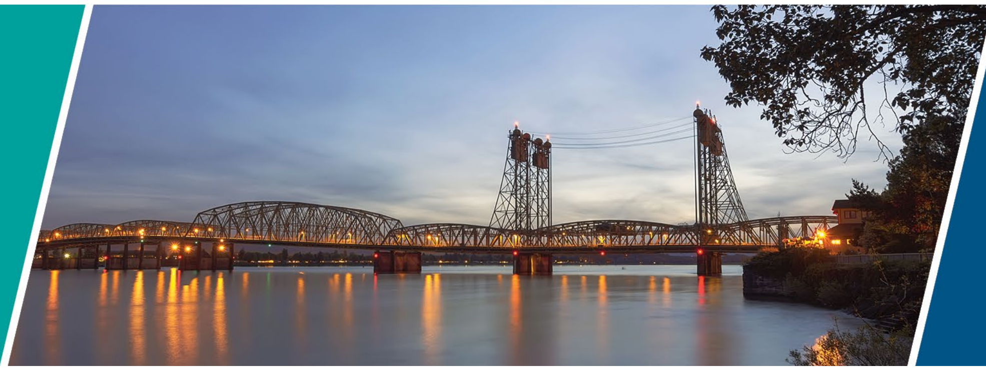
Considering the importance of our natural environment



# Electromagnetic Fields Technical Report

March 2026

**OREGON**

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# Electromagnetic Fields Technical Report

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# ACRONYMS AND ABBREVIATIONS

| Acronyms/Abbreviations | Definition |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | alternating current |
| ACGIH | American Conference of Governmental Industrial Hygienists |
| BMP | best management practice |
| BRT | bus rapid transit |
| CCFS | Columbia Corridor Flood Safety |
| C-D | collector-distributor |
| CRC | Columbia River Crossing |
| CTR | Commute Trip Reduction |
| C-TRAN | Clark County Public Transit Benefit Area Authority |
| DC | direct current |
| EIS | Environmental Impact Statement |
| ELF | extremely low frequency |
| EMF | electromagnetic fields |
| FTA | Federal Transit Administration |
| GIS | geographic information system |
| Hz | Hertz |
| I-5 | Interstate 5 |
| IBR | Interstate Bridge Replacement |
| ICNIRP | International Commission on Non-Ionizing Radiation Protection |
| kV | kilovolt |
| kV/m | kilovolts per meter |
| LPA | Locally Preferred Alternative |
| LRT | light-rail transit |

| Acronyms/Abbreviations | Definition |
|---|---|
| LRV | light-rail vehicle |
| MAX | Metropolitan Area Express |
| mG | milligauss |
| NAVD 88 | North American Vertical Datum of 1988 |
| NEPA | National Environmental Policy Act |
| ODOT | Oregon Department of Transportation |
| OMF | Operations and Maintenance Facility |
| ORS | Oregon Revised Statutes |
| OTC | Oregon Transportation Commission |
| PMLS | Portland Metro Levee System |
| PNCD | Preliminary Navigation Clearance Determination |
| RTC | Southwest Washington Regional Transportation Council |
| RTP | Regional Transportation Plan |
| SEIS | Supplemental Environmental Impact Statement |
| SOV | single-occupancy vehicle |
| SR | State Route |
| TPSS | traction power substation |
| TriMet | Tri-County Metropolitan Transportation District |
| UFSWQD | Urban Flood Safety and Water Quality District |
| USACE | U.S. Army Corps of Engineers |
| U.S.C. | United States Code |
| USCG | U.S. Coast Guard |
| V | volt |
| V/m | volts per meter |
| VNHR | Vancouver National Historic Reserve |

| Acronyms/Abbreviations | Definition |
|---|---|
| WSDOT | Washington State Department of Transportation |
| WSTC | Washington State Transportation Commission |

# 1. PROGRAM OVERVIEW

Electromagnetic fields (EMF) are radiated energy that is produced by many natural and human-made sources. Natural sources produce an ambient level of EMF of approximately 500 milligauss (mG). Human-made sources, such as cell phones, microwaves, and light-rail transit systems also produce EMF. Both electric and magnetic field strength decrease with distance from the source. Electrical fields are greatly reduced by walls and objects. However, magnetic fields can pass through objects, so it is magnetic fields which are generally the radiation of concern when evaluating EMF. There has been concern in the general public on the effects of exposure to EMF. However, studies in the health and medical community have proven inconclusive on the effects of EMF on human health.

The purpose of this report is to satisfy applicable portions of the National Environmental Policy Act (NEPA) 42 United States Code (U.S.C.) 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 Final Supplemental Environmental Impact Statement for the Interstate Bridge Replacement (IBR) Program pursuant to 42 U.S.C. 4332.

The objectives of this report are to:

- Define the study area and the methods of data collection and evaluation (Chapter 2).
- Describe existing EMF conditions (Chapter 3).
- Discuss and compare potential long-term, temporary, and indirect effects from EMF from the Modified Locally Preferred Alternative (LPA) and the No-Build Alternative (Chapters 4, 5 and 6).
- Provide proposed avoidance and mitigation measures, if needed, 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 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 Interstate 5 (I-5) corridor that extends from approximately Victory Boulevard in Portland to State Route (SR) 500 in Vancouver, as shown in Figure 1-1.

Figure 1-1. IBR Program Location Overview


## 1.1 Components of the Modified LPA

The basic proposed components of the LPA[1] 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 in each direction. When all highway, transit, and active transportation would be moved to the new Columbia River bridges, the existing

[1] All transportation facilities would be designed to current AASHTO, WSDOT, and ODOT specifications.

Interstate Bridge (both spans) would be removed.[2] The primary navigation channel would be relocated approximately 500 feet south (measured by the channel centerline) of its existing location near the Vancouver shoreline.

- 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 reconstruction of the existing Expo Center MAX Station. The Tri-County Metropolitan Transportation District of Oregon (TriMet), which operates the MAX system, would also operate the Yellow Line extension.
- Associated LRT improvements such as traction power substations (TPSS),[3] an 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 existing Ruby Junction Light-Rail Operations and Maintenance Facility (OMF).
- Connections to local bus transit service, including bus rapid transit (BRT) and express bus routes, in collaboration with the Clark County Public Transit Benefit Area Authority (C-TRAN), in addition to the proposed new LRT service.
- 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, including three additional bus bays for new buses at the existing C-TRAN OMF (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.
- 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 to Hayden Island 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."

[2] For purposes of this report, the existing I-5 bridges over the Columbia River are referred to as the "Interstate Bridge." The new replacement I-5 bridges over the Columbia River are referred to as the "Columbia River bridges."

[3] Each TPSS would be approximately 75 feet by 50 feet, including parking and access areas.

- Variable-rate tolling, including signage and equipment, for motorists using the river crossing as a demand-management and financing tool.

In addition to the basic components described above, the Modified LPA includes five sets of design options. The design options are related to (1) the number of auxiliary lanes; (2) the bridge configuration; (3) the presence of the C Street ramps; (4) the I-5 alignment in downtown Vancouver; and (5) the park and rides. The Recommended Design Options are identified with bold text and an asterisk in Table 1-1.

- **Auxiliary Lanes.** Options for one or two auxiliary lanes. Auxiliary lanes are ramp-to-ramp connections on the highway that improve interchange safety by providing drivers with more space and time to merge, diverge, and weave at highway access points.
  - The one auxiliary lane design option would extend across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange.
  - The two auxiliary lane design option would extend a second auxiliary lane in each direction of I-5 in addition to the one auxiliary lane included in the Modified LPA. The second auxiliary lane would also extend across the Columbia River bridges in addition to and in combination with the existing auxiliary lanes from approximately Interstate Avenue/Victory Boulevard to SR 500/39th Street.
- **Bridge Configurations.** Three bridge configurations are under consideration.
  - Double-deck fixed-span bridges: 116 feet of vertical navigation clearance over the primary navigation channel.
  - Single-level fixed-span bridges: 116 feet of vertical navigation clearance over the primary navigation channel.
  - Single-level movable-span bridges: with the movable spans over the primary navigation channel: 178 feet of vertical navigation clearance in the open position and 90 feet in the closed position (the north barge channel would have 99 feet of vertical navigation clearance and the south barge channel would have 90 feet of vertical navigation clearance).
- **C Street Ramps.** Options that retain or eliminate the existing C Street ramps in downtown Vancouver.
- **I-5 Alignment in Downtown Vancouver.** Options that maintain the I-5 mainline at its current location or shift the I-5 mainline up to 40 feet westward in downtown Vancouver between the SR 14 interchange and Mill Plain Boulevard interchange.
- **Park and Rides.** Options to provide parking capacity to accommodate 1,270 vehicles at designated park and rides near the Waterfront Station and Evergreen Station to serve LRT riders.

Table 1-1. Modified LPA Design Options

| Modified LPA Component | Design Options |
|---|---|
| Auxiliary lanes | • **One auxiliary lane in each direction on the new Columbia River bridges and nearby sections of I-5*** <br> • Two auxiliary lanes in each direction of I-5 would extend across the Columbia River bridges in addition to and in combination with existing auxiliary lanes from approximately Interstate Avenue/Victory Boulevard to SR 500/39th Street |
| Bridge configuration | • Double-deck fixed-span bridge configuration <br> • **Single-level fixed-span bridge configuration*** <br> • Single-level movable-span bridge configuration |
| C Street ramps | • **With C Street ramps*** <br> • Without C Street ramps |
| I-5 Alignment in downtown Vancouver | • **Centered I-5 alignment*** <br> • Westward shift of I-5 alignment |
| Park and Rides | • Provide parking capacity to accommodate 1,270 vehicles distributed across just two park and rides: one park and ride with 570 parking spaces near the Waterfront Station and one park and ride with 700 parking spaces near the Evergreen Station. The locations for park and rides that were evaluated included: <br> ➢ Potential Waterfront Station park and rides <br> ▪ Columbia Way (below I-5) <br> ▪ Columbia Street/SR 14 <br> ▪ Columbia Street/Phil Arnold Way <br> ➢ Potential Evergreen Station park and rides <br> ▪ Library Square <br> ▪ Columbia Credit Union <br> • **Provide parking capacity to accommodate 1,270 vehicles dispersed among five park and rides listed above *[a]** |

Notes:
* Recommended Design Options are in bold.
a Depending on final design considerations, the decision may be made to use fewer than the five sites. The analysis assumes all five sites as it encompasses all physical impacts.

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, they are identified in the sections below.

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. The description of the Modified LPA and design options are based on conceptual design and are subject to refinement as the design is finalized. The IBR Program will continue to consult with regulatory agencies, local agencies with jurisdiction, and tribes to seek opportunities for improvements and avoidance and minimization of impacts.

Figure 1-2. Modified LPA Components

Figure 1-3. Modified LPA – Geographic Subareas


### 1.1.1 Interstate 5 Mainline

Today, within the 5-mile corridor, I-5 has three, typically 12-foot-wide, through lanes in each direction, an approximately 6- to 12-foot-wide inside shoulder, and an approximately 6- to 12-foot-wide outside shoulder, with the exception of the Interstate Bridge, which has approximately 1- to 2-foot-wide inside and outside shoulders. There are currently intermittent one and two auxiliary lane sections 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 one or two 12-foot auxiliary lanes, as detailed below and shown on Figure 1-4. 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 existing Interstate Bridge over the Columbia River does not have auxiliary lanes; the Modified LPA would add one or two auxiliary lanes in each direction across the new Columbia River bridges.

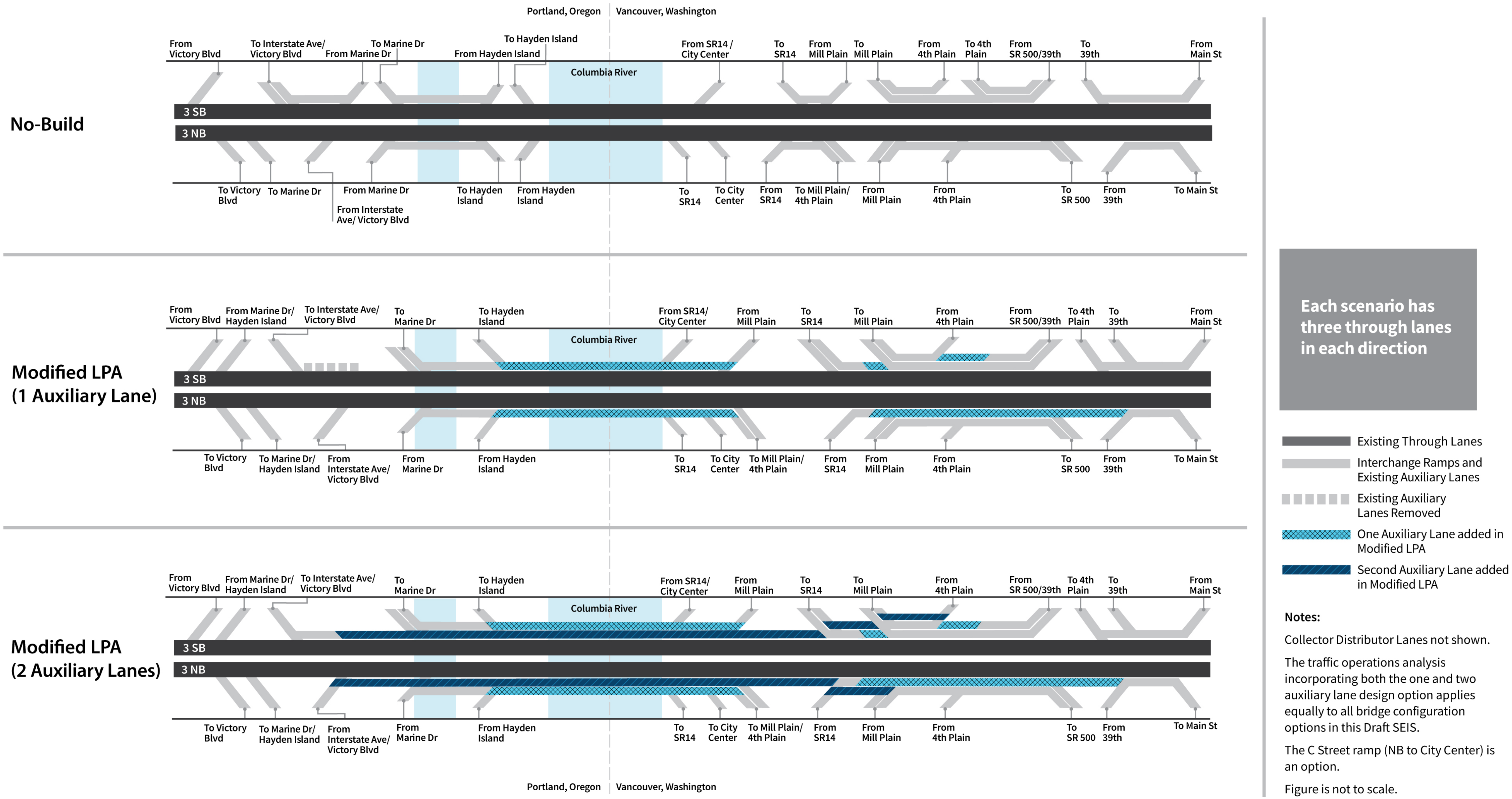
The Modified LPA would also include shoulders (11- to 14-foot inside shoulders and 10- to 14-foot outside shoulders) to be consistent with the design standards of the Oregon Department of Transportation (ODOT) and Washington State Department of Transportation (WSDOT). The inside shoulder would be used 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.

#### 1.1.1.1 Auxiliary Lane Design Options

The Modified LPA includes design options for one auxiliary lane in each direction or two auxiliary lanes in each direction across the Columbia River bridges in addition to and in combination with existing auxiliary lanes in the area. The one auxiliary lane design option would include an auxiliary lane in each direction across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange. The two auxiliary lane design option would include a second auxiliary lane from the Interstate Avenue/Victory Boulevard interchange and the SR 500/39th Street interchange, including on the Columbia River bridges (see Figure 1-4). This section provides an overview of the one auxiliary lane and the two auxiliary lane design options.

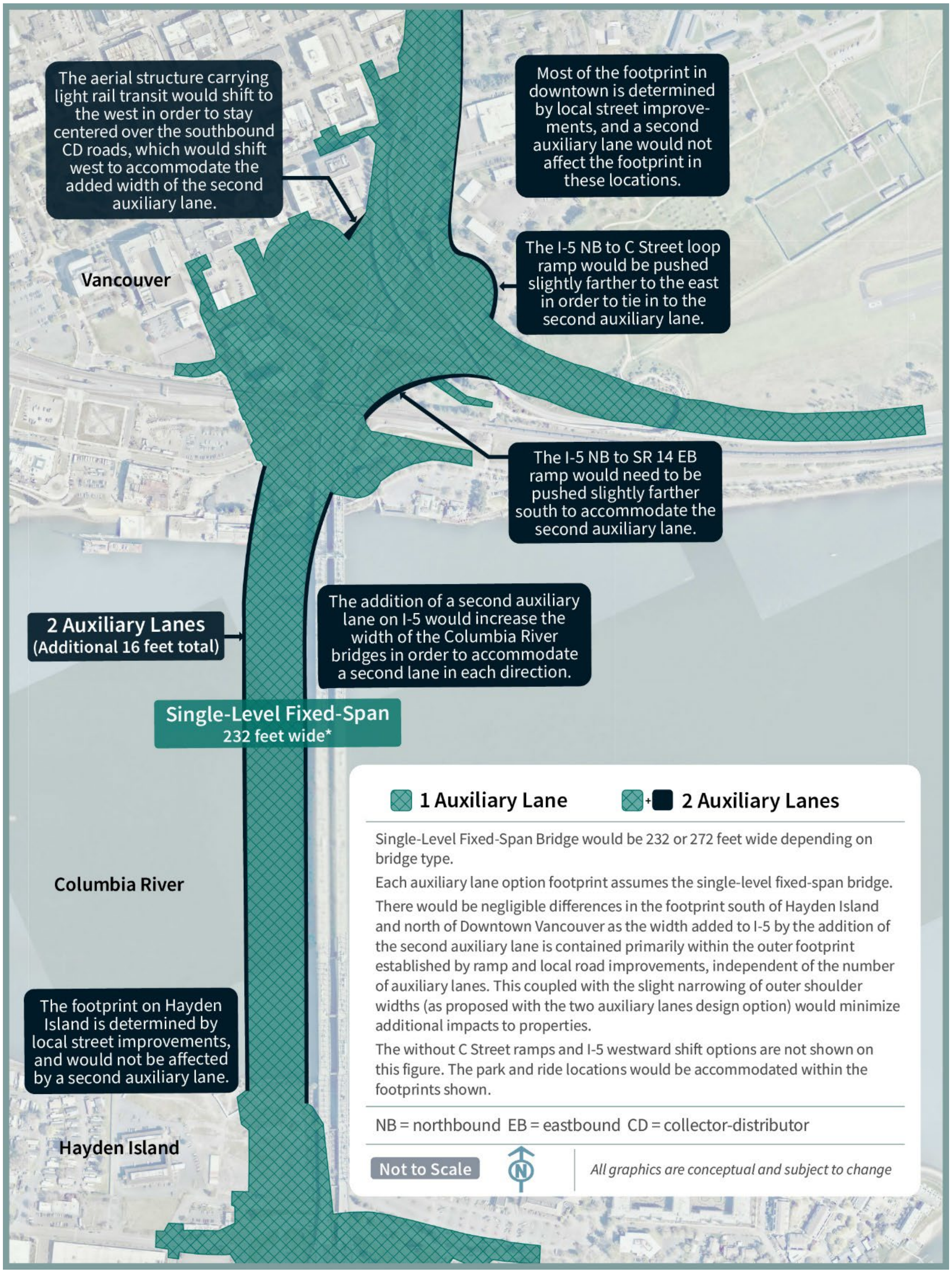
Figure 1-5, which shows a single-level fixed-span bridge configuration for comparison purposes, shows that the scale of the physical impacts (footprint, or the limits of permanent improvements) would be similar for the Modified LPA with one auxiliary lane design option and the Modified LPA with two auxiliary lanes design option, except over the Columbia River and in downtown Vancouver. For all bridge configuration design options, the two auxiliary lane design option would add a net of approximately 16 feet (8 feet in each direction) in total roadway width to the Columbia River bridges compared to the one auxiliary lane design option.

Figure 1-4. Auxiliary Lane Configurations




10.26.2023 | Copyright 2023 Interstate Bridge Replacement Program

Figure 1-5. Auxiliary Lane Configuration Footprint Differences




Note: All dimensions are approximate.

### ONE AUXILIARY LANE DESIGN OPTION – RECOMMENDED DESIGN OPTION

**The IBR Program recommends advancing the one auxiliary lane in each direction of I-5 design option.** The one and two auxiliary lane design options would provide important benefits to highway operations and safety. Both options received a mix of positive and negative feedback from the public. The one auxiliary lane design option is recommended because it would reduce overall environmental impacts while improving transportation operations and safety. The one auxiliary lane design option is also supported by local transportation agencies.

The one auxiliary lane design option would include a 12-foot-wide auxiliary lane in each direction across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange.

On northbound I-5, the auxiliary lane would extend the existing auxiliary from the Marine Drive on-ramp to the Hayden Island off-ramp to continue across the Columbia River bridge, and end at the combined off-ramp to Mill Plain/Fourth Plain Boulevard, north of SR 14 (see Figure 1-4). The existing auxiliary lane from the SR 14 on-ramp to the Mill Plain/Fourth Plain off-ramp would be extended to connect to the existing auxiliary lane from the 39th Street on-ramp to the Main Street off-ramp, creating an auxiliary lane beginning at the SR 14 on-ramp and ending at the Main Street off-ramp. The existing auxiliary lane located between the Mill Plain Boulevard on-ramp and the SR 500 off-ramp would remain.

On southbound I-5, the two existing auxiliary lanes between SR 500/39th Street and Mill Plain Boulevard would remain, with some reconfiguration due to the braided ramps between the SR 500/39th Street and Fourth Plain Boulevard interchanges. The new auxiliary lane across the Columbia River would begin at the Mill Plain Boulevard on-ramp and would continue across the Columbia River bridge, connecting to the existing auxiliary lane on Hayden Island and ending at the Marine Drive off-ramp. The existing southbound auxiliary lane between Marine Drive and Victory Boulevard/Interstate Avenue would be removed due to ramp reconfigurations as part of the Marine Drive braided ramp with the Victory Boulevard/Interstate Avenue off-ramp.

### TWO AUXILIARY LANE DESIGN OPTION

The two auxiliary lane design option would include the same improvements as described under the one auxiliary lane design option and would add a second 12-foot-wide auxiliary lane in each direction of I-5 across the Columbia River bridges to further improve safety and operations in the corridor.

