewed include the following:
    - Existing and proposed drainage patterns within the construction footprint.
    - Designated beneficial uses of study area streams.

- Water quality status in study area receiving waters, including existing and anticipated 303(d) listings, TMDLs, and Water Quality Management Plans.
- Project-specific sediment sampling data.

4. Reviewed the conceptual stormwater design, which proposes how stormwater may be conveyed, treated, and discharged.
5. Consulted with local, state, and federal water quality and stormwater agency representatives and interested parties.
6. Conducted field visits to study area waterways, road alignments, and stormwater outfall locations. During site reconnaissance surveys, collected data on existing conditions of study area waterways, existing stormwater facilities, and proposed locations for such facilities.
7. Calculated new and existing impervious surfaces using computer-aided design (CAD) and GIS mapping.
8. Calculated total disturbed area related to both in-water and out-of-water construction to assess temporary impacts.

Annual pollutant load estimates were conducted using Method 1: WSDOT Data-Federal Highway Administration (FHWA) Method as outlined in the WSDOT (2009) guide titled "Quantitative Procedures for Surface Water Impact Assessment." This method was selected because it provides estimates of pollutant loading for a wide range of average daily traffic volume highways (1,700 to 93,000) using data derived from observations made on highways in western Washington since 2001. It is directly applicable to the Program's location and is based on recently collected WSDOT data.

2.5 Analysis Methods

2.5.1 Long-Term Impacts

Beneficial and adverse potential long-term operational impacts of the Modified LPA on drainage systems and surface and ground water resources were determined by analyzing and reviewing the following:

- *Floodplain Impacts*. Floodplain impacts from the Modified LPA were compared by estimating its approximate footprint (e.g., loss of storage) and the extent of potential conveyance constrictions created by bridge crossings.
- *Groundwater Infiltration Impacts*. Increased impervious area can result in reduced groundwater recharge that, in some cases, can impact groundwater. For the Modified LPA, these were assessed by accounting for the total area of impervious surface over land resulting from new construction. Bridge segments directly over North Portland Harbor and the Columbia River were not included in the impervious surface tally for this particular impact analysis. Impervious surface area was further distinguished by study-specific watersheds.
- *Surface Water Quality Impacts*. Long-term surface water quality impacts were assessed based on comparisons of impervious surface areas requiring stormwater collection and by proximity to surface waters. Roadway located underneath another roadway, such as an overpass, was included in the impact analysis. Where new construction replaces existing impervious surface,

the effectiveness of treating the existing road runoff was considered. Existing runoff characteristics were determined from topographic maps and field observations. The study-specific watersheds for the impervious discharge of additional runoff were determined to assess the extent of interbasin transfers of stormwater runoff. A pollutant load analysis was performed for key constituents found in road runoff using Method 1: WSDOT Data-FHWA Method. Potential erosion impacts were assessed through examination of topographic maps, proximity of ground disturbance to drainage channels/streams, and vegetation loss.

- *Groundwater Quality Impacts*. Long-term groundwater impacts were assessed generally in all areas affected by construction and, more specifically, in areas lying in proximity of federal, state, and locally designated groundwater/wellhead protection zones.
- *Existing Drainage System Constraints*. Local jurisdictions were contacted for information about existing drainage system constraints.
- *Beneficial Impacts*. Since stormwater treatment would be provided in areas not currently receiving treatment, beneficial impacts were discussed.

2.5.2 Temporary Construction Impacts

Construction activities can impact surface water quality by allowing increased erosion, disturbing the beds and banks of waterbodies, discharging construction materials and chemicals incidentally, and removing shading vegetation.

Groundwater quality could be affected by direct infiltration of contaminants during below-grade construction and by infiltration of contaminated surface water.

Potential temporary construction impacts associated with the Modified LPA were determined by evaluating the total area of demolition and construction activities, the total area of below-grade construction, and implementation of impact minimization measures. The temporary construction impact analysis focused on the following:

- Area of total disturbance.
- Impacts from fine sediment and contaminants (e.g., hydraulic oil, fuel, etc.).
- Erosion/soil characteristics.
- Depth to groundwater.
- Streambank/slope steepness.
- Amount of in-water work.

2.5.3 Indirect Impacts

Indirect impacts include those that are not a direct result of the Modified LPA but would occur later in time or farther in distance as a result of the Modified LPA. Potential indirect impacts were determined by evaluating how the Modified LPA would comply with state and local land use plans intended to avoid or minimize impacts in light of the population growth and development anticipated to occur in the region.

3. AFFECTED ENVIRONMENT

3.1 Introduction

This section presents the existing water quality and hydrologic conditions within the study area and study-specific watersheds. For purposes of this technical report, the study area is differentiated by the study-specific watersheds (Figure 2-1), which are primarily referenced as “receiving waters” where runoff from the Modified LPA could potentially be discharged. The following discussion describes the baseline conditions of those receiving waters in terms of hydrology, water quality, and stormwater.

3.2 Regional Conditions

3.2.1 Surface Water Hydrology

The Columbia River mainstem and North Portland Harbor (a branch of the Columbia River south of Hayden Island) both cross under I-5 within the study area, while the Columbia Slough and Burnt Bridge Creek cross I-5 south and north of the study area, respectively. Thus, the Columbia River and North Portland Harbor dominate the topography of the study area. North Portland Harbor is part of the same body of water as the Columbia River but is named differently in this report to distinguish the part of the waterbody south of Hayden Island (North Portland Harbor) from the part of the waterbody north of the island (Columbia River). The study area lies within the Columbia River main valley, except for a small area north of the SR 500 interchange that is located in the Burnt Bridge Creek watershed (Figure 2-1). Burnt Bridge Creek flows into Vancouver Lake before discharging to the Columbia River. In addition, runoff from the Delta Park area between North Portland Harbor and the lower Columbia Slough, which used to be part of the Columbia River floodplain, is now discharged to the lower Columbia Slough via pump stations. The Columbia Slough, which parallels the Columbia River floodplain, discharges near the confluence of the lower Willamette River and Columbia River.

The study area around the Ruby Junction Maintenance Facility in Gresham, Oregon, lies within the 100-year floodplain of Fairview Creek (Figure 2-1). Fairview Creek discharges into the upper Columbia Slough downstream of the maintenance facility.

Study area elevations vary from approximately 10 feet in the Columbia River floodplain south of North Portland Harbor to about 220 feet at the drainage divide between the Columbia River and Burnt Bridge Creek valleys. South of the Columbia River, the study area is located entirely in a relatively flat and low-lying floodplain. Drainage within the floodplain is not well-defined and the Columbia Slough, which parallels the Columbia River floodplain, discharges into the Willamette River. North of the Columbia River, the study area is located within the gently sloped river valley.

Table 3-1 shows the average monthly discharges for each of these watercourses based on data available from U.S. Geological Survey (USGS) gauging stations. The information provides an indication of the relative size of each waterbody and permits a comparison of estimated project runoff with discharges in waterbodies receiving that runoff.

Table 3-1. Average Monthly Discharge (cubic feet per second) of Receiving Waters

Month	Columbia Slough at Portland (USGS 14211820)[a]	Columbia River at Vancouver (USGS 14144700)[b]	Burnt Bridge Creek near Mouth (USGS 14211902)[c]	Fairview Creek near Gresham (USGS 14211814)[d]
January	160	164,000	44	10
February	155	181,000	41	8.5
March	127	179,000	44	8.6
April	103	223,000	31	6.9
May	49[e]	308,000	23	5.2
June	88[f]	363,000	16	4.2
July	97	242,000	11	2.5
August	82	150,000	8.4	2.0
September	72	107,000	7.5	2.3
October	91	110,000	14	3.9
November	104	127,000	33	6.8
December	131	144,000	39	9.6

a USGS (2023a) from October 1989–September 2020.

b USGS (2023b) from October 1963–May 1970, April 2016–September 2021.

c USGS (2023c) from October 1998–September 2000, October 2010–October 2012.

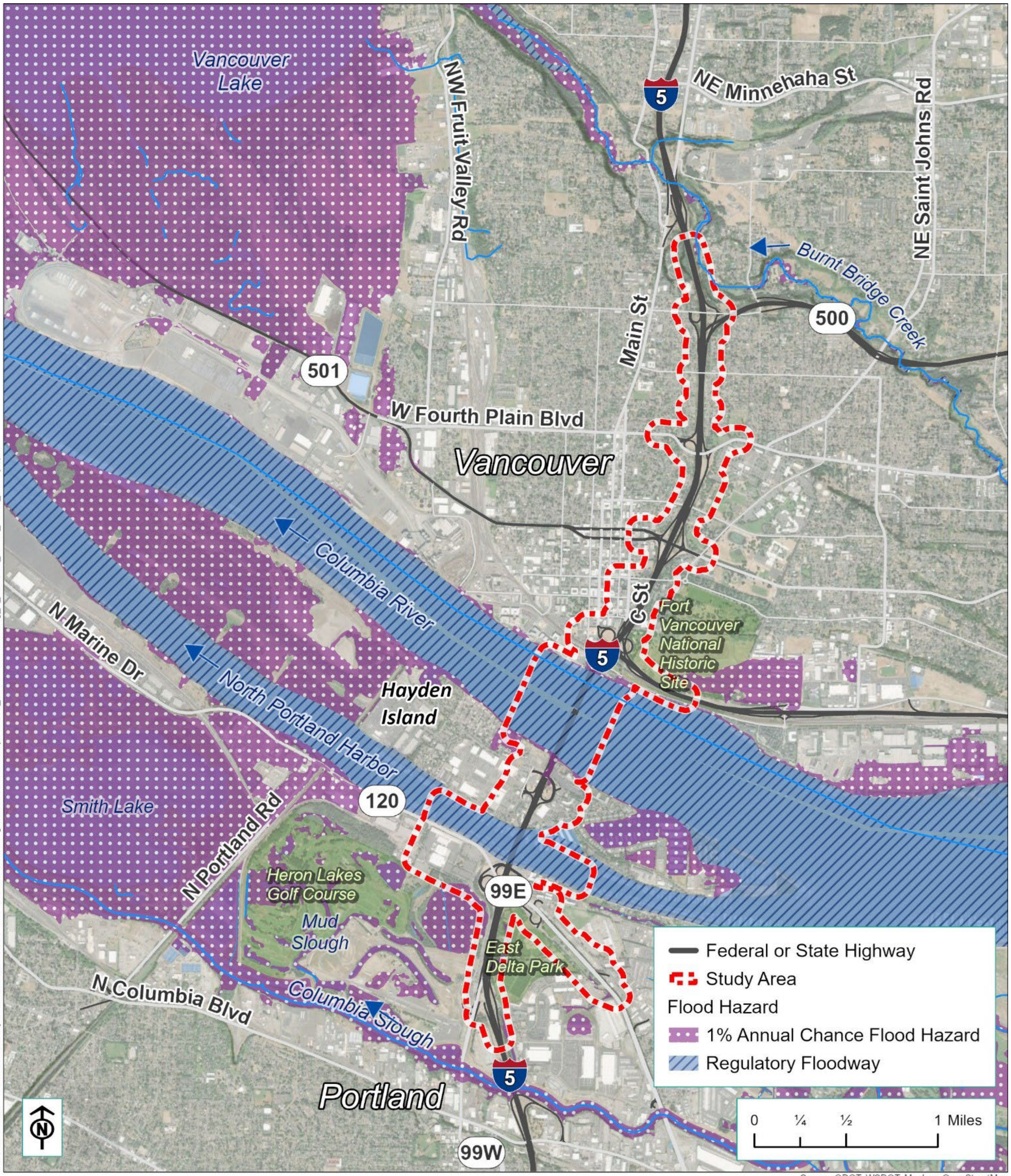
d USGS (2023d) from October 1992–March 2020.

e Average monthly reverse flow from the Willamette River was recorded in 1997, 2006, 2008, 2011, and 2018.

f Average monthly reverse flow from the Willamette River was recorded in 1990.

In the study area, floodplains designated by the Federal Emergency Management Agency (FEMA) that include those adjacent to the Columbia Slough, the Columbia River, and Burnt Bridge Creek (Figure 3-1). These floodplains are confined to the immediate vicinity of streams by levees or, in the case of Burnt Bridge Creek, by steep slopes. For reference, the FEMA-modeled water surface elevation of the 100-year floodplain at the Interstate Bridge crossing of the Columbia River is approximately 32 feet referenced to the North American Vertical Datum of 1988.

Figure 3-1. Federal Emergency Management Agency Floodplain Boundaries in the Study Area



3.2.2 Local Climate

The climate within the study area is characterized by short, dry, warm summers, with typically cool and wet spring, fall, and winter. The Coast Range to the west of the study area offers limited shielding from Pacific Ocean storms, while the Cascade Mountains to the east provide an orographic lift of moisture-laden westerly winds, resulting in moderate rainfall. As measured by NOAA monitors at the Portland International Airport (PDX), nearly 90% of the average annual rainfall of approximately 36 inches occurs from October through May (NOAA 2022). The maximum daily rainfall recorded was 2.69 inches in November 1996. Average annual snowfall accumulations are approximately 2 inches, and usually melt within a couple of days. The two-year, 24-hour rainfall event in the study area vicinity is 2.4 inches, at PDX (BES 2020; ODOT 2008).

Average monthly temperatures taken at PDX by NOAA (2022) vary from approximately 41 degrees Fahrenheit (°F) in January to 70°F in August. The maximum recorded temperature was 116°F in June 2021, and the minimum recorded temperature was -3°F in February 1950. Surface winds seldom exceed sustained wind speeds of 50 miles per hour, and gusts have rarely exceeded 75 miles per hour (NOAA 2022).

3.2.3 Groundwater

Within the Portland Basin Aquifer System on the Oregon side, the study area is located on the unconsolidated sedimentary aquifer of the upper sedimentary subsystem (McFarland and Morgan 1996). This aquifer consists primarily of late Pleistocene catastrophic flood deposits and Columbia River alluvium. Recharge of the aquifer is from infiltration of precipitation, via injection wells, and also from septic systems. Median hydraulic conductivity (the rate at which groundwater flows through soil and bedrock) of the aquifer is high, approximately 200 feet per day. However, surface and upper surface level infiltration in urban areas, such as within the study area, has been shown to have lower hydraulic conductivity due to experiencing decades of urban-development compaction of those surficial soil layers (Gregory et al. 2006).

South of the Columbia River, several wells have been identified within the study area and are likely screened within the unconsolidated sedimentary aquifer. These wells are used for a variety of industrial, irrigation, and municipal purposes. For further details on these wells, refer to the IBR Geology and Soils Technical Report.

North of the Columbia River, the I-5 corridor and other infrastructure facilities are underlain by the unconsolidated sedimentary aquifer and the Troutdale Aquifer. The Troutdale Aquifer is a water supply for Vancouver and has been designated by the EPA as a Sole Source Aquifer (SSA). An SSA is an aquifer that supplies at least 50% of the drinking water for its service area, and for which there are no reasonably available alternative drinking water sources should the aquifer become contaminated. Under this designation, proposed federal financially assisted projects that have the potential to contaminate the aquifer are subject to EPA notification and review. An SSA report for the Modified LPA would be prepared and submitted to the EPA once the Draft SEIS is out for agency review.

Consistent with the SSA designation and with critical areas management dictated by Washington state law, Special Wellhead Protection Areas have been designated within the Washington portion of the study area. As shown in Figure 3-2, “contribution” zones are delineated based on the amount of time that groundwater contamination would take to spread into each zone. There is one Special Wellhead Protection Area that overlaps the study area.

The City of Vancouver has designated the entire area within the city boundary as a Critical Aquifer Recharge Area. VMC 14.26.120 lists actions that are prohibited within a Critical Aquifer Recharge Area, such as hazardous material municipal waste disposal. Figure 3-2 identifies two Special Wellhead Protection Areas designated by the City of Vancouver, surrounded by 1,000- and 1,900-foot buffers and subject to the prohibitions of the Critical Aquifer Recharge Area. In addition, the Special Wellhead Protection Areas are subject to further provisions.

3.2.4 Relevant Land Uses

South of the Columbia River, land west and east of I-5 between Victory Boulevard and North Portland Harbor generally has an industrial and open space zoning designation, respectively. On Hayden Island, land in the vicinity of the study area is zoned commercial, but even though the zoning is commercial, there are some floating residential homes in the study area.

North of the Columbia River, areas on the west side of I-5 have extensive residential and commercial development. East of I-5, Pearson Field, Clark College, the Portland VA Medical Center-Vancouver, and the Vancouver National Historic Reserve are zoned as low density developments. Additionally, some residential development is located in this portion of the study area.

Land uses at the Ruby Junction Maintenance Facility are zoned heavy industrial and are abutted by a mix of residential and commercial developments.

