Wetlands and Waters Technical Report

Multnomah County | Earthquake Ready Burnside Bridge Project

Portland, OR

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EARTHQUAKE READY BURNSIDE BRIDGE

Earthquake Ready Burnside Bridge Wetlands and Waters Technical Report

Prepared for

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, as a Professional Wetland Scientist (PWS).

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Acronyms, Initialisms, and Abbreviations

API	Area of Potential Impact
BMP	Best Management Practice
CFR	Code of Federal Regulations
CSZ	Cascadia Subduction Zone
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DSL	Department of State Lands
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQRB	Earthquake Ready Burnside Bridge
GIS	geographic information system
GPS	Global Positioning System
I-5	Interstate 5
LiDAR	Light Detection and Ranging
NAVD88	North American Vertical Datum of 1988
NGVD29	National Geodetic Vertical Datum of 1929
NWI	National Wetland Inventory
OAR	Oregon Administrative Rules
OHWM	Ordinary High Water Mark
SFAM	Stream Functions Assessment Method
SSURGO	Soil Survey Geographic Database
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	U.S. Geological Survey

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Executive Summary

Impacts to jurisdictional waters anticipated for each alternative under consideration for the Earthquake Ready Burnside Bridge (EQRB) Project were assessed. Within an area encompassing the planned construction, field survey and database review determined the presence and geographic extent of the Willamette River, the only waters that would be affected by the project. The jurisdictional limits of the river within the project vicinity are set by the ordinary high water mark (OHWM), which the U.S. Army Corps of Engineers (USACE 2014) determined to be 20.1 feet elevation (North American Vertical Datum of 1988 [NAVD88] datum). This information was used in combination with recent on-site topographic surveys to determine the top of bank according to City of Portland guidance.

Analysis of impacts to waters followed the functions-based approach required by the federal Compensatory Mitigation Rule (33 CFR §332) and Oregon's Aquatic Resources Mitigation Framework. This analysis accounted for impacts anticipated prior to and after a Cascadia Subduction Zone (CSZ) earthquake. Of the Build Alternatives, the Enhanced Seismic Retrofit was determined have the greatest impact on waters prior to a CSZ earthquake because it would have the largest impact area. In contrast, the No-Build Alternative was identified as having the greatest impact to waters after such an earthquake occurs. Mitigation measures planned to minimize and compensate for the impacts associated with each of the Build Alternatives are briefly described. The report lists the permits and authorizations required for the waters impacts expected from each of the Build Alternatives, and identifies the agencies and organizations to be notified and consulted during preparation of the Environmental Impact Statement (EIS).

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1 Introduction

As a part of the preparation of the Environmental Impact Statement (EIS) for the Earthquake Ready Burnside Bridge (EQRB) Project, this technical report has been prepared to identify and evaluate wetlands and other waters within the Project Area and the Area of Potential Impact (API). For this analysis, the Project Area is coincident with the API.

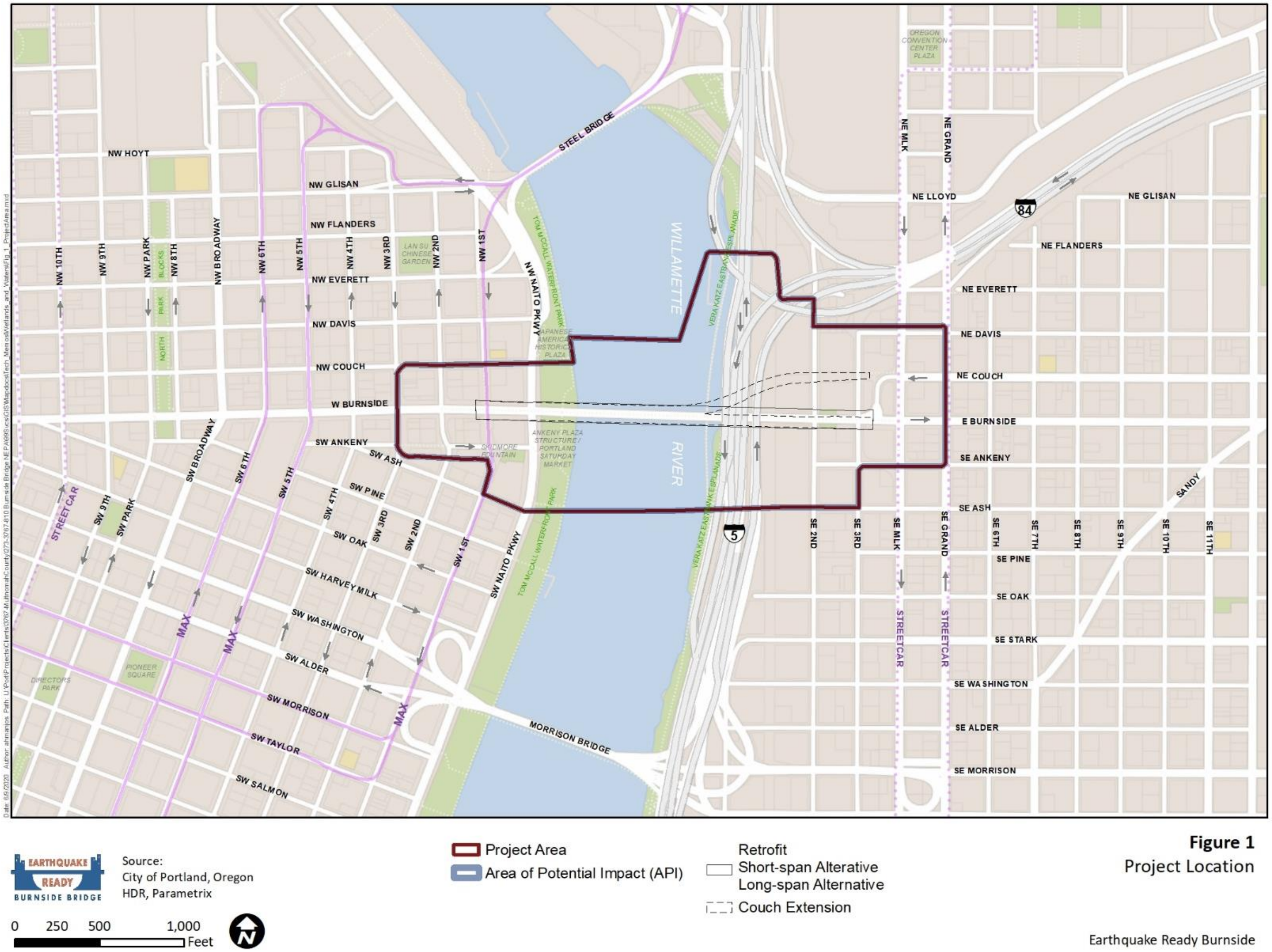
1.1 Project Location

The Project Area and the API are located within the central city of Portland, Oregon. The Burnside Bridge crosses the Willamette River connecting the west and east sides of the city. The Project Area encompasses a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river and NE/SE Grand Avenue on the east side. Several neighborhoods surround the area including Old Town/Chinatown, Downtown, Kerns, and Buckman. Figure 1 shows the Project Area and the API.

1.2 Project Purpose

The primary purpose of the Project is to build a seismically resilient Burnside Street lifeline crossing over the Willamette River that will remain fully operational and accessible for vehicles and other modes of transportation following a major CSZ earthquake. The Burnside Bridge will provide a reliable crossing for emergency response, evacuation, and economic recovery after an earthquake. Additionally, the bridge will provide a long-term safe crossing with low-maintenance needs.

Figure 1. Project Location



2 Project Alternatives

The Project Alternatives are described in detail with text and graphics in the *EQRB Description of Alternatives Report* (Multnomah County 2021b). That report describes the alternatives' current design as well as operations and construction assumptions.

Briefly, the Draft EIS (DEIS) evaluates the No-Build Alternative and four Build Alternatives. Among the Build Alternatives there is an Enhanced Seismic Retrofit Alternative that would replace certain elements of the existing bridge and retrofit other elements. There are three Replacement Alternatives that would completely remove and replace the existing bridge. In addition, the DEIS considers options for managing traffic during construction. Nomenclature for the alternatives/options are:

- No-Build Alternative
- Build Alternatives:
  - Enhanced Seismic Retrofit (Retrofit Alternative)
  - Replacement Alternative with Short-span Approach (Short-span Alternative)
  - Replacement Alternative with Long-span Approach (Long-span Alternative)
  - Replacement Alternative with Couch Extension (Couch Extension Alternative)
- Construction Traffic Management Options
  - Temporary Detour Bridge Option (Temporary Bridge) includes three modal options:
    - Temporary Bridge: All modes
    - Temporary Bridge: Transit, Bicycles and Pedestrians only
    - Temporary Bridge: Bicycles and Pedestrians only
  - Without Temporary Detour Bridge Option (No Temporary Bridge)

3 Definitions

The following terminology will be used when discussing geographic areas in the EIS.

- **Project Area –** The area within which improvements associated with the Project Alternatives would occur and the area needed to construct these improvements. The Project Area includes the area needed to construct all permanent infrastructure, including adjacent parcels where modifications are required for associated work such as utility realignments or upgrades. For the EQRB Project, the Project Area includes approximately a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river and NE/SE Grand Avenue on the east side.
- **Area of Potential Impact –** This is the geographic boundary within which physical impacts to the environment could occur with the Project Alternatives. The API is

resource-specific and differs depending on the environmental topic being addressed. For all topics, the API will encompass the Project Area, and for some topics the geographic extent of the API will be the same as that for the Project Area; for other topics (such as for transportation effects) the API will be substantially larger to account for impacts that could occur outside of the Project Area. The API for wetlands and waters is defined in Section 5.1.

- **Project Vicinity –** The environs surrounding the Project Area. The Project vicinity does not have a distinct geographic boundary but is used in general discussion to denote the larger area, inclusive of the Old Town/Chinatown, Downtown, Kerns, and Buckman neighborhoods.

4 Legal Regulations and Standards

4.1 Laws, Plans, Policies, and Regulations

The following is a list of federal, state and local laws, regulations, plans, and policies that guide or inform the assessment of wetlands and waters:

4.1.1 Federal

- Clean Water Act (Water Pollution Control Act of 1972 and Amendments; 33 United States Code [U.S.C.] §1251 et seq.), and associated regulations codified at 40 Code of Federal Regulations (CFR) and 33 CFR – protect, maintain and restore the integrity of the nation's waters
- Rivers and Harbors Act of 1899 (33 USC. §407) – protect navigable capacity of the nation's navigable waters
- Executive Order 11990 – Protection of Wetlands, 1977 – minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands
- Executive Order 11988 – Floodplain Management – avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains
- National Environmental Policy Act (42 USC §4321 et seq.), and associated regulations codified at 40 CFR §1500-1508 – encourage productive and enjoyable harmony between humans and their environment; provide guidance for preparation of an EIS
- Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 et seq.) – requires that fish and wildlife conservation shall receive equal consideration with other project purposes and coordinated with other features of water resources development projects

4.1.2 State

- Oregon's Removal-Fill Law (Oregon Revised Statutes 196.795-990 and Oregon Administrative Rules [OAR] 141-090 and 141-085) – protect the functions of wetlands and waterways of the state
- Oregon Department of Environmental Quality (DEQ), National Pollutant Discharge Elimination System (NPDES) MS4 Permit No. 101314 – prescribes all stormwater and allowable non-stormwater dischargers from the MS4 within the City of Portland urban services boundary to surface waters of the state.
- DEQ NPDES MS4 Permit No. 103004 – prescribes all stormwater and allowable non-stormwater discharges from the MS4 within the limits of the five County-operated Willamette River Bridges.
- Oregon's Statewide Planning Goals & Guidelines (OAR 660-015-0000)
    - Goal 5: Natural Resources – protect natural resources and conserve scenic and historic areas and open spaces
    - Goal 6: Air, Water, and Land Resources Quality – protect the integrity of air, water, and land resources
    - Goal 15: Willamette River Greenway – protect, conserve, enhance, and maintain the natural, scenic, historical, agricultural, economic, and recreational qualities of lands along the Willamette River

4.1.3 Regional and Local

- Multnomah County Comprehensive Plan Chapter 5: Natural Resources – plan goals to protect, conserve, and manage the county's natural resources
- City of Portland Zoning Code Title 33 Planning and Zoning, Chapter 475 River Overlay Zones – promote the protection, conservation, restoration, enhancement and maintenance of the economic, natural, scenic, and recreational qualities of lands along the central reach of the Willamette River
- City of Portland National Pollutant Discharge Elimination System Stormwater Discharge Permit No. 101314 - protect water quality of waters through regulation of point source discharges
- City of Portland Environmental Services Best Management Practices: Erosion and Sediment Control – provide guidance for temporary and permanent erosion prevention, sediment control, and control of other development activities

4.2 Design Standards

The following is a list of the design standards required by federal, state and local law, or by agency policy, that function to protect human and environmental health and that will apply to the project:

- Section 404(b)(1) Guidelines (40 CFR §230) – application of mitigation sequencing to avoid, minimize, restore, and compensate for impacts to aquatic resources

- Design standards in the current version of the Federal Aid Highway Program Programmatic
- Oregon Department of Transportation Standard Specifications for Construction
- Oregon Department of Transportation Bridge Design Manual
- Oregon Department of Transportation Erosion Control Manual
- Multnomah County Design Standards, Section 5 (Drainage), and Section 8 (Landscape Treatments)
- City of Portland Erosion, Sediment, and Pollutant Control Plan (Title 10 PCC)

5 Affected Environment

5.1 Area of Potential Impact

The API for the wetlands and waters analysis is the same as the Project Area (Figure 1). Direct impacts to waters are not anticipated to extend beyond the API. To the east and west, this area is bounded by the parcels of land immediately adjacent to the Project Area. The API includes a section of the Willamette River that is approximately 1,500 feet long at the west bank and approximately 2,250-foot long at the east bank.

5.2 Resource Identification and Evaluation Methods

5.2.1 Published Sources and Databases

The following is a list of the data sources used to characterize aquatic resources in the API.