On northbound I-5, the inside auxiliary lane would extend from the combined Interstate Avenue/Victory Boulevard on-ramp, continue across the Columbia River bridge, and end at the SR 500/39th Street interchange, connecting to the existing auxiliary lane between the SR 14 on-ramp and Mill Plain on-ramp and the existing auxiliary lane between the 39th Street on-ramp and the Main Street off-ramp. The outside auxiliary lane would extend from the Marine Drive on-ramp across the Columbia River bridge and end at the Mill Plain/Fourth Plain Boulevard off-ramp. A new outside auxiliary lane would begin at the SR 14 on-ramp connecting to the existing auxiliary lane between the Mill Plain Boulevard on-ramp and the SR 500/39th Street off-ramp.

On southbound I-5, the two existing auxiliary lanes between SR 500/39th Street and Mill Plain Boulevard would remain, with some reconfiguration because of the braided ramps between the SR 500/39th Street and Fourth Plain Boulevard interchanges. In addition, there would be a third auxiliary lane between the Fourth Plain Boulevard on-ramp and the Mill Plain Boulevard off-ramp to improve operations and safety between these two closely spaced ramps. The existing auxiliary lane between the SR 500/39th Street on-ramp would extend to the SR 14 collector-distributor off-ramp. This auxiliary lane would then continue across the Columbia River bridge to the Interstate Avenue/Victory Boulevard off-ramp. The outside auxiliary lane would extend from the Mill Plain on-ramp across the Columbia River bridge to connect to the existing auxiliary lane between Hayden Island and the Marine Drive off-ramp.

## 1.1.2 Portland Mainland and Hayden Island (Subarea A)

This section discusses the geographic Subarea A (Figure 1-3 provides an overview of the geographic subareas). Figure 1-6 shows highway and interchange improvements in Subarea A, including the North Portland Harbor bridges.

### 1.1.2.1 Levee System Improvements

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).

The levee systems are shown on Figure 1-7, and intersections with Modified LPA components are described throughout this section (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 were to fail. 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.[4]

There are two concurrent projects 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 Columbia Corridor Flood Safety (CCFS) projects (formerly known as “Flood Safe Columbia River” and “Levee Ready Columbia”).

[4] 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.

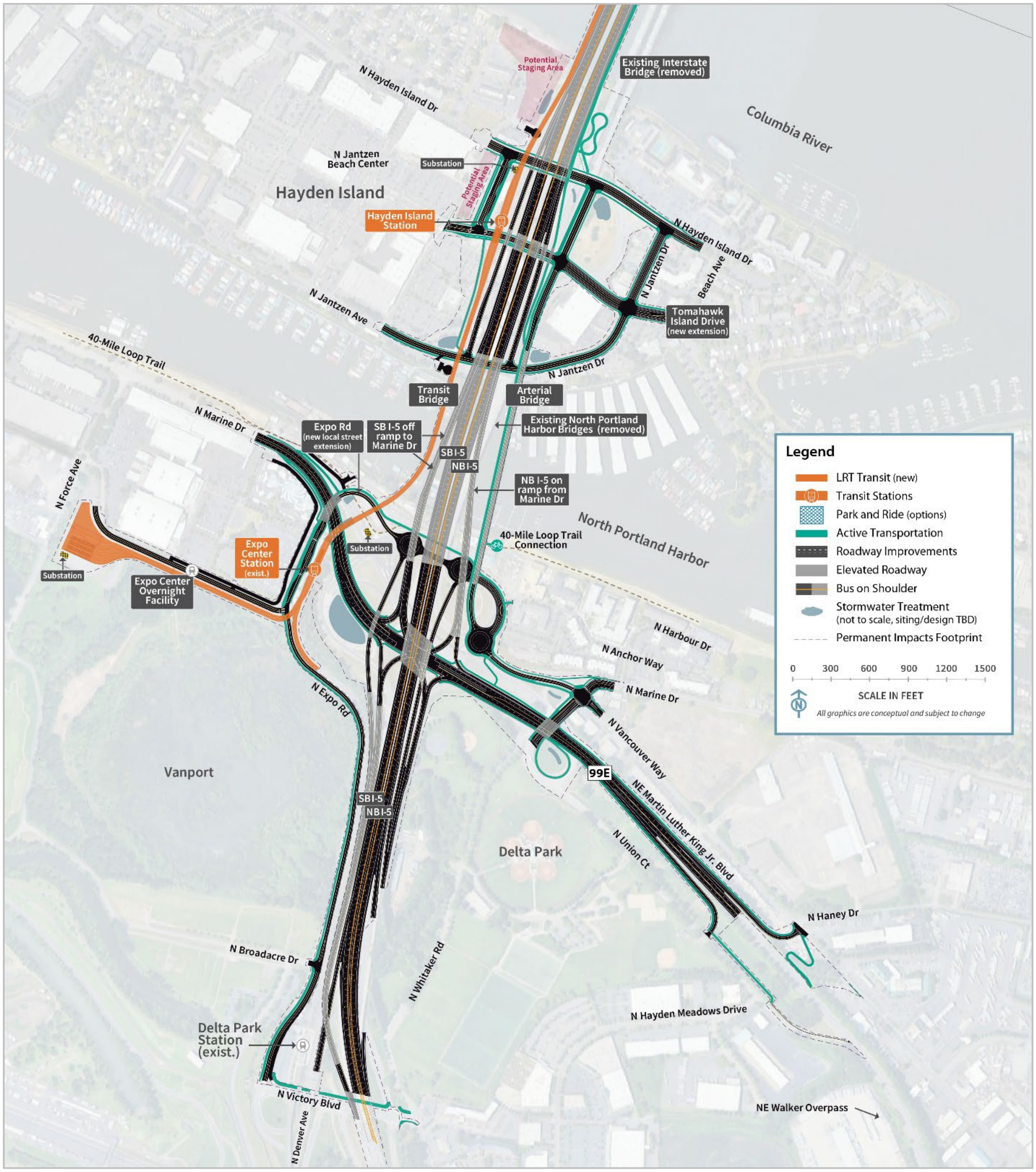
The Urban Flood Safety and Water Quality District (UFSWQD)[5] is working in partnership with the USACE on the PMLS project, which includes improvements at PEN 1 and PEN 2 (e.g., raising these levees to elevation 38.2 feet for earthen levees and 39.2 feet for flood walls North American Vertical Datum of 1988 [NAVD 88]).[6] Additionally, as part of the CCFS projects, UFSWQD has identified the need to raise a low spot in the Cross Levee on the southwest side of the Marine Drive interchange.

The IBR Program is in close coordination with UFSWQD and the USACE to ensure that the IBR Program's design efforts consider the timing and scope of the PMLS and the CCFS 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 CCFS projects are described below, where appropriate.

[5] UFSWQD includes PEN 1 and PEN 2, Urban Flood Safety and Water Quality District No. 1, and the Sandy Drainage Improvement Company.

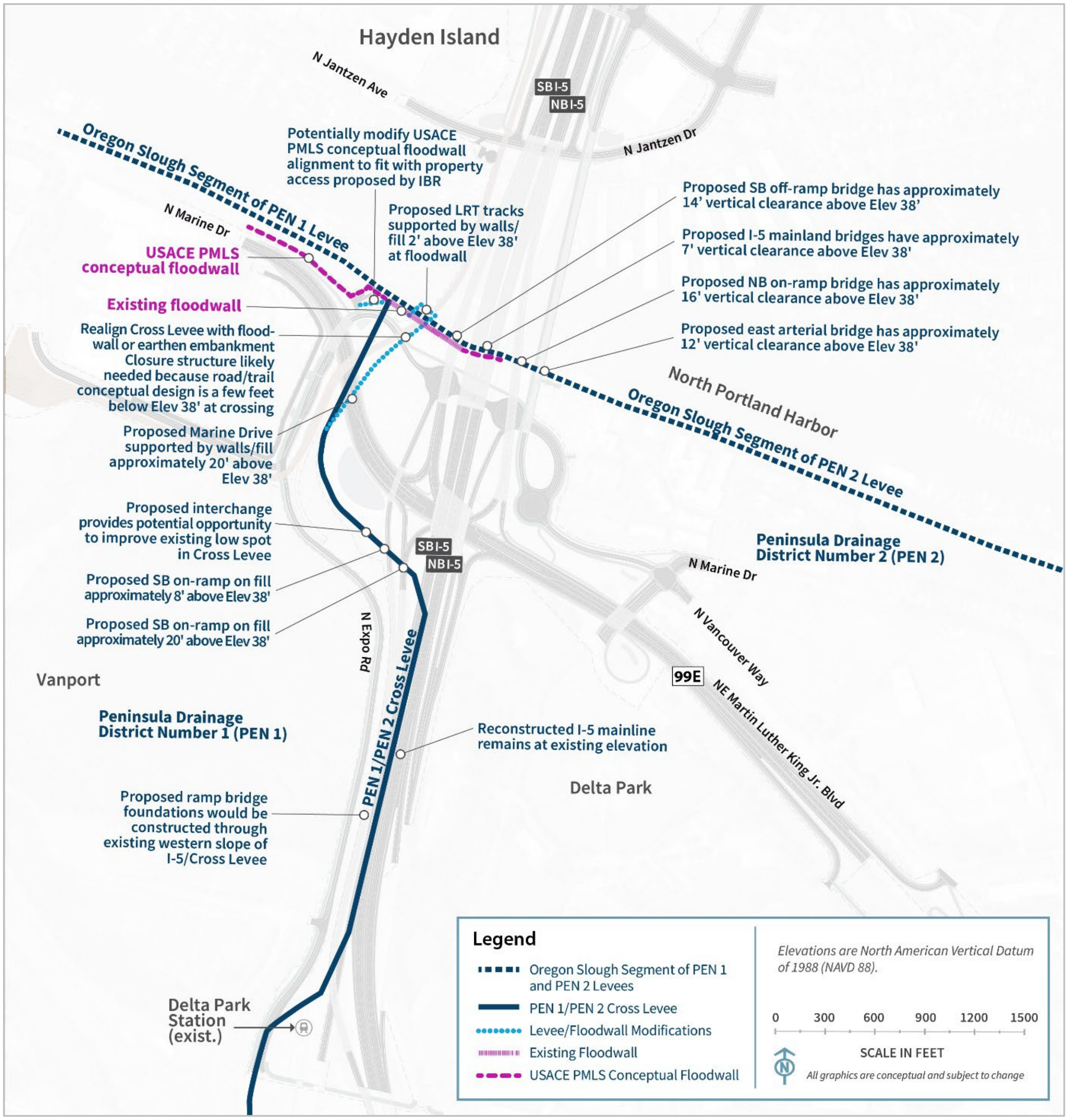
[6] NAVD 88 is a vertical control datum (reference point) used by federal agencies for surveying.

## Figure 1-6. Portland Mainland and Hayden Island (Subarea A)




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

Figure 1-7. Levee Systems in Subarea A




### 1.1.2.2 Highways, Interchanges, and Local Roadways

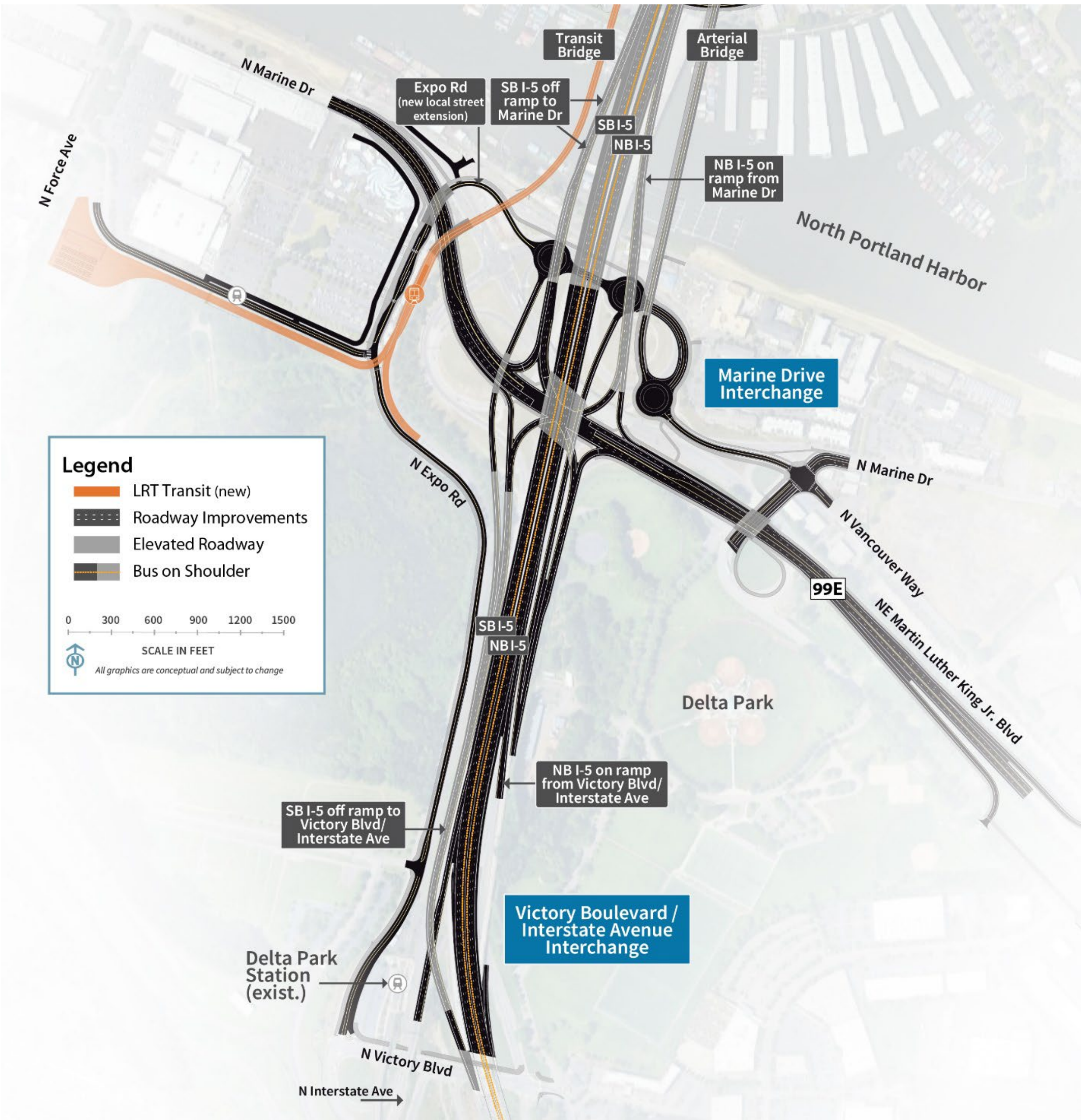
#### VICTORY BOULEVARD/INTERSTATE AVENUE INTERCHANGE AREA

The southern extent of the Modified LPA would improve two ramps at the Victory Boulevard/Interstate Avenue interchange (see Figure 1-6 and 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 1-7). 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.

Figure 1-8. Transit and Roadway Improvements in North Portland



### 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 improve safety and operations for motorists entering and exiting I-5, and all active transportation users accessing areas in the vicinity of the interchange. In addition, Marine Drive would be raised over the proposed LRT extension to separate motorist and transit users. The proposed Marine Drive interchange configuration would be a single-point urban interchange. Figure 1-8 shows Marine Drive interchange's layout and construction footprint.

Martin Luther King Jr. Boulevard would have new more direct connections to I-5. 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 Drive) would provide access to westbound Martin Luther King Jr. Boulevard for these two streets. The existing access to westbound Martin Luther King Jr. Boulevard from Vancouver Way east of Haney Drive would be closed. 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 (between the access to the East Delta Park Owens Sports Complex and N Hayden Meadows Drive).

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 intersections. The westernmost intersection would connect the new local street extension to I-5 southbound. The middle intersection would connect the I-5 northbound off-ramp to the local street extension. The easternmost intersection would connect the new local street extension to an arterial bridge crossing North Portland Harbor to Hayden Island. This intersection would also connect the local street extension to Marine Drive 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 intersection 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 intersection 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[7] for property access. The Modified LPA would realign Marine Drive to the south to maintain traffic on existing Marine Drive during construction. The Modified LPA would provide access to the two

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

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 approximately 5 to 10 feet to the south) and closure structure locations. The IBR Program is coordinating with USACE PMLS and the UFSWQD on modifications to the floodwall alignment.

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 1-6. 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 resilience.

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 with a shared-use path for pedestrians and bicyclists.

All new structures would have at least as much vertical navigation clearance over North Portland Harbor as the existing North Portland Harbor bridge.

All of the six bridges would be designed and constructed to have sufficient clearance over the levees for access and maintenance. 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.

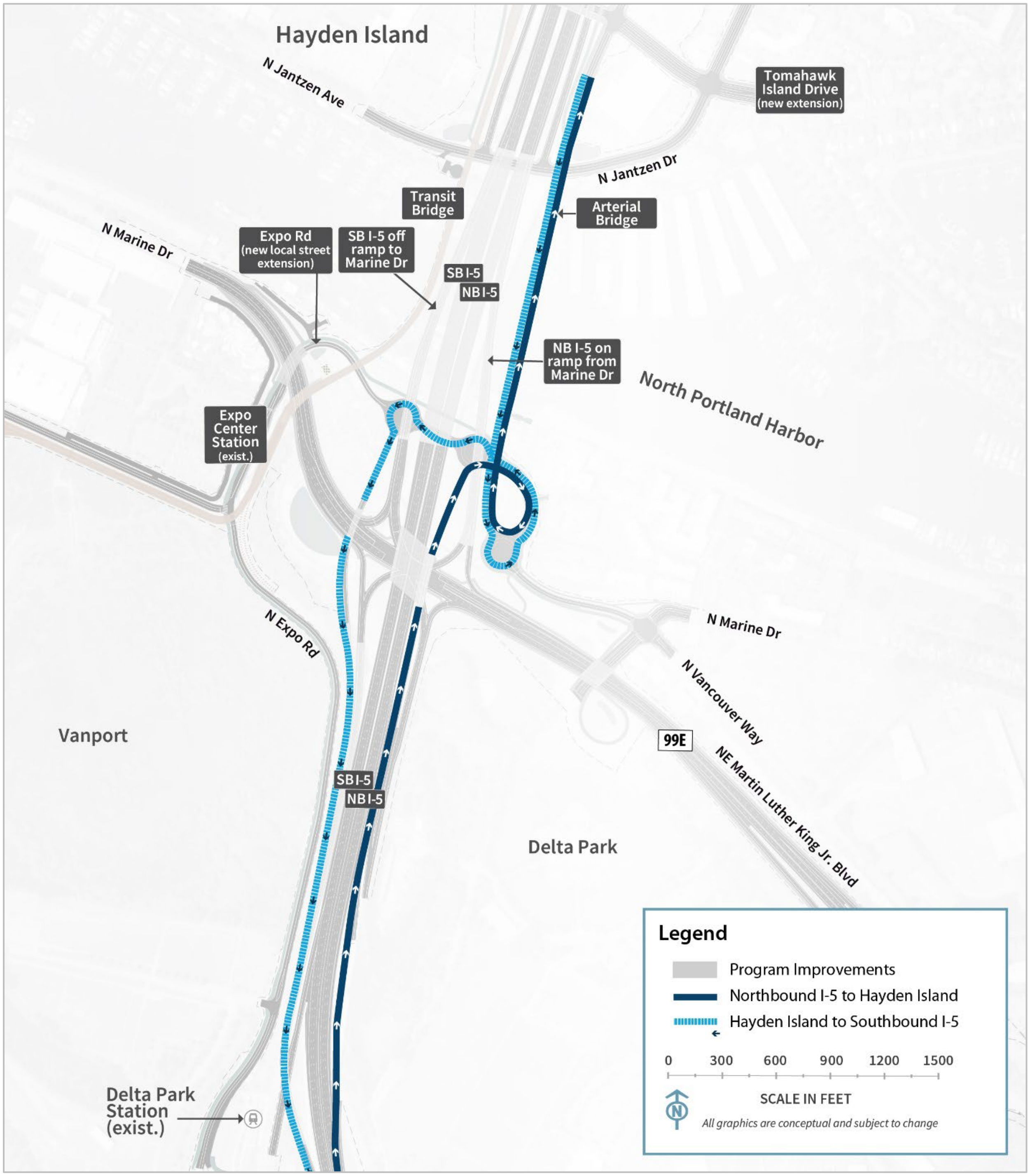
#### HAYDEN ISLAND INTERCHANGE AREA

All traffic movements for the Hayden Island interchange would be reconfigured. Figure 1-6 shows the layout and construction footprint of the Hayden Island interchange. A partial 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 improve ramp lengths to provide sufficient merging/diverging areas compared to the existing substandard ramps that require acceleration and deceleration in a short distance. The I-5 mainline would be partially located on fill across the island and partially elevated to provide east–west connections on Hayden Island.

There would not be a southbound I-5 on-ramp or northbound I-5 off-ramp located 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 1-9). 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 intersection at the Expo Road local street extension, 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 intersection, 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 1-9. Vehicle Circulation between Hayden Island and the Portland Mainland




NB = northbound; SB = southbound

#### 1.1.2.3 Transit

A new light-rail alignment for northbound and southbound trains would be constructed within Subarea A (Figure 1-6) 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 southwest corner of the Expo Center property (Figure 1-6) to provide storage for trains during hours when the 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 could require reconstruction of the operator break facility, signal/communication buildings, and TPSSs. The existing TPSS at the end of TriMet's MAX Yellow Line would be decommissioned. A new TPSS would be constructed to the east of the LRT tracks and south of Expo Road, as well as at the overnight LRV facility, east of N Force Avenue. Immediately north of the Expo Center MAX Station, the LRT alignment would curve east toward I-5, pass beneath an elevated 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.

After crossing the new Expo Road extension, the new light-rail track would cross over the main levee (Figure 1-7). The light-rail profile is anticipated to provide sufficient clearance 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 the Modified LPA's light-rail extension would cross the north end of the existing Cross Levee, the IBR Program is proposing to realign the Cross Levee to the east of the light-rail alignment. This realigned Cross Levee would intersect the new Expo Road extension. A levee closure structure would be required because the proposed roadway is a few feet lower than the proposed elevation of the improved levee.

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. Active transportation facilities, described below, would connect to the new Hayden Island Station. A new TPSS would be constructed at the Hayden Island Station, north of the transit platform. If a single-level fixed-span or movable-span Columbia River bridge configuration were implemented, the light-rail alignment would extend north on Hayden Island along the western edge of I-5 before transitioning onto the outer (western) edge of the new western single-level bridge over the Columbia River. For the double-deck configuration, the light-rail alignment would transition to the lower level of the new double-deck southbound I-5 bridge over the Columbia River.

