Exhibit 4-14. Annual Diesel PM Concentrations from On-Road Mobile Sources as Predicted by PATS

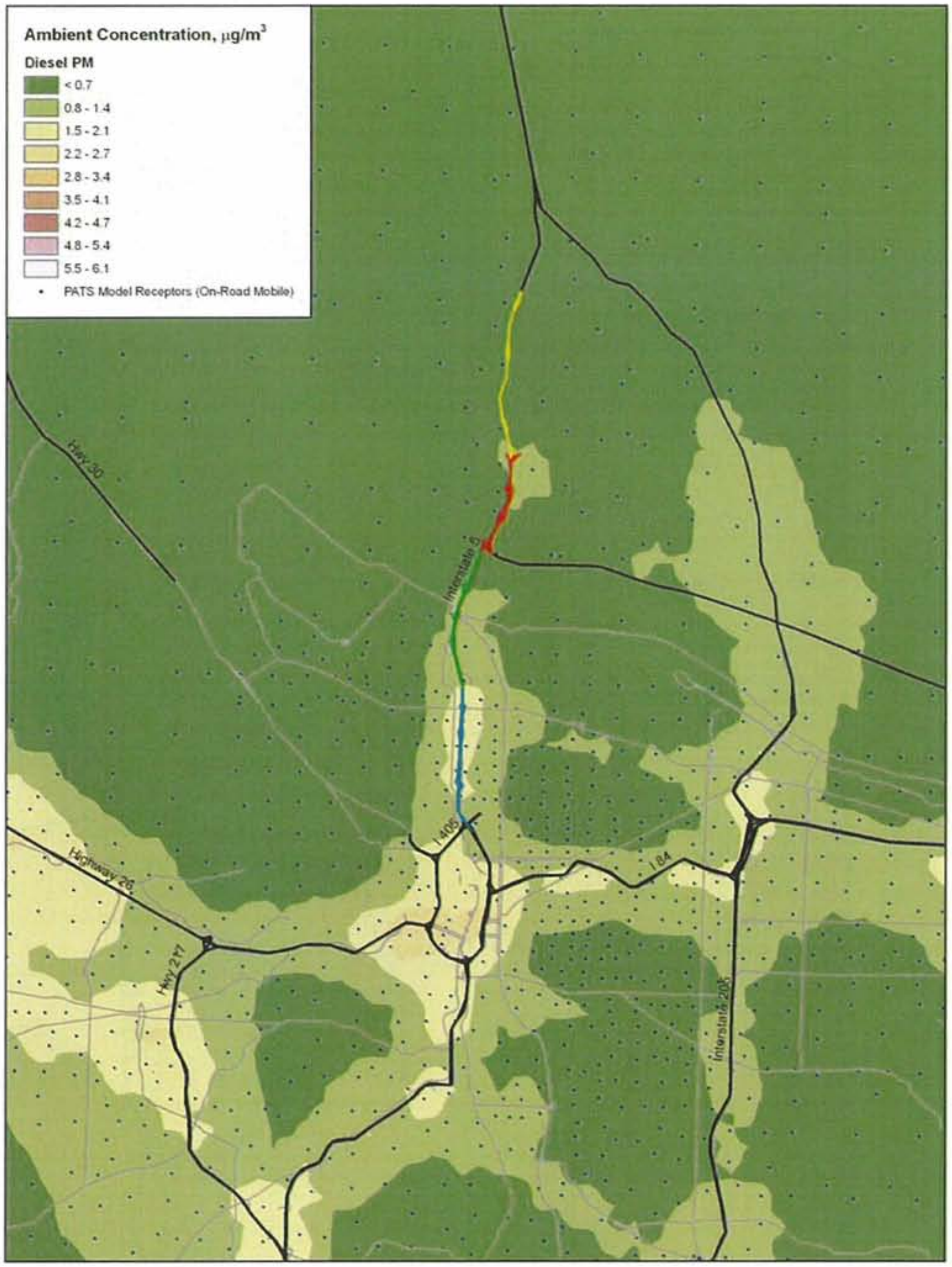
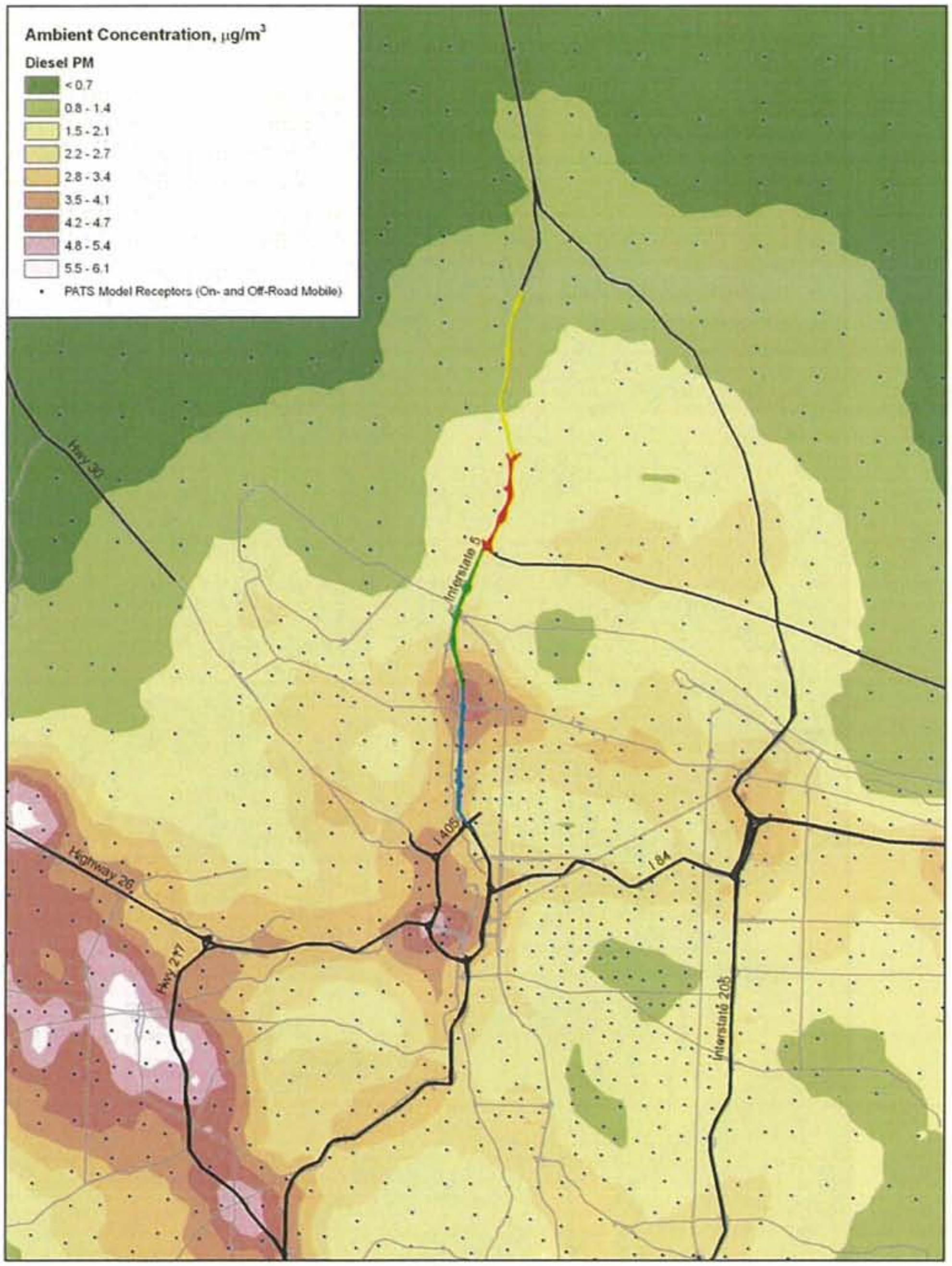


Exhibit 4-15. Annual Diesel PM Concentrations from On-Road and Off-Road Mobile Sources as Predicted by PATS



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5. Long-term Effects

5.1 How is This Chapter Organized?

This chapter describes the long-term impacts that would be expected from the I-5 CRC project alternatives and options. This section compares the impacts between the No-Build and LPA scenarios. Differences between LPA Full Build Option A and Option B, and LPA with highway phasing scenarios are small and thus, not evaluated. This discussion focuses on how the LPA or No-Build alternatives would affect corridor and regional impacts. The traffic data used in the analysis are based on regional models for land use and employment and includes traffic from all sources and potential induced growth as a result of the project alternatives. Consequently, the results analyzed and discussed in this section include both direct and indirect effects.

MSAT emissions were provided by Metro, with the exception of naphthalene, which was estimated using a composite area-wide emission rate and the VMT. MSAT emissions from the PATS study are listed for comparison to the existing conditions and the project alternatives. Although the same general methods were used to estimate MSAT emissions for the project and the PATS study, there were differences in some underlying inputs and assumptions to accommodate the need of the specific application. For example, in PATS, emissions from local roads were allocated to modeling zones instead of roadway links. Thus, the PATS emissions and project emissions are similar but not identical.

5.2 Impacts from No-Build and LPA Alternatives

This section describes the impacts from the No-Build Alternative and LPA. These are combinations of highway, river crossing, transit, and pedestrian/bicycle alternatives and options covering all of the CRC segments. They represent the range of system-level choices that most affect overall performance, impacts, and costs. The No-Build and LPA alternatives are most useful for understanding the regional impacts, performance, and total costs associated with the I-5 CRC project. The following sections summarize the major design elements associated with project alternatives.

5.2.1 Regional Effects

Estimated emissions of CO, NO_X, VOCs, PM_{10}, and $PM_{2.5}$ for the four-county region are listed in Exhibit 5-1. Other than CO, summertime emission rates are shown. For CO, the wintertime emission rates are presented, because summertime CO emissions are two-thirds to one half of winter emissions. For PM, the difference in summer to winter emissions is small (about 4 percent), so a wintertime adjustment was not made. Estimated regional emissions of the seven MSATs are shown in Exhibit 5-2. Because naphthalene makes up 80 to 90 percent of the POM emissions for mobile sources, POM emissions were not presented.

The results of the emissions analysis showed that for future conditions (No-Build or LPA), criteria pollutant emissions are expected to be substantially lower than existing emissions for the region for all pollutants. The expected emissions reductions are in the range of 30 percent for CO, 70 percent for NO_x, 50 percent for VOCs, and 90 percent for both PM_{10} and $PM_{2.5}$. Emissions reductions for MSATs track those for VOCs and PM with approximately 50 percent reductions in the volatile MSATs benzene, 1,3-butadiene, formaldehyde, naphthalene and acrolein, and a 95 percent reduction in diesel particulate emissions. On a regional basis, differences between the future 2030 emissions for project alternatives, including the No-Build Alternative, are 1 percent or less, which is not a meaningful difference.

Exhibit 5-1. Regional NAAQS Emissions

Alternative	VMT	Units	CO (winter)	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing	37,241,099	(tons/day)	869.5	88.7	52.2	1.2	1.1
		(pounds/day)	1,730,000	177,400	104,400	2,380	2,220
No-Build (2030)	52,485,308	(tons/day)	650.9	23	23.4	0.1	0.1
		(pounds/day)	1,302,000	46,00	46,900	181	167
LPA (2030)	52,078,456	(tons/day)	646.1	22.8	23.2	0.1	0.1
		(pound/day)	1,292,000	45,600	46,300	180	166

Exhibit 5-2. Regional MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formalde-hyde	Acrolein	Diesel PM	Naph-thalene
PATS (2005)[a]	3,658	390	1,042	57	2,210	42.4
Existing (2005)	3,787	426	1,049	52	2,380	69.8
No-Build (2030)	1,637	201	554	25	167	44.5
LPA (2030)	1,620	199	547	25	166	44.1

a Direct comparison between PATS results and CRC emissions should not be made.

5.3 Subarea Effects

To give an indication of whether emissions are expected to affect neighborhoods directly adjacent to I-5 along the project alignment, emissions were analyzed separately in four subareas, consisting of only the I-5 mainline and ramps. The emissions are listed in pounds per day as the model results reported them so that the differences in project alternatives and the level of emissions can be seen. However, please note that the emissions estimates are not accurate to the nearest pound.

The subareas analyzed are shown in Exhibit 5-3.

Exhibits 5-4 and 5-5 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 1. Emissions in Subarea 1 are substantially reduced in the future LPA and No-Build scenarios relative to existing conditions. Between the LPA and No-Build alternatives, the LPA scenario has lower emissions, as traffic flow is estimated to be better if the project is built.

Exhibit 5-3. Subarea Road Links

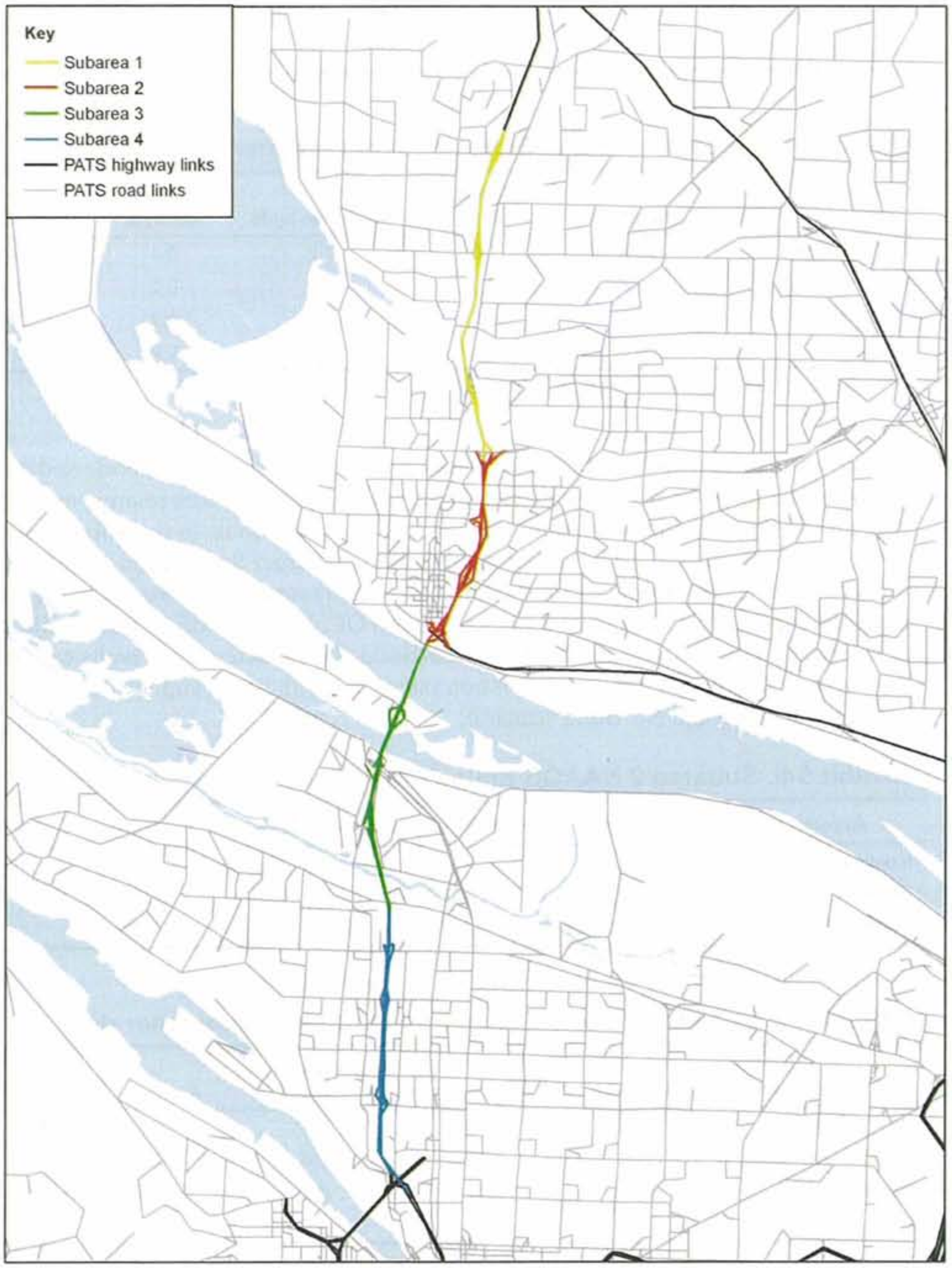


Exhibit 5-4. Subarea 1 NAAQS Emissions (pounds per summer day)

Alternative	VMT	CO (winter)	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing (2005)	273,600	14,840	1,530	886	19.3	18.1
No-Build (2030)	446,861	12,540	462	439	2.0	2.0
LPA (2030)	424,724	11,970	442	419	1.9	1.9

Exhibit 5-5. Subarea 1 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formalde-hyde	Acrolein	Diesel PM	Naph-thalene
PATS (2005)[a]	28.4	1.0	7.7	0.4	17.5	0.52
Existing (2005)	31.8	3.6	8.5	0.4	19.3	0.51
No-Build (2030)	15.2	1.9	4.7	0.2	2.0	0.38
LPA (2030)	14.5	1.8	4.5	0.2	1.9	0.36

a Direct comparison between PATS results and CRC emissions should not be made.

Exhibits 5-6 and 5-7 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 2. Emissions in Subarea 2 show a substantial reduction in the future relative to existing conditions. The reductions are similar to the regional reductions. In this subregion, the estimated vehicle miles traveled (VMT) for the build scenario is larger than the No-Build. This results in higher CO and NOx emissions for the build scenario compared the No-Build scenario, although the difference is small (less than 5 percent). For VOC, PM, and MSATs, the build scenario tends to be slightly lower or comparable to the No-Build. The difference in results can be explained by the variation in how the pollutant emission rates vary with speed and the difference in VMT between the build and No-Build scenario.

Exhibit 5-6. Subarea 2 NAAQS Emissions (pounds per summer day)

Alternative	VMT	CO (winter)	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing (2005)	298,504	16,160	1,591	985	21.1	19.2
No-Build (2030)	428,970	12,000	437	443	1.9	1.9
LPA (2030)	435,569	12,510	456	420	1.9	1.9

Exhibit 5-7. Subarea 2 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formalde-hyde	Acrolein	Diesel PM	Naph-thalene
PATS (2005)[a]	24.5	0.9	6.7	0.4	14.3	0.44
Existing (2005)	35.5	4.0	9.6	0.5	21.1	0.56
No-Build (2030)	15.1	1.9	4.9	0.2	1.9	0.36
LPA (2030)	14.7	1.8	4.5	0.2	1.9	0.37

a Direct comparison between PATS results and CRC emissions should not be made.

Exhibits 5-8 and 5-9 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 3. Emissions in Subarea 3 show a substantial reduction in the future relative to existing conditions. The reductions are similar to the regional reductions. For this subarea, the LPA emissions are lower than the No-Build for all pollutants.

Exhibit 5-8. Subarea 3 NAAQS Emissions (pounds per summer day)

Alternative	VMT	CO (winter)	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing (2005)	391,696	20,040	2,045	1,244	26.7	25.0
No-Build (2030)	528,264	14,410	518	557	2.3	2.3
LPA (2030)	472,325	12,800	461	435	2.1	2.0

Exhibit 5-9. Subarea 3 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formalde-hyde	Acrolein	Diesel PM	Naph-thalene
PATs (2005)[a]	33.8	1.4	9.6	0.5	19.7	0.62
Existing (2005)	44.5	5.0	12.2	0.6	26.7	0.73
No-Build (2030)	18.6	2.3	6.2	0.3	2.3	0.45
LPA (2030)	15.3	1.9	4.8	0.2	2.1	0.40

a Direct comparison between PATS results and CRC emissions should not be made.

Exhibits 5-10 and 5-11 list NAAQS and MSAT emissions for the I-5 mainline and ramps in Subarea 4. Emissions in Subarea 4 show a substantial reduction in the future relative to existing conditions. For this subarea, the build emissions are lower than the No-Build for all pollutants.

Exhibit 5-10. Subarea 4 NAAQS Emissions (pounds per summer day)

Alternative	VMT	CO (winter)	NO_X	VOC	PM_{10}	$PM_{2.5}$
Existing (2005)	366,309	17,740	1,835	1,038	24.1	22.5
No-Build (2030)	423,473	10,700	377	368	1.9	0.9
LPA (2030)	391,636	9,912	349	339	1.7	0.9

Exhibit 5-11. Subarea 4 MSAT Emissions (pounds per summer day)

Alternative	Benzene	1,3-Buta-diene	Formalde-hyde	Acrolein	Diesel PM	Naph-thalene
PATS (2005)[a]	35.0	1.4	9.8	0.5	22.6	0.68
Existing (2005)	37.7	4.2	10.1	0.5	24.1	0.69
No-Build (2030)	13.0	1.6	4.2	0.2	1.9	0.36
LPA (2030)	12.0	1.5	3.9	0.2	1.7	0.33

a Direct comparison between PATS results and CRC emissions should not be made.

In general, future emissions in the subareas are expected to be substantially lower than existing emissions for all project alternatives. For most subareas, the emissions for the LPA configuration are less than for the No-Build.

5.4 Local Effects

To determine if local congestion is likely to cause air quality impacts, a hot spot analysis was performed at the three worst performing intersections in both Portland and Vancouver. Existing conditions (2005 for Portland, 2009 for Vancouver) along with opening year (2018) and future year No-Build and build scenarios were evaluated. The intersection ranking tables are included in Appendix B. The rankings changed from the DEIS as changes were made in the project that altered intersection volumes. One method change was for the Mill Plain and I-5 interchange. For the DEIS, the northbound and southbound intersections were evaluated separately and thus were not identified for evaluation. For the FEIS, this interchange was reconfigured into an SPUI in which the left turn ramps were brought to a center intersection. Thus the two existing traffic signals to move vehicles through the interchange and the center intersection allow opposing left turns to and from the ramps to occur simultaneously. Since the three intersections are linked together, they were evaluated as a single intersection, thus making it the intersection with the highest entering volume. Given the complexity of this interchange, it stretches the intent of CAL3QHC and WASIST models in that the ramps do not align with the intersection itself. Since this is a non-standard configuration, a method to model the intersection with WASIST was discussed and coordinated with WSDOT. For the existing and No-Build scenarios, the northbound and southbound ramp intersections were modeled separately and the larger concentration used. For the build scenario, the center intersection was modeled but included the ramp traffic from the side intersections. Since the ramps are 200 to 300 feet from the center intersection, including the ramp volumes would raise impacts, thus providing for a conservative estimate for the intersection.

The results of the hot spot analysis are shown in Exhibits 5-12 and 5-13. Exhibit 5-14 shows the intersections analyzed for local CO impacts. The 1-hour and 8-hour CO concentrations were forecast and compared with 1-hour and 8-hour standards. No violations of the NAAQS were shown for existing conditions, the No-Build condition, or the build conditions. Therefore, long-term air quality impacts are not expected to occur as a result of the project.

Exhibit 5-12. Maximum One-Hour Carbon Monoxide Concentrations (ppm)

Intersections	Existing	Opening No-Build (2018)	Opening Build (2018)	Future No-Build (2030)	Future Build (2030)
Vancouver	(2009)				
East 39th Street at Main Street	5.6	4.6	4.5	5.2	5.1
Mill Plain Blvd at C Street	5.2	4.5	4.4	5.0	5.0
Mill Plain Blvd at I-5 Interchange	6.4	4.9	5.3	5.8	6.5
Portland	(2005)				
Lombard Street at Interstate Avenue	6.0	4.9	4.8	5.0	4.8
Fremont and MLK Jr. Blvd	6.9	5.7	5.2	5.4	5.4
Lombard and MLK Jr. Blvd	6.3	5.3	4.9	5.1	5.0

Note: The 1-hour CO standard is 35 ppm. A background concentration of 3.0 ppm is added to modeled concentrations to calculate the results shown.

Exhibit 5-13. Maximum Eight-Hour Carbon Monoxide Concentrations (ppm)

Intersections	Existing	Opening No-Build (2018)	Opening Build (2018)	Future No-Build (2030)	Future Build (2030)
Vancouver	(2009)				
East 39th Street at Main Street	4.8	4.1	4.0	4.5	4.5
Mill Plain Blvd at C Street	4.5	4.0	4.0	4.4	4.4
Mill Plain Blvd at I-5 Interchange	5.4	4.3	5.0	5.0	5.4
Portland	(2005)				
Lombard Street at Interstate Avenue	5.3	4.4	4.4	4.5	4.4

Intersections	Existing	Opening No-Build (2018)	Opening Build (2018)	Future No-Build (2030)	Future Build (2030)
Fremont at MLK Jr. Blvd	6.0	5.1	4.7	4.8	4.8
Lombard at MLK Jr. Blvd	5.5	4.7	4.4	4.6	4.5

Note: The 8-hour CO standard is 9 ppm. A background concentration of 3.0 ppm is added to modeled concentrations to calculate the results shown.

Since the three Vancouver high-volume intersections (E 39th Street and Main Street, Mill Plain Boulevard and C Street, and Mill Plain Boulevard and I-5 interchange) are unaffected by the east-west light rail transit alignment option, the selection of the east-west alignment has no bearing on the CO hotspot analysis. Thus, adoption of the 17th Street alignment for the Vancouver light rail segment light does not alter the outcome of the LPA hotspots analysis.

5.5 Impacts from Other Project Elements

5.5.1 Maintenance Base Operations

Maintenance of light rail transit vehicles would require an expansion of the existing facility at Ruby Junction in Gresham, Oregon. Stationary sources such as bus and light rail maintenance facilities are subject to the permitting regulations of either DEQ or SWCAA. The existing permitting regulations are designed to protect the health of the public. Consequently, no impacts are expected as a result of maintenance base operations.

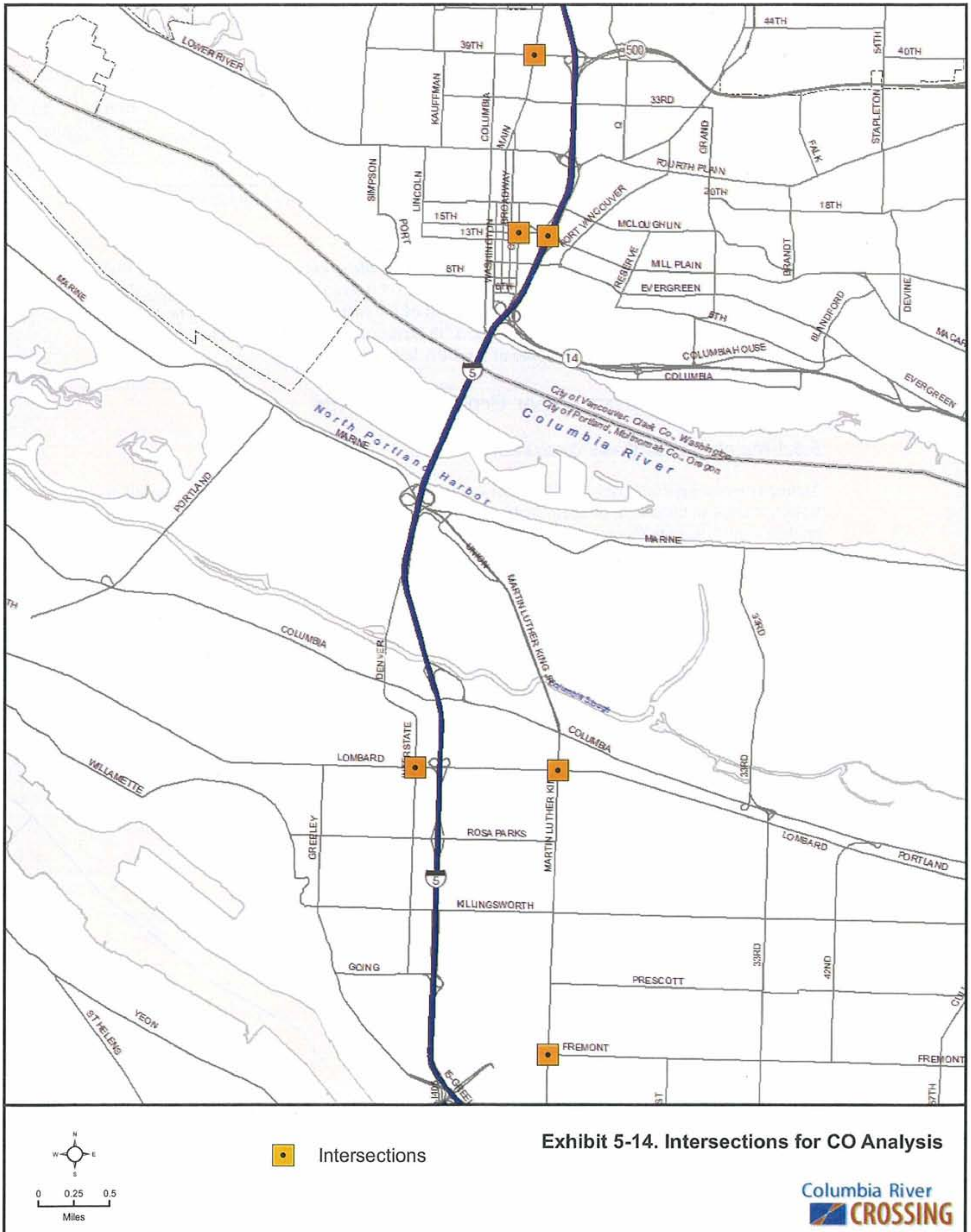


Exhibit 5-14. Intersections for CO Analysis

6. Temporary Effects

6.1 Introduction

Insufficient information is currently available to quantify the potential air quality effects of construction for the I-5 CRC LPA and No-Build alternatives. The following qualitative discussion gives an indication of the potential effects on air quality from project construction.

6.2 Construction Activities

A description of construction activities is provided in Section 1.2.3.

Construction-related activities would include direct construction activities such as:

- Earth moving (grading, earth removal and transport, fill transport)
- Pile driving (barge activities)
- Demolition (with barge activities)
- Concrete batch plant and transport.

Indirect effects would include increased traffic and congestion due to detouring at nearby intersections. The latter would be applicable to the SR 14 interchange area when the off-ramp to downtown Vancouver is closed. However, none of these individual activities is expected to last more than 5 years at any one location.

A wide variety of construction equipment will be in use for the duration of the construction, both on land and on the river. Much of the construction equipment is likely to be diesel. The EPA promulgated the Non-road Diesel Rule in May 2004. The rule requires ultra-low sulfur levels (15 ppm) in most non-road diesel fuel starting in 2010. The ultra-low sulfur limits will become applicable to locomotive and marine diesel fuel in 2012. New construction equipment will become subject to exhaust emission standards similar to those imposed on on-road diesel engines in a phased schedule between 2008 and 2015, with most large equipment affected by the **standards between 2012 and 2015. Consequently, by the time construction is expected to start on** the I-5 CRC project, ultra-low sulfur fuel would be in use for almost all construction equipment that would potentially be used. Because the new equipment exhaust emission standards would be phased in during the expected CRC construction timing, only a portion of the equipment would likely be new and the percentage of the overall equipment fleet affected would be low in the early years of implementation and higher in later years.

Existing transportation corridors consisting of highways and arterials will be the major routes into and out of the construction areas. Most transport of goods and services associated with the project will use trucks. I-5, SR 14, SR 500, Martin Luther King Jr. Boulevard, and Marine Drive will serve as the major corridors into and out of the construction areas. Fourth Plain and Mill Plain Boulevards will serve important roles, but they are not expected to be as heavily used. The Port of Vancouver lies west of the Washington side of the project, so West Fourth Plain and West Plain (SR 501) could experience higher use depending on the potential use of Port property. Road networks in Vancouver and on Hayden Island will provide access to individual work areas and circulation for construction vehicles. Columbia Way parallels SR 14 and becomes the main access into the industrial area that could be used for various staging purposes. As such, it could become a more heavily used haul route than envisioned for the other local roads. In addition, Columbia Way could be used as a detour route, which would compound construction-related issues. Trucks used on highways would be subject to the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirement Rules. Ultra-low sulfur fuel would be used in all highway trucks. In addition, trucks new in 2007 and later model years are subject to stringent exhaust emissions standards. The standards reduce PM and NO_x emissions by 90 and 95 percent respectively, relative to older technology.

6.3 Temporary Effects

Construction for any CRC Build Alternative will be extensive and will involve demolition, a wide variety of heavy construction equipment and operations, on-road construction vehicle activities, and potentially off-site activities such as concrete plant or borrow operations. Traffic congestion will occur in the construction area and potentially along detour or construction haul routes. Construction impacts will vary in extent and location, depending on the project alternative selected and on weather conditions (e.g., rain suppresses dust). Construction impacts in the project would logically be lowest with the No-Build Alternative and higher for the Build Alternative. Construction activities could cause short-term increases in air pollutant emissions and odors.

The primary impacts of direct construction activities will be the generation of dust from demolition, site clearing, excavating and grading activities, direct exhaust emissions from construction equipment, and impacts to traffic flow in the project area. Traffic congestion increases idling times and reduces travel speeds, resulting in increased vehicle emission levels. Demolition may involve structures containing lead or asbestos.

As described in Chapter 1, the staging and casting area are likely to have emissions associated with them. Exhibit 6-2 shows the proposed locations for the staging and casting areas. Construction of concrete structures or asphalt paving activities may have associated pollutant-emitting sources, such as mixing operations. Stationary sources, such as concrete mix and asphalt plants, are generally required to obtain an Air Contaminant Discharge Permit from either DEQ or SWCAA and to comply with regulations for controlling dust and other pollutant emissions. The proposed Port of Vancouver sites and the Sundial site are sufficiently far from the project area that they would not have a direct effect on the project area. The staging areas would have localized emissions.

Under the transportation conformity rules (40 CFR 93.123 (c)(5)):

> (5) CO, PM_{10}, and $PM_{2.5}$ hot-spot analyses are not required to consider construction-related activities which cause temporary increases in emissions. Each site which is affected by construction-related activities shall be considered separately, using established "Guideline" methods. Temporary increases are defined as those which occur only during the construction phase and last five years or less at any individual site.

Since project construction activities are not expected to last more than 5 years at any given site, a CO hot-spot analysis will not be required.

To address the potential of air quality impacts from construction, a search for construction-related monitoring conducted on other transportation construction sites was made. One project, the Dan Ryan Expressway Reconstruction project in the Chicago area, conducted air quality monitoring during their project construction phase. The Dan Ryan Expressway is the busiest expressway in

Chicago and is the major transportation artery from downtown through the City's South Side, accommodating over 300,000 vehicles per day at full capacity. In comparison, the I-5 corridor carries about 150,000 vehicles per day.

In 2006 and 2007, the Illinois Department of Transportation (IDOT) reconstructed the entire length of the Dan Ryan Expressway, including the addition of a travel lane from 47th Street to 95th Street. The project was the most massive expressway reconstruction plan in Chicago's history, with a total cost of $975 million. Construction activities included:

- Complete rebuilding of 28 east-west bridges over the expressway.
- Redesigned and rebuilt interchange with the Chicago Skyway (I-90).
- The addition of a lane in each direction.
- Construction of longer exit and entrance ramps.
- Improved drainage infrastructure to reduce pavement flooding and traffic tie-ups during heavy rains.

This project had a comparable level of construction as proposed for CRC, specifically, bridge rebuilding, pile driving, earth moving, and major amounts of concrete pavement replacement.

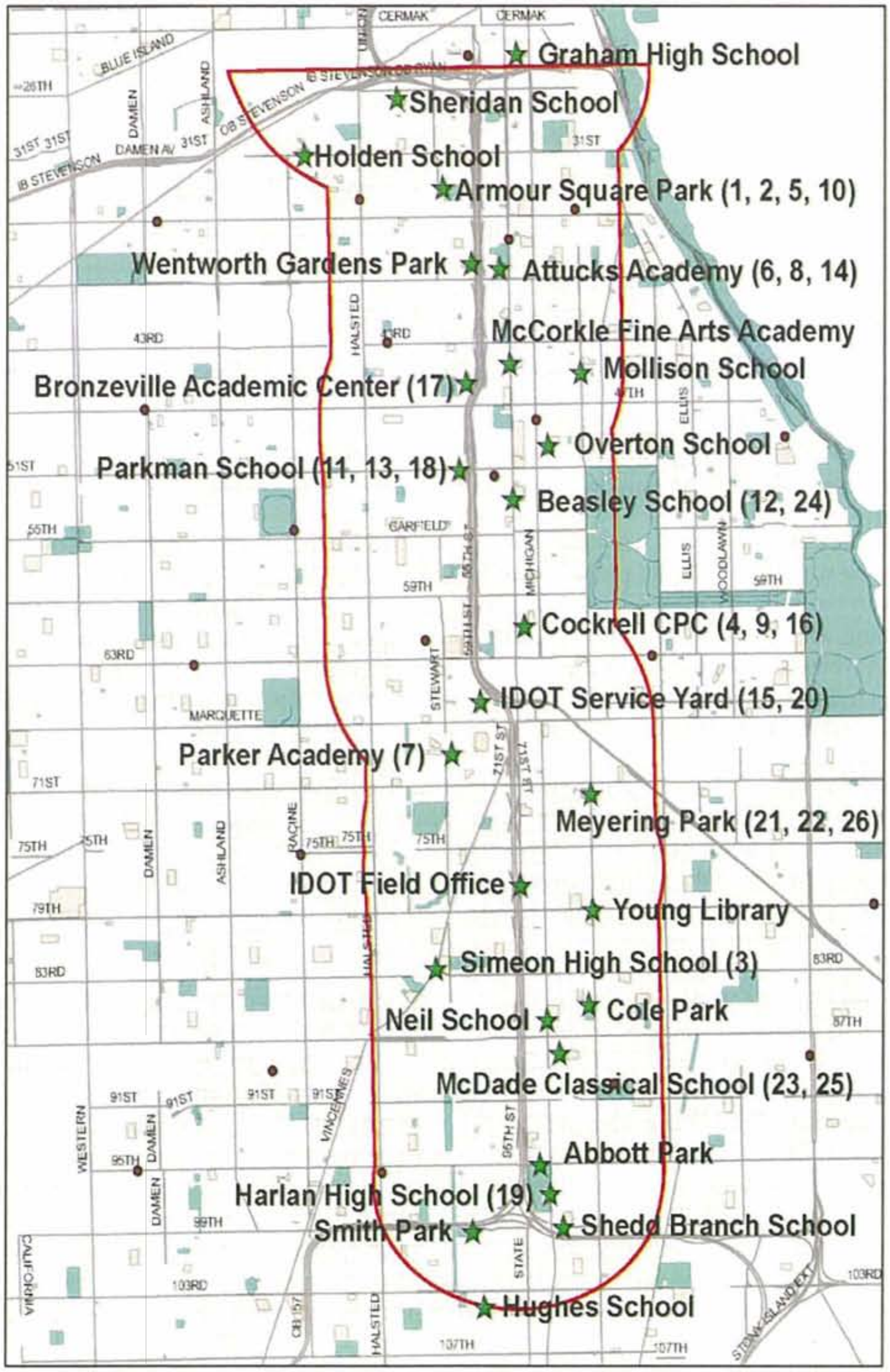
Because the Chicago area is a non-attainment area for the annual $PM_{2.5}$ standard, construction monitoring was required. The project area is in attainment for the 24-hour $PM_{2.5}$ standard. The Dan Ryan Expressway passes directly through the middle of the south side of Chicago. Air monitoring was conducted at 27 sites located at schools, parks, public housing and public facilities where the population is expected to be more sensitive to air contaminants such as those serving children and the elderly (Exhibit 6-1). The monitored pollutants included total dust, respirable silica, lead, asbestos, PAHs (as diesel components), PM_{10} and $PM_{2.5}$.

The baseline air quality monitoring was performed from September through December 2004 in areas where no reconstruction activities were occurring. Reconstruction air monitoring began in January 2005 and continued until October 2007. In March 2006, the monitoring of asbestos was discontinued due to no detections above laboratory detection limits and PAH sampling was reduced due to no detections of certain constituents above laboratory detection limits (EDI, 2008).

Project action levels were set for each pollutant. If these levels were exceeded, then the contractor attempted to identify the source and notified an IDOT project official and mitigating measures were then executed to reduce emissions. Concentrations above a project action levels did not constitute a violation, but rather were used to identify periods of elevated concentrations and implement mitigation (if deemed necessary) to reduce the projects possible effects. In general, the number of times the project action levels were exceeded was low. In many instances, the alert could be linked to instrument issues or regional scale events. In other cases, no obvious activity could be associated with the alert. For example in 2007, there were fourteen days with elevated $PM_{2.5}$ levels. All of the elevated readings appeared to be related to the regional air quality in the Chicago Metropolitan area and were not directly related to the Dan Ryan reconstruction activities (EDI, 2008). Even with some elevated concentrations, the air quality standards were maintained and not exceeded.

The results from the Dan Ryan Expressway project indicates that the CRC's construction activities should not result in any violations of the air quality standards and should not pose an undue health risk to the neighboring communities.

Exhibit 6-1. Locations of the Dan Ryan Expressway Air Quality Monitors



Source: EDI, 2008.

Note: Stars represent monitoring locations.

CITY OF PORTLAND
BUREAU OF TRANSPORTATION

Sam Adams
Mayor

Tom Miller
Director

July 1, 2011

Ms. Nancy Boyd, Project Director
Washington Department of Transportation
700 Washington Street, Suite 300
Vancouver, WA 98660-3177

Enclosed is the invoice for services provided by the City of Portland to the State of Washington Department of Transportation for the Columbia River Crossing Project (CRC Project) pursuant to Agreement GCA 6649. This invoice period is inclusive of the dates of 9/1/10 through 3/16/11.

The work conducted by the City of Portland has primarily been performed by the Bureau of Transportation (PBOT). John M. Gillam, Transportation Planning Supervisor, is the City Project Manager (City PM). Others that contributed to this work (5 hours or more):
PBOT
Patrick M. Sweeney, Senior Transit Planner.
Daniel Layden, Capital Program Manager
Jeanne-Marie Jeffrey, P.E., Traffic Engineer
David O'Longaigh, P.E., S.E., Supervising Engineer, Bridges
Eva Huntsinger, P.E., J.D. Senior Engineer
April L. Bertelsen, Pedestrian Planning Coordinator
Robert A. Hillier, Freight Planning Coordinator
Brett I. Kesterson, P.E., Civil Engineer
Teresa Boyle, P.E., Senior Engineer
Lewis Wardrip, P.E., Traffic Design Manager
Grant Morehead, Assoc. Transportation Planner
Water Bureau
Cherri Warnke, Capital Project Manager
Bureau of Planning and Sustainability
Mark Raggett, Senior Urban Design Planner

Paul B. Smith, Transportation Planning Manager, also contributed hours to the CRC Project but these were provided as part of overhead under this Agreement.

The tasks listed below in the Agreement are followed by the City accounting code, e.g. T00265.PM.

Task 1.0 – Project Management (T00265.PM)
Primary staff: Gillam - 35 hours; others – 4 hours.
Total hours: 39 hours.

PBOT staff provided support to the City's representative on the Project Sponsors Council (PSC) and the Integrated Project Staff (IPS) in the form of notes and oral briefings for upcoming PSC and IPS meetings. There were two PSC meetings during this period, on 12/10/10 and 2/18/11. There were nine IPS meetings during this period.

PBOT staff provided periodic briefings to the Mayor and his staff and PBOT senior management of CRC events and critical milestones to help establish City positions on major CRC project issues.

PBOT staff has managed a City CRC Technical Advisory Committee (CRC TAC), formed to provide consolidated City positions to the extent possible. The City Project Manager has also provided presentations and briefing materials to the Planning and Development Directors which consists of senior bureau managers in the City. The City Project Manager has provided a single point of contact for coordination and for the activities of all City bureaus of interest in the project.

Comment [cf1]: Agreement specified: participation in PDT meetings (NOT IPS OR PSC); and support IPS/PSC through development of products as requested by WSDOT (**includes only products or information prepared for the PSC or IPS** as requested by WSDOT) and does not include participation or internal briefings.

Task 2.0 – Project Controls (T00265.PC)
Primary staff: Gillam - 9 hours.
Total hours: 9 hours.

The City PM budget management and progress reports and PBOT staff provided accounting services and invoices as part of overhead in support of this Agreement.

Task 3. – Financial Structures
Not applicable to this Agreement.

Task 4. – Communications (T00265.CO)
Primary staff: Gillam - 4 hours.
Total hours: 4 hours.

PBOT staff participated in CRC public meetings as requested by CRC staff. Some of the standing public meetings with City staff participation are indicated under individual tasks, such as the Portland Working Group under Task 7.

Task 5. – Traffic Engineering/Transportation Planning (T00265.TP)
Primary staff: Gillam - 35 hours; Bertelsen – 23 hours; Hillier – 20 hours; Sweeney – 7 hours; Raggett – 5 hours; Jeffrey/Wardrip – 3 hours.
Total hours: 93 hours.

Comment [cf2]: Agreement specified work re: IAMP, PBAC; and, land use planning.

PBOT staff met with CRC staff on three occasions regarding the LPA Conditions Report and reviewed, prepared comments and suggested edits on this document prepared by CRC.

Comment [cf3]: Pertinent to tasks anticipated under the agreement.

PBOT staff participated in on-site review meetings of the Ross Island Sand & Gravel facility and the Diversified Marine Incorporated business operations on Marine Drive to assess truck ingress/egress issues and discuss potential transportation system improvements.

PBOT staff reviewed and provided input on freight mobility issues associated with the Expert Bridge Panel Report during the Freight Working Group Meeting on 3/8/11 and communicated CRC updates to the Portland Freight Committee at their regular monthly meetings.

Comment [cf4]: If allowable under agreement, should be included under task 8 – where FWG support is identified.

PBOT staff reviewed and provided input on pedestrian accessibility and design associated with the Expert Bridge Panel Report during the PBAC meeting on 3/9/11.

PBOT staff provided technical review and pedestrian and bicycle modal expertise for the review of the proposed multi-use path options crossing North Portland harbor and connecting to the river crossing bridge. This work was forwarded to the PMG as described under Task 7.

PBOT staff identified alternative process approaches for findings of plan consistency between the Portland Transportation System Plan and Comprehensive Plan and the improvements proposed by the CRC project.

City staff conducted an assessment of the different CRC bridge alignments on City land use plans such as the Hayden Island Plan and the Jantzen Beach Supercenter Redevelopment Plans for use by the PMG as described in Task 7.

City staff coordinated review of the Expo Conditional Use/Master Plan and urban design objectives with new roadway and LRT station plans and improvements being developed as part of the CRC project. At the request of CRC, City staff participated in meetings conducted with representatives of Expo/MERC.

Traffic engineering and transportation planning methodologies for reviewing plans were partly developed under this Task. Actual analyses were conducted as part of Transit Preliminary Engineering under Task 7.

PBOT staff attended meetings at the request of ODOT regarding stakeholder involvement and coordination with other workgroups on the CRC Interchange Area Management Plans (IAMPs).

City staff facilitated briefings by the CRC on the project to the City's Landmarks Commission and Design Review Commission.

Comment [cf5]: UDAG and architectural standards are included in the agreement under Task 8 – may need to adjust where this work effort is included.

Task 6. – Environmental (T00265.EN)
Primary staff: Gillam - 4 hours; Morehead – 5.5 hours.
Total hours: 9.5 hours.

During this period PBOT assembled materials and established a process for review of the FEIS. Most of the FEIS review will be conducted during the next reporting period. PBOT staff coordinated with CRC in the review of the Section 4(f) di minimus findings for the Marine Drive multi-use recreational trail.

Task 7. - Transit Planning and Engineering (T00265.TN)
Primary staff: Gillam - 183 hours; Sweeney - 299 hours; Jeffrey/Wardrip - 58.5 hours; O'Longaigh - 43 hours; Layden/Boyle - 32.5 hours; Bertelsen - 15.5 hours; Raggett - 4 hours.
Total hours: 635.5 hours.

City staff assembled a Project Management Group (PMG) to review and refine transit, highway, local street and pedestrian/bicycle facilities concept plans. This City group included all relevant discipline expertise to assist in plan evaluations including civil, traffic, transit and bridge engineers, pedestrian and bicycle modal specialists, and project development, policy and urban design planners. CRC requested fifteen meetings during this period and appropriate City staff attended each of these meetings as relevant to each meeting agenda.

Comment [cf6]: Is this city responsibility or CRC funded city-responsibility?

City staff assisted CRC in the development of technical and planning criteria for comparing and evaluating transit and related street and pedestrian/bicycle improvements. Using these criteria, and with a coordinated effort with CRC, City staff assisted in joint resolution of project issues including:

- Side-running vs. median running LRT.
- Elevated vs. at-grade LRT station.
- Multi-use path as part of local bridge vs. separated alignment.
- Local bridge structural design options and rough cost comparisons.
- Local bridge and LRT maintenance and inspection options.

Comment [cf7]: Does resolution on each of these items correspond with the time period of September 2010 through mid-march 2011?

PBOT staff reviewed various traffic engineering issues and recommended options for traffic control and approach alignment of intersections of local streets, signal vs. gate control of LRT intersections with street crossings, and LRT alignment and design based on ABS vs. line of sight operations.

PBOT staff coordinated City recommendations that received the concurrence of all affected City bureau staff and senior bureau managers and the Mayor's office.

Comment [cf8]: Is this effort part of city or CRC funded responsibility?

City staff participated in all six Portland Working Group (PWG) meetings conducted during this period plus PWG design subgroup meetings as requested by CRC. City staff assisted CRC in the development of materials presented to the PWG and produced original materials for use by the PWG. City staff actively engaged in discussions with the PWG and sought to establish consensus positions within the group.

City staff participated in the PWG Open House on 11/3/11, as requested by CRC. This participation included presentation and discussion of printed materials and graphics.

City staff reviewed reports prepared by the Bridge Expert Review Panel and their analysis of the three alternative bridge types and assisted CRC prepare the recommendations of ODOT and WSDOT to the Governors with particular focus on local and community project obligations.

City staff provided review and comment on the LRT station area and local streets concept work program proposed to be undertaken by ZGF for CRC.