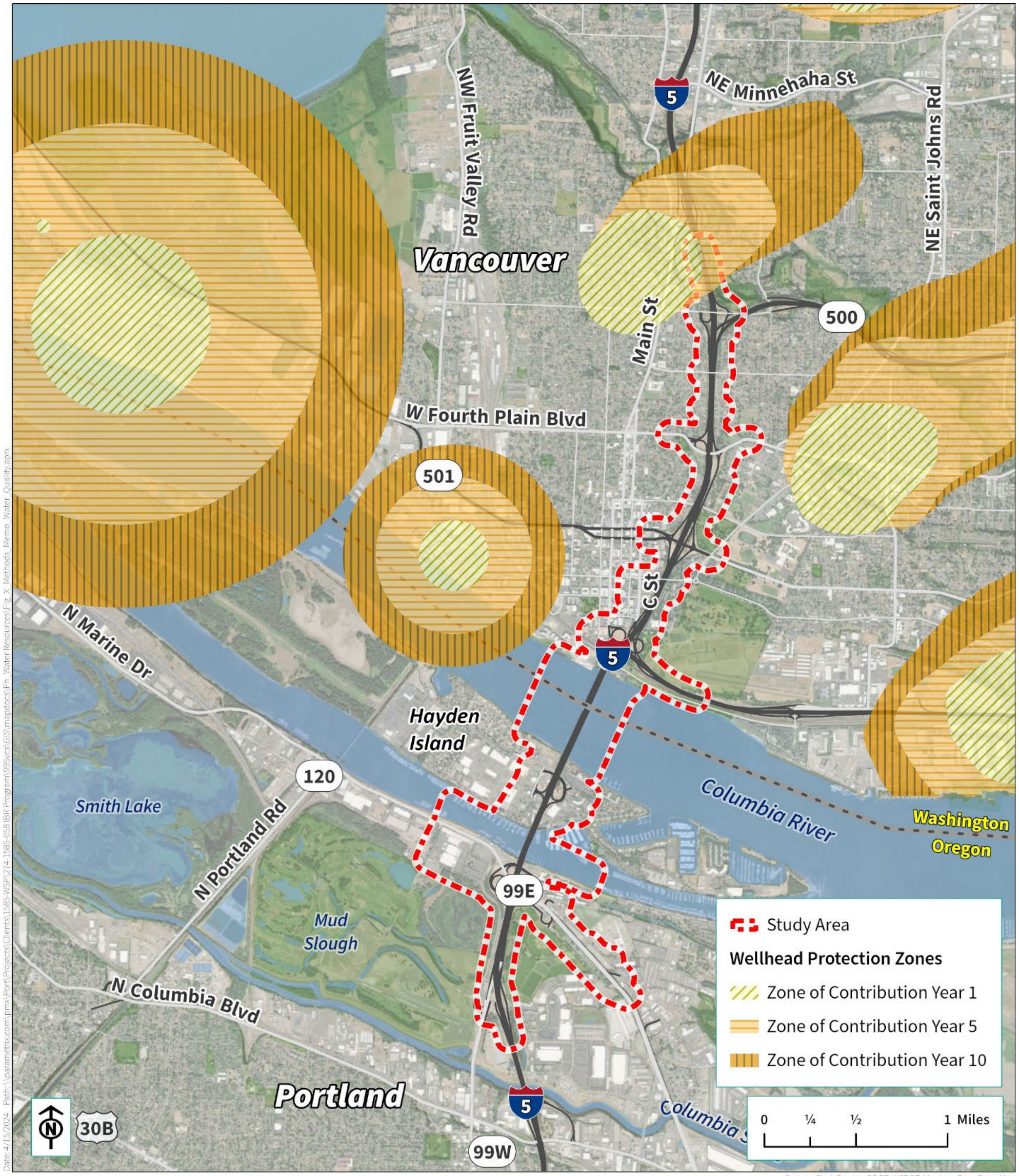
Additional references to land uses relevant to the Modified LPA in the study-specific watersheds are provided in the following sections.

3.2.5 Storm Drainage

In general, continuous curbs and concrete barriers confine surface runoff within I-5, and closed (pipe) drainage systems convey flows to surface water outfalls. Runoff from the bridges across North Portland Harbor and the Columbia River drains through scuppers to the water surface below.

The purpose of stormwater management strategies is to reduce stormwater runoff peak flows and the pollutants discharged into receiving waters from project-related changes in impervious surface area. BMP facilities have been shown to effectively reduce sediment, metals (including dissolved metals), and other pollutants from runoff. BMP effectiveness in removing polycyclic aromatic hydrocarbons (PAHs), microplastics, and constituents of emerging concern (CEC), including 6PPD-quinone, are less well known because the fate and transport of these pollutants remain unclear. However, emerging BMP technologies continue to evolve to address pollutants other than sediment and metals (WSDOT 2022).

Figure 3-2. Wellhead Protection Zones



Existing stormwater treatment within the study area occurs in only a few areas. The only engineered water quality facility within the study area is a treatment and infiltration pond in the Burnt Bridge Creek watershed. The facility reduces sediment, metals, and other pollutants from runoff, which is considered to be adequate treatment. Overflows from this treatment and infiltration pond are discharged to an existing wet pond in this vicinity that provides infiltration. In addition, a 3-acre area within the Columbia Slough watershed is infiltrated in adjacent pervious area and does not discharge to existing outfalls. Table 3-2 shows the existing conditions of the stormwater treatment along the study area by receiving waterbody.

Table 3-2. Existing Stormwater Drainage (acres)

Receiving Waterbody	Location along the Study Area	Total Contributing Impervious Area	Infiltrated Impervious Area	Treated Impervious Area Draining to Outfall(s)	Untreated Impervious Area Draining to Outfall(s)
Columbia Slough	Victory Boulevard interchange to the Southwest Marine Drive interchange	38.5	3.0	0.0	35.5
Columbia River – Oregon State	Marine Drive west of I-5 to the Columbia River bridges	45.8	0.0	0.0	45.8
Columbia River – Washington State	Columbia River bridges to downtown Vancouver	76.4	3.0	0.0	73.4
Burnt Bridge Creek	I-5 near SR 500	9.6	7.9	0.0	1.7
Fairview Creek	Ruby Junction Maintenance Facility located approximately 12 miles east of I-5	7.3	7.3	0.0	0.0
	Totals	**177.6**	**21.2**	**0.0**	**156.4**

I-5 = Interstate 5; SR = State Route

3.3 Receiving Waters

3.3.1 Columbia Slough

3.3.1.1 Waterbody Description

The Columbia Slough is a slow-moving, low-gradient drainage channel running nearly 19 miles from Fairview Lake in the east to the Willamette River in the west. The slough is a remnant of the historic system of lakes, wetlands, and channels that once dominated the south floodplain of the Columbia River. The Columbia Slough and surrounding area were historically used by Native Americans for fishing, hunting, and gathering food (DEQ 2012).

The Columbia Slough watershed drains approximately 32,700 acres of land in portions of Troutdale, Fairview, Gresham, Maywood Park, Wood Village, and unincorporated Multnomah County. The Columbia Slough Watershed Council and the City of Portland Bureau of Environmental Services (BES) Community Watershed Stewardship Program partnered with the Confederated Tribes of Grand Ronde in 2019 to investigate the health of the Columbia Slough for continued cultural practice (Columbia Slough Watershed Council 2020). Research on the health of Wapato from four separate sites in Columbia Slough—Wapato Slough, Ramsey Slough, Blind Slough, and Frog Spring—is ongoing.

The Columbia Slough and areas to its north are currently intensively managed to provide drainage and flood control with pumps, weirs, and levees; it is divided into upper, middle, and lower reaches. The upper and middle reaches receive water from Fairview Lake, Fairview Creek, Wilkes Creek, groundwater, natural springs, and overland flow and stormwater outfalls from PDX and other industrial, commercial, and residential neighborhoods in the surrounding area. Flows and water levels in the upper and middle reaches are managed to mitigate low dissolved oxygen issues, while allowing for withdrawals, flood control, and recreation (BES 2021). Over half of the system is considered highly altered by these facilities (BES 2019). The lower reach is tidally influenced, while flows in the middle and upper reaches are controlled by pumping and gravity gates (BES 2011).

In July 2005, a ROD was issued for the Columbia Slough Sediment Program, a cleanup program developed by the DEQ and the City of Portland (DEQ 2005). The Columbia Slough Sediment Program aims to remediate widespread sediment contamination through source control contamination reduction, contaminant removal by dredging “hot spots,” and long-term monitoring to ensure the Program’s effectiveness (BES and DEQ 2011). The Program seeks to control sources of pollution, treat stormwater runoff, and clean up contaminated sediments in the lower Columbia Slough, Whitaker Slough, and Buffalo Slough. DEQ has signed separate agreements with the Oregon Department of Fish and Wildlife (ODFW) and the UFSWQD in regard to cleanup activities in the Columbia Slough (BES and DEQ 2022).

The study area crosses the lower reach of the Columbia Slough near river mile (RM) 6.5. The lower reach extends from the Peninsula Drainage Canal to the Willamette River, less than 1 mile south of its confluence with the Columbia River. It undergoes 1 to 2 feet of tidal fluctuation in its water surface elevation. Water levels are generally unmanaged but are affected by the management of the dams on the Columbia and Willamette Rivers (DEQ 2012). The channel bottom in the lower reach ranges from elevation 2.0 to 4.5 feet National Geodetic Vertical Datum of 1929 (NGVD29), and the water surface elevation has been known to be as low as 2.4 feet NGVD29 and as high as 28.8 feet NGVD29 (USGS 2023a). The channel is generally between 100 and 200 feet wide. The lower reach receives water inputs from combined sewer overflows, stormwater, Smith and Bybee Wetlands, leachate from the St. John's Landfill, and the upper Columbia Slough (DEQ 2012). The majority (99%) of combined sewer overflows to the Columbia Slough have been controlled. However, 13 combined sewer overflow outfall pipes remain and may overflow into the Columbia Slough once every 10 years in summer and once every 5 years in winter on average (BES 2021).

The Columbia Slough watershed contains three drainage districts: Peninsula Drainage District No.1 (PEN 1), Peninsula Drainage District No. 2 (PEN 2), and the UFSWQD. Only PEN 1 and PEN 2 are located within the construction footprint of the Modified LPA, and they include areas north of the Columbia Slough. I-5 is the boundary between the two districts, with PEN 1 located to the west and PEN 2 to the east. Day-to-day operations of both districts are managed by the UFSWQD. Both PEN 1 and PEN 2 are protected by the Columbia River levees and rely on pump stations to move water through and out of the district areas.

The I-5 crossing of the Columbia Slough is in a highly urbanized area. Riparian habitat along the slough has been largely replaced by buildings and paved surfaces, although grasses, trees, and shrubs are present, especially along the south bank. However, riparian areas along the slough are generally not adequate to provide shade, bank stabilization, sediment control, pollution control, or streamflow moderation. The predominant land use around the Columbia Slough in the study area is light industrial, with some residential. The Columbia Slough connects to the Willamette River approximately 6.5 miles west of the study area, within a mile of the confluence of the Columbia and Willamette Rivers (BES and DEQ 2022).

Historically, the Columbia Slough consisted of multiple channels in a braided floodplain of wetlands, lakes, and waterways. However, much of the slough's wetland habitat has been filled, dredged, channelized, or degraded by current and past land uses. Prior to the construction of a main sewage treatment plant in 1951, raw sewage and industrial waste were dumped directly into the Columbia Slough and other Portland watersheds. Combined sewer outflow discharges to the Columbia Slough have nearly been eliminated in recent years (BES 2011). Remnant wetlands and restored wetlands in the slough watershed provide some thermoregulation and nutrient removal. The IBR Wetlands and Other Waters Technical Report discusses these wetlands in more detail. The DEQ has listed the beneficial uses of the Columbia Slough as irrigation, domestic and industrial water supply, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and hydropower (BES 2011).

3.3.1.2 Hydrology

The Columbia Slough area is highly urbanized with a complex system of roadways (including I-5, state highways, local access roads, and residential streets), parking lots, and other impervious surfaces. Approximately 36% of the watershed area contains impervious surfaces (BES 2011). The Columbia Slough has undergone profound hydrologic alteration. Originally, the Columbia Slough was a side channel of the Columbia River. Today, the Columbia Slough's original inlet is blocked at the upstream end, and it no longer receives flows from the Columbia River. The lower reach, downstream of pumping facilities and gravity gates, remains tidally influenced by the Columbia and Willamette Rivers. Numerous dikes, pumps, and weirs regulate flows to, from, or within the slough.

The USGS monitors flows of the Columbia Slough within the lower reach at RM 0.6. Average monthly discharge recorded by USGS between 1989 and 2020 was 105 cubic feet per second (cfs). Maximum daily mean discharge occurred December 5, 1995, and was 2,400 cfs (USGS 2023a). Minimum daily mean discharge occurred February 7, 1996, and was 6,700 cfs. Flows of the lower reach are tidally influenced, and the tides can cause flow direction to be reversed (USGS 2023a). Average monthly discharges are shown in Table 3-1. The levee (at RM 8.5) between the Lower Slough and Middle Slough prevents reverse flows from entering the Middle Slough (BES 2009). Above the Lower Slough, flows are regulated by piped water, levees, and pumps (BES 2021).

3.3.1.3 Water Quality

BES has undertaken intensive water quality monitoring on the Columbia Slough since 1994. BES collects continuous, 15-minute-interval water quality measurements at three stations, one from each of the three reaches in the Columbia Slough; the parameters include water temperature, pH, dissolved oxygen, and conductivity (BES 2022). Additionally, BES collects water quality grab samples from a different set of 25 sites in the Columbia Slough for a comprehensive suite of laboratory analyses, which includes metals, nutrients, solids, and bacteria (BES 2022).

DEQ placed the slough on the state's 303(d) list in 1994/1996. The Columbia Slough is 303(d) listed for biocriteria, temperature, iron, and aquatic weeds (DEQ 2022). The DEQ defines biocriteria as the measure by which "Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities" (OAR 340-041-0011). TMDLs have been established for pH, dissolved oxygen, phosphorus, chlorophyll *a*, bacteria, lead, polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethylene (DDE)/dichlorodiphenyltrichloroethane (DDT), dieldrin, dioxin, and temperature (DEQ 1998, 2006).

TEMPERATURE

The Willamette Basin TMDL: Lower Willamette Subbasin established TMDLs for tributary streams, including the Columbia Slough. The TMDL follows the state water quality standard of 18 degrees Celsius (°C) (64°F) criteria for salmon and trout rearing and migration in the slough (DEQ 2006). Water temperature in the lower reach does not meet this standard during the summer. The main cause of elevated water temperatures is likely the installation of levees that alter the slough's physical features. Elevated water temperatures are also likely due to the lack of shade sources, long water residence time in a shallow channel, and the altered hydrological cycle with reduced aquifer recharge and groundwater inflow during summer months (BES 2021).

SEDIMENT/TURBIDITY

As a stormwater-receiving waterbody, the Columbia Slough has DEQ-established statewide benchmarks for total suspended solids (TSS). The DEQ has set a benchmark of 30 milligrams per liter (mg/L) of TSS for stormwater discharges to the slough (DEQ 2022). Downstream of the study area, in the Portland International Raceway area, less than 50% of BES sampling met the target. Generally, however, TSS improves as one moves upstream of the confluence with the Willamette River.

Upstream of the study area, near the Vancouver Avenue crossing of the slough, more than 90% of sampling met the target.

The slough contains fine, silty sediment with a relatively high organic matter content. It gradually accumulates sediment, a process known as aggrading. Major sources of TSS in the slough include stormwater from streets, parking lots, driveways, agricultural runoff (in the upper and middle reaches), construction activities, sediment resuspension, and bank erosion.

Water quality is somewhat compromised by this excessive sediment and turbidity. The Columbia Slough near the study area is considered not properly functioning for suspended sediment and turbidity. Appropriate erosion and sediment control BMPs are required to minimize and avoid sediment discharges and elevated turbidity (BES 2021).

CHEMICAL CONTAMINATION/NUTRIENTS

The Columbia Slough is 303(d) listed for biocriteria, iron, and aquatic weeds. TMDLs have been established for pH, dissolved oxygen, phosphorus, chlorophyll *a*, bacteria, lead, PCBs, DDE/DDT, dieldrin, dioxin, and temperature (DEQ 1998, 2006).

Low levels of sediment contamination are found throughout the slough, with the main risks being PCBs and pesticides in fish tissues. Disposal of PCBs was not regulated prior to 1979, and their presence in the Columbia Slough watershed is likely from past practices. PCBs bioaccumulate and are environmentally persistent (DEQ 1998).

The lower reach consistently exceeds the upper pH limit of the water quality standard in the spring and summer and the chlorophyll *a* standards in the spring, summer, and fall (BES 2021).