#### 1.1.2.4 Active Transportation

In the Victory Boulevard interchange area (Figure 1-6), active transportation facilities would be provided on Victory Boulevard beneath I-5 and Interstate Avenue between Expo Road and the northbound on/off-ramp terminal east of I-5. Active transportation facilities would also be provided along Expo Road between Victory Boulevard and the Expo Center. These facilities would provide direct connections 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, active transportation facilities 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 active transportation 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 (Figure 1-6). On Hayden Island, active transportation facilities would be provided on Jantzen Avenue, Hayden Island Drive, and Tomahawk Island Drive and would connect to the Hayden Island Station. 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 outer edge of the new single-level, or lower level of the double-deck 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 (Figure 1-3 provides an overview of the geographic subareas). Figure 1-10 shows highway and interchange improvements in Subarea B.

Figure 1-10. Columbia River Bridges (Subarea B)

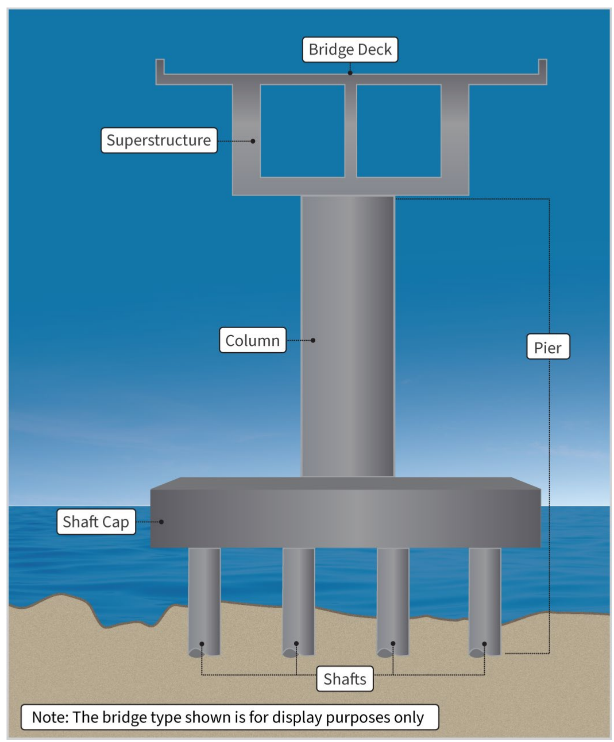

### 1.1.3.1 Highways, Interchanges, and Local Roadways

The two existing parallel northbound and southbound I-5 bridges that cross the Columbia River were constructed in 1917 and 1958, respectively. When the 1958 bridge was constructed, pier 5 of the 1917 bridge was removed and the profile was raised to match the new bridge. For the IBR Program, the two existing bridges would be replaced by two new parallel bridges, located west of the existing bridges (Figure 1-10). The new bridges would be designed to current American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design Bridge Design Specifications and AASHTO Seismic Guide Specifications and in compliance with ODOT and WSDOT design criteria. With all bridge configuration design options, the new eastern bridge would accommodate northbound highway traffic and a shared-use path. The new western bridge would carry southbound traffic and light-rail tracks. Whereas the existing bridges each have three lanes with no shoulders, each of the two new bridges would 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 1-12), the new Columbia River bridges would provide three navigation channels: a primary navigation channel and two barge channels (Figure 1-13). The current location of the primary navigation channel is near the Vancouver shoreline where the existing lift spans are located. The IBR Program is coordinating with the USACE to obtain authorization to change the location of the primary navigation channel. 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 USACE-authorized channel and 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.

The existing Interstate Bridge has nine in-water pier sets[8] and four pier sets on land (pier locations are shown on Figure 1-12). 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 1-13). 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 (Figure 1-11).

Figure 1-11. Bridge Foundation Concept




## BRIDGE CONFIGURATION OPTIONS

Three bridge configuration options are being considered: (1) double-deck fixed-span (with one bridge type); (2) a single-level fixed-span (with various 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, which was the vertical navigation clearance of the CRC LPA. The CRC LPA included a double-deck fixed-span bridge configuration. The single-

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

level fixed-span configuration was developed and is being considered as part of the IBR Program in response to the physical and contextual changes (e.g., design and operational considerations) since 2013 that allowed for opportunities to examine 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).

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. On January 16, 2026, the USCG issued a revised PNCD for the new Columbia River bridges and set the preliminary vertical navigation clearance at 116 feet or greater (USCG 2026).

The IBR Program is carrying forward the three bridge configurations, each of which meets the IBR Program's Purpose and Need, to address changed conditions to ensure a permittable bridge configuration is within the range of options considered in the Supplemental Environmental Impact Statement (SEIS). Each of the bridge configuration design options provides at least 116 feet of vertical navigation clearance and is consistent with the January 2026 PNCD issued by the USCG. Additional discussion on pending actions to obtain authorizations from USCG and USACE for the Columbia River bridges' primary navigation channel location are described in Section 2.6, Additional Compliance, of the Final SEIS.

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

Figure 1-12. Existing Navigation Clearances of the Interstate Bridge

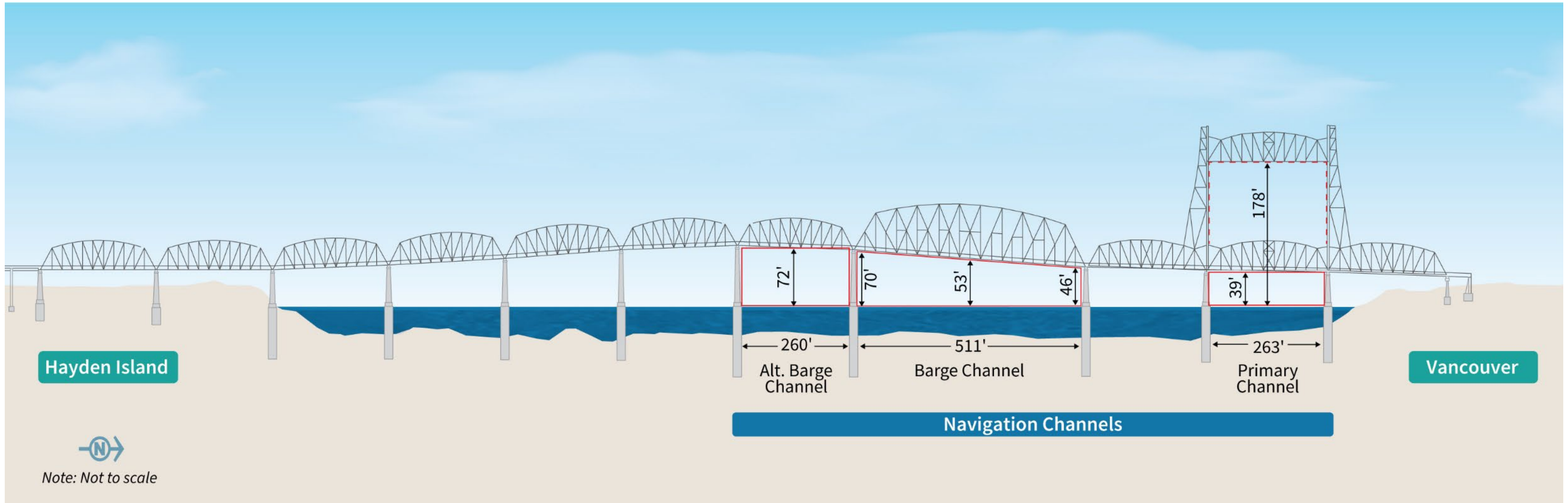
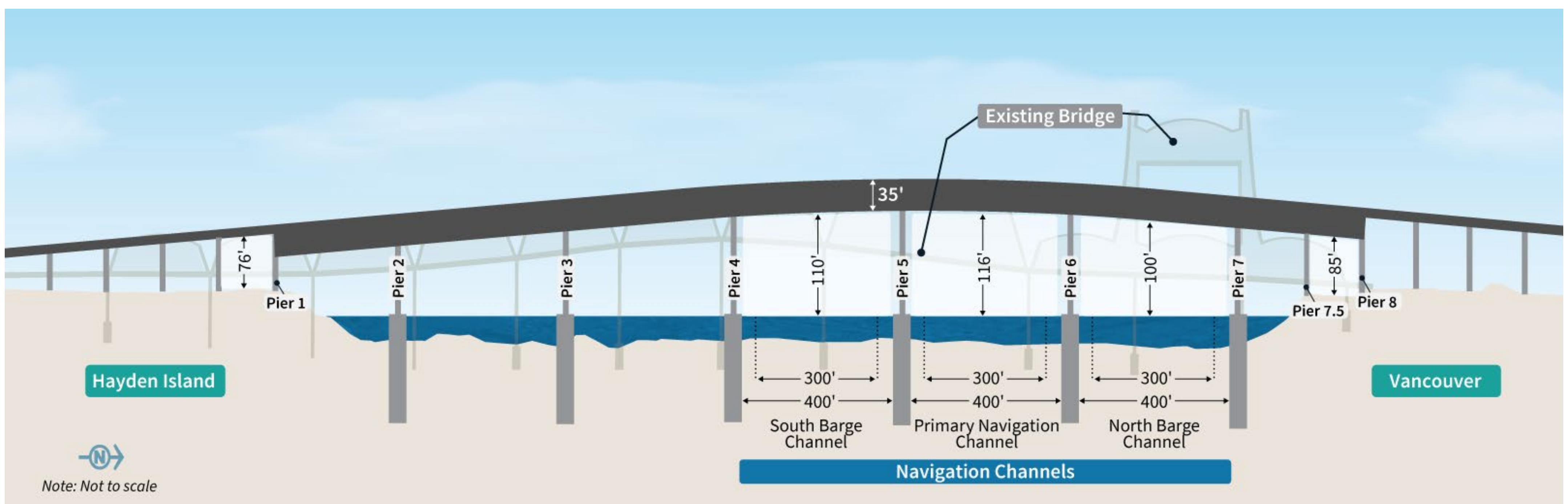



Figure 1-13. Navigation Clearances and Proposed Profile of the Modified LPA Columbia River Bridges with a Double-Deck Fixed-Span Configuration




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 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, as described in the following sections.

### 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 1-14 shows 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.

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 one set of light-rail tracks (one northbound track and one southbound track) on the lower level. Each bridge deck would typically be 79 feet wide, with a total out-to-out width of approximately 173 feet.[9]

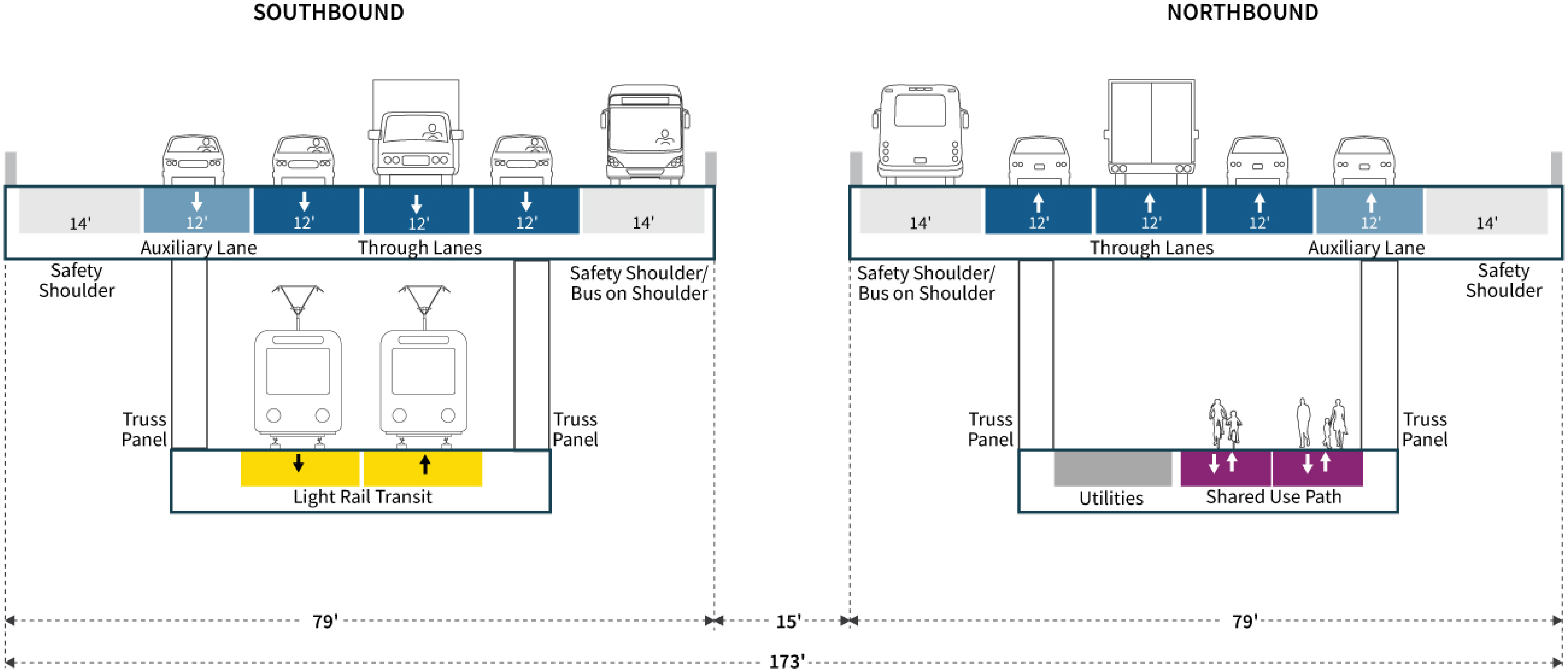
Figure 1-14. Conceptual Drawing of a Double-Deck Fixed-Span Configuration

Note: Visualization is looking southeast from Vancouver.

Figure 1-15 shows a typical cross section of the two parallel double-deck bridges. Like all bridge configuration design options under consideration, 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 up to a 4% maximum grade on both the Oregon and Washington sides. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

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

Figure 1-15. Typical Cross Section of the Double-Deck Fixed-Span Configuration




Note: Design is not final and subject to change. Widths may vary with final design. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

### Single-Level Fixed-Span Configuration – Recommended Design Option

**The IBR Program recommends advancing the single-level fixed-span bridge configuration.** All bridge configurations would provide important benefits to highway operations and safety and have similar impacts to many resources. The main differences between either of the fixed-span configurations and the movable-span configuration is that the latter would provide more vertical clearance to accommodate larger vessels and a lower grade for all land-based transportation modes (which would benefit freight and active transportation users in particular), but this configuration would also periodically disrupt all other land-based transportation modes (personal vehicles, freight, transit, and active transportation) with bridge openings. The main differences between the double-deck and single-level fixed-span configurations are that the slightly higher grade of the former would impact freight traffic and active transportation users, and the latter would have faster emergency response times (although there would also be more exposure to vehicles) and give users of the shared-use path a greater sense of security due to "eyes on the path." The fixed-span configurations received generally positive comments from the public, while there was mixed feedback on the movable-span because of the tradeoffs given above.

The single-level fixed-span configuration would have two side-by-side, single-level, fixed-span steel or concrete bridges. This report considers two single-level fixed-span bridge type options: a girder (steel or concrete segmental) bridge and an extradosed bridge.[10] The description in this section applies to both bridge types (unless otherwise indicated). Conceptual examples of both options are shown on Figure 1-16. 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, which is consistent with the January 2026 PNCD issued by the USCG.

The eastern bridge would accommodate northbound highway traffic and the shared-use path; the bridge deck would be approximately 104 feet wide. The western bridge would carry southbound traffic and light-rail tracks; the bridge deck would be approximately 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 as with the double-deck configuration. The total out-to-out width of the single-level fixed-span configuration (extradosed option) would be approximately 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 approximately 232 feet at its widest point. Figure 1-17 shows a typical cross section of the single-level configuration with an extradosed bridge as shown

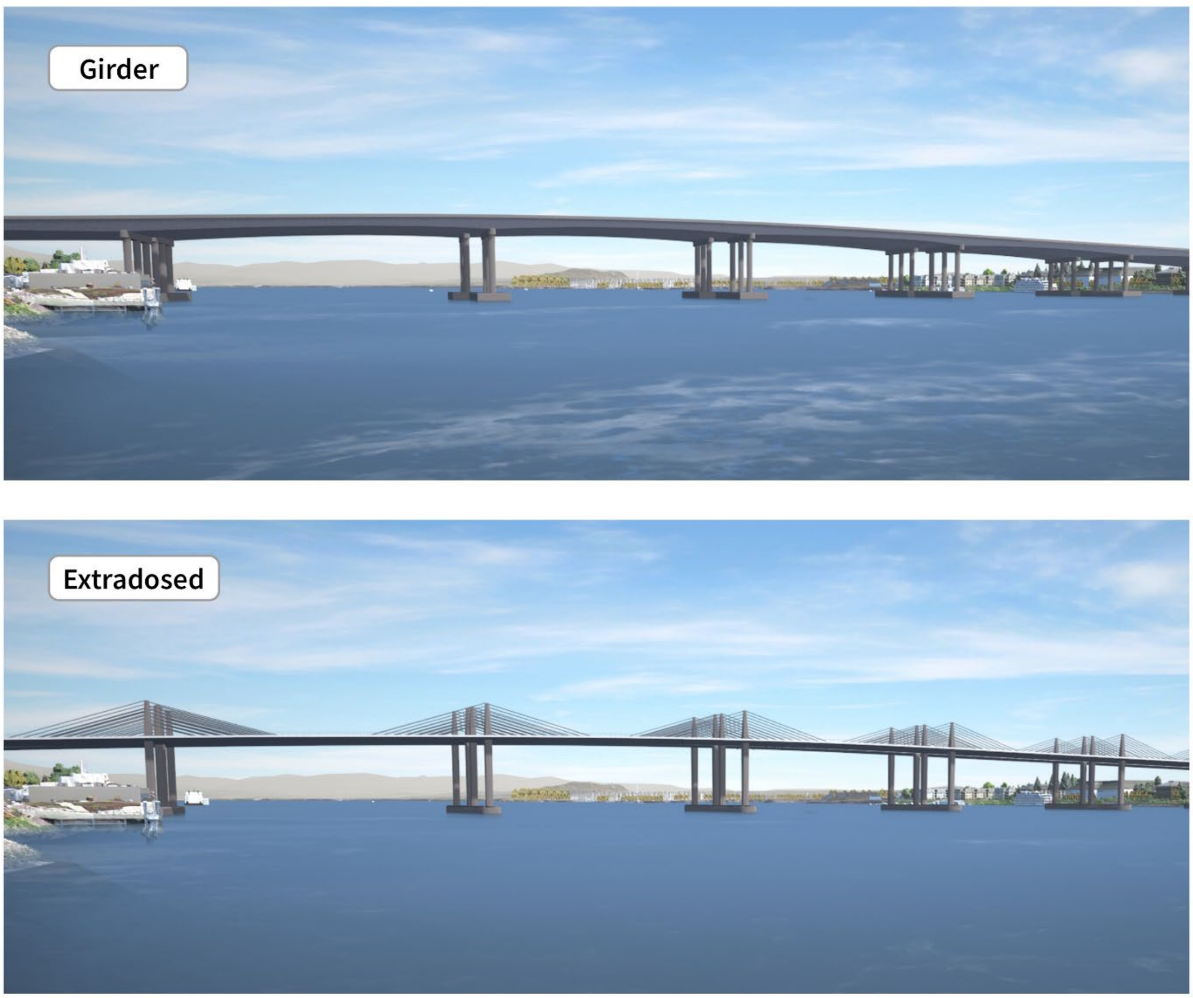
[10] The Draft SEIS also included a finback as a single-level fixed-span bridge type. As the design of the various bridge types progressed, it was determined that the finback would have higher risks associated with increased cost and construction schedule because this bridge type is less common and applying this bridge type to the scale of the new Columbia River bridges would introduce more design and construction challenges than the other bridge type options. Other bridge types, such as concrete or steel girder or extradosed, would have fewer risks and would be a more suitable for this location. As a result, the finback bridge type was dropped from further consideration.

by the 10-foot-wide bridge columns. Figure 1-18 shows a typical cross section with a girder bridge, which would not have the 10-foot-wide bridge columns shown on Figure 1-17.

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 approximately 50 feet by 230 feet.

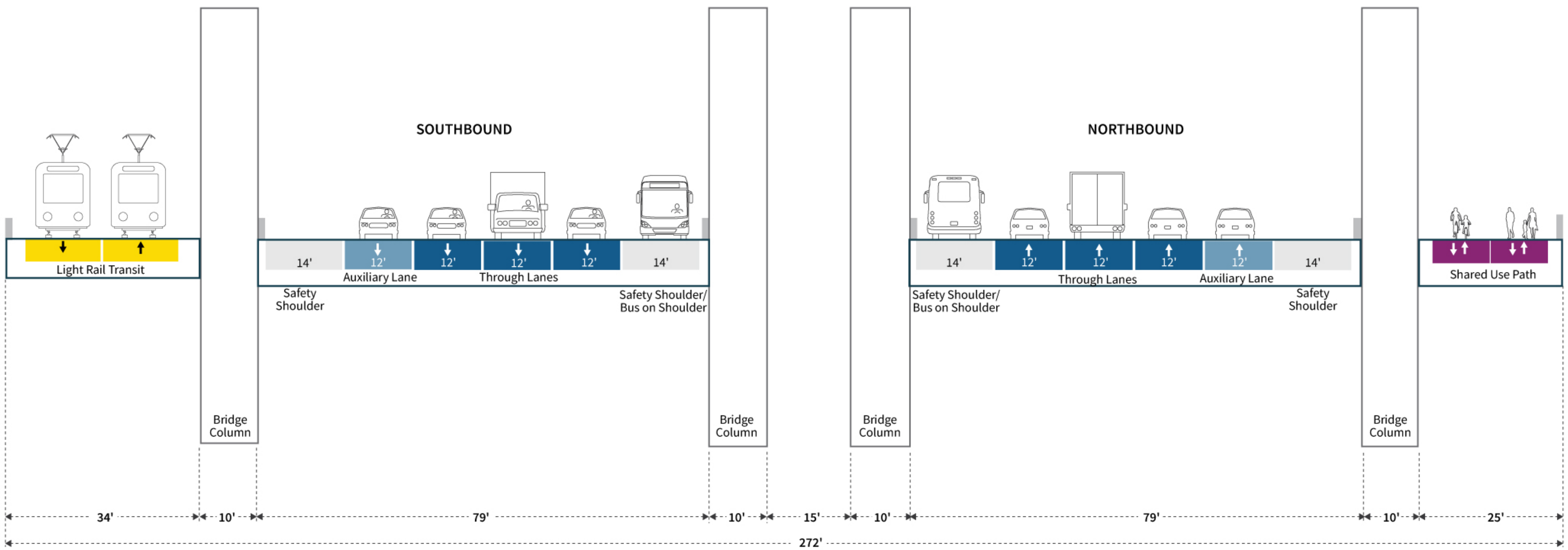
This bridge configuration would be expected to have an approximate grade of 3% on both the Oregon and Washington sides of the bridge. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

Figure 1-16. Conceptual Drawings of Single-Level Fixed-Span Bridge Types



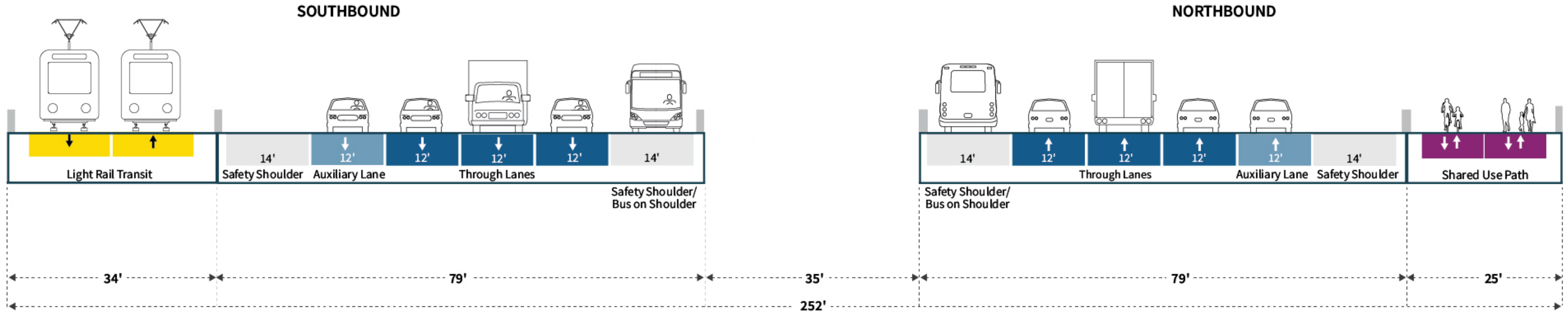

Note: Visualizations are for illustrative purposes only. They do not reflect property impacts or represent final design. Visualization is looking southeast from Vancouver.