- National Wetland Inventory (NWI) from the U.S. Fish and Wildlife Service
- National Hydrography Dataset from the U.S. Geographic Survey
- Soil Survey Geographic Database (SSURGO) for Multnomah County Area, Oregon, Web Soil Survey from the Natural Resources Conservation Service
- Portland-Vancouver Harbor Information Package Third Edition, Reservoir Regulation and Water Quality Section, U.S. Army Corps of Engineers (USACE)
- Light Detection and Ranging (LiDAR) data, Oregon Lidar Consortium, State of Oregon Department of Geology and Mineral Industries
- Wetlands geographic information system (GIS) data layer, PortlandMaps, City of Portland, Bureau of Planning & Sustainability
- Central City 2035 Volume 3B Willamette River Central Reach Natural Resources Protection Plan from the City of Portland
- Willamette/Columbia River Ordinary High Water GIS data layer, PortlandMaps, City of Portland, Bureau of Planning & Sustainability

- Aerial imagery from Google Earth™, City of Portland, and the U.S. Department of Agriculture

5.2.2 Surveys and USACE Analysis

Using long-term river gauge data, the USACE (2014) determined the OHWM for the lower Willamette River up to river mile 25 at Willamette Falls. The OHWM, as identified by the USACE, serves as the lateral limit of jurisdiction for the Willamette River under Section 404 of the Clean Water Act and Oregon's Removal-Fill Law (Klassen pers comm. 2020). For the portion of the river within the project vicinity, the OHWM is at 20.1 feet elevation (NAVD88 datum).

HDR conducted a field survey on June 19, 2019, to determine the presence and geographic extent of wetlands and other waters in the API. The field survey also intended to identify and locate the OHWM of the Willamette River as indicated by physical evidence in accordance with Regulatory Guidance Letter 05-05 (USACE 2005).

The only portion of the study area that was field surveyed is the east bank of the Willamette River. Photographs were taken at the accessible part of the riverbank and at those portions of the Vera Katz Eastbank Esplanade, a paved multiuse path, and the Burnside Bridge that provide views of inaccessible parts of the riverbank. Much of the river's east bank south of the bridge could not be accessed due to safety concerns, mainly due to the steep slope thickly covered by Himalayan blackberry (*Rubus armeniacus*). A portion of the river's east bank north of the Burnside Bridge could not be accessed due to the presence of a tall chain-link fence obstructing passage.

The west bank of the Willamette River within the API is comprised of a concrete levee. This levee, the "Portland Floodwall" (also known as the harbor wall) extends southward to a few feet south of the Hawthorne Bridge and northward to the Steel Bridge. No field surveying occurred in other parts of the survey area due to the high density of infrastructure and the lack of any indications of wetlands or other waters as determined by review of publically available databases cited above.

5.3 Existing Conditions

The following describes existing wetlands and waters within the API.

5.3.1 Wetlands

No wetlands were detected during the June 19, 2019, field survey. No wetlands occur within the API according to the NWI or the Wetlands GIS data from the City of Portland. No hydric soils, which are soil types that develop under wetland conditions, are mapped within the API by SSURGO for Multnomah County Area, Oregon. Lastly, review of recent aerial imagery indicates that no wetlands occur within the API.

5.3.2 Willamette River

The Willamette River extends through the length of the API; no other waters are present. The Willamette River is a jurisdictional water under both federal and state law. Activities that directly affect the river are regulated under the Clean Water Act, the Rivers and Harbors Act of 1899, and Oregon's Removal-Fill Law.

The Willamette River is a major tributary of the Columbia River, accounting for 12 to 15 percent of its annual flow. Flow velocities within the API are generally low and tidally influenced by the downstream Columbia River and Pacific Ocean; over 10 years of data from the Broadway Bridge gauge indicates that flow in the project vicinity typically ranges from -1 to 2 feet per second (U.S. Geological Survey [USGS] 2020). As a result, the potential for scour is fairly low. Bathymetric maps indicate localized scour at the existing Burnside Bridge that declines downstream and disappears entirely before reaching the Steel Bridge. See the *EQRB Hydraulic Impact Analysis Technical Report* (Multnomah County 2021d) and *EQRB Hazardous Materials Technical Report* (Multnomah County 2021c) for more information.

The watersheds encompassing the lower Willamette River, the lowermost 26.5 river miles extending from Willamette Falls to the Columbia River confluence, have been repeatedly filled and degraded for more than 150 years. Historically, the Willamette River watershed in the Portland area was an extensive interconnected system of active channels, side channels, backwaters, emergent wetlands, riparian forest, and adjacent upland forest (USACE 2015), Industrial, commercial, and residential development has required significant modification of the riverbanks, resulting in contamination of the sediments and water column, and causing a dramatic decrease in the extent of the river's shallow water habitat, which is critical for juvenile salmonids (City of Portland 2018a).

Most of the original floodplain has been eliminated, further reducing the river's value to fish and wildlife, as well as diminishing flood water storage, water quality protection, and groundwater recharge. According to the City of Portland (2018a), approximately 85 percent of the banks of the Willamette River in the Central City Reach, extending from just north of the Fremont Bridge south to the Ross Island Bridge, is armored with seawalls, pilings, rock fill, or riprap. The floodplain is now mainly constricted to the hardened riverbanks, but extends beyond in a few small patches, including the low-lying area on the east bank within the API; see Section 7.2 of this report and the *EQRB Hydraulic Impact Analysis Technical Report* (Multnomah County 2021d) for more information about the river's floodplain and anticipated impacts thereof.

Industrial development, stormwater discharge, and combined sewer overflows have generated a variety of pollutants, including heavy metals, polychlorinated aromatic hydrocarbons, and pesticides. These pollutants occur at ecologically harmful quantities in the bed of the lower Willamette River (DEQ 2018). Pollution primarily from industrial sources along the river led to the designation of the Portland Harbor Superfund Site, located from just south of the Columbia Slough (river mile 1.9) to just north of the Broadway Bridge (river mile 11.8), which is approximately 0.4 river mile downstream from the API (*EQRB Hazardous Materials Technical Report* [Multnomah County 2021c]). Although specific sediment data within the API are limited, DEQ and the Environmental Protection Agency (EPA) have concluded that concentrations of contaminants in the 4-mile-long reach immediately upriver from the Portland Harbor Superfund Site (and including the API) are substantially lower than those found in sediments within the Portland Harbor Superfund Site (EPA 2019).

Water quality in the lower Willamette River is moderately good. Partly due to sewer improvements made in 2011, E. coli bacteria, suspended solids, total phosphorus, and ammonia-nitrogen levels are low, dissolved oxygen levels are fairly high, and the river is safe for recreation for most of the year. However, warm water temperatures and pollutants derived from atmospheric deposition (e.g., mercury), pesticides, personal care products, and pharmaceuticals remain a concern (City of Portland 2019). In addition, pollutants in the riverbed, as discussed above, may possibly be mobilized by scour and available for uptake by aquatic organisms.

More than 15 major dams in the Willamette River basin collectively control the river's flow, suppressing the magnitude and frequency of large flow events and preventing an inflow of gravel and large woody debris (Wallick et al. 2013). The controlled flow regime, combined with channel armoring, has greatly reduced channel habitat diversity, including the distribution and abundance of side channels, islands, and gravel bars, and greatly reduced the potential to re-establish habitat diversity. A spatially heterogeneous environment induces greater biodiversity within riverine habitats (Allan and Castillo 2007). Habitat quality in the lower Willamette River is considered low due to channel simplification, limited tree canopy cover, and other urban development effects (City of Portland 2019).

Operation of the Willamette Valley dams have also diminished the river's habitat quality by creating water temperatures that are relatively cool in the summer and warm in the fall. This altered water temperature regime has been identified as one of the limiting factors preventing the recovery of Endangered Species Act-listed Spring Chinook Salmon and winter steelhead in the Willamette Valley (USACE 2019).

The pilings for the many Portland bridges crossing the Willamette collectively displace a small portion of the river, but attract a relatively high density of native and non-native fish (Friesen 2005). The pilings also generate some hydraulic and geomorphic heterogeneity, and thereby create habitat conditions that can benefit fish (Barkdoll and Huckins 2012) or at least not serve to preclude their growth and abundance (Able and Duffy-Anderson 2005). Piers 1, 2, 3, and 4 of the existing Burnside Bridge occupy approximately 15,400 square feet (0.35 acre) of the river.

5.3.3 Ordinary High Water Mark

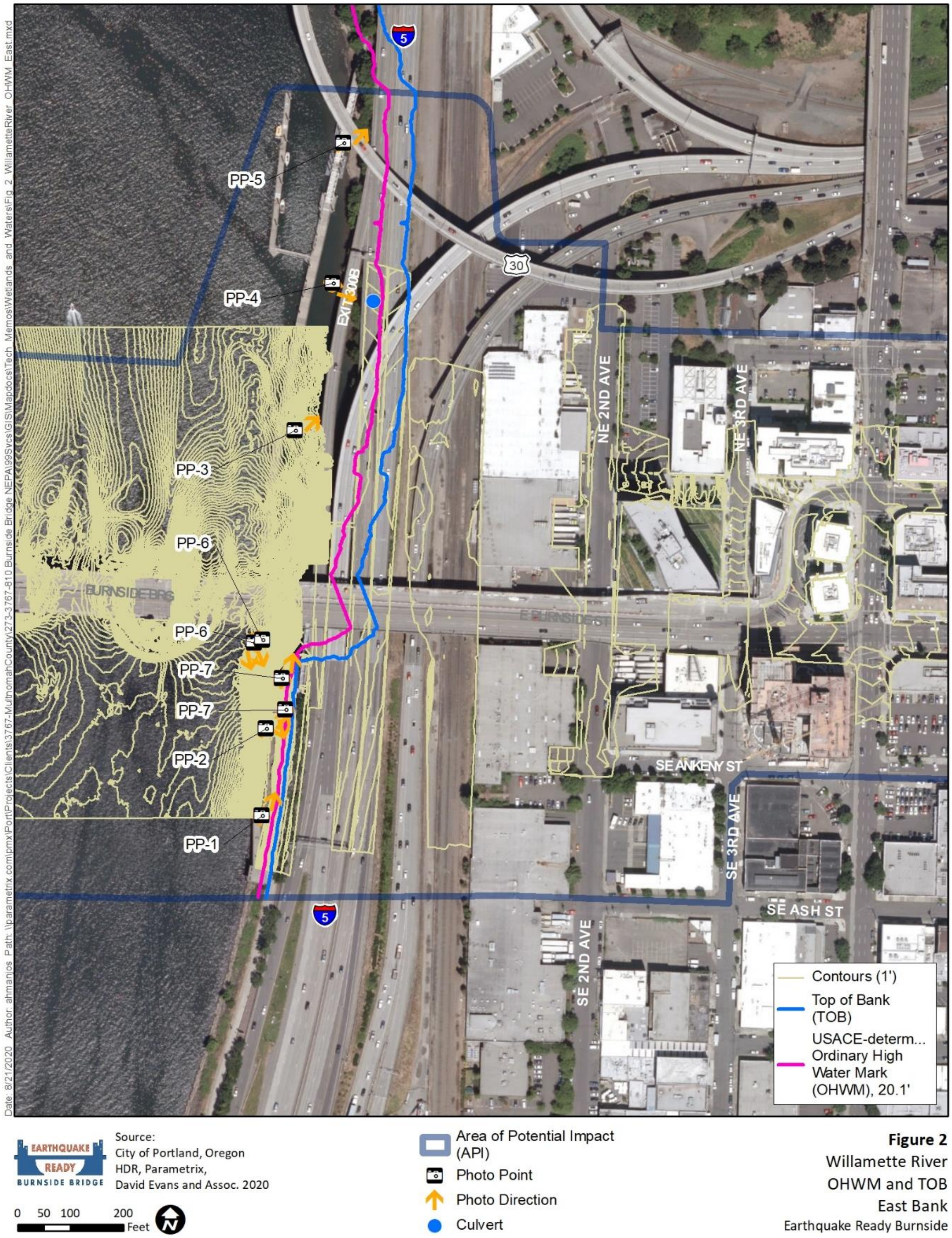
As mentioned in Section 5.2.2, the USACE (2014) used long-term river gauge data to determine the OHWM within the project vicinity at 20.1 feet elevation (NAVD88 datum). USACE determined the elevation by statistical analysis of gauge data for a tidal river and not by assessment of field indicators. The USACE-identified OHWM elevation extends from the river mouth to river mile 13, which is upriver of the API.

Within the API, the OHWM indicates the lateral limit of the USACE's regulatory authority under both Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This same elevation would likely be considered the highest measured tide and thereby serve as the lateral limit of Oregon's regulatory authority under Oregon's Removal-Fill Law.

Figure 2 shows the USACE-determined OHWM of the river in the API. Figure 2 also illustrates the locations where photographs were taken and the direction (azimuth) the camera was facing. Photographs taken during the investigation are shown in Appendix A. The location of the OHWM on both banks of the river in the API is shown in Figure 3. The OHWM elevation on the west bank within the API is along the face of the harbor wall, which rises to approximately 32.4 feet (City of Portland 2018b).

South of the Burnside Bridge, the east bank of the river below the OHWM slopes steeply (approximately 60 to 95 percent grade). This slope also serves as the embankment for the Vera Katz Eastbank Esplanade and the south-bound lanes of Interstate 5 (I-5). North of the bridge, the riverbank below the OHWM is moderately sloped (approximately 12 to 25 percent grade) and occurs slightly farther east than the portion of the bank south of the bridge. On both sides of the bridge, the substrate comprising the river's east bank is riprap (angular stones and boulders artificially placed for stabilization) of varying thickness; the more densely vegetated areas appear to have loamy soil underlying a thin cover of riprap.

Figure 2. Willamette River Ordinary High Water Mark and Top of Bank – East Bank



Vegetation is fairly abundant below the OHWM on the east bank south of the bridge, mainly due to the extent of loamy soil near the surface of a fairly thin layer of deep riprap. Although vegetation in this area is dominated by Himalayan blackberry, there are several other species present, including sword fern (*Polystichum munitum*), hardhack (*Spiraea douglasii*), tree of heaven (*Ailanthus altissima*) saplings, and many seral herbaceous plants such as nipplewort (*Lapsana communis*), common mullein (*Verbascum thapsus*), poison hemlock (*Conium maculatum*), and bird vetch (*Vicia cracca*). A large American elm (*Ulmus americana*) tree is present and there also are a few seedlings, saplings, and young trees of various native tree species including black oak (*Quercus kelloggii*) and black cottonwood (*Populus trichocarpa*).

North of the bridge, the bank is moderately to deeply shaded by transportation infrastructure and appears to have a limited extent of loamy soil and thereby supports less vegetation than south of the bridge. The infrastructure extending over the riverbank north of the bridge consists of the lane for I-5 Exit 300B and the on-ramp leading from Interstate 84 to I-5 South; these lanes are suspended via piers over the riverbank and a section of the riverbed. However, several mature trees of various species including big leaf maple (*Acer macrophyllum*), tree of heaven, western sycamore (*Platanus racemosa*), and American elm are present and rooted below the USACE-determined OHWM.