Transportation, land uses, stormwater runoff, industrial discharges, contaminated sites, auto wrecking yards, sediments, and air emissions are the main contributors to lead in the Columbia Slough. Other sources of chemical pollutants and nutrients include illegal dumping and hazardous spills. Lead samples taken in the lower reach met the dissolved lead standard, and 70% to 90% of the samples taken in the study area also met the total lead standard (BES 2021).

In addition to the contaminants listed above, dissolved copper—a neurotoxicant that damages the olfactory abilities of fish—is also known to occur in the Columbia Slough. Dissolved copper associated with highway runoff is a result of brake pad wear and vehicle exhaust; concentrations typically found in road runoff are within the range shown to affect predator avoidance and other behaviors (Hecht et al. 2007). Concentrations found in runoff are influenced by a number of factors, including traffic volume, congestion, adjacent land uses, air quality, and the frequency and duration of storms.

3.3.1.4 Stormwater Drainage

Conditions in the Columbia Slough, such as slow-moving water and existing water quality problems, make this waterbody more sensitive to TSS and other contaminants than other waterbodies within the study area.

Based on data available from the Natural Resources Conservation Service (NRCS), surficial soils in this area are mainly composed of the Sauvie-Rafton-Urban land complex. These soils belong to Hydrologic

Group D and have a low infiltration rate and high runoff potential. A soil survey conducted for Multnomah County indicates that water tables in this area are at a depth of less than 1 foot. Borehole logs available for the study area confirm the depths for the Sauvie-Rafton-Urban complex and also indicate that the soils can be highly variable. Land west and east of I-5 and south of North Portland Harbor generally has an industrial and open space zoning designation.

In this stormwater drainage area, much of I-5, Marine Drive, and NE Martin Luther King Jr. Boulevard are elevated on embankments or structures. The stormwater conveyance systems that serve these elevated roads do not convey runoff generated outside the right of way. These embankments are also part of the levee system. Surface runoff from I-5 and the roads within the study area is mostly confined to the roadway surface by continuous concrete barriers or curbs. It is collected almost entirely by closed gravity drainage systems consisting of inlets and stormwater pipes. One notable exception is NE Martin Luther King Jr. Boulevard east of I-5 where runoff is shed off the south shoulder and is conveyed in a system of sloughs before being discharged to the Columbia Slough via one of the PEN 1 or PEN 2 pump stations. Each pump station has two pumps with a design goal that each pump is capable of meeting at least two-thirds of the total pump station capacity. The measured capacities for the pump stations appear to be less than their rated capacities, which is likely due to the age of the pumps and other equipment and the condition of the discharge pipelines.

Within the study area, the existing impervious area in the Columbia Slough watershed is approximately 38.5 acres. Runoff from approximately 3 acres (NE Martin Luther King Jr. Boulevard and Union Court) is dispersed into adjacent impervious areas that are not connected to downstream conveyance (pipes or sloughs). Runoff from these areas generally ponds until it either infiltrates or evaporates. There are no flow control measures for runoff within the study area beyond the regulation of discharges provided by pump station operation. There are no engineered water quality facilities within the Columbia Slough study-specific watershed.

3.3.2 Columbia River and North Portland Harbor

3.3.2.1 Waterbody Description

The Interstate Bridge is located at RM 106 of the Columbia River. Shallow and near-shore habitat is present in the study area on both the Oregon and Washington shores and is influenced by flow and sediment input from tributaries and the mainstem river, which eventually settles to form shoals and shallow flats (USACE 2003).

Within the study area, the Columbia River and North Portland Harbor are a constrained and highly managed waterway primarily influenced by upstream dams; landform and bridge footings are the dominant and subdominant floodplain constrictions, respectively. Ten bridge footings are currently located below the OHWM. The IBR Wetlands and Other Waters Technical Report discusses the OHWM in more detail. A flood control levee runs along the south bank of North Portland Harbor and forms a boundary between the adjacent neighborhoods and the harbor. Sandy beaches created by dredge disposal are also present along the lower Columbia River. Shoreline erosion rates are likely slower than they were historically due to flow regulation and riverbank protection. The river channel is deeper and narrower than historical conditions and is routinely dredged as part of the Columbia and Lower Willamette Federal Navigation Channel Project, a joint effort by the USACE and the ports of

Kalama, Longview, Portland, Vancouver, and Woodland to maintain shipping navigation (USACE 2017a). The USACE and five lower Columbia River ports are developing an environmental impact statement for a long-term plan to maintain the river's 43-foot depth for another 20 years (USACE 2017b).

North Portland Harbor is a large side channel of the Columbia River located along the southern bank of Hayden Island. The channel branches off the Columbia River approximately 2 river miles upstream (east) of the existing bridge site and flows approximately 4.5 river miles downstream (west) before rejoining the mainstem Columbia River.

For the stormwater analysis, the Columbia River Watershed has been divided into the south and north sides of the river. The Columbia River South Watershed includes the portion of the study area that discharges to North Portland Harbor (a side channel of the Columbia River) and to the Columbia River south of the Oregon-Washington state line, including the Hayden Island area. The Columbia River North watershed includes the study area from the Oregon-Washington state line north to the SR 500 interchange.

3.3.2.2 Hydrology

Development of the hydropower system on the Columbia River has significantly influenced peak seasonal discharges and the velocity and timing of flows. The Columbia River estuary historically received annual spring freshet flows, which have been reduced on average by 50% to 55%. Flows between October and March have increased by 35% compared to historic rates (ISAB 2000). Average monthly discharges recorded by USGS on the Columbia River between 1963 and 2020 varied between 110,000 and 363,000 cfs. Maximum daily mean discharge occurred on June 19, 1964, and was 675,000 cfs (USGS 2023b). Minimum daily mean discharge occurred on September 23, 2018, and was 67,900 cfs. Average monthly discharges are shown in Table 3-1.

The Columbia River is also tidally influenced in its lower reaches below Bonneville Dam, which includes the study area. Flows and water surface elevations in this area are influenced by tidal fluctuations, resulting in minimal streamflow at times and daily elevation changes. On rare occasions, reverse flow may occur (ISAB 2000).

The study area in the vicinity of the Columbia River is highly urbanized and contains a complex system of roadways, including I-5, state highways, local access roads, and residential streets), parking lots, and other impervious surfaces. Over the past 150 years, historic off-channel areas have been filled, rechanneled, diverted, and otherwise developed for agricultural and urban use. The channelization of the watershed in addition to the development of the hydropower system have dramatically altered the historical hydrologic regime.

3.3.2.3 Water Quality

TEMPERATURE

A TMDL for temperature in the Columbia and lower Snake Rivers was established in May 2020. The TMDL applies a 20°C (68°F) summer maximum criterion for salmon and steelhead migration to the lower 397 miles of the Columbia, which includes the study area (EPA 2021b). Water temperatures in the vicinity of the study area exceed the 20°C standard for salmon and steelhead migration an average of 7 days per year. Since the 1960s, summer water temperatures in the Columbia River have increased by approximately 1.5°C (EPA 2021a).

Upstream river flows are highly controlled by dams and diversions on the mainstem Columbia River and its tributaries. Dams on the Columbia River elevate water temperatures during summers, contributing to elevated water temperatures in the study area (EPA 2021b). Riparian vegetation that could play a role in regulating water temperatures is lacking in the vicinity of the study area. However, due to the size of the Columbia River, riparian vegetation would play a minor, if any, role in temperature regulation.

SEDIMENT/TURBIDITY

Suspended sediment (e.g., sand, silt, and clay particles) is a naturally occurring component of the riverine habitat in the study area, and has historically been influenced by flow and currents, rain events, and geologic events (e.g., earthquakes and volcanic activity). The movement and deposition of suspended sediments in the water column and through the river system are an important component of habitat-forming processes that contribute to the creation and maintenance of shallow water habitats capable of sustaining emergent and riparian vegetation.

Turbidity in the study area is very low. From October 2002 to November 2010, Ecology conducted water quality sampling approximately 3 miles upstream of the Interstate Bridge (Ecology 2021a). Of 43 samples, all were 12 nephelometric turbidity units (NTUs) or under, and 34 were 5 NTUs or under, which is extremely low turbidity.

CHEMICAL CONTAMINATION/NUTRIENTS

The Columbia River and North Portland Harbor do not meet the DEQ standards and are 303(d) listed for the following parameters: PCBs, PAHs, and DDT metabolites (DDE 4,4’) (DEQ 2022). The Columbia River is on Ecology’s 303(d) list for vinyl chloride (Ecology 20222). In addition to the 303(d) listings, the EPA has issued TMDLs for the Columbia River for dioxin (EPA 1991), temperature (EPA 2021b), and total dissolved gas (DEQ and Ecology 2002).

In addition to the contaminants listed above, dissolved copper—a neurotoxicant that damages the olfactory abilities of fish—is known to be present in the Columbia River above naturally occurring levels (Fuhrer et al. 1996). Dissolved copper associated with highway runoff is a result of brake pad wear and vehicle exhaust; concentrations typically found in road runoff are within the range shown to affect salmonid predator avoidance and other behaviors (Hecht et al. 2007). Concentrations found in runoff are influenced by a number of factors, including traffic volume, congestion, adjacent land uses, air quality, and the frequency and duration of storms.

Two sites near the study area in North Portland Harbor have been identified that indicate elevated levels of contamination: Diversified Marine and Schooner Creek Boat Works. At Diversified Marine, heavy metals, benzene, toluene, ethylbenzene, and xylene (BTEX); PAHs; chlorinated volatile organic compounds; and PCBs are potentially contaminating soil, groundwater, river sediments, and surface water. The EPA completed a preliminary assessment of the Diversified Marine site and sampled river sediments at a distance of 200 to 250 feet from shore. The samplings showed that elevated metal levels were below levels of significant concern 200 feet downstream from the site. The DEQ is concerned about shoreline releases of metals, petroleum hydrocarbons, PCBs, and semivolatile organic compounds from this site.

At Schooner Creek Boat Works (Pier 99), the EPA completed a site investigation in August 2009. The data collected indicate that site soils are contaminated with heavy metals, PAHs, PCBs, DDT, phthalates, and tributyltin at concentrations that pose a potential risk to on-site workers, adjoining residents, on-site plants and wildlife, and nearby aquatic life. Sediments at the boat dock area are contaminated with metals, PAHs, and DDT that represents potential toxic and bioaccumulative threats to aquatic life.

3.3.2.4 Columbia River South Stormwater Watershed (Oregon)

Surficial soils on Hayden Island consist of the Pilchuck-Urban land complex based on available NRCS data. They are Hydrologic Group A soils that have a high infiltration rate and consist mainly of deep, well-drained to excessively-drained sands or gravelly sands. Available borehole information confirms this description. Limited piezometer data indicate that the water table is about 15 feet below ground and is expected to respond to changes in river level given the highly permeable nature of the soils. The land on each side of I-5 on Hayden Island is highly developed and comprises service-related businesses such as retail stores and restaurants, and their parking lots.

As with the Columbia Slough drainage, I-5 is elevated on an embankment across Hayden Island, but the adjacent roads and the ramp connections to I-5 are not elevated. However, runoff generated on I-5 and the local roads within the study area is mainly confined to the roadway corridors by continuous concrete barriers or curbs. Except for the North Portland Harbor bridge and the Interstate Bridge, runoff is collected entirely by closed gravity drainage systems with inlets and stormwater pipes that discharge directly to North Portland Harbor or Columbia River. Runoff from the bridges is discharged through scuppers directly to the water surface below. In this stormwater drainage area, the existing impervious surface area within the footprint of the Modified LPA is approximately 45.8 acres; there are no flow control measures or engineered water quality facilities within the Columbia River South study-specific watershed.

As in the Columbia Slough study-specific watershed, the footprint of the Modified LPA within this watershed was once part of the Columbia River floodplain. The portion south of North Portland Harbor is protected from flooding by the levee system, while material dredged from the Columbia River has been used to raise the overall ground surface on Hayden Island east of the BNSF Railway railroad tracks above the elevation of the Columbia River 100-year flood event.

3.3.2.5 Columbia River North Stormwater Watershed (Washington)

The Columbia River North study-specific watershed area includes the current I-5 corridor, as well as Vancouver city streets in the study area. In the Columbia River North watershed, there are approximately 76.4 acres of existing impervious surfaces and no flow control measures or engineered water quality facilities. Approximately 3 acres of SR 14 is dispersed to adjacent pervious surface area where it infiltrates and/or evaporates.

Within the study area, soils consist of the gently sloping Wind River and Lauren surficial soils that belong to Hydrologic Group B and have a moderate infiltration rate. While depths to the water table are not provided, borehole logs available for the area indicate groundwater levels are close to water levels in the Columbia River. In addition, piezometer readings taken by WSDOT in the SR 14 interchange area demonstrate that the water table, at least at that particular location, responds to changes in the river level.

Surface runoff from I-5 and local streets is generally confined to the roadway by continuous curbs and concrete barriers and is collected almost entirely by closed drainage systems. The only exceptions are the Interstate Bridge and a few ditches adjacent to I-5. These closed systems discharge runoff directly to the Columbia River via outfalls in the vicinity of the existing Interstate Bridge while runoff from the bridge itself drains through scuppers to the river below. A pump station located southeast of the SR 14 interchange discharges runoff from lower-lying portions of the interchange to the Columbia River during high river levels.

The vertical grade of I-5 is generally below the surrounding areas. As a result, the I-5 drainage system also conveys runoff from built-up areas outside the I-5 right of way. These areas, which are extensive, are estimated to make up over 50% of the total drainage area served by this system, and their contribution to flows was an important consideration when developing the approach to stormwater management in this watershed.

3.3.3 Burnt Bridge Creek

3.3.3.1 Waterbody Description

Burnt Bridge Creek is a small tributary to the lower Columbia River. It originates near the northeast boundary of Vancouver and flows 12.6 miles west (roughly paralleling SR 500 for approximately 5 miles) to its outlet at Vancouver Lake. Vancouver lake then drains into the Columbia River via Lake River.

The I-5 corridor is located in the vicinity of RM 2 of Burnt Bridge Creek. Within the study area, the stream passes through a valley surrounded primarily by residential development. Stream slope is between 0% and 2%, but approximately 80% of the stream has a gradient of less than 0.1% (PBS 2003).

Burnt Bridge Creek enters the study area east of 15th Avenue near Leverich Park, northeast of the SR 500/I-5 interchange. In the area of Leverich Park, some areas of the creek have substantial overhead cover from large-diameter trees and shrubs, and sparse cover in areas maintained by park staff by widely spaced large-diameter trees. In the more open areas of Leverich Park, the banks are highly eroded by regular visitor usage and mowing of herbaceous vegetation in the vicinity of the channel. Substrate on the channel bed just downstream of the I-5 crossing has been observed by the USGS at their former stream gauge to consist of silts, sands, gravels, and cobbles (USGS 2023c).

From Leverich Park, the Burnt Bridge Creek channel passes under Leverich Park Way through a concrete culvert and onto City of Vancouver property adjacent to I-5. The channel is armored for approximately 100 feet, after which it continues north, parallel to I-5 and Leverich Park Way, through a silt-dominated channel. The vegetation surrounding this portion of the channel is dominated by reed canarygrass (*Phalaris arundinacea*) with some overhanging blackberry (*Rubus* sp.) and dogwood (*Cornus* sp.). Site observations indicate that the channel banks are undercut due to the growth habit of reed canarygrass and eroded due to the presence of nutria (*Myocastor coypus*).

Approximately 500 feet north of the culvert, Leverich Park Way bends to the west and the Burnt Bridge Creek channel again passes under the roadway through a large, corrugated metal pipe culvert. The channel continues north through a densely vegetated, privately owned area for about 200 feet. The channel continues north with a WSDOT wetland mitigation site bounding the channel to the west and Bonneville Power Administration property and private land to the east. In this section of the study area, the channel is dominated by fine sediments (PBS 2003) and has moderate to dense overhanging vegetation consisting of deciduous and coniferous tree and shrub species.

In 2004, the City of Vancouver initiated the Burnt Bridge Creek Greenway Improvement Project to enhance water quality, riparian habitat, and recreation (through trail connections). Stormwater treatment facilities were also added and include infiltration basins, bioswales, vortex manholes, water quality ponds, and wetlands in the central greenway corridor of the watershed.

3.3.3.2 Hydrology

Average monthly discharge at Burnt Bridge Creek between 1998 and 2012 was 26 cfs (USGS 2023c). Burnt Bridge Creek experiences seasonal fluctuation in flow, with seasonal lows occurring between July and October and highs occurring between December and March. During low flow periods, streamflow is primarily fed by groundwater discharge.

Within the study area, development in the vicinity of Burnt Bridge Creek is similar to the vicinity of the Columbia River. Historically, Burnt Bridge Creek has been prone to flooding (USFWS 1996). Development of the study area has increased peak flows, reduced base flows, and altered the timing of flows compared to historical conditions. Throughout the system, several actions have been taken to reduce or relieve flooding, including channel modification, installation or upsizing of culverts, installation of storm lines, and construction of drainage systems (Clark County Department of Public Works 1998). Additional flow control elements, along with stormwater treatment facilities and habitat enhancements, were added as part of the Burnt Bridge Creek Greenway Improvement Project.