Figure 1-17. Typical Cross Section of the Single-Level Fixed-Span Configuration (Extradosed Type)




Note: Design is not final and subject to change. Widths may vary with final design. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

Figure 1-18. Typical Cross Section of the Single-Level Fixed-Span Configuration (Girder Type)




Note: Design is not final and subject to change. Widths may vary with final design. The cross section for a girder bridge type would be the same as an extradosed bridge type except that it would not have the four 10-foot bridge columns. The distance between the two bridges could be reduced to 10 feet. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

### 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 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 to the Final SEIS. 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 horizontal curvature and with minimal grade). 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 approximately 500 feet south of the existing lift span, between Piers 5 and 6.

The single-level movable-span configuration would provide approximately 90 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. 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] over the 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, which would be slightly shorter than the existing lift-span towers, which are 247 feet high.

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 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. Typical cross sections of the single-level movable-span configuration are shown in Figure 1-20; the top section depicts the vertical lift spans (Piers 5 and 6), and the bottom 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 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 approximately 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 (approximately 50 feet by 230 feet). The single-level movable-span configuration (with a vertical lift span) would have a total of 108 in-water drilled shafts.

This single-level movable-span configuration would be expected to have an approximate grade of 3% on the Oregon side of the bridge and an approximate grade of 1.5% on the Washington side. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

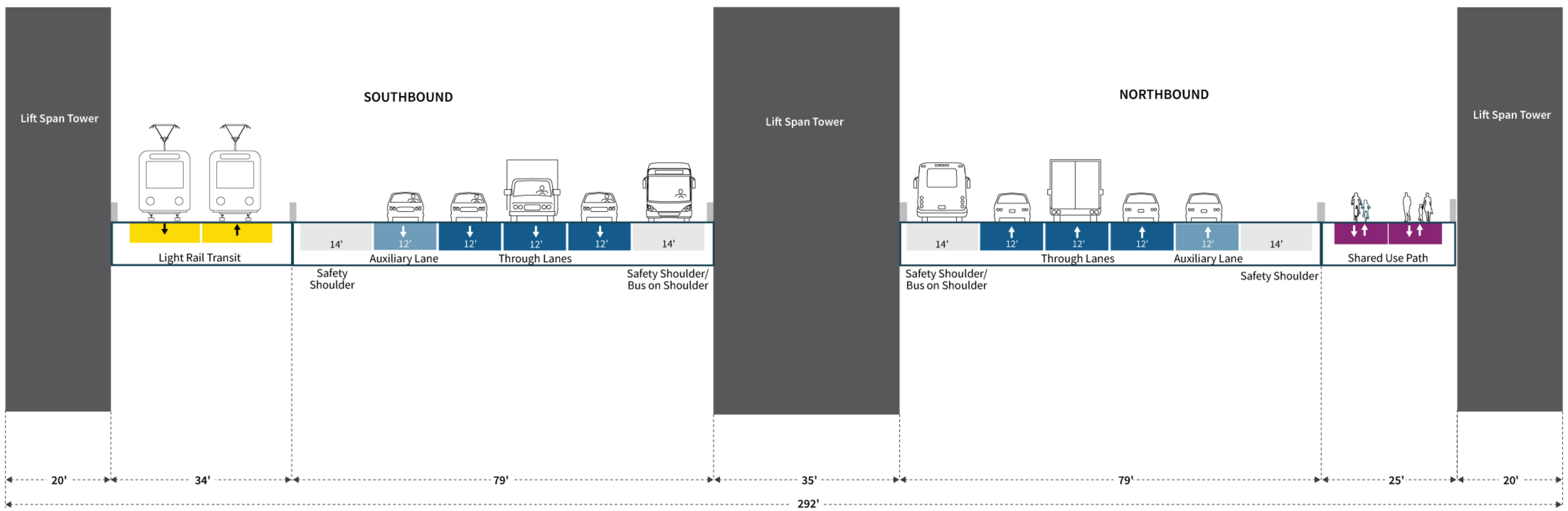
Figure 1-19. Conceptual Drawings of Single-Level Movable-Span Configurations in the Closed and Open Positions


**Visualizations are for illustration purposes only. They do not reflect property impacts or represent final design.**

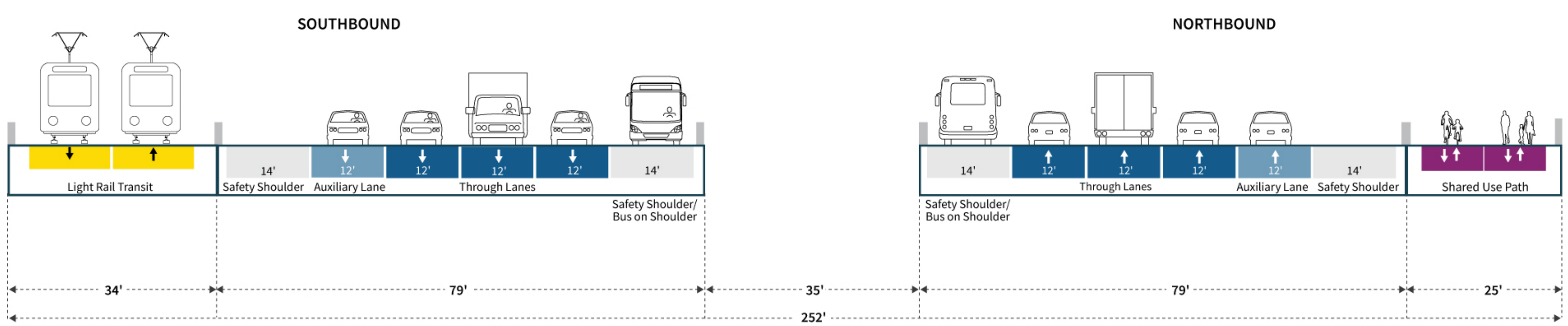
Note: Visualization is looking southeast (upstream) from Vancouver.

Figure 1-20. Typical 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)




Note: Design is not final and subject to change. Widths may vary with final design. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

## Bridge Configuration Comparison

This section summarizes and compares each of the bridge configurations. Table 1-2 lists the key considerations for each bridge configuration. Figure 1-21 compares each of the three bridge configurations' footprints with the one auxiliary lane design option (refer to Figure 1-5 for a comparison of the one and two auxiliary lane design options footprints). 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 approximately 173 feet wide. Comparatively, the extradosed bridge type of the single-level fixed-span configuration would be approximately 272 feet wide (approximately 99 feet wider), and the single-level fixed-span configuration with a girder bridge type would be approximately 232 feet wide (approximately 59 feet wider). The single-level movable-span configuration would be approximately 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 width of approximately 40 feet 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 and elevation of each configuration. The single-level fixed-span configuration and the lower deck of the double-deck fixed-span would have similar elevations, but the upper deck of the double-deck bridge would be approximately 35 feet higher. 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

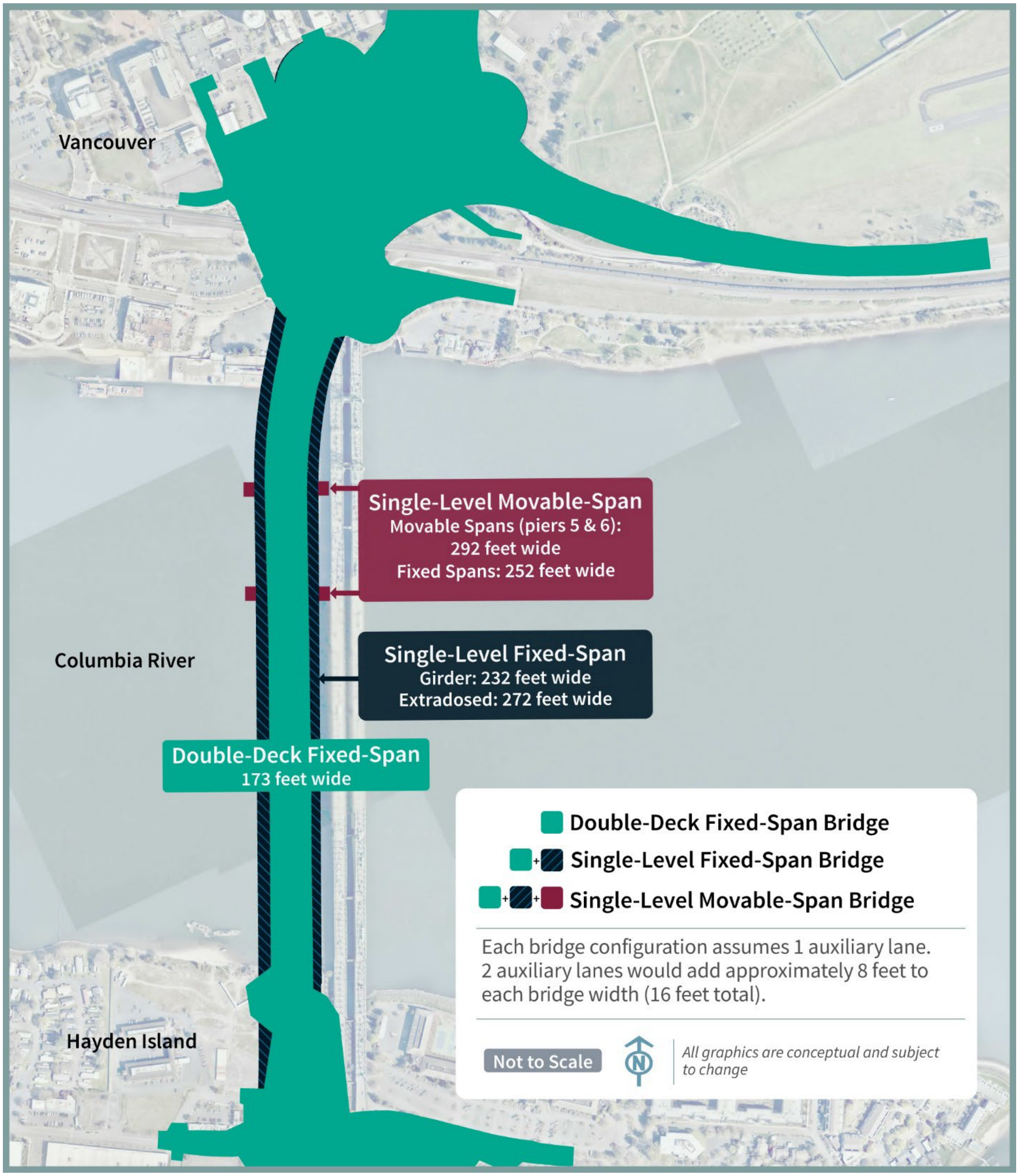
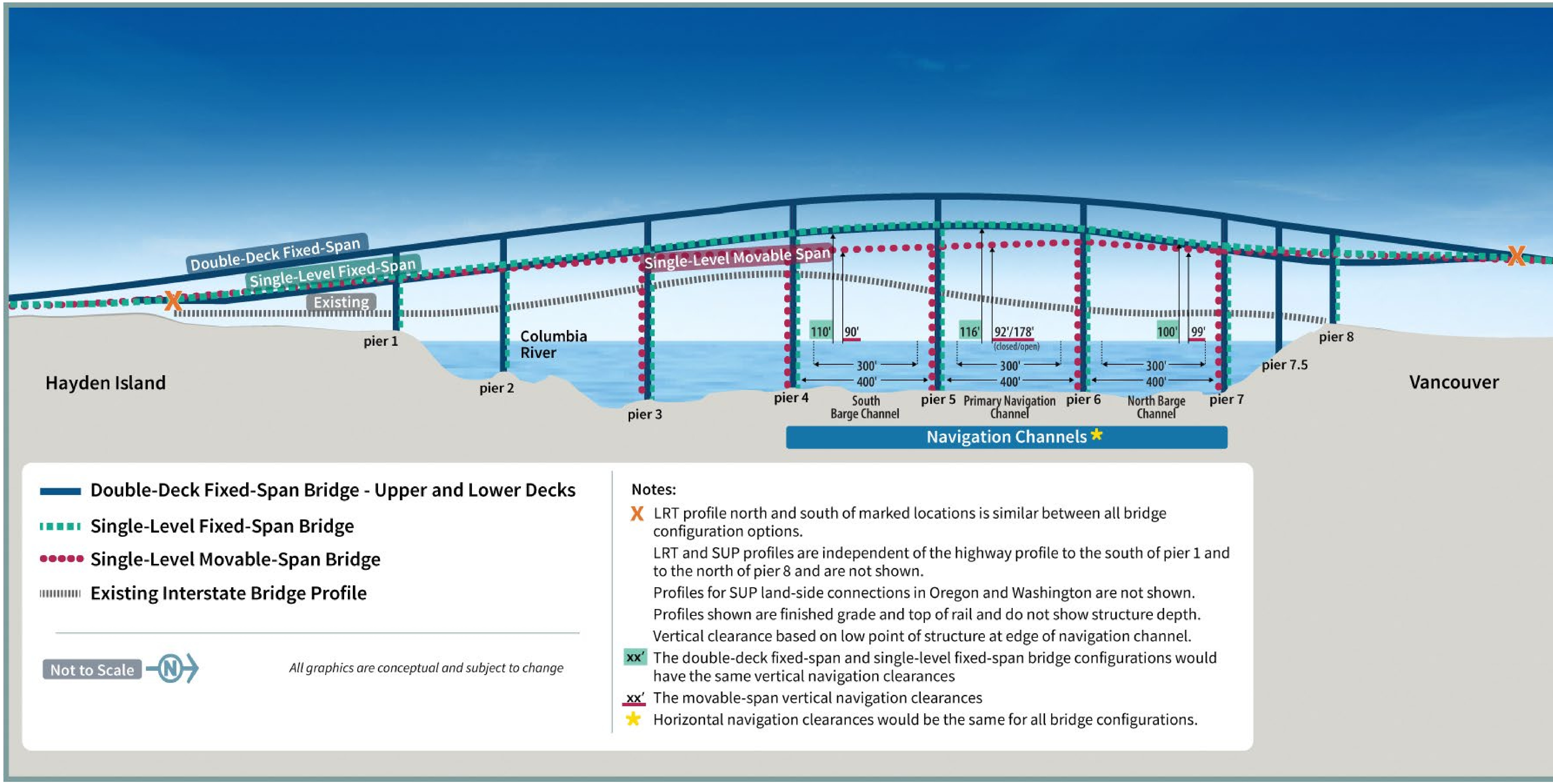


Figure 1-22. Bridge Configuration Profile Comparison




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

Table 1-2. Summary of Bridge Configurations

| Component | 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, or extradosed | 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 for vessels | Weekday peak AM and PM highway travel periods. [b]<br>Typical bridge opening/gate closure durations are approximately 9 to 27 minutes depending on the purpose of the bridge lift (i.e., maintenance or vessel traffic) and lift elevation (i.e., partial lift or full lift). From 2007 to 2024, there was an average of 152 lifts per year (IBR 2025). | N/A | N/A | • Considering 2007–2024 trends in vessels transiting under the Interstate Bridge, there would be fewer bridge lifts compared to the No-Build Alternative due to increased vertical navigation clearance in the closed position (99 feet compared to 72 feet).<br>• Additional restrictions to daytime bridge openings would be requested to consolidate fewer bridge openings outside of |

| Component | 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 |
|---|---|---|---|---|
| | | | | morning, midday, and evening peak hours when vehicle and transit demand is high in order to improve LRT on-time performance and system reliability and reduce highway congestion. Changes to bridge opening restrictions would require 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]<br>• 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 |

| Component | 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 |
|---|---|---|---|---|
| | | | | restart traffic after the bridge closes. |
| Out-to-out width [d] | 138 feet total width | ~173 feet total width | Girder: ~232 feet total width<br>Extradosed: 272 feet total width | • ~292 feet at the movable span<br>• ~252 feet at the fixed spans |
| Deck widths | 52 feet (SB)<br>52 feet (NB) | ~79 feet (SB)<br>~79 feet (NB) | Girder:<br>• ~113 feet (SB)<br>• ~104 feet (NB)<br>Extradosed:<br>• ~133 feet (SB)<br>• ~124 feet (NB) | ~113 feet (SB)<br>~104 feet (NB) |
| Vertical navigation clearance | Primary navigation channel:<br>• 39 feet when closed<br>• 178 feet when open<br>Barge channel:<br>• 46 feet to 70 feet<br>Alternate barge channel:<br>• 72 feet | Primary navigation channel:<br>• 116 feet maximum<br>North barge channel:<br>• 100 feet maximum<br>South barge channel:<br>• 110 feet maximum | Primary navigation channel:<br>• 116 feet maximum.<br>North barge channel:<br>• 100 feet maximum<br>South barge channel:<br>• 110 feet maximum | Primary navigation channel:<br>• Closed position: ~90 feet.<br>• Open position: 178 feet<br>North barge channel:<br>• ~99 feet maximum<br>South barge channel:<br>• ~90 feet maximum |
| Horizontal navigation clearance | • 263 feet for primary navigation channel<br>• 511 feet for barge channel<br>• 260 feet for alternate barge channel | 400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side) | 400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side) | 400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side) |

| Component | 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 height of bridge component (elevation relative to NAVD 88) [e] | 247 feet at top of lift tower | ~166 feet | Girder: ~137 feet.<br>Extradosed: ~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<br>Piers 5 and 6: 50 feet by 312 feet (one combined footing at each location to house tower/equipment for the lift span) |
| Conceptual vertical grade [f] | 4.8% | ~4% on the Washington side<br>~4% on the Oregon side | ~3% on the Washington side<br>~3% on the Oregon side | ~1.5% on the Washington side.<br>~3% on the Oregon side |
| LRT location | N/A | Below highway on SB bridge | West of highway on SB bridge | West of highway on SB bridge |

| Component | 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 |
|---|---|---|---|---|
| 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 |
| 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 |

All dimensions and quantities are approximate.

a When different bridge types are not mentioned, data apply to both bridge types under the single-level fixed-span bridge configuration.

b The No-Build Alternative assume 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). For the Modified LPA with a single-level movable-span bridge configuration design option, additional timing restrictions, which would increase restrictions on the timing for and duration of bridge openings, except for emergencies, would be requested and coordinated with the USCG. Bridge openings would be required for vessels and/or cargo with heights greater than 72 feet under the No-Build Alternative; whereas, bridge openings for vessels and/or cargo requiring more than 99 feet of clearance would be required for the Modified LPA with the movable-span bridge configuration design option.

c For the purposes of the transportation analysis in the Final SEIS (Section 3.1, Transportation of the Final SEIS), the movable-span opening time is assumed to be an average of 13.2 minutes.

d "Out-to-out width" is the measurement between the outside edges of both northbound and southbound bridge across its width at the widest point and includes the space between the two bridges. The deck width is the measurement of the outer edges of either the northbound bridge or the southbound bridge.

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

f The maximum allowable vertical grade according to ODOT and WSDOT standards on the I-5 mainline is 4%.

I-5 = Interstate 5; LPA = Locally Preferred Alternative; LRT = light-rail transit; N/A = not applicable; NAVD 88 = North American Vertical Datum of 1988; NB = northbound; ODOT = Oregon Department of Transportation; SB = southbound; SEIS = Supplemental Environmental Impact Statement; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; WSDOT = Washington State Department of Transportation

## 1.1.4 Downtown Vancouver (Subarea C)

This section discusses the geographic Subarea C (Figure 1-3 shows an overview of the geographic subareas). Figure 1-23 shows all highway and interchange improvements in Subarea C.