City staff assisted in the refinement of the "ladder" concept developed by CRC to illustrate the interconnection of surface streets and pathways throughout the project area which was used for PWG and other public meetings.

Task ~~8~~7. – Highway Engineering (T00265.HE)
Primary staff: Huntsinger – 68 hours; Layden – 51 hours; O'Longaigh – 47 hours; Warnke – 16.5 hours; Kesterson – 10 hours; Sweeney – 6 hours; Falbo – 3.75 hours; other Water Bureau – 4.5 hours.
Total hours: 206.75 hours.

Under this task PBOT staff reviewed and provided comment on the Bridge Review Panel Report on major river crossing alternatives including background reports on civil infrastructure, project delivery, costs, phasing and environmental considerations. This work was forwarded to the PMG as described under Task 7.

City staff provided urban design evaluations of bridge type alternatives for use by CRC in bridge type review process and reports at UDAG meetings.

PBOT bridge engineering staff evaluated and recommended local bridge structural design options, local bridge and LRT maintenance and inspection options and reviewed rough cost comparisons for use by the PMG as described in Task 7.

PBOT staff reviewed CRC Sustainability Goals as documented in the CRC draft Sustainability Strategy for compliance and consistency with City of Portland's Sustainability Policies.

Comment [cf9]: Agreement does not include reference to this task.

City staff began coordination efforts with the CRC regarding Section 106 requirements for historic properties and review of initial drafts for an upcoming Memorandum of Understanding.

Comment [cf10]: If applicable, this should fit under Task 6, right?

PBOT staff compared the CRC proposed project delivery program with City of Portland's project development requirements to define scope and general requirements for each CRC submittal for City's engineering design review and acceptance.

PBOT staff provided review and comment to the draft TriMet Continuing Control Agreement and related term sheets.

At the request of CRC, PBOT staff attended the CRC Tribal and Agency Leadership Consultation Meeting on 2/17/2011.

Please contact me at 503-823-7707 if you have any questions. If I am unavailable, please contact Dan Layden at 503-823-2804 or Paul Smith at 503-823-7736. The financial reports were prepared by Joanie Hough at 503-823-6193.

John M. Gillam
City Project Manager

PRELIMINARY

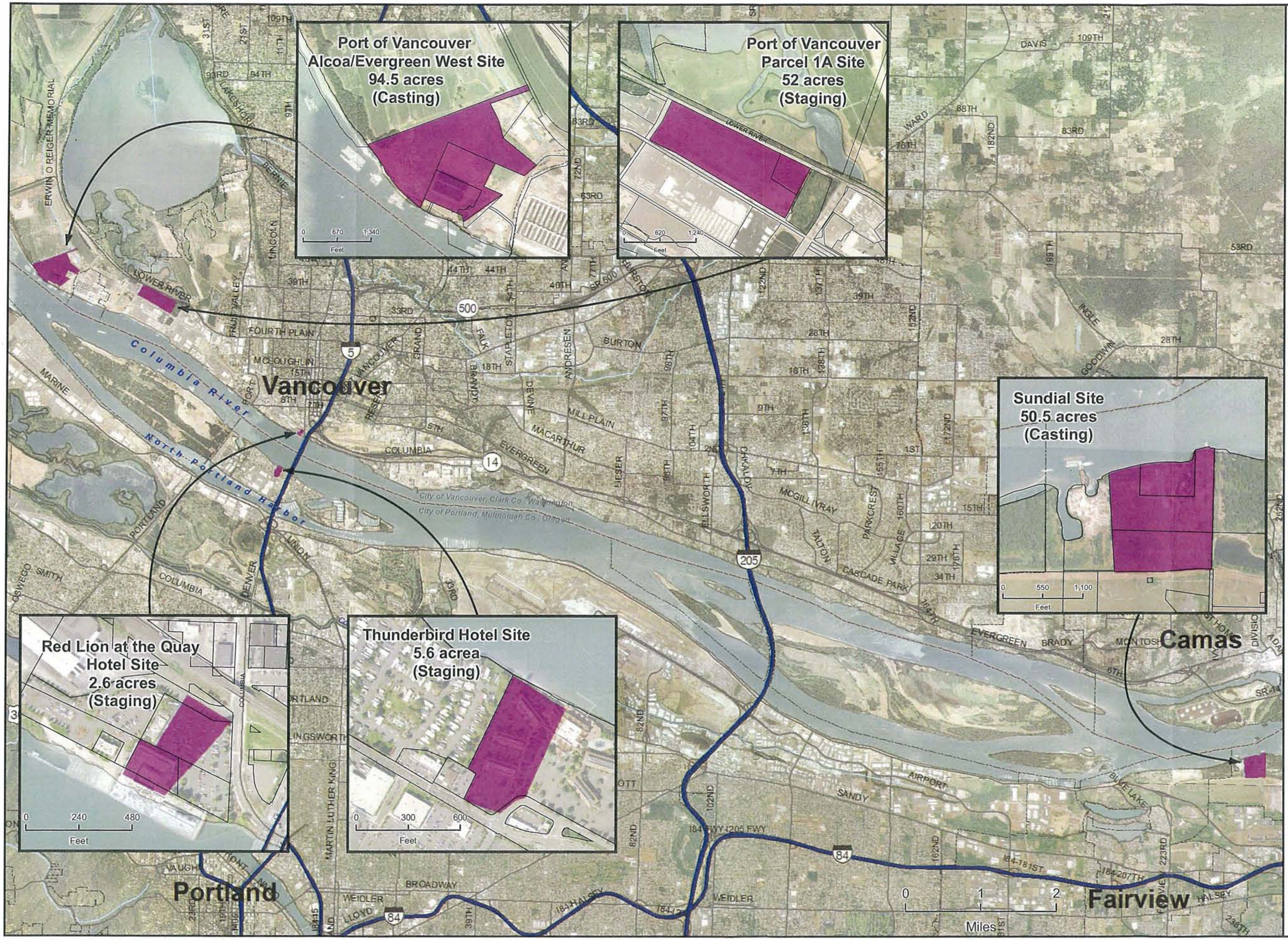


Exhibit 6-2. Potential Staging Areas and Casting Yards

Parcel Boundaries

Proposed Staging and Casting Areas

N E S W

Columbia River CROSSING

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7. Mitigation

7.1 Long-term Effects

Air pollutant emissions are expected to be substantially lower in the future than under existing conditions. On a regional basis, future differences between LPA and No-Build alternatives are small enough not to be meaningful within the accuracy of the estimation methods.

For the subareas, both the LPA and No-Build scenarios have substantially lower emissions than the existing condition. For three of the subareas, the LPA is beneficial in reducing emissions relative to the No-Build Alternative. For subarea 2, the LPA CO and NO_x emissions are higher than in the No-Build scenario while the VOC, PM, and MSATs emissions are lower or comparable to the No-Build scenario. However, the variation in the LPA and No-Build scenarios is small (less than 5 percent) and likely not meaningful given the uncertainties in the emissions and modeling.

A quantitative analysis of CO concentrations for the intersections expected to yield the worst congestion conditions was performed for three intersections in Vancouver and three intersections in Portland. No violations of the NAAQS were shown for existing conditions, the No-Build condition, or the LPA Build conditions.

Long-term air quality impacts are not expected to occur as a result of the project, and mitigation for long-term impacts is not proposed.

7.2 Temporary Effects

Construction mitigation should focus on controlling dust and exhaust emissions from demolition and construction activities and on minimizing the effects of traffic congestion. For a project of this magnitude, the contractor should be required to develop a pollution control plan that includes documentation of operational measures that will be used to reduce emissions. Section 290 of the ODOT standard specifications describes requirements for environmental protection, including air pollution control measures. These control measures are designed to minimize vehicle track-out and fugitive dust and should be included in the project specifications.

Stationary sources such as concrete and asphalt mix plants are generally required to obtain air permits from DEQ or SWCAA and to comply with regulations to control dust and other pollutant emissions. As a result, their operations are typically well controlled and do not require project-specific mitigation measures. This would also be true for demolition of asbestos containing structures, as this activity is regulated.

Contractors are required to comply with ODOT standard specifications (Section 290) for dust, diesel vehicles, and burning activities described above. Section 290 requires contractors to comply with Oregon Revised Statutes (ORS) 468, ORS 468A, Oregon Administrative Rule (OAR) 340-014, OAR 340-200 through OAR 340-268, and all other applicable laws. In order to control dust, the project should require all contractors to develop and implement a dust control plan, and to maintain air quality permits on all portable equipment. Stationary sources such as concrete and asphalt mix plants are generally required to obtain air permits from DEQ and to comply with regulations to control dust and other pollutant emissions. In Vancouver, Washington

Administrative Code (WAC) 173-400-040 places limits on fugitive dust that causes a nuisance or violates other regulations. Violations of the regulations can result in enforcement action and fines.

The OAR regulation provides a list of reasonable precautions to be taken to avoid dust emissions:

- Use of water or chemicals where possible for the control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land;
- Application of asphalt, water, or other suitable chemicals on unpaved roads, materials stockpiles, and other surfaces that can create airborne dusts;
- Do not use oil, waste, waste water, or other illegal materials as dust suppressants;
- Full or partial enclosure of materials stockpiles in cases where application of oil, water, or chemicals is not sufficient to prevent particulate matter from becoming airborne;
- Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials;
- Adequate containment during sandblasting or other similar operations;
- When in motion, always covering open-bodied trucks transporting materials likely to become airborne; and
- The prompt removal from paved streets of earth or other material that does or may become airborne.

In 2008, ODOT updated their standard specifications to address diesel emissions. ODOT specified that truck staging areas for diesel-powered vehicles should be located where truck emissions have a minimum impact on sensitive populations such as residences, schools, hospitals and nursing homes. Also, trucks and other diesel-powered equipment should limit idling to 5 minutes when the equipment is not in use or in motion, except as follows:

- When traffic conditions or mechanical difficulties, over which the operator has no control, force the equipment to remain motionless.
- When operating the equipment's heating, cooling or auxiliary systems is necessary to accomplish the equipment's intended use.
- To bring the equipment to the manufacturer's recommended operating temperature.
    - When the outdoor temperature is below 20 °F.
    - When needing to repair equipment.
    - Under other circumstances specifically authorized by the Engineer.

Strategies to minimize the occurrence and effect of roadway congestion in the project area will be developed throughout the design phase. Alternatives will be refined, impacts to traffic analyzed, and transportation agencies and experts brought in to develop mitigation plans and solutions. Some of these strategies may consist of:

- Providing alternatives to single-occupancy vehicle (SOV) trips.
- Providing incentives to reduce automobile trips and encourage mode shifts to non-SOV types.
- Managing traffic and lane closures to avoid congestion and delay.

- Providing traveler information at key junctions to encourage traffic diversion from the I-5 corridor project area and crossing routes.
- Promoting continuous information campaigns to alert motorists of delay times within the corridor and of upcoming traffic pattern changes and detours.
- Incorporating transit priority measures where feasible.
- Working with employers whose employees must commute through the area to promote alternative work schedules.
- Instituting contractor incentives to shorten construction durations and encourage the use of lower-emitting construction equipment including retrofitting diesel engines with verified control technologies, replacing older equipment with newer, and using cleaner fuels (e.g., 20 percent biodiesel fuel).

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8. Permits and Approvals

The primary approval required for the project is a finding that the project is in conformance with the State Implementation Plan (SIP).

8.1 Air Quality Conformity Determination

The project is located in the Portland/Vancouver CO maintenance area. To conform, the project must be included in a conforming RTP and MTIP with no substantive changes in design concept or scope, and a hot spot analysis must be completed to determine that local CO impacts will not occur.

In the February 2008, Air Quality Conformity Determination for the 2035 Metropolitan Regional Transportation Plan and the 2008-2011 Metropolitan Transportation Improvement Plan, the project description is for a replacement bridge with 10,000 vehicles per hour each direction, with $2 tolls, and light rail transit with termini at the Lincoln Park and Ride lot near Main Street and I-5. The project is to be completed by 2017. On June 10, 2010, an updated conformity determination was made by Metro for the 2035 Metropolitan Regional Transportation Plan and the 2008-2011 Metropolitan Transportation Improvement Plan. FHWA followed by issuing a finding of conformity on September 20, 2010.

The project as described in this report is consistent with the conformity determination description, with exception to the Vancouver light rail termini. In this report, the terminus of light rail is located at Clark College rather than the Lincoln Park and Ride. Since the two park and rides are of similar size, any differences in the regional emissions would be minor, and thus should not influence the conformity determination.

The project will not cause an exceedance of the NAAQS. Concentrations of CO in the Portland and Vancouver areas do not currently exceed the NAAQS. The project will not delay timely implementation of Transportation Control Measures (TCMs) included in the Portland CO Maintenance Plan. The included control measures are transit service increases and bicycle and pedestrian paths.

8.2 Other Permits

Air quality permits may be required for construction sources. Both DEQ and SWCAA require permitting of stationary sources such as concrete batch plants, and notification of asbestos demolition or removal activities. SWCAA requires permitting of non-road engines that remain at "any single site at a building, structure, or installation" for more than 12 consecutive months. This regulation could affect construction equipment in Washington, and requires dispersion modeling of emissions. The regulation excludes mobile cranes and pile drivers.

Under OAR 340-254-0010, operators planning to construct or modify a parking facility or similar indirect source in the Portland AQMA must obtain an Indirect Source Permit if a facility will provide 1000 or more parking spaces (800 or more spaces if the facility is within the Portland's Central Business District). An indirect source means a facility, building, structure, or installation, or any portion or combination thereof, which indirectly causes or may cause Mobile Source activity that results in emissions of an air contaminant for which there is a National Ambient Air Quality Standard.

PRELIMINARY

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APPENDIX A

Harriet Tubman Middle School Air Toxics Summary

Exhibit A-1. Air Toxics Data from Harriet Tubman Middle School Monitoring (2009)

		Sample									
MSATs	**SSL[a] (μg/m^3)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1,3-Butadiene	20	0.029	0.058	0.044	0.071	0.104	ND	0.064	--	0.062	0.268
Acetaldehyde	90	1.082	1.911	1.783	1.386	1.148	2.055	1.404	1.302	1.193	2.452
Benzene	30	0.432	0.806	0.432	0.684	1.093	0.716	0.738	--	0.604	2.247
Formaldehyde	50	3.429	3.232	3.085	2.925	1.831	5.321	3.220	2.003	3.035	2.827
Other Gaseous Pollutants	**SSL (μg/m^3)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1,1,2,2-Tetrachloroethane	120	ND	ND	ND	ND	ND	ND	ND	-	ND	ND
1,1,2-Trichloroethane	440	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
1,1-Dichloroethane	4400	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
1,1-Dichloroethylene	80	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
1,2,4-Trichlorobenzene	2000	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
1,2-Dichloropropane	200	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
1,4-Dichlorobenzene	10000	0.042	0.060	0.048	0.084	0.060	ND	0.042	--	0.084	0.078
Acetonitrile	600	6.854	13.994	20.831	15.001	24.023	40.150	2.352	--	19.991	37.294
Acrylonitrile	200	0.202	ND	ND	ND	ND	ND	ND	--	ND	ND
Benzyl chloride	140	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Bromoform	6400	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Bromomethane	200	0.093	0.082	0.074	0.062	0.051	ND	0.051	--	0.039	0.043
Carbon disulfide	7000	0.231	0.234	0.190	0.112	0.299	0.361	0.106	--	0.072	0.143
Carbon tetrachloride	200	1.058	0.982	0.724	0.629	0.988	1.152	1.246	--	0.573	0.724
Chlorobenzene	10000	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Chloroethane	40000	0.021	0.034	0.026	0.021	0.029	ND	0.042	--	ND	0.042
Chloroform	500	0.186	0.210	0.151	0.161	0.215	0.151	0.176	--	0.127	0.225
Chloromethane	1000	1.413	1.546	1.265	1.217	1.459	1.498	1.488	--	1.196	1.744
Chloroprene	70	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Dichloromethane	2000	0.775	0.636	1.008	0.455	1.786	0.570	0.792	--	0.521	2.979
Ethyl acrylate	20000	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Ethylbenzene	40000	0.361	0.487	0.239	0.421	0.630	0.200	0.196	--	0.322	0.934
Ethylene dibromide	12	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Ethylene dichloride	270	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Hexachlorobutadiene	320	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Methyl chloroform	10000	0.098	0.087	0.066	0.066	0.109	ND	0.098	--	0.055	0.087
Methyl isobutyl ketone	30000	0.607	1.115	0.955	0.717	0.377	0.353	0.107	--	0.545	0.541
Methyl methacrylate	7000	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Methyl tert-butyl ether	7000	ND	ND	ND	ND	ND	ND	ND	--	ND	ND
Propionaldehyde	80	0.204	0.328	0.318	0.264	0.193	0.376	0.254	0.195	0.197	0.338
Styrene	9000	0.486	0.482	0.341	0.618	0.371	0.251	0.149	--	0.443	0.575
Tetrachloroethylene	1400	0.068	0.129	0.102	0.129	0.231	0.095	0.122	--	0.109	0.821
Toluene	4000	0.894	1.863	1.425	2.760	2.394	1.146	0.984	--	1.889	5.317

						Sample					
Trichloroethylene	10000	0.038	ND	ND	0.032	0.065	ND	ND	--	ND	0.231
Vinyl chloride	1000	ND	ND	0.010	0.010	ND	ND	ND	--	ND	ND
o-Xylene	9000	0.391	0.591	0.226	0.395	0.652	0.213	0.169	--	0.339	0.930
Metals	**SSL (ng/m³)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Antimony	2000	0.86	0.83	1.21	2.66	2.78	1.28	3.12	2.96	1.8	5.47
Arsenic	150	0.16	0.25	0.28	0.54	1.15	ND	ND	1.03	0.61	2.93
Beryllium	20	ND	0.002	0.05	0.006	0.008	0.0003	0.002	0.009	0.04	ND
Cadmium	30	0.05	0.22	0.07	23.1	4.81	2.41	15.7	22.6	0.12	5.45
Cobalt	100	ND	0.52	0.56	0.18	0.24	0.41	0.43	0.35	0.25	0.37
Manganese	500	5.1	6.4	17.6	9.09	10.3	17.7	13.2	3.79	8.92	26.3
Mercury	3000	ND	ND	0.04	0.01	0.004	ND	0.004	0.005	0.03	0.06
Nickel	200	0.84	2.08	3.25	1.55	1.13	0.97	2.08	1.17	0.3	3.62
Selenium	20000	0.14	0.4	0.41	0.28	5.39	2.56	5.87	5.06	0.42	9.32

Notes:

a Sample Screening Level

ND - No detect

-- Sample not taken or invalid

APPENDIX B

Intersection Ranking Tables

Exhibit B-1. Vancouver Intersection Ranking

Number	Intersection	Period	TEV	LOS	V/C	Delay
Existing (2009)						
11	8th St. @ Esther St.	PM	605	A	0.05	8
20	9th St. @ Main St.	PM	305	A	0	6.7
22	Evergreen Blvd. @ Esther St.	PM	445	A	0.32	6.6
34	Mill Plain Blvd. @ Columbia St.	PM	1,355	B	0	14.7
38	Mill Plain Blvd. @ C St.	PM	2,195	B	0.34	14.1
39	Mill Plain Blvd. @ I-5 SB On-/Off-Ramps	PM	3,585	D	0.07	37.5
*	Mill Plain Blvd. @ I-5 SPUI	-	-	-	-	-
40	Mill Plain Blvd. @ I-5 NB On-/Off-Ramps	PM	3,310	C	0.18	26.8
63	33rd St. @ Main St.	PM	1,255	B		18.3
64	39th St. @ Main St.	PM	2,220	D		38.3
65	39th St. @ F St.	PM	1,340	F		> 100
66	39th St. @ H St.	PM	1,445	A	0.11	8.3
68	39th St. @ I-5 NB On-/Off-Ramps	PM	1,980	C	0.21	23.1
No-Build (2030)						
11	8th St. @ Esther St.	PM	1,185	B	0.50	14.6
20	9th St. @ Main St.	PM	640	A	0.06	6.0
22	Evergreen Blvd. @ Esther St.	PM	710	A	0.12	6.4
34	Mill Plain Blvd. @ Columbia St.	PM	2,145	F	0.75	> 100
38	Mill Plain Blvd. @ C St.	PM	3,345	D	0.78	51.9
39	Mill Plain Blvd. @ I-5 SB On-/Off-Ramps	PM	5,035	F	0.97	94.4
*	Mill Plain Blvd. @ I-5 SPUI	-	-	-	-	-
40	Mill Plain Blvd. @ I-5 NB On-/Off-Ramps	PM	4,495	D	0.97	36.5
63	33rd St. @ Main St.	PM	2,205	D	0.56	48.6
64	39th St. @ Main St.	PM	3,605	F	0.96	> 100
65	39th St. @ F St.	PM	2,085	F	0.33	> 100
66	39th St. @ H St.	PM	2,175	E	0.76	64.3
68	39th St. @ I-5 NB On-/Off-Ramps	PM	2,785	F	0.91	> 100
Full Build LPA (2030)						
11	8th St. @ Esther St.	PM	957	B	0.35	14.3
20	9th St. @ Main St.	PM	926	C	0.36	18.0
22	Evergreen Blvd. @ Esther St.	PM	620	A	0.22	9.7
34	Mill Plain Blvd. @ Columbia St.	PM	2,241	F	1.10	> 100
38	Mill Plain Blvd. @ C St.	PM	3,407	F	1.35	>81.4
39	Mill Plain Blvd. @ I-5 SB On-/Off-Ramps	-	-	-	-	-
*	Mill Plain Blvd. @ I-5 SPUI	PM	6,231	E	0.99	63.3
40	Mill Plain Blvd. @ I-5 NB On-/Off-Ramps	-	-	-	-	-
63	33rd St. @ Main St.	PM	1,559	B	0.58	14.5
64	39th St. @ Main St.	PM	3,297	F	1.03	> 100
65	39th St. @ F St.	PM	1,887	F	0.59	50.6
66	39th St. @ H St.	PM	1,995	C	0.76	30.8
68	39th St. @ I-5 NB On-/Off-Ramps	PM	1,944	F	0.65	> 100

Note: The intersections evaluated in the hot spots analysis are indicated with shading.

Exhibit B-2. Portland Intersection Ranking

Number	Intersection	Period	TEV	LOS	V/C	Delay
Existing (2005)						
14	Lombard and MLK Jr.	PM	3,485	E	0.85	74
11	Lombard and Interstate	PM	2,650	C	0.76	32
1	Fremont and MLK Jr.	PM	3,205	C	0.89	31
17	Columbia Blvd and MLK Jr.	PM	3,305	D	0.71	39
6	Alberta and MLK Jr.	PM	2,930	D	0.88	38
2	Going and Interstate	PM	2,605	C	0.72	34
No-Build (2030)						
14	Lombard and MLK Jr.	PM	4,685	F	0.99	> 100
11	Lombard and Interstate	PM	4,020	F	0.95	> 100
1	Fremont and MLK Jr.	PM	3,910	F	0.99	94
17	Columbia Blvd and MLK Jr.	PM	4,130	F	0.74	84
6	Alberta and MLK Jr.	PM	3,640	E	0.91	72
2	Going and Interstate	PM	3,345	E	0.84	65
Full Build LPA (2030)						
14	Lombard and MLK Jr.	PM	4,260	F	0.90	> 100
11	Lombard and Interstate	PM	3,950	F	0.92	> 100
1	Fremont and MLK Jr.	PM	3,785	E	0.98	62
17	Columbia Blvd and MLK Jr.	PM	3,720	D	0.77	46
6	Alberta and MLK Jr.	PM	3,415	D	0.88	46
2	Going and Interstate	PM	3,205	D	0.83	43

Note: The intersections evaluated in the hot spots analysis are indicated with shading.

INTERSTATE 5 COLUMBIA RIVER CROSSING

Archaeology Technical Report for the Final Environmental Impact Statement

Columbia River CROSSING

May 2011

Title VI

The Columbia River Crossing project team ensures full compliance with Title VI of the Civil Rights Act of 1964 by prohibiting discrimination against any person on the basis of race, color, national origin or sex in the provision of benefits and services resulting from its federally assisted programs and activities. For questions regarding WSDOT's Title VI Program, you may contact the Department's Title VI Coordinator at (360) 705-7098. For questions regarding ODOT's Title VI Program, you may contact the Department's Civil Rights Office at (503) 986-4350.

Americans with Disabilities Act (ADA) Information

If you would like copies of this document in an alternative format, please call the Columbia River Crossing (CRC) project office at (360) 737-2726 or (503) 256-2726. Persons who are deaf or hard of hearing may contact the CRC project through the Telecommunications Relay Service by dialing 7-1-1.

¿Habla usted español? La informacion en esta publicación se puede traducir para usted. Para solicitar los servicios de traducción favor de llamar al (503) 731-4128.

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Cover Sheet

Interstate 5 Columbia River Crossing

Archaeology Technical Report for the Final Environmental Impact Statement

Submitted By:

Rick Minor, Principal Investigator - Heritage Research Associates, Inc.

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ACRONYMS

Acronym	Description
ADA	Americans with Disabilities Act
AINW	Archaeological Investigations Northwest, Inc.
APE	area of potential effect
BNSF	Burlington Northern Santa Fe Railroad
CD	collector-distributor
CRC	Columbia River Crossing
CTR	Commute Trip Reduction (Washington)
C-TRAN	Clark County Public Transit Benefit Area Authority
DAHP	Washington Department of Archaeology and Historic Preservation
DEIS	Draft Environmental Impact Statement
DOE	Determination of Eligibility
ECO	Employee Commute Options (Oregon)
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GPR	Ground-Penetrating Radar
HERITAGE	Heritage Research Associates, Inc.
HBC	Hudson Bay Company
I-5	Interstate 5
LPA	Locally Preferred Alternative
LRV	light rail vehicle
MHz	Megahertz
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPS	National Parks Service
NRHP	National Register of Historic Places
ODOT	Oregon Department of Transportation
OTC	Oregon Transportation Commission
PMLR	Portland-Milwaukie Light Rail Project
ROD	Record of Decision
RTC	Regional Transportation Council

SHPO	Oregon State Historic Preservation Office
SPUI	single-point urban interchange
TDM	transportation demand management
TriMet	Tri-County Metropolitan Transportation District
TSM	transportation system management
VNHR	Vancouver National Historic Reserve
WSDOT	Washington State Department of Transportation
WTC	Washington Transportation Commission

1. Summary

1.1 Introduction

The Columbia River Crossing (CRC) project is a bridge, transit, and highway improvement project under joint development by the Washington Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT), in cooperation with the Federal Highway Administration (FHWA) and the Federal Transit Authority (FTA), as well as other sponsoring agencies. This project seeks to improve safety, access, and capacity for traffic and transit in the Interstate 5 (I-5) corridor crossing the Columbia River between Portland, Oregon, and Vancouver, Washington.

This report describes the methods and results of archaeological investigations carried out for the purpose of discovering and evaluating archaeological resources found within the area of potential effect (APE) for the CRC project. The objective of this report is to provide detailed information on the locations of significant prehistoric and historical archaeological sites that may be affected by the CRC project. This project is a challenging one for archaeology, because in terms of environmental and historical contexts the APE in Oregon and Washington could hardly be more different.

The APE in Oregon extends across the Columbia River flood plain, where evidence of prehistoric Native American occupation may potentially occur in sand and silt deposits in excess of 30 m deep. Euroamerican settlement on the Oregon shore in the historic period remained limited until the early decades of the twentieth century, when development was spurred by the growth of motor transportation and construction of bridges over the Columbia River. Significant archaeological sites dating to the historic period are unlikely to be encountered. The primary focus of investigations on the Oregon shore is on archaeological remains associated with Native Americans in the prehistoric period.

The situation is reversed in the APE on the Washington shore. Sand and silt deposits from the Columbia River are shallow and archaeological remains are relatively close to the surface. Some use of the area by prehistoric Native Americans occurred earlier, but the APE on the north shore mainly stands out as the setting of intense settlement and development during the historic period. The Hudson's Bay Company's (HBC) Fort Vancouver and Kanaka Village, and the U.S. Army's Vancouver Barracks, are situated directly east of the I-5 corridor in the Vancouver National Historic Reserve (VNHR). The VNHR encompasses properties owned by the National Park Service (NPS), U.S. Army, and the City of Vancouver. The Historic City of Vancouver, containing the core blocks first platted in the city, lies directly west of the I-5 corridor. Historical archaeology thus becomes the major focus of investigations on the Washington shore of the Columbia River.

The CRC project's location along a major interstate corridor requires that the archaeological investigations be undertaken according to a phased approach (36 CFR 800.4(b)(2)). Access to conduct archaeological investigations necessary to discover buried historic properties is restricted in large portions of the project area due to the actively and intensively used nature of the I-5 corridor. Some of the inaccessible portions of the APE are known to have a high potential to contain prehistoric and/or historical archaeological resources.

In addition, the APE in Oregon extends vertically through Holocene flood plain soils to Pleistocene gravels 30 m or more below the surface. Together with the issue of limited accessibility to conduct investigations within the narrow I-5 corridor, discovery and treatment of deeply buried sites is problematic and best undertaken in focused areas once the level of project design provides a high level of certainty of where possible impacts may occur. Ongoing archaeological investigations are geared toward using appropriate techniques to diligently secure archaeological and geoarchaeological data that will contribute to determining the likely presence of archaeological resources, and if possible the character and significance of any archaeological sites, found within the APE for the CRC project.

1.2 The APE

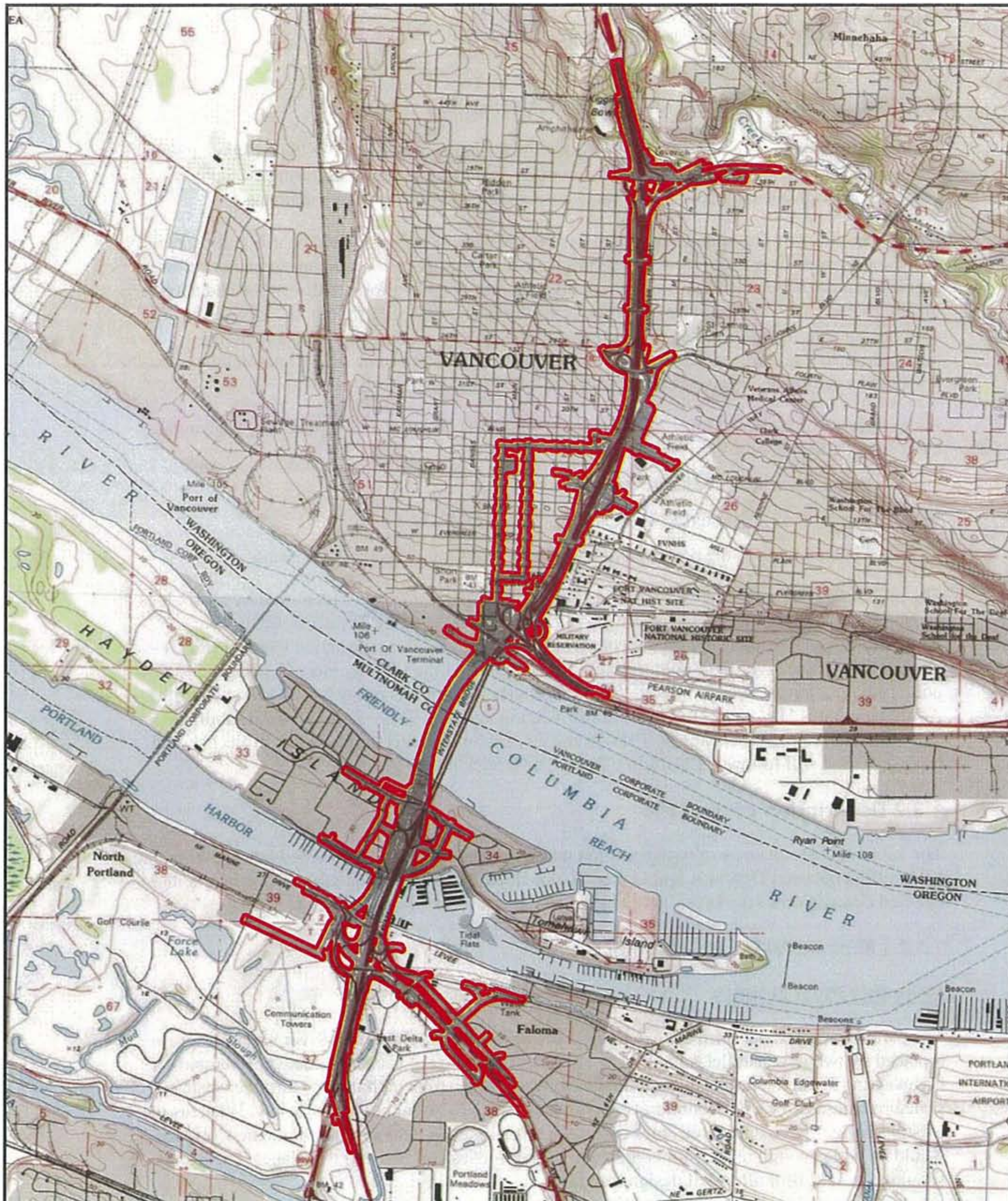
The APE is the geographic area within which an undertaking may directly or indirectly cause alterations in the character of historic properties, if any such properties exist (36 CFR 800.16). Specifically and primarily pursuant to 36 CFR 800.16(d), the APE for all historic property concerns regarding the CRC project extends along I-5 for approximately 5 miles from Victory Boulevard in Portland, Oregon, northward to SR 500 in Vancouver, Washington, and encompasses areas of concern regarding *all* of the various types of historic properties that might be affected by the project. The project's potential effects on the historic built environment resources encompasses the largest land area and forms the overall project APE (refer to the *Historic Built Environment Technical Report*).

The present report, however, is concerned with the archaeological area of concern within which direct and indirect effects to archaeological resources are reasonably expected to occur (Exhibit 1-1). The archaeological APE includes the project's proposed footprint, inclusive of existing facilities to be improved, new rights-of-way, and areas identified for construction and project staging. Additional parts of the APE include proposed transit alignments in Vancouver and proposed expansion of the Ruby Junction Maintenance Facility in Gresham, Oregon. The project also will address any potential impacts to archaeological resources in the VNHR.

In terms of legal description, the archaeological APE in Oregon occupies approximately 225 acres in Multnomah County in T1N, R1E, Sections 3 and 4, and T2N, R1E, Sections 33 and 34. In Washington, the archaeological APE extends over approximately 422 acres in Clark County in T2N, R1E, Sections 14, 15, 22, 23, 26, 27, and 34.

1.3 Description of Alternatives

This technical report evaluates the CRC project's locally preferred alternative (LPA) and the No-Build Alternative. The LPA includes two design options: The preferred option, LPA Option A, which includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge; and LPA Option B, which does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor (CD) lanes on the two new bridges that would be built adjacent to I-5. In addition to the design options, if funding availability does not allow the entire LPA to be constructed in one phase, some roadway elements of the project would be deferred to a future date. This technical report identifies several elements that could be deferred, and refers to that possible initial investment as LPA with highway phasing. The LPA with highway phasing option would build most of the LPA in the first phase, but would defer construction of specific elements of the project. The LPA and the No-Build Alternative are described in this section.



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APE - Area of Potential Effect

Project Footprint

Exhibit 1-1. Preliminary Area of Potential Effect (APE), Archaeological

Columbia River CROSSING

1.3.1 Adoption of a Locally Preferred Alternative

Following the publication of the Draft Environmental Impact Statement (DEIS) on May 2, 2008, the project actively solicited public and stakeholder feedback on the DEIS during a 60-day comment period. During this time, the project received over 1,600 public comments.

During and following the public comment period, the elected and appointed boards and councils of the local agencies sponsoring the CRC project held hearings and workshops to gather further public input on and discuss the DEIS alternatives as part of their efforts to determine and adopt a locally preferred alternative. The LPA represents the alternative preferred by the local and regional agencies sponsoring the CRC project. Local agency-elected boards and councils determined their preference based on the results of the evaluation in the DEIS and on the public and agency comments received both before and following its publication.

In the summer of 2008, the local agencies sponsoring the CRC project adopted the following key elements of CRC as the LPA:

- A replacement bridge as the preferred river crossing,
- Light rail as the preferred high-capacity transit mode, and
- Clark College as the preferred northern terminus for the light rail extension.

The preferences for a replacement crossing and for light rail transit were identified by all six local agencies. Only the agencies in Vancouver – the Clark County Public Transit Benefit Area Authority (C-TRAN), the City of Vancouver, and the Regional Transportation Council (RTC) – preferred the Vancouver light rail terminus. The adoption of the LPA by these local agencies does not represent a formal decision by the federal agencies leading this project – the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) – or any federal funding commitment. A formal decision by FHWA and FTA about whether and how this project should be constructed will follow the FEIS in a Record of Decision (ROD).

1.3.2 Description of the LPA

The LPA includes an array of transportation improvements, which are described below. When the LPA differs between Option A and Option B, it is described in the associated section. For a more detailed description of the LPA, including graphics, please see Chapter 2 of the FEIS.

1.3.2.1 Multimodal River Crossing

Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River would be replaced by two new parallel bridges. The eastern structure would accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path underneath; the western structure would carry southbound traffic, with a two-way light rail guideway below. Whereas the existing bridges have only three lanes each with virtually no shoulders, each of the new bridges would be wide enough to accommodate three through-lanes and two add/drop lanes. Lanes and shoulders would be built to full design standards.

The new bridges would be high enough to provide approximately 95 feet of vertical clearance for river traffic beneath, but not so high as to impede the take-offs and landings by aircraft using Pearson Field or Portland International Airport to the east. The new bridge structures over the

Columbia River would not include lift spans, and both of the new bridges would each be supported by six piers in the water and two piers on land.

North Portland Harbor Bridges

The existing highway structures over North Portland Harbor would not be replaced; instead, they would be retained to accommodate all mainline I-5 traffic. As discussed at the beginning of this chapter, two design options have emerged for the Hayden Island and Marine Drive interchanges. The preferred option, LPA Option A, includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge. LPA Option B does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor lanes on the two new bridges that would be built adjacent to I-5.

LPA Option A: Four new, narrower parallel structures would be built across the waterway, three on the west side and one on the east side of the existing North Portland Harbor bridges. Three of the new structures would carry on- and off-ramps to mainline I-5. Two structures west of the existing bridges would carry traffic merging onto or exiting off of I-5 southbound. The new structure on the east side of I-5 would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include a two-lane arterial bridge for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

LPA Option B: This option would build the same number of structures over North Portland Harbor as Option A, although the locations and functions on those bridges would differ, as described below. The existing bridge over North Portland Harbor would be widened and would receive seismic upgrades.

LPA Option B does not have arterial lanes on the light rail/multi-use path bridge. Direct access between Marine Drive and the island would be provided with collector-distributor lanes. The structures adjacent to the highway bridge would carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges.

1.3.2.2 Interchange Improvements

The LPA includes improvements to seven interchanges along a 5-mile segment of I-5 between Victory Boulevard in Portland and SR 500 in Vancouver. These improvements include some reconfiguration of adjacent local streets to complement the new interchange designs, as well as new facilities for bicyclists and pedestrians along this corridor.

Victory Boulevard Interchange

The southern extent of the I-5 project improvements would be two ramps associated with the Victory Boulevard interchange in Portland. The Marine Drive to I-5 southbound on-ramp would be braided over the I-5 southbound to the Victory Boulevard/Denver Avenue off-ramp. The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Denver Avenue. The current merging ramp would be extended to become an add/drop (auxiliary) lane which would continue across the river crossing.

Potential phased construction option: The aforementioned southbound ramp improvements to the Victory Boulevard interchange may not be included with the CRC project. Instead, the existing connections between I-5 southbound and Victory Boulevard could be retained. The braided ramp connection could be constructed separately in the future as funding becomes available.

Marine Drive Interchange

All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5 at this location. The interchange configuration would be a single-point urban interchange (SPUI) with a flyover ramp serving the east to north movement. With this configuration, three legs of the interchange would converge at a point on Marine Drive, over the I-5 mainline. This configuration would allow the highest volume movements to move freely without being impeded by stop signs or traffic lights.

The Marine Drive eastbound to I-5 northbound flyover ramp would provide motorists with access to I-5 northbound without stopping. Motorists from Marine Drive eastbound would access I-5 southbound without stopping. Motorists traveling on Martin Luther King Jr. Boulevard westbound to I-5 northbound would access I-5 without stopping at the intersection.

The new interchange configuration changes the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard and to northbound I-5. These two streets would access westbound Martin Luther King Jr. Boulevard farther east. Martin Luther King Jr. Boulevard would have a new direct connection to I-5 northbound.

In the new configuration, the connections from Vancouver Way and Marine Drive would be served, improving the existing connection to Martin Luther King Jr. Boulevard east of the interchange. The improvements to this connection would allow traffic to turn right from Vancouver Way and accelerate onto Martin Luther King Jr. Boulevard. On the south side of Martin Luther King Jr. Boulevard, the existing loop connection would be replaced with a new connection farther east.

A new multi-use path would extend from the Bridgeton neighborhood to the existing Expo Center light rail station and from the station to Hayden Island along the new light rail line over North Portland Harbor.

LPA Option A: Local traffic between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel via an arterial bridge over North Portland Harbor. There would be some variation in the alignment of local streets in the area of the interchange between Option A and Option B. The most prominent differences are the alignments of Vancouver Way and Union Court.

LPA Option B: With this design option, there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island would travel on the collector-distributor bridges that would parallel each side of I-5 over North Portland Harbor. Traffic would not need to merge onto mainline I-5 to travel between the island and Martin Luther King Jr. Boulevard/Marine Drive.

***Potential phased construction option*:** The aforementioned flyover ramp could be deferred and not constructed as part of the CRC project. In this case, rather than providing a direct eastbound Marine Drive to I-5 northbound connection by a flyover ramp, the project improvements to the interchange would instead provide this connection through the signal-controlled SPUI. The flyover ramp could be constructed separately in the future as funding becomes available.

Hayden Island Interchange

All movements for this interchange would be reconfigured. The new configuration would be a split tight diamond interchange. Ramps parallel to the highway would be built, lengthening the ramps and improving merging speeds. Improvements to Jantzen Drive and Hayden Island Drive would include additional through, left-turn, and right-turn lanes. A new local road, Tomahawk Island Drive, would travel east-west through the middle of Hayden Island and under the I-5 interchange, improving connectivity across I-5 on the island. Additionally, a new multi-use path would be provided along the elevated light rail line on the west side of the Hayden Island interchange.

LPA Option A: A proposed arterial bridge with two lanes of traffic, one in each direction, would allow vehicles to travel between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island without accessing I-5.

LPA Option B: With this design option there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that parallel each side of I-5 over North Portland Harbor.

SR 14 Interchange

The function of this interchange would remain largely the same. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Downtown Vancouver I-5 access to and from the south would be at C Street rather than Washington Street, while downtown connections to and from SR 14 would be made by way of Columbia Street at 4th Street.

The multi-use bicycle and pedestrian path in the northbound (eastern) I-5 bridge would exit the structure at the SR 14 interchange, and then loop down to connect into Columbia Way.

Mill Plain Interchange

This interchange would be reconfigured into a SPUI. The existing "diamond" configuration requires two traffic signals to move vehicles through the interchange. The SPUI would use one efficient intersection and allow opposing left turns simultaneously. This would improve the capacity of the interchange by reducing delay for traffic entering or exiting the highway.

This interchange would also receive several improvements for bicyclists and pedestrians. These include bike lanes and sidewalks, clear delineation and signing, short perpendicular crossings at the ramp terminals, and ramp orientations that would make pedestrians highly visible.

Fourth Plain Interchange

The improvements to this interchange would be made to better accommodate freight mobility and access to the new park and ride at Clark College. Northbound I-5 traffic exiting to Fourth Plain would continue to use the off-ramp just north of the SR 14 interchange. The southbound I-5 exit to Fourth Plain would be braided with the SR 500 connection to I-5, which would eliminate the non-standard weave between the SR 500 connection and the off-ramp to Fourth Plain as well as the westbound SR 500 to Fourth Plain Boulevard connection.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including bike lanes, neighborhood connections, and access to the park and ride.

SR 500 Interchange

Improvements would be made to the SR 500 interchange to add direct connections to and from I-5. On- and off-ramps would be built to directly connect SR 500 and I-5 to and from the north, connections that are currently made by way of 39th Street. I-5 southbound traffic would connect to SR 500 via a new tunnel underneath I-5. SR 500 eastbound traffic would connect to I-5 northbound on a new on-ramp. The 39th Street connections with I-5 to and from the north would be eliminated. Travelers would instead use the connections at Main Street to connect to and from 39th Street.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including sidewalks on both sides of 39th Street, bike lanes, and neighborhood connections.

***Potential phased construction option*:** The northern half of the existing SR 500 interchange would be retained, rather than building new connections between I-5 southbound to SR 500 eastbound and from SR 500 westbound to I-5 northbound. The ramps connecting SR 500 and I-5 to and from the north could be constructed separately in the future as funding becomes available.

1.3.2.3 Transit

The primary transit element of the LPA is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo Center in North Portland, where it currently ends, to Clark College in Vancouver. The transit element would not differ between LPA and LPA with highway phasing. To accommodate and complement this major addition to the region's transit system, a variety of additional improvements are also included in the LPA:

- Three park and ride facilities in Vancouver near the new light rail stations.
- Expansion of Tri-County Metropolitan Transportation District's (TriMet's) Ruby Junction light rail maintenance base in Gresham, Oregon.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Operating Characteristics

Nineteen new light rail vehicles (LRV) would be purchased as part of the CRC project to operate this extension of the MAX Yellow Line. These vehicles would be similar to those currently used by TriMet's MAX system. With the LPA, LRVs in the new guideway and in the existing Yellow Line alignment are planned to operate with 7.5-minute headways during the "peak of the peak" (the two-hour period within the 4-hour morning and afternoon/evening peak periods where demand for transit is the highest) and 15-minute headways during off-peak periods.

Light Rail Alignment and Stations

Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains would be constructed to extend from the existing Expo Center MAX station over North Portland Harbor to Hayden Island. Immediately north of the Expo Center, the alignment would curve eastward toward I-5, pass beneath Marine Drive, then rise over a flood wall onto a light rail/multi-use path bridge to cross North Portland Harbor. The two-way guideway over Hayden Island would be elevated at approximately the height of the rebuilt mainline of I-5, as would a new station immediately west of I-5. The alignment would extend northward on Hayden Island along the western edge of I-5, until it transitions into the hollow support structure of the new western bridge over the Columbia River.

Downtown Vancouver Light Rail Alignment and Stations

After crossing the Columbia River, the light rail alignment would curve slightly west off of the highway bridge and onto its own smaller structure over the Burlington Northern Santa Fe (BNSF) rail line. The double-track guideway would descend on structure and touch down on Washington Street south of 5th Street, continuing north on Washington Street to 7th Street. The elevation of 5th Street would be raised to allow for an at-grade crossing of the tracks on Washington Street. Between 5th and 7th Streets, the two-way guideway would run down the center of the street. Traffic would not be allowed on Washington between 5th and 6th Streets and would be two-way between 6th and 7th Streets. There would be a station on each side of the street on Washington between 5th and 6th Streets.

At 7th Street, the light rail alignment would form a couplet. The single-track northbound guideway would turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway would continue on Washington Street. Seventh Street will be converted to one-way traffic eastbound between Washington and Broadway with light rail operating on the north side of 7th Street. This couplet would extend north to 17th Street, where the two guideways would join and turn east.

The light rail guideway would run on the east side of Washington Street and the west side of Broadway Street, with one-way traffic southbound on Washington Street and one-way traffic northbound on Broadway Street. On station blocks, the station platform would be on the side of the street at the sidewalk. There would be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

East-west Light Rail Alignment and Terminus Station

The single-track southbound guideway would run in the center of 17th Street between Washington and Broadway Streets. At Broadway Street, the northbound and southbound alignments of the couplet would become a two-way center-running guideway traveling east-west on 17th Street. The guideway on 17th Street would run until G Street, then connect with McLoughlin Boulevard and cross under I-5. Both alignments would end at a station east of I-5 on the western boundary of Clark College.

Park and Ride Stations

Three park and ride stations would be built in Vancouver along the light rail alignment:

- Within the block surrounded by Columbia, Washington 4th and 5th Streets, with five floors above ground that include space for retail on the first floor and 570 parking stalls.
- Between Broadway and Main Streets next to the stations between 15th and 16th Streets, with space for retail on the first floor, and four floors above ground that include 420 parking stalls.
- At Clark College, just north of the terminus station, with space for retail or C-TRAN services on the first floor, and five floors that include approximately 1,910 parking stalls.

Ruby Junction Maintenance Facility Expansion

The Ruby Junction Maintenance Facility in Gresham, Oregon, would need to be expanded to accommodate the additional LRVs associated with the CRC project. Improvements include additional storage for LRVs and other maintenance material, expansion of LRV maintenance bays, and expanded parking for additional personnel. A new operations command center would also be required, and would be located at the TriMet Center Street location in Southeast Portland.

Local Bus Route Changes

As part of the CRC project, several C-TRAN bus routes would be changed in order to better complement the new light rail system. Most of these changes would re-route bus lines to downtown Vancouver where riders could transfer to light rail. Express routes, other than those listed below, are expected to continue service between Clark County and downtown Portland. The following table (Exhibit 1-2) shows anticipated future changes to C-TRAN bus routes.

Exhibit 1-2. Proposed C-TRAN Bus Routes Comparison

C-TRAN Bus Route	Route Changes
#4 - Fourth Plain	Route truncated in downtown Vancouver
#41 - Camas / Washougal Limited	Route truncated in downtown Vancouver
#44 - Fourth Plain Limited	Route truncated in downtown Vancouver
#47 - Battle Ground Limited	Route truncated in downtown Vancouver
#105 - I-5 Express	Route truncated in downtown Vancouver
#105S - I-5 Express Shortline	Route eliminated in LPA (The No-Build runs articulated buses between downtown Portland and downtown Vancouver on this route)

Steel Bridge Improvements

Currently, all light rail lines within the regional TriMet MAX system cross over the Willamette River via the Steel Bridge. By 2030, the number of LRVs that cross the Steel Bridge during the 4-hour PM peak period would increase from 152 to 176. To accommodate these additional trains, the project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail speed over the bridge from 10 to 15 mph. To accomplish this, additional work along the Steel Bridge lift spans would be needed.