3.3.3.3 Water Quality

TEMPERATURE

Desirable water temperatures for young salmonids during downstream migration range from 6.7°C to 13.3°C (44°F to 56°F). In freshwater, temperatures higher than 23°C (73.4°F) are lethal for juvenile salmonids, and temperatures higher than 21°C (70°F) are lethal for adult salmonids (EPA 2003). Several listed salmonids are present in Burnt Bridge Creek in the vicinity of the study area, which the IBR Ecosystems Technical Report, discusses in more detail. A temperature gauge at Leverich Park (gauge BBC 2.6), within the study area, indicated that from June 25 to October 15, 2018, the seven-day average daily maximum temperature exceeded 17.5°C (63.5°F) an estimated 70 times (Herrera 2018). Therefore, water temperatures in the vicinity of the study area likely exceed the NOAA Fisheries standard of 18°C (64°F) for salmonid migration and rearing in late summer.

SEDIMENT/TURBIDITY

Suspended sediment inclusive of sand, silt, and clay particles is a naturally occurring component of the riverine habitat in the study area, and has historically been influenced by flow and currents, rain events, and geologic events (e.g., earthquakes and volcanic activity). Ecology conducted water quality sampling in the study area vicinity approximately 0.25 mile east of I-5 on Burnt Bridge Creek between October 2003 and September 2009. Of 48 samples taken during this period, 40 were 10 NTUs or lower (Ecology 2021b). Turbidity within the watershed is generally lowest between July and October, which coincides with the period when the majority of flow within the stream is contributed via groundwater. In general, turbidity is not considered to be a parameter of concern in Burnt Bridge Creek (Herrera and PGG 2019). Water quality is consequently not compromised by excessive sediment and turbidity; however, habitat-forming processes requiring recruitment of suspended sediments are limited.

CHEMICAL CONTAMINATION/NUTRIENTS

Burnt Bridge Creek is not listed as having water quality issues related to chemical contaminants. However, the upper reaches of the stream pass through farmland where the use of chemical fertilizers and pesticides is likely. Furthermore, stormwater runoff is routed to the creek in several locations through pipes and ditches (Herrera and PGG 2019).

Water quality in Burnt Bridge Creek has been monitored extensively since the early 1970s and shows impairments typical of urban streams (Ecology 2020). Segments of Burnt Bridge Creek within the study area are considered impaired by fecal coliform bacteria, dissolved oxygen, pH, and temperature by the 303(d) list (Ecology 2022). Naturally occurring concentrations of phosphorus in the groundwater, coupled with nutrient inputs from urban and agricultural runoff, have supported nuisance growths of algae and further degraded the aquatic habitat (Herrera 2011).

Between October 2003 and September 2009, Ecology conducted water quality sampling of Burnt Bridge Creek in the study area vicinity, approximately 0.25 mile east of I-5. Of 49 fecal coliform bacteria samples taken during this time, 28 exceeded the criterion of 200 colony-forming units/100 milliliters. Out of 48 samples taken for dissolved oxygen, all exceeded the minimum criterion of 8.0 mg/L for salmonid spawning, rearing, and migration. Of the 48 samples taken for pH, values ranged between 6.85 and 8.06, within the approved range of 6.5 to 8.5 to protect designated aquatic life uses of salmonid spawning, rearing, and migration (McCarthy 2020; Ecology 2021b).

Ecology has not yet approved any TMDLs for Burnt Bridge Creek. The Burnt Bridge Creek TMDL Advisory Committee is currently conducting monitoring that would result in the determination of the required pollution reductions and the development of a detailed cleanup plan (Ecology 2021d).

3.3.3.4 Stormwater Drainage

The study area within this watershed includes approximately 9.6 acres of existing impervious surface area, including the SR 500 interchange and portions of I-5 to the north and SR 500 to the east. Surficial soils in this area typically consist of Wind River loams. These soils belong to Hydrologic Group B and are considered to have a moderate infiltration rate. Residential developments are located south of the SR 500 interchange; a school is located to the northwest of the SR 500 interchange; and a park is located to the northeast. While depths to the water table are not provided, borehole logs available for the area indicate groundwater levels are close to water levels in the Columbia River.

Typical of an urban environment, surface runoff from highways and local streets is generally confined to the roadway by continuous curbs and concrete barriers and is conveyed almost entirely by closed drainage systems. In contrast to the other watersheds, runoff from the entire CIA within this portion of the study area currently contains some form of treatment. Runoff from 7.9 acres within the study area is conveyed to a treatment pond at the Main Street interchange, and overflow runoff is conveyed to a wet pond north of SR 500 to be infiltrated for disposal.

The treatment and infiltration ponds are currently considered to provide adequate stormwater treatment in terms of water quality (dissolved metals reduction) and flow reduction.

3.3.4 Fairview Creek

3.3.4.1 Waterbody Description

Fairview Creek is a 5-mile-long urban stream that originates in a wetland near Grant Butte in Gresham, Oregon, and drains to Fairview Lake, and is a tributary to the eastern portion of the Columbia Slough. The Fairview Creek outlet at Fairview Lake is approximately 11 miles east of the study area. Historically, Fairview Creek had been a tributary of the Columbia River, but water from the wetlands was diverted into an artificial channel that drains into the Columbia Slough, which is a tributary of the Willamette River. In 1960, water managers built a dam along Fairview Creek to create Fairview Lake for water storage and recreation. Fairview Creek has two named tributaries: No Name Creek and Clear Creek (BES 2005).

The existing Ruby Junction Maintenance Facility is located on NW Eleven Mile Avenue in Gresham, Oregon. The existing facility would be expanded by approximately 10.4 acres (from 22.8 to 33.2 acres). Portions of parcels in the study area for the maintenance facility are located within the 100-year floodplain of Fairview Creek. These three parcels presently contain several buildings and some paved surfaces.

3.3.4.2 Hydrology

The Fairview Creek study-specific watershed is 6.5 square miles and receives stormwater runoff from Gresham, Wood Village, and Fairview. Fairview Creek is impounded by a dam that forms Fairview Lake. During summer months, starting in May, the lake's water levels are maintained at 10 feet NGVD29. In winter months, starting in October, water elevation is lowered to 8.5 feet NGVD29. This accounts for an exaggerated hydrologic regime.

Average monthly discharge between 1992 and 2020 in Fairview Creek at the USGS gauging station near Glisan Street, approximately 1.4 miles downstream of the Ruby Junction Maintenance Facility, was 6 cfs. Minimum daily discharge during this period was 0.03 cfs, and maximum daily discharge was 137 cfs (USGS 2023d). The 100-year floodplain for Fairview Creek is approximately 1,288 feet wide at its widest point and covers portions of the study area (Metro 2022).

3.3.4.3 Water Quality

The DEQ has placed Fairview Creek on its 303(d) list for biocriteria; it has approved TMDLs for bacteria and spring/summer temperature (DEQ 2009). In addition, Fairview Creek is included in the TMDLs for the Columbia Slough since it is a tributary. No additional water quality data were available for this creek.

Excessive fine sediments have been shown to settle in the streambeds of Fairview Creek. This has been caused by the erosion of upland areas and deposit of sediments by stormwater that is discharged into the creek. These sediments degrade native fish spawning areas and limit suitable habitat for benthic organisms (BES 2005).

3.3.4.4 Stormwater Drainage

The Ruby Junction Maintenance Facility is approximately 22.8 acres, all within the Fairview Creek watershed. Of the 22.8 acres, 7.3 are existing CIA. Stormwater from the existing impervious surface area (5.3 acres) is infiltrated through the use of dry wells, ultimately recharging the groundwater aquifer and contributing to flows in waterbodies within the Columbia Slough watershed.

4. LONG-TERM EFFECTS

For each study area waterway, this section describes the long-term effects on hydrology, water quality, and stormwater that may occur from operation of the Modified LPA. "Long-term effects" refers to direct, permanent effects that would occur as a result of the Modified LPA. Long-term effects may impact resources beyond the study area.

4.1 No-Build Alternative

Under the No-Build Alternative, most of the existing impervious surface area along roadways in the study area would remain untreated, which would allow for the continued release of stormwater with degraded quality into the study area's receiving waters. However, with no way to quantify future emissions or other pollutants, such as 6PPD-quinone and for the purposes of the present analysis, it is assumed that the No-Build Alternative would maintain existing water quality conditions and would not result in long-term changes (either increased or decreased impacts).

4.2 Modified LPA Long-Term Effects

4.2.1 Hydrology

This section describes potential hydrologic effects from the Modified LPA, which includes potential to increase flooding, alter peak flows, increase runoff volumes to local receiving waters, and decrease water infiltration and groundwater recharge.

The Modified LPA includes a stormwater conveyance and treatment system that would comply with all federal, state, and local water quantity and quality standards in place at the time of construction, including requirements that may be updated to reflect climate-induced heavier rainfall events. The proposed design for the Modified LPA includes inlets, catch basins, and gravity pipe drainage systems that would collect and convey runoff from the new bridges, transit guideway, and road improvements to stormwater treatment facilities. The treatment facilities would reduce total suspended solids, particulates, and dissolved metals to the maximum extent practicable before runoff reaches surface waters or is infiltrated.

The Modified LPA would also cross the Portland Metro Levee System (PMLS) with the extension of light-rail north from Expo Center, with modifications to the I-5 mainline north of N Victory Boulevard, with the North Portland Harbor bridges, and with local road revisions of North Marine Drive and North Expo Road. Such modifications may include activities to restore temporarily disturbed portions of the levees, or 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 be coordinated for consistency with the planned future condition of the levees under the Levee Ready Columbia project. The design of these improvements would be closely coordinated with the US Army Corps of Engineers through the Section 408 authorization approval process and the Urban Flood Safety and Water Quality District. The assessment presented below of long-term effects to water quality and hydrology associated with the Modified LPA includes effects associated with potential modifications to the federal levee system.

The Modified LPA would manage flow control and runoff in the Burnt Bridge Creek watershed and at the Ruby Junction Maintenance Facility via detention and infiltration. In the North Portland Harbor area, runoff from some existing impervious surfaces and a few sections of new or modified roadway with the Modified LPA would be conveyed, treated, and discharged to the Columbia Slough. All other runoff generated by the Modified LPA would be conveyed, treated, and discharged within the watershed in which it is generated.

Floodways designated by FEMA that are located within the study area include the Columbia Slough, the Columbia River, and Burnt Bridge Creek. These floodways are confined to the immediate vicinity of streams in the study area due to levees or, in the case of Burnt Bridge Creek, steeper slopes. For the FEMA-designated floodways in the study area, and in compliance with Executive Order 11988 for Floodplain Management, a Location Hydraulic Study would be conducted for the Modified LPA in coordination with the Final SEIS. Based on a preliminary hydraulic assessment, there may be a small net rise to the base flood elevation of the Columbia River and North Portland Harbor. This preliminary assessment would be confirmed with the hydraulic analysis once design concepts progress to a sufficient level of detail. If the hydraulic analysis showed a rise in base flood elevation, mitigation would be explored. Mitigation measures could include alternative pier cap shapes to improve hydraulic efficiency and cutting of soils to compensate for reduced flood storage capacity. Currently, the potential areas to cut are anticipated to be entirely within the footprint of the Modified LPA. The results of hydraulic analysis and coordination with the City of Portland will determine whether the needed cut volume would require the acquisition of additional property. If mitigation measures cannot reduce base flood elevation change from the IBR Program to zero net rise, the change would be documented in a Floodplain Evaluation Report and a public notice, which would include the reasons for this finding and alternatives considered. As design progresses, the IBR Program would evaluate whether the needed cut volume would require the acquisition of additional property. If mitigation measures cannot reduce base flood elevation impacts from the Program to zero net-rise, the impacts would be documented in a Floodplain Evaluation Report and public notice, which would include the reasons for this finding and alternatives considered.

Prior to construction, a floodplain permit from the City of Portland would be required. If the Modified LPA results in a net rise of base flood elevations, a Conditional Letter of Map Revision would be required from FEMA prior to issuance of the floodplain permit. In 2024, the City of Portland updated its building code and zoning code for development within floodplains. The updates are intended, in part, to comply with the recommendations of the 2016 Federal Emergency Management (FEMA) National Flood Insurance Program Biological Opinion (BO) that was issued by NOAA Fisheries in 2016.

No new or expanded roads or facilities are proposed for the Burnt Bridge Creek floodway. A small area within the study area at the Ruby Junction Maintenance Facility is mapped within the 100-year floodplain of Fairview Creek; however, the Modified LPA would not place new or expanded roads or facilities where they would encroach upon the Special Flood Hazard Area for Fairview Creek. Therefore, no increase in 100-year flood elevations is expected as a result of the Modified LPA.

The Columbia River and North Portland Harbor would be the only waterways crossed by the Modified LPA and subject to in-water work. However, long-term hydrologic effects may occur in the Columbia

Slough, Burnt Bridge Creek, and Fairview Creek due to an increase in impervious surfaces in each watershed.

An increase in impervious surface area typically increases flow volume fluctuations within receiving waters and is associated with greater peak flows and increased total runoff volume. Since the study area drains to major waterbodies that have relatively high flows, the Modified LPA is anticipated to result in a relatively small flow volume fluctuation and change to greater peak flows and increased runoff. Flow controls for runoff generated by the Modified LPA would be required for flows discharged to Fairview Creek and Burnt Bridge Creek, but not for the Columbia River or Columbia Slough, in accordance with the FAHP requirements. These are considered large waterbodies that are exempt from flow control requirements for direct discharges unless the conveyance systems indicate capacity limitations.

Runoff from some existing impervious surfaces and a few sections of new or modified roadway with the Modified LPA that currently drain to North Portland Harbor would instead be conveyed, treated, and discharged to the Columbia Slough. All other runoff generated by the Modified LPA would be conveyed, treated, and discharged within the watershed in which it is generated. Table 4-1 provides information on total watershed areas of receiving waters and proposed increases to impervious surface areas within the watersheds.

Table 4-1. Changes in Impervious Surface Area from the Modified LPA

Watershed	Total Watershed Area Square Miles	Total Watershed Area Acres	Modified LPA Total Increase to Impervious Surface Square Miles	Modified LPA Total Increase to Impervious Surface Acres	% Increase to Impervious Surface within Watershed Area
Columbia Slough	51	32,640	0.003	2.2	0.007%
Lower Columbia River	18,000	11,519,954	0.042	26.8	0.0002%
Burnt Bridge Creek	28	17,920	0.002	1.1	0.006%
Fairview Creek	7	4,480	-0.001	-0.5	-0.011%
Total	**18,086**	**11,574,994**	**0.046**	**29.6**	**0.0003%**

Technical literature suggests that stream quality can begin to degrade when there is more than 10% of effective impervious surface area in a watershed (Klein 1979). An increase of impervious surface area within a watershed close to or above that threshold could be vulnerable to some level of degradation (with respect to habitat). Each of the watersheds within the study area is composed of 10% or more impervious surface area. However, even though the increase in impervious surface area for each watershed would represent a very small fraction of the total watershed (Table 4-1), literature suggests that any incremental increase could adversely affect stream quality.

Impervious surfaces do not allow water to percolate into the ground, thereby increasing the amount of runoff. Decreased water infiltration also decreases groundwater recharge and the beneficial dilution effects from water entering the water table. Groundwater contributes significantly to the base flow in watercourses. In many instances, it is the base flow that maintains the minimum discharge in creeks, especially during the dry summer months.

The addition of impervious surface area from the Modified LPA is unlikely to measurably affect base flows of waterways within the study area. The study area is not within the headwaters of the intersecting waterways, and the watershed areas for these waterways are relatively large, which lessens the effect of decreased infiltration on base flows. This is reflected in regulations that only require flow control for runoff to Fairview and Burnt Bridge Creeks. Furthermore, the proposed stormwater facilities for the Modified LPA would provide infiltration to treat stormwater runoff from both existing and new impervious surfaces within the project footprint. The area of existing, untreated impervious surface that would be treated under the Modified LPA is more than double the proposed new impervious surface area.

4.2.1.1 Columbia Slough

To a minor extent, the Modified LPA would alter the current hydrologic regime of the Columbia Slough through the addition of impervious surface and stormwater treatment. The addition of approximately 2.2 acres of impervious surface area, representing 0.007% of the watershed area, would potentially increase stormwater volumes. However, the Modified LPA would also include the addition of stormwater treatment facilities and management design that would avoid or minimize potential increases in stormwater volumes. The discharge rates of stormwater runoff volumes generated by the Modified LPA that would flow into the Columbia Slough would be regulated by downstream pumps. The Columbia Slough may be exempt from flow control requirements when the storm sewer system has available capacity (BES 2020).