### 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).

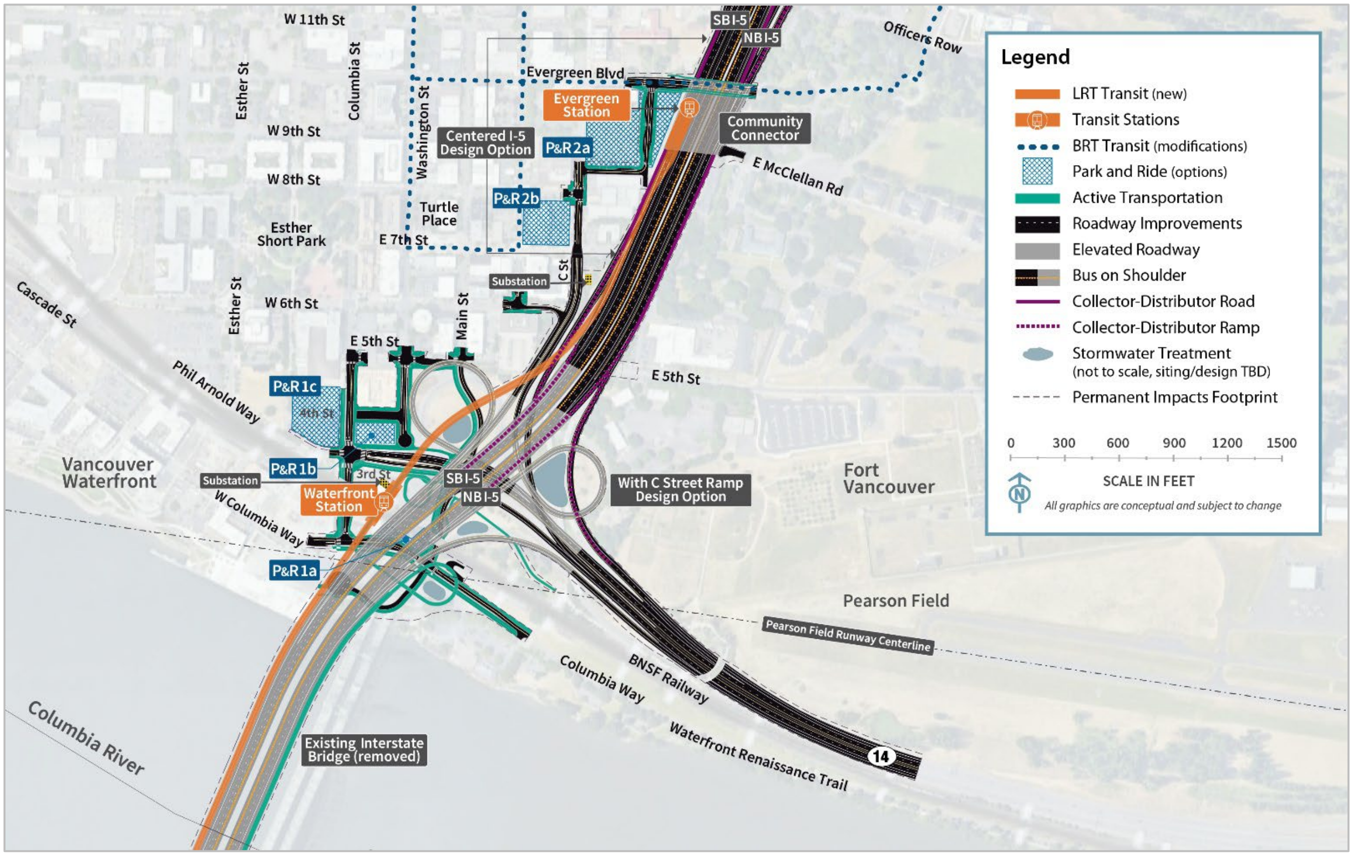
#### SR 14 INTERCHANGE/DOWNTOWN VANCOUVER

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 configuration would remain essentially the same as it is now, but the interchange would be elevated to meet the new Columbia River bridges that cross over the BNSF Railway tracks. 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. Access from downtown Vancouver to eastbound SR 14 would be relocated from the Washington Street and W 5th Street intersection to a new intersection at Columbia Street and W 3rd Street. Access from westbound SR 14 would also be shifted from C Street to the new Columbia Street and W 3rd Street intersection. Access from downtown Vancouver to southbound I-5 would be relocated from the Washington Street and W 5th Street intersection to C Street. Access from northbound I-5 to downtown Vancouver would remain at C Street. Connections to downtown Vancouver would vary under the two design options under consideration for this area (with C Street ramps and without C Street ramps), as detailed below.

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 intersection 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 intersection, 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.

Figure 1-23. Downtown Vancouver (Subarea C)




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

### C Street Ramp Design Options

#### *With C Street Ramps – Recommended Design Option*

The design option with C Street ramps would provide access to and from downtown Vancouver similar to existing conditions but with some of the connection points relocated. Access from northbound I-5 to downtown Vancouver would be rebuilt in the same location as the current connection. Downtown Vancouver I-5 access to and from the south would be consolidated at C Street with SR 14 connections to and from downtown at Columbia Street/W 3rd Street (Figure 1-24).

#### *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 northbound I-5 to C Street and no directional ramp on the west side of I-5 from C Street to southbound I-5. The existing eastside loop ramp would be removed. This option would reduce the footprint of the Modified LPA in this area.

**The IBR Program recommends advancing the with C Street ramps design option**. Both C Street ramp design options would provide important benefits to highway operations and safety and have similar impacts to many other resources, particularly the natural environment. While there would be some short-term construction cost savings and reduced visual impacts without C Street ramps, there would be greater impacts to local traffic as traffic that would have used the C Street ramps would be routed to the Mill Plain interchange, thereby increasing traffic volumes on the local street network and requiring additional mitigation. Both design options received a mix of positive and negative feedback from the public; however, there were more comments in support of the with C Street ramps design option. The with C Street ramps design option also has more support from the local partner agencies.

### I-5 Alignment Design Options

#### *Centered I-5 – Recommended Design Option*

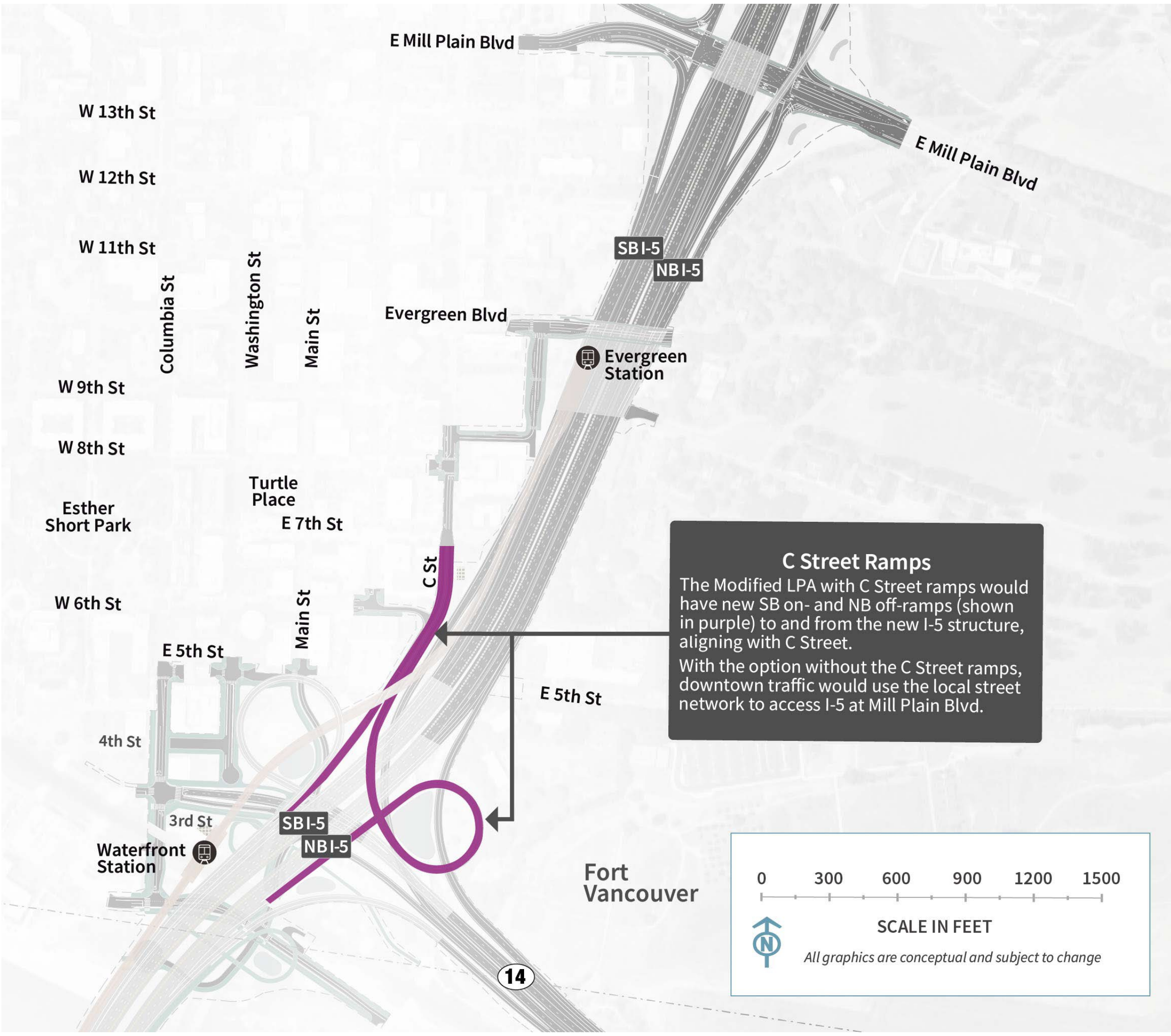
This design option would maintain the location of the existing I-5 mainline alignment through downtown Vancouver between the SR 14 interchange and the Mill Plain Boulevard interchange.

#### *I-5 Shifted West*

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 IBR Program recommends advancing the centered I-5 alignment design option**. Both I-5 mainline alignments would provide important benefits to highway operations and safety and have similar impacts to many other resources, particularly the natural environment. The westward shift design option would notably increase acquisitions resulting in the displacement of an additional three businesses (with approximately 140 employees) and 33 residential units, and the physical removal of the historic Normandy Apartments. However, the westward shift would reduce the area of acquisition and other impacts to the Vancouver National Historic Reserve (VNHR) Historic District (which includes the Fort Vancouver National Historic Site). While some public comments noted the reduced impacts to the VNHR Historic District from the westward shift design option, others raised concerns about its effects on safety, congestion, and increased residential and business displacements.

Figure 1-24. Modified LPA With C Street Ramps




## COLLECTOR-DISTRIBUTOR ROADWAYS

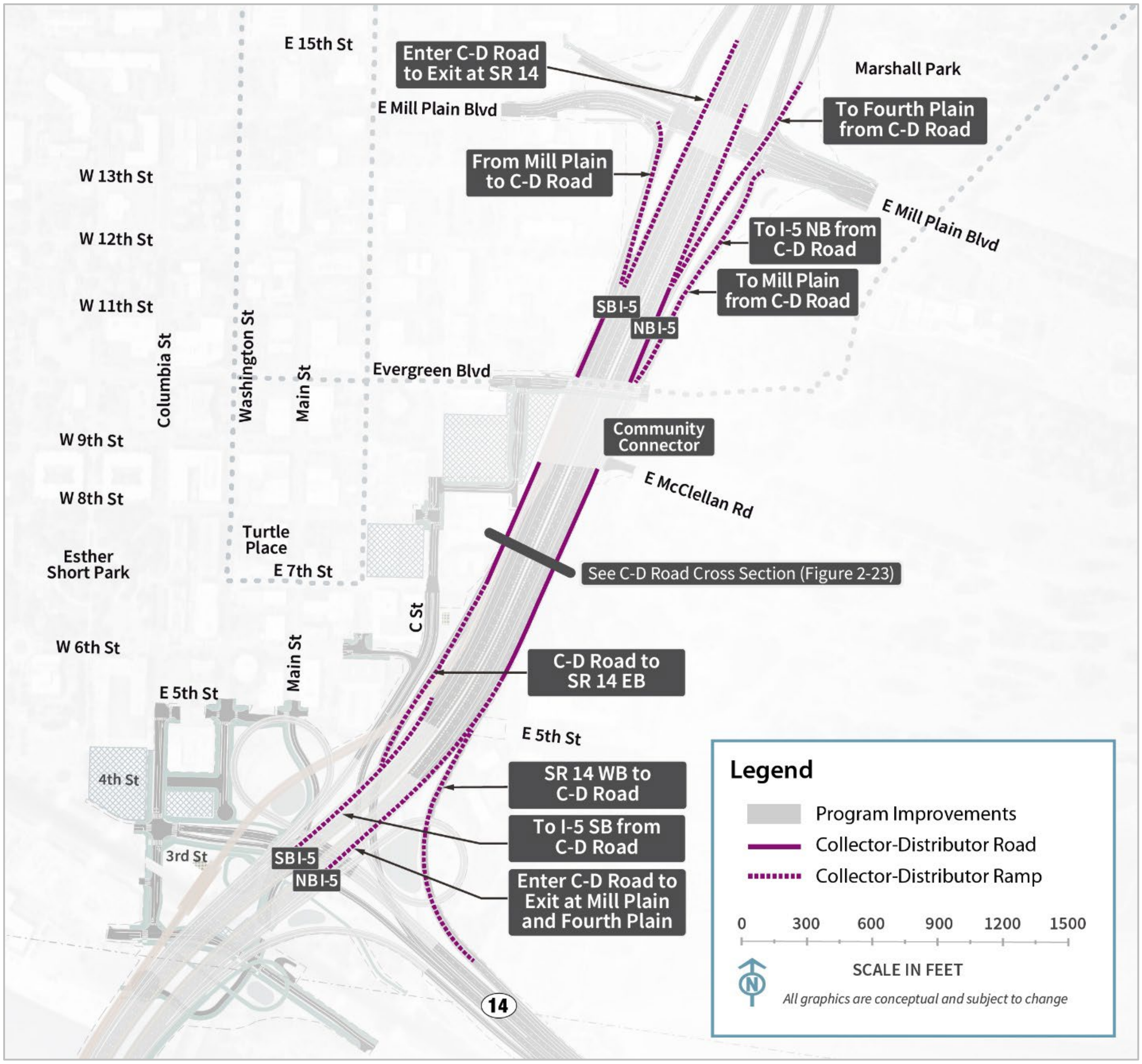
Figure 1-25 shows the location of the collector-distributor (C-D)[11] roadways in downtown Vancouver, and Figure 1-26 shows a typical cross section of the C-D roadways.

The on-ramp from SR 14 westbound would join the I-5 northbound off-ramp to Mill Plain/Fourth Plain Boulevard, forming the northbound C-D roadway between SR 14 and Fourth Plain Boulevard. The C-D roadway would provide access from northbound I-5 to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard. The C-D roadway would also provide access from westbound SR 14 to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard, and to the on-ramp to northbound I-5.

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

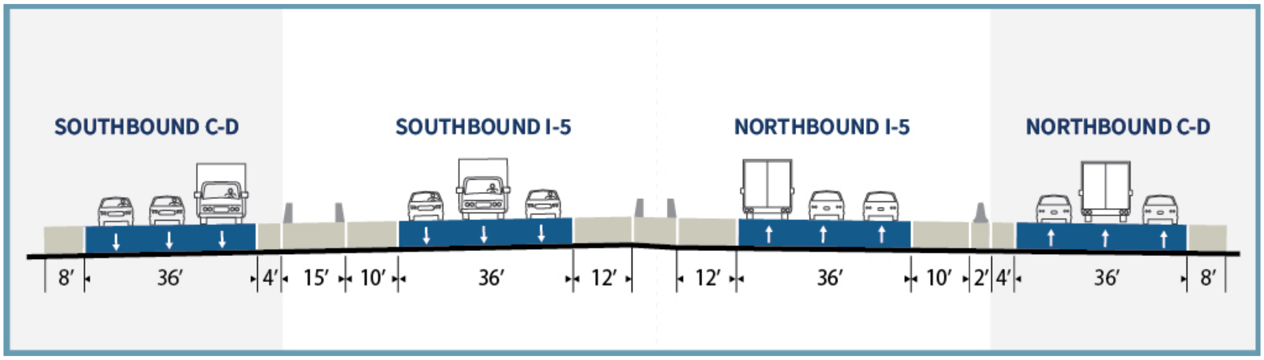
On southbound I-5, the off-ramp to SR 14 would join the southbound I-5 on-ramp from Mill Plain Boulevard to form a C-D roadway. The C-D roadway would provide access from southbound I-5 to the off-ramp to eastbound SR 14 and from Mill Plain Boulevard to the off-ramp to eastbound SR 14 and the on-ramp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

Figure 1-25. Collector-Distributor Roadways




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

Figure 1-26. Typical Cross Section of the Collector-Distributor Roadways




The location of this cross section is shown on Figure 1-25.

### 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 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 because the station would be situated approximately 90 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. Active transportation facilities, described below, would connect to the new Waterfront Station. A new TPSS would be constructed north of the transit platform. 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 would be similar between the C Street ramp and I-5 westward shift 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 (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 straddle bents[12] on either side of the roadway where needed. The Evergreen Station would be located at the same elevation as Evergreen Boulevard and the proposed Community Connector, and it would provide connections to the existing C-TRAN BRT system. Passenger drop-off facilities would be near the station and would be coordinated with the C-TRAN bus service at this location. Active transportation facilities, described below, would connect to the new Evergreen

[12] A straddle bent is a type of bridge support structure that “straddles” vehicle lanes and supports a flyover ramp.

Station. A new TPSS would be located on the south side of 7th Street, approximately 750 feet south of Evergreen Station.

### PARK AND RIDES

The Modified LPA would provide parking capacity to accommodate 1,270 vehicles at designated park and rides in Vancouver along the LRT alignment (Figure 1-23) located near the Waterfront and Evergreen LRT stations. Parking capacity would be provided for 570 vehicles near the Waterfront Station and for 700 vehicles near the Evergreen Station.

> Park and rides can expand the catchment area of public transit systems (the geographic area from which a station draws ridership), 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.

The park and rides would be designed to accomplish the following:

- Support transit ridership.
- Promote station access by walking, biking, rolling, and transit.
- Support City of Vancouver objectives to increase mobility and access for a vibrant downtown.
- Include existing parking facilities in downtown Vancouver to help meet the projected demand for park and rides in areas where City of Vancouver studies show surplus parking supply.

Additional information regarding the park and rides can be found in the Transportation Technical Report.

As presented in the Draft SEIS, the Modified LPA would provide parking capacity for LRT riders by locating a single park and ride near the Waterfront Station with approximately 570 parking spaces; three sites were considered for this facility. Similarly, a single park and ride near the Evergreen Station would provide approximately 700 parking spaces; two sites were considered. Based on further design analysis, public comment received on the Draft SEIS, and coordination with local agencies, the approach to providing parking capacity for LRT riders was adjusted to focus on dispersed parking across more facilities, including using all three sites previously identified near the Waterfront Station and both sites previously identified near the Evergreen Station. The approach to disperse parking capacity across more sites would correlate to smaller sites in terms of structure size above or below ground.

The sites under consideration are described below, and the evaluation of impacts and benefits to developing a single, large park and ride at each of the two LRT station or five smaller park and rides are evaluated in this report.

### Waterfront Station Park and Rides

Studies included in Appendix D to the Final SEIS have shown the need for park-and-ride capacity to accommodate 570 vehicles in the vicinity of the Waterfront Station. Three possible sites are analyzed (Figure 1-23):

- 1a. Columbia Way (below I-5). This 0.75-acre site could be developed as a new aboveground one-level parking structure. Access would be via Columbia Way. It could support approximately 70 parking spaces.
- 1b. Columbia Street/SR 14. This 0.50-acre site could be developed as a new aboveground six-level structure along the east side of Columbia Street and north of the SR 14 westbound off-ramp. Access would be via Washington Street. It could accommodate approximately 250 parking spaces. To provide all 570 parking spaces at this site, the structure would need to be 10 to 12 levels.
- 1c. Columbia Street/Phil Arnold Way (Waterfront Gateway Site). This 1.5-acre site could be developed as a new surface lot along the west side of Columbia Street, north of Phil Arnold Way. Access would be via Phil Arnold Way. A surface lot would provide approximately 250 parking spaces. To provide all 570 parking spaces at this site, a new four-level structure would be needed.

**The IBR Program recommends advancing 1,270 park-and-ride spaces dispersed across five sites in Vancouver along the light-rail alignment, including three sites near the Waterfront Station and two sites near the Evergreen Station**. All of the park and rides would provide similar benefits to the community by increasing the transit stations' catchment areas and making transit more accessible. There could be minor localized differences in traffic patterns and transit ridership depending on the location of spaces. Dispersing the 1,270 parking spaces across five park and rides rather than concentrating the spaces at a single location each near the Waterfront Station and Evergreen Station would promote compatibility with local planning goals and plans for multiuse development, multimodal access, and attractive public spaces. As the FTA's Capital Investment Grant process progresses, the IBR Program team will refine the Program's transit components, which will contribute to further information on parking needs to support transit ridership.

Studies (Appendix D to the Final SEIS) leading to the Modified LPA in 2022 evaluated a mix of light-rail station sites and park and rides and found that 1,270 spaces serving the Waterfront and Evergreen Stations, combined with bus and active transportation improvements, would attract the most riders.

### Evergreen Station Park and Rides

Studies included in Appendix D to the Final SEIS have shown the need for park and rides to accommodate 700 vehicles in the vicinity of the Evergreen Station. Two possible sites are analyzed in this technical report (see Figure 1-23):

- 2a. Library Square. This 3.2-acre site could be developed as a new underground three- to four-level structure east of C Street and south of Evergreen Boulevard. It could accommodate approximately 400 parking spaces. To provide all 700 parking spaces at this site, the structure would require seven or more levels below ground.[13] This site could be combined with Site 2b to provide a total of 700 spaces.

- 2b. Columbia Credit Union. This approximately 1-acre site is an existing parking structure/commercial building and provides an estimated 400 parking spaces to current users on four levels above ground. The parking capacity would not be exclusively available for transit users; however, up to 300 spaces could be used for transit riders. This site could be combined with Site 2a to provide a total of 700 spaces.

#### 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 helix path, cross back below I-5 to the west side of I-5, run beneath the elevated light-rail crossing over BNSF, and then loop down to connect to the Main Street extension at the intersection underneath I-5 with connections to the Waterfront Station from the active transportation facilities. Connections to the Waterfront Renaissance Trail would be made by facilities along Main Street and Columbia Way (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 for all design options.

As part of the Modified LPA, a Community Connector is proposed to be built over I-5 just south of Evergreen Boulevard and east of the Evergreen Station (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 with connections to the Evergreen Station from 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 (Figure 1-3 shows an overview of the geographic subareas). Figure 1-27 shows all highway and interchange improvements in Subarea D.