Some indicators of an OHWM on the east bank of the Willamette River were observed within the API at a much lower elevation than the USACE-determined OHWM. These indicators included water marks, a moderately sharp transition in vegetation cover, and accumulated wrack. Each of these indicators is generally caused by long-term inundation and thereby commonly used to determine OHWM.

Water marks, the discoloration of rocks, woody vegetation, or other fixed objects that have been exposed to prolonged inundation (Anderson et al. 2016), are evident on riprap in portions of the riverbank both south and north of the Burnside Bridge. The marks observed at the site entail a 1.5- to 2.5-foot-wide band of whitened riprap.

The upper edge of this band corresponds fairly well with the waterward limit of vascular vegetation. At this elevation, there is a moderately sharp transition from a thick cover of Himalayan blackberry to little vegetation cover, though there are several blackberry canes rooted above the OHWM and reaching down the slope below the OHWM.

Wrack, or water-borne debris mainly in the form of slightly decayed logs and other woody material, is strewn across the banks. South of the bridge, the upper (landward) extent of the debris is mostly at the change in vegetation cover. However, a discontinuous array of wrack was observed higher up the slope, nearly to the paved walkway that connects to the stairway leading up to the Burnside Bridge. This walkway is at approximately 20 feet elevation. North of the bridge there is much less woody debris and the larger debris (e.g., logs) present appear to extend 1-2 feet above the upper edge of the whitened riprap. The presence of wrack above the water marks is most readily explained by a high water event in April that reached 19.1 feet as determined by data collected at the Morrison Street Bridge gauge (USGS 2020).

Although the discrepancy between the three OHWM indicators observed at the site is fairly broad, with the water marks and vegetation cover transition indicating that the OHWM is at approximately 13.0 feet elevation and the wrack indicating that the OHWM is at approximately 20 feet elevation, the elevation indicated by the wrack agrees with the USACE-determined OHWM.

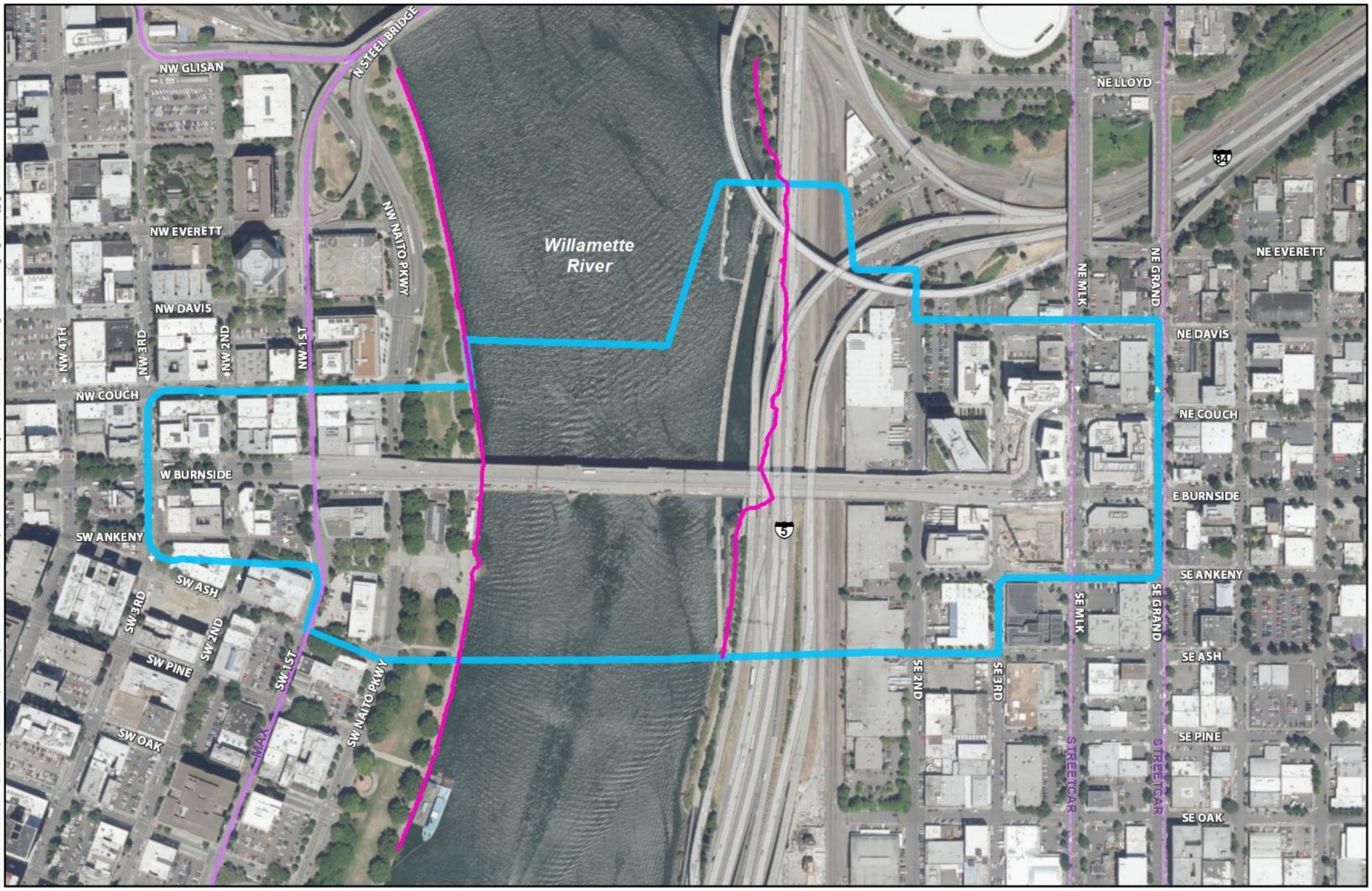
5.3.4 Top of Bank

The top of bank along the Willamette River determines the riverward edge of the 50-foot setback required by the City of Portland for buildings and other structures that are not river-dependent. Top of bank within the API was identified according to guidance in the City of Portland's Title 33, Planning and Zoning (City of Portland 2020).

From the southern edge of the API to approximately 50 feet south of the southern edge of the existing bridge deck, the top of bank was determined by a major change in gradient within 50 feet of the USACE-determined OHWM. Within this section, the top of bank is 28 feet in elevation (NAVD88). This elevation is approximately the elevation of the paved walkway (Vera Katz Eastbank Esplanade) at the top of the slope where it connects to a stairway leading up to the Burnside Bridge. Northward of this section, where there is no reliable topographic information, the top of bank is set at a default position 50 feet landward on the horizontal plane from the OHWM (Figure 3). The top of bank on the west bank within the API is along the top of the harbor wall, which is approximately 32.4 feet (City of Portland 2018a).

For comparison, the base flood elevation (the upper edge of the 100-year floodplain) within this part of the river was determined by the Federal Emergency Management Agency (2010) to be 32 feet NAVD88.

Figure 3. Willamette River Ordinary High Water Mark – Both Banks



Source:
City of Portland, Oregon
HDR, Parametrix

0 125 250 500 Feet

Area of Potential Impact (API)

USACE-determ... Ordinary High Water Mark (OHWM), 20.1'

Figure 3
Willamette River
Ordinary High Water Mark
Both Banks
Earthquake Ready Burnside

6 Impact Assessment Methodology and Data Sources

The impact assessment addresses the direct long-term, direct short-term, indirect, and cumulative impacts to waters within the API that would be caused by the Project Alternatives, including the No-Build Alternative. The approximate extent and volume of fill to be placed in jurisdictional waters was determined. In addition, the assessment identified and gauged the severity of anticipated impacts to aquatic functions. This assessment is necessary to follow the functions-based approach to impact assessment and compensatory mitigation required by the federal Compensatory Mitigation Rule (33 CFR §332) and Oregon's Aquatic Resources Mitigation Framework. Because no wetlands occur within the API, the assessment only addresses impacts to waters.

The impact assessment aligns with the framework used by the Stream Functions Assessment Method (SFAM), which was recently developed by the EPA and DSL (Nadeau et al. 2018a), and is required for assessing functions of wadeable streams in Oregon. SFAM is a semi-quantitative means of assessing streams for their hydraulic/hydrologic, geomorphic, water quality, and biological functions. Analysis of project impacts to aquatic functions adheres to this categorization and employed much of the scientific rationale used to develop SFAM (Nadeau et al. 2018b). Although SFAM is not directly applicable to the Willamette River because it is not a wadeable stream, qualitative assessment of river functions using this framework is warranted given the similarity of functional performance between streams and rivers.

6.1 Long-Term Impact Assessment Methods

The assessment of direct long-term impacts considered the anticipated effects of the project on waters within the API after construction is complete and the planned construction and operation in the context of current and anticipated environmental conditions. In particular, the assessment addressed the following:

- Hydraulic and geomorphic effects – changes in flow patterns, reduced capacity to store floodwaters, and scour of the riverbank and bed.
- Water quality effects – increases in suspended solids, nutrients that limit primary productivity (i.e., phosphorus and nitrogen), and contaminants.
- Biological effects – impacts to aquatic habitat that would result from hydraulic/hydrologic and geomorphic effects, water quality effects, and changes to the benthic environment and habitat diversity.

6.2 Short-Term Impact Assessment Methods

The assessment of direct short-term impacts considered the anticipated effects of the project on waters within the API during project construction. This assessment was predicated on review of the planned construction in the context of current and anticipated environmental conditions. In particular, the analysis addressed the following:

- Hydraulic and geomorphic effects – changes in flow patterns, reduced capacity to store floodwaters, and scour of the riverbank and bed.
- Water quality effects –increases in suspended solids, nutrients that limit primary productivity (i.e., phosphorus and nitrogen), and contaminants.
- Biological effects –impacts to aquatic habitat that would result from hydrologic and geomorphic effects, water quality effects, and changes to the benthic environment and habitat diversity.

6.3 Indirect Impact Assessment Methods

Indirect impacts take place later in time or are further removed in distance, but are reasonably foreseeable (40 CFR 1508.8). Assessment of indirect effects was predicated on understanding the potential growth-inducing effects of each alternative and their related effects on waters in the API, namely the Willamette River. As part of this task, the Land Use finding on induced traffic was reviewed.

6.4 Cumulative Impact Assessment Methods

Cumulative impacts are those that result from the incremental impact of a specific action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). The cumulative impacts assessment documented in this report considers the Project's impacts in combination with other past, present, and reasonably foreseeable future actions that have had or would have direct or indirect impacts to the section of river in the Project Area. Based on the list of foreseeable transportation and other development projects that are anticipated to occur in the API, as well as relevant past actions that have defined the API, a qualitative analysis examines potential cumulative effects on waters. This analysis includes both near-term construction effects as well as long-term operational impacts.

7 Environmental Consequences

7.1 Introduction

The description of long-term impacts to waters is divided into pre-earthquake impacts and impacts that would occur after the next CSZ earthquake.

Impacts to waters would occur with any of the Build Alternatives. Although these impacts would be fairly similar, key differences between the alternatives involve the areal extent of excavation and fill within the river and the duration of construction activity. For each alternative, the spatial and temporal extent of the excavation and fill is presumed to be directly correlated with the spatial and temporal extent of their impacts to the section of the Willamette River within the API, prior to the next CSZ earthquake. As will be discussed in Section 7.3, this correlation remains intact for the Build Alternatives, but becomes invalid for the No-Build Alternative. Each of the Build Alternatives would differ significantly from the No-Build Alternative, especially regarding those impacts that would occur after the next CSZ earthquake. There are no differences anticipated with regard to water-related impacts between the various traffic management options that could be implemented during construction.

For detailed descriptions of construction methods and schedules for each alternative, refer to the *EQRB Construction Approach Technical Report* (Multnomah County 2021a).

7.2 Pre-Earthquake Impacts

7.2.1 No-Build

The No-Build Alternative would cause no new permanent or temporary impacts to waters prior to a CSZ earthquake. Existing conditions within the river would essentially remain as they are for the foreseeable future. The 0.35 acre of bridge substructure situated within the river would remain in place. Infill development in the API and surrounding areas will continue; river flow will continue to be regulated, preventing most large flow events and greatly limiting the transport of coarse sediment and large wood. In contrast, riparian conditions in the API may slowly improve with natural colonization by or planting of trees and shrubs. As discussed in Section 5.3, there are many tree seedlings and saplings growing along part of the riverbank within the API. Further, the extent of riparian forest appears to have expanded in upstream portions of the Willamette River due to flood flow regulation and the associated decrease in channel complexity (Wallick et al. 2013). The water quality treatment system for the bridge, which currently treats a small percentage of the bridge's stormwater runoff, would continue to be minimal. If bridge retrofit or replacement does not occur, there would be no fill or excavation and none of the associated impacts to wetlands and waters.

7.2.2 Enhanced Retrofit

Direct

The Retrofit Alternative would cause both temporary and permanent direct impacts to the river prior to a CSZ earthquake. Temporary impacts would be caused by activities that involve fill placement and/or removal within the river during construction, but would not result in permanent placement of structure or a permanent change to the elevation of the riverbed. Activities that would cause temporary impacts to waters entail installation of temporary pilings, excavation of portions of the riverbed, installation of temporary cofferdams, and partial demolition of the bridge substructure (Figure 4). In addition, a section of the Portland floodwall (harbor wall) would be removed to access the bridge pier immediately adjacent to it. The harbor wall would be re-constructed after retrofit of the pier is complete.

The *EQRB Construction Approach Technical Report* (Multnomah County 2021a) describes in detail the potential methods for implementing the in-water work. Construction design and Best Management Practices (BMPs) listed in the current version of the City of Portland Erosion, Sediment, and Pollutant Control Plan would be implemented to minimize the geographic extent and severity of impacts to water resources.

Permanent impacts to aquatic resources caused by this alternative mainly stem from the installation of additional permanent structure (i.e., steel shafts and concrete seal course) within the river (Figure 5).