4.2.1.2 Columbia River and North Portland Harbor

Six new in-water pier complexes would be built for the Modified LPA, and the original pier complexes would be removed. New piers for the North Portland Harbor bridges would be added. Given the size of the Columbia River and North Portland Harbor relative to the size of the piers, and given that this section of the river is tidally influenced, it is extremely unlikely that backwater effects would be measurable. Regardless, the Modified LPA would likely require a floodplain permit from the local jurisdictions. Floodplain permits would require modeling studies, which would be conducted prior to applying for the permit and based on the progressed design information available at that time. However, preliminary hydraulic calculations show that the Modified LPA would not result in floodplain impacts. If results of the final modeling show a backwater effect that exceeds local standards, balanced earthmoving (i.e., cut and fill) remedies within the floodplain would likely be prescribed.

In the study area of the Columbia River watershed, the Modified LPA includes 26.8 acres of additional impervious surface area. The Modified LPA would provide an increased level of infiltration for stormwater runoff. This may have a net (albeit not measurable) benefit to the hydrology of the Columbia River.

4.2.1.3 Burnt Bridge Creek

The Modified LPA may slightly alter the stormwater conveyance network that drains to Burnt Bridge Creek by providing additional stormwater treatment and rerouting some roadside ditches. This may improve Burnt Bridge Creek's hydrologic regime by providing infiltration opportunities for runoff from impervious surface areas. Ecology requires that runoff volumes be reduced to pre-development conditions for peak discharges between 50% of the two-year event and the 50-year event.

Flow controls would be required for runoff generated by the Modified LPA that is discharged to Burnt Bridge Creek. The Modified LPA would provide infiltration water quality BMPs in the vicinity of the SR 500 interchange, which would avoid or minimize increased runoff in Burnt Bridge Creek.

4.2.1.4 Fairview Creek

For the City of Gresham, flow control is required to the extent that stormwater discharges do not increase flows in Fairview Creek over pre-development conditions for a 25-year or greater storm event. The term "pre-developed" conditions is not explicitly defined but has been interpreted as the condition of the land at the time when a construction permit application is submitted. However, the City of Gresham is in the process of revising the Public Works Standards to define "pre-developed condition" as the condition of the land prior to any development occurring.

Since the Modified LPA would adhere to these flow control requirements, the hydrologic regime of Fairview Creek is not anticipated to be altered in the long-term.

4.2.2 Water Quality

Increased sedimentation in streams may occur after road construction if slopes are not stabilized as designed or if stormwater facilities do not function effectively in removal of sediment from runoff. Sedimentation due to erosion can be increased by two potential pathways: directly from erosion of the finished roadside embankments or from increased streambank erosion as a result of increased peak flows.

The Modified LPA corridor on the Oregon side of the Columbia River is relatively flat, and the portion on the Washington side of the Columbia River has more topographical features, including the area around Burnt Bridge Creek. If flooding were to occur, the area around Burnt Bridge Creek would be susceptible to erosion hazards. However, peak flows would be managed by stormwater facilities in the Burnt Bridge Creek watershed area. Stormwater facilities would be designed to effectively remove sediments from runoff before discharging stormwater to receiving waters.

Because metals and other pollutants bind to fine particles, accumulations of road-derived sediments may have elevated levels of contaminants. Runoff from transportation facilities is typically associated with a suite of pollutants, including suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from mechanical and tire wear, 6PPD-quinone from tire wear and road dust, and copper from wear and tear of brake pads, bearings, metal plating, and engine parts. Fecal coliform, while not a product of roadway surfaces or activities, is known to be conveyed in road runoff. The concentration and load of these pollutants are affected by a number of factors, including traffic volumes, adjacent land uses, air quality, and the frequency, intensity, and duration of storms.

Stormwater management measures would be incorporated into the design of the Modified LPA to minimize the potential adverse impacts that road runoff can have on water quality.

Jurisdictionally prescribed water quality treatment design storms are believed to determine runoff flow rates that result in treatment of between 85% to 91% of all runoff volumes from all storm events, depending on the jurisdiction. Peak flows that exceed the water quality design storm often bypass a treatment facility leading to discharge of untreated runoff. However, the initial and generally low storm event runoff rates are considered to be the most pollutant-loaded and contain the initial flush of pollutants from a road surface. As a result, runoff volumes that bypass treatment can contain contaminants, but levels are believed to be lower than volumes that undergo treatment. It is understood that some pollutants (e.g., dissolved metals, PAHs, CECs, 6PPD-quinone) are toxic at very low levels and could be present in bypassed, untreated runoff.

The NPDES permit program, as authorized by the CWA, controls water pollution by regulating point sources that discharge pollutants into waters of the U.S. and compliance with designated TMDLs. Several of the waterways in the study area have TMDLs listed for certain pollutants. Study area waterways and their associated 303(d) listings and designated TMDLs are shown in Table 4-2.

Table 4-2. Study Area Waterways with 303(d) Listings and Total Maximum Daily Loads

Waterway	303(d) Listing Factors	Established TMDLs
Columbia Slough	• Biocriteria[a] • Toxics (iron) • Aquatic weeds	• Toxics (lead, PCBs, DDE/DDT, dieldrin, and dioxin) • Eutrophication (pH, phosphorus, dissolved oxygen, and chlorophyll *a*) • Bacteria • Temperature
Columbia River (includes North Portland Harbor)	**In Oregon:** • Toxics (PCBs, PAHs, DDE 4,4') **In Washington:** • Vinyl chloride	• Dioxin • Total dissolved gas • Temperature
Burnt Bridge Creek	• Eutrophication (pH, dissolved oxygen) • Fecal coliform bacteria • Temperature	• None

Waterway	303(d) Listing Factors	Established TMDLs
Fairview Creek	• Biocriteria	• Bacteria • Temperature

a Biological criteria (biocriteria) are a way of describing the qualities that must be present to support a desired condition in a waterbody. Biocriteria are based on the numbers and kinds of organisms present and are regulatory-based biological measurements. Oregon Department of Environmental Quality defines biocriteria as the measure by which “Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities” (Oregon Administrative Rule 340-041-0011).

DDE = dichlorodiphenyldichloroethylene; DDT = dichlorodiphenyltrichloroethane; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyl; TMDL = total maximum daily load

Section 303(d) of the CWA requires states to list (i.e., the 303(d) list) impaired waterbodies that do not meet applicable water quality standards based on the severity of the pollution and designated uses of the waterbodies. A TMDL is the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet water quality standards. TMDLs are implemented in Oregon and Washington through the issuance or reissuance of NPDES permits by the DEQ and Ecology. Therefore, to ensure compliance with NPDES permits, the Modified LPA would be required to demonstrate that water pollution would be minimized to the greatest extent possible.

Traffic models run for the Modified LPA predict that traffic congestion within the study area would decrease compared to the No-Build Alternative (see the IBR Transportation Technical Report). The anticipated decrease in congestion may potentially reduce the proportionate amount of copper—a known byproduct of brake pad wear that is correlated with traffic congestion—carried by stormwater runoff compared to what would be proportionately carried by the No-Build Alternative. In addition, the Modified LPA includes the extension of light-rail transit into downtown Vancouver and other transportation system management and transportation demand management measures, which could reduce the number of vehicles, and therefore tires (the source of 6PPD-quinone), on study area roads.

Annual pollutant load estimates conducted using Method 1: WSDOT Data-FHWA Method, as outlined in WSDOT’s (2009) guide, *Quantitative Procedures for Surface Water Impact Assessment*, are shown in Table 4-3. Table 4-3 also shows the mean estimated annual pollutant loads with the Modified LPA, which are constants provided by the WSDOT method.

Table 4-3. Estimated Annual Pollutant Loads from Untreated and Treated Highway Runoff (pounds/year • acre)

Pollutant	Mean Load from Untreated Runoff	Mean Load from Treated Runoff
Total Suspended Solids	769.00	88.00
Total Copper	0.16	0.04
Dissolved Copper	0.04	0.03
Total Zinc	0.98	0.21
Dissolved Zinc	0.31	0.14

Note: Values were derived using Western Washington WSDOT source data from the January 7, 2009, HI-RUN Model Documentation.

WSDOT = Washington State Department of Transportation

WSDOT has not yet vetted the data set through a formal quality assurance/control process. During development of annual loading estimates, apparent discrepancies were noted in the data. If discrepancies are valid, source data and loading rate estimates would be re-evaluated.

Table 4-4 shows the annual pollutant load estimates for the entire study area for the Modified LPA and the No-Build Alternative. Areas that are infiltrated are not factored into the pollutant load calculations since they are assumed to be naturally filtered through ground percolation before entering receiving waters through groundwater.

Table 4-4. Annual Pollutant Load Estimates for Entire Project Contributing Impervious Areas

Environmental Metric	No-Build Alternative	Modified LPA	Change
Treated CIA (acres)	0.0	189.7	189.7
Infiltrated CIA (acres)	21.2	17.5	-3.7
Untreated CIA (acres)	156.4	0.0	-156.4
Total CIA (acres)	178	207	29
TSS (lbs/year)	120,733	16,720	-86.1%
Total Cu (lbs/year)	25.0	7.6	-69.7%
Dissolved Cu (lbs/year)	6.3	5.7	-9.0%
Total Zn (lbs/year)	153.3	39.8	-74.0%
Dissolved Zn (lbs/year)	48.5	26.6	-45.2%

CIA = contributing impervious area; Cu = copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

Table 4-4 shows that the Modified LPA would provide stormwater treatment across the study area and decrease roadway-derived pollutants. Therefore, the Modified LPA would have a beneficial long-term effect on the water quality of receiving waters compared to the No-Build Alternative. Tables for each study-specific watershed are included in the following sections and include the pollutant-loading analysis for the Modified LPA and the No-Build Alternative.

Another potential water quality consideration is that the Modified LPA would involve additional roadway area and, consequently, additional winter maintenance activities. Highway sanding can result in large quantities of gravels and particulates making their way into adjacent waterbodies, with adverse effects to spawning beds and, occasionally, channel morphology. Chemical anti-icing and de-icing agents are a potential concern but are relatively benign. ODOT uses magnesium chloride with a corrosion inhibitor and solid salt, both as an anti-icer before a storm to help prevent ice and snow from bonding to the road, and as a deicer after a storm to help break the bond between the ice and the road. WSDOT uses liquid calcium chloride, sodium chloride, or magnesium chloride for anti-icing and solid salt for de-icing. These salt-based materials are known to reduce oxygen in water, but the applications to roads in Portland and Vancouver are infrequent and usually with low quantities.

Studies evaluating the effect of these kinds of anti-icing and de-icing agents on a small stream found no detectable change in water chemistry (Tanner and Wood 2000). Therefore, impacts from the potential use of anti-icing and de-icing agents within the study area would be expected to be negligible, particularly since the frequency of use of such chemicals is relatively low. Within the study area, there are only approximately 30 days a year, on average, with minimum temperatures below freezing (NOAA 2022). In many cases, the duration of freezing temperatures or ambient conditions are such that these agents are not applied. The water quality benefits of increased highway safety, which would reduce accidents and the risk of hazardous materials spills, could outweigh the potential adverse impacts from winter maintenance activities.

4.2.2.1 Columbia Slough

The Columbia Slough is 303(d) listed for biocriteria, iron, and aquatic weeds. The pollutants associated with highways that have been regulated through TMDLs on this system are fecal coliform, lead, and temperature. Stormwater is listed in the TMDLs as a comparatively minor source of these pollutants. While highway runoff is “stormwater,” highway runoff is not explicitly called out in the TMDLs.

The effect of the pollutants found in runoff depends to a large extent on the character of the receiving waters. Given the nature of the Columbia Slough, with its slow-moving water and identified water quality problems, TSS and other contaminants found in highway runoff are more of a concern within this stream than in other waterbodies within the study area. This is because slower flow, such as at the Columbia Slough, allows water to be exposed to stormwater pollutants for a longer period of time and increases the probability that contaminated sediments would accumulate. In addition to the accumulation of contaminated sediments, slower flows also provide a stable habitat for excessive growth of algae and macrophytes during the summer, which can lead to lower dissolved oxygen levels (BES 2019). These issues compound the water quality deficiencies of the lower reach of the Columbia Slough, making it more sensitive to added pollutants.

The Modified LPA would increase the total CIA in this watershed by approximately 2.2 acres. This increase could largely be due to capturing runoff from the bridges across North Portland Harbor. The runoff from the existing bridge structures currently drains directly to the water surface below. Table 4-5 shows the CIA acreages for the No-Build Alternative and the Modified LPA, as well as a pollutant-loading estimate for each.

Table 4-5. Pollutant-Loading Estimate for the Columbia Slough Study-Specific Watershed

Environmental Metric	No-Build Alternative	Modified LPA[a]	Change
Treated CIA (acres)	0.0	40.7	40.7
Infiltrated CIA (acres)	3.0	0.0	-3.0
Untreated CIA (acres)	35.5	0.0	-35.5
Total CIA (acres)	38.5	40.7	2.2
TSS (lbs/year)	27,299.5	3,581.6	-86.9%
Total Cu (lbs/year)	5.7	1.6	-71.3%
Dissolved Cu (lbs/year)	1.4	1.2	-14.0%
Total Zn (lbs/year)	34.8	8.5	-75.4%
Dissolved Zn (lbs/year)	11.0	5.7	-48.2%

a Percentage change may not be precise due to rounding of values for annual loads.

CIA = contributing impervious area; Cu = copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

As shown in Table 4-5, the construction of the Modified LPA would increase the total CIA and would decrease pollutant loading for all pollutants. It should also be noted that the analysis used to produce these pollutant-loading estimates are not based on enhanced stormwater treatment alone. Instead, it is based on the average of data collected from 13 different treatment facilities. Because the majority of treatment that would be provided by the Modified LPA is enhanced treatment compared to No-Build Alternative conditions (e.g., phosphorus-free compost-amended vegetated filtration strips or ecology embankments), the results shown in Table 4-5 are likely an overestimation of TSS, total copper, and dissolved copper pollutant loads that would enter the Columbia Slough.

Runoff concentrations of total zinc and dissolved zinc have not been shown to differ whether treated in different facility types. This analysis also does not include estimates for fecal coliform and lead, for which there are TMDLs, and it is not clear whether the Modified LPA would reduce these pollutants. However, with the addition of stormwater treatment and evidence that shows reduction of several pollutants, it is anticipated that the Modified LPA would result in a decrease of these pollutants.

4.2.2.2 Columbia River and North Portland Harbor

The Columbia River and North Portland Harbor within the study area are 303(d) listed for toxics (PCBs, PAHs, and DDE 4,4') in Oregon and vinyl chloride in Washington. The only pollutant associated with highway runoff that has been regulated through TMDLs on this system is temperature.

The Modified LPA would remove a few hundred feet of vegetation along the north and south shorelines of the Columbia River in the vicinity of the new bridge structures and along the north and south shorelines of Hayden Island. However, this would not be expected to change the Columbia River water temperatures due to its large size and the very minor role riparian vegetation currently plays on cooling water temperatures. Furthermore, increased highway runoff is not anticipated to increase water temperatures since it generally rains during cooler months when Columbia River water temperatures are not as much of a concern.

For the Columbia River pollutant-loading analysis, as in the stormwater analysis, the Oregon and Washington sides of the river were split into separate drainages to simplify the analysis of compliance with local stormwater regulations. The loading rates for nearly all pollutants considered in the analysis, presented in Table 4-6 and Table 4-7, would decrease substantially with the Modified LPA compared to the No-Build Alternative. The overall decrease in loading rates is expected because the Modified LPA would reduce untreated stormwater drainage and increase stormwater treatment within the Columbia River study-specific watershed on both the Oregon and Washington sides.

Table 4-6. Pollutant-Loading Estimate for the Columbia River South (Oregon) Study-Specific Watershed

Environmental Metric	No-Build Alternative	Modified LPA	Change
Treated CIA (acres)	0.0	51.6	51.6
Infiltrated CIA (acres)	0.0	0.0	0.0
Untreated CIA (acres)	45.8	0.0	-45.8
Total CIA (acres)	45.8	51.6	5.8
TSS (lbs/year)	35,220.2	4,540.8	-87.1%
Total Cu (lbs/year)	7.3	2.1	-71.8%
Dissolved Cu (lbs/year)	1.8	1.5	-15.5%
Total Zn (lbs/year)	44.9	10.8	-75.9%
Dissolved Zn (lbs/year)	14.2	7.2	-49.1%

CIA = contributing impervious area; Cu = copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

Table 4-7. Pollutant-Loading Estimate for the Columbia River North (Washington) Study-Specific Watershed

Environmental Metric	No-Build Alternative	Modified LPA	Change
Treated CIA (acres)	0.0	97.4	97.4
Infiltrated CIA (acres)	3.0	0.0	-3.0
Untreated CIA (acres)	73.4	0.0	-73.4
Total CIA (acres)	76.4	97.4	21.0
TSS (lbs/year)	56,444.6	8,571.2	-84.8%
Total Cu (lbs/year)	11.7	3.9	-66.8%
Dissolved Cu (lbs/year)	2.9	2.9	-0.5%
Total Zn (lbs/year)	71.9	20.5	-71.6%
Dissolved Zn (lbs/year)	22.8	13.6	-40.1%

CIA = contributing impervious area; Cu =copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

The Modified LPA is anticipated to have an overall beneficial long-term effect on the Columbia River and North Portland Harbor's water quality from proposed stormwater treatment.