#### 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.

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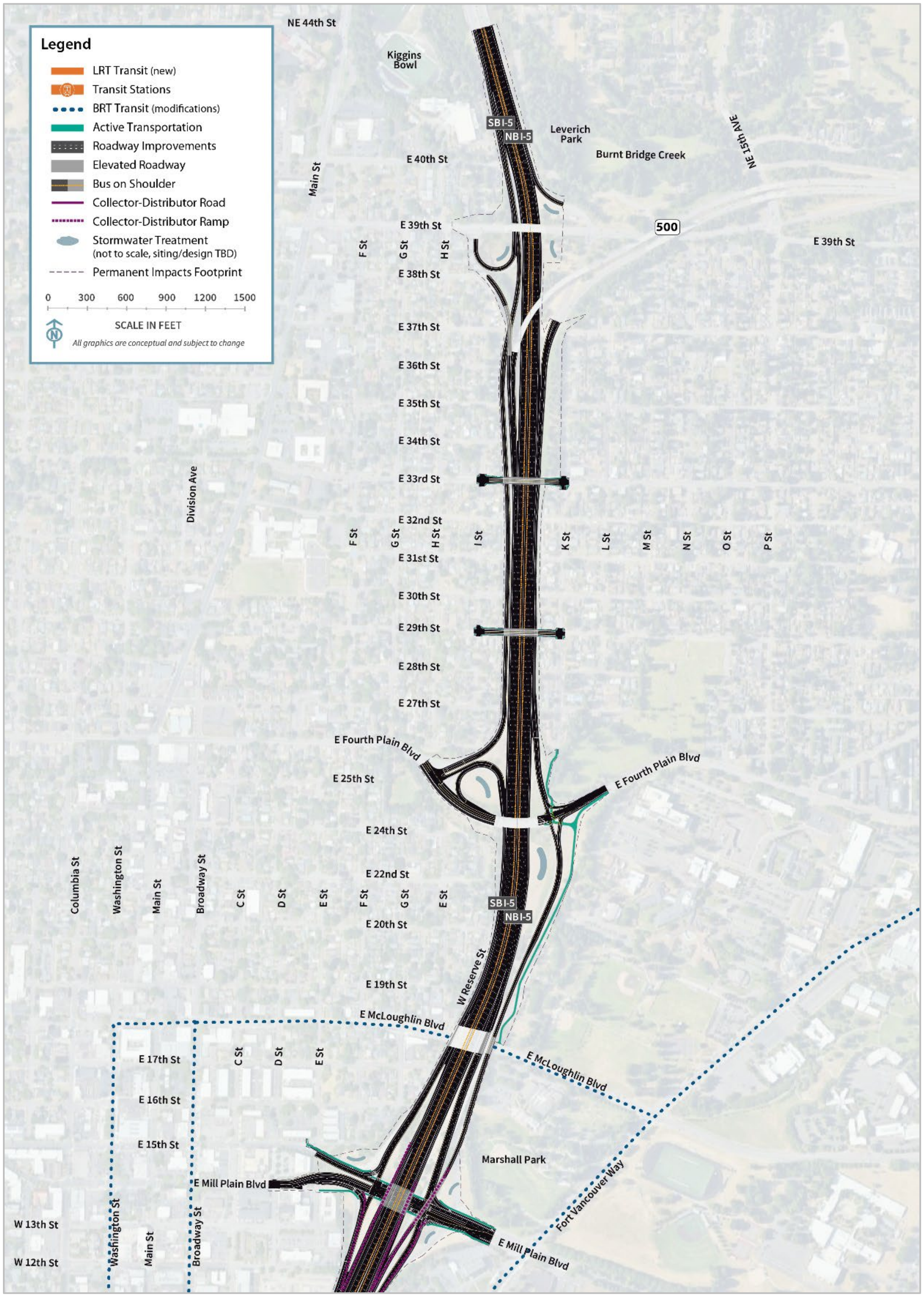
[13] The maximum depth of an underground parking structure at Library Square is provided for comparative purposes only. An underground parking structure would likely not exceed 3 or 4 levels because of engineering and environmental constraints.

Figure 1-27. Upper Vancouver (Subarea D)




BRT = bus rapid transit; LRT = light-rail transit; TBD = to be determined

### MILL PLAIN BOULEVARD INTERCHANGE

The Mill Plain Boulevard interchange is north of the SR 14 interchange (Figure 1-27). This interchange would be reconstructed as a tight-diamond configuration but would otherwise remain similar in function and footprint 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 1-27), improvements would include reconstruction of the I-5 ramp terminal intersections. The existing bridge for Fourth Plain Boulevard over I-5 would be retained. Northbound I-5 traffic exiting to Fourth Plain Boulevard would first exit to the northbound C-D roadway, which provides off-ramp access to Fourth Plain Boulevard and Mill Plain Boulevard. The westbound SR 14 to northbound I-5 on-ramp also joins the northbound C-D roadway before continuing north past the Fourth Plain Boulevard and Mill Plain Boulevard off-ramps as an auxiliary lane. The southbound I-5 off-ramp to Fourth Plain Boulevard would be braided below the 39th Street on-ramp to southbound I-5. This change would eliminate the existing nonstandard weave between the SR 500 interchange and the off-ramp to Fourth Plain Boulevard. It would also eliminate the existing westbound SR 500 to Fourth Plain Boulevard off-ramp connection. The existing overcrossing of I-5 at 29th Street would be reconstructed to accommodate a widened I-5, provide adequate vertical clearance over I-5, and provide pedestrian and bicycle facilities.

### SR 500/39TH STREET INTERCHANGE AREA

The northern terminus of the I-5 improvements would be in the SR 500 interchange area (Figure 1-27). 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. On the east side of I-5, a new shared-use path would connect E McLoughlin Boulevard to Fourth Plain Boulevard. 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 Light-Rail Operations and Maintenance Facility Expansion

The TriMet Ruby Junction Light-Rail OMF 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 1-28). Improvements would include additional storage tracks for LRVs and maintenance materials and supplies; expanded LRV maintenance bays; expanded parking and employee support areas for additional personnel; an additional maintenance building for daily cleaning and periodic weather-dependent treatments for LRV maintenance, demolition, and relocation of a maintenance building (Ruby West); tenant improvements and new structures for affected operations; and a third lead track at the northern entrance to the Ruby Junction Light-Rail OMF. Adjacent parcels would be acquired to accommodate maintenance and storage needs required for or impacted by the Modified LPA. Figure 1-28 shows the proposed footprint of the expansion.

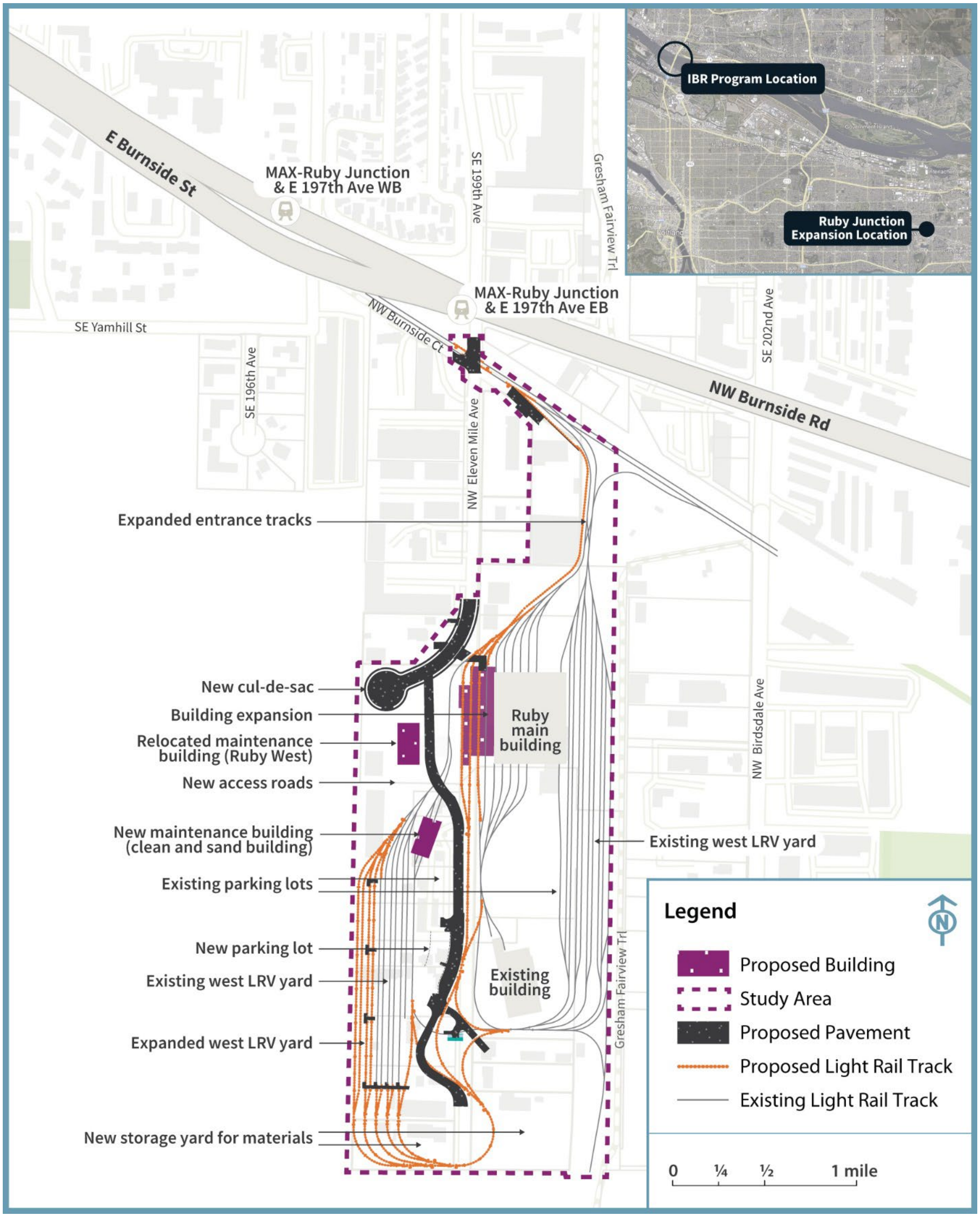
The existing main building would be expanded west to provide additional maintenance bays. Today, Eleven Mile Avenue extends from NW Burnside Road and dead ends at the southern limits of the existing OMF. To make space for the building expansion, the existing Eleven Mile Avenue public right of way would be vacated and would terminate in a new cul-de-sac west of the main building. A new cul-de-sac would be required to meet City of Gresham code requirements for fire access and turnaround. New internal/nonpublic access roads would be constructed to maintain access to TriMet buildings south of the cul-de-sac; these would impact an existing maintenance building (Ruby West), which would be demolished and rebuilt within Ruby Junction Light-Rail OMF.

The existing western 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 southeastern corner of the campus. Immediately east of the storage yard, a double track LRV maintenance building would be constructed impacting existing parking. Various other surface parking areas in the west yard would also be relocated north of the cul-de-sac.

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 and proposed tracks adjacent to the existing Ruby Junction building located to the south. The connections to the runaround track would require partial demolition of an existing TriMet building and, full demolition of one existing building and partial demolition of another building on the adjacent private property to the south. These affected functions would be housed in a new replacement building on site.

A third track would be needed at the north entrance to the Ruby Junction Light-Rail OMF 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 1-28. Ruby Junction Light-Rail Operations and Maintenance Facility Study Area




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

#### 1.1.6.2 Expo Center Overnight Light-Rail Vehicle Facility

An overnight facility for LRVs would be constructed on the southwest corner of the Expo Center property (as shown on Figure 1-29). The inclusion of the Expo Overnight Facility allows TriMet the ability to maintain current service and maintenance operations on their Blue Line system and reduce deadheading between Ruby Junction and the northern terminus of the MAX Yellow Line extension. Deadheading occurs when LRVs travel without paying passengers to move the vehicles to and from service. Currently, Blue Line is maintained through a limited nighttime work window. With the inclusion of the Expo Overnight Facility, trains originating service at Evergreen have substantially less deadhead time, reducing Yellow Line operating costs, and Blue Line maintenance windows are retained.

The facility would provide a yard access track, storage tracks for approximately 13 LRVs, one building for light LRV maintenance and operator facilities, a TPSS, a sand silo, a parking lot for operators and facility staff, space for security personnel, and other associated facilities. This facility and the lead tracks connecting to it would necessitate relocation and reconstruction of the internal circulation road from the Expo Road entrance to approximately 100 feet west of Building E of the Expo Center (including southern areas of the parking lot, including gates and booths). However, it would not affect existing Expo Center buildings.

The overnight facility lead track 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 TPSS building and potentially the existing signals/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 existing C-TRAN OMF located at 2425 NE 65th Avenue in Vancouver. These additional bus bays, which would not require the acquisition of any new property, would provide maintenance capacity for the additional express bus service on I-5 (Section 1.1.7, Transit Operating Characteristics). Modifications to the facility would accommodate new vehicles as well as maintenance equipment.

Figure 1-29. Expo Center Overnight LRV Facility


## 1.1.7 Transit Operating Characteristics

### 1.1.7.1 Light-Rail Transit 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 including all design options, LRT service in the new and existing portions of the Yellow Line in 2045 would operate with 6.7-minute average headways[14] during the 2-hour morning peak period. Midday and evening headways would be 15 minutes, and late-night headways would be 30 minutes. LRT 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 I-5 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: the 99th Street Transit Center and downtown Vancouver. This route currently provides weekday service with 20-minute peak and 60-minute off-peak headways.

In 2045, for both the No-Build Alternative and Modified LPA, C-TRAN Route 105 would be revised to only provide direct service from the Salmon Creek Park and Ride and 99th Street Transit Center to downtown Portland with no intermediate stops in downtown Vancouver. Under the Modified LPA with all design options, this route would operate at 5-minute peak headways with no service in the off-peak, compared to 10-minute peak headways under the No-Build Alternative. Under both the No-Build Alternative and the Modified LPA, 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 and would operate at 15-minute peak and 30-minute off-peak headways and 10-minute peak and 30-minute off-peak headways, respectively.

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 during the peak and 30 minutes during the off-peak. These two routes provide the same routing and frequencies in both the No-Build Alternative and the proposed Modified LPA.

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 (approximately 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

[14] Headways are defined as gaps between arriving transit vehicles.

shoulder widths at the north and south ends of the corridor. Figure 1-6, Figure 1-10, Figure 1-23, and Figure 1-27 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 double-decker or articulated buses would be purchased.

With the C Street ramps design option, C-TRAN Route 101 would use bus on shoulder south of the SR 14 interchange but would not use the full extent of bus-on-shoulder lanes that would be included in the Modified LPA because the route would need to begin merging over early to use the C Street off-ramp to access downtown Vancouver. Without the C Street ramps design option, C-TRAN Route 101 would be rerouted to use the Mill Plain interchange to access downtown Vancouver. Under this design option, the Route 101 would also not use the full extent of bus-on-shoulder lanes that would be included in the Modified LPA but would use the bus on shoulder south of Mill Plain Boulevard and begin merging over early to use the Mill Plain off-ramp.

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

Two TriMet bus routes would be adjusted to accommodate the transit improvements associated with the Modified LPA. TriMet Line 6 bus route would be changed to terminate at the Expo Center MAX Station instead of Hayden Island, where it terminates currently and in the No-Build Alternative. The new Line 6 route would require passengers to transfer to the new LRT connection to access Hayden Island. TriMet Line 6 is anticipated to travel from Delta Park MAX Station north along Expo Road to the Expo Center MAX Station. Table 1-3 shows the existing service and anticipated future changes to TriMet Line 6. In addition to Line 6, TriMet Route 11 could require slight modifications to maintain transfers to the Expo Center MAX Station, depending on the final design of the station and surrounding area.

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 at the proposed 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 may move service from Broadway to C Street.

For both TriMet and C-TRAN detailed service planning analysis, including obtaining public feedback for service changes associated with the Modified LPA, would be conducted prior to the start of revenue service.

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 the Delta Park MAX Station, north along Expo Road to connect via facilities on the west side of I-5 with the Expo Center MAX Station. |
| TriMet Line 11 | Connects East Columbia, Expo Center, Smith/Bybee lakes, Rivergate and St. Johns via Marine Drive, Lombard, Columbia, Fessenden, and Ivanhoe. | Stops along Marine Drive would be relocated or the line would be rerouted slightly to connect via facilities on the west side of I-5 with the Expo Center MAX Station. |
| C-TRAN Fourth Plain and Mill Plain bus rapid transit (The Vine) | Runs between downtown Vancouver and the Vancouver Mall Transit Center via Fourth Plain Boulevard, with a second line along Mill Plain Boulevard. In the study area, service currently runs along Washington and Broadway Streets through downtown Vancouver. | Route would be revised to begin/end near the Evergreen Station in downtown Vancouver and provide service along Evergreen Boulevard to Fort Vancouver Way, where it would travel to or from Mill Plain Boulevard or Fourth Plain Boulevard depending on clockwise/counterclockwise operations. The Fourth Plain Boulevard route would continue to serve existing Vine stations beyond Evergreen Boulevard. |
| C-TRAN #2 Lincoln | Connects the 99th Street Transit Center to downtown Vancouver via Lincoln and Kaufman Avenues. Within the study area, service currently runs along Washington and Broadway Streets between 7th and 15th Streets in downtown Vancouver. | Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver. |
| C-TRAN #25 St. Johns | Connects the 99th Street Transit Center to downtown Vancouver via St. Johns Boulevard and Fort Vancouver Way. Within the study area, service currently runs along Evergreen Boulevard, Jefferson Street/Kaufman Avenue, 15th Street, and Franklin Street in downtown Vancouver. | Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver. |

| Bus Route | Existing Route | Changes with Modified LPA |
|---|---|---|
| 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

Consistent with the CRC LPA, 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 provide different mode, time, and destination choices for trips across the Columbia River. The sections below describe the tolling authority and tolling operations.

#### 1.1.8.1 Tolling Authority

Federal and state laws provide authority to toll the I-5 crossing. The IBR Program plans to toll the new Columbia River bridges under the federal tolling authorization program codified in 23 U.S.C. § 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 on the Interstate Bridge in 2013 and gave the Oregon Transportation Commission (OTC) the authority to set toll rates and policies. Subsequently, in January 2025, the OTC reviewed and approved the I-5 tollway project application that designated the IBR Program as a "tollway project" and the facility (the I-5 bridge) as a tollway for construction as defined in Oregon Revised Statutes (ORS) 383.003(8) and pursuant to ORS 383.015.

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, which consists of two commissioners each from the OTC and WSTC, and tasked the subcommittee with developing toll rate and policy recommendations for joint consideration and adoption by each state's commission. At the direction of the commissions, all toll scenarios being analyzed in the next round of tolling analysis (referred to as a level 3 toll traffic and revenue study) for the IBR Program assume a low-income discount. Formal action is still needed by the commissions to implement rates and policies, including discounts and exemptions.

In December 2024, a memorandum of understanding was executed by both states that outlined their shared understanding of tolling operations, including cooperation between the state Departments of Transportation and roles and responsibilities for the IBR Program. Toll collection would be managed by WSDOT, including drivers' option to use *Good To Go!* accounts for paying tolls. In addition to the memorandum, 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.

**Tolling Equipment**

Below are the key types of equipment used to collect data for billing purposes.

**Transponders:** Small tags affixed to vehicles that communicate with tolling equipment as the vehicle passes.

**Antenna/Readers:** As a vehicle with a transponder enters a toll zone, an antenna transmits a signal between the transponder and the reader. The reader then transmits pertinent information to the toll zone controller.

**Automatic Vehicle Classification:** Various roadway devices installed overhead and/or in pavement to detect and identify the vehicle type (e.g., truck, bus, personal vehicle, etc.).

**License Plate Image Capture Cameras:** Cameras and software that capture images of license plates as vehicles pass.

**Digital Video Audit System:** Various types of cameras monitor traffic flow and equipment locations.

### 1.1.8.2 Tolling Operations

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 evaluated multiple toll scenarios with two different variable toll schedules by time of day. For purposes of this NEPA analysis, the lowest toll schedule was analyzed, with tolls assumed to range between $1.50 and $3.15 (state fiscal year 2026 dollars) for passenger vehicles and light trucks (i.e., vehicles with two axels) with a *Good To Go!* account. The assumed toll range and other assumptions are documented in the IBR Program Level 2 Toll Traffic and Revenue Study (IBR 2023). Medium and heavy trucks (i.e., vehicles with more than two axels) would be charged a higher toll than passenger vehicles and light trucks. Passenger vehicles and light trucks without a *Good To Go!* 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.

It is assumed that tolling would begin on the existing Interstate Bridge, referred to as "pre-completion tolling," in 2027, allowing time after receiving a Record of Decision to hire a contractor, install tolling equipment, and conduct the rate-setting process. The purpose of pre-completion tolling would be to generate initial capital construction funding on a pay-as-you-go basis. Later, toll revenue would be used to secure a portion of Program financing to pay back bonds or loans. Pre-completion tolling would also help pay current interest on the debt to minimize interest costs. Once the new Columbia River bridges are completed, the traffic and tolling operations would shift from the existing Interstate Bridge over to the new bridges, and 24-hour tolls would be implemented; this is referred to as "post-completion tolling."

The start dates for pre-completion tolling would be determined based on the IBR Program environmental and construction timelines; placeholders for tolling start dates were used in this NEPA analysis. This NEPA analysis assumed that pre-completion tolling on the existing Interstate Bridge would be toll-free overnight between 11 p.m. and 5 a.m. (IBR 2023). The OTC and WSTC are also considering this as an option during the level 3 toll traffic and revenue study; however, a decision has not been made on whether these toll-free hours would be implemented. This toll-free period could help avoid situations where users would be charged during lane or partial bridge closures when construction delays may occur.

Tolls would be collected using an all-electronic toll collection system using transponder pass readers and license plate cameras mounted to structures over the roadway. Each traffic lane and shoulder would have a pass reader and license plate camera to ensure accurate detection of vehicles. Toll collection booths would not be required. Instead, motorists could obtain a pass and set up a *Good To Go!* account that would automatically bill the account holder associated with the pass each time the vehicle crossed the bridge. Customers without passes would be tolled by a license plate recognition system that would bill the address of the owner registered to that vehicle's license plate.

There would be two separate "toll zones," which are the area in which the tolling system would detect and classify passing vehicles and then transmit pertinent information to the toll zone controller (Figure 1-30). There would be one zone for northbound traffic and one zone for southbound traffic. During pre-completion tolling, the toll zones would be located on I-5 in Vancouver, between the Interstate Bridge and the BNSF Railway. The location of the post-completion toll zones would be determined at a later date, but it is anticipated that both toll zones would remain in Vancouver.

One gantry (i.e., overheard structure) would be located in each toll zone (Figure 1-30). Generators and equipment cabinets would be located nearby, which would house various equipment needed to support toll operations.

Figure 1-30. Toll Zone

Additional equipment cabinets would be placed throughout the Program area to support tolling operations, such as near the toll rate signage (see below).

As previously noted, a key element of tolling would be variable-rate pricing, where toll rates would differ based on the time of day a vehicle uses the bridge. To accomplish this, toll rate signs would be installed at route decision points on local roads, I-5 on-ramps, and on I-5, including locations north and south of the bridges where drivers make informed route decisions (e.g., I-5/Interstate 205 junction and I-5/Interstate 84 junction). The intent of the toll rate signs is to provide both static and variable pricing information. The static sign would contain details such as direction, wayfinding, or other information. These signs would also include a variable message sign panel that would show toll rate(s) in effect at that time.

### 1.1.9 Transportation System- and Demand-Management Measures

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

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

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

In addition to these fundamental elements of the Modified LPA, facilities and equipment would be

**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.

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 primary 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 strategies including ramp metering and dynamic speed limits. These strategies are intended to manage congestion by controlling traffic flow.