1.3.2.4 Tolling

Tolling cars and trucks that use the I-5 river crossing is proposed as a method to help fund the CRC project and to encourage the use of alternative modes of transportation. The authority to toll the I-5 crossing is set by federal and state laws. Federal statutes permit a toll-free bridge on an interstate highway to be converted to a tolled facility following the reconstruction or replacement of the bridge. Prior to imposing tolls on I-5, Washington and Oregon Departments of Transportation (WSDOT and ODOT) would have to enter into a toll agreement with U.S. Department of Transportation (DOT). Recently passed state legislation in Washington permits WSDOT to toll I-5 provided that the tolling of the facility is first authorized by the Washington legislature. Once authorized by the legislature, the Washington Transportation Commission (WTC) has the authority to set the toll rates. In Oregon, the Oregon Transportation Commission (OTC) has the authority to toll a facility and to set the toll rate. It is anticipated that prior to tolling I-5, ODOT and WSDOT would enter into a bi-state tolling agreement to establish a cooperative process for setting toll rates and guiding the use of toll revenues.

Tolls would be collected using an electronic toll collection system: toll collection booths would not be required. Instead, motorists could obtain a transponder that would automatically bill the vehicle owner each time the vehicle crossed the bridge, while cars without transponders would be tolled by a license-plate recognition system that would bill the address of the owner registered to that license plate.

The LPA proposes to apply a variable toll on vehicles using the I-5 crossing. Tolls would vary by time of day, with higher rates during peak travel periods and lower rates during off-peak periods. Medium and heavy trucks would be charged a higher toll than passenger vehicles. The traffic-related impact analysis in this FEIS is based on toll rates that, for passenger cars with transponders, would range from $1.00 during the off-peak to $2.00 during the peak travel times (in 2006 dollars).

1.3.2.5 Transportation System and Demand Management Measures

Many well-coordinated transportation demand management (TDM) and transportation system management (TSM) programs are already in place in the Portland-Vancouver Metropolitan region and supported by agencies and adopted plans. In most cases, the impetus for the programs is from state-mandated programs: Oregon's Employee Commute Options (ECO) rule and Washington's Commute Trip Reduction (CTR) law.

The physical and operational elements of the CRC project provide the greatest TDM opportunities by promoting other modes to fulfill more of the travel needs in the project corridor. These include:

- Major new light rail line in exclusive right-of-way, as well as express bus and feeder routes;
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians, and improve connectivity, safety, and travel time;
- Park and ride lots and garages; and
- A variable toll on the highway crossing.

In addition to these fundamental elements of the project, facilities and equipment would be implemented that could help existing or expanded TSM programs maximize capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs or other traveler information systems in the CRC project area;
- Expanded incident response capabilities;

- Queue jumps or bypass lanes for transit vehicles where multi-lane approaches are provided at ramp signals for entrance ramps;
- Expanded traveler information systems with additional traffic monitoring equipment and cameras, and
- Active traffic management.

1.3.3 LPA Construction

Construction of bridges over the Columbia River is the most substantial element of the project, and this element sets the sequencing for other project components. The main river crossing and immediately adjacent highway improvement elements would account for the majority of the construction activity necessary to complete this project.

1.3.3.1 Construction Activities Sequence and Duration

The following table (Exhibit 1-3) displays the expected duration and major details of each element of the project. Due to construction sequencing requirements, the timeline to complete the initial phase of the LPA with highway phasing is the same as the full LPA.

Exhibit 1-3. Construction Activities and Estimated Duration

Element	Estimated Duration	Details
Columbia River bridges	4 years	• Construction is likely to begin with the bridges. • General sequence includes initial preparation, installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
Hayden Island and SR 14 interchanges	1.5 - 4 years for each interchange	• Each interchange must be partially constructed before any traffic can be transferred to the new structure. • Each interchange needs to be completed at the same time.
Marine Drive interchange	3 years	• Construction would need to be coordinated with construction of the southbound lanes coming from Vancouver.
Demolition of the existing bridges	1.5 years	• Demolition of the existing bridges can begin only after traffic is rerouted to the new bridges.
Three interchanges north of SR 14	4 years for all three	• Construction of these interchanges could be independent from each other or from the southern half of the project. • More aggressive and costly staging could shorten this timeframe.
Light rail	4 years	• The river crossing for the light rail would be built with the bridges. • Any bridge structure work would be separate from the actual light rail construction activities and must be completed first.
Total Construction Timeline	6.3 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work, weather, materials, and equipment, could all influence construction duration. • This is also the same time required to complete the smallest usable segment of roadway – Hayden Island through SR 14 interchanges.

1.3.3.2 Major Staging Sites and Casting Yards

Staging of equipment and materials would occur in many areas along the project corridor throughout construction, generally within existing or newly purchased right-of-way or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Suitable sites must be large and open to provide for heavy machinery and material storage, must have 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 must have roadway or rail access for landside transportation of materials by truck or train.

Three sites have been identified as possible major staging areas:

1. Port of Vancouver (Parcel 1A) site in Vancouver: This 52-acre site is located along SR 501 and near the Port of Vancouver's Terminal 3 North facility.
2. Red Lion at the Quay hotel site in Vancouver: This site would be partially acquired for construction of the Columbia River crossing, which would require the demolition of the building on this site, leaving approximately 2.6 acres for possible staging.
3. Vacant Thunderbird hotel site on Hayden Island: This 5.6-acre site is much like the Red Lion hotel site in that a large portion of the parcel is already required for new right-of-way necessary for the LPA.

A casting/staging yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, including either a slip or a dock capable of handling heavy equipment and material; a large area suitable for a concrete batch plant and associated heavy machinery and equipment; and access to a highway and/or railway for delivery of materials.

Two sites have been identified as possible casting/staging yards:

1. Port of Vancouver Alcoa/Evergreen West site: This 95-acre site was previously home to an aluminum factory and is currently undergoing environmental remediation, which should be completed before construction of the CRC project begins (2012). The western portion of this site is best suited for a casting yard.
2. Sundial site: This 50-acre site is located between Fairview and Troutdale, just north of the Troutdale Airport, and has direct access to the Columbia River. There is an existing barge slip at this location that would not have to undergo substantial improvements.

1.3.4 The No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2030 if the CRC project is not built. This alternative makes the same assumptions as the build alternatives regarding population and employment growth through 2030, and also assumes that the same transportation and land use projects in the region would occur as planned. The No-Build Alternative also includes several major land use changes that are planned within the project area, such as the Riverwest development just south of Evergreen Boulevard and west of I-5, the Columbia West Renaissance project along the western waterfront in downtown Vancouver, and redevelopment of the Jantzen Beach shopping center on Hayden Island. All traffic and transit projects within or near the CRC project area that are anticipated to be built by 2030 separately from this project are included in the No-Build and build alternatives.

Additionally, the No-Build Alternative assumes bridge repair and continuing maintenance costs to the existing bridge that are not anticipated with the replacement bridge option.

1.4 Coordination and Consultation

The archaeological field investigations for the CRC project were coordinated with the Washington State Department of Archaeology and Historic Preservation (DAHP), Oregon State Historic Preservation Office (SHPO), ODOT, WSDOT, and Native American Tribal governments. This coordination included meetings at the CRC office attended by Matthew Sterner (DAHP), Scott Williams, Roger Kiers, and Sarah Schufelt (WSDOT), and Carolyn McAleer (ODOT). Two meetings in the field were attended by Sterner, Williams, and Schufelt during the course of the fieldwork. Jenna Gaston and Tom Becker have served as Cultural Resource Coordinators for the CRC project.

Native American tribes with interests in the project area were regularly notified as fieldwork progressed to facilitate site visits. Ed Arthur from the Cowlitz Indian Tribe participated in the discovery probing early in the field investigations on the Washington shore. Don Day and Brian Krehbiel of the Confederated Tribes of Grand Ronde served as tribal monitors during NPS excavations in the VNHR.

Tribes notified of the field investigations included the Cowlitz Indian Tribe, Confederated Tribes of the Grand Ronde Community of Oregon, Nez Perce Tribe, Confederated Tribes of Siletz Indians, Spokane Tribe of Indians, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Bands and Tribes of the Yakama Nation, and the Chinook Tribe.

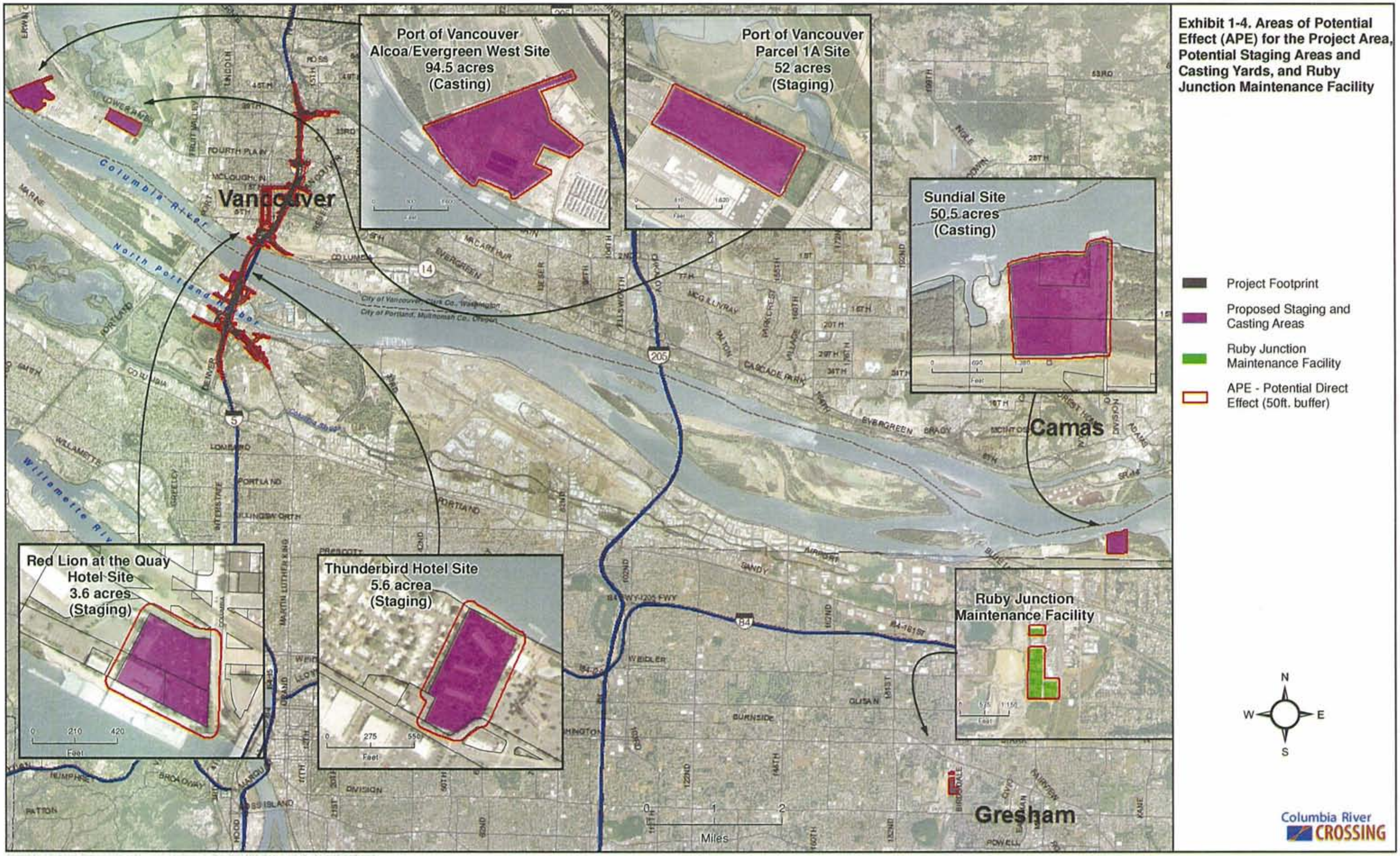

Exhibit 1-4. Areas of Potential Effect (APE) for the Project Area, Potential Staging Areas and Casting Yards, and Ruby Junction Maintenance Facility

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2. Methods

The archaeological discovery and significance evaluation program for the CRC project primarily involved field investigations on all properties to which CRC was granted right-of-entry, including properties owned by ODOT, WSDOT, NPS, the U.S. Army, and the City of Vancouver. The investigations on the WSDOT and ODOT properties were undertaken by archaeologists from Heritage Research Associates, Inc. (HERITAGE), the principal archaeological consultant for the CRC project, with Rick Minor serving as Principal Investigator, directly overseeing all investigations. On the east side of I-5 in Washington, the CRC APE extends into the periphery of the VNHR, and includes properties owned by NPS, the U.S. Army, and the City of Vancouver. Archaeological investigations in the VNHR for the CRC project were undertaken by archaeologists from the NPS, with Douglas C. Wilson serving as Principal Investigator and Leslie O'Rourke as Field Supervisor.

In addition to the bridge replacements and improvements along the I-5 corridor, the CRC project includes three important non-highway-related elements: 1) light rail construction, particularly in downtown Vancouver; 2) Large Casting/Staging Yards; and 3) expansion of the Ruby Junction Maintenance Facility in Gresham. Access and current use issues precluded archaeological investigations in connection with these first two project elements.

The existing TriMet Ruby Junction Maintenance Facility in Gresham will be expanded to accommodate additional light rail vehicles needed for the CRC project. The Ruby Junction Maintenance Facility is also part of the Portland-Milwaukee Light Rail project (PMLR). Archaeological discovery investigations in connection with expansion of this facility were conducted by Archaeological Investigations Northwest (AINW), the archaeological consultant for the PMLR project. Pedestrian surveys and shovel test excavations in two of three high probability areas potentially affected by the proposed expansion found no archaeological evidence. No further archaeological work was recommended. Access to a third high probability area was denied by the landowner; survey in this area is recommended prior to construction (Punke et al. 2010:29).

2.1 Objective

The overall objective of the archaeological discovery investigations was to identify any significant evidence of human occupation or activity within the CRC project's APE over the last 12,000 years BP (Before Present). This date is derived from the estimated time of occurrence of the last of the Pleistocene Missoula Floods. At least 40 floods from cataclysmic releases of glacially-dammed Lake Missoula in Montana swept down the Columbia River, eroding away many of the earlier landforms and creating the modern landscape in the Lower Columbia Valley.

It was long thought that the last in this series of floods occurred around 20,000 BP, but more recent research indicates that "more than 13 floods perhaps postdate ca. 13 ka [13,000 years BP]" (Benito and O'Connor 2003:624). The Pleistocene gravels deposited by these floods serve as a baseline and reference point for archaeological investigations exploring for archaeological evidence through the full time range during which humans may have occupied the APE.

Scattered evidence, mostly in the form of Clovis and Folsom fluted projectile points, indicates the presence of Native Americans in the Pacific Northwest as early as 12,000 BP. Along the Middle

Columbia River, sites occupied by prehistoric peoples have been investigated and radiocarbon dated to as early as 10,000 BP (Ames et al. 1998). Currently, the earliest radiocarbon dated archaeological sites in the Lower Columbia Valley, where the CRC project is located, are only about 3,000 to 3,500 years old.

Extension of the search for evidence of human occupation in the CRC APE back to 12,000 BP requires an emphasis on the detailed reconstruction of the near-surface geology of the Portland-Vancouver Basin. This section of the Lower Columbia has been much less intensively studied by geologists in comparison to sections upstream in the Middle and Upper Columbia River Valley. The effort to identify strata buried deep below the ground surface that may potentially contain evidence of human occupation requires close collaboration between archaeologists and geologists. Archaeological investigations for the CRC project involve an integration of archaeology and geology, often referred to as the geoarchaeological approach, to a significantly greater extent than has been the case in previous archaeological research in the Lower Columbia Valley.

2.2 Study Area

The Study Area extends along the intensively developed I-5 corridor in Oregon and Washington. From Victory Boulevard in North Portland, Oregon, the study area stretches northward across the Columbia River flood plain, through the Marine Drive interchange, and crosses Oregon Slough to Hayden Island. With the exception of the Vanport Wetlands on the west side south of Marine Drive, the margins of the I-5 corridor are intensively developed with commercial, industrial and recreational land uses, roadways, and extensive above- and below-ground utilities.

In addition to the bridge replacements and improvements along the I-5 corridor, the CRC project includes three important non-highway-related elements: 1) light rail construction; 2) Casting/Staging Yards; and 3) expansion of the Ruby Junction Maintenance Facility in Gresham.

The nature of land disturbance in the Study Area varies widely, and includes a complex mix of deep excavations associated with features such as pier foundations, cuts associated with roadway excavations, fills associated with roadway and building locations, and various levels of grading ranging from parklands to parking lots. To date, archaeological discovery investigations on the Oregon shore for the CRC project have been limited for the most part to the narrow ODOT right-of-way and, more specifically, to areas where sediments are exposed along the margins of I-5 and associated interchanges.

From Hayden Island, the existing I-5 bridges extend across the Columbia River to Vancouver, Washington. Immediately north of the river, I-5 proceeds under an overpass for the Burlington Northern Railroad and through the SR 14 interchange. I-5 then continues northward through an intensively developed business district and adjacent residential neighborhoods.

The I-5 corridor immediately north of the Columbia River and through Vancouver is bounded on both sides by areas settled early in the historic period. East of I-5 is the site of the HBC Fort Vancouver established at this location in 1829, and the site of Vancouver Barracks, where the U.S. Army's presence dates to 1849 (Hussey 1957). This area is encompassed within the VNHR, listed on the National Register of Historic Places (NRHP) in 2007 (Owens et al. 2007). West of I-5 is the Historic City of Vancouver, the oldest portion of the city, which emerged to the west of the HBC Fort Vancouver beginning in the 1840s and 1850s.

Archaeological investigations on the Washington shore for the CRC project have been focused primarily on the narrow WSDOT right-of-way in areas where sediments are exposed along the margins of I-5 and associated interchanges, as well as immediately east of the I-5 corridor on the western periphery of the VNHR.

2.3 Regulatory Setting and Effects Guidelines

The archaeological investigations reported here were undertaken to ensure compliance by the CRC project with the National Historic Preservation Act (NHPA), National Environmental Policy Act (NEPA), and stipulations of the Transportation Act. The NHPA, as amended, requires that federal agencies identify and assess the effects of federally assisted undertakings on "historic properties" and to consult with others to find acceptable ways to avoid, minimize, or mitigate adverse effects.

As defined in 36 CFR Part 800, one of the key regulations implementing the NHPA, an "historic property means any prehistoric or historic district, site, building, structure or object included in or eligible for inclusion in the National Register of Historic Places…(and) includes artifacts…and remains that are related to and located within such properties." Amendments to Section 106 of the NHPA in 1992 explicitly allowed properties of traditional religious and cultural importance to be eligible for inclusion in the NRHP.

In addition to federal laws, the CRC project is also subject to laws regarding the identification and protection of historic properties promulgated by each state. In Oregon, these statutes include Archaeological Sites and Objects (ORS 358.905 to 358.955), Permit and Conditions for Excavation or Removal of Archaeological or Historical Material on Public Lands (ORS 390.235), and Indian Graves and Protected Objects (ORS 97.740-97.760). In Washington, these laws include Archaeological Sites and Resources (RCW 27.53), Indian Graves and Records (RCW 27.44), and Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60).

Archaeological resources include the physical remains of human activity as evidenced in artifacts, remains, sites, buildings, structures, or objects. An archaeological resource is considered an "historic property," and "significant" pursuant to 36 CFR 800, if it is determined to be National Register-eligible. Eligible properties generally must be at least 50 years old, possess integrity of physical characteristics, and meet at least one of the four criteria of significance:

A. That are associated with events that have made a significant contribution to the broad patterns of our history.

B. That are associated with the lives of persons significant in our past.

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction.

D. That have yielded, or may be likely to yield, information important in prehistory or history.

The National Register eligibility of archaeological resources, and cultural resources in general, are based on criteria set forth in 36 CFR 60, further referenced in 36 CFR 800.4(c), and detailed in *Treatment of Archaeological Properties: A Handbook issued by the Advisory Council on Historic Preservation*, as well as in a series of bulletins, including:

- National Register Bulletin 15 – How to Apply the National Register Criteria for Evaluation.
- National Register Bulletin 36 – Guidelines for Evaluating and Registering Historical Archaeological Sites and Districts.
- National Register Bulletin 36 (Revised) – Guidelines for Evaluating and Registering Archaeological Properties.
- National Register Bulletin 38 – Guidelines for Evaluating and Documenting Traditional Cultural Properties.
- National Register Bulletin 41 – Guidelines for Evaluating and Registering Cemeteries and Burial Places.

2.4 Research Design

The present report is the most recent in a series of documents pertaining to cultural resources that have been prepared for the CRC project. As a means of establishing the prehistoric and historic contexts of the project area, the prehistory, ethnography, ethnohistory, history, and historical archaeology were reviewed and summarized in the *Interstate 5 Columbia River Crossing Archaeology Technical Report* prepared for the project Draft Environmental Impact Statement (DEIS) (Minor et al. 2007). To establish a foundation for extending the search for evidence of prehistoric occupation to 12,000 BP, a synthesis of the geology and geomorphology of the project area was included as an appendix to the Archaeology Technical Report (Peterson 2007). These studies have been included as Appendix 1A to this document.

After the synthesis of the cultural background appeared in the DEIS, ethnohistorian Robert Boyd brought attention to references in the early historical literature to one or more Native American encampments on the Oregon shore across from Fort Vancouver. These encampments were occupied by native peoples drawn to the trading and other activity at the fort. The most important Indian settlement, the Cascades Indian winter encampment, "is clearly documented only for the post-fever and pre-reservation period, a time span of about twenty years, from 1833 to 1853" (Boyd 2010:1). Although the existing I-5 bridges are slightly downstream from Fort Vancouver, these references nevertheless point to the possibility of encountering evidence of these historic Native American encampments during construction of the CRC project.

In an effort to expand upon information contained in written documents, inquiries were made by CRC with consulting tribes as to their interest in conducting oral history studies about past Native American use of lands within the CRC project area. Reports were subsequently prepared by the Confederated Tribes of the Umatilla Indian Reservation (Engum 2009) and the Confederated Tribes of the Warm Springs Reservation of Oregon (Whipple 2009). The information presented in these studies was general in nature. Due to issues of confidentiality, the reports did not identify any specific cultural sites within the APE that might be addressed during the archaeological investigations for the CRC project.

To date, archaeological evidence of prehistoric Native American occupation has not been identified on the Oregon shore within, or in the close vicinity of, the CRC APE. Several reasons for this situation can be suggested:

- The CRC APE represents a very narrow transect across the Columbia River flood plain, and it may not include any areas in which Native American or historic period Euro-American sites are preserved.

- Evidence of Native American occupation and activity may be present, but over time it has been buried by natural flood deposits and/or introduced fill deposits associated with development in the twentieth century.
- Previous archaeological surveys have for the most part been limited to inspection of the existing ground surface and/or shallow probing. These efforts have not employed methods suitable for locating Native American sites buried under historic fill or within alluvium deposited over the last 12,000 years.

Fourteen archaeological sites have been recorded on the Washington shore of the Columbia River within, or in the vicinity of, the CRC APE. Eight of these recorded sites are associated with the VNHR (Owens et al. 2007) created in 1996 on the east side of the I-5 corridor: 1) HBC-USA Trash Dump (45CL47); 2) Officers Row (45CL160H); 3) Vancouver Barracks (45CL162H); 4) Fort Vancouver National Historic Site (45CL163H); 5) Old Apple Tree (45CL164H); 6) Pearson Air Park (45CL224); 7) Kanaka Village (45CL300H); and 8) Pearson Airfield (45CL524). With the exception of Pearson Airfield recorded in 2001, these sites were assigned site numbers in the late 1970s, before establishing site boundaries through archaeological fieldwork became a fundamental requirement in cultural resource management. The boundaries of these sites tend to be based more on administrative units than on archaeological data. Three of these sites are characterized by boundaries that overlap (the implication of this situation is considered below in Section 3.6.1).

Two sites, the Quartermaster East Site (45CL400) and Benoit Site (45CL401), are underwater in the Columbia River south of the VNHR. The remaining four recorded historical archaeological sites within the CRC APE (45CL514, 45CL582, 45CL583, 45CL687) are west of the I-5 corridor in the Historic City of Vancouver.

A pedestrian survey carried out by a team of two archaeologists found no evidence of prehistoric or historic occupation exposed on the ground surface along the margins of I-5 and within state rights-of-way in the CRC APE in Oregon or Washington. At the time, it was assumed that the negative survey results were due to the presence of a shallow mantle of soil introduced for landscaping purposes, and that this soil mantle was shallow enough that manual excavations would be sufficient to reach intact native soil below. Once the discovery archaeological investigations were underway, however, it became clear that construction of the existing I-5 interstate involved cut-and-fill activity on such a massive scale that mechanical excavations were the only effective means of identifying intact artifact-bearing strata and cultural features within the existing interstate rights-of-way within the CRC APE. Lands within the VNHR outside the existing right-of-way were not subject to impacts from highway construction.

Before any archaeological excavations were undertaken, a document titled *An Archaeological Research Design for the Washington Portion of the Columbia River Crossing CRC Project* was prepared, reviewed, and submitted to DAHP (Williams 2009). Building on the DEIS Archaeology Technical Report, this research design document discussed research domains and research questions that data recovered during archaeology in the CRC APE might potentially address. Various methods that might potentially be employed in identifying and evaluating archaeological sites were outlined in some detail. These methods ranged from remote sensing to manual probing and augering to mechanical coring and trenching.

The actual methods of investigation employed in the field were necessarily adapted to the variable ground conditions found in different subareas of the CRC APE (as described below in Section 3). A report describing the procedures and results of investigations on the ODOT parcels is presented in Appendix 1B, *Archaeological Discovery and Evaluation: ODOT Parcels*. A report describing the procedures and results of investigations on the WSDOT parcels is provided in Appendix 1C, *Archaeological Discovery and Evaluation: WSDOT Parcels*.

Similarly, the investigations for the CRC project conducted by NPS in the portion of the CRC APE along the western periphery of the VNHR were guided by work plans compiled in a document entitled *Amendments to the Archaeological Research Design and Work Plan for Archaeological Testing, Columbia River Crossing Project, Vancouver National Historic Reserve, Washington* (Northwest Cultural Resources Institute 2009). A final report on investigations for the CRC project in five subareas on the VNHR is presented in Appendix 1D, *Results of National Park Service Archaeological Evaluation and Testing on the Vancouver National Historic Reserve for the Columbia River Crossing Project* (O'Rourke et al. 2010).

It should be noted that in this document elevations, borehole depths, and river miles are expressed in terms of U.S. customary units (e.g., feet above/below sea level). In keeping with common practice among most archaeologists working in the region today, measurements more directly related to archaeology (e.g., auger diameters, test pit size, excavation depth) are generally expressed in terms of the metric system.

2.5 Permits and Approvals

All proposed archaeological investigations undertaken for the CRC project were closely reviewed in advance by DAHP for Washington and by SHPO for Oregon. Tribal representatives were notified of proposed fieldwork in each work area. Archaeological investigations on the north shore of the Columbia River in Washington were conducted on WSDOT lands under the terms of Washington State Department of Transportation General Permits 47065 and 47066 (for ground-penetrating radar surveys) and General Permit 47428 (for discovery excavations and testing for significance evaluation). Archaeological discovery investigations on the south shore of the Columbia River in Oregon for the CRC project were conducted under the terms of State of Oregon Archaeological Permit No. 1148.

3. Affected Environment

3.1 Geological and Geomorphic Setting

The CRC APE is located at River Mile 106.4 in the Portland-Vancouver Basin of the Lower Columbia River Valley. This basin was formed early in the Pliocene by a gentle syncline, or downwarp, of flows of volcanic rock known collectively as Columbia River Basalt. Near the end of the Pliocene, the velocity of the Columbia River appears to have been slowed or impounded, leading to deposition of 1500 feet of fine-grained Sandy River Mudstone (Trimble 1963). The Columbia River Basalt and Sandy River Mudstone are not exposed in the CRC APE.

Before the end of the Pliocene a change in deposition occurred, as a sand and gravel delta, emanating from the west end of the Columbia Gorge, formed in the Portland-Vancouver Basin. These deposits are referred to as either Troutdale (cemented) or Pleistocene (uncemented) fluvial gravels. The upper member of the Troutdale Formation, which includes sand, cobbles, and boulders, ranges from 5- to 2-million years in age (Trimble 1963; Beeson and Tolan 1993). The younger Pleistocene gravel deposits could range from 2-million years in age to the last ice age (e.g., the late Wisconsin). The younger Pleistocene gravels occur well above the present grade of the Columbia River, indicating changing base levels in late-Pleistocene times.

Uncemented naturally stratified sand and silt deposits at elevations higher than historic flood heights or latest Holocene floods (approximately 35 feet NGVD29) represent cataclysmic flood deposits from glacial Lake Missoula. Multiple dam bursts from this glacial lake produced numerous sequences of fining-up beds called rhythmites, which were locally remobilized to form interbeds of loess (Lentz 1983). The youngest glacial flood deposits from Lake Missoula that inundated the Lower Columbia Valley are dated to about 12,000 BP, which corresponds to the temporal boundary for the CRC project. The upland terraces adjacent to the north and south sides of the Columbia River in the CRC APE are covered by the glacial flood rhythmites and loess, representing the latest-Pleistocene peri-glacial deposits (Beeson et al. 1991).

Sea level at 16,000 BP was approximately 360 feet below what it is today. At that time, the waters of the Columbia River flowed through a deep canyon several hundred feet below the surrounding landscape. As sea level rose, the valley floor was submerged. By 12,000 BP sea level extended upslope (landward) in the valley to an elevation of -230 feet. At the time of the deposition of Mazama ash from the eruption of Mount Mazama at approximately 7,700 BP, sea level in the Lower Columbia Valley was approximately -41 feet below what it is today.

The declining rate of sea level rise after 7,000 years ago resulted in sea level approaching its present elevation by several thousand years ago. Sea level and corresponding river level in the CRC project area have risen only 9.8 feet (3.0 m) in the last 3,000 years, a rate of about 1.0 mm/year.

The highest Columbia River flood on record in 1948 reached a measured height in the north Portland area of +32.8 feet (NGVD29). The flood of 1894 is reported to have had a slightly higher elevation. Other flood heights range from 17 feet for one-year freshets to 32 feet for 20-year floods (Kuper and Lawes 1994:12). Elevations on the south shore flood plain in the CRC APE range from 0.0- to +30 feet. Thus, this area was regularly subject to inundation from seasonal floods.

In comparison, the terrain on the north shore in the CRC APE ascends quickly, so that only a narrow strip of ground adjacent to the river lies at elevations of 30 feet or less and was subject to regular inundation and deposition of flood silts. The rising ground north of the river is covered by relatively shallow wind-blown loess deposits overlying Pleistocene gravels. The landscape near the north end of the CRC APE is cut by Burnt Bridge Creek, an overflow channel from the Missoula Floods. The flood waters cut a deeply incised canyon through which this small stream flows generally westward to its outlet at Vancouver Lake.

3.2 Cultural Setting

The abundant natural resources in the Lower Columbia Valley supported one of the densest Native American populations in North America. At the time of historic contact, native peoples who spoke Chinookan languages occupied villages and camps along the shores of the Lower Columbia River. Their dense population is reflected in the large number of archaeological sites associated with Native American occupation that have been recorded.

Although evidence of prehistoric Native Americans dating as early as 10,000 BP has been found farther upstream on the Columbia River, the archaeological record in the Lower Columbia Valley has a much more limited time depth. Evidence of early occupation on the valley floor has been submerged by rising sea levels or buried under alluvial deposits, with the result that the earliest radiocarbon dated sites along this section of the river date to only about 3,000 to 3,500 BP. Deep excavations below the present level of the Columbia River during construction of the CRC project have the potential to encounter evidence of prehistoric occupation much older than has so far been documented.

The CRC project area contains an historical archaeological record associated with settlement by Euroamericans and other ethnic groups that is unmatched anywhere else in the Pacific Northwest. This record begins with archaeological features, deposits, and artifacts from the HBC Fort Vancouver on the north bank of the Columbia River east of present-day I-5. Originally established in 1825 on high ground farther east, the fort was relocated in 1829 to the present site of the reconstructed stockade in the VNHR. An extensive multi-cultural settlement known historically as Kanaka Village, where the majority of the HBC employees lived, emerged along the southwest side of the fort. In 1849, the U.S. Army established Camp Vancouver on the upper plain above the HBC stockade. With establishment of a military reservation in 1850 the name was changed to Columbia Barracks. This post expanded over the years, with the name changed to Vancouver Barracks in 1879, to become one of the most important military installations in the Pacific Northwest during the late nineteenth and early twentieth century's.

The City of Vancouver developed beginning in the 1840s and 1850s on the north bank of the Columbia River immediately west of the military reserve. The Historic City of Vancouver, consisting of the first platted blocks, was situated in the area that today is immediately west of I-5. Archaeological remains in the city for the most part postdate the initial HBC occupation at Fort Vancouver and relate to civilian settlement and development coterminous with the U.S. Army occupation at Vancouver Barracks. Although much less intensively investigated compared to the area east of I-5, recent studies have shown that historical archaeological investigations in the oldest portions of the city have begun to shed light on the development over time of the Vancouver's urban environment.

3.3 Defining Characteristics of the CRC APE

The APE for the CRC project has a number of defining characteristics that directly affect efforts to meet the objective of identifying significant archaeological sites.

First, archaeological investigations conducted for the CRC project to date have been restricted for the most part to areas in which the CRC has obtained right-of-entry, primarily along I-5 and connecting interchanges (e.g., Marine Drive in Oregon, SR 14 and SR 500 in Washington). The areas available for archaeological investigations tend to be narrow linear strips of ground bounded by active travel lanes on one side and by chain link property fences on the other. The lands on the east side of I-5 in the VNHR are exceptional in this regard, as they occur for the most part in a long continuous strip, with only two small areas south of SR 14 set apart as separate parcels.

Second, the I-5 corridor within the CRC APE is a zone of intense past construction. This activity has involved earth-moving on a massive scale, including deep cuts into the native sediments and underlying gravels in some areas, and the introduction of deep fill deposits in other areas. As encountered during the archaeological investigations for the CRC project, evidence of cut-and-fill episodes from past construction sometimes occurs in the same local area. An additional aspect of past construction is the degree of compaction of the fill introduced along the margins of the roadways. As indicated by penetrometer measurements in the field, these fill deposits routinely yielded values that, according to engineering standards, are too compact for manual excavations. The lands on the east side of I-5 in the VNHR again are an exception to this situation, as they generally have not been subject to construction disturbance to the extent experienced by the WSDOT parcels.

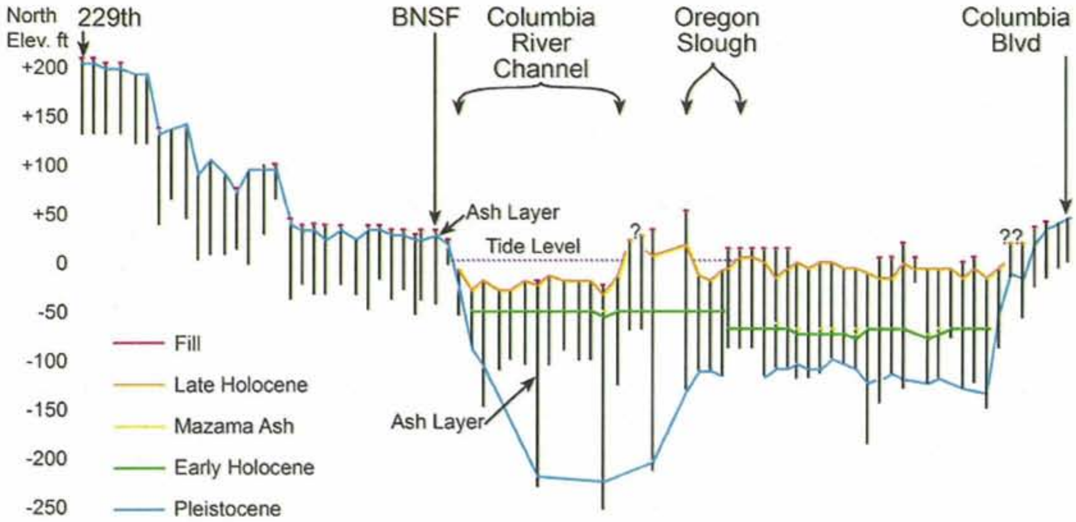
Third, the Pleistocene gravels, the geological baseline for the project, occur at significantly different depths below surface on either side of the Columbia River. As a means of documenting the depths of the target Pleistocene gravels, borehole logs recorded during previous geotechnical investigations drilled along the I-5 corridor were reviewed and compiled into a data base (Peterson 2007). A stratigraphic profile derived from this data base, extending north/south across the river valley, illustrates a significant difference in the near-surface geology on the two sides of the river (Exhibit 3-1). On the Washington shore, the Pleistocene gravels are relatively accessible, often within 1.2 to 1.5 m of the surface. In contrast, on the Oregon shore the Pleistocene gravels are deeply buried, generally in excess of 30 m below surface, beneath flood plain deposits. Obviously, the widely differing depths of the target Pleistocene gravels directly affects the strategies employed for identifying significant archaeological sites in the CRC APE.

3.4 Field Methods

3.4.1 Integrated Approach to Ground-Penetrating Radar and Archaeology

Experiments with various remote sensing methods have been conducted on the VNHR, but there has been little follow-through to assess the efficacy of these methods. The ground within the VNHR, a military reservation and national park, is less disturbed than in the WSDOT parcels. Remote sensing methods that might have some utility in the VNHR are unlikely to yield meaningful results in the WSDOT parcels. Considering the construction zone nature of the WSDOT rights-of-way along I-5, ground-penetrating radar (GPR) is the remote sensing method with the greatest potential for usefulness on the WSDOT parcels.

Exhibit 3-1. Stratigraphic Cross-section Showing the Varying Depths of the Pleistocene Gravels across the Lower Columbia River Valley



As proposed in *Archaeological Work Plan for Ground-Penetrating Radar (GPR) Exploration, Columbia River Crossing Project* (Minor and Peterson 2008), before any excavations were undertaken, GPR surveys were conducted as a means of obtaining an understanding of the near-surface geology on the WSDOT parcels. The GPR surveys were conducted in phases, with both 200 to 250 megahertz (MHz) and 500 MHz antennae employed. The results of the GPR surveys were "ground-truthed" during the follow-up discovery probing and evaluative testing by regular inspection and profiling of exposed walls in backhoe trenches and manual excavation units.

The results proved highly useful in establishing 1) the extent of introduced materials from cut-and-fill activities, 2) the depth to native soils, and 3) the depth to the target Pleistocene gravels on the Washington shore (the gravels on the Oregon shore are much too deep below surface to be reached by GPR). The profile method of GPR data presentation, in which GPR data are presented as vertical cross-sections, proved highly amenable to comparison with the stratigraphy exposed in the trenches and test units. (The alternative to the profile method, time-slice amplitude mapping which presents data in horizontal slices, would not have been useful for interpreting the mixed and disturbed stratigraphy encountered on the WSDOT parcels).

The GPR profile data are archived as raw data files, processed data files, and .jpg cross-section plot images. The locations of the ground-truth sites, as well as any anomalies found to correspond to cultural features, were located directly on the GPR profiles, with all information compiled in a Ground-Truth Profiles database (Excel spreadsheet). For this report, the GPR results have been summarized in a separate section integrated into the reports prepared for each area/site on WSDOT parcels on which archaeological investigations were conducted (Appendix 1C).

On the less disturbed VNHR lands investigated by NPS, both GPR and magnetometer surveys were conducted before any excavations for the CRC project were undertaken. The results of these studies are presented in consultant's reports included in the larger document prepared by NPS on investigations on the VNHR for the CRC project (Appendix 1D).

3.4.2 Adapting Field Methods to Field Conditions

In all areas within the ODOT and WSDOT rights-of-way where GPR surveys were conducted, the GPR data strongly suggested that the native soils, in which evidence of prehistoric and historic occupation might be found, are covered by fill material. The presence of deep fill deposits was repeatedly confirmed as the discovery investigations proceeded from one WSDOT parcel to another. The massive extent of cut-and-fill activities during past construction along I-5 and SR 14 gradually became apparent. The search beneath these fill deposits for native soils containing evidence of prehistoric and historic occupation, a search that routinely extended to the top of the underlying Pleistocene gravels, required a change in the anticipated approach to discovery probing.

It was originally assumed that discovery probing for archaeological deposits would follow a standard approach involving manual excavation of round (30-cm diameter) or square (50 x 50 cm) shovel probes placed at systematic intervals (e.g., 10-m apart) across each WSDOT parcel. This approach was successfully implemented, although not without difficulty, in the first parcel subjected to archaeological investigations (W17). In this parcel, however, the fill deposits were relatively shallow, and the Pleistocene gravels were close to the surface.

In the second parcel investigated (W9A), shovel probes (30-cm diameter) placed at 10-m intervals recovered historical artifacts as deep as 70-cm below surface (cmbs). However, the stratigraphic context of the artifacts remained uncertain because the small diameter of the probes precluded visual inspection of the sediments and the interval spacing hindered correlations in probes spaced so far apart. Historical artifacts were still being found at the maximum depths excavated in the probes (70 cm), and the top of the Pleistocene gravels had not been reached.

The stratigraphic context of the artifacts recovered in the probes became clear after excavation of a backhoe trench. The trench stratigraphy clearly showed that fill material containing historical artifacts extended to depths greater than the probes could reach. The historical artifacts recovered from the probes, then, occurred in fill material introduced onto the WSDOT property from elsewhere. The extent and depth of fill material across W9A was easily traced in the trench walls. The presence of historical materials in fill material was subsequently encountered on a regular basis during archaeological discovery probing on the other WSDOT parcels.

Below the fill material, near the bottom of the trench, a cultural feature was exposed consisting of black-stained sediments associated with a nineteenth century blacksmith shop at the U.S. Army Quartermaster's Depot. This feature would have been missed if discovery probing had been limited to shovel probe excavations. The backhoe trench excavation reached the top of the Pleistocene gravels, ensuring that the full time-depth represented in the sediments in W9A was tested for the presence of archaeological remains.

This sequence of discovery excavation methods, manual excavation of probes and/or test units followed by mechanical trenching with a backhoe, was repeated in the next three areas investigated (W9B, W5A, W5B). These investigations clearly demonstrated that limiting the discovery investigations to manual shovel probe excavations would have resulted in 1) misinterpretations of stratigraphy (e.g., in distinguishing fill and disturbed sediments from intact cultural deposits), and 2) failure to expose significant cultural features deeply buried beneath the surface. Mechanical trenching with a backhoe proved essential in establishing the presence or absence of archaeological remains in the construction zones along the I-5 corridor.

3.4.3 Implemented Field Methodology

Given the objective of extending the search for archaeological remains to the top of the target Pleistocene gravels, as well as the presence of substantial fill deposits along the I-5 corridor, mechanical excavations with a backhoe emerged as the most suitable method for archaeological discovery investigations in Washington. In the implemented field methodology, backhoe trenches were excavated first, with manual probes and test units excavated in follow-up investigations to more fully expose and document any cultural features encountered. In some areas the trenches were spaced at systematic intervals roughly 10-m apart (e.g., in W1, W8A, and W19A), but in most areas the trenches were placed opportunistically as best they could fit on the properties.

The backhoe trench excavations extended from the present-day ground surface into the top of the ca. 12,000-year-old Pleistocene gravels. In this manner, all evidence of cultural deposits and features, both prehistoric and historic, was exposed. The reliance on backhoe trench excavations during the discovery investigations is consistent with the feature-oriented nature of historical archaeology, the primary focus of the archaeological investigations on the Washington shore. The introduced fill covering the parcels is analogous to the layers of building debris that have to be removed before buried architectural and archaeological remains can be studied. Several extensive cut-and-fill episodes containing cultural debris were exposed in the trench excavations (e.g., in W5B and W19A) that could easily have been mistaken for intact cultural features if examined through the narrow aperture of a manual shovel probe or test unit.

The objective of extending the search for archaeological remains to the top of the Pleistocene gravels was successful in most of the WSDOT parcels. The Pleistocene gravels could not be reached in the south portion of W19A, where the gravels slope steeply downward toward the Columbia River. The gravels also could not be reached in W19C and W20, where the excavations extended across a former slough shown on early Sanborn maps that was later filled in to create new blocks for development in the City of Vancouver.

In some areas the trench excavations exposed very deep cut-and-fill episodes from previous highway construction that had removed the upper portion of the gravels. The most noteworthy example was in W5B, where an extensive cut-and-fill episode on the north side of SR 14 appears to have removed all evidence within the WSDOT right-of-way of the landscape feature known as the Pond.

The exposures provided in the backhoe trench walls proved crucial to understanding site formation processes, particularly in distinguishing different types of fill material (e.g., highway construction fill versus building rubble) from buried cultural strata. In discovery investigations under these conditions, recovery of individual artifacts found in undifferentiated deposits is not the primary concern. Instead, the focus is on the identification of intact artifact-bearing strata and cultural features that can yield meaningful information about the prehistoric and historic past.

3.5 Results of Investigations on the Oregon Shore

The objective of identifying any significant evidence of human activity or occupation within the CRC project's APE since 12,000 years BP is complicated by the considerable depth of the alluvial flood plain deposits on the Oregon shore. Previous borehole drilling has established that alluvial deposits measuring over 30 m in depth overlie the Pleistocene gravels in the project vicinity.

Historically, the flood plain in the project vicinity was subject to seasonal flooding by the Columbia River. Consequently, substantial fill material was imported when the interstate was constructed to raise the grade of I-5 above the surrounding flood plain. The first task undertaken in the archaeological investigations was to establish the thickness of the artificial fill that covers the margins of I-5 in the CRC APE. Accomplishing this task was necessary in order to determine which archaeological discovery methods might be applicable in the CRC APE.

The task of establishing the depth of the introduced fill in the CRC APE on the Oregon shore was first addressed by means of GPR surveys. Preliminary GPR field tests on the Oregon shore established the necessity of employing high-power/low-frequency GPR systems (Bristow and Jol 2003) to penetrate through artificial fill to the prehistoric flood plain soils. GPR surveys were undertaken in six separate areas, recorded in terms of 20 profile lines, over a total distance of slightly over 1600 m (Exhibit 3-2).

GPR profiling indicated the presence of artificial fill deposits extending to substantial depths in all areas where the GPR surveys were conducted. In view of this situation, it became clear that measures beyond the standard approaches to archaeological site discovery were necessary. Manual probe excavations, and even mechanical trenching, would not be able to reach the depths required to sample the native soils below the artificial fill deposits.

Probing for deeply buried archaeological remains on the Oregon shore was undertaken by means of rotary-sonic coring to recover continuous samples of sediments from the present ground surface down to the Pleistocene gravels. Following preparation of a *Proposed Work Plan for Geoarchaeological Discovery Probing on the Oregon Shore for the CRC Project* (Minor et al. 2009), a rotary-sonic core was employed to drill 14 boreholes for geoarchaeological purposes in the CRC APE on the Oregon shore (Exhibit 3.2).

The value of deep coring lies primarily in the information it can provide about 1) the evolution over time of the landscape inhabited by prehistoric Native Americans on the Oregon shore, and 2) the *potential* for archaeological evidence of human occupation to be found. Due to the small (10-cm) diameter of the instrument, rotary-sonic drilling has only a small chance of encountering direct evidence (e.g., stone artifacts, cultural features) of prehistoric Native American occupation.

The rotary sonic boreholes were drilled in incremental sections (referred to as "runs") of 5 to 20 feet. After each run, an approximately 4-inch-diameter continuous core was extruded (in 2.5 to 10-foot intervals) into plastic bags and secured in wooden core boxes. Following completion of the geoarchaeological drilling, two additional rotary-sonic boreholes drilled as part of the geotechnical investigations (TB-5 and TB-7) were subjected to the same field and laboratory procedures.

Core sections from twelve of the geoarchaeological boreholes (two boreholes underwent partial collapse due to driller's error and were abandoned) and the two geotechnical boreholes were processed and analyzed under controlled laboratory conditions. Each of the 550 sections containing Holocene alluvium was split lengthwise; one half was examined and sub-sampled for geoarchaeological analyses, while the other half was subjected to archaeological analysis involving screening for cultural materials through 1/8-inch mesh.

No evidence of prehistoric Native American activity was found in either the archaeological samples examined through rigorous screening or in the samples subjected to close inspection during geoarchaeological analyses.

Exhibit 3-2. Map of GPR Survey Areas and Geoarchaeological Borehole Locations on the Oregon Shore

Each geoarchaeological core split was photographed, described with regard to lithology, grain size (sand and gravel), moist color, and presence/absence and type of organics, and sub-sampled for organics and tephra, if present. Core splits from selected boreholes (BH-1 through 3, 6, 7, and 8D) were also sub-sampled for microfossils (pollen), dry bulk density, and sand-fraction mineralogy.

The rotary-sonic coring served to "ground-truth" the findings of the earlier GPR surveys, confirming the presence of deep fill on the ODOT parcels. Fill deposits in the CRC APE range from 1.9 m (6.2 ft) to 5.8 m (19.0 m) deep. The depth to the Pleistocene gravels ranged from 60.6 m (198.8 ft) in the borehole on Hayden Island, to 36.2 m (118.8 ft), 34.7 m (113.9 ft), and 33.9 m (111.3 ft) in boreholes just south of Oregon Slough, to 40.0 m (132.6 ft) and 34.6 m (113.5 ft) in boreholes just north of Victory Boulevard.