Figure 4. Temporary In-water Impacts – Enhanced Retrofit

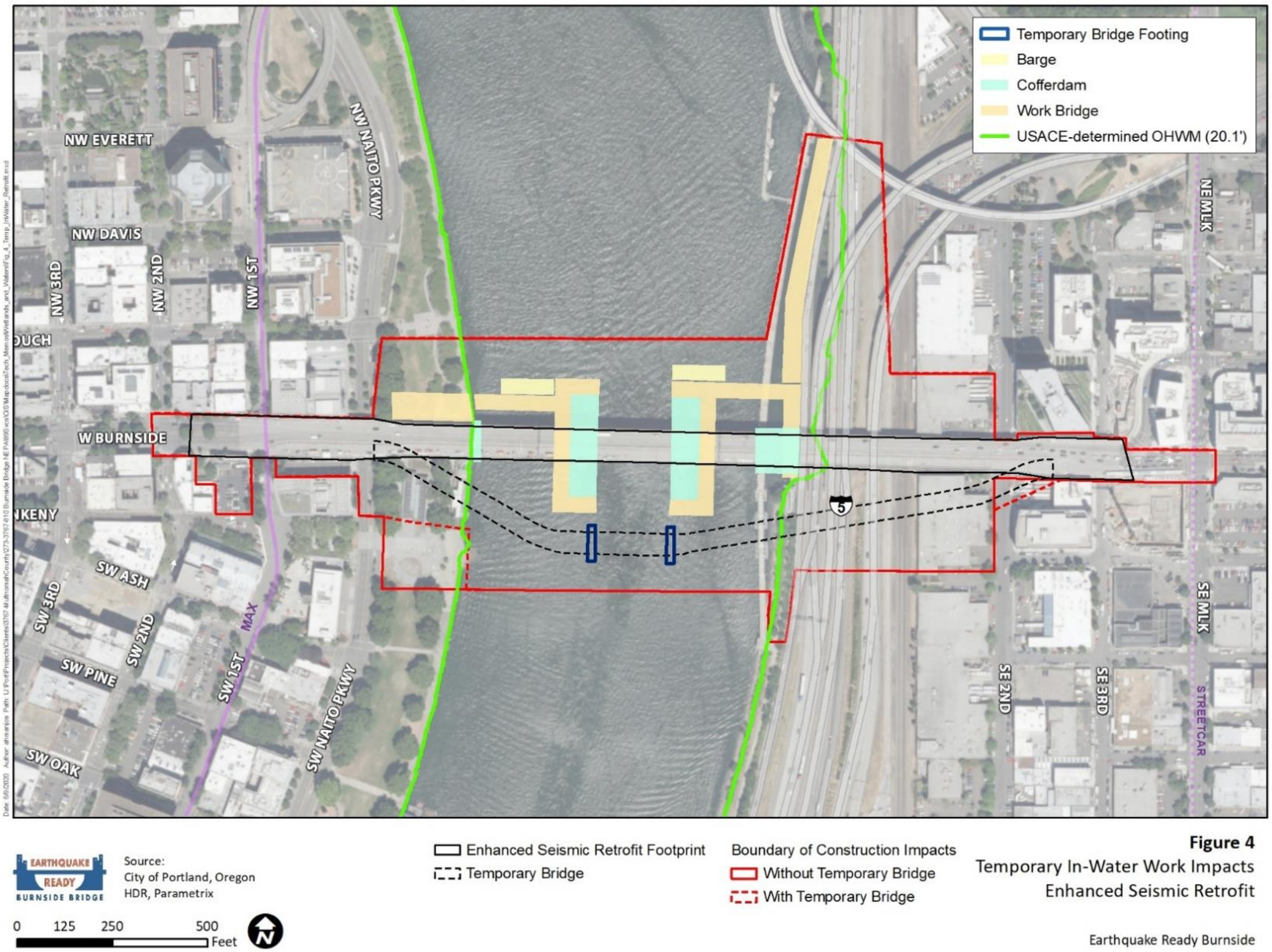
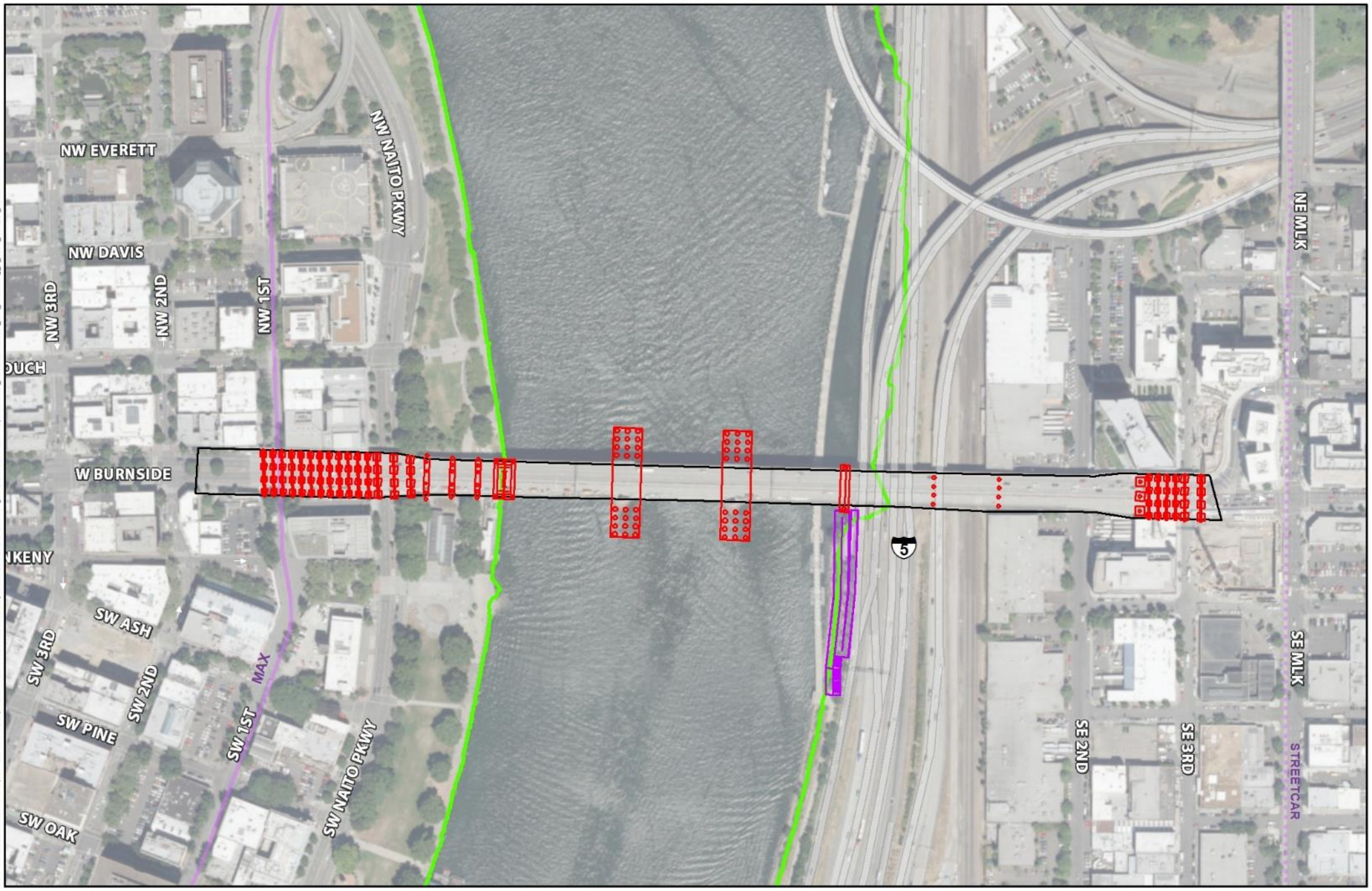


Figure 5. Permanent In-water Impacts – Enhanced Retrofit



Source:
City of Portland, Oregon
HDR, Parametrix

0 125 250 500 Feet

Enhanced Seismic Retrofit Footprint
Non-motorized Access Improvement
Permanent Footings
USACE-determined OHWM (20.1')

Figure 5
Permanent In-Water Work Impacts
Enhanced Seismic Retrofit

Earthquake Ready Burnside

The areal extent and quantities of permanent and temporary construction elements that would be placed within the river (below OHWM) for the Retrofit Alternative are provided in Table 1. The total area of permanent structure below OHWM would be approximately 1.4 acres; thus, this alternative would add approximately 1.0 acre of permanent structure below OHWM to the 0.35 acres of bridge structure. Relative to the other alternatives, the Retrofit Alternative would require the highest number of permanent shafts and the greatest areal extent of new footings within the river. All Build Alternatives would use the same chemically inert and structurally sound materials for the permanent structure below OHWM.

The areal extent of temporary piles placed below OHWM is uncertain for the Retrofit Alternative, but would be in the range of 500 to 700 square feet. On the east side of the river, an existing staircase from the south side of the bridge to the Vera Katz Eastbank Esplanade would be replaced with an ADA-accessible ramp connection and stairs. This new connection would be installed with all Build Alternatives, and require the insertion of temporary piles and permanent structures below OHWM. In addition to the in-water impacts, this project component would also clear a few trees and other vegetation in proximity to the Vera Katz Eastbank Esplanade and below OHWM.

The areal extent of the cofferdams needed during construction of the Retrofit Alternative is approximately 1.1 acres, which is in the middle of the range exhibited by the Build Alternatives. Four temporary cofferdams are anticipated to be installed for the Retrofit Alternative: two in the middle of the river surrounding Piers 2 and 3 (main river piers), one on the west side of the river around Pier 1, and one on the east side of the river at Pier 4. Work within the cofferdams would include footing expansion, consisting of pouring seal courses, installing drilled shafts, partial demolition of the existing bridge substructure, and ground improvements.

Table 1. Enhanced Retrofit Structure below OHWM

Permanent		Temporary		
Area of Structure (acres)	Number of Shafts	Area of Piles (ft^2)	Number of Piles	Cofferdam Area (acres)
1.4	57	500-700	160-220	1.1

[1] Permanent structure = shafts + seal course, and includes the existing bridge structure below OHW, which totals 0.35 acre

The construction approach for each Build Alternative would disturb the riverbed as little as practicable. Temporary work bridges, installed for each of the Build Alternatives, would be installed on steel piles driven into the riverbed from equipment mounted on barges or from equipment mounted on the partially constructed work bridge. The barges would be held in place by vertical steel shafts known as spuds, which would cause minimal habitat displacement and sedimentation. Barges would also provide areas to store and/or pre-build materials, and allow moving these materials in and around the construction area as needed. Impacts that would be caused by a temporary detour bridge, which may or may not be constructed, are discussed in Section 7.4.2.

Installation of new permanent structures in the river (shafts and concrete seal course) would occur within cofferdams to limit sediment release and contain drilling spoils and slurry, if used. Each shaft would be installed after the corresponding concrete seal was poured and the cofferdam dewatered.

As previously mentioned, a portion of the harbor wall that extends along the west edge of the river's OHW would be removed during construction. The length of the harbor wall removed would be approximately 175 feet, the minimum needed to access the bridge pier immediately adjacent. The section of wall would be removed once stabilizing the upland area immediately landward of the wall had occurred; the area would then be isolated with a three-sided cofferdam. The wall section would be replaced within the dewatered area after the retrofit of the pier is complete. BMPs would be implemented during construction; thus, no water quality impacts are anticipated from this part of the retrofit.

Any contaminated substrate excavated during construction would be disposed in accordance with federal and state regulations. In-water work would follow strict protocols to minimize disturbance to the riverbed and thereby suppress the mobilization of sediments and their associated nutrients and contaminants into the water column.

Construction of the Retrofit Alternative would occur for approximately 3.5 years, which is 1 year less than is projected for construction of the other Build Alternatives.

By installing a slightly larger bridge structure in the river than is currently occupied by the existing bridge, the Retrofit and all the Build Alternatives would expand on the current hydraulic encroachment and increase scour potential at the bridge (*EQRB Hydraulic Impact Analysis Technical Report* [Multnomah County 2021d]). The length of the scour channel downriver from the inner bridge piers is expected to more than double from completion of the Retrofit Alternative. This anticipated increase is much greater than the other Build Alternatives. The increased scour may mobilize and transport riverbed sediments and their associated nutrients and contaminants, making them more available for uptake by aquatic organisms. Detailed modeling analysis will be initiated after a preferred alternative is selected to identify design changes that would minimize these impacts to the extent practicable.

The increased hydraulic encroachment would also increase the base flood elevation, albeit slightly. However, additional design modifications could potentially be implemented to minimize volumetric displacement of the river and maintain the current base flood elevation (*EQRB Hydraulic Impact Analysis Technical Report* [Multnomah County 2021d]).

Stormwater treatment facilities constructed as part of the project would treat runoff from the newly constructed impervious surfaces, including runoff from a small extent of existing areas within the API that currently do not undergo treatment (*EQRB Stormwater Technical Report* [Multnomah County 2021f]). The treatment facilities would be designed to meet current regulatory requirements and would thereby limit adverse impacts and impart a benefit to water quality by treating to current standards and treating areas not currently treated. Furthermore, the impact to water quality likely would be minimal because only a small portion of the watershed would be treated; the quality of the large volume of water flowing through the API would remain essentially unaffected. As a result of these minimization measures and the small proportion of the watershed affected by the project, direct impacts to water quality from the Retrofit and all Build Alternatives are expected to be minimal.

As discussed in the *EQRB Vegetation, Wildlife, and Aquatic Species Technical Report* (Multnomah County 2021h), construction of the Retrofit and all the Build Alternatives would cause some minimal detrimental effects to aquatic habitat. Installation of temporary piles and cofferdams will temporarily degrade habitat quality via increased turbidity, elevated noise, and displacement of benthic habitat. In addition, these activities may cause contaminated sediments assumed within the riverbed to be temporarily released into the water column. However, these impacts to the aquatic community and aquatic habitat within the API would be minimal due to planned construction BMPs and a design that minimizes excavation and fill activities within the river.

The increased area occupied by permanent structures would cause a slight decrease in the amount of available in-stream habitat that resident and ESA-listed fish use for migration, spawning, and rearing. However, a survey of the lower Willamette River found both native and non-native fish at higher densities near pilings, and that non-native piscivorous fish do not appear to be foraging on juvenile salmonids (Friesen 2005). Furthermore, ground improvements planned for the riverbed would displace potential habitat for macroinvertebrates, reducing their abundance and thereby reducing prey availability for fish and other organisms (*EQRB Vegetation, Wildlife, and Aquatic Species Technical Report* [Multnomah County 2021h]).

As discussed above, the Retrofit and all the Build Alternatives would impart minor impacts to the hydraulic, geomorphic, water quality, and biological functions of the lower Willamette River. Design modifications may be made to further minimize these impacts to the extent practicable. Moreover, compensatory mitigation, discussed in Section 8, will be implemented to offset those unavoidable impacts that cannot be minimized.