4.2.2.3 Burnt Bridge Creek

Burnt Bridge Creek is on the 303(d) list for pH, dissolved oxygen, temperature, and fecal coliform bacteria. Highway runoff is not identified in the listing as a source for these pollutants.

An existing infiltration pond at the Main Street interchange would not be modified by the Modified LPA; however, the Modified LPA would reduce the total impervious surface draining to this facility by approximately 7.9 acres. Currently, during extreme runoff events, overflows from this infiltration pond are discharged to Burnt Bridge Creek without receiving adequate treatment. The reduction of stormwater flows to this facility and the addition of infiltration water quality treatment BMPs would reduce pollutant loading. As presented in Table 4-8, compared to the No-Build Alternative, the Modified LPA would eliminate the loading rates for all pollutants considered in the analysis since infiltration is assumed to remove pollutants entirely.

Table 4-8. Pollutant-Loading Estimate for the Burnt Bridge Creek Study-Specific Watershed

Environmental Metric	No-Build Alternative	Modified LPA	Change
Treated CIA (acres)	0.0	0.0	0.0
Infiltrated CIA (acres)	7.9	10.7	2.8
Untreated CIA (acres)	1.7	0.0	-1.7

Environmental Metric	No-Build Alternative	Modified LPA	Change
Total CIA (acres)	9.6	10.7	1.1
TSS (lbs/year)	1,307.3	0.0	-100%
Total Cu (lbs/year)	0.3	0.0	-100%
Dissolved Cu (lbs/year)	0.1	0.0	-100%
Total Zn (lbs/year)	1.7	0.0	-100%
Dissolved Zn (lbs/year)	0.5	0.0	-100%

CIA = contributing impervious area; Cu =copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

4.2.2.4 Fairview Creek

DEQ has placed Fairview Creek on its 303(d) list for biocriteria; it also has approved TMDLs for bacteria (E. coli) and spring/summer temperature (DEQ 2006, 2022; EPA 2021b). The source of E. coli bacteria is not thought to be specifically from roadway runoff (DEQ 2006). Fairview Creek is also included in the TMDLs for the Columbia Slough since it is a tributary. These TMDLs include lead and fecal coliform bacteria that are associated with highway runoff.

Portions of three of the 14 parcels in the study area around the Ruby Junction Maintenance Facility are located within the 100-year floodplain of Fairview Creek. These three parcels presently contain several buildings and some paved surfaces. No new structures are planned to be constructed in the floodplain, but some impervious surface would be added and some would be replaced or converted to pervious outside the floodplain. Overall, there would be a net reduction of 0.5 acre of CIA.

Since the majority of the existing impervious area and the entire impervious area of the proposed expansion of the Ruby Junction Maintenance Facility would be infiltrated, a pollutant-loading estimates would remain zero (Table 4-9). The Modified LPA would not have a long-term adverse effect on Fairview Creek's water quality since runoff from the Ruby Junction Maintenance Facility expansion area would be infiltrated and not discharged to Fairview Creek.

Table 4-9. Pollutant-Loading Estimate for the Fairview Creek Study-Specific Watershed

Environmental Metric	No-Build Alternative	Modified LPA	Change
Treated CIA (acres)	0.0	0.0	0.0
Infiltrated CIA (acres)	7.3	6.8	-0.5
Untreated CIA (acres)	0.0	0.0	0.0
Total CIA (acres)	7.3	6.8	-0.5
TSS (lbs/year)	0.0	0.0	0%
Total Cu (lbs/year)	0.0	0.0	0%

Environmental Metric	No-Build Alternative	Modified LPA	Change
Dissolved Cu (lbs/year)	0.0	0.0	0%
Total Zn (lbs/year)	0.0	0.0	0%
Dissolved Zn (lbs/year)	0.0	0.0	0%

CIA = contributing impervious area; Cu =copper; lbs = pounds; LPA = Locally Preferred Alternative; TSS = total suspended solids; Zn = zinc

4.2.3 Stormwater

The effects on stormwater and water quality are not mutually exclusive, yet they may be evaluated separately to highlight where notable differences in their effects potentially exist. This section, therefore, builds on the effects analysis of water quality presented above to focus on long-term effects from changes in CIA and the Modified LPA stormwater BMP facilities.

Stormwater runoff from highways has elevated levels of contaminants. The Modified LPA would replace and create new impervious surface. However, improvements to stormwater treatment on new and improved impervious surfaces (including the Columbia River and North Portland Harbor bridges) are anticipated to reduce stormwater pollutant loads discharged to the Columbia Slough, Columbia River, North Portland Harbor, and Burnt Bridge Creek from the study area. Discharges to Fairview Creek would likely remain the same.

Other than the infiltration pond near Burnt Bridge Creek, the Modified LPA would replace the existing water quality facilities with enhanced stormwater treatment that would meet stormwater management requirements in place at the time of construction, including requirements that may be updated to reflect climate-induced heavier rainfall events.

Much of the current stormwater runoff generated by the existing highway corridor is not treated in accordance with current stormwater treatment standards for new construction. The Modified LPA would treat all new impervious surfaces, as well as existing impervious surfaces that would be replaced, in accordance with current stormwater treatment standards before being discharged to receiving waters.

Table 4-4 presents an overall summary of the anticipated long-term effect of the Modified LPA on CIA from which runoff would be treated or infiltrated. The stormwater drainage areas used in these calculations do not include temporary construction staging areas that would be outside the construction footprint of the Modified LPA (i.e., casting yards that might be required for fabricating bridge elements). Nor does it include the area associated with the expansion of the Ruby Junction Maintenance Facility.

Exclusive light-rail guideway is considered non-pollutant-generating because the light-rail vehicles are electric and other potential sources of pollution, such as bearings and gears, are sealed to prevent the loss of lubricants. Braking for light-rail vehicles is almost exclusively accomplished via regenerative (power) braking, which avoids friction or wear on the vehicle brake pads and, therefore, generates very few pollutants. Sand, however, may be applied to the tracks to aid traction on steeper grades and this is considered when assessing water quality facility requirements. While bus shelter roofs might be pollutant-generating (e.g., constructed from galvanized metal), such areas would be very small in relation to the overall area and were not included in the areas of CIA. In addition, facilities such as transit stations are not highly defined at this early stage of project development.

Results from the traffic models showed that the Modified LPA would improve traffic congestion within the study area (see the IBR Transportation Technical Report). Decreasing traffic congestion on the Columbia River and North Portland Harbor bridges and associated roadways would decrease idling and brake pad wear, which may reduce the amount of copper and other traffic-related pollutants currently carried by corridor runoff.

The Modified LPA would increase impervious surface areas by approximately 29.6 acres, which may reduce natural infiltration rates and increase stormwater pollutant loads of suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear of brake pads, bearings, metal plating, and engine parts. However, the Modified LPA would reduce the untreated impervious surface area by approximately 156 acres.

Therefore, in comparison to the No-Build Alternative, the Modified LPA would have an overall beneficial long-term effect on stormwater generation and treatment due to increased stormwater treatment and decreased traffic congestion.

4.2.3.1 Columbia Slough

Conditions in the Columbia Slough, such as slow-moving water and existing water quality problems, make this waterbody more sensitive to TSS and other contaminants related to stormwater than other waterbodies within the study area. This is due to the fact that stream sediments are exposed longer to dissolved pollutants due to the slow water velocity.

With the Modified LPA, the impervious surface area in the Columbia Slough watershed would increase by approximately 2.2 acres, as shown in Table 4-5. However, untreated impervious surface would be reduced by approximately 35.5 acres. Most of the increase in total impervious surface can be attributed to the Modified LPA capturing runoff from the bridges across North Portland Harbor. Stormwater runoff from the existing bridge currently drains directly to the water surface below. The Modified LPA would create and treat approximately 40.7 acres of new and rebuilt CIA in the Columbia Slough watershed. While I-5 would generally follow its current alignment and grade, the Modified LPA would completely rebuild the Marine Drive interchange in a different configuration from its existing layout.

4.2.3.2 Columbia River and North Portland Harbor

On the Oregon side, the Modified LPA would rebuild the Hayden Island interchange, retrofit the existing North Portland Harbor bridge with a stormwater collection and conveyance system, and demolish the existing Interstate Bridge. The last two components would result in eliminating runoff from approximately 8 acres of bridge deck that currently discharges directly to the water surface below. In this watershed, the Modified LPA would increase the CIA by approximately 5.8 acres (Table 4-6). Currently, there are no water quality facilities for runoff from the study area in this watershed. Table 4-6 summarizes the changes from the Modified LPA on the impervious surface area from which runoff would be treated. Table 4-6 demonstrates that the Modified LPA proposes to treat runoff from the entire CIA.

This watershed includes existing surface parking in the vicinity of the Hayden Island interchange that may or may not remain after the Modified LPA has been completed. For the purpose of this analysis, it has been assumed that the land on the west side of the proposed interchange and transit guideway would be used for staging during construction and, independent of the Modified LPA, would be converted into transit-oriented development following construction. This land encompasses about 10 acres west of the Modified LPA's footprint and is bounded by the transit guideway, Center Avenue, Hayden Island Drive, and Jantzen Drive. Redevelopment of these areas would need to comply with the stormwater development and discharge requirements of either ODOT or the City of Portland and, in the numbers presented in Table 4-6, it is assumed that the impervious surface area would receive stormwater treatment.

Instead of biofiltration ponds, the Modified LPA would include bioretention ponds and roadside planters with underdrain pipe systems for the main water quality facilities on Hayden Island even though the soils belong to the Pilchuck-Urban land complex and are classified as Hydrologic Group A. At locations where such facilities are being considered, the depth to groundwater is only about 15 feet, and may be less depending on the influence of the Columbia River levels on the water table. Considering the likely depth of each facility, there would likely not be adequate separation between the facility bottom and water table for treating runoff. The EPA recommends a separation distance of at least 2 feet between the bottom of an infiltration basin and the seasonal high-water table (EPA 2005). No flow control facilities are required or proposed.

On the Washington side, the Modified LPA would increase the CIA in this study-specific watershed by approximately 21 acres, most of which may be attributed to the reconfigured interchanges and increased number and length of merge lanes for I-5. The Modified LPA would create and treat approximately 97.4 acres of new and rebuilt CIA. Table 4-7 summarizes the changes from Modified LPA on the impervious surface area from which runoff would be treated.

Flow control is not required for this watershed, and none is proposed under the Modified LPA. In addition, no new outfalls are currently proposed, but outfall capacities and conditions might result in upgrades or modifications resulting from increased discharges. Table 4-7 demonstrates that the Modified LPA proposes to treat runoff from the entire CIA.

From about Sixth Street in Vancouver, I-5 would generally continue to follow its existing alignment and grade. The SR 14 and Mill Plain interchanges would be reconfigured, which would alter the current interchange footprint. In contrast, the Fourth Plain interchange would be rebuilt, and the interchange footprint would be similar to what currently exists. New streets would be constructed at the SR 14 interchange to improve local connections. The light-rail guideway would be constructed primarily along the existing I-5 right of way.

4.2.3.3 Burnt Bridge Creek

The Modified LPA would improve connectivity between I-5 and SR 500 through the reconstruction of existing ramps the construction on a new bridge from 39th Street to I-5 southbound over a new I-5 southbound to Fourth Plain ramp. This would increase the total impervious area in the watershed by approximately 1.1 acres and would create approximately 10.7 acres of new and rebuilt CIA, as shown in Table 4-8. Unlike the other watersheds, runoff to Burnt Bridge Creek must be reduced to pre-development (forested) conditions for peak discharges between 50% of the two-year event and the 50-year event.

Soils in this area belong to Hydrologic Group B, which are considered suitable for infiltration. A soil assessment was previously obtained that matches the findings of available soil data. The IBR Program's design team has preliminarily integrated bioretention ponds as the primary BMP for this watershed. The Modified LPA currently includes bioretention ponds to treat CIA associated with the Modified LPA.

An existing infiltration pond at the Main Street interchange would not be modified. Rather, the Modified LPA would reduce the total impervious surface area draining to this facility through the replacement of other existing water quality facilities with enhanced stormwater treatment. The infiltration pond was constructed as part of the I-5: Burnt Bridge Creek to NE 78th Street Project, which was completed in 2003. Overflows from this pond during extreme runoff events are discharged to Burnt Bridge Creek via a spillway and open channel.

4.2.3.4 Fairview Creek

The expansion of the Ruby Junction Maintenance Facility would result in a slight net decrease of impervious surface area (0.5 acres), as shown in Table 4-9. 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 new impervious surface would be infiltrated to reduce pollutants of concern. 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. Therefore, the water quality of Fairview Creek would not be adversely impacted by the Modified LPA.

4.2.4 Design Options – Hydrology, Water Quality, and Stormwater

4.2.4.1 Two Auxiliary Lanes

The long-term effects of the Modified LPA with two auxiliary lanes would be similar as with one auxiliary lane, except for an approximately 3.9-acre increase (+1.9%) in CIA with the wider I-5 roadway. Because all generated stormwater runoff would be treated, the overall effect to water quality and hydrology would be similar. However, as stormwater treatment does not remove all pollutant loads, the additional impervious surface from two auxiliary lanes would result in slightly increased pollutant loads compared to one auxiliary lane.

4.2.4.2 Single-Level Fixed-Span Configuration

The long-term effects of the Modified LPA with the single-level fixed-span configuration would be similar to the Modified LPA with the double-deck fixed-span configuration except for an approximately 3.3-acre increase (+1.6%) in CIA resulting from the slightly different configuration and dimensions of the bridges and interchanges. However, given the similarity of construction activities and BMPs, all long-term effects would be similar.

4.2.4.3 Single-Level Movable-Span Configuration

Long-term effects of the Modified LPA with the single-level movable-span bridge configuration would be similar to the Modified LPA with the single-level fixed-span configuration and the double-deck fixed-span configuration, except that there would be the potential for additional pollutants. There would also be minor long-term water quality impacts associated with the logistical difficulty in stormwater collection off of the movable portion of the bridge structure when lifting, lifted, and lowering as well as accidental spills directly into the waterbody during over-water maintenance of the movable span. In addition, the Modified LPA with a movable-span bridge configuration would continue to have occurrences where traffic on I-5 would be stopped during a bridge lift, which would result in additional vehicle idling and brake pad wear compared to the Modified LPA with a fixed-span bridge configuration.

4.2.4.4 Interstate 5 Mainline Westward Shift

The I-5 mainline westward shift design option would have a similar footprint and long-term operation of the Modified LPA with the centered I-5 mainline; therefore, the long-term effects would be similar.

4.2.4.5 State Route 14 Interchange without C Street Ramps

The design option without the C Street ramps at the SR 14 interchange would have a slightly smaller footprint than the Modified LPA with the C Street ramps, which would reduce the amount of existing and new CIA. However, because all generated stormwater runoff would be treated, the long-term effects of this option would be similar.

4.2.4.6 Park and Rides

None of the park-and-ride site options would be located within the FEMA-designated floodplain. The park-and-ride site options located in areas that currently have unpaved surfaces would result in small increases in the amount of new impervious surface. However, because stormwater from all Modified LPA-related CIA would be treated, including from park-and-ride facilities, the options would each have similar long-term effects on water quality and hydrology resources.

5. TEMPORARY EFFECTS

For purposes of this discussion, temporary direct effects are only those likely to occur during construction, including removal of the existing Interstate Bridge, and would cease once construction is completed. In some cases, such as the construction of a bridge crossing, temporary effects may last several years.

For the Modified LPA, the temporary effects discussed in this chapter are likely to be avoided or minimized with the proper implementation of measures, as discussed in Chapter 7 of this technical report. The temporary effects would result from construction activities such as soil mixing, pile driving, demolishing the existing bridge structure, installing cofferdams, and other temporary construction activities.

Temporary effects on hydrology include placing obstructions in the water column and altering groundwater flows by pumping during depressed roadway construction. Temporary water quality impacts include increased turbidity due to sediment disturbance associated with in-water work, pollutants from disturbance of sediments with existing contamination during in-water work, and pollutants due to potential equipment leaks or spills in the vicinity of waterways. See the IBR Hazardous Materials Technical Report for a discussion of the need to sample and analyze potentially hazardous sediments. Temporary effects to stormwater include turbid overland flows due to soil disturbance and release of pollutants from leaking equipment.