Volcanic tephra deposits, ranging from one to as many as three layers from separate volcanic eruptions, were observed in the boreholes. The most common tephra represented is from the climactic eruption of Mount Mazama at present-day Crater Lake with a calendrical age of 7,627 cal BP (Zdanowicz et al. 1999; Bacon and Lanphere 2006). Identification of this tephra as originating from Mount Mazama was confirmed by microprobe analysis conducted at Washington State University (Foit 2010). Based on depth below surface and radiocarbon dating, other tephra layers represented appear to correlate with Mount St. Helens Set W deposited around 500 BP, and Mount St. Helens Set Y deposited between 3,900 and 3,300 BP (Mullineaux 1996).

Materials recovered from the borehole samples submitted to Beta Analytic for radiocarbon analysis have returned a suite of ten radiocarbon dates (reported here as 2 sigma values). The earliest radiocarbon date of 10,740-11,190 cal BP (2 sigma) was obtained from a depth of 55.6 m (182.5 ft) below surface in BH-1. The depositional period of the Mazama ash is well constrained in BH-3 by radiocarbon dates of 6,900-7,170 cal BP from 18.6 m (61.1 ft) and 7,700-7,940 cal BP from 23.3 m (76.4 ft) below surface. Other early radiocarbon dates include 8,590-8,980 cal BP from a depth of 32.4 m (106.3 ft) in BH-3, and 8,600-9,000 cal BP from a depth of 31.7 m (104.0 ft) in TB-7. The radiocarbon dates from the boreholes are currently being correlated with the volcanic tephra deposits to develop a tephrachronology for the Oregon shore.

The encountering of tephra layers on the Oregon shore is significant, as it indicates the preservation of flood plain muds in some areas that have not been disturbed by erosive channel migrations over at least the last 7,000 years, and possibly over an even longer time span extending back to perhaps 9,000 to 11,000 years BP. This situation raises the likelihood that intact archaeological deposits associated with Native American activity are preserved within the flood plain muds on the south shore of the Columbia River.

3.6 Results of Investigations on the Washington Shore

The CRC APE on the Washington shore is divided by roadways associated with the I-5/SR 14 interchange into a number of small parcels. For ease in identification, an alpha-numeric system was developed, with the areas designated “W1” through “W24” (Exhibit 3-3 and Exhibit 3-4). The bulk of these areas are WSDOT-owned lands. A number of additional non-WSDOT parcels (e.g., City of Vancouver, U.S. Army, National Park Service, and private properties) were initially included in this designation system. Some of these areas were not subjected to archaeological investigations either because they were no longer identified as affected parcels or because landowners declined access. The designations for areas within the VNHR were later changed to VNHR Area #1 through VNHR Area # 5, where investigations were conducted by NPS archaeologists.

An area summary of the archaeological investigations conducted to date for the CRC project is presented in Exhibit 3-5. A breakdown of the specific field methods employed (e.g., manual excavations of probes and/or test units, mechanical trenching), the number of cultural features recorded (if present), and number of artifacts recovered during the archaeological investigations for the CRC project is presented in Exhibit 3-6.

3.6.1 Site Nomenclature

The way in which archaeological sites were defined and designated years ago differs from how they are recorded today. This difference is highlighted, in particular, in the designation and management of archaeological resources in the CRC APE on the Washington shore, on the east side of I-5.

Archaeological research on the Washington shore in the CRC project area began with excavations at the site of HBC Fort Vancouver from 1947 to 1952 (Caywood 1955). Initial excavations in Kanaka Village were undertaken in 1968 and 1969 (Kardas 1971). In 1974 and 1975 extensive excavations were undertaken in advance of the reconstruction of the intersection of I-5 and SR 14 (Chance and Chance 1976; Chance et al. 1982; Carley 1982).

It was during these latter investigations in the late 1970s, that site numbers were first assigned to archaeological properties. The sites recorded at that time include 1) the HBC - USA Trash Dump Site, better known as the Pond (45CL47); 2) Vancouver Barracks (45CL162H), 3) Fort Vancouver National Historic Site (45CL163H); 4) Old Apple Tree (45CL164H); and 5) Kanaka Village (45CL300H). These sites are now within the VNHR created in 1996 (Owens et al. 2007).

Although recorded as *archaeological sites*, these designations actually referred more to historical sites (e.g., Fort Vancouver National Historic Site, Vancouver Barracks) and historical landscape features (Pond, Old Apple Tree) rather than to specific archaeological deposits. To a considerable degree, HBC Fort Vancouver, Kanaka Village, and Vancouver Barracks occupied the same landscape and, not surprisingly, these "historical sites" exhibit a considerable degree of spatial overlap. At the time these sites were recorded, defining archaeological site boundaries was not a high priority, and little or no information was provided about site extents and boundaries on the original site record forms.

Today, the recording of any archaeological site begins with identification of its location and extent, which includes the delineation of the horizontal and vertical boundaries of the archaeological deposits. This basic information is required for effective management of archaeological sites by property owners. One of the primary objectives of the discovery and evaluation phases of archaeological fieldwork undertaken for the CRC project was the identification of any archaeological sites, including delineation of the horizontal and vertical extent of any archaeological deposits, present in the CRC APE.

The HERITAGE team of archaeologists conducted investigations in 18 separate areas on the Washington shore. Sufficient archaeological remains were found to warrant the formal recording of archaeological sites with DAHP in 17 of these areas (all except W24). The 17 archaeological sites recorded by HERITAGE (45CL910 to 45CL926) all refer to archaeological deposits on WSDOT lands.

Six archaeological sites recorded in the WSDOT parcels east of the I-5 right-of-way overlap with the boundaries of 45CL300 as proposed in 1980 (Exhibit 3-7). As originally assigned in the late 1970s, this site number referred to a relatively small area east of I-5 and north of SR 14 known as Kanaka Village, described as "an historic village; housing for majority of Hudson's Bay Co employees at Fort Vancouver" (Anonymous n. d.). In a Determination of Eligibility (DOE) document for "Fort Vancouver - Kanaka Village" prepared in 1980 in conjunction with proposed improvements to the I-5/SR 14 interchange, the area of 45CL300 was greatly expanded to include lands administered by NPS, the U.S. Army, and WSDOT to be affected by this project (Smith 1980).

It appears that all lands east of I-5 that potentially contained archaeological resources and that faced a potential effect by the WSDOT project were grouped into a single site designation comprising over 50 acres, most likely to simplify the processing of compliance paperwork. The boundaries of 45CL300 were based on land ownership within an anticipated construction impact area rather than any delineation of the extent of archaeological deposits by means of archaeological fieldwork. The expanded boundaries of 45CL300 overlap with those of the Fort Vancouver National Historic Site (45CL163H) and completely envelop the Pond (45CL47). The designation 45CL300 continues to be used by NPS today. Encompassed under this designation are archaeological resources ranging in age from prehistoric to historic, with significant historical archaeological remains from HBC Fort Vancouver, Kanaka Village, the U.S. Army Quartermaster's Depot, and later U.S. Army activities through the Spanish-American War, World War I, and World War II eras.

In a similar way, the current recording of archaeological sites on WSDOT property, noted above, was undertaken for a specific purpose, namely for the management of archaeological sites that may be affected by construction of the CRC project. The site designations obtained from DAHP refer to specific archaeological deposits on WSDOT property. The strict definition of these sites is intended to allow for directed management, and if needed, mitigation, to maintain compliance with the NHPA Section 106 process for the CRC project.

The approach implemented for WSDOT facilitates the treatment and management of each recorded archaeological site. At the time of the field investigations, the CRC project's effects on the WSDOT parcels were not yet known. The approach implemented avoids the messiness of having the same site number applied to archaeological deposits and features in different WSDOT parcels that will be differentially affected by the CRC project (see discussion of site 45CL300 above).

Although there is some slight overlap with the *administrative* boundaries of 45CL300, the recording of the archaeological deposits on WSDOT property as separate archaeological sites is consistent with the precedent set by the previous inclusion of portions of multiple sites with overlapping boundaries under the designation 45CL300 (as well as the overlapping of the boundaries of other archaeological sites within the VNHR). The recognition of the archaeological sites on WSDOT property with individual DAHP site numbers brings clarity to the management obligations of the agency owner and underscores the State of Washington's responsibility for managing these cultural resources.

Exhibit 3-3. Areas Investigated in Southern Portion of CRC APE on the Washington Shore

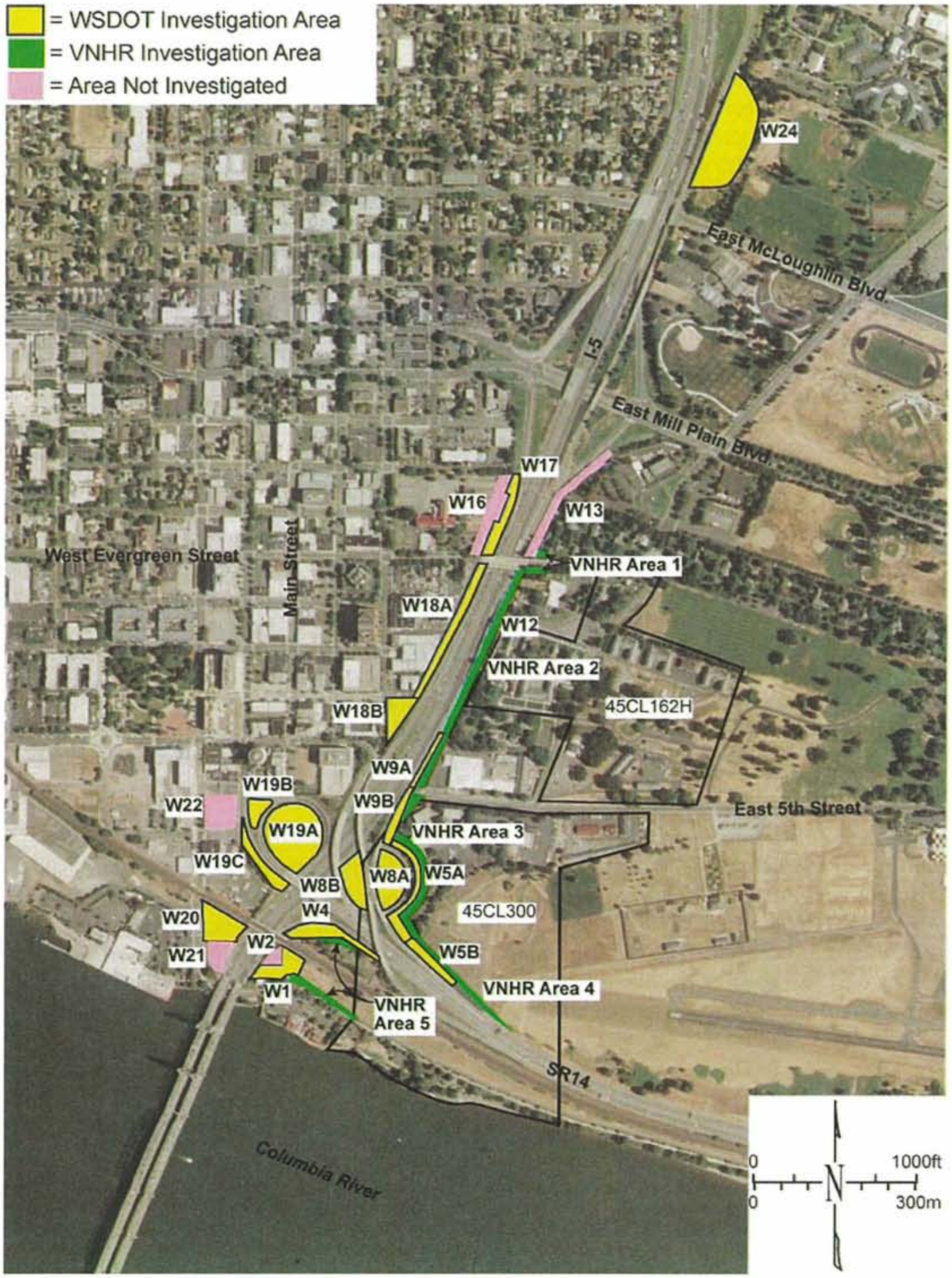


Exhibit 3-4. Areas Investigated in Northern Portion of CRC APE on the Washington Shore

Exhibit 3-5. Summary of Archaeological Investigations by Area on the Washington Shore

Area Designation	Site Number[a]	Archaeological Investigator	Significant Archaeology	Comments
W1	45CL910	HERITAGE Appendix 1C	Yes	Only eastern portion tested; western portion not accessible
W2		None		No access–BNSF/City of Vancouver property
VNHR 5	45CL163H[b]	NPS Appendix 1D	Yes	Formerly W3
W4	45CL911	HERITAGE Appendix 1C	No	
W5A	45CL912	HERITAGE Appendix 1C	No	
W5B	45CL913	HERITAGE Appendix 1C	No	
VNHR 4	45CL300[b]	NPS Appendix 1D	Yes	Formerly W6
VNHR 3	45CL300[b]	NPS Appendix 1D	Yes	Formerly W7
W8A	45CL914	HERITAGE Appendix 1C	Yes	
W8B	45CL915	HERITAGE Appendix 1C	Undetermined	Covered by deep fill for SR 14 on & off ramps
W9A	45CL916	HERITAGE Appendix 1C	No	
W9B	45CL917	HERITAGE Appendix 1C	Yes	
VNHR 2	45CL162H[b]	NPS Appendix 1D	Yes	Formerly W10, W11, W12
W13			Undetermined	Fieldwork pending; within former Post Cemetery
VNHR 1	45CL160H[b]	NPS Appendix 1D	Yes	Formerly W14
W15		None		PUD property
W16		None		Academy property
W17	45CL918	HERITAGE Appendix 1C	No	
W18A	45CL919	HERITAGE Appendix 1C	No	
W18B	45CL920	HERITAGE Appendix 1C	Yes	
W19A	45CL921	HERITAGE Appendix 1C	Yes	
W19B	45CL922	HERITAGE Appendix 1C	Yes	
W19C	45CL923	HERITAGE Appendix 1C	No	
W20	45CL924	HERITAGE Appendix 1C	Yes	
W21		None		No access–Red Lion property
W22		None		No access–private parcel
W23A	45CL925	HERITAGE Appendix 1C	No	
W23B	45CL926	HERITAGE Appendix 1C	Yes	
W24		HERITAGE Appendix 1C	No	No archaeological remains found

a Site number is a trinomial in which 45 refers to Washington, CL refers to Clark County, and the final three digits are assigned according to the order in which archaeological sites are recorded by DAHP.

b Correlation of VNHR Areas with previously recorded archaeological sites suggested by the National Park Service (O'Rourke et al. 2010:286-287).

Exhibit 3-6. Summary of Archaeological Investigations for the CRC Project on the Washington Shore

CRC Area	Site Number	Mechanical Trenches (No./Total Length)	Probes[a]	Test Units[b]	Cultural Features	Artifacts
HERITAGE Investigations						
W1	45CL910	3 / 80.5 m		1	1	403
W4	45CL911	2 / 128.0 m	7			17
W5A	45CL912	17 / 132.3 m	6		5	153
W5B	45CL913	5 / 118.5 m	1	13		1,322
W8A	45CL914	12 / 41.9 m		2	2	217
W8B	45CL915	1 / 42.0 m				30
W9A	45CL916	1 / 58.0 m	11	14	1	502
W9B	45CL917	1 / 82.0 m	11	6	11	933
W17	45CL918	(None)	40		2	1,850
W18A	45CL919	1 / 77.0 m	14			23
W18B	45CL920	11 / 201.7 m		5	18	3,212
W19A	45CL921	12 / 666.1 m		4	17	2,377
W19B	45CL922	3 / 103.0 m		4	3	2,336
W19C	45CL923	5 / 44.1 m				72
W20	45CL924	5 / 102.0 m	3		1	12
W23A	45CL925	4 / 85.0 m			1	7
W23B	45CL926	3 / 44.0 m			2	1,178
W24	no site	10 / 247.4 m				0
Subtotals:		96 / 2,253.5 m	**93**	**49**	**64**	14,644
NPS Investigations						
VNHR 1	45CL160H	(None)	5	5	1	1,457
VNHR 2	45CL162H	19 / 43.1 m	11	1		2,467
VNHR 3	45CL300	39 / 257.4 m		22	23	8,778
VNHR 4	45CL300	(None)	5	11	3	10,285
VNHR 5	45CL163H	21 / 58.4 m	4	13	9	11,027
Subtotals:		79 / 358.9 m	25	52	36	34,014
Grand Totals:		**175 / 2,612.4 m**	**118**	**101**	**100**	**48,658**

a The term "Probe" encompasses auger holes (25-cm diameter), round probes (30-cm diameter), and shovel probes (50 × 50 cm).

b "Test Units" generally measure 1 × 1 m.

Exhibit 3-7. Concordance of Sites Recorded in WSDOT Parcels on East Side of I-5/SR 14 Interchange with Previously Recorded Sites in VNHR

WSDOT Parcels	CRC Recorded Site	Previously Recorded Site Number	Comments
W1	45CL910	None	45CL910 is a newly-recorded site on WSDOT property
W4	45CL911	45CL300 (partial)	45CL911 is a newly-recorded site on WSDOT property; the western line of the administrative boundary of 45CL300 cuts through this site
W5A	45CL912	45CL300	45CL912 extends along the narrow strip of WSDOT property bordering the I-5 exit ramp to downtown Vancouver; it is adjacent on the west to U.S. Army property within the administrative boundaries of 45CL300
W5B	45CL913	45CL300 & 45CL47	45CL913 extends across WSDOT property on the north side of SR 14 within the administrative boundaries of 45CL300; no evidence of the Pond (45CL47) was found on WSDOT property
W8A	45CL914	45CL300	45CL914 is on WSDOT property within the eastern half of the circle of the I-5 exit ramp to downtown Vancouver within the administrative boundaries of 45CL300
W8B	45CL915	45CL300 (partial)	45CL915 is on WSDOT property in the western half of the circle of the I-5 exit ramp to downtown Vancouver; the western line of the administrative boundary of 45CL300 cuts through this site
W9A	45CL916	None	45CL916 is a newly recorded site, in the narrow strip of WSDOT property adjacent on the west to the FHWA property
W9B	45CL917	45CL300	45CL917 is in the narrow strip of WSDOT property adjacent on the west site of the U.S. Army property within the administrative boundaries of 45CL300

3.6.2 Prehistoric Archaeology

A relatively small number of stone artifacts, characteristically associated with Native Americans, were recovered by both the HERITAGE and NPS archaeologists. The finding of these materials is consistent with the recovery of stone tools and debitage during previous archaeological investigations in the former area of Kanaka Village at Fort Vancouver.

In the reports on previous investigations, stone artifacts are regularly assumed to represent evidence of activity in the prehistoric period. This has been the case even when these materials 1) are not temporally diagnostic and 2) even when they are found in the same excavation levels and strata with items of Euroamerican manufacture associated with Native Americans visiting or residing in Kanaka Village in the historic period.

Distinguishing evidence of prehistoric activity from activity by Native Americans in the historic period is made difficult by the sedimentary context in which archaeological remains occur along the Washington shore. In comparison to the Oregon shore, relatively little deposition of sediment has occurred on the Washington shore during the Holocene. As a result, stone artifacts that are potentially prehistoric in age more often than not occur in the same shallow sediments as historic period materials.

For the purpose of this report, the stone artifacts found during the investigations for the CRC project are discussed here under prehistoric archaeology. This treatment is consistent with evidence that there was, in fact, some earlier use during the prehistoric period of the area along the north shore that was later the setting of Kanaka Village. As shown below, however, the contexts in which most of the stone tools and debitage were found, points to the conclusion that most of these artifacts reflect manufacture and use after the time of historic contact by the inhabitants of Kanaka Village.

3.6.2.1 Previous Findings of Stone Artifacts

Although a "Prehistoric/Contact-Period Native American Character Area" was included in the Vancouver National Historic Reserve Historic District nomination (Owens et al. 2007), no prehistoric archaeological sites have been formally recorded on the Washington shore within the CRC APE. However, one underwater archaeological site identified as prehistoric in age by its recorder has been recorded offshore in the Columbia River. This site may extend into the CRC APE. The Benoit Site (45CL401) is an artifact scatter situated 15 feet offshore on a shelf in the river, resting 18 to 22 feet below the surface (Stenger 1988b). Stone artifacts, characteristically associated with Native Americans, observed at this site include net sinkers and net weights, pre-forms, and lightly worked cobbles. A resurvey of the shoreline in 2007 concluded that the area in which the stone artifacts were observed is part of a "large, mixed, component site," characterized primarily by artifacts representing the secondary discard of materials by the HBC and U.S. Army Quartermaster's Department (Marcotte and Wilson 2007:19). Although this site has not been formally evaluated, the preponderance of HBC- and U.S. Army-related artifacts suggests that the cultural materials at this underwater location likely contribute to the significance of the VNHR District.

Although no prehistoric archaeological sites have been formally recorded on the north shore of the Columbia River within the CRC APE, investigations over the years have recovered stone tools in contexts that seem to indicate evidence of prehistoric activity in the area of the future site of HBC Fort Vancouver, Kanaka Village, and the U.S. Army's Vancouver Barracks. Most of this evidence has been found in the Riverside and Pond Areas (sometimes known as the HBC Riverside Complex), (Chance and Chance 1976:28, 43, 246-247), and in the strip of ground between SR 14 and the railroad berm (Carley 1982:251). However, with the possible exception of the lower deposits in the Pond, and the recovery of 11 stone items below historical materials in a single 50- by 50-centimeter probe excavated for the Land Bridge project (Wilson 2005:27, 29), the stone tools thought to represent prehistoric occupation have not been found in clearly defined strata in which historical artifacts are absent.

The most compelling evidence of prehistoric occupation has been found in the form of broad-necked projectile points. Of the 40 points illustrated in earlier reports, that are classifiable to some degree, approximately 50 percent appear to be large broad-necked points (some may have served as hafted knives) associated with the atlatl and dart weapon system, which in the Portland Basin was predominant from approximately 600 BC to AD 200 (Pettigrew 1981). The largest numbers of broad-necked points were found in the area between SR 14 and the river bank (Chance and Chance 1976:246-247; Carley 1982:261, Figure 135). The recovery of broad-necked projectile points strongly points to occupation of this area in prehistoric times.

The remaining 50 percent of the projectile points reported are narrow-necked specimens used with the bow and arrow. These points have also been found in the area between SR 14 and the river bank, as well as elsewhere on the Washington shore. Narrow-necked points were made over at least the last 1,500 years (Pettigrew 1981). In view of this long time span, most of the narrow-necked points found probably represent additional evidence of prehistoric (rather than post-contact) activity in the area. These points continued to be made into the historic period, and some specimens may have been introduced by Native Americans after the establishment of Fort Vancouver and Kanaka Village.

By all accounts, the great majority of stone artifacts found along the north shore of the Columbia River have been recovered in association with items of Euroamerican manufacture introduced after historic contact. In some cases, stone artifacts were found in direct association with historical materials (e.g., on the floors of houses in Kanaka Village), and thus were associated with Native Americans who settled near the HBC stockade (Kardas 1971; Thomas and Hibbs 1984). In other cases, stone artifacts found outside the known distribution of Kanaka Village houses have been interpreted as associated with temporary encampments occupied by Native Americans visiting HBC Fort Vancouver (Thomas 1992:4).

3.6.2.2 CRC Findings of Stone Artifacts

Nineteen stone items indicative of Native American activity were recovered from WSDOT parcels in the CRC APE (Exhibit 3-8). Three of these items are tools, including one tip fragment from a chert biface that might have served as a projectile point, one chert scraper edge fragment, and one chert uniface,. The remaining 16 specimens are debitage, of which 14 are chert and 2 are basalt.

Exhibit 3-8. Stone Tools and Debitage from WSDOT Sites and VNHR Areas

CRC Area	Site Number/ Location	Unit	Level[a]	Stratum[b]	Artifact Description
HERITAGE Investigations					
W5A	45CL912	SP4	9	A horizon	chert biface tip (proj. point?) (n=1)
W5B	45CL913	TU-A	5	Bw horizon	chert flake fragments (n=2)
	45CL913	TU-B	1	Mixed fill	chert uniface (n=1)
	45CL913	TU-C	5	Bw horizon	chert flake fragment (n=1)
	45CL913	TU-F	3	A horizon	basalt primary cortex flake (n=1)
	45CL913	TU-G	1	A horizon	chert flake fragments (n=2)
	45CL913	TU-K	7	Mixed fill	chert heat spall fragment (n=1)
W9A	45CL916	RP4	1	Fill (Stratum 1)	chert scraper edge fragment (n=1)
W9B	45CL917	SP2	6	Fill	chert broken flake (n=1)
	45CL917	SP2	7	Fill/Bw horizon	chert angular debris (n=1)
	45CL917	SP4	4	Fill	basalt flake fragment (n=1)
	45CL917	SP4	6	Fill	chert flake fragment (n=1)
	45CL917	SP5	5	Fill	chert primary cortex flake (n=1)
	45CL917	SP5	5	Fill	chert complete flake (n=1)
	45CL917	SP5	5	Fill	chert angular debris (n=1)
	45CL917	SP5	5	Fill	chert split nodule (n=1)
	45CL917	RP12	7	Fill	chert flake fragment (n=1)
Subtotals:					3 tools, 16 pieces debitage
NPS Investigations					
VNHR #1		TU1-01	2	IIc	Flake shatter (n=1)
VNHR #3	ca. 1840 Tayenta's House	TU3-02	3	III	Flake shatter (n=1)
	ca. 1840 Tayenta's House	TU3-03	4, 5, 6	IIa	Flake tool (n=1)
		TU3-04	2	IIa	Flake tool (n=1)
	ca. 1840 Tayenta's House	TU3-06	2	IIa/III	Core (n=1)

CRC Area	Site Number/ Location	Unit	Level[a]	Stratum[b]	Artifact Description
	ca. 1840 Tayenta's House	TU3-06	3	III/IV	Flake tool (n=1)
	ca. 1840 Tayenta's House	TU3-06	3	III/IV	Angular shatter (n=1)
	ca. 1840 Tayenta's House	TU3-06	3	III/IV	Flakes (n=2)
	ca. 1840 Tayenta's House	TU3-08	4	III	Angular shatter (n=1)
	ca. 1840 Kanaka House	TU3-12	5	IIa	Flake (n=1)
	ca. 1840 Kanaka House	TU3-14	2	IIc	Core (n=1)
		TU3-17	4	IIc	Flake (n=1)
	ca. 1859 Quartermaster's Stable Building	TU3-19	6, 7	IIc	Flake tool (n=1)
	ca. 1859 Quartermaster's Stable Building	TU3-20	5	IIc	Flake tool (n=1)
	ca. 1892 U.S. Army Stable Building	Trench 3-39b	1	N/A	Angular shatter (n=1)
VNHR #4	HBC Pond	ST4-04	9	IIc	Flake tool (n=1)
	HBC Pond	ST4-04	9	IIc	Flake shatter (n=1)
	ca. 1840 House 4B	TU4-01	3	IIc//III	Flake tool (n=1)
	ca. 1840 House 4B	TU4-01	4	III	Flake tool (n=1)
	ca. 1840 House 4B	TU4-02	2	III	Biface tool (n=1)
	ca. 1840 House 4B	TU4-02	2	III	Angular shatter (n=4)
	ca. 1840 House 4B	TU4-02	2	III	Flake shatter (n=1)
	ca. 1840 House 4B	TU4-02	3	III	Flaked tool fragment (n=1)
	ca. 1840 House 4B	TU4-02	3	III	Flake shatter (n=1)
	ca. 1840 House 4B	TU4-02	3	III	Flake (n=2)
	ca. 1840 House 4B	TU4-02	4	III	Flake (n=1)
	ca. 1840 House 4B	TU4-03	3	III	Projectile point (n=1)
	ca. 1840 House 4B	TU4-03	3	III	Flake (n=1)
	ca. 1840 House 4B	TU4-03	4	III	Flake shatter (n=1)
	ca. 1840 House 4B	TU4-03	5	III	Angular shatter (n=1)
	ca. 1840 House 4B	TU4-04	4	IIa/III	Flakes (n=2)
	ca. 1840 House 4B	TU4-04	5	IIa/III	Flakes (n=7)
	ca. 1840 House 4B	TU4-04	5	IIa/III	Angular shatter (n=2)
	ca. 1840 House 4B	TU4-04	5	IIa/III	Flake shatter (n=1)
		TU4-05	2	IIc	Flake tool (n=1)
		TU4-05	2	IIc	Angular shatter (n=1)
		TU4-06	3	IIa/IV	Angular shatter (n=1)
		TU4-06	3	IIa/IV	Flake shatter (n=2)
		TU4-06	3	IIa/IV	Flake (n=1)
		TU4-06	4	III/IV	Cobble tool (n=1)
		TU4-08	1	I/IIc	Flake tool (n=1)
		TU4-08	4	IIa	Flake shatter (n=1)
		TU4-08	4	IIc	Flake (n=1)
		TU4-08	5	III	Flakes (n=2)
		TU4-08	6	III	Flake tool (n=1)

CRC Area	Site Number/ Location	Unit	Level[a]	Stratum[b]	Artifact Description
	ca. 1840 House 4B	TU4-10	2	IIb/III	Flake (n=1)
	ca. 1840 House 4B	TU4-10	4	III	Flake tools (n=2)
	ca. 1840 House 4B	TU4-10	4	III	Projectile point (n=1)
	ca. 1840 House 4B	TU4-10	4	III	Flakes (n=2)
	ca. 1840 House 4B	TU4-10	5	III	Angular shatter (n=1)
	ca. 1840 House 4B	TU4-10	6	III/IV	Flake (n=1)
	ca. 1840 House 4B	TU4-11	3	IIc	Flakes (n=2)
VNHR #5		TU5-02	2	IIc	Core tool (n=1)
		TU5-02	3	IIc	Flake (n=1)
		TU5-02	3	IIc	Flake shatter (n=1)
		TU5-03	3	IIc	Flake shatter (n=1)
		TU5-03	5	IIc	Flake (n=1)
		TU5-03	7	IIc	Flake (n=1)
		TU5-05	2	III	Angular shatter (n=1)
		TU5-06	2	III	Projectile point (n=1)
		TU5-06	4	IV	Flake shatter (n=1)
		TU5-07	2	IIb	Flake (n=1)
		TU5-07	2	IIb	Flake shatter (n=1)
		TU5-07	3	IIb/IV	Flake shatter (n=1)
		TU5-08	2	III	Flake (n=1)
		TU5-08	3	III/IV	Core (n=1)
		TU5-08	3	III/IV	Flake shatter (n=1)
		TU5-08	3	III/IV	Flake (n=1)
	1859 U.S. Army Building	TU5-09	3	IIa	Flakes (n=2)
	1859 U.S. Army Building	TU5-09	3	IIa	Flake shatter (n=1)
	1859 U.S. Army Building	TU5-09	3	IIc	Flake shatter (n=1)
	1859 U.S. Army Building	TU5-09	6	IIa	Biface (n=1)
	1859 U.S. Army Building	TU5-09	6	IIa	Flakes (n=5)
	1859 U.S. Army Building	TU5-09	6	IIa	Flake shatter (n=3)
	1859 U.S. Army Building	TU5-09	7	IIa	Flake shatter (n=1)
	1859 U.S. Army Building	TU5-09	11	IIa	Flakes (n=2)
	1859 U.S. Army Building	TU5-09	11	IIa	Flake shatter (n=1)
	1859 U.S. Army Building	TU5-10	6	III	Projectile point (n=1)
	1859 U.S. Army Building	TU5-10	6	III	Angular shatter (n=1)
	1859 U.S. Army Building	TU5-11	6	IIa	Core (n=1)
	ca. 1874 Vancouver House Hotel	TU5-12	2	IIc	Angular shatter (n=1)
Subtotals:					22 tools, 81 pieces debitage, 4 cores
Grand Totals:					**25 tools, 97 pieces debitage, 4 cores**

a Levels are in 10-cm increments below surface

b Key to NPS Strata: I = Sod IIa = 19th Century fill IIb = 20th Century fill IIc = Mixed/undifferentiated fill III = Intact U.S. Army or HBC deposits IV = B Horizon V = C Horizon

These stone items were recovered from four different WSDOT sites. Seventeen of the 19 items were found in only two sites, 45CL913 (n=8) and 45CL917 (n=9). Site 45CL913 falls within the former area of Kanaka Village, while 45CL917 is situated slightly to the west and north of the known location of Kanaka Village. Single specimens recovered from 45CL912 (the chert biface/projectile point tip) and 45CL916 (the chert scraper fragment) may have been associated with Native American activity around the village periphery.

In terms of specific contexts, all 19 stone artifacts recovered from the WSDOT sites were found in the same 10-centimeter excavation levels as historical materials. Consequently, all the stone tools and debitage found in the WSDOT sites were recovered from contexts suggesting association with Native American activity in the historic period.

Another 22 stone tools, 81 pieces of debitage, and 4 cores were recovered from VNHR Areas #1, #3, #4 and #5 (Exhibit 3-8). The 22 tools include 4 projectile points, one biface, one biface tool, 14 flake tools, one cobble tool, and one core tool. VNHR Area #4 (n=54) contained the highest number of stone items, followed by VNHR Area #5 (n=37), VNHR Area #3 (n=15), and VNHR Area #1 (n=1). Fire-cracked rock (n=206) was reported to be similarly distributed (Appendix 1D).

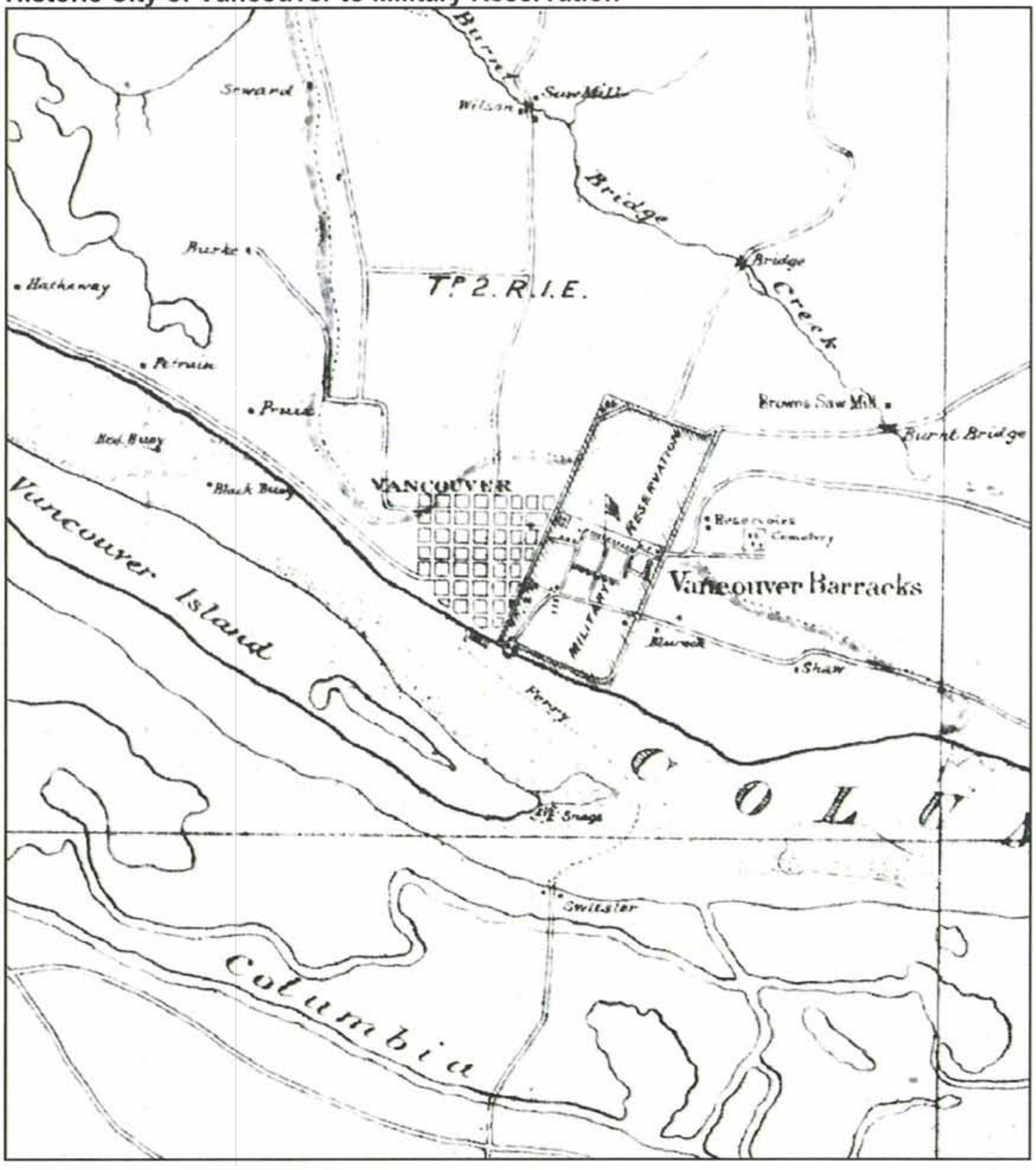
In terms of specific contexts in which stone artifacts were found in the VNHR areas, 43 are from fill deposits (IIa, IIb, IIc), 32 are from intact HBC or U.S. Army deposits (III), 21 are from deposits mixed with intact HBC or U.S. Army deposits (IIa/III, III/IV), 4 are from intact HBC or U.S. Army deposits mixed with B horizon (III/IV), 5 are from fill mixed with B horizon (IIa/IV, IIb/IV), one is from B horizon, and one is identified as N/A. Although the recovery of much of the debitage from fill deposits obscures any strong patterning, the distribution by stratigraphic units appears consistent with the results of previous investigations in indicating, that most of the stone tools recovered in the VNHR areas were found in association with historical materials.

Native Americans clearly were present in the CRC APE on the Washington shore over a long span of time, as indicated by the temporally-diagnostic projectile points recovered during previous investigations. To date, however, stone artifacts that very well may date to the prehistoric period have almost all been found along with items of Euroamerican manufacture introduced after historic contact. The data on the distribution of stone tools and debitage in the VNHR areas and the WSDOT parcels are generally complementary and follow the previously established pattern of concentration in the former area of Kanaka Village and vicinity. Although no prehistoric sites have been formally recorded on the Washington shore, the evidence clearly indicates the potential for prehistoric archaeological remains to be encountered, on land and in the river, during construction of the CRC project.

3.6.3 Historical Archaeology

The overwhelming majority of the archaeological evidence collected during the investigations for the CRC project on the Washington shore relates to activity and/or occupation in the historic period. This evidence includes archaeological remains that span more or less the entire history of this area, beginning with activity in and around Kanaka Village at HBC Fort Vancouver, and continuing with occupation by military personnel at the U.S. Army's Vancouver Barracks and by the civilian population in the Historic City of Vancouver (Exhibit 3-9).The alignment of I-5 extends across lands formerly within the City of Vancouver and U.S. Army Military Reservation. Archaeological remains associated with HBC Kanaka Village, the U.S. Army, and civilians in the Historic City of Vancouver all may potentially be encountered in the CRC APE. In practical terms, I-5 now serves as a boundary between the VNHR on the east and the City of Vancouver on the west. The archaeological and historical resources on the VNHR have been the subject of innumerable studies, culminating in placement of the VNHR Historic District on the National Register of Historic Places in 2007 (Owens et al. 2007).

Exhibit 3-9. Portion of Goethals' "A Map of the Country in the Vicinity of Vancouver Barracks, Washington Territory" (1883) showing relationship of Historic City of Vancouver to Military Reservation



In comparison, relatively few archaeological studies have been undertaken in, and relatively little has been written about, the Historic City of Vancouver, which can be defined as encompassing the core blocks in which the earliest settlement and development occurred. Settlement and development began on the bank of the Columbia River and generally spread northward along Main Street and the adjacent streets to the east (Broadway) and west (Washington and Columbia). For the purposes of the CRC project, the boundaries of the Historic City of Vancouver extend

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north from the Columbia River to 19th Street, and from West Reserve Street on the east to the Union Pacific Railroad tracks and depot on the west.

Historic City of Vancouver is an appropriately descriptive and straight-forward name that evokes the age, nature, and spirit of the cultural resources associated with early settlement and development in the city. As outlined in a recent study, *Townsites: Historic Context and Archaeological Research Design* (HARD Townsites Team 2007), towns and cities have their own distinctive characteristics, contexts, and research themes. The archaeological record in the historic city is different in many ways from the archaeological record of the HBC and U.S. Army on the east side of I-5 (e.g., in terms of formation processes, material culture, architecture, nature of population represented) and warrants study for the information it can contribute about the historical settlement and development of Vancouver.

3.6.3.1 Application of National Register Criteria

Evaluation of the significance of the archaeological remains in Washington followed the standards and criteria outlined in *Guidelines for Evaluating and Registering Historic Archaeological Sites and Districts* (Townsend et al. 1993), *Guidelines for Evaluating and Registering Archaeological Properties* (Little et al. 2000), and 36 CFR 800.4(c).

Key elements in determining whether a property is eligible for listing on the NRHP are two-fold: 1) a property must meet at least one of the four National Register significance criteria, and 2) it must retain sufficient integrity of location, design, setting, materials, workmanship, feeling and association to convey its significance under the applicable criteria (Townsend et al. 1993; Little et al. 2000). Stated succinctly, significance + integrity = eligibility (Little et al. 2000).

Resources that are significant under criterion a (events and broad patterns of events), "must retain the ability to convey its association as the former repository of important information, the location of historic events, or the representation of important trends" (Little et al. 2000). The integrity of its physical environment is an important part in conveying the setting of events. Integrity of setting and feeling, along with location, design, materials, and association, is considered important under criterion a.

To qualify under criterion b (important persons), the property must be associated with individuals who are significant within a historic context. A property under criterion b must be illustrative of a person's life, meaning that the property must be directly and strongly linked to the person and to the reason why that person is considered to be important within a local, state, or national historic context. Further, the property should have sufficient integrity such that the "essential features during its association with the person's life are intact" (Little et al. 2000). If there are not physical cultural remains, then the setting must be intact to qualify under criterion b. Archaeological properties "need to be in good condition with excellent preservation of features, artifacts, and spatial relationships." The *Guidelines* suggest that "an effective test is to ask if the person would recognize the property;" if not, then integrity may not be sufficient to qualify under criterion b (Little et al. 2000).

An archaeological site may qualify under criterion c (design, construction, and work of a master) if it retains "remains that are well-preserved and clearly illustrate the design and construction of the building or structure," and exhibits distinctive characteristics of type, period, or method of construction (Little et al. 2000). As with the preceding criteria, integrity is an important part of the ability of the resource to convey its eligibility under this criterion. Integrity of design, materials, and workmanship are prime considerations under criterion c.

Archaeological sites are typically evaluated under criterion d (information potential) because of their ability to provide information important to history or prehistory. Location, design, materials, and association are generally the most relevant aspects of integrity for resources assessed under criterion d.

Archaeological resources identified during investigations in connection with the CRC project in 2009 were evaluated for significance under all four NRHP criteria. Cultural resources within the VNHR, situated on the east side of I-5, were previously evaluated for significance in 2004. At that time, resources in the VNHR Historic District were determined significant under criteria a, c, and d (Owens et al. 2007).

Archaeological investigations for the CRC project by HERITAGE archaeologists resulted in the recording of archaeological sites on 17 of the 18 WSDOT parcels (except W24). Eight of these 17 sites were assessed as National Register-eligible resources. NPS archaeologists identified 15 cultural resources located within the five VNHR areas that contribute to the significance of the VNHR Historic District. All of these resources were assessed as significant under National Register criterion d, as sites that "have yielded, or may be likely to yield, information important in prehistory or history." Summary descriptions of the eligible archaeological sites are presented in Exhibit 3-10, and the locations of the eligible sites are shown in Exhibits 3-11 and 3-12.

In practical terms, WSDOT parcels identified as containing eligible archaeological sites are characterized by intact artifact-bearing strata and/or multiple cultural features with associated artifacts. Three parcels where only one cultural feature was documented (W1, W20, W23B) were assessed as eligible because 1) the discovery investigations were curtailed by legal boundary uncertainties and/or the presence of underground utilities, and 2) there is a high degree of likelihood that additional cultural features are present.

The same standards—intact artifact-bearing strata and/or multiple cultural features—also were applied to localities in the VNHR identified by NPS archaeologists as eligible. However, because the VNHR is already listed on the National Register, some localities in the VNHR were identified as eligible based on the former presence of buildings or features on historic maps, or because intact deposits were identified during earlier archaeological investigations, rather than the documentation of significant archaeological remains encountered during archaeological testing for the CRC project.

Six of the 17 sites recorded by HERITAGE archaeologists partially or wholly overlap with the boundaries of previously recorded site 45CL300 in the VNHR (Exhibit 3-7). Two of these six sites, 45CL914 and 45CL917, were assessed as containing National Register eligible archaeological resources that contribute to the significance of the VNHR Historic District.

The remaining four sites on WSDOT parcels, wholly or partially within the boundaries of 45CL300, do not meet the requirements for National Register eligibility identified by the National Park Service (Townsend et al. 1993; Little et al. 2000). Specifically, the four sites that do not meet NRHP requirements are characterized by 1) "temporally diverse culture material found in undifferentiated/mixed stratigraphic contexts or disturbed spatial associations and the absence of classifiable archaeological features," and 2) "site formation processes that have severely compromised the physical integrity of the archaeological record" (Townsend et al. 1993:30). Consequently, these four sites do not contribute to the significance of the VNHR Historic District.

The NPS has recommended that certain archaeological resources in the VNHR may warrant consideration as significant under other National Register criteria in addition to criterion d. Specifically, resources in VNHR Area #1, VNHR Area #3, and VNHR Area #4 may be significant under criteria a, b, or c. The presence of cultural resources on the VNHR that may be NRHP-eligible under criteria a, b, c, as well as d, reflects the relatively higher degree of integrity of the physical environment retained within the U.S. Army installation at Vancouver Barracks.

In comparison, none of the 17 archaeological sites recorded on the WSDOT parcels, including the 8 sites assessed as significant under criterion d, meets the requirements for significance under criteria a, b, or c. The inapplicability of criteria a, b, and c to sites on the WSDOT parcels is a direct result of the location of these parcels in the construction zone for I-5 and SR 14. The massive amount of earth-moving resulted in the widespread destruction of the native soils and natural setting in the I-5 and SR 14 corridors, destroying any sense of the quality of integrity required for cultural resources to be considered significant under criteria a, b, or c.

Exhibit 3-10. Summary Description of Archaeological Resources on the Washington Shore Assessed as Eligible Under NRHP Criterion D

CRC Area	Eligible Resource	Archaeological Resource Description[a]
W1	45CL910	City Block 2 (418): Brick foundation/wall correlates with south wall of large building shown on 1884, 1888, 1890, and 1892 Sanborn maps. In another area, nineteenth and twentieth century cultural materials were recovered from apparently intact cultural deposits at 130 to 160 cmbs.
W8A	45CL914	Quartermaster's Depot: Two brick piers, with associated artifact-bearing deposits, were exposed. The piers are similar to those used to support late nineteenth and early twentieth century U.S. Army structures.
W9B	45CL917	Quartermaster's Depot Stable: Among the 11 cultural features documented were the concrete stable foundation corner and a concrete/brick wall and sidewalk from a wagon shed at the depot complex shown on military maps, as well as Sanborn Insurance maps from 1907 and 1911.
W18B	45CL920	City Block 26 (456): Among the 17 cultural features documented directly across Reserve Street from the Quartermaster 's Depot were 7 trash disposal burn pits containing late nineteenth and early twentieth century artifacts, as well as concrete/brick foundations from buildings shown on Sanborn Insurance maps from 1892 to 1949.
W19A	45CL921	City Blocks 4 (392) and 5 (391): Among the 18 cultural features documented on the west side of Main Street were numerous brick foundation/wall segments, a brick pier, and two trash disposal burn pits containing late nineteenth and early twentieth century artifacts.
W19B	45CL922	City Block 5 (391): The three cultural features found in this area at the southeast corner of 5th and Washington Streets included two trash disposal/burn pits and one burned structure deposit, all containing substantial quantities of late nineteenth and early twentieth century artifacts.
W20	45CL924	City Block 17 (370): A section of wall constructed of concrete blocks and a concrete floor uncovered deep below the surface correlate with a large building on the southwest corner of 2nd and Columbia Streets shown on the 1907 and 1911 Sanborn maps. Some 20th century cultural materials present. Augering located deeply buried wetland soils containing artifacts that trace the course of an historic slough farther to the south from where it is shown on the 1884, 1888, and 1890 Sanborn maps.
W23B	45CL926	City Block 1178: A single cultural feature, a trash disposal burn pit, uncovered on the south side of 39th Street contained an abundance of artifacts from a domestic site dating from the last decades of the nineteenth and early decades of the twentieth century.
VNHR 1	Old Post Cemetery	A single cultural feature, a possible grave shaft, was encountered, and a human metatarsal was recovered, in the former area of the Old Post Cemetery. The cultural material consisted of nineteenth and twentieth century artifacts. The Old Post Cemetery was in use from the 1850s to 1883, when the cemetery was relocated.
VNHR #1 & #2	1879 Line Officers Quarters	Vancouver Barracks, Officers Row. Cultural materials consisted of nineteenth and twentieth century artifacts possibly associated with the architectural remains of an officer's quarters.