Indirect

Potential indirect impacts associated with transportation improvement projects typically include increased traffic during and after construction and increased development induced by improved access that increase runoff into waterways. However, the project would neither induce development (see *EQRB Land Use Technical Report* [Multnomah County 2021e) nor increase traffic in the API (see *EQRB Transportation Technical Report* [Multnomah County 2021g]). Further, the Retrofit and all the Build Alternatives would be designed to maintain safe passage for all boats under the bridge in accordance with U.S. Coast Guard requirements and thereby not affect the congestion or volume of boat traffic in the API. Thus, there are no potential indirect effects to waters prior to a CSZ earthquake for the Retrofit Alternative.

7.2.3 Replacement, Short-span

The Short-span Alternative has two bridge lift options: bascule lift and vertical lift. Each option has a different areal expanse of permanent and temporary structure and their associated magnitude of impact.

Direct

The direct impacts of the Short-span Alternative prior to a CSZ earthquake would be similar to those described in Section 7.2.2 for the Retrofit Alternative. Temporary impacts during construction would entail installation of temporary pilings, excavation of portions of the riverbed, and installation of temporary cofferdams (Figure 6). In contrast to the Retrofit Alternative, the Short-span Alternative would require full demolition of the bridge substructure, which would occur within the cofferdams. Further, this alternative does not entail removing and replacing a section of the harbor wall. As previously discussed, construction design and BMPs would be implemented to minimize the geographic extent and severity of impacts to water resources.

Permanent impacts to the river would be caused by the erection of a permanent structure within the river (Figure 7). The nature of these impacts would be similar to those described for the Retrofit Alternative. However, the anticipated increase in scour for all replacement alternatives is much less than for the Retrofit Alternative. Thus, there would be less potential to mobilize and transport contaminated sediments present in the riverbed.

Figure 6. Temporary In-water Impacts – Replacement, Short-span

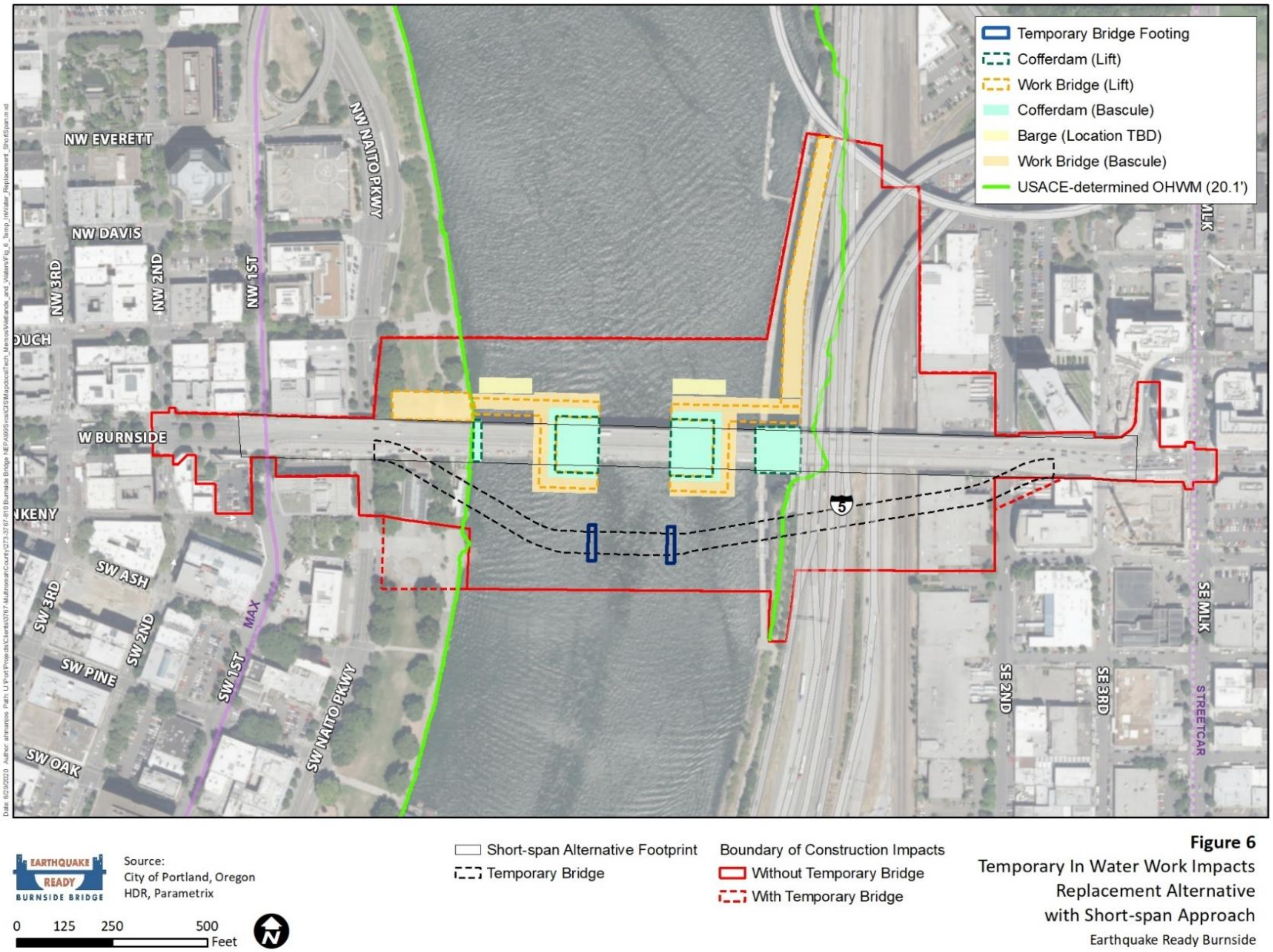


Figure 7. Permanent In-water Impacts – Replacement, Short-span

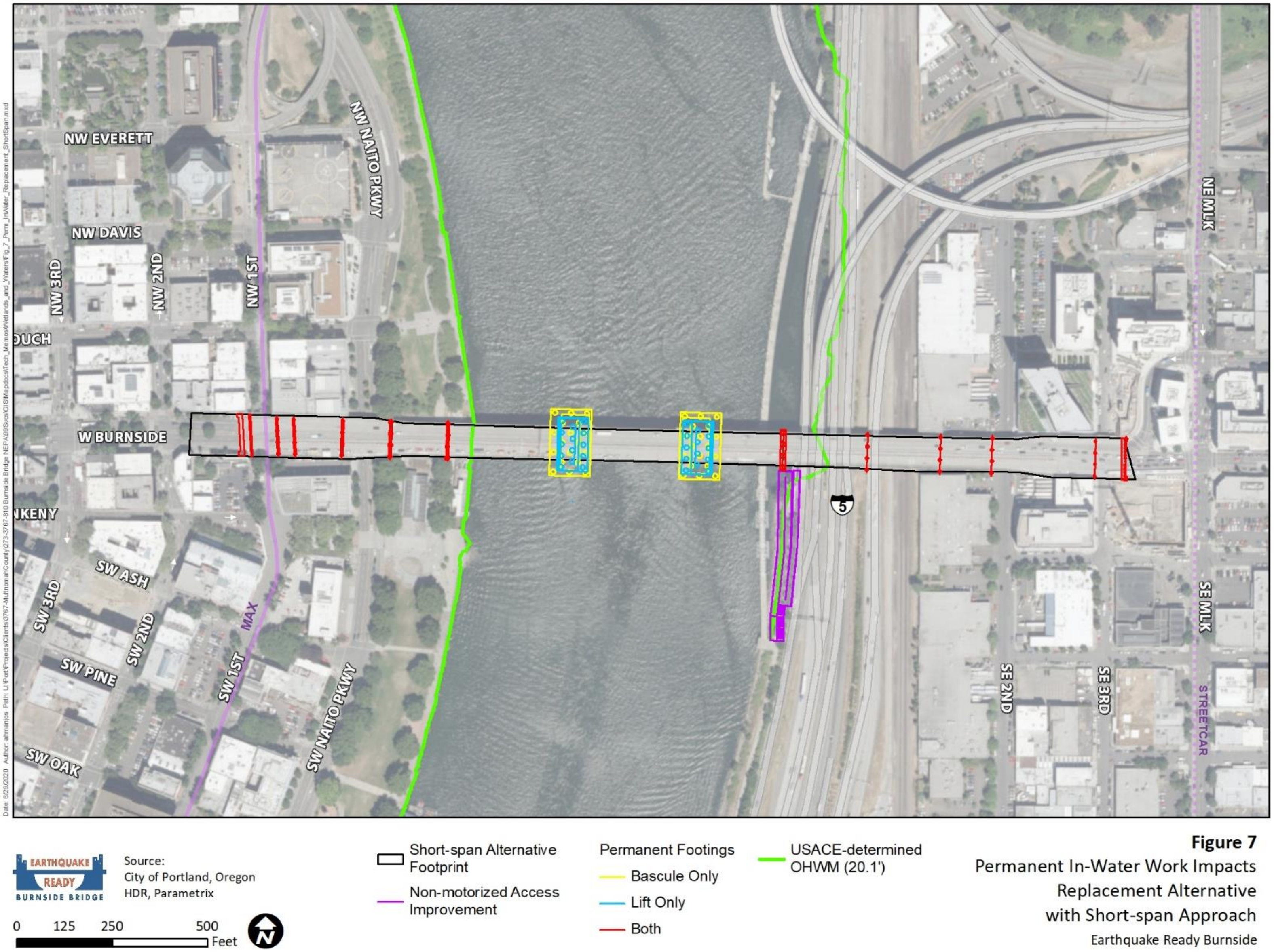


Table 2 provides the anticipated temporary and permanent impacts to water resources for the two bridge lift options. The total area of permanent structure below OHW would be 1.2 acres for the bascule variation and 0.8 acre for the vertical variation. The areal extent of temporary piles placed below OHW for construction of the Short-span Alternative would be in the range of 500 to 700 square feet. The areal extent of the cofferdams needed during construction of the Short-span Alternative would be 1.5 acres for the bascule variation and 1.2 acres for the vertical variation. The estimated construction period for this alternative is 4.5 years.

Table 2. Replacement, Short-span Impacts below Ordinary High Water Mark

Lift Variation	Permanent		Temporary		
	Area of Structure (acres)	Number of Shafts	Area of Piles (ft^2)	Number of Piles	Cofferdam Area (acres)
Bascule	1.2	45	500-700	160-220	1.5
Vertical	0.8	37	500-700	160-220	1.2

Indirect

There are no potential indirect effects to waters for the Short-span Alternative.

7.2.4 Replacement, Long-span

The Long-span Alternative would clear span a substantially longer section of the land and water under the east and west approaches to the movable span. As with the Short-span Alternative, the Long-span Alternative has two bridge lift options: bascule lift and vertical lift. Each option has differing extents of permanent and temporary impacts.

Direct

As with the Short-span Alternative, the direct impacts of the Long-span Alternative prior to a CSZ earthquake would be similar to those described in Section 7.2.2 for the Retrofit Alternative. Temporary impacts during construction would entail installation of temporary pilings, excavation of portions of the riverbed, and installation of temporary cofferdams (Figure 8). As with the Short-span Alternative, full demolition of the bridge substructure would occur within the cofferdams and would not require removing and replacing a section of the harbor wall. As previously discussed, construction design and BMPs would be implemented to minimize the geographic extent and severity of impacts to water resources.

Permanent impacts to the river would be caused by erection of permanent structure within the river (Figure 9). The nature of these impacts would be fairly similar to those described for the Retrofit Alternative. However, as with the other Build Alternatives, the anticipated increase in scour is much less than for the Retrofit Alternative. Thus, there would be less potential to mobilize and transport contaminated sediments present in the riverbed.