### 1.1.10 Off-Site Mitigation Sites

The IBR Program will provide off-site mitigation for unavoidable impacts to natural resources, including fish and wildlife species and their habitats, wetlands, surface waters, floodplains, and other regulated habitat features (refer to the Final SEIS, Sections 3.14, Water Quality and Hydrology; 3.15, Wetlands; and 3.16, Ecosystems).[15] Applicable federal, state, and local regulatory frameworks require mitigation sequencing that includes avoidance and minimization of impacts, and compensatory mitigation to achieve "no net loss" of the resource or its functions. Mitigation must fully offset the impacts of the Modified LPA and achieve this "no net loss" standard. The Modified LPA would result in unavoidable impacts to natural resources, which would require mitigation under one or more regulatory frameworks. Mitigation plans and mitigation bank use plans will be prepared to provide compensation for any such unavoidable impacts to regulated resources (wetlands, waters, floodplain, sensitive habitats) and to demonstrate that the IBR Program will achieve "no net loss" of function of these resources. The IBR Program is preparing functional assessments and coordinating with regulatory agencies to quantify the amount and type of compensatory mitigation required to offset Program impacts and achieve "no net loss."

It is anticipated that compensatory mitigation for unavoidable impacts to aquatic and terrestrial habitats and species in Washington will be provided through the purchase of credits from the proposed Wapato Valley Mitigation and Conservation Bank (Figure 1-31). The bank is approximately 876 acres and is located in the Columbia River floodplain at the mouth of the Lewis River, approximately 19 river miles downstream of the Interstate Bridge. Approval of the bank is expected in 2026.

It is anticipated that compensatory mitigation for unavoidable impacts to wetlands, and aquatic and terrestrial habitats and species in Oregon will be provided partially through the purchase of advance

[15] On-site mitigation is identified and analyzed in relevant subsections of Chapter 3, Existing Conditions and Environmental Consequences of the Final SEIS.

mitigation credits at ODOT's proposed Columbia Bottomlands Advance Mitigation/Conservation Site, and partially through the purchase and protection under conservation easement of a site on West Hayden Island (shown on Figure 1-31). The Columbia Bottomlands Advanced Mitigation/Conservation site is located in Scappoose Bay, a slough of Multnomah Channel, in Columbia County, Oregon. The site is located approximately 1 mile upstream of where the Multnomah Channel meets the Columbia River and approximately 20 river miles downstream of the Interstate Bridge. The site has been designed to provide advance mitigation credits for impacts to wetlands and aquatic and terrestrial habitats and species for future ODOT projects. All impacted wetlands and other water features would be mitigated in accordance with current USACE mitigation policies, and the conditions of the Section 404 Permit. All compensatory mitigation plans would be developed in coordination with the USACE and other appropriate agencies as part of the Section 404 permitting process. The USACE and other appropriate agencies would determine the appropriate level of mitigation based upon the functions lost or adversely affected as a result of impacts to aquatic resources.

The proposed site on West Hayden Island is approximately 65 acres in size and is located approximately 2.5 river miles downstream of the Interstate Bridge, on the south side of the island adjacent to North Portland Harbor. The site is currently owned by the Oregon Department of State Lands, but ODOT has proposed to purchase this site and place it under a conservation easement. One or more compensatory mitigation projects may also be conducted on the site. The specific activities to be conducted at this site would be developed in coordination with the applicable regulatory agencies for each of the various permit applications.

In addition to the compensatory wetland and habitat mitigation described above, the IBR Program may need to excavate material from within the 100-year floodplain to address the compensatory excavation requirements of the City of Portland's recently updated floodplain ordinance. If such activity is required, it is anticipated that this material would be removed from upland portions of the 65-acre parcel on West Hayden Island described above or from aquatic areas adjacent to this parcel. If such excavation activities are conducted, excavated materials will be disposed of at a location approved to receive that type of material.

Figure 1-31. Potential Compensatory Mitigation Sites

## 1.2 Modified LPA Construction

Construction of the IBR Program would be sequenced in accordance with many factors, such as the scale of improvements, different types of infrastructure and associated construction specialties required, timing of funding received, maintenance of traffic on I-5, navigation on the Columbia River, seasonal and weather constraints, permit conditions, and other considerations. Multiple construction packages are anticipated to be developed and delivered by different agencies—WSDOT, ODOT, TriMet, and C-TRAN—that will use various delivery methods (e.g., design-bid-build, design-build, progressive design-build, construction manager/general contractor).

The first construction packages are anticipated to be the new Columbia River bridges and approaches. Subsequent construction packages would be sequenced throughout the Program area. Early construction activities may occur in the Program area to prepare for the bridge replacement work. Demolition of the existing Interstate Bridge would take place after the new Columbia River bridges were opened to traffic. Construction of other components of the Modified LPA would be sequenced during and after the construction of the new Columbia River bridges begins.

Electronic tolling infrastructure for the existing Interstate Bridge would be constructed and operational near the start of construction on the new Columbia River bridges and would be constructed and operational for the new Columbia River bridges in time for their opening. The toll rates and policies for tolling (including pre-completion tolling) would be determined by the OTC and WSTC (refer to Section 1.1.8, Tolling).

### 1.2.1 Construction Components, Packaging Plan, and Duration

Table 1-4 lists the main construction components of the Modified LPA along with the estimated construction durations and descriptions of the associated work. Construction packages are also listed in Table 1-4 and illustrated in Figure 1-32. These main construction components would be defined by some functional improvement to the Program corridor; for example, construction of the new bridges would be coordinated with the construction of the connections to the existing I-5, enabling use of the new bridges while other components of the Program are constructed. Each listed component would require multiple construction packages—small and large, general and specialty. As construction progresses, interim connections may be in place while subsequent components are built and final connections and finishes are completed. This preliminary construction plan may change as the Program advances toward construction. Construction packages may further be combined or separated throughout delivery of the Program. Construction of all components identified in the Program could last more than 10 years.

The estimated durations are shown as ranges to reflect the potential for Program funding to be sequenced over time. In addition to funding, contractor schedules, regulatory restrictions on in-water work, 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 most periods of construction, three travel lanes in each direction on I-5 (accommodating personal vehicles, freight, and buses) would remain open during peak hours. Off-peak and weekend restrictions and closures could be required during construction. Active transportation connections would be maintained throughout construction. Advanced coordination and public notice would be given for restrictions, intermittent or longer-term closures, and detours for highway, local roadway, transit, and active transportation users via accessible facilities and wayfinding (refer to the Final SEIS, Section 3.1, Transportation, for additional information, including for local street and ramp or interstate access closures). At least one Columbia River navigation channel would remain open to shipping throughout construction. Advanced coordination and notice would be given for restrictions or intermittent closures to navigation channels as required (refer to the Final SEIS Section 3.2, Navigation, for additional information).

Table 1-4. Preliminary Construction Packaging Plan

| Component and General Location | Estimated Duration | Description | Construction Packages |
|---|---|---|---|
| Columbia River bridges, approaches, and demolition of Interstate Bridge<br>*Hayden Island to Evergreen Boulevard* | 6 to 8 years | • General sequence for new bridges would include initial preparation and installation of foundation piles, shaft caps, pier columns, superstructure, and deck elements, followed by systems and finish work.<br>• SR 14 interchange would be constructed in a separate construction package and must be completed before all traffic could be transferred to the new Columbia River bridges.<br>• Demolition of the existing Interstate Bridge could begin only after traffic is transferred to the new Columbia River bridges. | • Columbia River Bridges [a]<br>• Approaches [a]<br>• Pre-completion Tolling Signage and Equipment Installation<br>• SR 14 A<br>• Evergreen Bridge<br>• Interstate Bridge Demolition |
| Light-rail and bus-on-shoulder transit<br>*Expo Station to Evergreen Station; Ruby Junction* | 4 to 7 years | • The light-rail alignment would be partially supported by the southbound Columbia River bridge and approach structure guideways.<br>• Light-rail construction would include all infrastructure associated with light-rail elements of the Transit Packages construction package (e.g., overhead catenary system, tracks, stations, and park and rides).<br>• Bus on shoulder would include corresponding bus elements of the Transit Packages construction package. | • North Portland Harbor Transit Bridge<br>• Marine Drive A (supports transit improvements)<br>• Hayden Island A (supports transit improvements)<br>• Light-rail Overnight Facility<br>• Transit Packages<br>• Ruby Junction |

| Component and General Location | Estimated Duration | Description | Construction Packages |
|---|---|---|---|
| Marine Drive and Hayden Island interchanges and North Portland Harbor bridges<br>*Marine Drive to Hayden Island* | 4 to 10 years | • Hayden Island interchange construction duration would not necessarily entail continuous active construction.<br>• The North Portland Harbor bridges could include sequenced construction of southbound bridges, northbound bridges, and demolition of the existing North Portland Harbor bridge to maintain traffic mobility during construction.<br>• Hayden Island and Marine Drive interchanges could be broken into several contracts, which could spread work over a longer duration. | • Hayden Island Surface Streets<br>• Hayden Island Interchange<br>• North Portland Harbor Bridges<br>• Oregon I-5 Southbound<br>• Oregon I-5 Northbound<br>• North Portland Harbor Bridge Removal<br>• Marine Drive Interchange<br>• North Expo Road |
| Mill Plain Boulevard, Fourth Plain Boulevard, and SR 500/39th Street interchanges<br>*Mill Plain Boulevard to SR 500* | 3 to 4 years | • Construction of these interchanges could be independent from each other. | • Mill Plain Boulevard Interchange<br>• Washington North |

a The Columbia River Bridges and Approaches construction packages include light-rail guideway from the Hayden Island Bridge Approach, the Columbia River bridges, north to Evergreen Boulevard.

Figure 1-32. Preliminary Construction Packages

### 1.2.2 Potential Staging Sites and Casting Yards

Equipment and materials would be staged in the primary 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 parcels. However, at least one large site could be required for construction offices, equipment maintenance and storage, maintenance of traffic equipment, employee parking, and construction material storage and other needs. 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 1-6). Both sites are located on Hayden Island on the west side of I-5. A large portion of both parcels would be required for new right of way for the Modified LPA. 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 to 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, USCG, and the Federal Aviation Administration 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. Such a site would likely be between approximately 50 and 100 acres. As with the staging sites, casting yards would be identified during the design process or by the contractor and would be subject to the same contract and permit requirements to implement the best management practices (BMPs) described in Appendix M to the Final SEIS unless more stringent permitting requirements and conditions are required at the time of identification.

All material staging, equipment staging areas, equipment fueling areas, and casting yards would be contained and located outside of environmentally and culturally sensitive areas. To the extent practicable, these sites would be located in upland locations, on areas that are already or have been previously disturbed. These activities would be conducted consistent with the impact minimization BMPs described in Appendix M to the Final SEIS. Construction of the Modified LPA would also include revegetating temporarily disturbed areas consistent with federal, state, and local regulations, and the net result would be no net loss of habitat function in the long term. 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* (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 (referred to collectively as the 2018 RTP in this report).[16] 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 planning stage, permitting stage, or partway through phased development. They include the Waterfront Vancouver 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.

[16] The 2018 RTP was the adopted regional transportation plan available when the IBR Program initiated the SEIS. In 2023, Oregon Metro and RTC updated their respective RTPs as part of their five-year update cycle, as required under 23 CFR § 450.324. The 2023 RTP was adopted by Oregon Metro in 2023 and RTC in 2024, several years after the IBR Program Draft SEIS analysis was initiated in early 2021. To use the regional travel demand model supporting the 2023 RTP, additional refinement and coordination would be necessary for it to be ready for use in a facility-specific study, such as the IBR Program. This refinement and coordination process is lengthy and can take up to a year and a half for a complex project with numerous partner agencies, like the IBR Program. Therefore, the NEPA lead agencies exercised their discretion and determined, based on their technical expertise, that the 2018 RTP and Travel Demand Model continued to be the most appropriate base tool for the purposes of comparing the No-Build Alternative to the Modified LPA and design options in the Final SEIS.

# 2. METHODS

With regard to EMF, this section describes the methods used to:

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

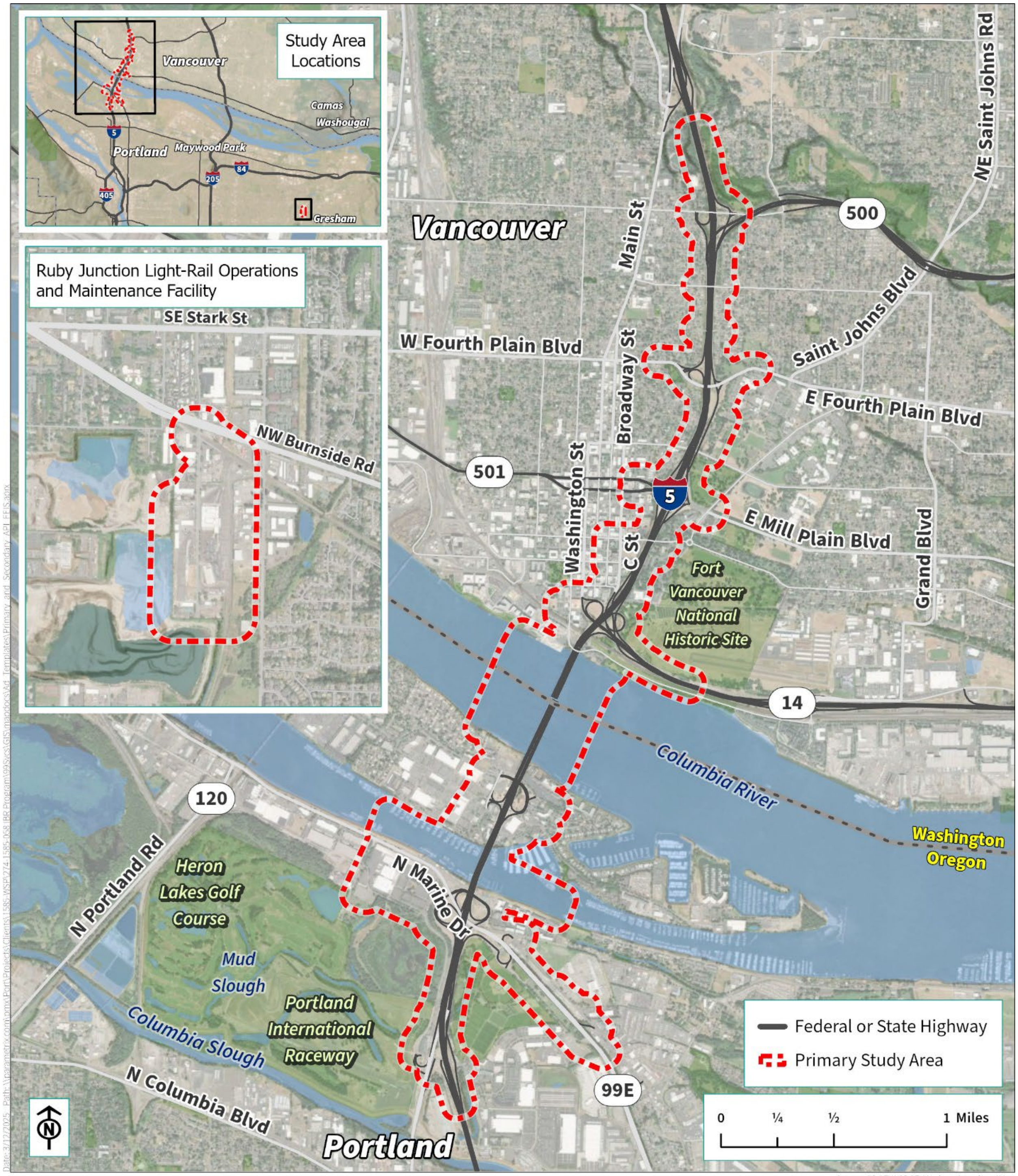
The methods and analysis comply with NEPA and relevant federal, state, and local laws and build on those developed for the CRC project. The methods used for this analysis have been updated for the IBR Program to reflect the following applicable guidelines:

- Federal Transit Administration Guidance on the Prevention and Mitigation of Environmental, Health and Safety Impacts of Electromagnetic Fields and Radiation for Electric Transit Systems (FTA 2008). This document is relevant because it provides EMF data on electric rail and transit operated in the U.S.
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to time-varying EMF (1 hertz [Hz] to 100 kilohertz). The 2010 update to the ICNIRP standard remains relevant and doubled the exposure limits for public and occupational exposure (ICNIRP 2010).
- ICNIRP Statement on EMF-emitting New Technologies—specifically, data related to electrified trains (ICNIRP 2008).

## 2.1 Study Area

The study area for EMF runs along a 5-mile segment of I-5, approximately between the SR 500 interchange in Washington and the I-5/Columbia Boulevard interchange in Oregon and the area around TriMet's existing Ruby Junction Light-Rail Operations and Maintenance Facility in Gresham, Oregon. Most physical changes associated with the Modified LPA would occur in this area, though mitigation could still occur outside of it. Figure 2-1 shows the study area for the Modified LPA.

Figure 2-1. Electromagnetic Fields Study Area



## 2.2 Relevant Laws and Regulations

Federal regulations set limits for high-frequency EMF exposure in the workplace and in public areas that apply to AM and FM radio, television, and wireless sources (47 Code of Federal Regulations 1.1307(b)). Schools, daycare facilities, hospitals, senior living facilities, research facilities, and universities are considered sensitive receptors to EMF. There are no federal laws that regulate exposure to extremely low frequency (ELF) EMF.

The Federal Transit Administration (FTA) has adopted guidance on approaches to preventing and reducing community environmental, health, and safety impacts from transit-generated EMF and electromagnetic radiation, including best management practices for light-rail systems to reduce EMF (FTA 2008).

Two organizations—ICNIRP, in association with the World Health Organization, and the American Conference of Governmental Industrial Hygienists (ACGIH)—have developed voluntary occupational guidelines for EMF exposure. The guidelines are intended to prevent EMF effects such as nerve stimulation or inducing currents in cells (these effects have been shown to occur with higher frequency EMF than is typical in residences or occupations). Section 2.4 outlines the exposure guidelines and thresholds that were used for the IBR Program analysis.

## 2.3 Data Collection

Data collection for this analysis relied primarily on existing literature sources and field measurements of EMF. The following sources were used for the evaluation:

- Literature on the TriMet light-rail system, which included EMF measurements conducted for use in the Central Link Environmental Impact Statement (EIS) (Federal Transit Administration and Sound Transit 2001, as cited in CRC 2011) and East Link EIS for Sound Transit in Seattle (Sound Transit 2011).
- Literature on EMF measurements of light-rail systems similar to the TriMet system, such as the Mid-Coast Corridor Transit Project in San Diego (SANDAG 2014), Santa Clara Valley Transit System in the San Francisco Bay Area (VTA 2016), and Peninsula Corridor Electrification project (ICF International 2014).
- Literature on potential health effects from exposure to EMF (FTA 2008).

Data and measurements from the TriMet light-rail system, and similar systems, were compared to EMF exposure standards as the basis for assessing probable human health impacts. The analysis in this report includes a review of the EMF measurements reported in the CRC EMF technical report (CRC 2011), updated with similar and more recent rail systems approved and in operation since 2011. Because the proposed light-rail extension with the Modified LPA would include systems elements consistent with the existing TriMet Metropolitan Area Express (MAX) light-rail transit (LRT) system (such as power levels, TPSS ratings, and facility and system design) EMF levels along the light-rail extension would be identical to those produced along the current TriMet MAX system. Therefore, the data from the CRC EMF technical report is sufficient to assess potential EMF exposure levels for the Modified LPA.

## 2.4 Impact Analysis

The analysis includes an updated geographic information system (GIS)-based review of sensitive receptors (defined as schools, daycare facilities, hospitals, or senior housing) in the vicinity of the TPSS locations for the Modified LPA, as well as a discussion of potential exposure for human receptors at light-rail stations and near light-rail tracks. Additionally, the analysis includes a review of the EMF measurements reported in the CRC EMF technical report (CRC 2011), updated with similar and more recent rail systems approved and in operation since 2011.

As outlined in Section 2.2, the ICNIRP, in association with the World Health Organization, and the ACGIH, have developed voluntary occupational guidelines for EMF exposure. Table 2-1 shows the exposure guidelines for the typical power frequency (60 Hz) that have been developed by these organizations. The ICNIRP addresses acute and chronic health effects from exposure to low frequency EMF. Separate guidance is given for occupational and general public exposures. "Occupational exposure" in these guidelines refers to adults exposed to time-varying EMF from 1 Hz to 10 megahertz at their workplaces, generally under known conditions and as a result of performing their regular or assigned job activities. By contrast, the term "general population" refers to individuals of all ages and of varying health statuses, which might increase the variability of susceptibility in individuals (ICRNP 2010).

Table 2-1. Exposure Guidelines for Power Frequency (60 Hz) Electromagnetic Fields

| Exposure at 60 Hz | Electrical Field (kV/m) | Magnetic Field (mG) |
|---|---|---|
| **International Commission on Non-Ionizing Radiation Protection** | | |
| Occupational | 8.3 | 10,000 |
| General Public | 4.2 | 2,000 |
| **American Conference of Governmental Industrial Hygienists** | | |
| Occupational Exposure Should Not Exceed | 25 | 10,000 |
| Prudence Dictates Use of Protective Clothing above this Level | 15 | --- |
| Exposure of Workers with Cardiac Pacemakers Should Not Exceed this Level | 1 | 1,000 |

Sources: ICNIRP 2010; ACGIH 2015
Hz = hertz; kV/m = kilovolts per meter; mG = milligauss

It is important to note that these limits are for 60 Hz power frequency fields, which are relevant for the alternating current (AC) feeders between TPSSs and connecting the TPSSs to the grid but may not be directly applicable to direct current (DC) magnetic fields produced by the railway catenary and TPSSs. It may be more appropriate to use the 1 to 8 Hz field limits from the ICNIRP standards to compare against DC (0 Hz) magnetic fields. The 1 to 8 Hz reference exposure levels range from 6,250 mG (8Hz) up to 400,000 mG (1 Hz) (ICRNP 2010).

Washington State has no standards relating to EMF exposure; Oregon has a standard for electrical field exposure. The electrical field exposure standard for Oregon is 9 kilovolts per meter (kV/m) within the right of way of an electrical transmission line. Transit system planners and operators that intend to build a rail system along a power line right of way should be aware of these restrictions for compliance and consider minimizing incremental EMF contributions.

The Oregon Energy Facilities Siting Council (within the Oregon Department of Energy) has a “prudent avoidance policy” safety standard. Many utility companies have adopted this policy. A prudent avoidance policy is the exercising of sound judgments and caution in dealing with EMF—for example, limiting or avoiding exposure to EMF, particularly in the workplace. This type of policy arose based on the absence of absolute scientific proof that EMF affects human health (e.g., causes cancer).

# 3. AFFECTED ENVIRONMENT

## 3.1 Introduction to Electromagnetic Fields

EMF are invisible forces of radiated energy that are produced by many natural and man-made sources. Natural sources include the earth itself, which generates a weak magnetic field from currents flowing deep within the magma of the earth's core (the intensity of this DC magnetic field is approximately 500 mG). Air turbulence and other atmospheric activity such as lightning can also create electrical fields (World Health Organization 2022). Human sources of EMF are generally produced by electrical systems such as wireless telecommunications (including cell phones), electric motors, electronics, power transmission and distribution lines, and other electrically powered equipment.