CRC Area	Eligible Resource	Archaeological Resource Description[a]
VNHR #2	1851 Blacksmith Shop	Fort Vancouver/Vancouver Barracks, Quartermaster's Depot. Cultural material consisted of nineteenth and twentieth century artifacts.
VNHR #2	1859 Workshops	Fort Vancouver/Vancouver Barracks, Quartermaster's Depot. Discontinuous intact strata with cultural deposits. Cultural material consisting of nineteenth and twentieth century artifacts.
VNHR #3	1892 U.S. Army Stable	Fort Vancouver/Vancouver Barracks, Quartermaster's Depot. Two cultural features, a brick wall or foundation, and OP52B excavation units from Thomas and Hibbs (1984). The cultural material consisted of nineteenth and twentieth century artifacts.
VNHR #3	1859 Quartermaster's Stable	Fort Vancouver/Vancouver Barracks, Quartermaster's Depot. Three cultural features, two brick foundation piers, and wood structural elements. The cultural material consisted on nineteenth and twentieth century artifacts.
VNHR #3	1850 McLoughlin Road	Fort Vancouver/Vancouver Barracks. A single cultural feature, the 1850 road surface.
VNHR #3	1880s McLoughlin Road Tree Allée	Fort Vancouver/Vancouver Barracks. Five heritage trees dating to the 1880s.
VNHR #3	1840s HBC Village, Kanaka House	Fort Vancouver Village. Nine cultural features, a concrete post base, a pit, a wood footing or post with vertical orientation, burned soil with 19th century artifacts, Feature 71 footing from Thomas and Hibbs (1984), Feature 66 pit from Thomas and Hibbs (1984), Feature 71 footing from Thomas and Hibbs (1984), the Kanaka House 1981 excavation baulk, and the 1981 Thomas and Hibbs excavation unit. Abundant HBC village artifacts.
VNHR #3	1840s HBC Village, Tayenta's House	Fort Vancouver Village/Vancouver Barracks Quartermaster's Depot. Five cultural features, a wood board, a post and post hole, a post hole, a possible pit feature, and a railroad tie. The cultural material consisted of nineteenth and twentieth century artifacts. Intact nineteenth and twentieth century cultural deposits with abundant HBC Village artifacts.
VNHR #4	1840s HBC Village, House 4	Fort Vancouver Village. Intact nineteenth century deposits. Perimeter of HBC Village House 4/4B delineated. Abundant HBC Village artifacts.
VNHR #4	HBC Village Pond	Fort Vancouver/Vancouver Barracks Quartermaster's Depot. The cultural material consisted of nineteenth and twentieth century material in stratified deposits. The bottom of the pond deposits was not reached.
VNHR #5	1859 U. S. Army Building	Fort Vancouver/Vancouver Barracks Quartermaster's Depot. Six cultural features, a midden, a midden wood elements, an upper midden, a modern post hole, a lower midden wood elements, and a lower midden (bottom not reached). The cultural material consisted of nineteenth and twentieth century artifacts.
VNHR #5	1874 Vancouver House Hotel	City of Vancouver. Three cultural features, a midden, a modern trench, and a post remnant. The cultural material consisted of nineteenth and twentieth century artifacts.
VNHR #5	1826 Old Apple Tree	Old Apple Tree. The tree itself is not located within the CRC APE, and no archaeological excavations were conducted in its vicinity.

a See Appendix 1C and Appendix 1D for more information.

Exhibit 3-11. Archaeological Resources Identified in Southern Portion of CRC APE on the Washington Shore

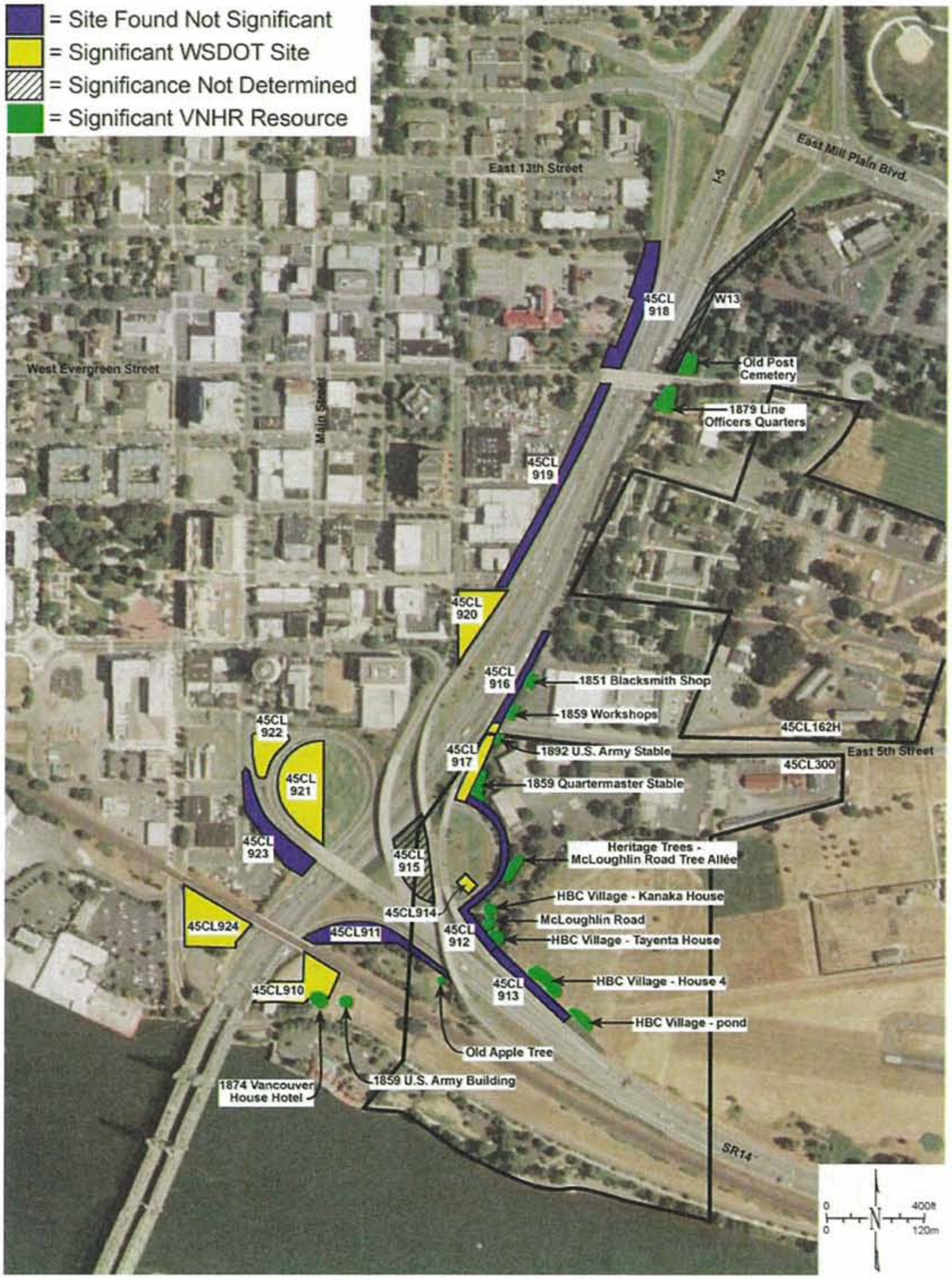

Exhibit 3-12. Archaeological Resources Identified in Northern Portion of CRC APE on the Washington Shore

3.6.3.2 Assessment Summary for Eligible Archaeological Resources

The I-5 corridor, to a large extent, follows the old alignment of West Reserve Street, the former boundary between the Military Reservation and the City of Vancouver. Significant historical archaeological resources in the CRC APE occur in both the military and civilian zones. The oldest historical archaeological resources in the CRC APE are on the east side of I-5, within the VNHR, and are associated with Kanaka Village at HBC Fort Vancouver. Cultural features were documented and artifacts recovered that were associated with three separate houses in this village—Kanaka House, Tayenta's House, and House 4. Artifacts were also recovered that may be associated with the former landscape feature known as the Pond. Previous investigations in connection with a reconfiguration of SR 14 in the 1970s, recovered an outstanding sample of HBC and U.S. Army artifacts preserved in the Pond's deposits (Chance and Chance 1976).

Later historical archaeological remains in the CRC APE on the east side of I-5 relate to activity and occupation on the Military Reservation by the U.S. Army Quartermaster's Department and other U.S. Army activity at Vancouver Barracks. The locations of six former structures shown on historical maps, and now within the VNHR, fall within the CRC APE. NPS archaeologists have identified all six of these structures as significant archaeological resources. Also within the CRC APE in the VNHR are two landscape features identified as significant archaeological resources, the 1850 McLoughlin Road and the 1880s McLoughlin Road Tree Allée.

Among the eligible archaeological resources within the CRC APE in the Historic City of Vancouver are sites on blocks where the earliest settlement and development in the city occurred. On the east side of I-5, structural remains were exposed that were associated with a warehouse in site 45CL910 and the Vancouver Hotel in VNHR Area #1. On the west side of I-5, extensive brick foundations/walls were exposed in site 45CL921 that correspond with buildings that formerly stood on the west side of the 300 and 400 blocks of Main Street. A brick foundation exposed at the southwest corner of Fourth and Main may be from the first brick building in Vancouver, erected in 1866 (McLellan 1935:88).

Aside from foundations, the most common features encountered during discovery investigations in the historic city were historic pits of various kinds that are generally referred to together as "shaft features." The most common shaft features found in urban environments are privy pits from outhouses, wells, cisterns, and cellars. Shaft features often served a secondary function as receptacles for disposal of refuse from adjacent homes and businesses. In these situations, recovery and analysis of this material can reveal aspects of daily life in great detail.

Although refuse-disposal pits were among the most common features documented, more substantial brick- or stone-lined shaft features were not encountered during the discovery investigations in the historic city. This situation is almost certainly due to the nature of the discovery investigations, which were limited to sampling of the parcels by excavation of trenches and test units. Shaft features including privy pits, wells, and cellars have been found during previous investigations on nearby city blocks, and similar features almost certainly are present beneath the fill in the other sites in the historic city.

Exhibit 3-13. Summary of Significance Evaluation

CRC Area	Site Number	Eligible/ Contributing	Significance Criteria[a]	Investigator	Report Section
Oregon Shore					
No archaeological resources documented				HERITAGE	Appendix 1B
Washington Shore					
WSDOT Parcels					
W1	45CL910	Yes	d	HERITAGE	Appendix 1C
W4	45CL911[b]	No	–	HERITAGE	Appendix 1C
W5A	45CL912[b]	No	d	HERITAGE	Appendix 1C
W5B	45CL913[b]	No	–	HERITAGE	Appendix 1C
W8A	45CL914[b]	Yes	d	HERITAGE	Appendix 1C
W8B	45CL915[b]	Undetermined	–	HERITAGE	Appendix 1C
W9A	45CL916	No	–	HERITAGE	Appendix 1C
W9B	45CL917[b]	Yes	d	HERITAGE	Appendix 1C
W17	45CL918	No	d	HERITAGE	Appendix 1C
W18A	45CL919	No	–	HERITAGE	Appendix 1C
W18B	45CL920	Yes	d	HERITAGE	Appendix 1C
W19A	45CL921	Yes	d	HERITAGE	Appendix 1C
W19B	45CL922	Yes	d	HERITAGE	Appendix 1C
W19C	45CL923	No	–	HERITAGE	Appendix 1C
W20	45CL924	Yes	d	HERITAGE	Appendix 1C
W23A	45CL925	No	–	HERITAGE	Appendix 1C
W23B	45CL926	Yes	d	HERITAGE	Appendix 1C
W24	no site	No	–	HERITAGE	Appendix 1C
VNHR Areas[c]					
VNHR #1	45CL160H	Yes	a,b,d	NPS	Appendix 1D
VNHR #2	45CL162H	Yes	d	NPS	Appendix 1D
VNHR #3	45CL300	Yes	a,b,c,d	NPS	Appendix 1D
VNHR #4	45CL300	Yes	a,c,d	NPS	Appendix 1D
VNHR #5 (north)		No	–	NPS	Appendix 1D
VNHR 5 (south)	45CL164H	Yes	a,d	NPS	Appendix 1D

a Criteria a through d of the NRHP.

b Site in WSDOT parcel that overlaps with administrative boundary of 45CL300 in VNHR.

c Correlation of VNHR Areas with previously recorded archaeological sites suggested by the National Park Service (O'Rourke et al. 2010:286-287).

At first glance, the I-5 corridor along the CRC APE appears an unlikely setting in which archaeological remains might be found. Construction of this section of I-5 and associated interchanges required earth-moving on a massive scale. Much of this earth-moving involved the cutting and removal of native soils in which archaeological evidence of occupation and activity in the prehistoric and historic past may once have been present, but in some areas fill covered and protected archaeological features. The results of the discovery and significance evaluation investigations for the CRC project underscore, once again, the potential preservation of significant archaeological remains beneath the ground surface, even in construction zones where massive earth-moving has occurred.

4. Assessment of Adverse Effect and Resolution to Adverse Effect

Section 106 regulations (35 CFR 800.4(b)(2) and 35 CFR 800.5(a)(3)) allow a "phased" process that provides flexibility in addressing how outstanding efforts to identify, assess, and resolve adverse effects would be implemented to protect historic properties consistent with the requirements of the NHPA. This phased process can be carried out by executing a MOA that will include appropriate stipulations regarding archaeological discovery methods and clear instructions on how and when archaeological field investigations will be conducted. The MOA will afford sufficient protection of the archaeological resources while allowing the project to move forward in steps that would provide opportunities to consider avoidance, minimization, and mitigation options.

In several parts of the APE, access to conduct archaeological investigations necessary to discover buried historic properties is restricted by denial of right-of-entry, as well as the actively and intensively used urban landscapes, such as roadways, sidewalks, and parking lots, in addition to areas beneath actively used roadways, and other areas which present safety and access challenges. Additionally, some areas are out of reach of typical field techniques, so that conducting archaeological subsurface excavations in these areas is practically and logistically highly problematic. As specific project impacts are finalized, these areas will be investigated in a phased manner prior to or during construction, following protocols established in a Treatment Plan.

4.1 Effects

To date, archaeological discovery and site evaluation investigations in connection with the CRC project have been conducted in all areas in which CRC has been granted right-of-entry, including properties owned by ODOT, WSDOT, NPS, the U.S. Army, and the City of Vancouver. No archaeological sites have been identified in the CRC APE on the Oregon shore. To reach the Pleistocene gravels that underlie the project area, to reach the Pleistocene gravels that underlie the project area, archaeological discovery investigations employed rotary-sonic coring to drill through the deep alluvial sediments to depths of 30 m or more. Although no artifacts were recovered, analysis of the sediments from the boreholes suggests archaeological resources may be preserved in the deep flood plain soils on the Oregon shore.

Archaeological discovery and site evaluation investigations have identified significant archaeological sites in the CRC APE on the Washington shore that meet criterion d for eligibility to the National Register. These include seven eligible archaeological sites on WSDOT parcels around the I-5/SR 14 interchange, and one eligible archaeological site around the I-5/SR 500 interchange. Localities that may contribute to the significance of the VNHR District under criterion d have also been identified by NPS archaeologists in all five areas in the VNHR investigated in connection with the CRC project.

Construction excavations during the CRC project could directly affect the significant archaeological resources so far identified. Considering the extensive earth-moving construction activities that will be needed to construct the CRC project, it is likely that these activities would severely alter or destroy the integrity of that portion of each identified archaeological resource that lies within the direct impact areas. As well, additional significant archaeological sites may be identified and damaged by construction in areas not yet subjected to archaeological discovery investigations.

The design of the CRC project has not been finalized, and all areas in which construction impacts may occur have not been identified. Although avoidance alternatives may be considered, the identified sites in the APE in Washington will likely be affected by a wide range of construction and staging activities, and given the project description this effect would be "adverse."

At this point, it is assumed that any archaeological sites in the existing ODOT and WSDOT rights-of-way within the CRC APE will be subject to adverse effects until demonstrated otherwise. Any impacts from the CRC project outside the ODOT and WSDOT rights-of-way still need to be assessed.

Potential adverse effects will be resolved in a Section 106 MOA developed among WSDOT, ODOT, FHA, FHWA, DAHP, SHPO, and affected tribes. The MOA will identify responsible parties for complying with elements of the agreement, outline mitigation measures and archaeological treatment and monitoring plans that would be applied, and will bind signatories to comply with the mitigation measures.

4.2 Work Remaining and to be Incorporated into MOA

The substantial efforts undertaken to date to identify eligible archaeological resources in the CRC APE have been described in this report and related appendices. Additional work to be conducted includes pre-construction investigations in areas not already examined, phased construction fill removal and archaeological testing of native soils in areas currently inaccessible due to deep fill, and monitoring by an archaeologist during construction.

In particular, archaeological monitoring of earth-moving during construction is expected to play a major role due to the current inaccessibility of substantial portions of the APE (e.g., the existing I-5 infrastructure), and in view of the high potential for encountering significant prehistoric and historical archaeological remains in the APE. The MOA will include stipulations to ensure that appropriate measures are taken with respect to the NHPA and other applicable cultural resource protection laws and regulations.

4.2.1 Determination of Significance at W8B and W13

The archaeological significance of two WSDOT parcels has not been determined. Further archaeological investigations will need to be conducted at some time in the future if construction during the CRC project will result in impacts to these parcels.

W8B on the northeast side of the I-5/SR 14 interchange is covered by deep fill deposits that support travel ramps providing access to and from SR 14 to I-5 and the City of Vancouver. W8B is situated on the western periphery of the U.S. Army's Quartermaster's Depot at Vancouver Barracks (Exhibit 3-11). Archaeological remains were identified in the W8B vicinity during investigations in connection with earlier reconfigurations of the I-5/SR 14 interchange. Historical artifacts recovered from fill deposits in a backhoe trench were recorded as site 45CL915. A backhoe could not reach deep enough to determine if any intact artifact-bearing deposits or cultural features are present beneath the fill deposits covering W8B.

W13 is a narrow strip of ground on the east side of I-5 beginning on the north side of Evergreen Boulevard (Exhibit 3-11). Historically, W13 falls within the former area of the Old Post Cemetery at Vancouver Barracks, in use from the 1850s to 1883. In 1883 the burials at this cemetery were relocated to a new military cemetery on Fourth Plain Boulevard. However, the uncovering of human skeletal remains during construction of I-5 in 1953 (Thomas and Freidenburg 1998:6), as well as the recent discovery by NPS archaeologists of a human metatarsal at VNHR Area #1 immediately to the east, raises the possibility that additional human remains missed during the burial relocation may be present at W13. Discovery investigations at W13 are on hold pending the outcome of ongoing consultations regarding the appropriate investigative approach.

4.2.2 Transit Alignments in Vancouver, Washington

Identifying archaeological resources along the proposed transit alignments in Vancouver is highly problematic due to their occurrence below existing city streets. In addition to asphalt or concrete pavement covering the street surfaces, the underlying sediments are intensively layered by utilities. Conducting archaeological testing in the streets would be disruptive to pedestrians, automobile traffic, residences, and businesses.

Construction of the transit system will entail substantial excavations within existing streets. In addition to installation of the rails themselves, excavations will be required for rail utility vaults, replacement of street cross-sections including sidewalks, and underground utility relocations. Combined, these actions constitute an undertaking of substantial magnitude that warrants serious consideration and disclosure of the potential to affect archaeological resources.

Scattered evidence of prehistoric Native American activity has been found, but the primary concern in the Vancouver area is with historical archaeological resources. A wide range of historical archaeological features, some many feet below fill material, has been encountered during previous investigations in the Historic City of Vancouver. These features include artifact sheet scatters and midden-like trash deposits, several types of shaft and pit features (e.g., privy vaults, trash pits, wells, cisterns, cesspools), and structural remains from commercial, residential, and industrial buildings.

The majority of the proposed transit alignment could be considered to have a high probability of containing archaeological resources, as it passes through parts of Vancouver that were developed between the mid-1800s to early 1900s. However, within the existing roadways, the most likely archaeological resources will be sheet scatters of artifacts that were disposed of in front yards or roads prior to garbage disposal regulations, and abandoned or filled cisterns at intersections. Although the rails from the historic railway systems reportedly were removed (Freece 1985), rails have been observed within Columbia Street between West 3rd and West 6th Streets (Robbins 1996), and additional evidence of the historic street railway system may be encountered during construction. Due to the nature of the work, and the nature of the potential archaeological resources to be encountered, archaeological monitoring is recommended along the transit alignment. Identified archaeological resources will be evaluated according to protocols established in the treatment plan.

Development of the transit system includes construction of the proposed Mill District Park and Ride, an entire block currently used as a parking lot. This block was occupied by the Hidden Brother's brick factory/kiln/drying racks and lumber yard. The Hidden Brothers were prominent Vancouver citizens. Brick from their business was used extensively in town development. Investigations on this block have the potential to recover new information about a business that played a major role in the development of Vancouver and the surrounding area. Archaeological investigations of this block should be conducted prior to construction.

4.2.3 Casting and Staging Areas

Construction activities for the CRC project will require at least one large site to stage equipment and materials (Exhibit 1-4). Three locations have been identified as possible major staging areas for the CRC project. Background research was conducted in order to assess the possibility of each potential staging area to contain significant archaeological resources.

- The Port of Vancouver location is a 52-acre tract along SR 501 and near the Port of Vancouver's Terminal 3 North facility. Portions of this tract are buried by substantial fill material, and in other portions the ground surface has been disturbed by past construction and use. The tract contains no recorded archaeological sites, but it is located within the Vancouver Lakes Archaeological District, determined to be NRHP-eligible in 1982. In view of its location in proximity to the archaeological district and to the Columbia River, the likelihood of encountering deeply buried archaeological resources in this parcel is high.
- The Red Lion at the Quay Hotel location is a 2.6-acre tract immediately west of I-5 in Vancouver. This tract is covered by fill material. The tract contains no recorded archaeological sites, and it lies outside the Vancouver Lakes Archaeological District. However, in view of its location in the Historic City of Vancouver and on the Columbia River shoreline, the likelihood of encountering deeply buried archaeological resources in this parcel is high.
- The Old Thunderbird Hotel location is a 5.6-acre tract immediately west of I-5 on Hayden Island in Portland. This tract is covered by fill material. The tract contains no recorded archaeological sites. However, in view of its location on the Columbia River shoreline, the likelihood of encountering deeply buried archaeological resources in this parcel is high.

A casting yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. Two locations have been identified as possible casting yards for the CRC project. Background research was conducted in order to assess the potential of each potential casting yard to contain significant archaeological resources.

- The Alcoa/Evergreen location is a 95-acre tract along SR 501 and near the Port of Vancouver's Terminal 3 North facility. This tract contains no recorded archaeological sites, but it is located within the Vancouver Lakes Archaeological District. In view of its location in the archaeological district and its proximity to the Columbia River shoreline, the likelihood of encountering deeply buried archaeological resources in this tract is high.
- The Sundial location is a 50-acre tract situated on the Columbia River shoreline between Fairview and Troutdale, just north of the Troutdale Airport. This tract contains no recorded archaeological sites. However, it is located near the confluence of the Sandy and Columbia Rivers, an area considered to have a high probability of containing prehistoric archaeological resources. In view of its setting, the likelihood of encountering buried archaeological resources in this tract is high.

Each of these potential casting and staging areas has a high potential to contain archaeological resources, but the areas are mostly covered by deep fill material. Staging and casting areas will primarily be used for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate, activities that are unlikely to have deep subsurface impacts. The MOA will include stipulations to ensure that the selected parcels are investigated with respect to the NHPA and other applicable cultural resource protection laws and regulations.

4.2.4 Submerged Shelf on Washington Shore

There is a high potential for underwater archaeological resources in the Columbia River along the Washington shore. Previous underwater explorations identified a relatively flat shelf, about 300 feet in length and about 50 to 60 feet in width, paralleling the river bank along the Washington shore. Underwater surveys conducted along the submerged shelf upstream from the existing I-5 bridges noted the presence of stone artifacts as well as artifacts of Euroamerican manufacture, and recorded two archaeological sites (Stenger 1988a, 1988b; Marcotte and Wilson 2007).

As currently designed, two bridge piers will be located on this shelf, just west of the existing I-5 bridges. One pier will be located in the footprint of an existing quay belonging to the Red Lion at the Quay, and the other will be located between the quay and the existing I-5 bridges. After discussions with the Department of Natural Resources, which manages submerged lands for the state, CRC will conduct an archaeological survey once the footprints of the bridge piers are finalized, the U.S. Army conducts a survey for unexploded ordnance, right-of-entry to the property is gained, and during an available in-water work window to avoid harm to fish.

4.2.5 Oregon Shore

The rotary-sonic borings undertaken for geoarchaeological purposes have produced a substantial amount of information about the evolution of the environment in the CRC APE on the Oregon shore over the last 12,000 years. This information suggests the reasonable likelihood that archaeological remains may be encountered in the thick alluvium during construction of the CRC project. The most likely locations for finding archaeological remains are on natural levees along the banks of Oregon Slough.

The thickness of the artificial fill that overlies the alluvium precludes conventional archaeological discovery investigations. Due to the considerable thickness of the alluvium, any archaeological materials found are likely to be recovered during the drilling of boreholes and any other deep excavations undertaken during construction. Accordingly, any additional boreholes drilled, as well as any construction excavations that penetrate below the artificial fill, should be monitored by an archaeologist to ensure that any archaeological materials encountered are identified. In the event that archaeological remains are encountered during drilling and/or construction, archaeological testing and/or data recovery investigations will be taken (to the extent such work is feasible given the depth below surface of the findings) in compliance with federal and state cultural resource laws and regulations.

4.2.6 Submittal of Final Report

The present document presents interim final report on archaeological discovery and significance evaluation efforts undertaken for the CRC project. Geoarchaeological investigations by HERITAGE on the Oregon shore involved processing and interpretation of samples of sediments, tephra, and wood/charcoal for radiocarbon dating from 14 rotary-sonic boreholes. Archaeological investigations were conducted by HERITAGE on 18 separate parcels in Washington, resulting in the documentation of 64 cultural features and the recovery of 14,643 artifacts from 17 archaeological sites. Likewise, NPS documented 36 cultural features and recovered 34,014 artifacts from five areas in the CRC APE along the periphery of the VNHR.

Analysis and integration of the accumulated results of archaeological investigations of this magnitude required a substantial effort to identify, catalogue, analyze, interpret, and synthesize the accumulated geoarchaeological and archaeological data. Completion of the series of reports synthesizing the results of the investigations conducted reflects a substantial commitment by CRC to ensure that the maximum amount of information is gained from the public's investment in the archaeological research undertaken for this project.

5. Permits and Approvals

Several federal, state, and local environmental laws and regulations addressing historic resources may require permits and approvals.

5.1 Federal

National Historic Preservation Act (NHPA) of 1966 (P.L. 102-575; 16 USC 470), as amended. 36 CFR 800. 40 CFR 1508.27. Executive Order 11593. This act is the primary authority used in complying with the nation's cultural resources protection objectives. It is implemented through federal regulations (36 CFR 64, 36 CFR 800, 40 CFR 1508.27).

- As required by Section 106 of the National Historic Preservation Act (1966) the SHPO and DAHP must be consulted and have the opportunity to comment on the APE, determinations of eligibility for the National Register of Historic Places, level of effect, and all MOA. As described in 36 CFR 800.1 to 800.7 also known as the Section 106 Process.
- FHWA and FTA must agree and approve all Section 106 findings and mitigation plans and Section 4(f) Evaluations required by the Federal Highway Act (1966).

5.2 State

Section 106 of the National Historic Preservation Act requires SHPO consultation and agreement and supersedes state laws.

5.3 Local

The City of Portland, City of Vancouver, Multnomah County, and Clark County planning departments and local historic resources commissions are considered interested parties and should be informed about the effects on historic properties and resources in their jurisdictions.

Alteration or demolition of any structure listed on the Clark County Heritage Register will require a Certificate of Appropriateness (C of A) from the Clark County Historic Preservation Commission. No alterations or demolitions to listed structures have been identified.

The northbound I-5 bridge is listed on the National Register of Historic Places. National Register-listed properties are subject to a demolition review process by the Portland Landmarks Commission. The Bureau of Development Services (BDS) is responsible for conducting this as a type of land use review. The Landmarks Commission recommendation is advisory to City Council. See Zoning Code section 33.445.810 for additional details.

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INTERSTATE 5 COLUMBIA RIVER CROSSING

Wetlands and Jurisdictional Waters Technical Report for the Final Environmental Impact Statement

Columbia River CROSSING

May 2011

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PRELIMINARY

Cover Sheet

Interstate 5 Columbia River Crossing

Wetlands and Jurisdictional Waters Technical Report for the Final Environmental Impact Statement:

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ACRONYMS

Acronym	Description
API	area of potential impact
BMP	best management practice
BNSF	Burlington Northern Santa Fe Railroad
CAO	critical areas ordinance
CD	collector-distributor
CPC	City of Portland Code
CRC	Columbia River Crossing
C-TRAN	Clark County Public Transportation
CTR	Commute Trip Reduction (Washington)
CWA	Clean Water Act
DCP	depressional closed permanent wetland
DEA	David Evans and Associates
DEIS	Draft Environmental Impact Statement
DEQ	Oregon Department of Environmental Quality
DOT	United States Department of Transportation
DSL	Oregon Department of State Lands
Ecology	Washington State Department of Ecology
ECO	Employee Commute Options (Oregon)
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GMA	Growth Management Act
HGM	hydrogeomorphic assessment method
HPA	Hydraulic Project Approval
I-5	Interstate 5
InterCEP	Interstate Collaborative Environmental Process
JARPA	Joint Aquatic Resource Permits Application
LPA	locally preferred alternative
LRV	light rail vehicle
MAX	Metropolitan Area Express
Metro	Metropolitan Regional Government

NAVD88	North American Vertical Datum 1988
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRMP	natural resource management plan
NWI	National Wetlands Inventory
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ORS	Oregon Revised Statutes
PEMA	palustrine emergent, temporarily flooded wetland
PEMC	palustrine emergent, seasonally flooded wetland
PFO/SS/EMH	palustrine, forested/scrub-shrub/emergent, permanently flooded, excavated wetland
PFOC/F	palustrine forested, seasonal/semipermanently flooded wetland
PJWA	potentially jurisdictional water area
PSS/EMC	palustrine, scrub-shrub/emergent, seasonally flooded wetland
PSSC	palustrine scrub-shrub, seasonally flooded wetland
PUBHx	palustrine, unconsolidated bottom, permanently flooded, excavated
PUBHx	palustrine unconsolidated bottom, permanently flooded, excavated wetland
R1UBV	riverine tidal, unconsolidated bottom, permanent-tidal wetland
RCW	Revised Code of Washington
RI	riverine impounding
RM	river mile
ROD	Record of Decision
RTC	Regional Transportation Commission
SMA	Shoreline Management Act
SPUI	single-point urban interchange
SR	state route
TDM	transportation demand management
TriMet	Tri-County Metropolitan Transportation District
TSM	transportation system management
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

VMC	Vancouver Municipal Code
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WTC	Washington Transportation Commission

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1. Summary

1.1 Introduction

The Wetlands and Jurisdictional Waters Technical Report will:

- Summarize the Alternatives Analysis,
- Discuss existing conditions within areas that will potentially be affected by the Columbia River Crossing (CRC) project,
- Compare and contrast long-term, temporary, and cumulative impacts from the LPA,
- Provide potential mitigation measures for project impacts, and
- Summarize/list necessary permits and approvals.

Wetlands surveys were performed within the primary area of potential impact (API); preliminary determinations were conducted for the Ruby Junction Maintenance Facility and Steel Bridge site. A delineation report was completed for areas within the Oregon portion of the API, and preliminary determinations were made for areas within the Washington portion of the API and Ruby Junction.

1.2 Description of Alternatives

This technical report evaluates the CRC project's locally preferred alternative (LPA) and the No-Build Alternative. The LPA includes two design options: The preferred option, LPA Option A, which includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge; and LPA Option B, which does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor (CD) lanes on the two new bridges that would be built adjacent to I-5. In addition to the design options, if funding availability does not allow the entire LPA to be constructed in one phase, some roadway elements of the project would be deferred to a future date. This technical report identifies several elements that could be deferred, and refers to that possible initial investment as LPA with highway phasing. The LPA with highway phasing option would build most of the LPA in the first phase, but would defer construction of specific elements of the project. For wetlands, there is no difference in effects between the LPA and the LPA with highway phasing, therefore LPA Option A and LPA Option B described herein is for both the LPA and the LPA with highway phasing. The LPA and the No-Build Alternative are described in this section.

1.2.1 Adoption of a Locally Preferred Alternative

Following the publication of the Draft Environmental Impact Statement (DEIS) on May 2, 2008, the project actively solicited public and stakeholder feedback on the DEIS during a 60-day comment period. During this time, the project received over 1,600 public comments.

During and following the public comment period, the elected and appointed boards and councils of the local agencies sponsoring the CRC project held hearings and workshops to gather further public input on and discuss the DEIS alternatives as part of their efforts to determine and adopt a locally preferred alternative. The LPA represents the alternative preferred by the local and regional agencies sponsoring the CRC project. Local agency-elected boards and councils determined their preference based on the results of the evaluation in the DEIS and on the public and agency comments received both before and following its publication.

In the summer of 2008, the local agencies sponsoring the CRC project adopted the following key elements of CRC as the LPA:

- A replacement bridge as the preferred river crossing,
- Light rail as the preferred high-capacity transit mode, and
- Clark College as the preferred northern terminus for the light rail extension.

The preferences for a replacement crossing and for light rail transit were identified by all six local agencies. Only the agencies in Vancouver – the Clark County Public Transit Benefit Area Authority (C-TRAN), the City of Vancouver, and the Regional Transportation Council (RTC) – preferred the Vancouver light rail terminus. The adoption of the LPA by these local agencies does not represent a formal decision by the federal agencies leading this project – the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) – or any federal funding commitment. A formal decision by FHWA and FTA about whether and how this project should be constructed will follow the FEIS in a Record of Decision (ROD).

1.2.2 Description of the LPA

The LPA includes an array of transportation improvements, which are described below. When the LPA differs between Option A and Option B, it is described in the associated section. For a more detailed description of the LPA, including graphics, please see Chapter 2 of the FEIS.

1.2.2.1 Multimodal River Crossing

Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River would be replaced by two new parallel bridges. The eastern structure would accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path underneath; the western structure would carry southbound traffic, with a two-way light rail guideway below. Whereas the existing bridges have only three lanes each with virtually no shoulders, each of the new bridges would be wide enough to accommodate three through-lanes and two add/drop lanes. Lanes and shoulders would be built to full design standards.

The new bridges would be high enough to provide approximately 95 feet of vertical clearance for river traffic beneath, but not so high as to impede the take-offs and landings by aircraft using Pearson Field or Portland International Airport to the east. The new bridge structures over the Columbia River would not include lift spans, and both of the new bridges would each be supported by six piers in the water and two piers on land.

North Portland Harbor Bridges

The existing highway structures over North Portland Harbor would not be replaced; instead, they would be retained to accommodate all mainline I-5 traffic. As discussed at the beginning of this chapter, two design options have emerged for the Hayden Island and Marine Drive interchanges. The preferred option, LPA Option A, includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge. LPA Option B does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor lanes on the two new bridges that would be built adjacent to I-5.

LPA Option A: Four new, narrower parallel structures would be built across the waterway, three on the west side and one on the east side of the existing North Portland Harbor bridges. Three of the new structures would carry on- and off-ramps to mainline I-5. Two structures west of the existing bridges would carry traffic merging onto or exiting off of I-5 southbound. The new structure on the east side of I-5 would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include a two-lane arterial bridge for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

LPA Option B: This option would build the same number of structures over North Portland Harbor as Option A, although the locations and functions on those bridges would differ, as described below. The existing bridge over North Portland Harbor would be widened and would receive seismic upgrades.

LPA Option B does not have arterial lanes on the light rail/multi-use path bridge. Direct access between Marine Drive and the island would be provided with collector-distributor lanes. The structures adjacent to the highway bridge would carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges.

1.2.2.2 Interchange Improvements

The LPA includes improvements to seven interchanges along a 5-mile segment of I-5 between Victory Boulevard in Portland and SR 500 in Vancouver. These improvements include some reconfiguration of adjacent local streets to complement the new interchange designs, as well as new facilities for bicyclists and pedestrians along this corridor.

Victory Boulevard Interchange

The southern extent of the I-5 project improvements would be two ramps associated with the Victory Boulevard interchange in Portland. The Marine Drive to I-5 southbound on-ramp would be braided over the I-5 southbound to the Victory Boulevard/Denver Avenue off-ramp. The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Denver Avenue. The current merging ramp would be extended to become an add/drop (auxiliary) lane which would continue across the river crossing.

***Potential phased construction option*:** The aforementioned southbound ramp improvements to the Victory Boulevard interchange may not be included with the CRC project. Instead, the existing connections between I-5 southbound and Victory Boulevard could be retained. The braided ramp connection could be constructed separately in the future as funding becomes available.

Marine Drive Interchange

All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5 at this location. The interchange configuration would be a single-point urban interchange (SPUI) with a flyover ramp serving the east to north movement. With this configuration, three legs of the interchange would converge at a point on Marine Drive, over the I-5 mainline. This configuration would allow the highest volume movements to move freely without being impeded by stop signs or traffic lights.

The Marine Drive eastbound to I-5 northbound flyover ramp would provide motorists with access to I-5 northbound without stopping. Motorists from Marine Drive eastbound would access I-5 southbound without stopping. Motorists traveling on Martin Luther King Jr. Boulevard westbound to I-5 northbound would access I-5 without stopping at the intersection.

The new interchange configuration changes the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard and to northbound I-5. These two streets would access westbound Martin Luther King Jr. Boulevard farther east. Martin Luther King Jr. Boulevard would have a new direct connection to I-5 northbound.

In the new configuration, the connections from Vancouver Way and Marine Drive would be served, improving the existing connection to Martin Luther King Jr. Boulevard east of the interchange. The improvements to this connection would allow traffic to turn right from Vancouver Way and accelerate onto Martin Luther King Jr. Boulevard. On the south side of Martin Luther King Jr. Boulevard, the existing loop connection would be replaced with a new connection farther east.

A new multi-use path would extend from the Bridgeton neighborhood to the existing Expo Center light rail station and from the station to Hayden Island along the new light rail line over North Portland Harbor.

LPA Option A: Local traffic between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel via an arterial bridge over North Portland Harbor. There would be some variation in the alignment of local streets in the area of the interchange between Option A and Option B. The most prominent differences are the alignments of Vancouver Way and Union Court.

LPA Option B: With this design option, there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island would travel on the collector-distributor bridges that would parallel each side of I-5 over North Portland Harbor. Traffic would not need to merge onto mainline I-5 to travel between the island and Martin Luther King Jr. Boulevard/Marine Drive.

***Potential phased construction option*:** The aforementioned flyover ramp could be deferred and not constructed as part of the CRC project. In this case, rather than providing a direct eastbound Marine Drive to I-5 northbound connection by a flyover ramp, the project improvements to the interchange would instead provide this connection through the signal-controlled SPUI. The flyover ramp could be constructed separately in the future as funding becomes available.

Hayden Island Interchange

All movements for this interchange would be reconfigured. The new configuration would be a split tight diamond interchange. Ramps parallel to the highway would be built, lengthening the ramps and improving merging speeds. Improvements to Jantzen Drive and Hayden Island Drive would include additional through, left-turn, and right-turn lanes. A new local road, Tomahawk Island Drive, would travel east-west through the middle of Hayden Island and under the I-5 interchange, improving connectivity across I-5 on the island. Additionally, a new multi-use path would be provided along the elevated light rail line on the west side of the Hayden Island interchange.

LPA Option A: A proposed arterial bridge with two lanes of traffic, one in each direction, would allow vehicles to travel between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island without accessing I-5.

LPA Option B: With this design option there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that parallel each side of I-5 over North Portland Harbor.

SR 14 Interchange

The function of this interchange would remain largely the same. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Downtown Vancouver I-5 access to and from the south would be at C Street rather than Washington Street, while downtown connections to and from SR 14 would be made by way of Columbia Street at 4th Street.

The multi-use bicycle and pedestrian path in the northbound (eastern) I-5 bridge would exit the structure at the SR 14 interchange, and then loop down to connect into Columbia Way.

Mill Plain Interchange

This interchange would be reconfigured into a SPUI. The existing "diamond" configuration requires two traffic signals to move vehicles through the interchange. The SPUI would use one efficient intersection and allow opposing left turns simultaneously. This would improve the capacity of the interchange by reducing delay for traffic entering or exiting the highway.

This interchange would also receive several improvements for bicyclists and pedestrians. These include bike lanes and sidewalks, clear delineation and signing, short perpendicular crossings at the ramp terminals, and ramp orientations that would make pedestrians highly visible.

Fourth Plain Interchange

The improvements to this interchange would be made to better accommodate freight mobility and access to the new park and ride at Clark College. Northbound I-5 traffic exiting to Fourth Plain would continue to use the off-ramp just north of the SR 14 interchange. The southbound I-5 exit to Fourth Plain would be braided with the SR 500 connection to I-5, which would eliminate the non-standard weave between the SR 500 connection and the off-ramp to Fourth Plain as well as the westbound SR 500 to Fourth Plain Boulevard connection.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including bike lanes, neighborhood connections, and access to the park and ride.

SR 500 Interchange

Improvements would be made to the SR 500 interchange to add direct connections to and from I-5. On- and off-ramps would be built to directly connect SR 500 and I-5 to and from the north, connections that are currently made by way of 39th Street. I-5 southbound traffic would connect to SR 500 via a new tunnel underneath I-5. SR 500 eastbound traffic would connect to I-5 northbound on a new on-ramp. The 39th Street connections with I-5 to and from the north would be eliminated. Travelers would instead use the connections at Main Street to connect to and from 39th Street.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including sidewalks on both sides of 39th Street, bike lanes, and neighborhood connections.

***Potential phased construction option*:** The northern half of the existing SR 500 interchange would be retained, rather than building new connections between I-5 southbound to SR 500 eastbound and from SR 500 westbound to I-5 northbound. The ramps connecting SR 500 and I-5 to and from the north could be constructed separately in the future as funding becomes available.

1.2.2.3 Transit

The primary transit element of the LPA is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo Center in North Portland, where it currently ends, to Clark College in Vancouver. The transit element would not differ between LPA and LPA with highway phasing. To accommodate and complement this major addition to the region's transit system, a variety of additional improvements are also included in the LPA:

- Three park and ride facilities in Vancouver near the new light rail stations.
- Expansion of Tri-County Metropolitan Transportation District's (TriMet's) Ruby Junction light rail maintenance base in Gresham, Oregon.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Operating Characteristics

Nineteen new light rail vehicles (LRV) would be purchased as part of the CRC project to operate this extension of the MAX Yellow Line. These vehicles would be similar to those currently used by TriMet's MAX system. With the LPA, LRVs in the new guideway and in the existing Yellow Line alignment are planned to operate with 7.5-minute headways during the "peak of the peak" (the two-hour period within the 4-hour morning and afternoon/evening peak periods where demand for transit is the highest) and 15-minute headways during off-peak periods.

Light Rail Alignment and Stations

Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains would be constructed to extend from the existing Expo Center MAX station over North Portland Harbor to Hayden Island. Immediately north of the Expo Center, the alignment would curve eastward toward I-5, pass beneath Marine Drive, then rise over a flood wall onto a light rail/multi-use path bridge to cross North Portland Harbor. The two-way guideway over Hayden Island would be elevated at approximately the height of the rebuilt mainline of I-5, as would a new station immediately west of I-5. The alignment would extend northward on Hayden Island along the western edge of I-5, until it transitions into the hollow support structure of the new western bridge over the Columbia River.

Downtown Vancouver Light Rail Alignment and Stations

After crossing the Columbia River, the light rail alignment would curve slightly west off of the highway bridge and onto its own smaller structure over the Burlington Northern Santa Fe (BNSF) rail line. The double-track guideway would descend on structure and touch down on Washington Street south of 5th Street, continuing north on Washington Street to 7th Street. The elevation of 5th Street would be raised to allow for an at-grade crossing of the tracks on Washington Street. Between 5th and 7th Streets, the two-way guideway would run down the center of the street. Traffic would not be allowed on Washington between 5th and 6th Streets and would be two-way between 6th and 7th Streets. There would be a station on each side of the street on Washington between 5th and 6th Streets.

At 7th Street, the light rail alignment would form a couplet. The single-track northbound guideway would turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway would continue on Washington Street. Seventh Street will be converted to one-way traffic eastbound between Washington and Broadway with light rail operating on the north side of 7th Street. This couplet would extend north to 17th Street, where the two guideways would join and turn east.

The light rail guideway would run on the east side of Washington Street and the west side of Broadway Street, with one-way traffic southbound on Washington Street and one-way traffic northbound on Broadway Street. On station blocks, the station platform would be on the side of the street at the sidewalk. There would be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

East-west Light Rail Alignment and Terminus Station

The single-track southbound guideway would run in the center of 17th Street between Washington and Broadway Streets. At Broadway Street, the northbound and southbound alignments of the couplet would become a two-way center-running guideway traveling east-west on 17th Street. The guideway on 17th Street would run until G Street, then connect with McLoughlin Boulevard and cross under I-5. Both alignments would end at a station east of I-5 on the western boundary of Clark College.

Park and Ride Stations

Three park and ride stations would be built in Vancouver along the light rail alignment:

- Within the block surrounded by Columbia, Washington 4th and 5th Streets, with five floors above ground that include space for retail on the first floor and 570 parking stalls.
- Between Broadway and Main Streets next to the stations between 15th and 16th Streets, with space for retail on the first floor, and four floors above ground that include 420 parking stalls.
- At Clark College, just north of the terminus station, with space for retail or C-TRAN services on the first floor, and five floors that include approximately 1,910 parking stalls.

Ruby Junction Maintenance Facility Expansion

The Ruby Junction Maintenance Facility in Gresham, Oregon, would need to be expanded to accommodate the additional LRVs associated with the CRC project. Improvements include additional storage for LRVs and other maintenance material, expansion of LRV maintenance bays, and expanded parking for additional personnel. A new operations command center would also be required, and would be located at the TriMet Center Street location in Southeast Portland.

Local Bus Route Changes

As part of the CRC project, several C-TRAN bus routes would be changed in order to better complement the new light rail system. Most of these changes would re-route bus lines to downtown Vancouver where riders could transfer to light rail. Express routes, other than those listed below, are expected to continue service between Clark County and downtown Portland. The following table (Exhibit 1-1) shows anticipated future changes to C-TRAN bus routes.

Exhibit 1-1. Proposed C-TRAN Bus Routes Comparison

C-TRAN Bus Route	Route Changes
#4 - Fourth Plain	Route truncated in downtown Vancouver
#41 - Camas / Washougal Limited	Route truncated in downtown Vancouver
#44 - Fourth Plain Limited	Route truncated in downtown Vancouver
#47 - Battle Ground Limited	Route truncated in downtown Vancouver
#105 - I-5 Express	Route truncated in downtown Vancouver
#105S - I-5 Express Shortline	Route eliminated in LPA (The No-Build runs articulated buses between downtown Portland and downtown Vancouver on this route)

Steel Bridge Improvements

Currently, all light rail lines within the regional TriMet MAX system cross over the Willamette River via the Steel Bridge. By 2030, the number of LRVs that cross the Steel Bridge during the 4-hour PM peak period would increase from 152 to 176. To accommodate these additional trains, the project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail speed over the bridge from 10 to 15 mph. To accomplish this, additional work along the Steel Bridge lift spans would be needed.

1.2.2.4 Tolling

Tolling cars and trucks that use the I-5 river crossing is proposed as a method to help fund the CRC project and to encourage the use of alternative modes of transportation. The authority to toll the I-5 crossing is set by federal and state laws. Federal statutes permit a toll-free bridge on an interstate highway to be converted to a tolled facility following the reconstruction or replacement of the bridge. Prior to imposing tolls on I-5, Washington and Oregon Departments of Transportation (WSDOT and ODOT) would have to enter into a toll agreement with U.S. Department of Transportation (DOT). Recently passed state legislation in Washington permits WSDOT to toll I-5 provided that the tolling of the facility is first authorized by the Washington legislature. Once authorized by the legislature, the Washington Transportation Commission (WTC) has the authority to set the toll rates. In Oregon, the Oregon Transportation Commission (OTC) has the authority to toll a facility and to set the toll rate. It is anticipated that prior to tolling I-5, ODOT and WSDOT would enter into a bi-state tolling agreement to establish a cooperative process for setting toll rates and guiding the use of toll revenues.

Tolls would be collected using an electronic toll collection system: toll collection booths would not be required. Instead, motorists could obtain a transponder that would automatically bill the vehicle owner each time the vehicle crossed the bridge, while cars without transponders would be tolled by a license-plate recognition system that would bill the address of the owner registered to that license plate.

The LPA proposes to apply a variable toll on vehicles using the I-5 crossing. Tolls would vary by time of day, with higher rates during peak travel periods and lower rates during off-peak periods. Medium and heavy trucks would be charged a higher toll than passenger vehicles. The traffic-related impact analysis in this FEIS is based on toll rates that, for passenger cars with transponders, would range from $1.00 during the off-peak to $2.00 during the peak travel times (in 2006 dollars).

1.2.2.5 Transportation System and Demand Management Measures

Many well-coordinated transportation demand management (TDM) and transportation system management (TSM) programs are already in place in the Portland-Vancouver Metropolitan region and supported by agencies and adopted plans. In most cases, the impetus for the programs is from state-mandated programs: Oregon's Employee Commute Options (ECO) rule and Washington's Commute Trip Reduction (CTR) law.

The physical and operational elements of the CRC project provide the greatest TDM opportunities by promoting other modes to fulfill more of the travel needs in the project corridor. These include:

- Major new light rail line in exclusive right-of-way, as well as express bus and feeder routes;
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians, and improve connectivity, safety, and travel time;
- Park and ride lots and garages; and
- A variable toll on the highway crossing.

In addition to these fundamental elements of the project, facilities and equipment would be implemented that could help existing or expanded TSM programs maximize capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs or other traveler information systems in the CRC project area;
- Expanded incident response capabilities;
- Queue jumps or bypass lanes for transit vehicles where multi-lane approaches are provided at ramp signals for entrance ramps;
- Expanded traveler information systems with additional traffic monitoring equipment and cameras, and
- Active traffic management.