Figure 8. Temporary In-water Impacts – Replacement, Long-span

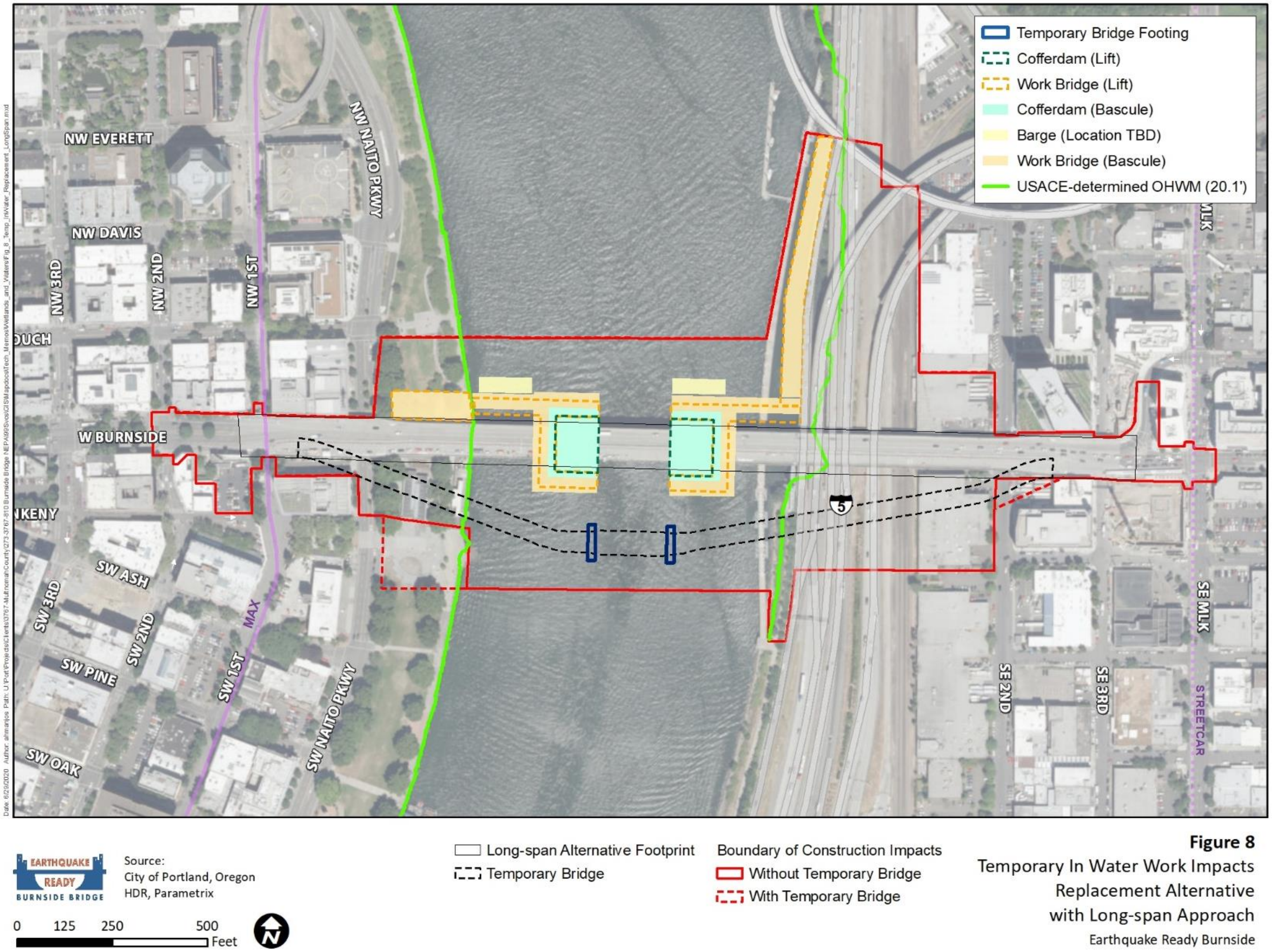
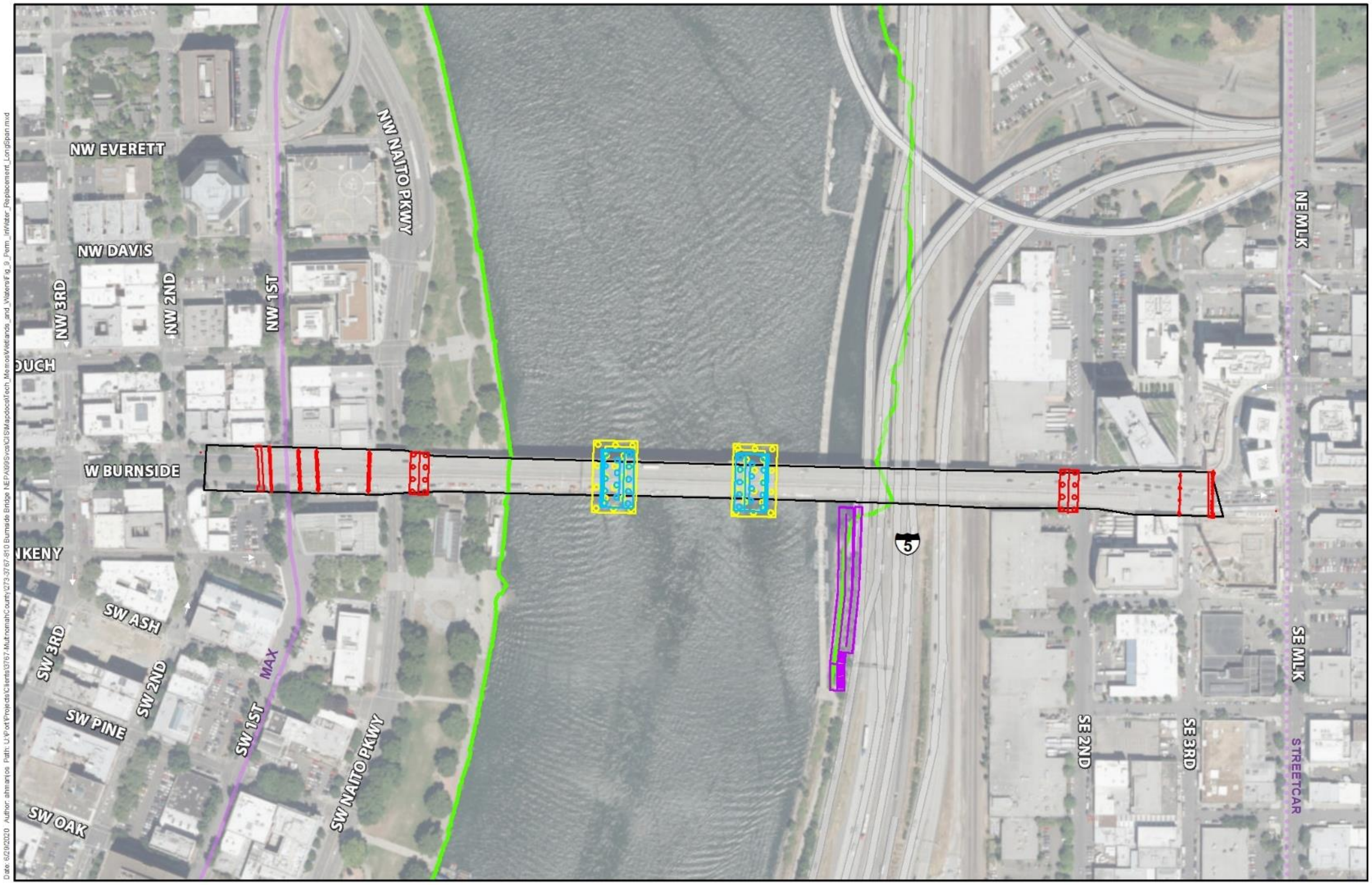


Figure 9. Permanent In-water Impacts – Replacement, Long-span



Source:
City of Portland, Oregon
HDR, Parametrix

0 125 250 500 Feet

Long-span Alternative Footprint

Non-motorized Access Improvement

Permanent Footings
- Bascule Only
- Lift Only
- Both

USACE-determined OHWM (20.1')

Figure 9
Permanent In-Water Work Impacts
Replacement Alternative
with Long-span Approach
Earthquake Ready Burnside

Table 3 provides the anticipated temporary and permanent impacts to water resources for the two bridge lift options. The total area of permanent structure below OHW would be 1.1 acres for the bascule variation and 0.8 acre for the vertical variation. The areal extent of temporary piles placed below OHW is uncertain for the Short-span Alternative, but would be in the range of 500 to 700 square feet. The areal extent of the cofferdams needed during construction of this alternative would be 1.1 acres for the bascule variation and 0.8 acre for the vertical variation. The estimated construction period for this alternative is 4.5 years.

Table 3. Replacement, Long-span Impacts below Ordinary High Water Mark

Lift Variation	Permanent		Temporary		
	Area of Structure (acres)	Number of Shafts	Area of Piles (ft^2)	Number of Piles	Cofferdam Area (acres)
Bascule	1.1	41	500-700	1.1	1.1
Vertical	0.8	33	500-700	0.8	0.8

7.2.5 Replacement with Couch Extension

The Couch Extension Alternative is the same as the Short-span Alternative from the west bridge approach eastward to just past the movable span. Like all of the other Replacement Alternatives, it has the same movable span options (bascule or vertical lift). Impact associated with this alternative will also be similar to those of the other Replacement Alternatives.

Direct

The direct impacts of the Couch Extension Alternative prior to a CSZ earthquake would be similar to those described in Section 7.2.3 for the Short-span and Long-span Alternatives. Temporary impacts during construction would entail installation of temporary pilings, excavation of portions of the riverbed, and installation of temporary cofferdams (Figure 10). As with the Short-span and Long-span Alternatives, the Couch Extension Alternative would require full demolition of the bridge substructure, which would occur within the cofferdams. Further, this alternative does not entail removing and replacing a section of the harbor wall. Construction design and BMPs would be implemented to reduce the geographic extent and severity of impacts to water resources.

Permanent impacts would be caused by erection of permanent structures within the river (Figure 11). The nature of these impacts would be similar to those described for the Retrofit Alternative. However, as with the other Replacement Alternatives, the anticipated increase in scour is much less than for the Retrofit Alternative. Thus, there would be less potential to mobilize and transport contaminated sediments present in the riverbed.

Figure 10. Temporary In-water Impacts – Replacement with Couch Extension

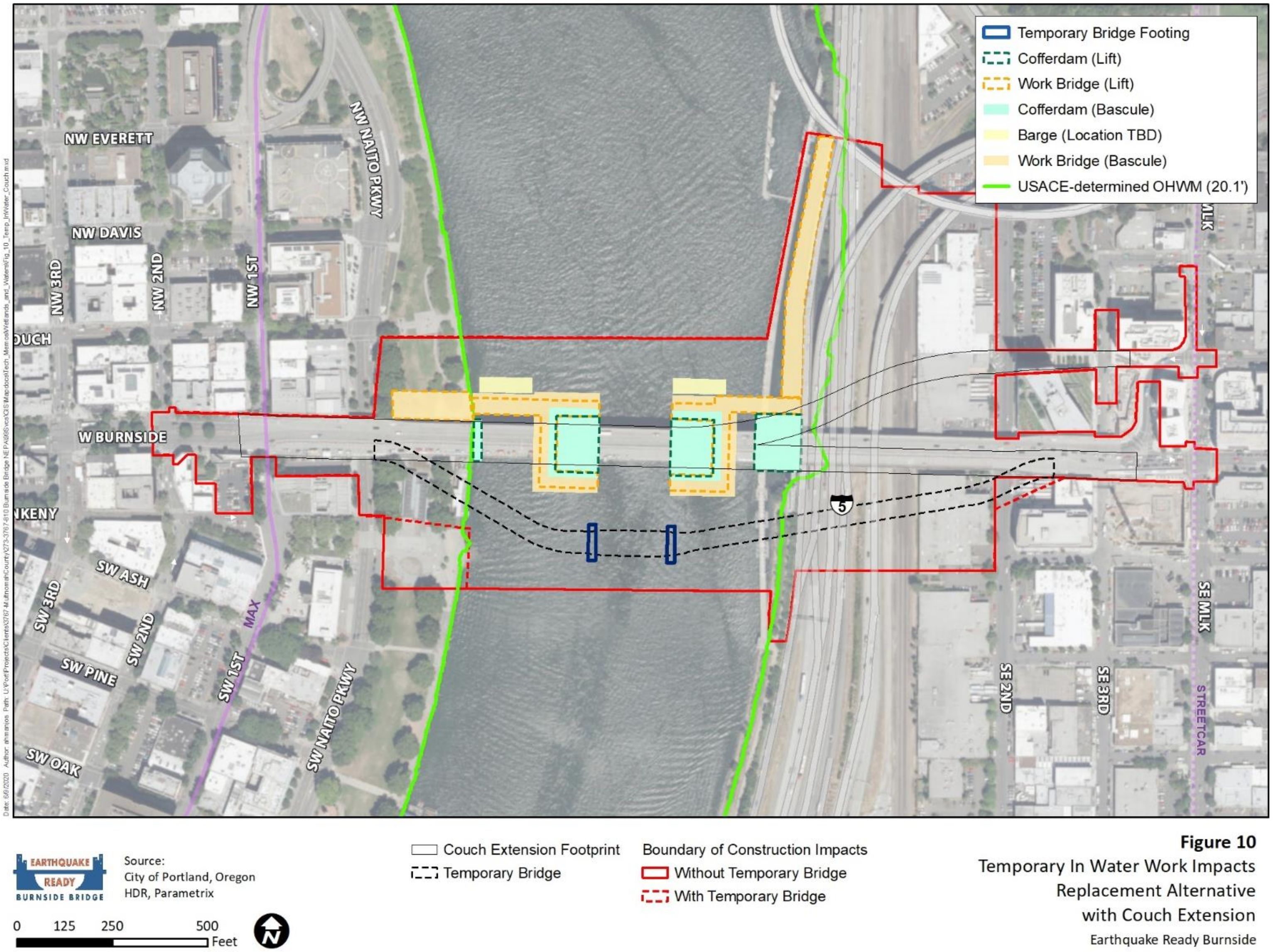


Figure 11. Permanent In-water Impacts – Replacement with Couch Extension

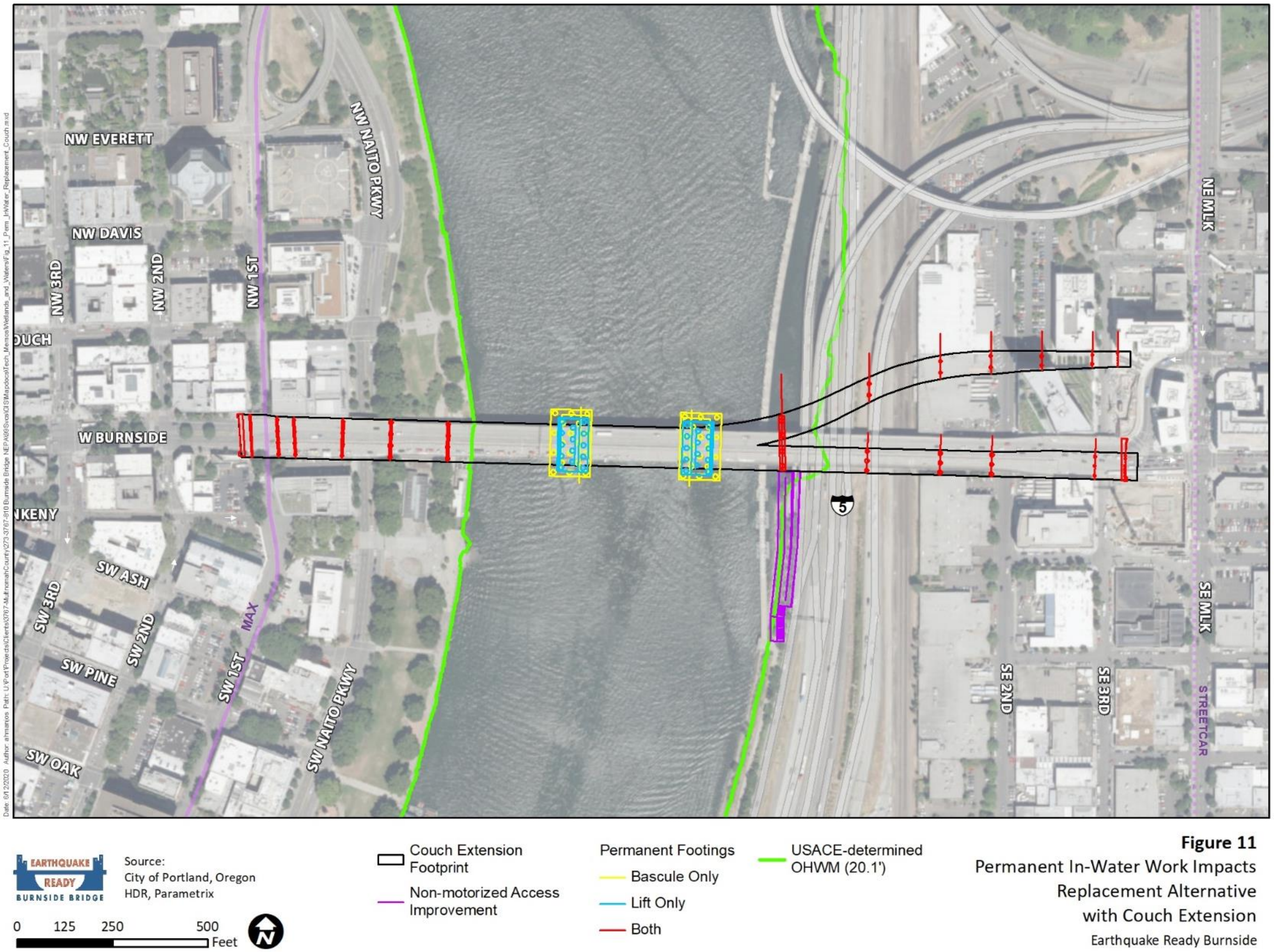


Table 4 provides the anticipated temporary and permanent impacts to water resources for each of the two Couch Extension Alternative lift options. The total area of permanent structure below OHW would be 1.2 acres for the bascule variation and 0.8 acre for the vertical variation. The areal extent of temporary piles placed below OHW is uncertain for the Couch Extension Alternative, but would be in the range of 500 to 700 square feet. The areal extent of the cofferdams needed during construction of the Couch Extension Alternative would be 1.6 acres for the bascule variation and 0.8 acre for the vertical variation. The estimated construction period for this alternative is 4.5 years.