Scientists have classified EMF into an electromagnetic spectrum based on the wavelength and frequency of the various forms of radiation (expressed in Hz, which is defined by the number of wave cycles per second). The spectrum ranges from DC (0 Hz) and ELF radiation (3 to 3,000 Hz) to radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays, and gamma rays (10E20 to 10E22 Hz). Some types of operations can generate electromagnetic energy in many frequencies simultaneously, such as welding, which produces energy in the ultraviolet, visible, infrared, radio wave, and ELF range. The typical power frequency used in the United States (such as in electrical transmission and distribution lines and residential wiring) is in the ELF range and is 60 Hz. This analysis focuses on EMF from electrical systems in the ELF range.

In a typical situation involving electrical wiring, an electrical field is generated. For example, a lamp or microwave oven that is plugged into a wall socket but turned off will generate an electrical field from the voltage in the line. The voltage can be thought of as "electrical pressure" in the line or the potential to do work, which is measured in volts (V) or kV. The electrical field produced by the voltage is measured in V/m. Once the lamp or oven is turned on, it creates an electrical current through the line. This electrical current produces a magnetic field in addition to the electrical field. Magnetic fields are measured in units of gauss (or tesla). Since most magnetic field exposure involves a fraction of a gauss, EMF exposure is typically measured in milligauss (1/1,000 gauss).

Electrical systems can be either DC or AC. DC is defined as the unidirectional flow or movement of the electric charge through a line. The intensity of the current can vary with time, but the general direction of movement stays the same at all times.

The electricity in residences and power lines is AC. AC does not move in one direction, but rather back and forth. The power frequency used in the United States alternates back and forth 60 times per second. This frequency is measured in Hz; thus, the typical frequency for electricity within a line (such as in household wiring or high voltage power transmission lines) is 60 Hz. Power line AC can be converted to DC by means of a power supply consisting of a transformer, a rectifier (which prevents the flow of current from reversing), and a filter (DC is used to power the MAX LRT system in Portland).

EMF are stronger closer to the source and decrease with distance. For example, the electrical field directly beneath a 115 kV power line is approximately 1.0 kV/m, and the magnetic field is approximately 35 mG. At 50 feet, the electrical field is approximately 0.4 kV/m, and the magnetic field is approximately 7 mG. Similarly, at 100 and 200 feet, the electrical field is approximately 0.07 kV/m and 0.01 kV/m, respectively, and the magnetic field is approximately 2 mG and 0.5 mG, respectively.

Research indicates that electrical fields can be greatly reduced by the walls of homes (electrical fields in homes are generated almost entirely by household wiring and appliances). However, magnetic fields are not blocked by most materials and can enter homes from nearby power lines. Magnetic fields in homes are also commonly caused by electrical appliances and wiring within a home. These internal sources of magnetic fields can extend into rooms other than where the source is located. For example, if an electrical appliance is located near a wall, its magnetic field will extend into the room on the other side of the wall.

Electrical and magnetic fields that occur in the same place can add to or subtract from the strength of the field. For example, if there are two separate 60 Hz sources located at the same place and each has a field strength of 4 V/m, and if they are alternating in strength and direction together at 60 Hz (i.e., they are exactly in phase), then the electrical field will be 8 V/m. If the two fields are exactly out of phase, then the field will measure 0 V/m. Because of this property, power companies frequently situate their high voltage lines in close proximity and operate them at different phases to help cancel out their EMF.

Table 3-1 shows some typical ranges of electric and magnetic fields at the surface of the human body from power lines (directly beneath the power line) and next to an appliance (at a distance of 6 inches).

Table 3-1. Approximate Strength of Average Electric and Magnetic Fields at the Surface of the Human Body Produced by Common Power Sources

| Power Source (60 Hz) | Electrical Field (kV/m) | Magnetic Field (mG) |
|---|---|---|
| 500 kV Electricity Transmission Line | 0.9–7.5 | 20–800 |
| Electrical Distribution Line | 0.009–0.12 | 0.6–30 |
| Electric Blanket | 0.1–3.0 | 5–100 |
| Shaver | 0.05–1.0 | 100–1,500 |
| Toaster | 0.005–0.09 | 5–20 |
| Microwave | N/A | 100–300 |
| Average Household Background Level | 0.002–0.02 | 0.2–9 |
| Copy Machine | N/A | 4–200 |
| Fax Machine | N/A | 4–9 |
| Personal Computer Video Display Terminal | N/A | 7–20 |

Source: CRC 2011
kV/m = kilovolts per meter; mG = milligauss; N/A = not available

## 3.2 Potential Human Health Effects of Electromagnetic Fields

It is uncertain whether 60 Hz fields pose health risks. Scientists have found that EMF produce biological effects on humans and animals such as changes in the cell growth rates and intercellular communication. However, scientists do not agree on EMF's potential health effects because the available evidence is fragmentary, complex, and often inconclusive. The problem has been exacerbated by studies using "weak" scientific evidence, which have produced results that are contradictory to other studies (CRC 2011).

Three kinds of studies have been done on EMF: 1) laboratory studies that expose single cells or groups of cells and organs to EMF under a variety of conditions and look for effects, 2) laboratory studies that expose animals or humans to EMF and look for effects, and 3) epidemiological studies of varying human population groups that look for an association between EMF and diseases.

Researchers in laboratories have studied the effects of EMF on isolated tissue and cells. These studies have indicated changes in cell growth rates, intercellular communication, movement of calcium ions, and levels of various enzymes. The scientific community, however, does not agree on the biological significance of these results. While changes from EMF have been shown to occur, it is uncertain what effect these changes have on human health or the incidence of diseases (CRC 2011).

Laboratory studies have also found several effects from EMF on animals. Effects attributed to these fields include changes in behavior and activity, biological rhythms, some hormone levels, bone fracture healing, response to drugs, and learning abilities. These effects have been small and required special conditions in the laboratory to achieve. For example, in some cases for changes to take place, very strong fields were needed, while in other studies, changes only occurred under certain field frequencies (CRC 2011).

Epidemiological studies involve research on the statistical occurrence and possible causes of disease in human populations. These studies have resulted in conflicting conclusions. Some studies have found an association with cancer and certain types of power lines. Associations have been found for both increased and decreased occurrences of cancer for those living in proximity to power lines. Other studies have concluded that there is no association whatsoever (CRC 2011).

Overall, the biological and epidemiological results suggest that there may be a link between EMF and certain diseases; however, no cause-and-effect relationship has been established at this time. The most widely accepted consensus concerning the effects of EMF on human health is that more research is needed (CRC 2011).

## 3.3 Regional Conditions

The existing EMF environment in the study area varies depending on location, as EMF levels are site- and time-specific. The main sources of EMF considered in this report are the traction power system and TPSSs associated with the TriMet MAX LRT system. The traction power system is an electricity grid to power electrified rail systems. It is composed of catenary rail current loops, and power rectification (inverters) TPSSs. The MAX system is described below.

MAX is served by two local utilities with three-phase AC electricity at 12.5 to 13.8 kV (Porter and Helig 2003). There is a system in place to regulate the electrical load so that loads throughout the system are balanced. The TPSSs convert from AC to DC for the overhead lines. The TPSSs for the Interstate MAX TPSSs are rated at 1 megawatt. The other MAX line TPSSs are rated at 750 kilowatts. TPSSs along the alignments convert high voltage AC power from the public supply system to the 750-volt DC system used to power the trains. TPSSs are located approximately 1 mile apart.

The MAX light-rail line uses a 750-volt DC overhead system to deliver power to the cars. The overhead system (catenary) is made up of either a single or dual wire. In the study area, the catenary system is a dual wire (messenger and contact wire). Other elements of the light-rail system use either AC or DC electricity for power. These include electricity for lights, signals, and switches along the alignment.

Generally, strong magnetic fields are not associated with the operation of LRT. The major LRT sources that generate magnetic fields are associated with the traction power and the control equipment under the vehicle's floor (Federal Railroad Administration 1993).

For the purposes of a study of EMF for a Sound Transit Link LRT project in Seattle, measurements of the TriMet MAX system were taken to help evaluate possible EMF effects from the new light-rail line (Edelson and Holmstrom 1998). DC magnetic fields were measured at distances of 10, 20, and 30 meters from the MAX light-rail track. The results are shown in the Table 3-2 and reflect measurements taken at an open field location with a DC magnetometer. The TriMet MAX system data cited, from 10 years ago, is still relevant and applicable.

Table 3-2. Magnetic Field Strength at Distance from TriMet's Light-Rail Tracks (mG)

| Direction | 10 Meters (30 Feet) | 20 Meters (65 Feet) | 30 Meters (100 Feet) |
|---|---|---|---|
| Horizontal | 167.0 | 44.6 | 13.3 |
| Vertical | 17.8 | 8.2 | 3.4 |

Source: Edelson and Holmstrom 1998
mG = milligauss

As shown in Table 3-2, the DC magnetic field diminishes with distance from the track. The highest value was 167 mG, at 32 feet from the track. These values are well below the ICNIRP standard of 2,000 mG for general public exposure to magnetic fields.

DC magnetic fields were measured at light-rail stations and TPSSs during a site visit conducted in 2008 and found to range from 107 to 601 mG at TPSSs (measured at the perimeter of the buildings that enclosed the Delta Park and Killingsworth TPSSs). DC field intensities ranged from 47 to 551 mG at light-rail stations (Delta Park and Killingsworth). Similar to the DC magnetic field measurements conducted in 1998, all of the field intensities measured in TriMet's system are below the general public exposure guidelines (CRC 2011).

AC magnetic field measurements were also taken at rail stops and TPSSs. The AC magnetic field levels at light-rail stations (Delta Park and Killingsworth) fluctuated depending on the movement of the light-rail cars (higher values were associated with the cars accelerating) and ranged from 0.76 to 12.77 mG at a distance of 3 feet from the track. The levels of the AC magnetic fields at the TPSSs ranged from almost 0 to 2.86 mG (measured at the perimeter of the buildings that enclosed the Delta Park and Killingsworth TPSSs).

Measurements of AC and DC magnetic fields conducted at 20 feet from the Killingsworth light-rail station showed the predicted decrease in field strengths as AC fields ranged from 0.76 to 1.47 mG and DC fields ranged from 86 to 199 mG.

Measurements of EMF at other light-rail systems have produced similar results. For example, the Vasona Corridor for the Santa Clara Valley, California, light-rail system measured magnetic field strength at four light-rail stations and one TPSS in 1999 (Santa Clara Valley Transportation Authority 2005) with the following results:

- At a distance of 20 to 30 feet from the closest track, DC magnetic fields were typically within a few hundred mG of the Earth's ambient DC field (approximately 500 mG).
- Measured AC magnetic fields were typically 5 mG or less within 10 feet of the tracks and 2 mG or less at 20 feet from the track.
- At the perimeter of TPSSs, DC magnetic field levels ranged from 194 to 921 mG, and AC magnetic fields ranged from 0.3 to 31.3 mG. The higher levels at the TPSSs were thought to be caused by the location of underground electrical feeder cables.

The existing levels of AC and DC magnetic fields from the MAX are largely isolated in the TriMet-owned right of way because field intensities are relatively low and decrease quickly with distance from the track and overhead catenary lines. This is also true of the TPSSs. Thus, it is unlikely that there have been exposures at adjacent residences located along the light-rail line or near TPSSs that would be a cause for concern since they do not exceed the ICNIRP exposure standards.

The general public and train operators are also currently exposed to EMF at station stops and in the light-rail cars themselves. AC magnetic field measurements were taken in the light-rail cars during a site visit (between the Delta Park and Killingsworth light-rail stations) and found to fluctuate from approximately 0.38 to 8.13 mG at a height of approximately 20 inches from the floor (approximate seat height) (CRC 2011). Thus, EMF emissions were also very low within the light-rail vehicles.

A survey conducted for the EMF Rapid Program (under the National Institute of Health) provides some perspective on the potential exposures to EMF from light-rail. The purpose of the 1997 survey was to characterize personal magnetic field exposure in the general population (Enertech Consultants 1998). Slightly more than 1,000 people participated in the survey of exposure over a 24-hour period. The results indicated that approximately 14 percent of the general population is exposed to a 24-hour average magnetic field strength exceeding 2 mG. About 25 percent of the survey participants spent more than 1 hour at fields greater than 4 mG, and 9 percent spend more than 1 hour at fields greater than 8 mG. Approximately 1.6 percent of the participants experienced at least one gauss (1,000 mG) during a 24-hour period. Compared to this study, the typical time that people would be riding the MAX system and thus exposed to its magnetic fields is very low and, when averaged over a 24-hour period, would amount to a minimal level.

# 4. LONG-TERM EFFECTS

The existing LRT system, which would be extended under the Modified LPA, uses overhead electrical lines powered by TPSSs to power the trains, which creates EMF. Buses and cars on I-5 and other area roadways generate only minor EMF emissions. Therefore, this section addresses impacts near light-rail infrastructure within the study area. The GIS-based analysis focuses on receptors near the traction power TPSSs because the majority of the light-rail extension would not traverse populated areas.

## 4.1 No-Build Alternative

There is existing EMF in the study area due to a variety of nearby EMF sources (e.g., utility power cables, office equipment, internal building wiring, and any other electrical apparatus). The EMF levels fluctuate over time, depending on the operation of these nearby sources. Under the No-Build Alternative, there would be no construction of an LRT line into Vancouver, Washington, and consequently, no change in existing EMF levels.

## 4.2 Modified Locally Preferred Alternative

No changes to existing EMF sources or levels would result from the highway components (i.e., the bridges, shoulders, I-5 interchange and mainline improvements, and active transportation) of the Modified LPA.

The Modified LPA includes a 1.9-mile extension of the LRT system, extending the current MAX Yellow Line from the Expo Center in North Portland, where it currently ends, to a point near Evergreen Boulevard in Vancouver. The light-rail trains would be powered by electricity, creating EMF fluctuations each time a train passes by. Due to the operation of electrical power sources of AC and DC magnetic fields, particularly the overhead catenary lines and power TPSSs, EMF would be generated during train operations. The public (internal receptors) would be exposed to EMF along the new light-rail tracks, near new TPSSs, at new station stops, and in the light-rail cars. In the study area overall, EMF levels under the Modified LPA would be similar to those under the No-Build Alternative. Within and near the new light-rail right of way, near TPSSs, and within the light-rail vehicles, EMF emissions would increase slightly compared to the No-Build Alternative but would remain well below exposure guidelines.

The Modified LPA would include five new TPSSs, shown in Figure 4-1. An existing TPSS at the end of TriMet's MAX Yellow Line would be decommissioned and a new one constructed to the east of the LRT tracks and south of Expo Road. Four new TPSSs would also be constructed at the following locations: Expo Overnight Facility (east of N Force Ave), Hayden Island Station (located north of the transit platform); Waterfront Station (located at the north end of the platform); and Evergreen Station terminus (located on the south side of 7th Street, approximately 750 feet south of Evergreen Station). There would be no difference in the field intensities generated by the LRT.

It is anticipated that future levels of EMF along the LRT line extension would be identical to those produced in the current light-rail system, since the proposed elements of the system, such as power levels, TPSS ratings, and facility and system design, would be the same as the existing MAX system in

Portland. EMF measurements taken along the existing MAX system demonstrated that EMF emissions are very low within the existing light rail vehicles, fluctuating from 0.38 to 8.13 mG measured at approximate seat height (CRC 2011). Because the current levels of EMF are not considered excessive and fall below the ICNIRP exposure standards, there would be no expected adverse risk to human health.

External receptors located at greater distances from the MAX electrical system than passengers or MAX workers would also receive some exposure to EMF from the MAX line. However, because field strengths decrease rapidly with distance and generated field intensities are below the ICNIRP exposure standards, there would be no expected effect on the health of external receptors.

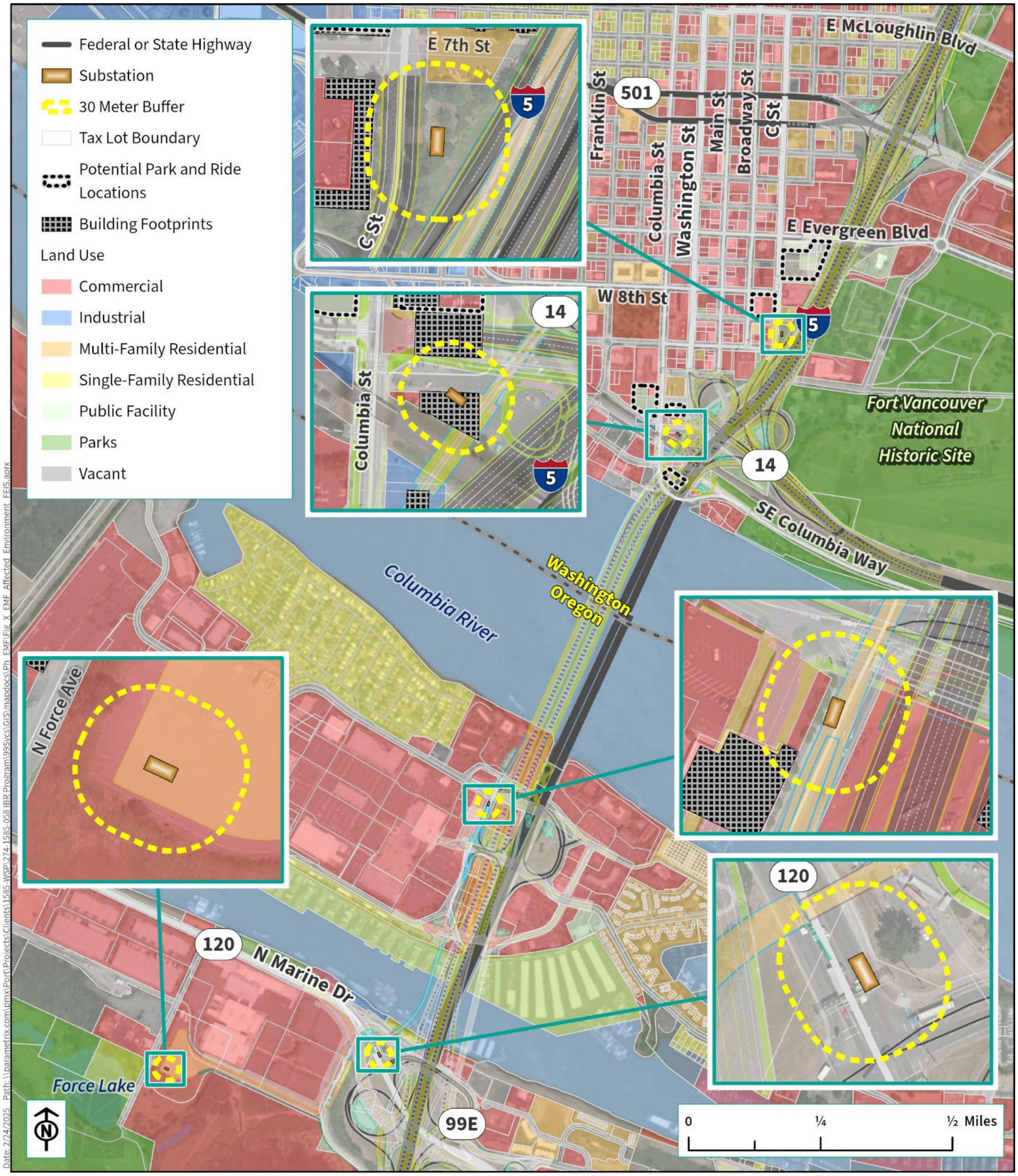
Measurements taken at existing MAX system traction power TPSSs were reported in the range of 107 to 601 mG (measured at the perimeter of the buildings that enclosed the TPSSs) and 47 to 551 mG at transit stop stations. The field intensities at the transit stations and TPSSs were below the general public exposure standards (CRC 2011). Furthermore, post-electrification EMF measurements to traction power stations operated by Amtrak have shown maximum magnetic field level of 2.0 mG at 15 meters (ICF International 2014).

Although EMF levels resulted below the exposure guidelines at the perimeter of the TPSS buildings, the land uses around each TPSS were examined to determine whether sensitive receptors are located nearby. Figure 4-1 illustrates the locations of the five TPSSs proposed under the Modified LPA and the adjacent land uses. The locations of these TPSSs would not change relative to design options related to I-5 components. Additionally, EMF levels would reduce with distance and presence of physical barriers such as enclosures, building walls, and typical TPSS design features. The five proposed TPSSs would not be located near residential buildings or other EMF-sensitive land uses.

### 4.2.1 Design Options

There would be no changes to existing EMF sources or levels from the highway components of the Modified LPA, including the one or two auxiliary lane design options, the design option with or without the C Street ramps, and the design option to shift the I-5 mainline to the west. The Modified LPA with a single-level configuration (both fixed-span and movable-span), would shift the LRT alignment across the Columbia River slightly west of the double-deck fixed-span configuration. This would shift the geographic location of the EMF impacts, but EMF levels would remain well below exposure guidelines.

Figure 4-1. Light-Rail Traction Power TPSSs with the Modified Locally Preferred Alternative and Existing Land Uses




Source: Clark County, Portland Metro RLIS, ODOT, WSDOT, ESRI, Mapbox, OpenStreetMap

# 5. TEMPORARY EFFECTS

Temporary effects on EMF would not differ among the Modified LPA design options. Construction of the Modified LPA and all design options, would require electrical power (i.e., through the use of generators) for certain activities (e.g., to operate certain tools and lighting equipment) but is not expected to result in appreciable changes to EMF levels in the study area. Magnetic fields from generators and associated cables at accessible distances would be well under the maximum short-term exposure limits (ICNIRP 2008, 2020).

# 6. INDIRECT EFFECTS

Indirect effects on EMF would not differ among the Modified LPA design options. After decades of study and human exposure, a direct link between EMF levels and adverse health impacts has not been firmly established (ICNIRP 2010); therefore, the likelihood of a direct health impact on human populations is low. Consequently, no indirect effects from EMF are anticipated from the Modified LPA, including all design options.

# 7. MITIGATION FOR LONG-TERM EFFECTS

The levels of EMF anticipated as a result of the Modified LPA are less than the exposure standards for both the workplace and the general public. The power TPSSs have been designed and sited to minimize exposure to users of the system, the general public, and sensitive users. Thus, mitigation would not be required as it would not appreciably lower exposure beyond the TPSS design measures to minimize exposure.

The design and location of facilities would help to reduce the intensity of magnetic fields and exposure of the public to EMF. Some examples include ensuring that all electrical equipment is operated with a good ground system and that proper shielding is provided for all electrical lines. The IBR Program would follow FTA guidance on best management practices for avoiding and minimizing EMF levels from light-rail systems.

# 8. PERMITS AND APPROVALS

No permits or approvals associated with EMF are required for the Modified LPA.

# 9. REFERENCES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