1.2.3 LPA Construction

Construction of bridges over the Columbia River is the most substantial element of the project, and this element sets the sequencing for other project components. The main river crossing and immediately adjacent highway improvement elements would account for the majority of the construction activity necessary to complete this project.

1.2.3.1 Construction Activities Sequence and Duration

The following table (Exhibit 1-2) displays the expected duration and major details of each element of the project. Due to construction sequencing requirements, the timeline to complete the initial phase of the LPA with highway phasing is the same as the full LPA.

Exhibit 1-2. Construction Activities and Estimated Duration

Element	Estimated Duration	Details
Columbia River bridges	4 years	• Construction is likely to begin with the bridges. • General sequence includes initial preparation, installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
Hayden Island and SR 14 interchanges	1.5 - 4 years for each interchange	• Each interchange must be partially constructed before any traffic can be transferred to the new structure. • Each interchange needs to be completed at the same time.
Marine Drive interchange	3 years	• Construction would need to be coordinated with construction of the southbound lanes coming from Vancouver.
Demolition of the existing bridges	1.5 years	• Demolition of the existing bridges can begin only after traffic is rerouted to the new bridges.
Three interchanges north of SR 14	4 years for all three	• Construction of these interchanges could be independent from each other or from the southern half of the project. • More aggressive and costly staging could shorten this timeframe.
Light rail	4 years	• The river crossing for the light rail would be built with the bridges. • Any bridge structure work would be separate from the actual light rail construction activities and must be completed first.
Total Construction Timeline	6.3 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work, weather, materials, and equipment, could all influence construction duration. • This is also the same time required to complete the smallest usable segment of roadway – Hayden Island through SR 14 interchanges.

1.2.3.2 Major Staging Sites and Casting Yards

Staging of equipment and materials would occur in many areas along the project corridor throughout construction, generally within existing or newly purchased right-of-way or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Suitable sites must be large and open to provide for heavy machinery and material storage, must have 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 must have roadway or rail access for landside transportation of materials by truck or train.

Three sites have been identified as possible major staging areas:

1. Port of Vancouver (Parcel 1A) site in Vancouver: This 52-acre site is located along SR 501 and near the Port of Vancouver's Terminal 3 North facility.

2. Red Lion at the Quay hotel site in Vancouver: This site would be partially acquired for construction of the Columbia River crossing, which would require the demolition of the building on this site, leaving approximately 2.6 acres for possible staging.
3. Vacant Thunderbird hotel site on Hayden Island: This 5.6-acre site is much like the Red Lion hotel site in that a large portion of the parcel is already required for new right-of-way necessary for the LPA.

A casting/staging yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, including either a slip or a dock capable of handling heavy equipment and material; a large area suitable for a concrete batch plant and associated heavy machinery and equipment; and access to a highway and/or railway for delivery of materials.

Two sites have been identified as possible casting/staging yards:

1. Port of Vancouver Alcoa/Evergreen West site: This 95-acre site was previously home to an aluminum factory and is currently undergoing environmental remediation, which should be completed before construction of the CRC project begins (2012). The western portion of this site is best suited for a casting yard.
2. Sundial site: This 50-acre site is located between Fairview and Troutdale, just north of the Troutdale Airport, and has direct access to the Columbia River. There is an existing barge slip at this location that would not have to undergo substantial improvements.

1.2.4 The No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2030 if the CRC project is not built. This alternative makes the same assumptions as the build alternatives regarding population and employment growth through 2030, and also assumes that the same transportation and land use projects in the region would occur as planned. The No-Build Alternative also includes several major land use changes that are planned within the project area, such as the Riverwest development just south of Evergreen Boulevard and west of I-5, the Columbia West Renaissance project along the western waterfront in downtown Vancouver, and redevelopment of the Jantzen Beach shopping center on Hayden Island. All traffic and transit projects within or near the CRC project area that are anticipated to be built by 2030 separately from this project are included in the No-Build and build alternatives. Additionally, the No-Build Alternative assumes bridge repair and continuing maintenance costs to the existing bridge that are not anticipated with the replacement bridge option.

1.3 Long-term Effects

The long-term effects to wetlands and waters resulting from the project include decreased vegetated wetland buffer areas, increased impervious surface areas, and placement of fill and other alterations of waters of the states and the United States (U.S.).

The LPA results in impacts, with either Option A or Option B, of approximately 0.02 acre to the buffers of Wetland H. Wetland H is in the Burnt Bridge Creek Watershed, west of the intersection of NE 45th St and NE Leverich Park Way, on the east side of I-5 in the City of Vancouver.

A potentially jurisdictional water area (PJWA) is located in the Burnt Bridge Creek watershed, west of I-5 in the Kiggins Bowl area in the City of Vancouver; both LPA Option A and Option B impacts approximately 0.31 acre of the PJWA I buffer.

LPA Option A impacts 1.30 acres of PJWA O located between N Marine Drive and N Vancouver Way (PJWA O); PJWA O is not impacted by Option B.

The Columbia River flows from east to west through the project area, between the Cities of Portland and Vancouver. The LPA impacts approximately 1.33 acres of the Columbia River, and 0.15 acres of North Portland Harbor.

Exhibit 1-3. Buffers and Other Waters of the State and U.S. Impacts Summary

Wetland/Water Name	Location	No-Build Alternative[a]	LPA	
			Option A	Option B
Wetland H – 80-ft. buffer	Washington	0.00	0.02	0.02
PJWA I – 50-ft. buffer[a]	Washington	0.00	0.31	0.31
Total Wetland Buffer Impacts		**0.00**	**0.33 acre**	**0.33 acre**
PJWA-O – wetland	Oregon	0.00	1.30	N/A
N Portland Harbor	Oregon	0.00	0.15	0.15
Columbia River	Oregon/Washington	0.00	1.33	1.33
Total Wetland / Waterways Impacts:		**0.00**	**2.78**	**1.48**
Total Impact to Wetlands, Wetland Buffers, and Waterways:		**0.00 acre**	**3.11 acres**	**1.81 acres**

a In Washington, 0.09 acre of potentially jurisdictional ditches will be affected by the cut/fill and edge of pavement of the project.

Permanent bridge piers in the Columbia River for replacement bridges would cover an area of 1.48 acres and displace a volume of 60,300 cubic yards.

Project construction may directly degrade water quality due to lost vegetation and increased impervious surfaces within watersheds intersected by the project. However, long-term improvements to water quality would be realized through improved stormwater treatment of runoff from new and retrofitted impervious surfaces. For more information on water quality and stormwater impacts, see the Water Quality and Hydrology Technical Report. Section 4 of this technical report discusses long-term effects in more detail.

Differences in wetland and waters impacts with highway phasing: The impacts described above would occur with the LPA Full Build. Option A impacts an undeveloped parcel (PJWA O) that is suspected of being wetland. Refusal to grant CRC right-of-entry preclude verification, so the entire affected area is assumed to be wetland until verified in the field. Option B does not affect PJWA O. Certain components of the project may be phased and constructed at a later unknown date. Delaying the construction of these components would not result in changes to affected wetlands, wetland buffers, and waterways. The No-Build Alternative would result in no additional effects to wetlands and other waters of the states and U.S.

1.4 Temporary Effects

Temporary construction impacts are expected to occur where project construction, including construction of staging and casting yards, is in the vicinity of wetlands or their vegetated buffers and in waters of the states and U.S. Because best management practices (BMP) will be employed during construction, temporary effects to wetlands can largely be avoided. However, all wetlands and other waters that are directly impacted may have some unavoidable temporary impacts such as disrupted wildlife activity and reduced water quality.

Temporary effects to the Columbia River are unavoidable for the project and depend on construction methods and timing. For more discussion of temporary effects to the Columbia River, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report. Section 5 of this technical report discusses temporary effects in more detail.

The No-Build Alternative would result in no temporary effects to wetlands and other waters of the states and U.S.

1.5 Proposed Mitigation

Mitigation of impacts to jurisdictional waters take the form of BMPs, conservation measures, avoidance/minimization measures, or creation, restoration, or enhancement of wetlands or waters to offset losses due to the project. Standard construction BMPs and conservation measures would be implemented in the build alternatives to avoid impacts to wetlands and waters from construction activities. Designs have avoided and/or minimized impacts to existing wetland and water resources.

Mitigation to offset losses is explored in detail in section 6 of this technical report. Mitigation would likely occur in areas with existing hydric soils that are in close proximity to existing wetland resources, and that are not proposed for development. Compensatory mitigation for impacts to waters would likely occur at or near the project site, but may be located several miles away if uplift in functions and values are more certain to occur at a more distant site. Mitigation for buffer impacts will be via revegetation of those areas to an equal or better function. Final compensatory mitigation measures will be addressed through coordination and permit reviews by regulatory agencies.

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2. Methods

2.1 Introduction

This section describes the approach and methods used to collect data and evaluate impacts to jurisdictional wetlands and waters for the CRC project alternatives. The analysis was developed to comply with the NEPA, applicable state environmental policy legislation, and local and state policies, standards and regulations.

This section addresses the following questions:

- How was the study area, the area of potential impact (API), defined?
- What methods and data were used to determine the location and function of jurisdictional wetlands and waters within the API?
- How were potential short- and long-term impacts on jurisdictional wetlands and waters identified and analyzed, and what constitutes a significant impact?
- How is mitigation identified and analyzed?

2.2 Study Area

This evaluation examines the primary and secondary APIs as shown in Exhibit 2-1. In addition, the Ruby Junction light rail vehicle maintenance base site in Gresham, Oregon was evaluated. The primary API addresses direct impacts and is similar across technical disciplines. The secondary API represents areas where indirect effects could occur from the proposed project. The APIs used for this analysis are shown in Exhibit 2-1 and are described below. These areas may change during the course of the analysis as the project alternative matures and as technical studies evolve.

2.2.1 Primary API

The primary API contains the natural resources most likely to experience direct impacts from the construction and operation of the LPA. Direct physical changes in the landscape will likely be limited to this area, though mitigation strategies can be applied outside of it.

As currently defined, the primary API extends about five miles from north to south. It starts at the I-5/SR 500 interchange in Washington, and extends just south of the I-5/Victory Avenue interchange in Oregon. At its northern end the API expands west into downtown Vancouver, and east near Clark College to include the proposed light rail transit alignments and park and ride locations. Heading south along the existing bridge alignment, the primary API extends 0.25 mile from either side of the I-5 river crossing. South of the river crossing, this width narrows to 300 feet on either side of the I-5 right-of-way.

2.2.2 Secondary API

The secondary API represents the area where the LPA could influence travel patterns, and therefore the area where indirect impacts (e.g., traffic and development changes) could occur from the LPA. The study team relied primarily on existing data sources to evaluate indirect project impacts.

Currently, the secondary API, over 15 miles long, starts one mile north of the I-5/I-205 interchange and ends near the I-5/I-84 interchange. The secondary API also extends one mile east and west of the I-5 right-of-way. Traffic projections for alternative alignments will continue to help determine the geographic extent of potential indirect impacts.

2.2.3 Ruby Junction Maintenance Facility

Ruby Junction is an existing TriMet operations and maintenance facility located in Gresham, Oregon, along NW Eleven Mile Ave, south of E Burnside. The expansion of the current Ruby Junction Maintenance Facility for the CRC project would require the acquisition of up to 15 parcels.

2.3 Effects Guidelines

The project team coordinated with federal, state, and local resource agencies on multiple occasions to determine the significance of impacts to jurisdictional wetlands and waters. Potentially significant impacts to wetlands and waters evaluated by this approach include:

- Modification of hydrologic regimes, destruction of a wetland or its designated buffer vegetation, and/or destruction or fill of the wetland that results in:
  - Any significant adverse change in function of the wetland or its designated buffer.
  - Significant degradation in the quality of the wetland or its designated buffer.
- Substantial disturbance within a wetland or designated wetland buffer that provides habitat for a special-status species.
- Loss of a substantial portion of the total area of wetlands within the primary API.
- Impacts to a wetland or its designated buffer that cannot be mitigated.
- Net loss of wetland function caused by the project.

PRELIMINARY

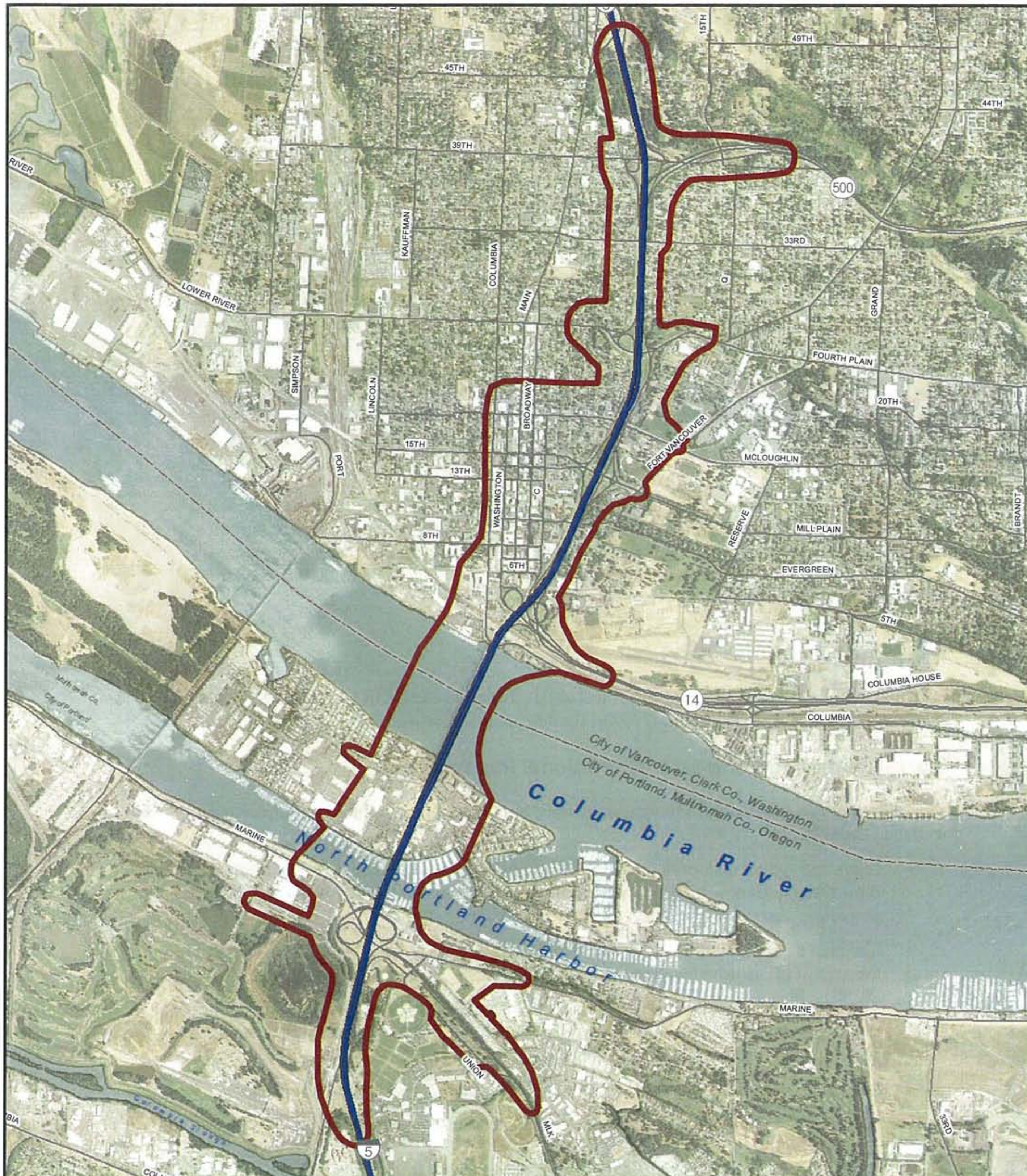


Exhibit 2-1. Area of Potential Impact

Columbia River CROSSING

2.4 Data Collection Methods

Jurisdictional wetlands and waters within the primary API were identified, and wetland conditions characterized, as the basis for evaluating potential project impacts. Boundaries of jurisdictional wetlands and waters within the primary API were delineated (USACE 1987, USACE 2008 supplement) and wetland functional assessments were performed. Wetlands extending outside of the API boundary were considered in their entirety. Methods suitable for delineating wetlands in both Oregon and Washington were implemented. Wetland boundaries were recorded with a high-accuracy (sub-meter) global positioning system (GPS) receiver and wetlands were classified in both states using the Cowardin classification method (Cowardin et al. 1979). The indicator status of vegetation within sample areas was determined using the List of Plant Species that Occur in Wetlands (Reed 1993). Wetland functions were assessed using the Washington rating system as described in Hruby (2004), and the Oregon Hydrogeomorphic (HGM) Judgmental Method as described in Adamus (2001). Current literature on wetland resources was reviewed, including information on existing compensatory wetland mitigation sites.

Using the information gathered from existing maps, literature, field delineation, and spot verification, revised wetlands maps were produced showing wetland boundaries within the primary API. Right-of-entry was not available for PJWA O. Because this area is currently unimproved and because the potential for wetland functions exist, PJWA O is assumed to be wetland until verified otherwise.

2.5 Analysis Methods

Potential cumulative effects from this project are evaluated in the DEIS Cumulative Effects Technical Report. Please refer to this report for an evaluation of possible cumulative effects.

2.5.1 Identifying Long-term Operational Impacts

The following process was used to determine long-term operational impacts on jurisdictional wetlands and waters:

- Maps and spatial data of delineated wetland boundaries, protected wetlands, and designated buffers were used to determine sensitive areas that may be impacted by the project.
- The area of impacts to wetlands and designated buffers was quantified and compared to the area of undisturbed wetlands within the APIs.
- The Oregon HGM and Washington wetland rating systems were used during delineations to provide numerical measures for wetland function. These measures were then used for quality comparisons and impact analysis.
- Local, state, and federal biologists were consulted to discuss potential impacts.
- Potential beneficial impacts of the proposed alternatives were identified.

2.5.2 Identifying Short-term Construction Impacts

The following process was used to determine short-term construction impacts on jurisdictional wetlands and waters:

- Maps and spatial data of delineated wetland boundaries, protected wetlands, and designated buffers were used to determine sensitive areas that may be impacted by the project.
- The Oregon HGM and Washington wetland rating systems were used during delineations to provide numerical measures for wetland function. These measures were then used for quality comparisons and impact analysis.
- The area of high quality wetlands and designated buffers affected by the proposed alternatives was quantified.
- Local, state, and federal biologists were interviewed to discuss potential impacts.

2.5.3 Identifying Cumulative Impacts

Cumulative impacts may occur when a project's effects are combined with those from past, present, and reasonably foreseeable future projects. They can also result from individually small but collectively significant actions that occur over a long period of time.

2.5.4 Identifying Mitigation Measures

Bi-state coordination occurred to identify best mitigation measures for impacts to jurisdictional wetlands and waters. The intent of this analysis was to explore mitigation measures that are consistent with the mitigation policies and requirements of both states. This analysis involved exploring the following strategies for mitigating impacts on jurisdictional wetlands and waters:

- Avoid the impact through design modification or by not taking a certain action or parts of an action (discussed in Section 6 of this document).
- Identify and evaluate ways to minimize impacts to wetlands. Research and identify BMPs (discussed in Section 6 of this document).
- Consider BMPs and potential mitigation needs with input from local, state, and federal agencies.
- Rectify temporary impacts by repairing, rehabilitating, or restoring the affected resource.
- Reduce or eliminate the impact over time by preservation and maintenance operations.
- Compensate for permanent impacts by replacing, enhancing, or providing substitute resources or environments.

Compensation for unavoidable impacts will be consistent with U.S. Army Corps of Engineers (USACE), DSL, Washington Department of Ecology (Ecology), the City of Portland, Clark County, and the City of Vancouver rules for wetland mitigation. Priority will be given to on-site compensatory mitigation first, but will also consider off-site mitigation options where appropriate. In choosing between the two options, the likelihood for success, ecological sustainability, practicability of long-term monitoring and maintenance, and relative costs will be evaluated. The mitigation goal is to fully replace wetland functions and values; emphasis will also be put on preserving and restoring wetlands that provide habitat for fish and wildlife.

2.6 Coordination

The CRC project team, together with state and federal resource agencies, FHWA and FTA, formed the Interstate Collaborative Environmental Process (InterCEP) Agreement, in order to coordinate various state and federal environmental regulatory issues through the NEPA process.

Through the InterCEP, coordination with representatives of DSL, Ecology, and USACE, among others, occurred over several meetings between 2005 and 2010. The three agencies named above agreed upon the methodology to be used for wetlands fieldwork and reporting.

The InterCEP process also gave these agencies the opportunity to review and comment on, and ultimately concur with project Evaluation Criteria used to screen alternatives, and the Range of Alternatives carried into the DEIS.

Additional coordination with Ecology and USACE will occur in order to determine jurisdiction of wetlands and waters within the project area. A wetland delineation report for the Oregon portion of the project was submitted for concurrence to the Oregon Department of State Lands (DSL) in summer 2008. It was concurred with in September 2008(DSL #WD 2008-0205) (Appendix A).

3. Affected Environment

3.1 Introduction

The project area is in northwestern Oregon and southwestern Washington and is bisected by the Columbia River. Exhibit 3-1 shows the project area, including the primary and secondary APIs. The project area encompasses portions of the Columbia Slough watershed, the Columbia River, the Willamette River, and Burnt Bridge Creek watershed.

3.2 Regional Conditions

The central project area is highly urbanized with some remnant wetlands and other waters. Natural Resources Conservation Service (NRCS) soils maps (Exhibit 3-2 and Exhibit 3-3) show large areas of hydric soils, especially in the North Portland area. The National Wetlands Inventory (NWI) maps wetlands throughout the region (Exhibit 3-4 and Exhibit 3-5).

East and west of the project area there are large wetland systems including the Columbia Slough, Vanport Wetland, Force Lake, Smith and Bybee Lakes, West Hayden Island wetlands, and Vancouver Lake wetlands. Southeast of the project area, the Columbia Slough watershed has scattered wetlands and other waters present within the urban matrix. The Salmon Creek watershed, north of the project, has similar characteristics. These large systems are remnants of the historic system of wetlands, sloughs, and marshes that once occupied most of the project area. Although they are somewhat cut off from each other and the larger Columbia River system due to urbanization of the area, they perform many functions and have a high value due to their rarity and wildlife value.

3.3 Columbia Slough Watershed

The project area intersects approximately 69.51 acres of the Columbia Slough watershed. The Columbia Slough is a slow-moving, low-gradient drainage canal running nearly 19 miles from Fairview Lake in the east to the Willamette River in the west. Running roughly parallel to the Columbia River, the Slough is a remnant of the historic system of lakes, wetlands, and channels that dominated the south floodplain of the Columbia River. The eastern sections of Slough are now intensively managed to provide drainage and flood control with dikes, pumps, weirs, and levees (FHWA and ODOT 2005). The western section of Slough has a free and open connection to the Willamette River, and is tidally influenced. The Columbia Slough Watershed drains approximately 37,741 acres in portions of Portland, Troutdale, Fairview, Gresham, Maywood Park, Wood Village, and Multnomah County (unincorporated areas), and is separated into lower, middle, and upper Columbia Slough.

I-5 crosses the western section of Slough at RM 6.5 in a highly urbanized area. The predominant land use around the Slough in the project vicinity is light industrial, with some residential. The Slough connects to the Willamette River approximately 6.5 miles west of the project area, within a mile of the confluence of the Columbia and Willamette Rivers.

Anadromous fish can access Lower Columbia Slough up to an impassable levee near NE 18th Avenue (RM 8.3). At Smith and Bybee Lakes in the Lower Columbia Slough, a water control structure allows fish passage.

3.3.1 Mapped Soils

In the Columbia Slough Watershed in Oregon, mapped soils include Rafton silt loam, protected (40); Sauvie-Rafton-Urban land complex, 0 to 3 percent slopes (47A); and Water (W) (Exhibit 3-2).

Rafton silt loam, protected and Sauvie-Rafton-Urban land complex, 0 to 3 percent slopes are hydric soils.

3.3.2 Mapped Wetlands

Available NWI data indicate five palustrine wetlands within the intersection of the project area and the Columbia Slough watershed (Exhibit 3-4). Vanport Wetland, located south of N. Marine Drive and west of I-5, is mapped as a palustrine emergent, seasonally flooded (PEMC) wetland. Three small wetlands within East Delta Park are mapped as palustrine unconsolidated bottom, permanently flooded, excavated (PUBHx) wetlands. A palustrine scrub-shrub, seasonally flooded PSSC-PEMC-PUBHx wetland complex is mapped primarily east of I-5 along N Whitaker Road between N Victory Boulevard and N Schmeer Road. This wetland extends west under I-5, just north of N Schmeer Road.

3.3.3 Identified Wetlands and Waters of the State and U.S.

There are seven wetland systems and a potentially jurisdictional ditch within the intersection of the project area and the Columbia Slough watershed. The two wetland areas not included in NWI data are Wetland A and Wetland System L/M.

3.3.3.1 Waters of the State and U.S.

A potentially jurisdictional ditch is adjacent to Wetland System L/M. The ditch enters the Wetland System from the north and the south and is conducted to Vanport Wetlands through two culverts that pass under N Expo Road. The ditch is located at the toe of slope from the existing highway roadway prism. It receives stormwater from the prism slope and from the TriMet tracks. It was not considered a jurisdictional resource by DSL, but is likely jurisdictional under current USACE protocol.

3.3.3.2 Wetlands

Wetland areas are identified alphabetically, in the order in which they were identified in the field or using off-site data. As property access permission was not obtained sequentially, wetland areas are not named sequentially. Exhibit 3-6 shows the locations of these features.

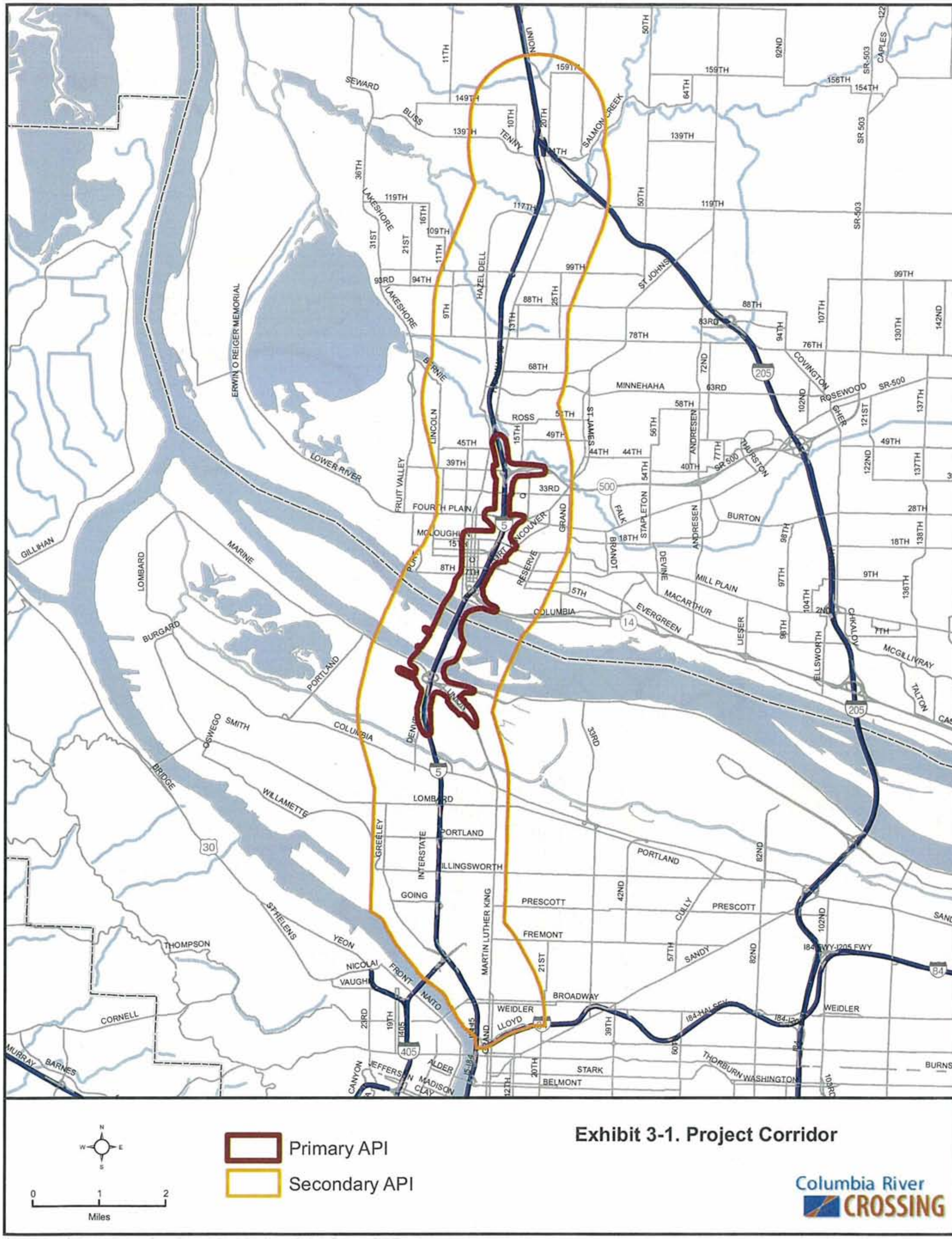
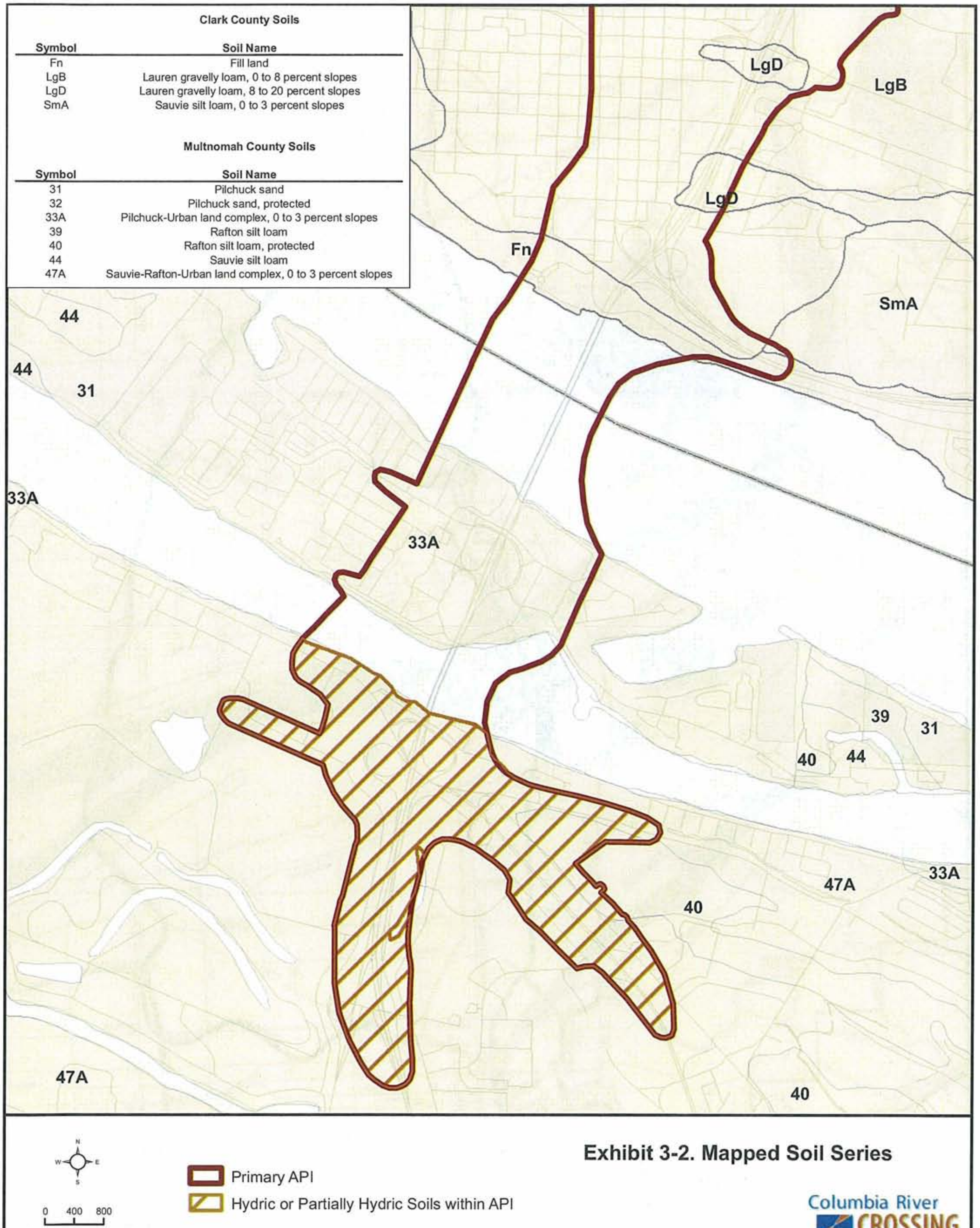


Exhibit 3-1. Project Corridor



Clark County Soils

Symbol	Soil Name
Fn	Fill land
LgB	Lauren gravelly loam, 0 to 8 percent slopes
LgD	Lauren gravelly loam, 8 to 20 percent slopes
SmA	Sauvie silt loam, 0 to 3 percent slopes

Multnomah County Soils

Symbol	Soil Name
31	Pilchuck sand
32	Pilchuck sand, protected
33A	Pilchuck-Urban land complex, 0 to 3 percent slopes
39	Rafton silt loam
40	Rafton silt loam, protected
44	Sauvie silt loam
47A	Sauvie-Rafton-Urban land complex, 0 to 3 percent slopes

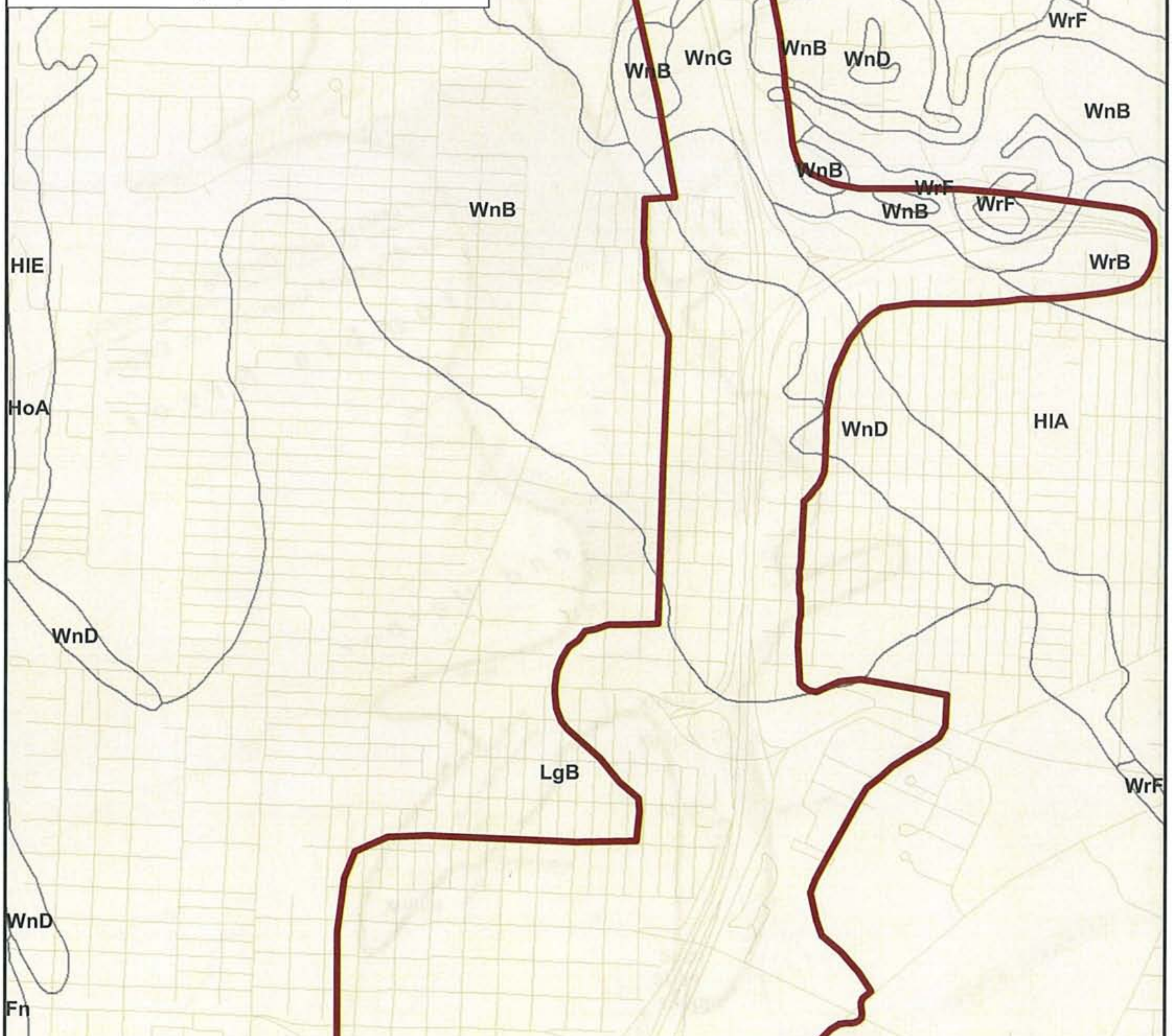
Exhibit 3-2. Mapped Soil Series

Columbia River CROSSING

Source: Natural Resources Conservation Service Soils Database

Clark County Soils

Symbol	Soil Name
Fn	Fill land
HIA	Hillsboro silt loam, 0 to 3 percent slopes
HIB	Hillsboro loam, 3 to 8 percent slopes
HIC	Hillsboro loam, 8 to 15 percent slopes
HIE	Hillsboro loam, 20 to 30 percent slopes
HoA	Hillsboro silt loam, 0 to 3 percent slopes
LgB	Lauren gravelly loam, 0 to 8 percent slopes
WnB	Wind River sandy loam, 0 to 8 percent slopes
WnD	Wind River sandy loam, 8 to 20 percent slopes
WnG	Wind River sandy loam, 30 to 65 percent slopes
WrB	Wind River gravelly loam, 0 to 8 percent slopes
WrF	Wind River gravelly loam, 12 to 50 percent slopes



Primary API

Hydric or Partially Hydric Soils within API

0 300 600
Feet

Exhibit 3-3. Mapped Soil Series

Columbia River CROSSING

Source: Natural Resources Conservation Service Soils Database

Symbol	Wetland Type
PEMC	Palustrine Emergent
PUBHX	Palustrine Unconsolidated bottom
PSSC	Palustrine Scrub-Shrub
PEMC	Palustrine Emergent
R1UBV	Riverine Tidal Unconsolidated bottom

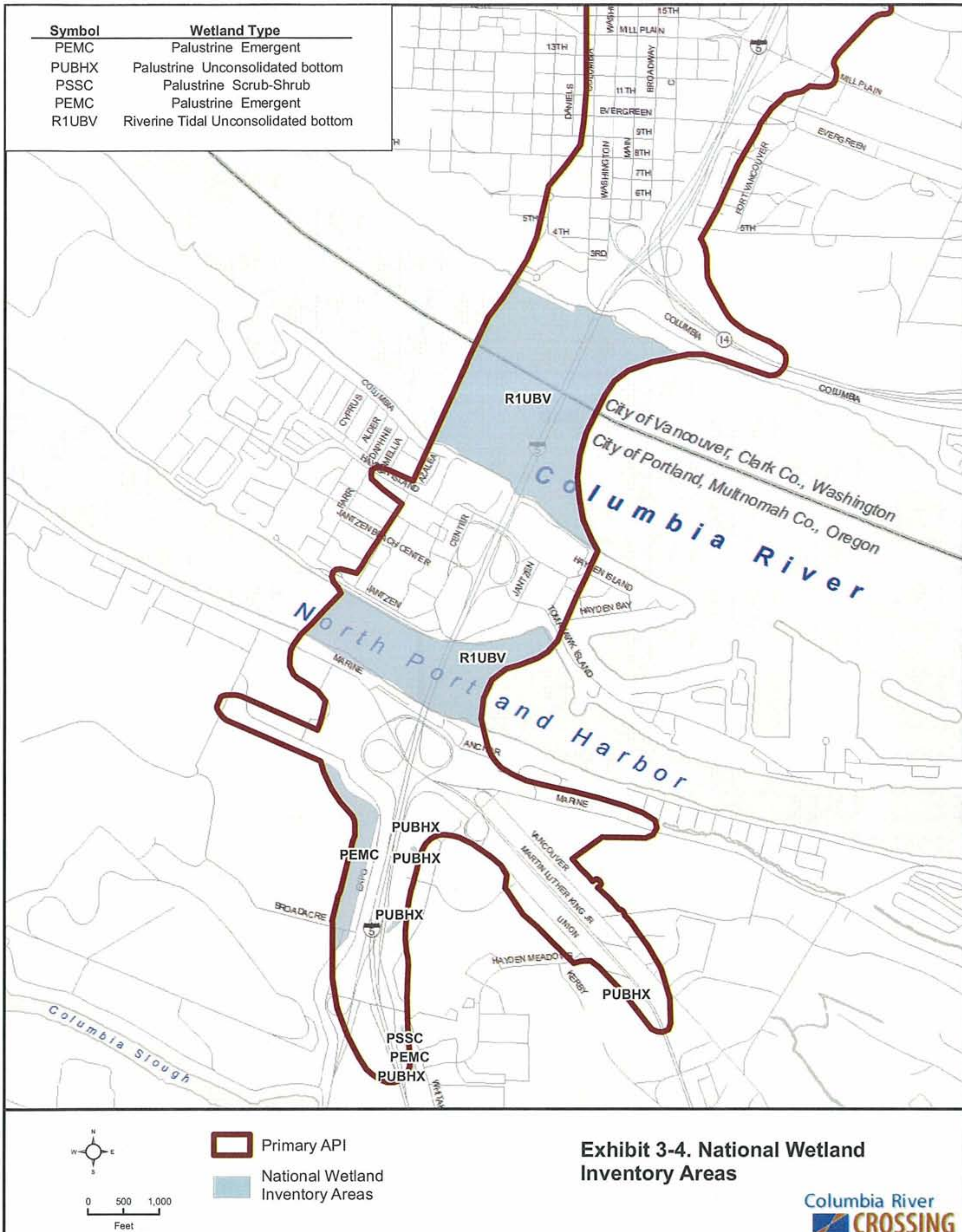
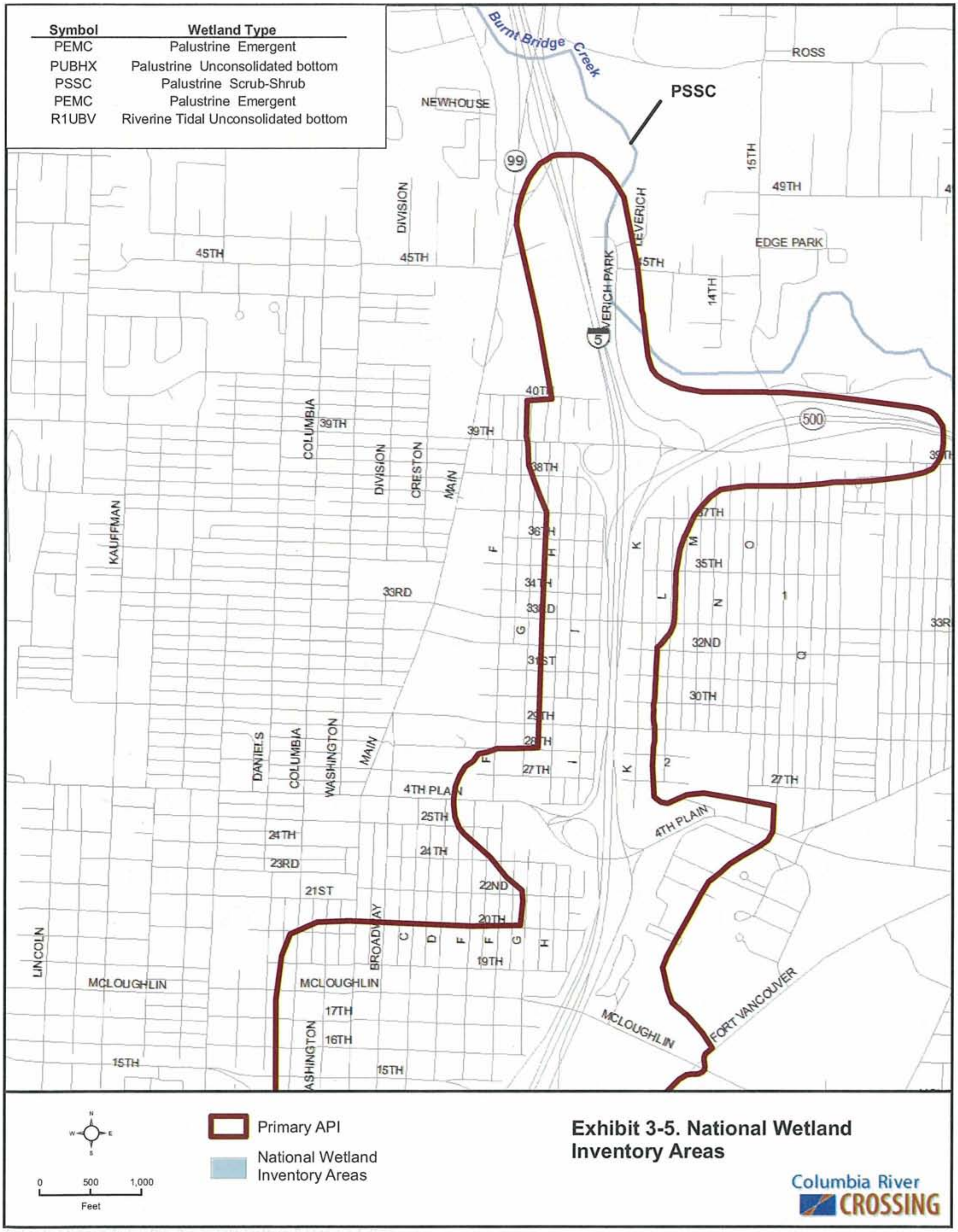


Exhibit 3-4. National Wetland Inventory Areas

Columbia River CROSSING



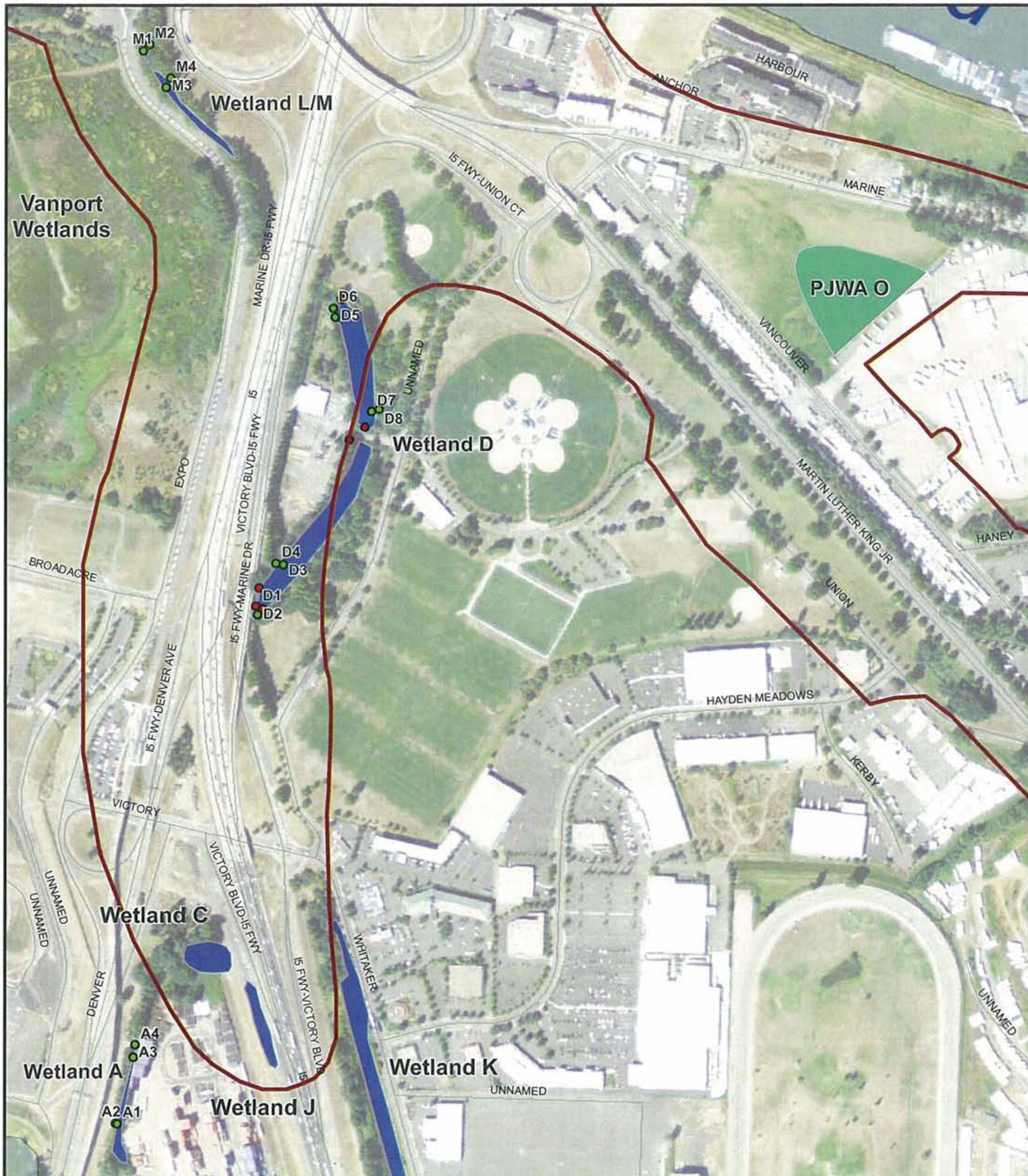
Primary API

National Wetland Inventory Areas

Exhibit 3-5. National Wetland Inventory Areas

Columbia River CROSSING

PRELIMINARY



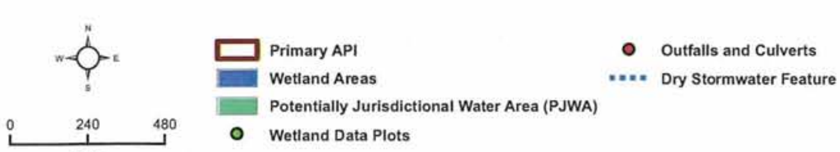


Exhibit 3-6. Field Identified Wetlands

Columbia River CROSSING

Source: Locally Identified Wetlands = Clark Co. and Metro; Project Delineated Wetlands = Columbia River Crossing (Parametrix)

Wetland System L/M is a set of two palustrine, forested, seasonally flooded (PFOC) wetlands approximately 0.339 acres in size (Exhibit 3-6). It is within a City of Portland environmental zone. The HGM classification is Flats. Wetland System L/M is southwest of the southbound I-5 entrance ramp at Marine Drive and northeast of the TriMet light rail tracks at the Expo Center. The NWI does not map a wetland in the vicinity of wetland system L/M. The wetland appears to be part of a stormwater system and has two stormwater culverts for overflow from the wetland, one at the northwestern end and one at the southern end of the wetland system. Both culverts appear to drain to the Vanport Wetlands, west of the wetland area. A potentially jurisdictional stormwater ditch enters the Wetland System from the north and the south. See Section 3.3.3.1 Waters of the State and U.S. for further details. The boundary of wetland system L/M was determined by topography and a change in vegetation from wetland to upland species.