Table 4. Replacement with Couch Extension In-water Impacts

Lift Option	Permanent		Temporary	
	Area of Structure below OHW (acres)	Number of Shafts	Area of Piles below OHW (ft^2)	Cofferdam Area (acres)
Bascule	1.2	46	500-700	1.6
Vertical	0.8	38	500-700	1.3

Indirect

There are no potential indirect effects to waters prior to a CSZ earthquake for the Couch Extension Alternative.

7.3 Post-Earthquake Impacts

7.3.1 No-Build

Direct

A CSZ earthquake would have considerable direct impacts to water resources in the API if the No-Build Alternative is selected. The Burnside Bridge would either collapse or become severely damaged from a positional shift in one or more of the bridge piers. Either a collapse or pier shift would greatly alter the riverbed and/or bank stability and thereby cause substantial erosion and sedimentation, at least in the days following the earthquake. Sediment and associated pollutants would become suspended in the water column, which would degrade water quality and aquatic habitat. In addition, the existing stormwater facilities on the bridge as well as conveyance outfalls on the banks of the river would fail.

Indirect

The No-Build Alternative would cause substantial indirect effects to water resources after a CSZ earthquake. Erosion caused by the collapse or pier shift of the Burnside Bridge would increase levels of suspended sediment and associated nutrients that limit biological productivity. These increases likely would increase primary productivity, which could depress oxygen levels and impact water quality. Such effects could generate harmful conditions for fish and other aquatic organisms. These effects likely would occur within, and potentially several river miles downstream of, the API.

7.3.2 Enhanced Retrofit

Direct

The Retrofit Alternative would have the same permanent direct effects and temporary (construction-related) impacts on the river before and after a CSZ earthquake (Section 7.2.2).

Implementation of the Retrofit Alternative would sustain bridge utility, at least for emergency vehicle traffic, after a CSZ earthquake of up to a 9.0 magnitude. After implementation of the Retrofit Alternative, earthquakes up to this magnitude would not cause the bridge to collapse or become severely damaged. Portions of the bridge would not be deposited on the riverbed and the bridge piers would not move.

Indirect

Unlike most of the other bridges in downtown Portland, the Burnside Bridge would remain functional after an earthquake up to 9.0 magnitude if the Retrofit Alternative or any of the Build Alternatives is selected. The bridge likely would support an increased volume of traffic for the months to years that would be necessary to re-construct the other bridges that collapse or become severely damaged. Increased volume and congestion of vehicular traffic likely would cause a corresponding increase in contaminant concentrations within runoff from the bridge, which could cause water quality impacts and associated aquatic habitat degradation within the API and possibly downstream of the API. However, the stormwater treatment facilities planned for all the Build Alternatives would greatly minimize or prevent these impacts from occurring. Thus, increased concentrations of pollutants associated with road runoff would be relatively small and the effect on the river's water quality and aquatic habitat would be negligible.

7.3.3 Replacement, Short-Span

Direct

The Short-span Alternative would have the same permanent direct effects and temporary (construction-related) impacts on the river before and after a CSZ earthquake (Section 7.2.3).

Implementation of this alternative would sustain bridge utility, at least for emergency vehicle traffic, after a CSZ earthquake of up to a 9.0 magnitude. After implementation of the Short-span Alternative, earthquakes up to this magnitude would not cause the bridge to collapse or become severely damaged. Portions of the bridge would not be deposited on the riverbed and the bridge piers would not move.

Indirect

The Short-span Alternative would have the same indirect effects to the river after a CSZ earthquake as described for the Retrofit Alternative (Section 7.3.2).

7.3.4 Replacement, Long-span

Direct

The Long-span Alternative would have the same permanent direct effects and temporary (construction-related) impacts on the river before and after a CSZ earthquake (Section 7.2.3).

Implementation of this alternative would sustain bridge utility, at least for emergency vehicle traffic, after a CSZ earthquake of up to a 9.0 magnitude. After implementation of the Long-span Alternative, earthquakes up to this magnitude would not cause the bridge to collapse or become severely damaged. Portions of the bridge would not be deposited on the riverbed and the bridge piers would not move.

Indirect

The Long-span Alternative would have the same indirect effects to the river after a CSZ earthquake as described for the Retrofit Alternative (Section 7.3.2).

7.3.5 Replacement with Couch Extension

Direct

The Couch Extension Alternative would have the same permanent direct effects and temporary (construction-related) impacts on the river after a CSZ earthquake as would occur before a CSZ earthquake (Section 7.2.4).

Implementation of the Couch Extension Alternative would sustain bridge utility, at least for emergency vehicle traffic, after a CSZ earthquake of up to a 9.0 magnitude. After implementation of the Couch Extension Alternative, earthquakes up to this magnitude would not cause the bridge to collapse or become severely damaged. Portions of the bridge would not be deposited on the riverbed and the bridge piers would not move.

Indirect

The Couch Extension Alternative would have the same indirect effects to the river after a CSZ earthquake as described for the Retrofit Alternative (Section 7.3.2).

7.4 Construction Impacts

7.4.1 Without Temporary Bridge

The previous sections describe each alternative based on scenarios without a temporary detour bridge. There are no additional impacts or changes to construction without a Temporary Bridge.

Enhanced Retrofit

No additional impacts are anticipated without a Temporary Bridge for the Retrofit Alternative.

Replacement, Short-span

No additional impacts are anticipated without a Temporary Bridge for the Short-span Alternative.

Replacement, Long-span

No additional impacts are anticipated without a Temporary Bridge for the Long-span Alternative.

Replacement with Couch Extension

No additional impacts are anticipated without a Temporary Bridge for the Couch Extension Alternative.

7.4.2 With Temporary Bridge

Use of a temporary detour bridge during construction would lead to additional impacts to water resources. As with the alternatives, the spatial and temporal extent of the fill for the temporary detour bridge is presumed to be directly correlated with the spatial and temporal extent of their impacts to the section of the Willamette River within the API, prior to the next CSZ earthquake. These impacts would be similar to the ones described in Section 7.2. The nature and extent of the impacts would not differ between the Build Alternatives. No permanent impacts are anticipated from construction or demolition of the Temporary Bridge.

The Temporary Bridge would be located south of the existing Burnside Bridge, spanning Tom McCall Waterfront Park on the west side and I-5, I-84, and the Union Pacific Railroad on the east side. If a Temporary Bridge were selected for use, the first construction activity for any of the Build Alternatives would be to install the Temporary Bridge pilings, both on land and in the river. Removal of the Temporary Bridge would be the final construction activity.

In-water pilings would be installed using a combination of vibratory and driving methods. The *EQRB Construction Approach Technical Report* (Multnomah County 2021a) describes in detail the potential methods for installing the Temporary Bridge.

There are two variations for the Temporary Bridge: one that would maintain vehicular, pedestrian, and bicycle traffic; and one that would maintain pedestrian and bicycle traffic only. The vehicular/pedestrian/bicycle variation of the bridge would be wider than the pedestrian/bicycle only variation and thereby require more in-water structural support. The vehicular/pedestrian/bicycle variation would be supported by up to 180 steel piles below OHW, occupying up to 570 square feet. The pedestrian/bicycle only variation of the bridge would be supported by up to 90 steel piles below OHW, occupying up to 290 square feet. Table 5 outlines the anticipated impacts associated with each variation of the Temporary Bridge.

Table 5. Temporary Bridge Construction Impacts

Bridge Variation	Area of Piles below OHW (square feet)	Number of Piles below OHW	Construction Time (years)
Vehicular/Pedestrian/Bicycle	410-570	130-180	1.5
Pedestrian/Bicycle	220-290	70-90	1.5

Enhanced Retrofit

Construction of either variation of the Temporary Bridge would occur over 1.5 years and extend the overall construction period for the Retrofit Alternative from 3.5 to 5 years.

Replacement, Short-Span, Long-Span, and Couch Extension Alternatives

Construction of either variation of the Temporary Bridge for any of the other Build Alternatives aside from the Retrofit Alternative would occur over 1.5 years and extend the overall construction period from 4.5 to 6 years.

7.4.3 Potential Off-Site Staging Areas

The construction contractor may use one or more off-site staging areas, outside the bridge study area to store and and/or assemble materials that would then be transported by barge to the construction site. Off-site staging could occur with any of the alternatives. Whether, where and how to use such sites would be the choice of the contractor and therefore the actual site or sites cannot be known at this time. Given this uncertainty, detailed analysis of impacts is not possible at this time. To address this uncertainty, four possible sites have been identified that represent a much broader range of potential sites where off-site staging might occur. While the contractor could choose to use one of these or any other site, it is assumed that because of regulatory and time constraints on the contractor, any site they choose would need to be already developed with road and river access. It is also assumed that the contractor would be responsible for relevant permitting and/or mitigation that could be required for use of a chosen site. The Draft EIS identifies the types of impacts that could occur from off-site staging, based on the above assumptions. This analysis is not intended to “clear” any specific site, but rather to ensure disclosure of the general types of impacts based on the possible sites.

The four representative sites include:

- A Willamette Staging Option off Front Avenue
- B USACE Portland Terminal 2
- C Willamette Staging Option off Interstate Avenue
- D Ross Island Sand and Gravel Site

Based on the four potential sites identified, the types of impacts to waters that could occur from off-site staging include delivery to the Willamette River of petrochemicals, heavy metals, sediments, nutrients and other pollutants commonly associated with urban runoff.

Construction activity could result in minor spills and/or soil destabilization that could make these pollutants available for conveyance to the river via runoff during storm events.

If a contractor chooses to use an off-site staging area, the following local, state and federal regulations could apply Section 402 of the Clean Water Act as implemented by the National Pollution Discharge Elimination System (NPDES) permit program. Specifically, the off-site staging would need to comply with one or both of the following MS4 Permits issued by DEQ and the City of Portland:

1. No. 101314 – prescribes all stormwater and allowable non-stormwater dischargers from the MS4 within the City of Portland urban services boundary to surface waters of the state.
2. No. 103004 – prescribes all stormwater and allowable non-stormwater discharges from the MS4 within the limits of the five County-operated Willamette River Bridges.

7.5 Cumulative Effects

A number of actions have been and/or are likely to be undertaken that, when combined with any of the Build Alternatives, would have cumulative effects on the waters within the API as well as on adjacent portions of the river extending both upstream and downstream of the API.

Development and its associated impacts to the Willamette River within the API has been ongoing for approximately 150 years. Construction of bridges, hardened banks, and the harbor wall along with repeated dredging over the years has significantly altered the riverine environment. These and other urban development features have greatly increased impervious surface area, leading to elevated inputs of sediment, nutrients, and contaminants to the river. Furthermore, operation of the Willamette Valley dam system has greatly reduced the inflow of gravel and woody debris and altered water temperatures. These changes also have reduced the areal extent and ecological integrity of both the river and adjacent riparian zone in the lower Willamette River (City of Portland 2018a).

Infill development will continue in the API and surrounding areas in the future, regardless of which project alternative is selected. According to the City of Portland (2018a), "…the area from the Ross Island Bridge to just north of the Burnside Bridge and from the east bank of the river to approximately 0.5 mile of the riverbank will continue to support light industry while developing into a center for new urban industries that create jobs and provide products and services to the region." Although such development likely would cause a negligible effect on river flow dynamics and water quality, it may lead to increased human activity on, in, and along the river that would diminish habitat quality of the river and riparian area.

As mentioned previously, urban development in general and industrial development primarily led to significant contamination in the lower Willamette River and the consequent designation of the Portland Harbor Superfund Site, the upstream edge of which is approximately 0.4 river mile downstream of the API. The EPA (2019) determined that pollutant concentrations in surface sediments in the part of the river within and upstream of the API do not warrant removal and/or remediation. Further, DEQ expects that pollutant concentrations in this part of the river will decline over time as the in-water sources are addressed, upland sources are controlled, and natural recovery mechanisms take effect (DEQ 2019).

The combination of these past, present, and foreseeable future alterations to the lower Willamette River result in the following impacts:

- Constriction of the channel and simplification of channel form
- Reduction of the areal extent of the waters
- Reduction of floodplain dynamics
- Degradation of water quality
- Reduction of the abundance and diversity of native aquatic and riparian-dependent organisms that were present prior to European settlement

7.5.1 No-Build Alternative

Prior to the occurrence of a CSZ earthquake, the No-Build Alternative would not generate any additional impacts to water resources within the API or to adjacent portions of the river upstream or downstream of the API. After a CSZ earthquake, the No-Build Alternative would lead to a variety of direct and indirect effects as described in Section 7.3.1. These direct and indirect effects combined with the historical, ongoing, and future effects on the river discussed in Section 5.3.2 and summarized in Section 7.5 would lead to substantial cumulative effect on the river in the API and to adjacent portions of the river upstream or downstream of the API.

Flow hydraulics and associated distribution and rates of erosion and sedimentation would be further altered and water quality further degraded. These effects, in combination with the historical, ongoing, and future effects on the aquatic habitat, would engender a considerable cumulative effect on the aquatic biological community. Presuming that most of the debris and the associated contamination from the collapse would be removed from the API within a year or so after the collapse, the cumulative impacts would be mostly temporary.