5.1 Modified LPA

5.1.1 Hydrology

Temporary effects on hydrology due to construction of the Modified LPA pertain to the placement of obstructions in the water column at the Columbia River during superstructure construction and groundwater impact during depressed roadway construction across the study area.

Groundwater may be temporarily impacted by construction below grade and close to or beneath the water table. A detailed analysis of the depth to the water table within the study area has not yet been conducted. However, a regional groundwater study indicates that the elevation of the water table is relatively constant over time and follows topographical features (McFarland and Morgan 1996). For instance, the water table within the SR 500 area would be farther from the surface than would the water table on Hayden Island. Without a detailed analysis, below-grade construction is conservatively assumed to potentially require groundwater pumping. This pumping may affect the contribution of the surficial aquifer to waterway flows as well as the groundwater quality of the surficial aquifer and stormwater quantity. Temporary effects on stormwater are discussed in Section 5.1.3. Since pumping would likely occur when the water table is high (e.g., during winter flows), this is not likely to affect the hydrologic regimes of waterways significantly.

5.1.1.1 Columbia Slough

Temporary effects to the hydrology of the Columbia Slough due to construction of the Modified LPA are not anticipated beyond the potential for groundwater pumping during depressed roadway construction along the I-5 corridor.

5.1.1.2 Columbia River and North Portland Harbor

During construction of the Modified LPA there is potential for groundwater pumping during depressed roadway construction within the Columbia River and North Portland Harbor study-specific watershed. This would be temporary and is not anticipated to have a noticeable effect on the hydrologic regime since this waterway is such a high-flow system.

Another temporary hydrologic effect on the Columbia River and North Portland Harbor is the placement of large temporary structures in the water column, which may be in place for several years. The Modified LPA would use cofferdams at some pier complexes to isolate the work area from active flow in the Columbia River. The purpose of the cofferdams would be to avoid contaminating the Columbia River with work or waste material, contain resuspended sediments, and minimize disturbance of fish. The type and number of cofferdams needed for the Modified LPA have not yet been determined but would be prior to construction. In addition to cofferdams, hundreds of temporary steel piles would be installed and removed during the multi-year construction of the mainstem Columbia River and North Portland Harbor bridge structures. Due to the heavy equipment and stresses placed on the support structures, many of these temporary piles would need to be load-bearing. The need for piles would be staged over the scheduled construction period so that only a few hundred piles would likely be in the water at a given time. Temporary piles would also be installed to assist in the demolition of the existing bridge structure across the Columbia River.

Given the width, volume, and flow rates of the Columbia River, and the regulation of river flows by upstream dams, the hydraulic effect of placing these temporary structures in the Columbia River and North Portland Harbor water column is expected to be minor. In addition to the large size of the watershed, there are 12 major dams located in the Columbia Basin that regulate the flow in the study area that would minimize the probability of temporary hydrologic effects. While the Columbia River is a highly managed waterbody that no longer resembles its original free-flowing state, it still experiences seasonal variation in flows, including large winter storm-induced flooding. The flow and stage of the Columbia River are also tidally influenced by the Pacific Ocean up to the Bonneville Dam, which includes the study area. Construction of the Modified LPA would require a floodplain permit from local jurisdictions, and further hydraulic analysis to ensure there are no temporary adverse effects on the Columbia River's hydrologic regime.

5.1.1.3 Burnt Bridge Creek

Temporary effects to the hydrology of Burnt Bridge Creek due to construction of the Modified LPA are not anticipated beyond the potential for groundwater pumping during depressed roadway construction.

5.1.1.4 Fairview Creek

No temporary effects to the hydrologic regime of Fairview Creek are anticipated for the expansion of the Ruby Junction Maintenance Facility since the required stormwater treatment facilities, which include infiltration for the entire expansion area, would be constructed ahead of and in preparation for construction of the expanded facilities.

5.1.2 Water Quality

All reasonable precautions would be taken to avoid and minimize water quality impacts during staging and construction, including construction of the new bridges, removal of the Interstate Bridge, and modifications to levees. These measures are outlined in Section 7.2. Temporary effects on the water quality of receiving waters within the study area may still be possible and may include the following:

- Increased turbidity due to ground disturbance around waterways associated with construction or staging.
- Discharge of pollutants to surface waters due to equipment leaks or spills in the vicinity of waterways.
- Groundwater contamination due to upland ground improvement activities, including deep soil mixing with cementitious material or aggregate.
- Sediment and contaminant migration into groundwater or surface water from equipment pressure or steam-cleaning operations following construction periods.
- Discharge of pollutants to surface waters due to use of fertilizers, pesticides, or herbicides during restoration or revegetation activities.
- Contamination of groundwater due to direct infiltration of toxic contaminants during groundwater pumping from locations of known existing groundwater contamination.
- Infiltration of polluted surface water into groundwater.
- Increased turbidity due to riverbed disturbance during in-water work.
- Release of existing contaminated sediments due to disturbance of riverbed sediments containing hazardous materials during in-water work. Sampling and analyzing potentially hazardous sediments prior to construction is addressed in the IBR Hazardous Materials Technical Report.
- Construction material or other objects falling into the Columbia River and North Portland Harbor during construction of the new bridges and demolition of the Interstate Bridge.

Following construction, the use of fertilizers, pesticides, or herbicides for restoration and revegetation activities could affect the water quality of waterways. While most of these substances are expected to be infiltrated into the pervious ground at restoration and revegetation sites, the potential for runoff during heavy precipitation events cannot be ruled out. Temporary effects that are a result of in-water work are applicable only to the Columbia River and North Portland Harbor for the Modified LPA since in-water work would not be performed at other waterways in the study area.

Throughout the study area, bridge, highway, transit, and other related construction improvements would disturb the ground, which may expose soil to erosion from wind, rain, and runoff. Waterbodies in the study area could receive sediment-laden runoff by way of stormwater inlets, ditches, or other forms of conveyance, which could result in increased turbidity and excessive sediment deposits.

The NPDES stormwater permitting program is administered by the DEQ in Oregon and Ecology in Washington. Generally, for projects disturbing 1 or more acres, 1200-C or 1200-CA permits apply to construction activities, including clearing, grubbing, grading, excavation, and stockpiling activities. The major provisions of these NPDES permits include: no discharge of significant amounts of sediment to surface waters; implementation of a TESCP; maintenance of BMPs; proper material and waste handling; compliance with water quality standards and any TMDLs for drainage basins; and visual inspection of BMPs.

Upland construction could cause turbidity in the study area waterways, though this would be prevented if the upland sites are managed appropriately. During construction, the Modified LPA would adhere to a TESCP that specifies type and placement of BMPs, mandates frequent inspection, and outlines contingency plans in the event of failure. Additionally, there would likely be numerous other barriers between the source and the waterway. Therefore, to the greatest extent practicable, turbid discharges due to land-based BMP failure would be avoided.

Construction equipment operating on land could release pollutants (e.g., petroleum-based fuel or other fluids) or materials that could enter waterbodies by way of stormwater inlets, ditches, or other forms of conveyance. In addition, pressure or steam cleaning of construction equipment prior to or following construction periods could release sediment and pollutants into ground or surface waters. These activities could affect the waterbodies in the study area (i.e., Columbia River, North Portland Harbor, Columbia Slough, Burnt Bridge Creek, and Fairview Creek).

Although there are numerous sources of chemical pollutants, there is a low risk that chemicals would actually enter the receiving waters. The Modified LPA would employ numerous containment methods that would greatly minimize the potential release of pollutants and would ensure that accidental releases are confined to a limited area and cleaned up quickly. In addition to a TESCP, a spill prevention, control, and countermeasures plan (SPCCP) would be developed and implemented to minimize the probability of pollutants entering waterways.

The pumping of groundwater to facilitate construction may create a cone of depression and the potential for the movement of contaminated groundwater to from nearby hazardous materials sites. A review of high-ranking potential hazardous materials sites indicates that there are potential sources of existing contamination near proposed depressed road sections, except north of SR 500. See the IBR Hazardous Materials Technical Report for more details.

The major site for construction staging and bridge assembly/casting areas considered by the Modified LPA is the 5.6-acre Thunderbird Hotel site on Hayden Island, which is adjacent to the Columbia River. The staging and casting/assembly site activities may increase stormwater runoff over existing conditions and may increase pollutant loading. For this site, or others identified by the contractor, the staging and casting sites would meet all applicable stormwater requirements during and following its use. When the construction staging sites have been confirmed, a site-specific environmental analysis would be conducted to ensure that water quality impacts during construction are minimized. As with all construction activities, impacts to water quality would be minimized through the use of BMPs specified in the TESCPs and SPCC Plans developed for all necessary NPDES permits. All necessary permits would be secured prior to site development and operations.

Following construction, the use of fertilizers, pesticides, or herbicides during restoration and revegetation activities may affect the water quality of receiving waters. Their use, however, would be minimized, especially near receiving waters. The Modified LPA would adhere to requirements described in ODOT Standard Specifications 01040.00 to 01040.90 and/or WSDOT Standard Specification 8-02 “Roadside Restoration.”

5.1.2.1 Columbia Slough

Temporary effects on the water quality of the Columbia Slough includes increased turbidity due to ground disturbance associated with construction or staging; release of pollutants due to equipment leaks, spills, or cleaning activities in the vicinity of the waterway; release of pollutants of groundwater due to groundwater pumping during depressed roadway construction and infiltration of contaminated surface water; and release of pollutants associated with chemicals used during revegetation activities. All temporary effects are described above. For the Modified LPA, these effects would be minimized through the implementation of a TESCP and an SPCCP.

5.1.2.2 Columbia River and North Portland Harbor

Temporary effects on the water quality of the Columbia River and North Portland Harbor include:

- Increased turbidity due to ground disturbance associated with construction or staging.
- Release of pollutants due to equipment leaks, spills, or cleaning activities in the vicinity of the river.
- Release of pollutants associated with chemicals used during revegetation activities, construction material, and other objects falling into the Columbia River and North Portland Harbor during the construction of the new bridge and demolition of the old bridge.
- Contamination of groundwater due to groundwater pumping during depressed roadway construction and infiltration of contaminated surface water.
- Increased turbidity due to riverbed disturbance during in-water work.
- Release of existing contaminated sediments due to disturbance of riverbed sediments containing hazardous materials during in-water work. Sampling and analyzing potentially hazardous sediments prior to construction is addressed in the IBR Hazardous Materials Technical Report.

Temporary effects of upland construction activities are described above in Section 5.1.2.

Numerous potential sources of chemical pollutants are associated with in-water work in the Columbia River and North Portland Harbor, including:

- Equipment located in or over water (such as barges or equipment operating on barges, temporary work platforms, the existing structure, or the new structure) are potential sources of pollutants, including petroleum fuel and other fluids.

- Concrete would be placed in numerous locations both in and over water for the construction of the pier footings and columns for the new bridge.
- Construction of the superstructure would involve the use of numerous other potential contaminants, such as various petroleum products, adhesives, metal solder, concrete and metal dust, and asphalt.
- Bridge demolition would occur both in and over water and may release contaminants such as concrete debris, concrete dust created by saw cutting, and lead paint.

Dropped construction materials or demolition debris may alter water quality by stirring up sediments. Portions of the existing Interstate Bridge contain lead-based paints. Significant modification of the existing bridge without proper implementation of BMPs may contaminate surface waters. Accidental chemical spills from construction machinery may be directly toxic to aquatic life.

The construction of bridge piers requires pouring concrete pier cap elements. Concrete may be poured on land or overwater during the course of construction. This fresh concrete may accidentally come into contact with the Columbia River and North Portland Harbor either by dropping into the water while it is being poured or by mixing with stormwater runoff during on land construction and being discharged into a waterbody. Fresh concrete is known to raise pH when it comes into contact with water.

The Modified LPA is likely to generate turbidity during the course of in-water work in the Columbia River and North Portland Harbor. The riverbed would be disturbed during in-water construction and cause sand and fine sediments to be resuspended in the water column. The following activities are likely to generate turbidity:

- Installation and removal of temporary piles.
- Installation and removal of cofferdams.
- Drilling shafts.
- Removal of old piers and riprap in the channel where new piers would be placed.
- Operating and anchoring the barge in shallow water.
- Demolishing the various elements of the existing bridge.

Sediment plumes, as a result of these activities, are expected to be localized and brief because of the implementation of containment measures. Containment measures are outlined in more detail in Section 7. In addition, the riverbed within the study area consists mostly of sand, which is anticipated to settle quickly once disturbed. A turbidity monitoring plan would be implemented during in-water work to ensure compliance with water quality permits.

The Modified LPA would employ numerous BMPs to minimize turbidity during the course of in-water work. Nevertheless, due to the large size and strong currents of the Columbia River and North Portland Harbor, there is no equipment that would completely contain turbidity. In addition, it is possible that BMPs may fail as a result of an accident or poor management and cause turbidity above ambient levels in these waterbodies.

Potential adverse effects from in-water work within the deeper waters of the Columbia River are assumed to be minimal. This is due to the likelihood that contaminated sediments within the deeper water environment are not present due to the high-energy fluvial environment and the presence of coarse-grained sediments that tend to not retain contaminants. Therefore, there is very little risk that in-water work in the Columbia River would resuspend contaminated sediments. In North Portland Harbor, contaminated sediments have been identified, but they are thought to be outside of the Modified LPA's construction footprint. If there is potential that in-water work could disturb these sediments, they would be analyzed in accordance with regulatory criteria and removed and disposed of properly (see the IBR Hazardous Materials Technical Report). Removed sediments may be disposed of in a permitted upland disposal site if required.

5.1.2.3 Burnt Bridge Creek

Temporary effects to the water quality of Burnt Bridge Creek would include turbidity due to ground disturbance associated with construction or staging; potential release of pollutants from equipment leaks, spills, or cleaning activities in the vicinity of waterways; and potential pollutants associated with chemicals used during revegetation activities. These effects would be minimized through the implementation of a TESCP and SPCCP for the study area.

5.1.2.4 Fairview Creek

No temporary effects on the water quality of Fairview Creek are anticipated since runoff is almost completely infiltrated and runoff from the entire facility would be infiltrated as a result of the Modified LPA. If runoff were conveyed off site, although this is not anticipated, temporary effects may include increased turbidity due to ground disturbance around waterways associated with construction or staging; potential release of pollutants from equipment leaks, spills, or cleaning activities in the vicinity of waterways as described above; and potential pollutants associated with chemicals used during revegetation activities. These effects would be minimized during construction of the Modified LPA through the implementation of a TESCP and SPCCP regardless of whether construction runoff is treated on site through infiltration or conveyed off site.

5.1.3 Stormwater

Temporary effects to stormwater throughout the study area and watersheds are directly related to effects discussed in regard to hydrology and water quality, and in many cases the effects overlap. Temporary effects to stormwater include increased turbid runoff across the study area related to ground disturbance activities, potential release of pollutants to stormwater due to equipment or construction components, the potential for increased stormwater volumes due to groundwater pumping during depressed roadway construction, and at the Columbia River and North Portland Harbor, an increased exposure of stormwater to pollutants due to surface staging areas, barges, temporary work bridges, and other structures related to overwater construction.

Ground-disturbing activities would occur along the study area and in the vicinity of receiving waters. Turbid runoff is anticipated to occur during rain events around ground-disturbing activities such as clearing, grubbing, excavation, grading, stockpiling fill materials, and ground improvement activities. A TESCP would be designed and implemented for the Modified LPA that would prevent turbid runoff from entering receiving waters. The site would be monitored by an environmental compliance monitor during construction to ensure turbid runoff is contained on site. In the event of an accidental turbid discharge into surface waters, the TESCP would provide a framework for reporting and corrective actions per permit requirements.

At active construction sites, as well as staging and equipment storage areas, pollutants from equipment or construction components may be released into stormwater. Potential pollutant sources include equipment fuel/oil leaks or spills, "green" concrete (concrete that has not fully cured), and buried waste unearthed during excavation. An SPCCP would be designed and implemented for the Modified LPA to provide a framework for containment, prevention, monitoring, reporting, and disposal of pollutants during construction.

During depressed roadway construction groundwater may be pumped to lower water table elevations below construction activities. At this level of design, the location where the groundwater would be discharged or treated before being discharged or returned to groundwater flows has not been identified. If the groundwater that is pumped is discharged overland, stormwater volumes would increase. In this case, stormwater treatment provided by the TESCP would need to be sized to account for these volumes.

5.1.3.1 Columbia Slough

Temporary effects to stormwater in the vicinity of the Columbia Slough include increased sedimentation in stormwater facilities due to turbid discharges related to ground disturbance activities, potential release of pollutants to stormwater due to equipment or construction components, and the potential for increased stormwater volumes due to groundwater pumping during depressed roadway construction. These effects and minimization measures are described above in Section 5.1.2.1.