Wetland System L/M is dominated by *Salix lasiandra* (FACW), *Populus balsamifera* ssp. *trichocarpa* (FAC), *Rubus armenicus* (FACU), and *Phalaris arundinacea* (FACW). Indicators of wetland hydrology present at the time of survey include watermarks, water-stained leaves, and surface organic pan. Soils are sandy (no color assessment), with redox concentrations and an organic pan.

The upland areas around wetland system L/M are dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC) and *Rubus armenicus* (FACU). No indicators of wetland hydrology were present at the time of survey. Soils are sandy, without redox concentrations or an organic pan.

Wetland System L/M received moderate to low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland System L/M are water storage and delay and primary production.

Exhibit 3-7. Oregon HGM and Washington Rating System Results for Wetlands in the Columbia Slough Watershed, Oregon

Wetland	A	C	D	J	K	L/M	Vanport	O[a]
Wetland Function	**Oregon HGM**							
Water Storage and Delay	0.45	0.5	0.6	0.5	0.5	0.5	0.75	n/a
Sediment Stabilization and Phosphorus Retention	0.36	0.4	0.38	0.4	0.4	0.28	0.56	n/a
Nitrogen Removal	0.34	0.27	0.37	0.27	0.3	0.28	0.41	n/a
Thermoregulation	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Primary Production	0.42	0.36	0.44	0.36	0.42	0.36	0.44	n/a
Resident Fish Habitat Support	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Anadromous Fish Habitat Support	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Invertebrate Habitat Support	0.31	0.27	0.37	0.27	0.33	0.27	0.4	n/a
Amphibian and Turtle Habitat	0.27	0.25	0.38	0.25	0.3	0.32	0.39	n/a
Breeding Water Bird Support	0.19	0.19	0.28	0.19	0.25	0.18	0.57	n/a
Wintering and Migrating Waterbird Support	0.24	0.26	0.36	0.26	0.32	0.25	0.55	n/a
Songbird Habitat Support	0.25	0.22	0.45	0.22	0.23	0.25	0.57	n/a
Support of Characteristic Vegetation	0.24	0.25	0.42	0.21	0.5	0.5	0.55	n/a
	Washington Rating System							

Wetland	A	C	D	J	K	L/M	Vanport	O[a]
Water Quality	14	14	10	14	14	14	26	n/a
Hydrological	16	10	16	10	10	16	24	n/a
Habitat	9	4	15	6	10	8	22	n/a

a Functional assessment of potential wetland area O has not been performed due to recent addition of this area into the project area and missing right of entry permission.

Vanport Wetland is on the west side of I-5, west and south of N Expo Road (Exhibit 3-6). This wetland is a palustrine forested/scrub-shrub/emergent system managed as a mitigation site by the Port of Portland. Vanport Wetland is mapped by the NWI as a palustrine emergent, seasonally flooded (PEMC) wetland. It is located within a City of Portland environmental zone. The wetland was not delineated by project staff.

Vanport Wetlands received mostly moderate and one high HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Vanport Wetlands are water storage and delay, breeding water bird support, and songbird habitat support.

Wetland A is a palustrine forested, seasonal/semipermanently flooded (PFOC/F) wetland and occupies approximately 0.32 acre within the project area (Exhibit 3-6). It is not located within a City of Portland environmental zone. The HGM classification is depressional closed permanent (DCP). It is located in the southwest end of the Oregon project area. It is immediately east of N Denver Avenue and the Interstate light rail line, north of N Schmeer Road, and west of a shipping container yard. The NWI does not map a wetland in the vicinity of Wetland A. Wetland A is a linear feature, paralleling N Denver Avenue. The wetland experiences seasonal flooding in the northern portion of the wetland and semi-permanent flooding in the southern portion. The northern and western edges of the wetland were determined through topography and a shift from wetland plant species to upland vegetation. The eastern edge of the wetland was determined through topography and vegetation in some areas; in other areas the pavement associated with the container yard defined the boundary. The southern edge of the wetland was determined through aerial photograph interpretation as it could not be accessed due to lack of right of entry permission. As this property is not directly impacted by any of the build alternatives, more precise boundary mapping is not necessary for impacts analysis.

Wetland A is dominated by *Salix lasiandra* (FACW), *Populus balsamifera* ssp. *trichocarpa* (FAC), *Salix* sp. (generally FAC or wetter), *Phalaris arundinacea* (FACW), *Equisetum arvense* (FAC), and *Rubus armenicus* (FACU). Wetland hydrology is indicated by free water and saturation in the upper 12 inches of soil, watermarks, sediment deposits, and water-stained leaves. Soils exhibit low chroma colors (10YR 3/2 and 10YR 3/1) with redox concentrations.

The wetland occurs at the base of the N Denver Avenue roadway prism. It is constrained by the roadway prism slope to the west and a shipping container yard to the east. There is no apparent outlet from the wetland; however, the southernmost edge of the wetland could not be viewed due to access restrictions. Due to the presence of stagnant surface water at the time of survey, it is unlikely that a permanent outlet is present.

The upland areas adjacent to Wetland A are characterized by the presence of *Salix lasiandra* (FACW), *Populus balsamifera* ssp. *trichocarpa* (FAC), *Rubus armenicus* (FACU), and *Phalaris arundinacea* (FACW). No hydrologic indicators were observed at the time of survey. Soils in upland plots are very dark grayish brown (10YR 3/2) without redox concentrations.

Wetland A received moderate to low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland A were water storage and delay and primary production.

Wetland C (David Evans & Associates [DEA] Wetland 1, Appendix B) is a palustrine, forested wetland and occupies approximately 0.1 acre within the project area. It is west of I-5, and in close proximity to the southbound highway entrance ramp at Victory Boulevard. It is not located within a City of Portland environmental zone. The boundary of Wetland C was determined by a shift from the presence of wetland hydrological indicators to the absence of indicators and a change in vegetation from wetland to upland species (DEA 2006).

Wetland C is dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC), *Rubus discolor* (FACU), *Equisetum arvense* (FAC), and *Phalaris arundinacea* (FACW). Indicators of wetland hydrology include sediment deposits, cracked soils, and drainage patterns. Soils exhibit low chroma colors (10YR 3/1 and 10YR 4/1) with redox concentrations (DEA 2006).

The upland areas adjacent to Wetland C are dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC), *Populus nigra* (NOL), *Rubus discolor* (FACU), and *Festuca arundinacea* (FAC). There are no indicators of wetland hydrology in upland areas. Soils exhibit low chroma colors (10YR 3/1 and 10YR 4/1) with redox concentrations (DEA 2006).

Wetland C received moderate to low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland C are water storage and delay and sediment stabilization and phosphorous retention.

Wetland J (DEA Wetland 2, Appendix B) is a palustrine emergent wetland and occupies approximately 0.1 acre within the project area. It is a linear wetland along the base of the I-5 roadway prism. It is along the west side of I-5, south of Victory Boulevard. It is not within a City of Portland environmental zone. The boundary of Wetland J was determined by topography (toe of slope), a shift from the presence of wetland hydrological indicators to the absence of indicators, and a change in vegetation from wetland to upland species (DEA 2006).

Wetland J is dominated by *Phalaris arundinacea* (FACW). *Juncus effusus* (FACW) is a subdominant species. Wetland hydrology indicators present include saturated soils and drainage patterns. Soils are gleyed (Gley 1, 3/10GY) clay with many redox concentrations (DEA 2006).

The upland area around Wetland J is dominated by *Rubus discolor* (FACU), *Cytisus scoparius* (UPL), *Rubus ursinus* (FACU), and *Phalaris arundinacea* (FACW). No indicators of wetland hydrology were present in upland areas at the time of survey. Soils in upland plots are very dark grayish brown (10YR 4/2) with redox concentrations (DEA 2006).

Wetland J received moderate to low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland J are water storage and delay and sediment stabilization and phosphorous retention.

Wetland D is a palustrine, forested/scrub-shrub/emergent, permanently flooded, excavated (PFO/SS/EMHx) wetland and is approximately 2.668 acre (Exhibit 3-6). It is in the northeast corner of the Oregon API within Delta Park (City of Portland). It is within a City of Portland environmental zone. It consists of two small, oblong ponds connected by a culvert under a City of Portland Parks and Recreation access road. The wetland receives stormwater from a culvert on the north end and from overland flow. Wetland D drains to Schmeer Slough through a storm drain pipe at the south end of the wetland. The HGM classification is depressional. The NWI maps three palustrine, unconsolidated bottom, permanently flooded, excavated (PUBHx) wetlands in the vicinity of Wetland D. The northernmost of the NWI mapped wetlands is not present. The area is without any wetland indicators. The boundary of Wetland D was determined by topography and a change in vegetation from wetland to upland species.

Wetland D is dominated by *Fraxinus latifolia* (FACW), *Populus balsamifera* ssp. *trichocarpa* (FAC), *Salix babylonica* (FAC), *Salix hookeriana* (FACW), *Salix sitchensis* (FACW), *Carex obnupta* (OBL), *Bidens cernua* (FACW), and *Phalaris arundinacea* (FACW). Wetland hydrology is demonstrated by free water and saturation in the upper 12 inches of soil, watermarks, and drift lines. The soils exhibit low chroma colors (10YR 2/1 and 10YR 3/1) with redox concentrations.

The upland areas adjacent to Wetland D are characterized by *Alnus rubra* (FAC), *Fraxinus latifolia* (FACW), *Populus balsamifera* ssp. *trichocarpa* (FAC), *Prunus virginiana* (FACU), *Acer circinatum* (FAC), *Rubus armenicus* (FACU), *Symphoricarpos albus* (FACU), and *Phalaris arundinacea* (FACW). No indicators of wetland hydrology were present at the time of survey. Soils in upland plots are very dark brown and very dark grayish brown (10YR 2/2 and 10YR 3/2) without redox concentrations.

Wetland D received moderate and one low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland D are water storage and delay and songbird habitat support.

Wetland K (DEA Wetland 3 – Schmeer Slough, Appendix B) is a deep excavated ditch with water levels managed by the Multnomah County Drainage District. This wetland historically has been dredged by Multnomah County Drainage District. It occupies approximately 2.5 acres within the project area. Wetland K is east of I-5 with a portion wrapping under the highway overpass at Schmeer Road. It is within a City of Portland environmental zone. The boundary of Wetland K was determined by topography (toe of slope), a shift from the presence of wetland hydrological indicators to the absence of indicators, and a change in vegetation from wetland to upland species (DEA 2006).

Wetland K is dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC), *Salix lasiandra* (FACW), *Rubus ursinus* (FACU), *Bromus carinatus* (NOL), *Elymus glaucus* (FACU), *Phalaris arundinacea* (FACW), *Hordeum brachyantherum* (FACW), and *Equisetum arvense* (FAC), with plantings of *Fraxinus latifolia* (FACW) and *Ribes* sp. (assumed FAC) contributing to the understory. The water level within Schmeer Slough is controlled between 2.0 and 2.5 feet (NGVD). Indicators of wetland hydrology in higher elevation portions of Wetland K include drainage patterns and sediment deposits. Wetland indicators in lower elevations, near the ordinary high water mark of Schmeer Slough include soil saturation at the surface, watermarks, drift lines, and sediment deposits. Soils exhibit low chroma colors (10YR 5/1 and 10YR 4/1) with redox concentrations (DEA 2006).

The upland areas around Wetland K are dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC), *Sambucus racemosa* (FACU), *Rubus armenicus* (FACU), *Equisetum arvense* (FAC), *Bromus carinatus* (NOL), *Elymus glaucus* (FACU), and *Phalaris arundinacea* (FACW). No indicators of wetland hydrology were present in upland areas at the time of survey. Soils in upland plots are very dark grayish brown (10YR 3/2) with redox concentrations (DEA 2006).

Wetland K received moderate to low HGM ratings for all functions evaluated. As shown in Exhibit 3-7, the highest rated functions for Wetland K are water storage and delay and sediment stabilization and phosphorous retention.

Potential Wetland O: Due to recent changes in project alignment, an unsurveyed area is present between N Marine Drive and N Vancouver Way, immediately east of the intersection. The NWI does not show wetlands in this area. It is not within a City of Portland environmental zone. Soils mapped by NRCS are Rafton silt loam, protected (40), a hydric soil.

3.4 Columbia River

The project area intersects approximately 146.48 acres of the Columbia River/Columbia Slope watershed.

The I-5 bridges are at RM 106 of the Columbia River. The action area, as it occurs within the Columbia River, extends from RM 101 to 118. Ten bridge footings are currently located below OHW.

The Columbia River within the action area is highly altered by human disturbance. Urbanization extends up to the shoreline. There has been extensive removal of historic streamside forests and wetlands. Riparian areas have been further degraded by the construction of dikes and levees and the placement of stream bank armoring. For several decades, industrial, residential, and upstream agricultural sources have contributed to profound water quality degradation in the river. Additionally, the river receives high levels of disturbance in the form of heavy barge traffic.

The Columbia River is a highly managed stream that more resembles a series of slack water lakes rather than its original free-flowing state due to existing dams upstream of the API. The upper end of the action area is below Bonneville Dam, which is a major factor in down-stream water discharge and quality. The major second factor regulating stream flow in the action area is tidal influence from the Pacific Ocean. Although the salt water wedge does not extend into the action area, high tide events affect flow and stage in the Columbia up to Bonneville Dam at river mile 146.1.

3.4.1 Mapped Soils

In the Columbia River watershed (including Hayden Island and the Columbia Slope Watershed in Washington) mapped soils include Pilchuck-urban land complex, 0 to 3 percent slopes (33A); Fill land (Fn); Lauren gravelly loam, 0 to 8 percent slopes (LgB); Lauren gravelly loam, 8 to 20 percent slopes (LgD); Wind River sandy loam, 0 to 8 percent slopes (WnB); Sauvie silt loam, 0 to 3 percent slopes (SmA); and Water (W) (Exhibit 3-2).

3.4.2 Mapped Wetlands

The NWI maps the Columbia River (including the North Portland Harbor) as a riverine tidal, unconsolidated bottom, permanent-tidal (R1UBV) wetland.

The Clark County Wetland Inventory maps the Columbia River as a wetland area.

3.4.3 Identified Wetlands and Waters of the State and U.S.

There is one regulated waterway of the State and U.S, the Columbia River, within the Primary API in the Columbia River/Columbia Slope watershed. The Columbia River (including the North Portland Harbor), flows from east to west through the project area. It is considered a traditional navigable water. It is the primary hydrologic feature of the project. For more detailed discussion of this water of the State and U.S., refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report. The City of Portland includes the Columbia River in its Environmental Zone overlay. The City of Vancouver/State of Washington considers the Columbia River a critical area and a shoreline management area.

3.5 Burnt Bridge Creek Watershed

The project area intersects approximately 25.51 acres of the Burnt Bridge Creek watershed.

Burnt Bridge Creek is a small perennial tributary to the lower Columbia River. It originates near the Mill Plain suburb east of Vancouver, Washington and flows west (roughly paralleling SR 500 for approximately 5 miles) to its outlet at Vancouver Lake. The lake drains to the lower Columbia River via Lake River. I-5 crosses Burnt Bridge Creek at approximately RM 2.

3.5.1 Mapped Soils

In the Burnt Bridge Creek Watershed mapped soils include Lauren gravelly loam, 0 to 8 percent slopes (LgB); Hillsboro loam, 0 to 3 percent slopes (HIA); Wind River sandy loam, 0 to 8 percent slopes (WnB); Wind River sandy loam, 8 to 20 percent slopes (WnD); Wind River sandy loam, 30 to 65 percent slopes (WnG); Wind River gravelly loam, 0 to 8 percent slopes (WrB); and Wind River gravelly loam, 12 to 50 percent slopes (WrF) (Exhibit 3-3).

3.5.2 Mapped Wetlands

The NWI maps one wetland feature within the intersection of the project area and the Burnt Bridge Creek watershed (Exhibit 3-5). Burnt Bridge Creek, a perennial stream, was mapped as a PSSC wetland.

The Clark County Wetland Inventory mapped wetlands in the northeastern portion of the Primary API within the Burnt Bridge Creek watershed. Several linear wetland features are mapped within the I-5 right-of-way in the vicinity of the I-5/Highway 99 interchange. Wetlands are mapped intermittently along Burnt Bridge Creek. One additional wetlands is mapped southeast of the I-5/SR 500 interchange. These features are shown in Exhibit 3-8.

3.5.3 Identified Wetlands and Waters of the State and U.S.

There are two delineated wetland systems, one mitigation site, two stormwater treatment pond systems, one potentially regulated waters of the State and U.S., and one water of the State and U.S. within the Burnt Bridge Creek portion of the Primary API. These features are shown in Exhibit 3-8.

Waters of the State and U.S.

Burnt Bridge Creek flows from southeast to northwest through the project area, passing under I-5 through a culvert. For further discussion of this water of the State and U.S., refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

PJWA I is in the Kiggins Bowl area immediately west of I-5, north of 39th Street, on Vancouver School District property (Exhibit 3-8). PJWA I appears to be part of an existing drainage system. A stormwater conveyance system on Main Street discharges into a ditch traveling from the intersection of Main Street and 45th Street east towards PJWA I along an access road to Kiggins Bowl. The ditch discharges through a culvert to a steep slope on the northwest side of PJWA I. There is no defined channel east of the culvert discharge area. PJWA I also likely receives stormwater from the surrounding area, including I-5 and the school grounds. There is an additional discharge culvert on the southwest side of PJWA I. It is unclear where this culvert initiates. It discharges to the northeast, towards PJWA I. Riprap is present immediately below the culvert discharge area; however there is no defined channel east of the riprap.

PRELIMINARY

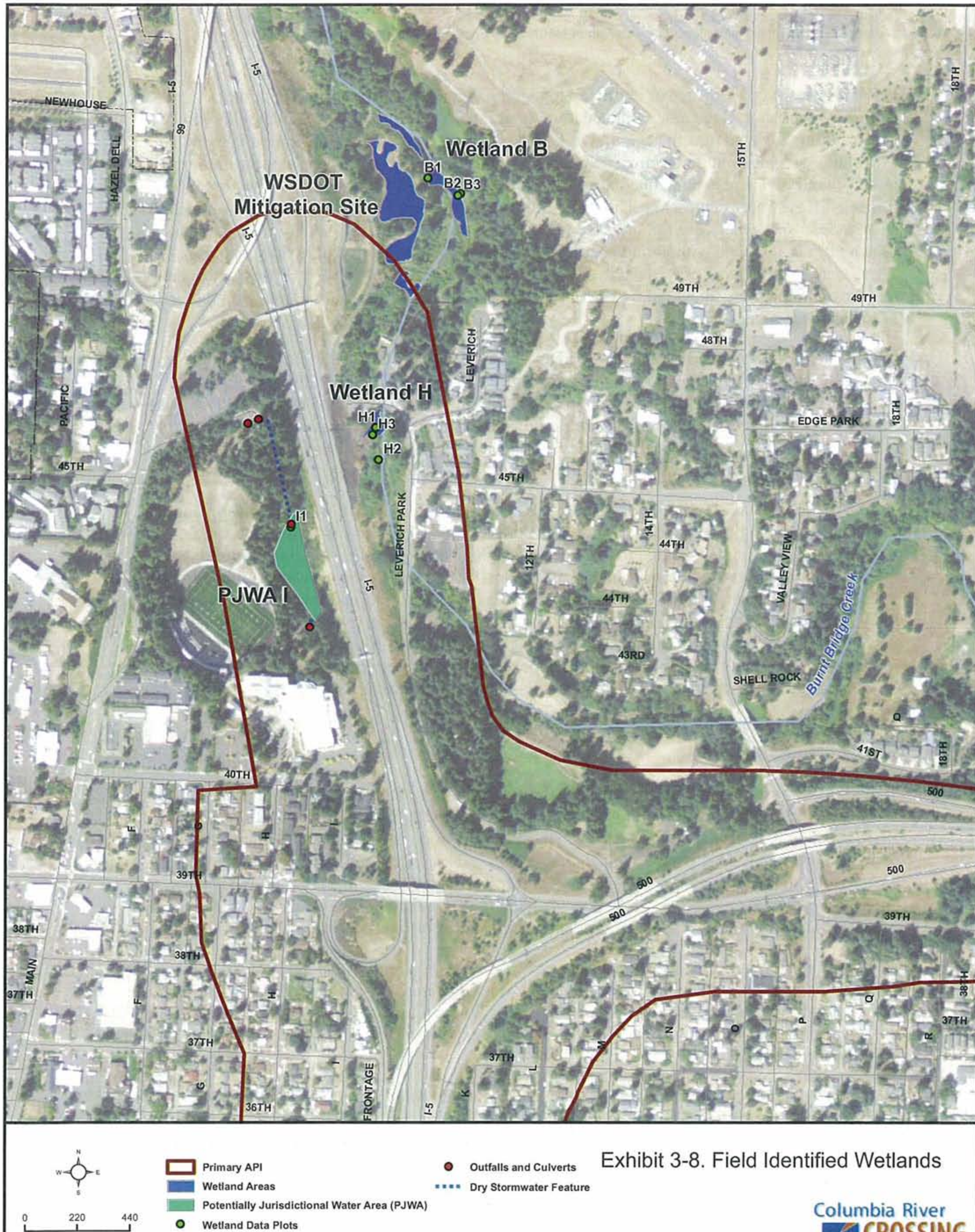


Exhibit 3-8. Field Identified Wetlands

Source: Locally Identified Wetlands = Clark Co. and Metro; Project Delineated Wetlands = Columbia River Crossing (Parametrix)

PJWA I is at the convergence of two steep topographic grades; one associated with the I-5 roadway prism and the other with a natural grade starting at the edge of the school grounds. The resulting low area runs in a parallel direction to I-5. The surveyed sample point is in the lowest topographic point in the area, near a culvert passing under I-5 and presumably draining into Wetland H. There is no defined drainage channel in the area; however, the valley bottom forms a diffuse linear depression. The area is dominated by *Populus balsamifera* ssp. *trichocarpa* (FAC), *Salix* sp. (generally FAC or wetter), and *Phalaris arundinacea* (FACW). Soils are dark brown (10YR 3/3) sand without redox concentrations or other indicators of hydric conditions. There were no indicators of wetland hydrology present at the time of survey. However, this area may be considered jurisdictional by USACE and/or Ecology. Further coordination with these agencies is required.

Stormwater detention ponds within the WSDOT right-of-way, immediately east of I-5 at the Main Street/NE Highway 99 – I-5 interchange and northeast of the SR 500/NE 15th Avenue interchange (Exhibit 3-8), have not been investigated. Information provided by WSDOT indicates that the Main Street stormwater ponds are designed to infiltrate. They contain surface water and/or discharge to the WSDOT mitigation site (Section 3.5.3.1) several times a year. The ponds receive 100 percent of the run-off from 39th Street to 78th Street along I-5.

Within the project area, Burnt Bridge Creek is on Ecology's 303(d) list for fecal coliform and temperature (Ecology 2007). Ecology has not approved any TMDLs for Burnt Bridge Creek. Some stormwater runoff is routed to the creek through pipes and ditches, but most runoff is discharged into the ground through buried infiltration facilities. Three stormwater outfalls from I-5 discharge into Burnt Bridge Creek: —one on the eastern side of I-5 and two on the western side of I-5. Runoff from I-5 at the north of the SR 500 interchange area is routed to a retention pond east of I-5 and south of the Main Street interchange. Retained runoff usually evaporates or infiltrates, and releases to Burnt Bridge Creek only occur during peak runoff events. Runoff from SR 500 east of I-5 flows to a detention pond at NE 15th Avenue before being released to Burnt Bridge Creek.

3.5.3.1 Wetlands

Wetland B is east of Burnt Bridge Creek in the northeast portion of the project area in Washington. It is a palustrine, scrub-shrub/emergent, seasonally flooded (PSS/EMC) wetland approximately 0.33 acre (Exhibit 3-8). The HGM classification is riverine impounding (RI). It is between the Burnt Bridge Creek channel and an unpaved access road. The wetland experiences seasonal flooding associated with high flows in Burnt Bridge Creek and a high ground water table. The NWI does not map a wetland in the vicinity of Wetland B. The boundary of Wetland B was determined by topography and a change in vegetation from wetland to upland species.

Wetland B is dominated by *Physocarpus capitatus* (FACW), *Rubus armenicus* (FACU), *Cornus stolonifera* (FACW), *Phalaris arundinacea* (FACW), *Impatiens noli-tangere* (FACW), *Veronica americana* (OBL), and *Epilobium ciliatum* (FACW). Wetland hydrology is demonstrated by drift lines, watermarks, and water-stained leaves. The soils exhibit low chroma colors (10YR 2/1) with redox concentrations.

The upland areas adjacent to Wetland B are characterized by *Rubus armenicus* (FACU), *Physocarpus capitatus* (FACW), *Cornus stolonifera* (FACW), and *Phalaris arundinacea* (FACW). No indicators of wetland hydrology were present at the time of survey. Soils exhibit high chroma colors (10YR 3/3) without redox concentrations.

As shown in Exhibit 3-9, Wetland B received a water quality rating of 16, a hydrological rating of 18, and a habitat rating of 15. The total rating for Wetland B is 49, making it a Category III wetland.

Exhibit 3-9. Washington State Wetland Rating System Results for Western Washington

	Wetland B	Wetland H	PJWA I[a]	WSDOT Mitigation Site
Washington Rating System				
Water Quality	16	16	8	14
Hydrological	18	18	4	16
Habitat	15	10	14	22
Total	49	44	26	52
Category	3	3	4	2

a HGM and rating assessments for PJWA I are preliminary estimates. Additional coordination and field assessment of these areas is necessary.

The **WSDOT mitigation site**, east of I-5 and stormwater detention ponds and described in Section 4.4.4, consists of three wetland areas totaling approximately 1.5 acres (Exhibit 3-8). It is a palustrine, scrub-shrub/emergent, seasonally flooded (PSS/EMC) wetland, constructed on both sides of Burnt Bridge Creek. It was designed to receive stormwater input from the stormwater detention ponds described below. The mitigation site receives stormwater from the detention ponds several times a year. Water from the mitigation site is released to Burnt Bridge Creek. The NWI does not map a wetland in the vicinity of the mitigation site.

The mitigation site is still within its permit period and WSDOT provided recent wetland monitoring data for use in this technical report. As the site is still within the establishment phase, this information is not considered final. The wetland areas are dominated by *Phalaris arundinacea* (FACW), *Alopecurus pratensis* (FACW), and planted shrubs including *Cornus stolonifera* (FACW), *Ribes sanguineum* (NOL), *Rubus spectabilis* (FAC), and *Symphoricarpos albus* (FACU). Signs of wetland hydrology include saturation in the upper 12 inches and drainage patterns in wetlands. Soils exhibited low chroma colors with redox concentrations and concretions.

As shown in Exhibit 3-9, assessment of the WSDOT mitigation site performed by WSDOT staff resulted in a water quality rating of 14, a hydrological rating of 16, and a habitat rating of 22. The total rating for the WSDOT mitigation site is 52, making it a Category II wetland.

Wetland H is a palustrine emergent, temporarily flooded (PEMA) wetland and is approximately 0.122 acre in size (Exhibit 3-8). The HGM classification is Riverine impounding (RI). Wetland H is northwest of Leverich Park, on the west side of Burnt Bridge Creek, east of I-5. The NWI does not map a wetland in the vicinity of Wetland H. The boundary of Wetland H was determined by a shift from the presence of wetland hydrological indicators to the absence of indicators. The wetland receives water from a stormwater culvert passing under I-5 and from the adjacent Burnt Bridge Creek.

Wetland H is dominated by *Phalaris arundinacea* (FACW), *Polygonum hydropiper* (OBL), and *Polygonum persicaria* (FACW). Indicators of wetland hydrology present at the time of survey include saturation in the upper 12 inches of soil, watermarks, and drainage patterns. Soils exhibit low chroma colors (10YR 3/2) with redox concentrations.

The adjacent upland areas are dominated by *Cornus stolonifera* (FACW), *Corylus cornuta* (FACU), *Rubus armenicus* (FACU), and *Phalaris arundinacea* (FACW). No indicators of wetland hydrology were present at the time of survey. Soils are very dark grayish brown (10YR 3/2) with redox concentrations.

As shown in Exhibit 3-9, Wetland H received a water quality rating of 16, a hydrological rating of 18, and a habitat rating of 10. The total rating for Wetland H is 44, making it a Category III wetland.

Wetland F is a non-jurisdictional feature based on evidence that it formed on an elevated median constructed as part of the original SR 500 project (Exhibit 3-9). Per WSDOT Guidance for Delineating Wetlands, Streams, and Buffers adjacent to roadway prisms, an elevated (filled) median between two roadway surfaces is considered part of the roadway prism and is, therefore, exempt for USACE and local jurisdiction (WSDOT 2008). As-built design sheets dated August 27, 1982 show the area correlating to Wetland F as having been filled during construction Appendix B).

Wetland F functions as a small palustrine, emergent, seasonally flooded (PEMC) wetland approximately 0.437 acres in size. The wetland is located between the SR 500 eastbound on-ramp and 39th Street (Exhibit 3-8). The western end of the wetland has a stormwater outlet. The HGM classification is depressional. The NWI does not map a wetland in the vicinity of Wetland F. The boundary of Wetland F was determined by topography and a change in vegetation from wetland to upland species.

Water Area G is located between SR-500 and the eastbound SR-500 entrance ramp from P Street (Exhibit 3-9). Water Area G is a non-jurisdictional feature based on evidence that it formed on an elevated median constructed as part of the original SR 500 project. Per WSDOT Guidance for Delineating Wetlands, Streams, and Buffers adjacent to roadway prisms, an elevated (filled) median between two roadway surfaces is considered part of the roadway prism and is, therefore, exempt for USACE and local jurisdiction (WSDOT 2008). As-built design sheets from August 27, 1982 show the area correlating to Water Area G as having been filled during construction (Appendix B).

This feature is a drainage ditch with a stormwater drain at the western end. Runoff from the ditch is conveyed to a stormwater detention pond north of SR 500 before being discharged into Burnt Bridge Creek.

Exhibit 3-10. Oregon HGM and Washington Rating System Results for Wetlands in Burnt Bridge Creek Watershed, Washington

	Wetland B	Wetland H	PJWA I[a]	WSDOT Mitigation Site
Wetland Functions				
Water storage and delay	0.4	0.4	0.40	0.45
Sediment stabilization and phosphorus retention	0.5	0.42	0.40	0.41
Nitrogen removal	0.33	0.27	0.23	0.26
Thermoregulation	n/a	n/a	n/a	n/a
Primary production	0.6	0.46	0.42	0.44
Resident fish habitat support	n/a	n/a	n/a	n/a

	Wetland B	Wetland H	PJWA I[a]	WSDOT Mitigation Site
Anadromous fish habitat support	n/a	n/a	n/a	n/a
Invertebrate habitat support	0.4	0.3	0.24	0.29
Amphibian and turtle habitat support	0.41	0.26	0.28	0.34
Breeding water bird support	0.41	0.25	0.19	0.41
Wintering and migrating water bird support	0.41	0.29	0.24	0.39
Songbird habitat support	0.53	0.32	0.28	0.48
Support of characteristic vegetation	0.46	0.26	0.30	0.44
Water quality	16	16	8	14
Hydrological	18	18	4	16
Habitat	15	10	14	22

a HGM and Rating assessments for PJWA-G and PJWA I are preliminary estimates. Additional coordination and field assessment of these areas is necessary.

3.6 Maintenance Base Stations

The Ruby Junction Maintenance Facility is in Gresham, Oregon, and would provide repair and maintenance for light rail vehicles. The Ruby Junction site is included in the analysis below.

3.6.1 Mapped Soils

Soils mapped within the vicinity of the Ruby Junction Maintenance Base (**Error! Reference source not found.**) include Multnomah silt loam, 0 to 3 percent slopes (29A), Multnomah silt loam, 8 to 15 percent slopes (29C), Multnomah silt loam, 15 to 30 percent slopes (29D), Multnomah-Urban land complex, 0 to 3 percent slopes (30A), Pits (PT), and Wapato silt loam (55). Wapato silt loam is a hydric soil.

3.6.2 Mapped Wetlands and Other Waters

The NWI (USFWS 1988a) mapped several palustrine, unconsolidated bottom, permanently flooded, excavated (PUBHx) wetlands; two palustrine unconsolidated shore, seasonally flooded, excavated (PUSCx) wetlands; and one palustrine emergent, seasonally flooded, excavated (PEMCx) wetland west and southwest of the Ruby Junction area (**Error! Reference source not found.**).

The NWI and United States Geological Survey (USGS) mapped Fairview Creek in the Vicinity of the Ruby Junction Maintenance Base. The Creek flows generally from southwest to northwest, passing south of the Ruby Junction Maintenance Base. It connects to the Columbia River through Osborn Creek and the Columbia Slough.

3.6.3 Wetland and Other Waters Identified

Hydric soils are mapped under a portion of the Ruby Junction maintenance facility. Air photo examination confirmed the presence of several permanent wetland features west and southwest of the Ruby Junction Maintenance Facility and of Fairview Creek. The wetlands appear to be excavated quarries. Fairview Creek was also identified on the air photo and appears to be highly constrained by the surrounding urban landscape. The wetland and creek are both outside the area potentially impacted by Ruby Junction expansion.

3.7 Staging and Casting Yards/Sites

The staging and casting yards/sites have not been subject to field study. The following information is based on NWI and soils maps and should, therefore, be considered preliminary. The extent of wetlands shown on NWI maps of these areas should be treated cautiously given the high degree of historic site manipulation and changes to base conditions caused by levees, excavation, and flood control measures. In many areas, the extent of wetlands shown on NWI maps is likely greater than the extent of jurisdictional wetlands if studied and measured by field verification (Exhibit 3-12).

Port of Vancouver - Alcoa/Evergreen West Site:

The NWI (USFWS 1988a) mapped several palustrine, unconsolidated bottom, artificially flooded, excavated (PUBKx) wetlands; palustrine unconsolidated bottom, permanently flooded, excavated (PUBHx); and palustrine emergent, seasonally flooded, (PEMC) and palustrine emergent, temporarily flooded (PEMA) wetlands (Exhibit 3-12).

Soils mapped for this area include Newberg silt loam (NbA) and Pilchuck fine sand (PhB). Neither of these soils are classified as hydric soils.

Port of Vancouver - Parcel 1A Site:

The NWI (USFWS 1988a) mapped palustrine emergent, seasonally flooded, (PEMC) and palustrine emergent, temporarily flooded (PEMA) wetlands over most of this site. The southwest corner includes a small palustrine forested, seasonally flooded (PFOC) wetland map unit (Exhibit 3-12).

Soils mapped for this area include Sauvie silty clay loam (SpB) and Newberg silt loam (NbA). Sauvie silty clay loam is classified as a hydric soil.

Sundial Site:

There are no wetlands mapped at the Sundial site. Hydric soils are mapped over approximately 80% of the site. The area consists entirely of paved surfaces, buildings and infrastructure, and landscaped vegetation (Exhibit 3-12).

Soils mapped by NRCS soil survey include Pilchuck sand (31) and Faloma silt loam (15). Faloma silt loam is classified as a hydric soil.

Red Lion at the Quay Hotel Site:

There are no wetlands and no hydric soils mapped at the Red Lion at the Quay Hotel site. The area consists entirely of paved surfaces, buildings and infrastructure, and landscaped vegetation (Exhibit 3-12).

Thunderbird Hotel Site:

There are no wetlands and no hydric soils mapped at the Thunderbird Hotel site. The area consists entirely of paved surfaces, buildings and infrastructure, and landscaped vegetation (Exhibit 3-12).

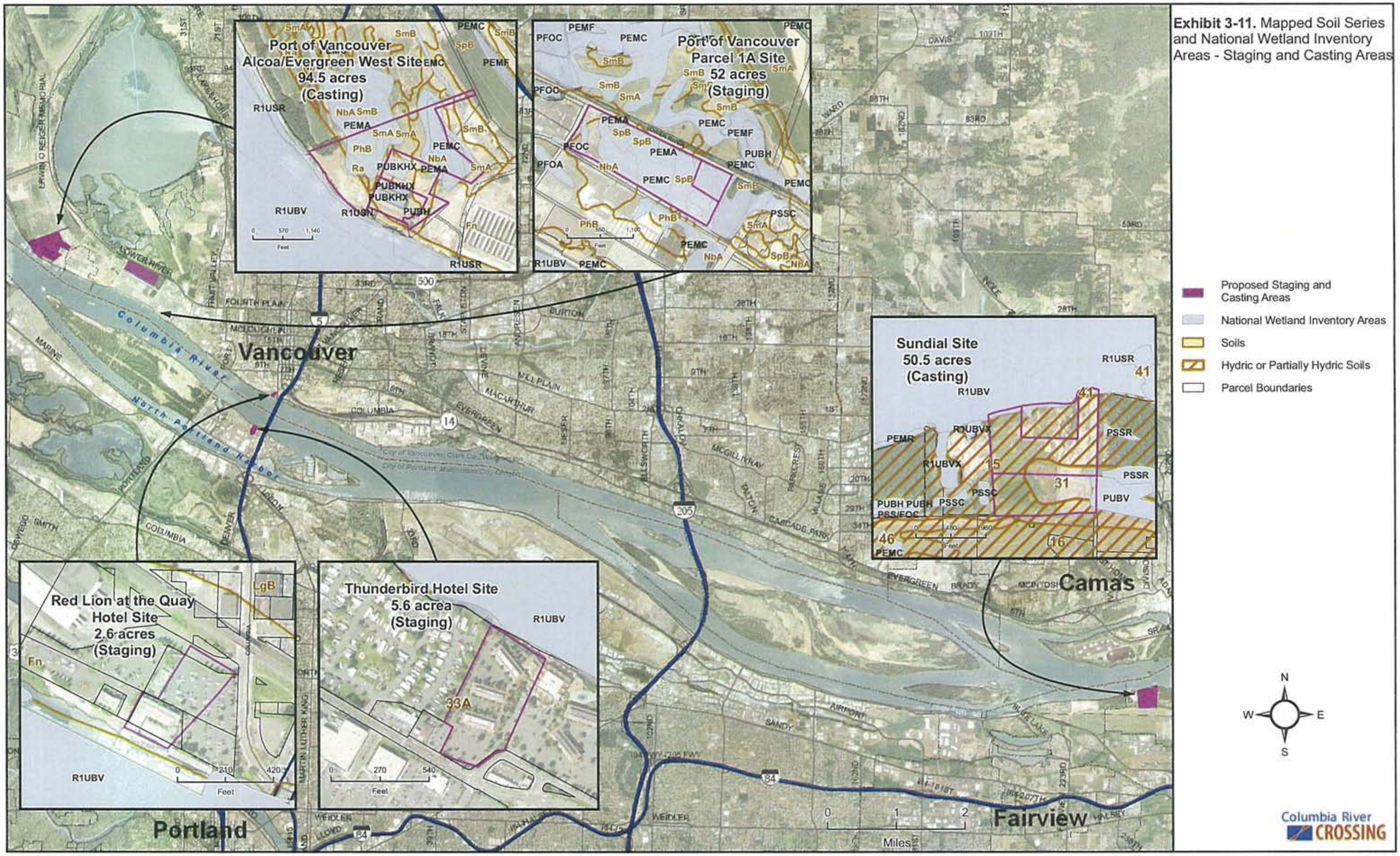


Exhibit 3-11. Mapped Soil Series and National Wetland Inventory Areas - Staging and Casting Areas
Proposed Staging and Casting Areas
National Wetland Inventory Areas
Soils
Hydric or Partially Hydric Soils
Parcel Boundaries
Port of Vancouver Alcoa/Evergreen West Site 94.5 acres (Casting)
Port of Vancouver Parcel 1A Site 52 acres (Staging)
Sundial Site 50.5 acres (Casting)
Red Lion at the Quay Hotel Site 2.6 acres (Staging)
Thunderbird Hotel Site 5.6 acrea (Staging)
Vancouver
Portland
Camas
Fairview
Columbia River
North Portland Harbor
0 1 2 Miles
N
W
E
S
Columbia River CROSSING

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4. Long-term Effects

4.1 Introduction

This chapter describes long-term impacts expected from the I-5 CRC alternatives and options. It first describes impacts from the No-Build Alternative and locally preferred alternative. The LPA includes specific highway, transit, bicycle, pedestrian and other elements. This discussion focuses on how the LPA would affect corridor and regional impacts for both options A and B of the LPA.

4.2 Regional Long-term Effects

This section describes the impacts from the No-Build Alternative and LPA Option A and LPA Option B. Both long-term direct impacts and indirect impacts are discussed in this section.

Long-term direct impacts occur when the selected alternative results in removal or fill within jurisdictional wetlands, regulated wetland buffers, or other waters of the State or U.S. These impacts are quantifiable and are discussed in units of area and volume where that information is available. In addition, long-term direct impacts to wetlands are discussed in terms of their specific wetland functions and values (DSL) and ratings (Ecology).

Less easily quantifiable direct impacts to wetlands would potentially occur:

- Where improved public access to wetland areas resulting from the alignment may introduce nuisance plant species, disrupt wildlife activity and other functions performed by existing wetlands; and
- Where permanent bridge piers alter flow patterns.

Indirect impacts to wetlands and other waters of the State and U.S. would potentially occur:

- Where the selected alternative comes within the buffer area of existing wetlands (usually between 25 to 300 feet), disturbing natural resources and vegetation cover;
- Where there is decrease in vegetation cover, an increase in impervious surfaces (without associated stormwater treatment), or traffic volumes associated with the alternatives in the immediate vicinity of existing wetlands.

A vegetated area immediately surrounding a wetland provides a buffer from detrimental land uses. Vegetated buffers can provide water quality, hydrological, and wildlife habitat benefits. Adequate wetland buffer zones are highly dependent upon local topography and other landscape features such as permeability and complexity.

Increased impervious surface areas associated with new or improved roadways, infrastructure, and other developments not proposed as part of the CRC project could occur with any of the alternatives. In most cases, stormwater treatment would be required and provided. However, stormwater runoff or other contaminants could reach wetlands if the increased impervious surface area is in close proximity to the wetland area. In addition, increased traffic volumes or changes in traffic patterns are likely to occur with the alternatives as a result of non-CRC construction activities, alternative designs, or population growth. Increases in traffic volume or trip time in the vicinity of wetlands could result in increased contaminant load in stormwater runoff. Further details on traffic effects are not yet available.

Increased public access to wetland areas resulting from the project may disrupt wildlife activity and other functions performed by existing wetlands. More frequent visits by humans may be precipitated by transit stations, park and rides, and other developments in the vicinity of wetlands. Increased public access may result in disruptions to normal wildlife activity, greater volumes of trash within and around wetland areas, and damage to vegetation and substrates.

Permanent bridge piers within the Columbia River may alter flow patterns and aquatic wildlife activity within this regulated resource. For greater discussion of these indirect impacts, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

Anticipated impacts to jurisdictional and potentially jurisdictional wetlands and other waters, and their buffers are mapped in Exhibits 4-1, 4-2, and 4-3, and listed in Exhibits 4-4 and 4-5.

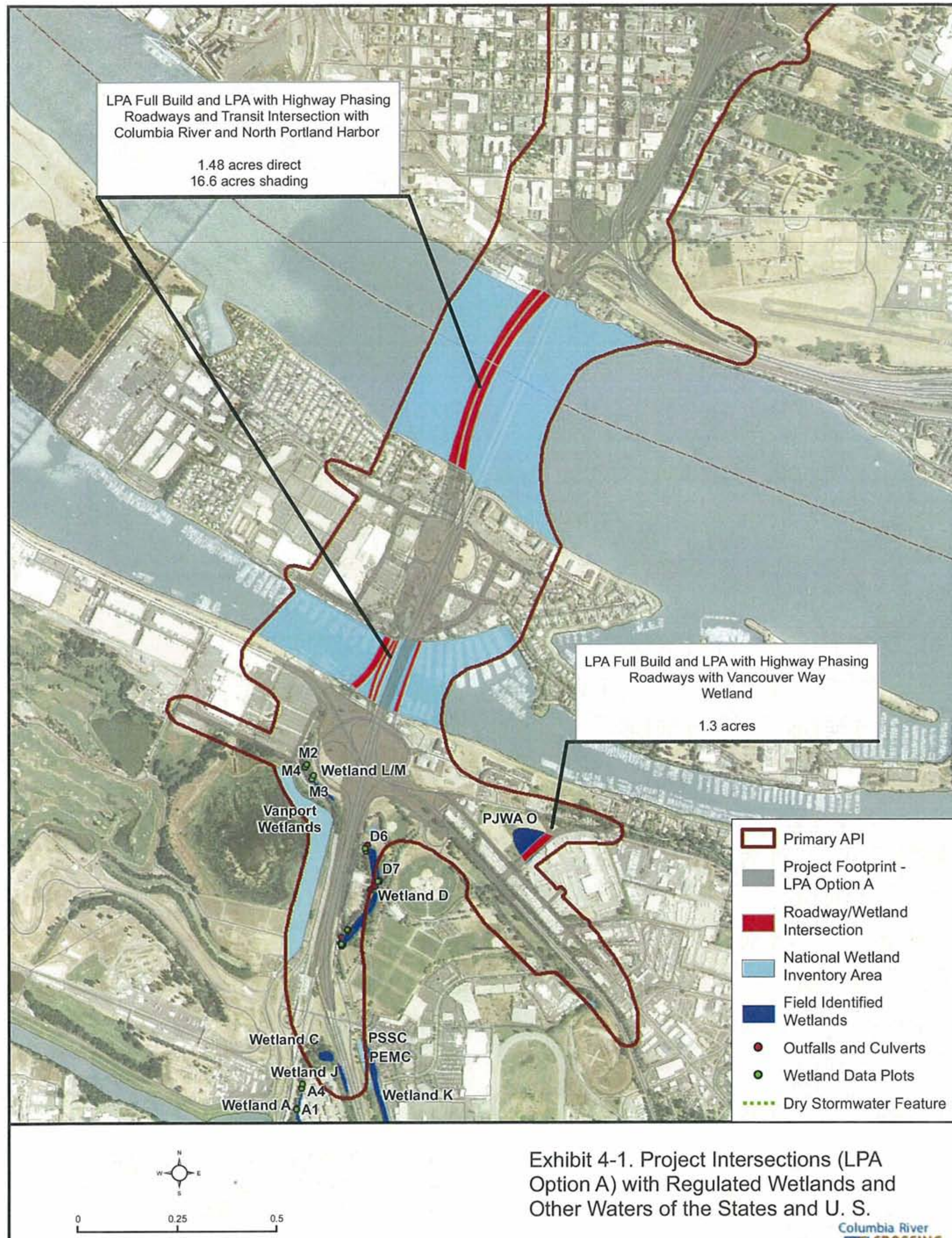

Exhibit 4-1. Project Intersections (LPA Option A) with Regulated Wetlands and Other Waters of the States and U. S.