7.5.2 Build Alternatives

The Build Alternatives would have a negligible contribution to cumulative impacts on the waters within the API before and after a CSZ earthquake. Although excavation and fill placement within the river is required for all Build Alternatives, the areal extent of these actions would be limited to a small portion of the API. The construction approach with planned BMPs would cause little to no additional detriment to the waters within and beyond the API. Within the API, the planned stormwater treatment would diminish loads and concentrations of pollutants typically associated with urban runoff; however, these reductions would have a negligible effect on water quality due to the large influx of water from other portions of the Willamette Valley. These negligible cumulative effects on hydraulics, geomorphic character, and water quality would lead to a negligible cumulative effect on the aquatic habitat within the API. Although compensatory mitigation would impart a benefit to the river's ecological functionality through restoration and/or enhancement of aquatic habitat (Section 8), the benefit likely would be small. Thus, the

Build Alternatives would have minimal additional effect on the river's flow dynamics, geomorphic character, water quality, and aquatic habitat.

7.6 Compliance with Laws, Regulations, and Standards

The Project would comply with all federal, state, and local laws and regulations listed in Section 4. Permits and authorizations required by these laws and regulations would be acquired before Project construction begins.

Required permits related to water resources must be obtained from federal, state, and local agencies. Table 6 presents the key water resource-related permits that would be needed. These permits would be required for the Project regardless of which Build Alternative is selected.

Table 6. Required Permits Related to Water Resources

Permit/Authorization	Relevant Laws	Implementing Agency
Individual Permit	Clean Water Act (33 USC 1251–1387); Rivers and Harbors Act of 1899 (33 USC 403)	USACE
Water Pollution Control Facilities Permit	Clean Water Act (33 USC 1251–1387)	DEQ
Removal-Fill Permit	Oregon's Removal-Fill Law (ORS 196.795-990)	DSL
National Pollutant Discharge Elimination System 1200-C Stormwater Permit	Clean Water Act (33 USC 1251–1387)	DEQ
Supplemental Permit	City of Portland Zoning Code Title 33 Planning and Zoning, River Environmental Overlay Zone	City of Portland

7.7 Conclusion

Of the Build Alternatives, the Retrofit Alternative would have the greatest impact on waters as it would have the largest permanent impact area, which is the area of bridge substructure placed below OHW (Table 7). As stated in Section 7.1, the spatial and temporal extent of project activities in the water is presumed to be directly correlated with the spatial and temporal extent of their impacts to the section of the Willamette River within the API. The gross area of permanent structure that would be placed below OHW for this alternative is approximately 1.35 acres, which equals the existing area of bridge substructure (0.35 acre) plus the area that would be added by the Retrofit Alternative (1.0 acre). The Retrofit Alternative would also cause much greater scour than the other Build Alternatives; such scour could mobilize and transport sediment-bound contaminants, which could harm aquatic organisms.

The Build Alternative with the least permanent impact area is the vertical lift variation for the Long-span Alternative. The net area of permanent structure that would be placed below OHW for this option is approximately 0.45 acre.

The temporary (construction-related) impacts caused by the Build Alternatives are anticipated to be fairly similar to each other and fairly minimal. BMPs would be implemented during construction to minimize water quality impacts and any contaminated substrate excavated during construction would be disposed in accordance with federal and state regulations. Although the area occupied by temporary piles would be the same for each Build Alternative, the area occupied by coffer dams would vary from 0.8 acre for the Long-span Alternative, vertical lift variation to 1.6 acres for the Couch Extension Alternative, bascule lift variation. Construction of the Retrofit Alternative, in combination with construction of a temporary detour bridge, would require up to 5 years, which is 1 year less than the maximum time anticipated for the other Build Alternatives.

Table 7. Permanent Impacts to Waters by Alternative

Alternative	Bridge Lift Variation	Number of Shafts below OHW	Gross Area of Permanent Impact below OHW (acre)	Net Area of Permanent Impact below OHW (acre)
Enhanced Retrofit	n/a	52	1.4	1.05
Replacement, Short-span	Bascule	40	1.2	0.85
	Vertical	32	0.8	0.45
Replacement, Long-Span	Bascule	36	1.1	0.75
	Vertical	28	0.8	0.45
Replacement with Couch Extension	Bascule	40	1.2	0.85
	Vertical	32	0.8	0.45

Although the No-Build Alternative would not have the least direct impact to waters before a CSZ earthquake compared to the Build Alternatives, it would have the greatest impact to waters of all the alternatives after a CSZ earthquake.

8 Mitigation Measures

The mitigation measures planned for the Build Alternatives will minimize and compensate for impacts to waters. Avoidance was determined to be unfeasible for the Build Alternatives due to the need for in-water work. Minimization will be achieved by constraining the in-water footprint as much as practicable, implementing construction BMPs, and providing stormwater treatment. Other potential minimization measures include modifying the shape of the in-water structure to reduce hydraulic response and associated scour, and/or excavating a portion of the existing floodplain to increase flood storage (*EQRB Hydraulic Impact Analysis Technical Report* [Multnomah County 2021d]). Compensation would be achieved by support and implementation of a habitat restoration project within and along the lower Willamette River.

Compensatory mitigation for waters impacts of the EQRB Project would meet the requirements and guidance provided by USACE, DSL, and the City of Portland. The mitigation would compensate impacts to aquatic functions as required by the federal

Final Mitigation Rule and Oregon's Aquatic Resource Mitigation Framework policy. Once an alternative is selected, specific mitigation measures will be discussed with the City of Portland, National Oceanic and Atmospheric Administration, and Oregon Department of Fish and Wildlife. The required mitigation area would be calculated based on impacts to area and functions.

At this time, there are two potential restoration projects that could serve as compensation for the unavoidable impacts to waters that would be caused by one of the Build Alternatives. Both restoration sites are situated along the Willamette River, within a few river miles of and in the same subwatershed as the Burnside Bridge (Hydrologic Unit Code 170900120202).

The first potential compensatory mitigation project is the Linnton Mill Restoration Site, which included the dismantling of a riverside industrial site along the Portland Harbor Superfund site and restoration of riparian and riverine habitat. Multiple buildings, two docks, and several hundred pilings have been removed and will be replaced with off-channel habitat along the Willamette River, a daylighted section of Linton Creek where it enters the river (currently contained by pipe), and newly planted native trees and shrubs. Habitat features such as partly submerged logs, upland rock piles and dead-standing trees have been be installed. Some of the credits to be generated these credits may be available in 2020 (Marinai pers comm. 2020) are reserved to compensate for natural resources damage caused by the Portland Harbor Superfund site. However, it is likely there will be credits available for use as compensation for impacts to waters caused by the EQRB Project, and the credits may be available over the next few years (Marinai pers comm. 2020).

The second potential compensatory mitigation project is the Eastbank Crescent Riverfront project, which would ecologically enhance a steep, poorly vegetated section of riverbank and adjacent nearshore habitat near the Oregon Museum of Science and Industry. This site is adjacent to a heavily used section of the Greenway Trail on the east bank of the river. The project would entail grading to establish a gentle to moderate slope, creating shallow water alcoves, and revegetating with native trees and shrubs. It also would construct a path and dock, enabling safe public access to the river for non-motorized recreation. The project is being led by the City in coordination with affected property owners, private consultants, permitting agencies, and other stakeholders. Credits generated by this project may not be available until 2024 or 2025 (Lovell pers comm. 2020).

As compensation for construction of the ADA-accessible ramp and the associated in-water impact and vegetation clearing it would cause, the County may propose to conduct riparian restoration in proximity to the ramp and along the Vera Katz Eastbank Esplanade. The restoration would likely include removing the Himalayan blackberry and other non-native invasive vegetation that dominate this area and replacing it with a suite of native trees and shrubs.

The mitigation measures outlined above apply to all the Build Alternatives. The only differences among the Build Alternatives would be the areal expanse of required compensatory mitigation, which will be determined at a later date.

9 Contacts and Coordination

Project work will include an extensive public involvement and agency coordination effort. During the impacts analysis, the following government agencies and community organizations were contacted for data and other information related to wetlands and waters:

Agency/Organization
City of Portland Bureau of Planning and Sustainability Oregon Department of Environmental Quality (DEQ) Oregon Department of State Lands (DSL) U.S. Army Corps of Engineers (USACE) U.S. Coast Guard

Agencies and organizations were notified through the Federal Register and project website of the intent to prepare an EIS. Participating agencies were provided the opportunity to review and comment on the wetlands and waters analysis through the course of the Project. All agencies and stakeholders will have the opportunity to review the technical reports during the public comment period for the Draft EIS.

10 Preparers

Name	Professional Affiliation [form or organization]	Education [degree or certification]	Years of Experience
Greg Mazer	HDR, Inc.	M.S., Environmental Science B.S., Natural Resources	27

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Appendix A. Site Photographs

Photo-point 1	View of Willamette River east bank from upper part of ramp of Vera Katz Eastbank Esplanade; OHWM at upper edge of woody debris and lower edge of vegetation; Burnside Bridge in background
Date: 19 June 2019	
Azimuth: 12°	

Photo-point 2	View of Willamette River east bank from lower part of ramp of Vera Katz Eastbank Esplanade; water mark on riprap evident
Date: 19 June 2019	
Azimuth: 37°	

Photo-point 3	View of Willamette River east bank north of Burnside Bridge and under I-5; water mark on riprap visible
Date: 19 June 2019	
Azimuth: 43°	

Photo-point 4	View of Willamette River east bank north of Burnside Bridge and under I-5; culvert positioned just landward of OHWM is visible
Date: 19 June 2019	
Azimuth: 105°	

Photo-point 5	View of Willamette River east bank north of Burnside Bridge and under I-5; woody debris below OHWM visible
Date: 19 June 2019	
Azimuth: 41°	

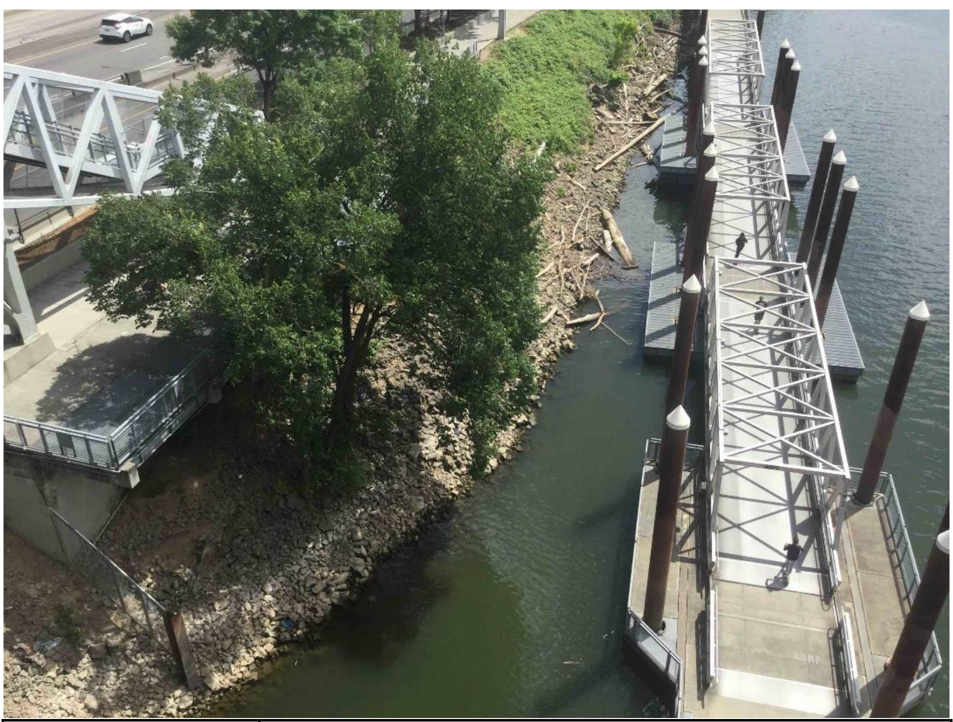

Photo-point 6	View of Willamette River east bank and Vera Katz Eastbank Esplanade from south side of Burnside Bridge; water mark in foreground and vegetation cover transition and wrack (woody debris) in background
Date: 19 June 2019	
Azimuth: 157°	

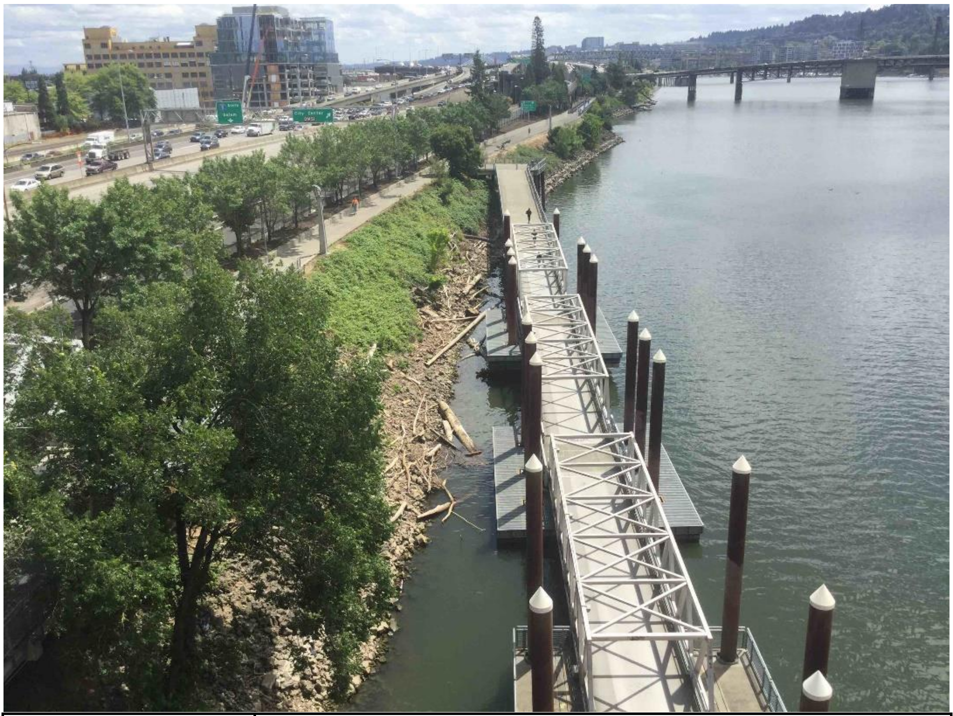

Photo-point 6	View of Willamette River east bank and Vera Katz Eastbank Esplanade from south side of Burnside Bridge; vegetation cover transition and wrack (water-borne debris) visible
Date: 19 June 2019	
Azimuth: 168°	

Photo-point 7	Looking south-southeast at vegetation cover transition/upper extent of most wrack on Willamette River east bank
Date: 19 June 2019	
Azimuth: 166°	

Photo-point 7	Looking north at upper extent of water mark on Willamette River east bank
Date: 19 June 2019	
Azimuth: 7°	