5.1.3.2 Columbia River and North Portland Harbor

In addition to the temporary effects discussed above that pertain to the whole of the Modified LPA, the Columbia River and North Portland Harbor would experience an increase in stormwater volumes due to the impervious surfaces of staging areas, barges, temporary work bridges, and other structures related to overwater construction. The TESCP and SPCCP that would be prepared for construction of the Modified LPA would address these temporary overwater construction components and prescribe methods for stormwater conveyance, treatment, monitoring, reporting, and emergency response.

5.1.3.3 Burnt Bridge Creek

Temporary effects on stormwater in the vicinity of the Burnt Bridge Creek include increased sedimentation in stormwater facilities due to turbid discharges related to ground disturbance activities, potential release of pollutants to stormwater due to equipment or construction components, and the potential for increased stormwater volumes due to groundwater pumping during depressed roadway construction. These effects and minimization measures are described in Section 5.1.2.3.

5.1.3.4 Fairview Creek

Temporary effects to stormwater in the vicinity of Fairview Creek at the Ruby Junction Maintenance Facility include increased sedimentation in stormwater facilities due to turbid discharges related to ground disturbance activities and potential release of pollutants to stormwater due to equipment or construction components. Both of these temporary construction effects are not anticipated to affect Fairview Creek because stormwater is currently treated or infiltrated on site and would continue to be during construction and after the completion of construction activities. Stormwater conveyed off site would require prescribed treatment to ensure that runoff was not turbid or contaminated. Stormwater conveyance, treatment, monitoring, and emergency response from the Modified LPA's expansion of the Ruby Junction Maintenance Facility would be included in the TESCP and SPCCP.

5.1.4 Design Options

All design options would have similar temporary effects as the Modified LPA because of the similarity in footprint, potential levee modifications, construction activities, and BMPs. While the SR 14 interchange without C Street Ramps design option would have a slightly smaller footprint than the Modified LPA, it would still have similar construction activities and therefore, the temporary effects would be similar.

6. INDIRECT EFFECTS

This chapter addresses water quality and hydrology of surface waters only. For groundwater effects, see Section 4.2.2.

Population growth and land use development are anticipated to occur under both the Modified LPA and the No-Build Alternative. With both alternatives, potential impacts to receiving waters and floodplains could result from land use development changes, with potential positive and adverse impacts to water quality and water quantity in study area waterbodies and the floodplain. However, in compliance with local land use plans, the Modified LPA could encourage higher-density development, such as transit-oriented development around light-rail stations, in already urbanized areas relative to the No-Build Alternative. Concentrating growth can help protect natural resources from the potentially adverse effects of development on the urban periphery, such as habitat conversion and pollutants in stormwater runoff. Conversely, the No-Build Alternative, because it would not provide new high-capacity transit, would be less likely to result in dense growth and hence would be less protective of natural resources.

Under the Modified LPA, adjacent development or redevelopment would require compliance with applicable City of Portland and City of Vancouver land use codes, including existing stormwater treatment and floodplain regulations. Any development and redevelopment resulting from the Modified LPA would have to comply with the relevant laws, regulations, policies, and codes in force at the time. Regulatory approvals range from tree and street tree removal to stormwater treatment and floodplain regulations to environmental zone and critical areas protections to more complicated processes for larger developments.

Local and state land use requirements would limit negative impacts from development and redevelopment. These regulations require avoidance or minimization of impacts on environmentally sensitive resources, including water quality and hydrology and floodplains. In light of these protections, indirect effects from the Modified LPA and potential future development are expected to be negligible. Local regulations require the avoidance or minimization of impacts to protected resources. These resources include shorelines, floodplains, wetlands, streambanks, and their buffers. With implementation of regulations, such as environmental zones, the Shoreline Management Act, and Critical Areas Ordinance, impacts to existing resources would be negligible.

Relevant stormwater regulations that would apply to other development out of the scope of the Modified LPA are listed in Table 6-1.

Table 6-1. Jurisdictional Stormwater Treatment Requirements

Jurisdiction	Water Quality Design Criteria	Flow Design Criteria
ODOT	Treat 85% of the cumulative runoff.	Not applicable. Flow control not required for receiving waterbodies in this portion of the study area.
WSDOT	Treat 91% of the runoff volume over the period of simulation.	• Columbia River – not applicable (flow control not required for this waterbody). • Burnt Bridge Creek discharge must be reduced to pre-development (forested) flow rates from 50% of the 2-year to the 50-year peak flow.
City of Portland	70% removal of total suspended solids from 90% of the average annual runoff.	Flow control not required for receiving waterbodies in this portion of the study area. Not applicable.
City of Vancouver	Same as WSDOT.	Same as WSDOT.

ODOT = Oregon Department of Transportation; WSDOT = Washington State Department of Transportation

7. POTENTIAL AVOIDANCE, MINIMIZATION, AND COMPENSATORY MITIGATION MEASURES

The proposed design of the Modified LPA avoids and minimizes water quality and hydrology impacts. In addition, the Modified LPA would not begin construction until compliance with regulatory requirements (identified below) are sufficiently demonstrated. The following identifies regulatory requirements and program-specific mitigation measures to address long-term and temporary effects of the Modified LPA to water quality and hydrology.

7.1 Long-Term Effects

7.1.1 Regulatory Requirements

- As design progresses, conduct a detailed hydraulic analysis of the affected floodplains. If a rise in the base flood elevation is predicted, assess mitigation through floodplain excavation (cut/fill balance) activities within the footprint of the Modified LPA and determine whether additional land may be required to accomplish the required mitigation. Conduct a Location Hydraulic Study to document the impacts, mitigation measures, evaluation of alternatives, and findings in accordance with the provisions of 23 CFR 650A.
- Work with the City of Portland to ensure flood storage compensation does not jeopardize threatened and endangered species and their habitat (revised Floodplain Development Code Chapter 24.50 Flood Hazard Areas).
- Comply with ODOT and WSDOT stormwater management requirements and the Cities of Portland and Vancouver regulations for the portions of the Modified LPA along City-managed roads during construction and for the long-term treatment of stormwater runoff prior to discharge into receiving waters.
- Select and design water quality BMPs to ensure compliance with all federal, state, and local regulatory requirements, including construction and municipal stormwater permit requirements issued through CWA Section 401, to reduce suspended solids, particulates, and dissolved metals; to reflect the latest climate models; and to treat newly identified pollutants like 6PPD-quinone.
- Construct flow control facilities to infiltrate or reduce the flow rates of all study area runoff, pursuant to local regulatory requirements. Mitigation for increased runoff to the Columbia Slough or the Columbia River would not be required because these water bodies are exempt from stormwater quantity management. However, the effects of increased runoff would be reduced using stormwater infiltration. This would allow groundwater recharge to continue and minimize the increase in runoff volumes and peak discharges.

7.1.2 Program-Specific Mitigation

7.1.2.1 Hydrology

- Offset potential rise in the base flood elevation through floodplain excavation (cut/fill balance) activities as determined through a Location Hydraulic Study.

- In the Burnt Bridge Creek watershed, construct infiltration facilities to provide complete infiltration of all Program-related runoff, such as providing underground injection control requirements, to the extent practicable, for the wellhead protection zone present in the watershed to manage stormwater volumes. As design progresses, select site-specific BMP facilities**.**
- Prepare stormwater monitoring plan(s) to evaluate the long-term performance and effectiveness of the updated stormwater conveyance and treatment systems. Based on the findings, complete modifications or enhancements to the system(s) to meet discharge performance criteria.
- Compensate for additional fill in floodplains to achieve a no net loss of floodplain as a result of removal of materials within the City of Portland Floodplain Hazard Areas.

7.1.2.2 Water Quality

Where applicable in the project area, the following proposed water quality treatment facilities would be used to treat stormwater runoff and mitigate the increase in contributing impervious surfaces. Definitions of these treatment facility types are presented in Section 7.2.2 of the Water Quality and Hydrology Technical Report.

- Treat stormwater runoff through bioretention ponds/planters, biofiltration swales, bioslopes (Oregon), and/or media filter drains (Washington) that provide water quality treatment via infiltration through a phosphorus-free, compost-amended soil medium and/or vegetation. Vegetation also provides uptake of some water.
- Water quality treatment facilities that have demonstrated effectiveness for advanced treatment will be designed according to each jurisdiction's specifications, such as Ecology's Technology Assessment Protocol program (Washington), the 2020 Stormwater Management Manual (Portland), and Vancouver's Surface Water Management Program.

7.2 Temporary Effects

7.2.1 Regulatory Requirements

Regulatory requirements for temporary effects of stormwater runoff during construction would include compliance with ODOT, WSDOT, Portland, and Vancouver's regulations including the preparation of an SPCCP and pollution control plan (PCP), and TESCP. In addition, all federal, state, and local permits related to water quality and hydrology would be obtained. See Section 8 in the Water Quality and Hydrology Technical Report for a complete list of required federal, state, and local permits.

7.2.1.1 Spill Prevention/Pollution Control Measures

- Require the 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 in the event of a spill. All elements of the SPCC plan and PCP would be available at the project site at all times. For additional details, consult ODOT Standard Specification 00290.00 to 00290.90 and WSDOT Standard Specification 1-07.15.

7.2.1.2 Site Erosion/Sediment Control Measures

- Require the contractor to prepare and implement a 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 in areas impacted by 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 construction. For additional details, consult ODOT Standard Specifications 00280.00 to 00280.90 and WSDOT Temporary Erosion and Sediment Control Manual M3109.02.
- 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 details, consult ODOT Standard Specifications 01030.00 to 01030.90 and WSDOT Temporary Erosion and Sediment Control Manual M3109.02.
- 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 details, consult ODOT Standard Specifications 01040.00 to 01040.90 and WSDOT Temporary Erosion and Sediment Control Manual M3109.02.

7.2.2 Program-Specific Mitigation

7.2.2.1 Hydrology

- Minimize changes to groundwater hydrology by limiting groundwater pumping to areas where it cannot be avoided.

7.2.2.2 Water Quality

- Study, test, and remediate sites with existing soil or groundwater contamination near construction areas before any construction. See Section 3.18, Hazardous Materials for specific mitigation actions.
- Conduct in-water work during approved periods for the Columbia River, as approved by WDFW, ODFW, NOAA Fisheries, and U.S. Fish and Wildlife Service. See Section 3.16, Ecosystems for specific mitigation measures.
- Stage construction equipment used for in-water work activities above the OHWM. Only the operational portion of construction equipment would enter the active stream channel (below the OHWM).
- If in-water dredging is required outside of a cofferdam, use a clamshell bucket within the established in water work windows. Dredging, handling, and disposal of dredged materials shall be conducted consistent with the requirements and conditions of the regulatory permits issued for the Modified LPA.
- If required, monitor turbidity and provide a “rest” period to allow turbidity, if any, to dissipate between in-water work activities.

8. PERMITS AND APPROVALS

This chapter summarizes potential permits and approvals that would be needed for the Modified LPA related to water quality and hydrology resources. Permits and approvals may overlap across federal, state, and local requirements.

8.1 Federal Permits

8.1.1 National Pollutant Discharge Elimination System

A Section 402 NPDES permit may be needed if a new outfall is developed on Hayden Island that discharges to North Portland Harbor.

Existing NPDES permits addressing stormwater outfalls may need to be amended to address additional stormwater flows generated by the Modified LPA.

Existing construction NPDES permits held by ODOT and WSDOT may also require modification to address construction of the Modified LPA.

In Oregon, NPDES permits are administered through DEQ. In Washington these permits are administered through Ecology. Specific state requirements are discussed below.

8.1.2 Clean Water Act Section 404

A CWA permit would be required for in-water work within the Columbia River and North Portland Harbor. A Section 404 permit would also be required for removal or placement of material within a jurisdictional wetland.

8.1.3 Flood Control Facilities Disturbance

Per 33 CFR § 208.10:

> *No improvement shall be passed over, under, or through the walls, levees, improved channels, or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the Department of the Army or his authorized representative that such improvement, excavation, construction, or alteration would not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice.*

Further, the USACE Flood Control Operations and Maintenance Policies, Regulation 1130-2-530, states that projects that protect urban areas or ones where failure would be catastrophic and result in loss of life should be inspected annually. It also instructs USACE personnel to report non-federal sponsors that are not complying with the regulations.

Actions impacting federal levees may require USACE Section 408 permission.

8.2 State Permits

8.2.1 Water Quality Certification

Section 401 states water quality certification approval would be required in association with the Section 404 permit application process. Section 401 requires an applicant for a federal license or Section 404 permit who plans to conduct an activity that may result in a discharge to waters of the state or U.S. to obtain certification that the activity complies with state water quality requirements and standards. State agencies certify whether the project meets state water quality standards and does not endanger waters of the state/U.S. or wetlands. These certifications are issued by DEQ in Oregon and by Ecology in Washington. The DEQ and Ecology would also review and approve the stormwater management plan, as well as overall effects on water quality.

8.2.2 Safe Drinking Water Act Permits

Both Washington and Oregon implement the federal SDWA within their jurisdictions. This law would apply if infiltration basins or underground injection control measures were incorporated into the preferred stormwater management design.

8.2.3 Wetland/Waters Removal-Fill Permits

In Washington, a Joint Aquatic Resource Permits Application is submitted to both the USACE and Ecology for removal or fill within wetlands or waters. Ecology reviews the permit application for 401 water quality certification.

In Oregon, removal or fill in jurisdictional wetlands or other waters of the state (including some ditches) requires a Removal-Fill permit from the DSL. DSL requires a wetland delineation and compensatory mitigation plan as part of the permit application. A JPA is submitted to the DSL, the USACE (Portland Regional Office), and DEQ.

8.2.4 Waste Discharge General Permit

In Washington, a state general permit program is administered through Ecology and is applicable to the discharge of pollutants, wastes, and other materials to state or federal waters. Permits issued are designed to satisfy the requirements for discharge permits under the CWA.

8.2.5 National Pollutant Discharge Elimination System

WSDOT uses a NPDES Construction Stormwater General Permit to cover all WSDOT construction activities disturbing more than 1 acre. Under the conditions of this permit, WSDOT must submit to Ecology a Notice of Intent to discharge stormwater associated with construction activities and to meet stormwater pollution prevention requirements.

In Oregon, the DEQ issues and enforces NPDES and WPCF permits. However, a WPCF permit is not generally required for stormwater treatment facilities and therefore not anticipated to be necessary for this project.

Compliance with the 1200-CA and MS4 permit would be required for: (1) the construction, installation, or operation of any activity that would cause an increase in the discharge of wastes into the waters of the state or would otherwise unlawfully alter the physical, chemical, or biological properties of any waters of the state; (2) an increase in volume or strength of any wastes in excess of the discharges authorized under an existing permit; and (3) the construction or use of any new outlet for the discharge of any wastes into the waters of the state. ODOT has a NPDES General Construction 1200-CA Stormwater Permit to cover ODOT construction activities on sites covering more than 1 acre. This permit requires a TESCP.

8.3 Local Permits

Both the City of Vancouver and the City of Portland have written into their municipal codes and administrative rules specific requirements for projects to manage stormwater, minimize erosion, and protect water quality. These requirements will be assessed during each city's respective development and building permit review processes. The following is a list of codes specific to stormwater and erosion control that would pertain to the Modified LPA.

8.3.1 Clark County Code 40.420 "Flood Hazard Areas"

Clark County requires a flood hazard permit for construction or development within land area subject to a 1% or greater chance of flooding in any given year.

8.3.2 Vancouver Municipal Code 14.09. "Stormwater Management"

The City of Vancouver implements its own NPDES permit, as issued by Ecology. Vancouver defers to Ecology's Stormwater Management Manual for Western Washington (Ecology 2019) for guidance but requires stormwater mitigation for development that increases the impervious area by more than 2,500 square feet.

8.3.3 Vancouver Municipal Code 14.24 "Erosion Control"

This code establishes regulations to minimize erosion from land development and land-disturbing activities.

8.3.4 Vancouver Municipal Code 14.25 "Stormwater Control"

This code establishes regulations for new development and redevelopment activity compliance with NPDES permitting, City General Requirements, and BMPs for stormwater management.

8.3.5 Vancouver Municipal Code 14.26 “Water Resources Protection”

This code establishes allowable and prohibited discharges and BMPs for protecting stormwater, surface water, and groundwater quality.

8.3.6 City of Portland Administrative Rule ENB-4.01, Stormwater Management Manual

The City of Portland requires stormwater mitigation for development or redevelopment that creates or replaces 500 square feet or more of impervious area.

8.3.7 City of Portland Code 33.653 “Stormwater Management”

The CPC establishes criteria and standards for placement and capacity of stormwater facilities.

8.3.8 City of Portland Code 17.38 “Drainage and Water Quality”

This portion of the CPC provides guidelines for the effective management of stormwater, groundwater, and drainage to protect and improve water quality in the watercourses and waterbodies within City of Portland limits.

8.3.9 City of Portland Code 24.50 “Flood Hazard Areas”

Section 24.50.060 outlines the specific requirements for development within flood hazard areas.

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