Columbia River CROSSING

Source: NWI Wetlands = Clark Co. and Metro; Field Identified Wetlands = Columbia River Crossing (Parametrix)

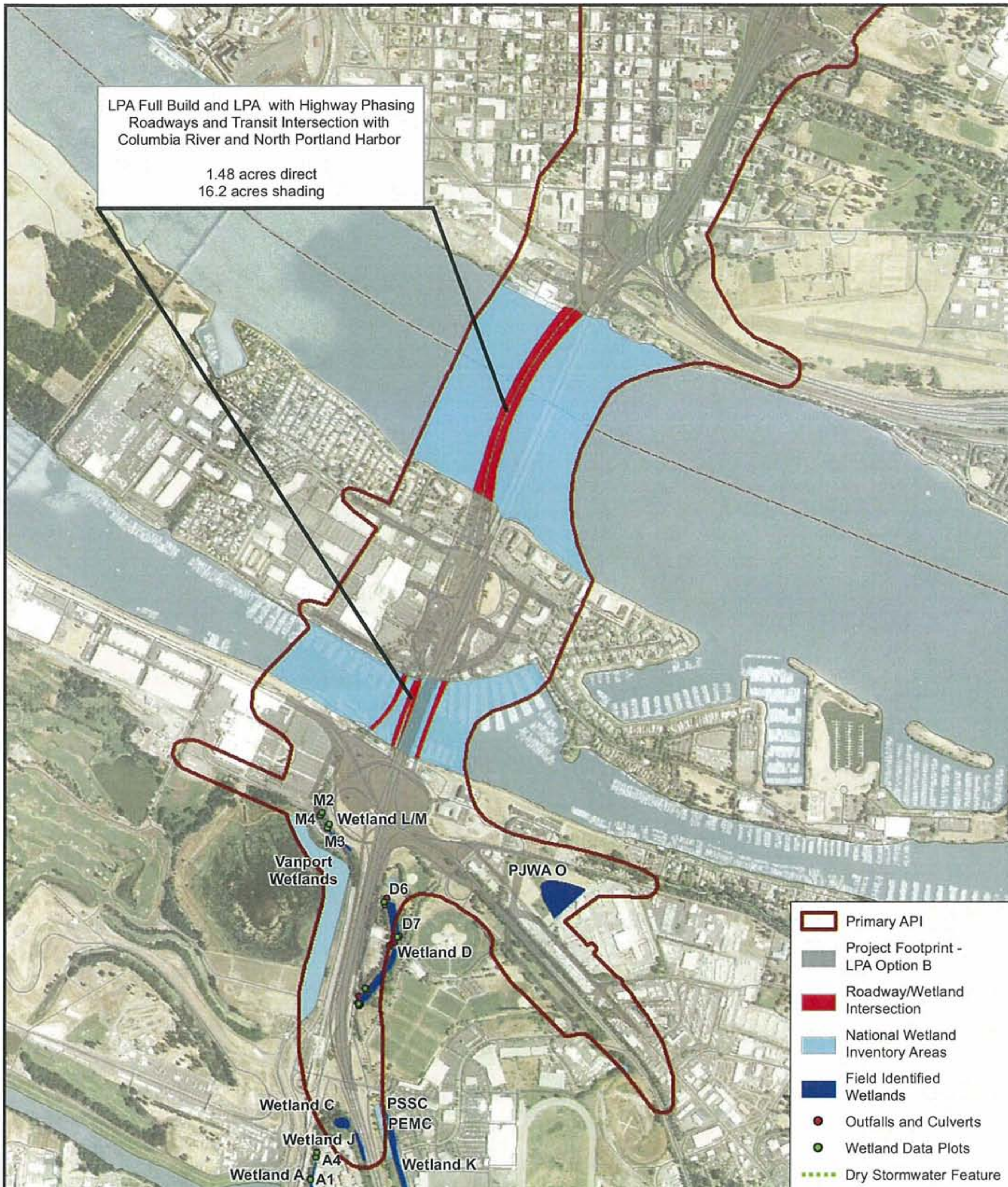

Exhibit 4-2. Project Intersections (LPA Option B) with Regulated Wetlands and Other Waters of the States and U. S.

0 0.25 0.5
Miles

Source: NWI Wetlands = Clark Co. and Metro; Field Identified Wetlands = Columbia River Crossing (Parametrix)

Columbia River CROSSING

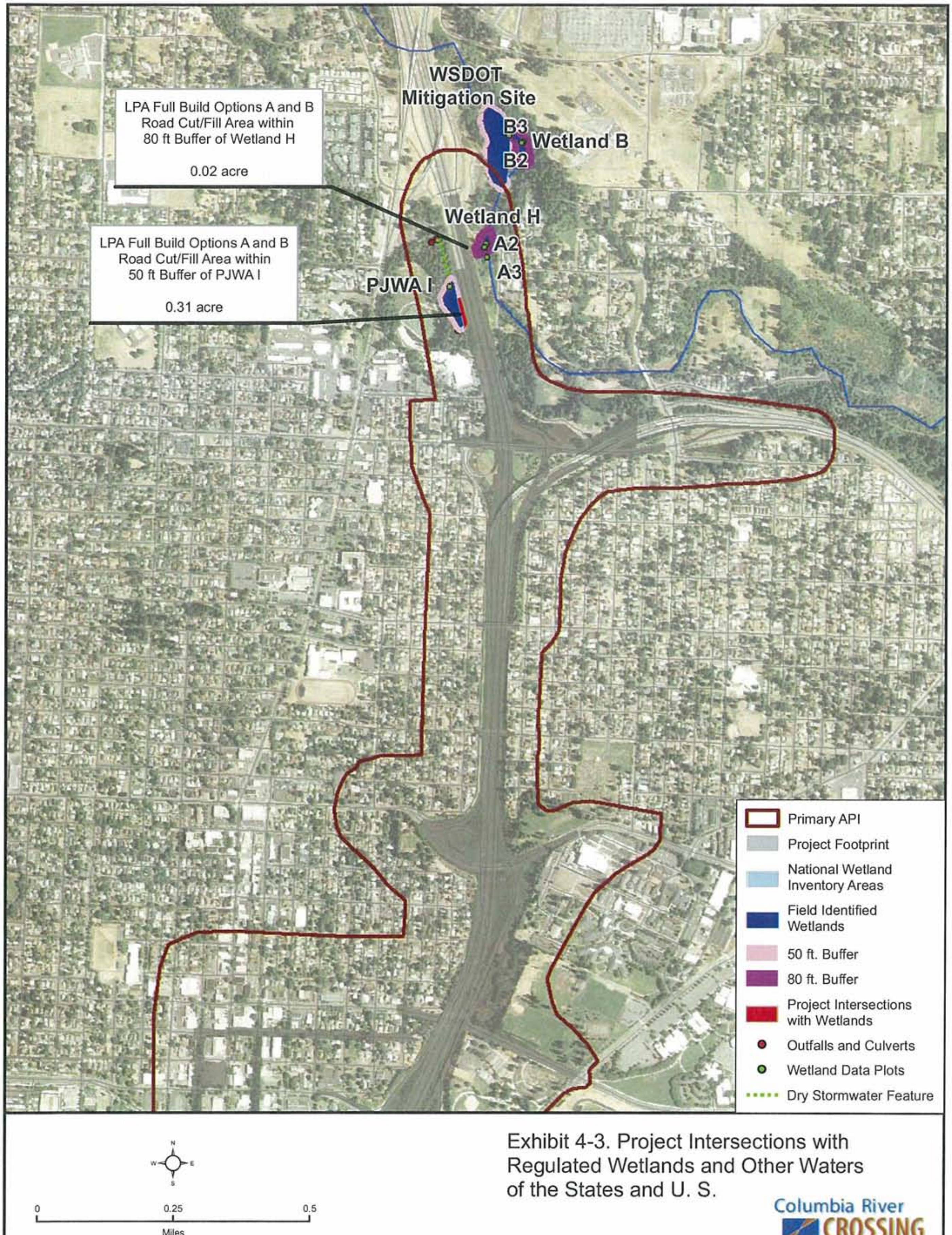

Exhibit 4-3. Project Intersections with Regulated Wetlands and Other Waters of the States and U. S.

Source: NWI Wetlands = Clark Co. and Metro; Field Identified Wetlands = Columbia River Crossing (Parametrix)

Exhibit 4-4. Long-term Direct Impacts to Wetlands and Other Waters from Full Alternatives

Affected Resources	LPA Full Build and w/Hwy Phasing Option A	LPA Full Build and w/Hwy Phasing Option B	No-Build	Alt 2: Repl Crossing with BRT	Alt 3: Repl Crossing with LRT	Alt 4: Suppl Crossing with BRT	Alt 5: Suppl Crossing with LRT
Wetland L/M Expo Road wetlands (acres)	0	0	0	0.09	0.04	0.13	0.08
PJWA I Kiggins Bowl wetlands (acres)	0	0	0	<0.01	<0.01	<0.01	<0.01
PJWA O	1.30	0	0	0	0	0	0
Total wetlands impact (acres)	1.30	0	0	0.09	0.04	0.13	0.08
PJWA I Kiggins Bowl buffer (acres)	0.31	0.31	0	0	0	0	0
Wetlands B and H Burnt Bridge Creek wetlands buffer (acres)	0.02	0.02	0	<0.01	<0.01	0	0
Total wetland buffer impact (acres)	0.33	0.33	0	1.11	0.56	1.31	0.76
Columbia River fill (acres)	1.48	1.48	0	2.81	2.81	1.93	1.93
Columbia River remove (acres)	.43	.43	0	0.75	0.75	0.25	0.25
Columbia River bridge piers (total cubic yards)	60,300	60,300	40,400	66,700	66,700	101,400	101,400

Exhibit 4-5. Long-term Indirect Impacts to Wetlands and Other Waters from Full Alternatives

	No-Build Alternative	LPA Option A	LPA Option B
Wetland A			
Anticipated impacts	None	Potential disruption of wildlife activity.	Potential disruption of wildlife activity.
Wetland B			
Anticipated impacts	None	None	None
Wetland C			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential disruption of wildlife activity. Potential improvement in stormwater runoff.	Potential disruption of wildlife activity. Potential improvement in stormwater runoff.
Wetland D			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.
Wetland H			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.
Wetland J			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.
Wetland K			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.
Wetland L/M			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.
PJWA O			
Anticipated impacts	Continued discharge of untreated stormwater.	Likely disruption of wildlife activity. Potential water quality impacts.	None
		Waters of the State and U.S.	
Columbia River			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.

	No-Build Alternative	LPA Option A	LPA Option B
Burnt Bridge Creek			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts.	Potential improvement, but nearby footprint may result in water quality impacts.
PJWA I (stormwater feature)			
Anticipated impacts	Continued discharge of untreated stormwater.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.	Potential improvement, but nearby footprint may result in water quality impacts. Likely disruption of wildlife activity.

4.3 Columbia Slough Watershed Long-term Effects

4.3.1 Oregon Mainland

Potential long-term wetland loss would occur at PJWA O under LPA Option A. There would be no long-term direct effects to wetlands or other Waters of the State and U.S. in the Columbia Slough watershed under LPA Option B. Long-term indirect effects are discussed in Section 4.3.1.1 and Section 4.3.1.2 and the Indirect Effects Technical Report.

4.3.1.1 Wetlands

Potential long-term direct impacts to 1.30 acre of suspected wetlands (PJWA O) in the Columbia Slough watershed will occur under LPA Option A. There will be no long-term direct impacts to wetlands in the Columbia Slough resulting from construction of LPA Option B.

Potential long-term direct effects will result from construction of LPA Option A due to the potential direct loss of wetlands at PJWA O. New impervious surface will eliminate any existing wetland functions. Potential wetlands directly adjacent will be subject to disturbance from nearby traffic. The closer proximity of traffic may disrupt wildlife activities associated with wetlands.

Long-term indirect effects may result from construction of the project due to the larger area of impervious surface in the vicinity of project wetlands and the closer proximity of traffic. New impervious surfaces would have improved stormwater treatment over existing systems and all pollutants entering surface waters and wetlands, with the exception of copper, are expected to be reduced. Decreased vegetation cover in areas of new impervious surface may also result in water quality impacts. The closer proximity of traffic may disrupt wildlife activities associated with wetlands. For more information on long-term indirect impacts, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

4.3.1.2 Other Waters of the State and U.S.

There would be no long-term direct impacts to other Waters of the State and U.S. in the Columbia Slough Watershed. However, long-term indirect effects may result from construction of the project due to increased impervious surface area. Greater stormwater quantity into the Columbia Slough, especially during large rain events, may result in decreased water quality. However, new impervious surfaces would have improved stormwater treatment over existing systems and all pollutants entering surface waters and wetlands, with the exception of copper, are expected to be reduced. Decreased vegetation cover in areas of new impervious surface may also result in water quality impacts. For more information on long-term indirect impacts, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

4.4 Columbia River Watershed Long-term Effects

4.4.1 Hayden Island

Long-term direct and indirect impacts to the Columbia River are discussed in Section 4.4.1.2.

4.4.1.1 Wetlands

No wetlands were identified within the project area in the Columbia River Watershed.

4.4.1.2 Other Waters of the State and U.S.

Permanent bridge piers in the Columbia River (including the North Portland Harbor) for a replacement bridge would add an area of 64,460 square feet (1.48 acres) and displace a volume of 60,300 cubic yards. Demolition of existing bridge piers would remove 18,730 square feet (0.43 acres) and restore 17,500 cubic yards of in-channel volume to the river.

Permanent bridge piers in the Columbia River (including the North Portland Harbor) for a replacement bridge will affect flow patterns which may result in indirect impacts to wildlife activity. For further discussion refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

The LPA would provide more congestion relief than the No-Build alternative, and is most likely to result in improved water quality associated with vehicular traffic.

4.5 Burnt Bridge Creek Watershed Long-term Effects

4.5.1 Downtown Vancouver

No wetlands or other waters of the State and U.S. were identified in the Downtown Vancouver portion south of McLoughlin Boulevard.

4.5.2 Upper Vancouver

This consists of the area north of McLoughlin Boulevard.

4.5.2.1 Wetlands

The permanent cut/fill line of the project would impact approximately 0.02 acre of the Wetland H buffer. Long-term indirect effects may result from construction of the project due to the larger area of impervious surface in the vicinity of project wetlands and the closer proximity of traffic. New impervious surfaces would have improved stormwater treatment over existing systems and all pollutants entering surface waters and wetlands, with the exception of copper, are expected to be reduced. Decreased vegetation cover in areas of new impervious surface may also result in water quality impacts. The closer proximity of traffic may disrupt wildlife activities associated with wetlands. For more information on long-term indirect impacts, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

4.5.2.2 Other Waters of the State and U.S.

The permanent cut/fill line of the LPA would impact 0.31 acre of PJWA I.

There would be no long-term direct impacts to Burnt Bridge Creek. However, indirect impacts such as decreased water quality and disrupted habitat function to the Burnt Bridge Creek area may occur because the project footprint along I-5 comes in closer proximity to the Burnt Bridge Creek riparian area. Stormwater treatment would be provided and may be an improvement to existing stormwater quality. For further discussion refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

4.6 Ruby Junction Maintenance Base

4.6.1.1 Wetlands

During a preliminary survey of the Ruby Junction facility and the surrounding properties, no potential wetlands were identified. However, right-of-entry for the properties was not obtained and the sites could not be thoroughly examined. Prior to initiation of project activities, further wetland investigations would be necessary.

4.6.1.2 Other Waters of the State and U.S.

There would be no long-term direct impacts to other Waters of the State and U.S. due to infiltration of new pollutant generating impervious surfaces. Stormwater treatment fulfilling the City of Gresham's stormwater requirements would be provided and may be an improvement to existing stormwater quality. For further discussion refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

4.6.1.3 Staging Areas

No impacts likely except for fill associated with piers and access to Columbia River.

5. Temporary Effects

5.1 Introduction

Temporary direct impacts to wetlands and other waters of the State and U.S. may occur where long-term direct impacts are anticipated. Temporary disturbances to wildlife activity, hydrology, and water quality would be avoided as much as possible through the use of BMPs such as silt fences, construction fencing, wildlife exclusionary netting, and other appropriate measures, during the construction process.

Temporary direct impacts to the Columbia River would be anticipated due to the in-water work required to deconstruct the existing bridge structures and install new bridge piers and decks. For more details, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

The potential sites for a bridge assembly/casting yard are unknown at this time. However, they are likely to be adjacent to the Columbia River, Willamette River, or other water body in the region. The existing conditions on the assembly/casting yard could range from a developed and paved port terminal to a currently undeveloped site that could contain wetlands. The development and operations of the assembly/casting yard would be subject to the same federal and state environmental regulations that apply to other aspects of project construction (depending on which state it is in). Before any site is selected, a thorough, site-specific environmental impact analysis would be conducted. All necessary permits would be secured prior to site development and construction activities.

5.2 Regional Temporary Effects

Temporary effects include those related primarily to construction activities.

5.3 Oregon Temporary Effects

Temporary disturbances to wildlife activity, hydrology, and water quality would be avoided as much as possible through the use of BMPs, including the use of silt fences, construction fencing, wildlife exclusionary netting, and other appropriate measures, during the construction process.

5.3.1 Oregon Mainland

There would be no temporary direct impacts to wetlands in the Oregon Mainland portion of the project area. However, several wetlands and other waters of the State and U.S. are located very near the proposed project footprint and may experience temporary effects.

5.3.1.1 Wetlands

Wetland J buffer would have temporary direct impacts. Temporary impacts due to construction activity and proximity may occur.

5.3.1.2 Other Waters of the State and U.S.

There would be no temporary impacts to other waters of the State and U.S. in the Oregon Mainland portion of the project area.

5.3.2 Hayden Island

Construction activities in the Columbia River would result in temporary impacts.

5.3.2.1 Wetlands

There are no wetlands identified in the Hayden Island portion of the project area.

5.3.2.2 Other Waters of the State and U.S.

Temporary impacts to the Columbia River would occur based on the specific in-water construction methods employed. Further details are provided in the Ecosystems Technical Report.

5.4 Washington Temporary Effects

Temporary disturbances to wildlife activity, hydrology, and water quality would be avoided as much as possible through the use of BMPs, including the use of silt fences, construction fencing, wildlife exclusionary netting, and other appropriate measures, during the construction process.

5.4.1 Downtown Vancouver

There were no wetlands or other Waters of the State and U.S. identified in the Downtown Vancouver portion (south of McLoughlin Boulevard) of the project area.

5.4.2 Upper Vancouver

5.4.2.1 Wetlands

The LPA project footprint would not encroach upon any wetlands identified for this project.

5.4.2.2 Other Waters of the State and U.S.

PJWA G and PJWA I may have temporary impacts due to construction activity and proximity.

Temporary impacts to the Burnt Bridge Creek area may occur based on the specific construction methods employed. Further details are provided in the Ecosystems Technical Report.

5.5 Ruby Junction Maintenance Base

There were no wetlands or other Waters of the State and U.S. identified in the Ruby Junction Maintenance Base area. Temporary disturbances to wildlife activity, hydrology, and water quality in Fairview Creek (adjacent to the site) would be avoided as much as possible through the use of BMPs, including the use of silt fences, construction fencing, wildlife exclusionary netting, and other appropriate measures, during the construction process.

6. Proposed Mitigation for Adverse Effects

6.1 Introduction

In accordance with state and federal regulations and Executive Order 11990, the project has avoided and minimized impacts to wetlands to the extent practicable during the design of the highway and transit alignments.

Mitigation of impacts to wetlands and other jurisdictional waters would take the form of BMPs, conservation measures, avoidance/minimization measures, or creation, restoration, or enhancement of wetlands or waters to offset losses due to the project. Standard construction BMPs and conservation measures would be implemented in the build alternative to avoid impacts to wetlands and waters from construction activities. The design will avoid and minimize impacts to existing wetland and water resources. Mitigation to offset losses of wetland areas and functions and values will be explored in detail. Mitigation opportunities in existing or newly acquired rights-of-way will be explored. Mitigation may occur within the same watershed but not necessarily in close proximity to existing wetland resources given the constrained urban area found in the API.

6.2 Proposed Mitigation for Long-term Adverse Effects

The project would impact 1.48 acres of waterways and 0.11 acres of buffer areas. No direct wetland impacts are proposed. Mitigation for these direct impacts is regulated by federal, state, and local jurisdictions, and would typically require restoring or enhancing degraded wetland areas or establishing new wetlands nearby to compensate for functions lost or degraded by those impacts.

Likely mitigation sites depend on the area needed for mitigation, current and future ownership of potential mitigation sites, and site characteristics. Mitigation sites would be selected based on ability of the mitigation site to offset habitat function and value losses. Off-site mitigation would also be considered.

Mitigation needs for waterway impacts could range from 1.48 to 4.6 acres depending on the type of mitigation associated with the project.

Mitigation for Washington wetland buffers would require the replacement of lost functions and values and would likely be less than 0.33 acres, depending on the amount of affected buffer and pending jurisdictional determinations.

6.3 Proposed Mitigation for Adverse Effects during Construction

Mitigation for temporary effects includes the use of erosion and sediment control procedures and avoidance of jurisdictional resources. Where vegetation is cleared for construction activity, it will be replaced in accordance with local regulatory guidance.

Temporary impacts to the Columbia River would be anticipated due to the in-water work required to deconstruct the existing bridges and install new bridge piers and decks. For more details, refer to both the Ecosystems Technical Report and the Water Quality and Hydrology Technical Report.

Construction activities will implement appropriate sediment and erosion control procedures under the LPA. Measures to avoid jurisdictional and potentially jurisdictional resources will be implemented under the LPA. Mitigation for impacts to the Columbia River is discussed more fully in the Ecosystems Technical Report.

It is understood that due to statutory requirements, impacts to water resources on the Oregon side of the project require compensation within Oregon; and impacts to water resources on the Washington side of the project require compensation within Washington. The compensatory mitigation selected is based on a functional assessment of adverse effects and replacement of equivalent functional value. The project mitigation will provide meaningful improvement in the size, distribution, and productivity of the listed species populations, or in amount, distribution, and quality of habitats relative to that which existed prior to implementation of the CRC project.

In Oregon, the Hood River Off-Channel Reconnection Project has been selected as compensatory mitigation for temporary and permanent impacts to the Columbia River. In Washington, the Lewis River Confluence Side Channel Restoration Project has been selected. Specific designs for these projects will be determined in coordination with state and federal regulatory agencies.

7. Permits and Approvals

7.1 Federal

7.1.1 Clean Water Act (CWA). 1977. 33 USC 1251-1376, as amended

Impacts to jurisdictional wetlands or other jurisdictional waters will require a Section 404 CWA permit and a Section 401 certification under the Clean Water Act.

Background: The CWA requires States to set water quality standards for all contaminants in surface waters based on the "beneficial" or "designated" uses for the water body, and makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit is obtained under its provisions. It also recognizes the need to address the problems posed by nonpoint source pollution. Some of the permitting processes that fall within the purview of the CWA include National Pollutant Discharge Elimination System (NPDES) permits, Section 404 permits, and Section 401 Water Quality Certifications.

If there are any impacts to jurisdictional wetlands or other waters of the U.S. (which may include ditches), then a Section 404 CWA permit from the USACE would likely be required. Section 401 of the CWA requires an applicant for a federal license or permit, who conducts an activity that may result in a discharge to waters of the state or U.S., to obtain a certification that the activity complies with water quality requirements and standards. Dredging, filling, and other activities that alter a waterway require a Section 404 permit and Section 401 certification. Applicants must submit a Section 404 application form to the appropriate state agency and the USACE, who forward the application to the certifying state agency. The state agency then certifies that the project meets state water quality standards and does not endanger waters of the State, U.S., or wetlands. Certifications are issued by Oregon Department of Environmental Quality (DEQ) in the state of Oregon (Oregon Revised Statutes [ORS] 468, Oregon Administrative Rules [OAR] 340-041-001 to 340-041-0350) and by Ecology in the state of Washington (Revised Code of Washington [RCW] 90.48, as amended, Washington Administrative Code [WAC] 173-201A and 173-201A-070).

7.1.2 Rivers and Harbors Act. 1899. 33 USC 403, as amended.

Under the River and Harbors Act, the project will have to submit final plans for congressional and USACE approval.

Background: Under the Rivers and Harbors Act, the USACE is authorized to regulate the construction of any structure or work within navigable waters. The act prohibits the construction of any bridge over or in navigable waters of the U.S. without congressional approval and the consent of the Secretary of Transportation.

7.1.3 Fish and Wildlife Coordination Act. 1934. 16 USC 661-667e, as amended.

Consultation with the U.S. Fish and Wildlife Service (USFWS), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW) will be required if the project impounds, diverts, channelizes, or otherwise controls or modifies the waters of any stream or other body of water. The agencies may place constraints upon the LPA to prevent damage or loss to wetlands within the primary API. Currently, it is not anticipated that project activities will have to be permitted under the Fish and Wildlife Coordination Act.

Background: The Fish and Wildlife Coordination Act requires consultation with the USFWS and the appropriate state wildlife agency when a project will impound, divert, channelize, or otherwise control or modify the waters of any stream or other body of water. Such actions would also require compliance with Section 404 of the CWA. Consideration must be given to preventing damage or loss to wildlife and to mitigating any effects caused by a federal project. The environmental assessment must include an evaluation of how the actions may affect fish and wildlife resources, and must identify measures to reduce impacts to fish and wildlife.

7.1.4 Endangered Species Act. 1973. 16 USC 1531-1544, as amended.

If the project may affect listed species and/or designated critical habitat, a Section 7 consultation will be required. An incidental take permit may be required as part of a Section 7 consultation. If a Section 7 consultation is required, a biological assessment will need to be written and submitted to USFWS or the National Marine Fisheries Service (NMFS).

Background: The federal Endangered Species Act (ESA) prohibits the take of any listed species. Take is defined in the law to include harass and harm. Harm is further defined to include any act which actually kills or injures listed species, including acts that may modify or degrade habitat in a way that significantly impairs essential behavioral patterns of the species. Under Section 7 of the ESA, any federal agency that authorizes, funds, or carries out an action is required to that the action is not likely to jeopardize the continued existence of listed species or ensure result in the destruction or adverse modification of designated critical habitat.

If there is a potential for the project to impact a listed species or its critical habitat, then a biological assessment is required. If listed species are found within the CRC project area, an informal or formal consultation with NMFS and the USFWS under Section 7 of the ESA may be required. Informal consultations occur for projects that would not likely adversely affect listed species, whereas formal consultations occur for projects that would likely adversely affect listed species.

7.2 State

7.2.1 Oregon

Oregon Revised Statutes. 1989. "Oregon's Removal-Fill Law Definitions." ORS 196.800-196.990 and ORS 196.600-196.692. OAR 141-085-0005 to 141-089-0615. "Issuance and Enforcement of Removal-Fill Authorizations." Salem, OR.

Impacts to jurisdictional wetlands and waters will require a joint permit from USACE and DSL.

Background: If there are any impacts to jurisdictional wetlands or other waters of the state (which may include ditches), then a Removal-Fill permit from the DSL would likely be required. This regulation is often associated with Section 404 of the CWA, and Section 10 of the Rivers and Harbors Act, under the jurisdiction of the USACE. In most cases, the preparation of a joint permit application for impacts to wetlands and jurisdictional waters and a wetland delineation and conceptual mitigation plan are required. A wetland delineation is required if wetlands are in the API. Compensatory mitigation (e.g., for wetland or riverine habitats) is required for any unavoidable impact to wetlands or waterways.

Oregon Administrative Rules. Water Quality Standards. ORS 468, OAR 340-041-001 to 340-041-0350. Salem, OR.

In Oregon, DEQ issues and enforces NPDES permits and authorizes Section 401 water quality certifications. Impacts to jurisdictional wetlands or other waters will require a Section 404 CWA permit and a Section 401 certification.

Background: A joint 404 permit application is submitted to the DSL and USACE (Portland Regional Office), who forward it to DEQ. DEQ reviews the project for 401 water quality certification. Frequently, applicants will be required to incorporate protective measures into their construction and operational plans, such as bank stabilization, treatment of stormwater runoff, spill protection, and fish and wildlife protection. The DEQ certification process requires a Land Use Compatibility Statement, signed by the local government land use authority, to ensure that permits affecting land use are compatible with local government comprehensive plans.

Oregon Administrative Rules. 1973. "Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces." OAR 660-15-0000 (5). Salem, OR.

Permitting may be required through local government Goal 5 ordinances.

Background: To protect natural resources and conserve scenic and historic areas and open spaces, local governments throughout Oregon have adopted programs that will protect natural resources and conserve scenic, historic, and open space resources under Goal 5. Goal 5 parameters related to jurisdictional wetlands and waters within the CRC project area include the following:

- Fish and wildlife areas and habitats should be protected and managed in accordance with ODFW's fish and wildlife management plans.
- Stream flow and water levels should be protected and managed at a level adequate for fish, wildlife, pollution abatement, recreation, aesthetics, and agriculture.
- Significant natural areas that are historically, ecologically or scientifically unique, outstanding or important, including those identified by the State Natural Area Preserves Advisory Committee, should be inventoried and evaluated.
- Plans should provide for the preservation of natural areas consistent with an inventory of scientific, educational, ecological, and recreational needs for significant natural areas.

7.2.2 Washington

Revised Code of Washington. "State Environmental Protection Act" (SEPA). 1971. RCW 43.21C, WAC 197-11, and WAC 468-12. Olympia, WA.

An environmental impact statement (EIS) must be prepared when the lead agency determines that a proposed action is likely to have significant adverse environmental impacts. Approval of this EIS by state and local agencies will be required.

Background: SEPA requires all governmental agencies to consider the environmental impacts of a proposed action before making decisions. An EIS must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. RCW and WAC allow adoption of an EIS prepared in compliance with NEPA to fulfill SEPA obligations.

Revised Code of Washington. 1971. "Shoreline Management Act of 1971." RCW 90.58. Olympia, WA.

A permit will be required from the City of Vancouver for project activities occurring along the shoreline of the Columbia River or Burnt Bridge Creek. A permit will be required from Clark County for activities occurring along Salmon Creek. Ecology may require approval.

Background: The goal of Washington's Shoreline Management Act (SMA) is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." The act establishes a broad policy of shoreline protection, which includes fish and wildlife habitat. The SMA uses a combination of policies, comprehensive planning, and zoning to create a special zoning code overlay for shorelines. Under the SMA, each city and county is required to adopt a shoreline master program that is based on state guidelines and may be tailored to the specific geographic, economic and environmental needs of the community. Master programs provide policies and regulations addressing shoreline use and protection as well as a permit system for administering the program.

Revised Code of Washington. 1949. State Water Pollutant Control Act. RCW 90.48, as amended, WAC 173-201A and 173-201A-070. Olympia, WA.

A permit will be required if jurisdictional wetlands and waters are negatively impacted by the project under the Washington State Water Pollution Control Act.

Background: This act gives Ecology "jurisdiction to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, and other surface and underground waters of the state of Washington." Amendments to state water quality standards in 1997 included wetlands in the definition of surface waters. The act's definition of pollution includes impacts that typically degrade wetland function, including placing fill and discharging stormwater runoff.

The implementing standards for the act include surface water quality standards (WAC 173-201A) and an antidegradation policy (WAC 173-201A-070). The regulations allow for short-term impacts to waters of the state as long as the degradation does not "interfere(s) with or become injurious to existing water uses or causes long-term harm to the environment." Ecology can permit alterations of wetlands, including filling, only if the net result does not result in long-term harm to the environment. With adequate mitigation that effectively offsets the impacts, Ecology can permit projects that would otherwise not comply with the regulations.

Washington Administrative Code. 2005. "National Pollutant Discharge Elimination System Permit Program (Department of Ecology)." WAC 173-220. Olympia, WA.

Impacts to jurisdictional wetlands or other waters will require a Section 404 CWA permit and a Section 401 certification.

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

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

Revised Code of Washington. 1949. "Hydraulic Code." RCW 77.55.100 and WAC 220-110. Olympia, WA.

An Hydraulic Project Approval (HPA) process will be required for work occurring within streams.

Background: The state legislature has given WDFW the responsibility of preserving, protecting, and perpetuating all fish and shellfish resources of the state. To assist in achieving that goal, the state legislature passed a law in 1949, now known as the "Hydraulic Code." The purpose of the law is to ensure that damage or loss of fish and shellfish habitat does not result in direct loss of fish and shellfish production. The enactment of the Hydraulic Code by the state legislature was recognition that virtually any construction within the high water area of the waters of the state has the potential to cause habitat damage. It was also an expression of a state policy to preclude that potential from occurring. The law's purpose is to ensure that required construction activities are performed in a manner to prevent damage to the state's fish, shellfish, and their habitat. By applying for and following the provisions of the HPA process from WDFW, most construction activities around water can be allowed with little or no adverse impact on fish or shellfish.

Revised Code of Washington. 1990. "Growth Management Act." RCW 36.70A. Olympia, WA.

Background: Each county and city must adopt development regulations protecting critical areas that are required to be designated under the Growth Management Act (GMA). Counties and cities are required to periodically review and update their critical areas ordinance (CAOs). The GMA defines critical areas that must be designated and protected as wetlands, critical habitat, geologic hazard areas, flood hazard areas, and critical aquifer recharge areas. The focus of the GMA is to avoid unplanned growth and conserve natural resources, while allowing for economic development. Under the GMA, counties, cities, and towns must classify, designate, and regulate critical areas through their CAOs. Any of the five types of critical areas listed above may serve as fish, wildlife, or sensitive plant habitat.

All regulated habitat and critical areas should be identified during the project development phase. Some local jurisdictions may have fish and wildlife habitat regulation inventory maps. These maps identify what types of habitat the jurisdiction is regulated, indicate where all of the inventoried habitat areas are, and identify the regulations that apply to the management and development of these areas. If available, these maps should be reviewed to help identify critical areas. Local planning departments should be contacted to determine requirements that could affect a project.

7.3 Local

7.3.1 Portland

Metro. Nature in Neighborhoods. 2005. Ordinance No. 05-1077C. Portland, OR.

No permitting will be required through Metro, but implementation of Nature in Neighborhoods by the City of Portland may require permitting (CPC 1994).

Background: The Nature in Neighborhoods ordinance is designed to help local communities meet the requirements of Statewide Planning Goal 5: Open Spaces, Scenic and Historic Areas, and Natural Resources. This ordinance amends Metro's Regional Framework Plan and is implemented by cities and counties. It relies on voluntary, incentive-based approaches for development in upland areas, and includes new regulations on future urban areas. The ordinance conserves and protects fish and wildlife habitat, but does not prohibit development. It uses regulation to protect the region's highest value streamside habitat, called habitat conservation areas, while also encouraging protection of other valuable habitat through a combination of incentives and voluntary efforts.

City of Portland Code (CPC). 1994. "Environmental Zones." CPC 33.430, as amended, Portland, OR. CPC. 2002. "Streams, Springs, and Seeps." CPC 33.640. Portland, OR.

Permits are required for development or disturbance within environmental zones.

Background: Environmental Zones Code provides for fish habitat protection through the designation of environmental protection zones and environmental conservation zones. An environmental protection zone provides the highest level of protection to the most important resources and functional values. Development is approved in an environmental protection zone only in rare and unusual circumstances. An environmental conservation zone conserves important resources and functional values in areas where these can be protected while allowing environmentally sensitive urban development.

In these zones, development and disturbances must be at least 50 feet from the boundary of any wetland. Development within these zones requires a permit application and additional information. Natural resource management plans (NRMPs) may be developed and approved, and may contain regulations that supersede or supplement the environmental zone regulations. Whenever natural resource management plan provisions conflict with other environmental zone provisions, the natural resource management plan provisions take precedence. NRMPs within the CRC project's primary API include the East Columbia Neighborhood NRMP and the Peninsula Drainage District No. 1 NRMP.

These regulations apply to building permit and development permit applications for activities within the resource area of an environmental conservation zone. Activities within an environmental conservation zone are subject to the Development Standards of Section 33.430.110-190. These regulations do not apply to building or development permit applications for development that has been approved through environmental review.

Fish habitat is also protected in the "Streams, Springs, and Seep" code. This code is applicable when there are land division actions. The standards in this chapter ensure that important streams, seeps, and springs that are not already protected by the environmental overlay zones are maintained in their natural state.

7.3.2 Vancouver

Vancouver Municipal Code (VMC). 2005. "Critical Areas Protection Ordinance." VMC 20.740. Vancouver, WA.

VMC. 2005 "Wetlands." VMC 20.740.140. Vancouver, WA.

A Critical Areas Report and Permit will be required for project activities occurring on properties containing wetlands or their buffers.

Background: The City of Vancouver's regulations that affect wetlands and their buffers are found in the Critical Areas Protection Ordinance. Adopted on February 28, 2005, the ordinance combines separate permitting processes for critical areas (wetlands, frequently flooded areas, geologic hazard areas, and fish and wildlife habitat conservation areas) into a single integrated process. VMC 20.740, Critical Areas Protection, implements the goals and policies of the Vancouver Comprehensive Plan, 2003-2023, under the GMA and other related state and federal laws. Regulations related to wetlands and their buffers and ordinance compliance in Chapter 20.740 are described below.

The Wetlands code outlines the City's regulations related to wetlands and their buffers, and it describes which areas in the City of Vancouver are designated as wetlands. Designations include, but are not limited to, swamps, marshes, bogs, and similar areas and buffers (required buffer widths vary from 300 to 50 feet for wetlands surrounded by high intensity land use).

Applicants must provide a Critical Areas Report with their permit applications. A Critical Areas Report for a riparian management area or riparian buffer must include an evaluation of habitat functions using the Clark County Habitat Conservation Ordinance Riparian Habitat Field Rating Form or another habitat evaluation tool approved by the WDFW. In addition, there are several performance standards that apply to habitat conservation areas, riparian management areas, and riparian buffers.

Vancouver Municipal Code. 2005. "Shoreline Management Area." VMC 20.760. Vancouver, WA.

Both a Substantial Development Permit and a Critical Areas Permit will be required for project activities on properties containing a wetland or buffer in a shoreline area.

Background: The purpose of the Shoreline Management Area code is to implement the policies and procedures set forth by the Shoreline Management Act of 1971 (SMA), as amended, and all applicable provisions contained in the Washington Administrative Code. The Shoreline Management Master Program (Ord. M-3231, as amended) is used to regulate uses within the Shoreline Management Area.

Vancouver Municipal Code. 2004. "SEPA Regulations." VMC 20.790.

An environmental impact statement must be prepared when the lead agency determines that a proposal is likely to have significant adverse environmental impacts. Approval of the EIS by state and local agencies will be required.

Background: This is the adoption of Washington's SEPA law by the City of Vancouver. RCW and WAC allow adoption of an EIS prepared in compliance with NEPA to fulfill the SEPA obligations.

Clark County Code. Title 40.4. 2005. "Critical Areas and Shorelines." Vancouver, WA.

A permit may be required if a project activity occurs in wetlands protected by the Clark County Code.

Background: Clark County has designated critical areas in accordance with GMA. The County updated its critical areas in 2005. Regulated activities in the Wetland Protection chapter (40.450) include the removal, excavation, grading, dredging, dumping, discharging, or filling of any material in excess of fifty (50) cubic yards or impacting more than one (1) acre of wetland or buffer, the construction of a structure, and the destruction or alteration of wetlands vegetation through clearing, harvesting, intentional burning, or planting of vegetation that would alter the character of a wetland or buffer.

City of Vancouver. Comprehensive Plan. 2004. Environmental Policies.

No permitting of project activities will be required under the City of Vancouver Comprehensive Plan.

Background: Vancouver's Comprehensive Plan includes the following provisions:

- Environmental protection (EN-1): Protect, sustain, and provide for healthy and diverse ecosystems.
- Habitat (EN-5): Protect riparian areas, wetlands, and other fish and wildlife habitat. Link fish and wildlife habitat areas to form contiguous networks. Support sustainable fish and wildlife populations.
- Trees and other vegetation (EN-8): Conserve and restore tree and plant cover, particularly native species, throughout Vancouver. Promote planting using native vegetation.

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Reed, P.B., Jr. 1993. "1993 Supplement to list of plant species that occur in wetlands: Northwest (Region 9)". U.S. Fish and Wildlife Service, Supplement to Biological Report 88(26.9).

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APPENDIX A

Oregon Department of State Lands Wetland Delineation Concurrence for CRC Project Area

Oregon
Theodore R. Kulongoski, Governor

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregonstatelands.us.

September 24, 2008

Heather Gundersen
Columbia River Project Crossing Team
700 Washington Street, Suite 300
Vancouver, WA 98660

Re: Wetland Delineation Report for a Portion of the Columbia River Crossing Project, Multnomah County; T2N, R1E, Sec. 33 and 34; and T1N, R1E, Sec.3 and 4; Portions of Multiple Tax Lots; WD # 08-0205.

Dear Ms. Gundersen:

The Department of State Lands has reviewed the wetland delineation report prepared by Parametrix for the site referenced above. Please note that the study area for this report includes only the portion of the area described above as indicated on the attached maps. Based upon the information presented in the report and additional information submitted upon request, we concur with the wetland and waterway boundaries as mapped in revised Figures 6a through 6d. Please replace all copies of the preliminary wetland maps with these final Department-approved maps. Within the study area, 4 wetlands, totaling 2.61 acres, portions of the Columbia River and the Oregon Slough, and 2 roadside ditches were identified. The wetlands, river, slough, and the portion of the one ditch created from Wetland L are subject to the permit requirements of the state Removal-Fill Law. A state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in the wetlands or below the ordinary high water line (OHWL) of a waterway (or the 2 year recurrence interval flood elevation if OHWL cannot be determined). The portions of the 2 delineated roadside ditches created from uplands are exempt as per OAR 141-085-0015 (12) and are not subject to the permit requirements of the state Removal-Fill law.

In addition, the Columbia River and the Oregon Slough are state-owned waterways. Any activity encroaching within the submerged and submersible land below the line of ordinary high water may require a lease, registration, or easement to occupy state-owned land. Please contact Tami Hubert at (503) 986-5272 for more information.

This concurrence is for purposes of the state Removal-Fill Law only. Federal or local permit requirements may apply as well. The Army Corps of Engineers will review the report and make a determination of jurisdiction for purposes of the Clean Water Act at the time that a permit application is submitted. We recommend that you attach a copy of this concurrence letter to both copies of any subsequent joint permit application to speed application review.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter, unless new information necessitates a revision. Circumstances under which the Department may change a determination and procedures for renewal of an expired determination are found in OAR 141-090-0045 (available on our web site or upon request). The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within 60 calendar days of the date of this letter.

Thank you for having the site evaluated. Please phone me at (503) 986-5232 if you have any questions.

Sincerely,

Peter Ryan, PWS
Wetland Specialist

Approved by Janet C. Morlan
Janet C. Morlan, PWS
Wetlands Program Manager

Enclosures

ec: Tina Farrelly, Parametrix
City of Portland Planning Department
James Holm, Corps of Engineers
Mike McCabe, DSL
Tami Hubert, DSL

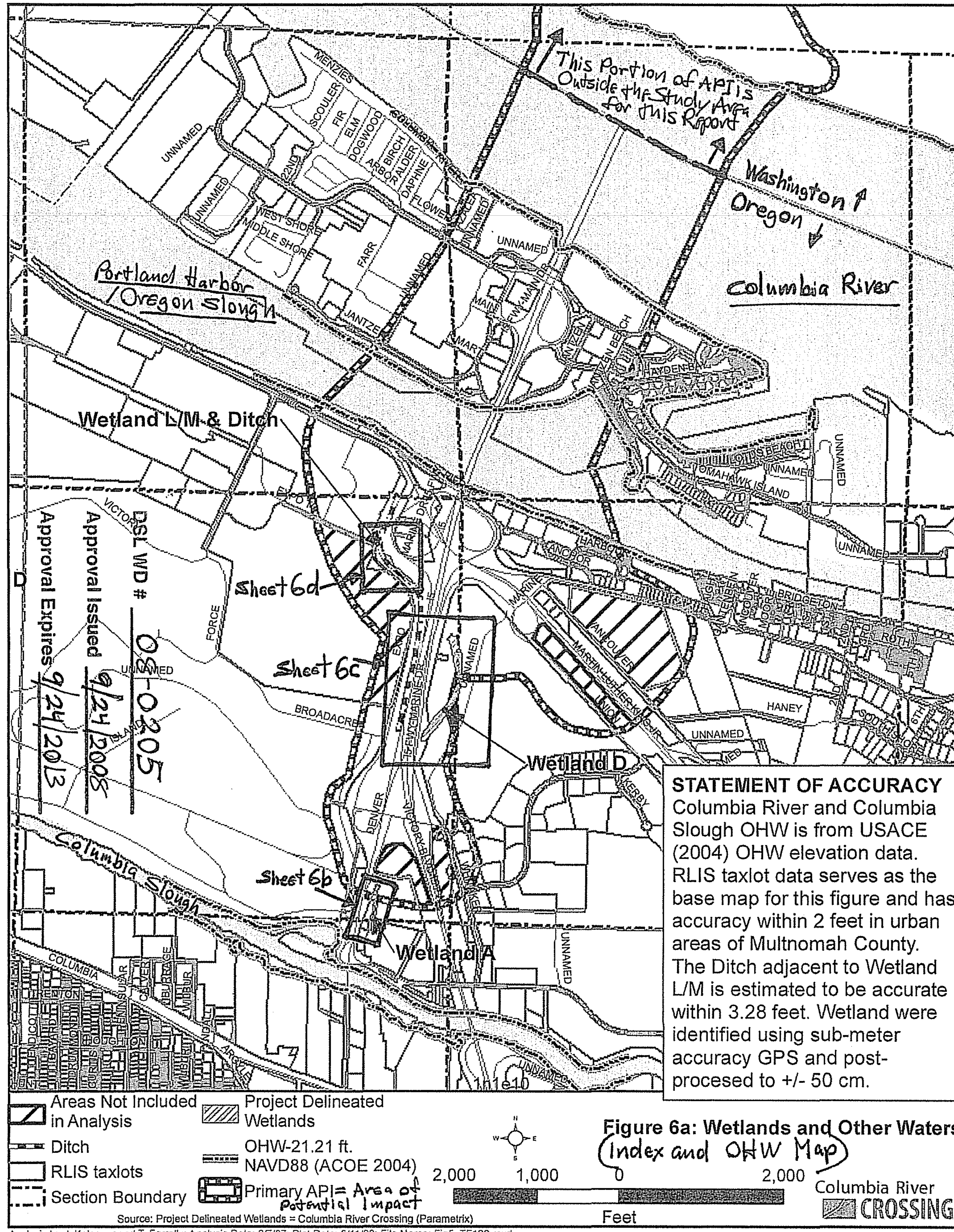
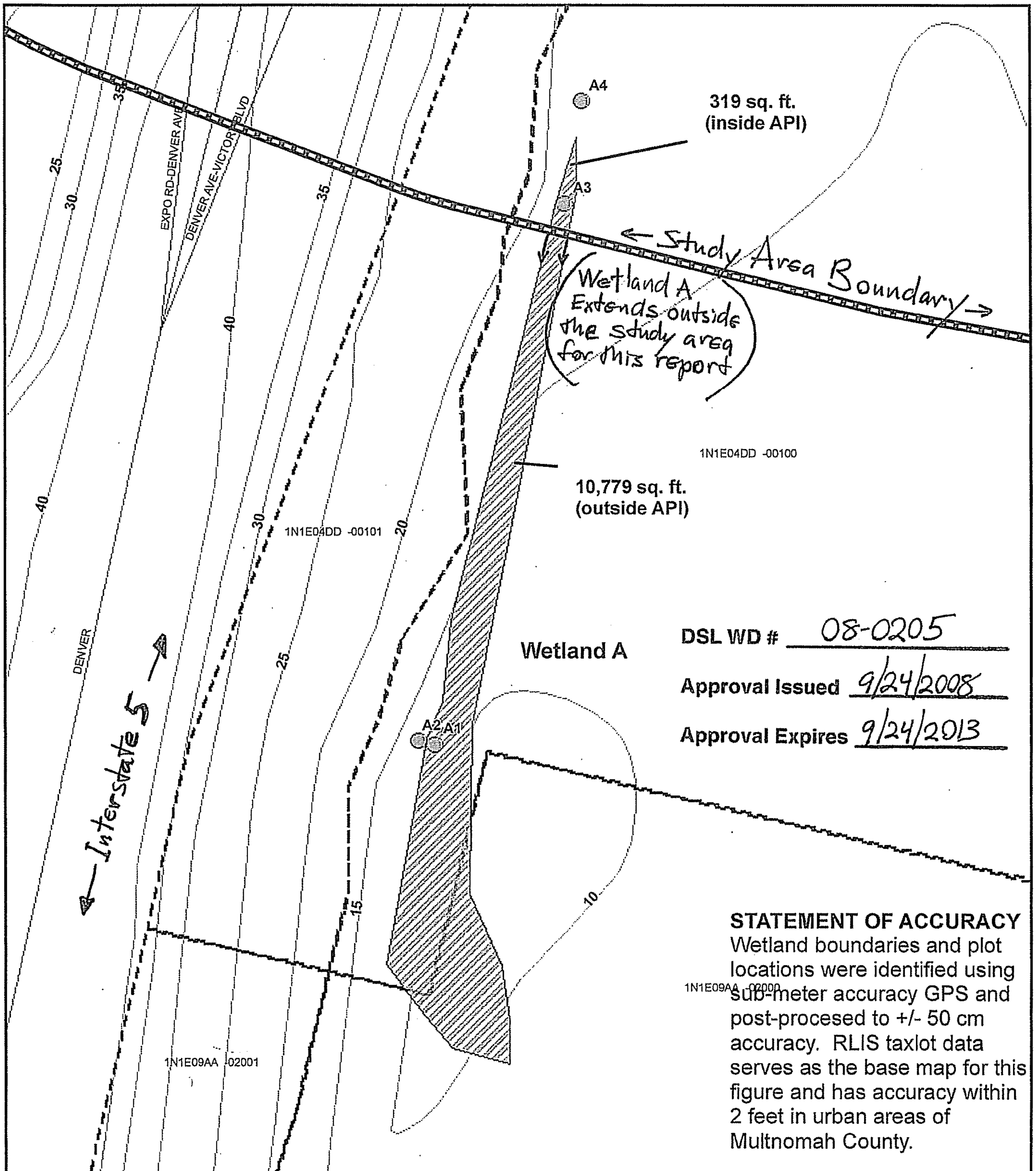


Figure 6a: Wetlands and Other Waters (Index and OHW Map)

Analysis by J. Koloszar and T. Farrelly; Analysis Date: 8/7/07; Plot Date: 9/11/08; File Name: Fig5_TF120.mxd



STATEMENT OF ACCURACY
Wetland boundaries and plot locations were identified using sub-meter accuracy GPS and post-procesed to +/- 50 cm accuracy. RLIS taxlot data serves as the base map for this figure and has accuracy within 2 feet in urban areas of Multnomah County.

Figure 6b: Wetland A

0 37.5 75 150 Feet

5 ft.Contours
Wetland Data Plots
Tax Lots
Project Delineated Wetlands
Primary API

Columbia River CROSSING

Source: Project Delineated Wetlands = Columbia River Crossing (Parametrix)

Analysis by J. Koloszar and T. Farrelly; Analysis Date: 8/7/07; Plot Date: 9/9/08; File Name: Fig5_TF120.mxd

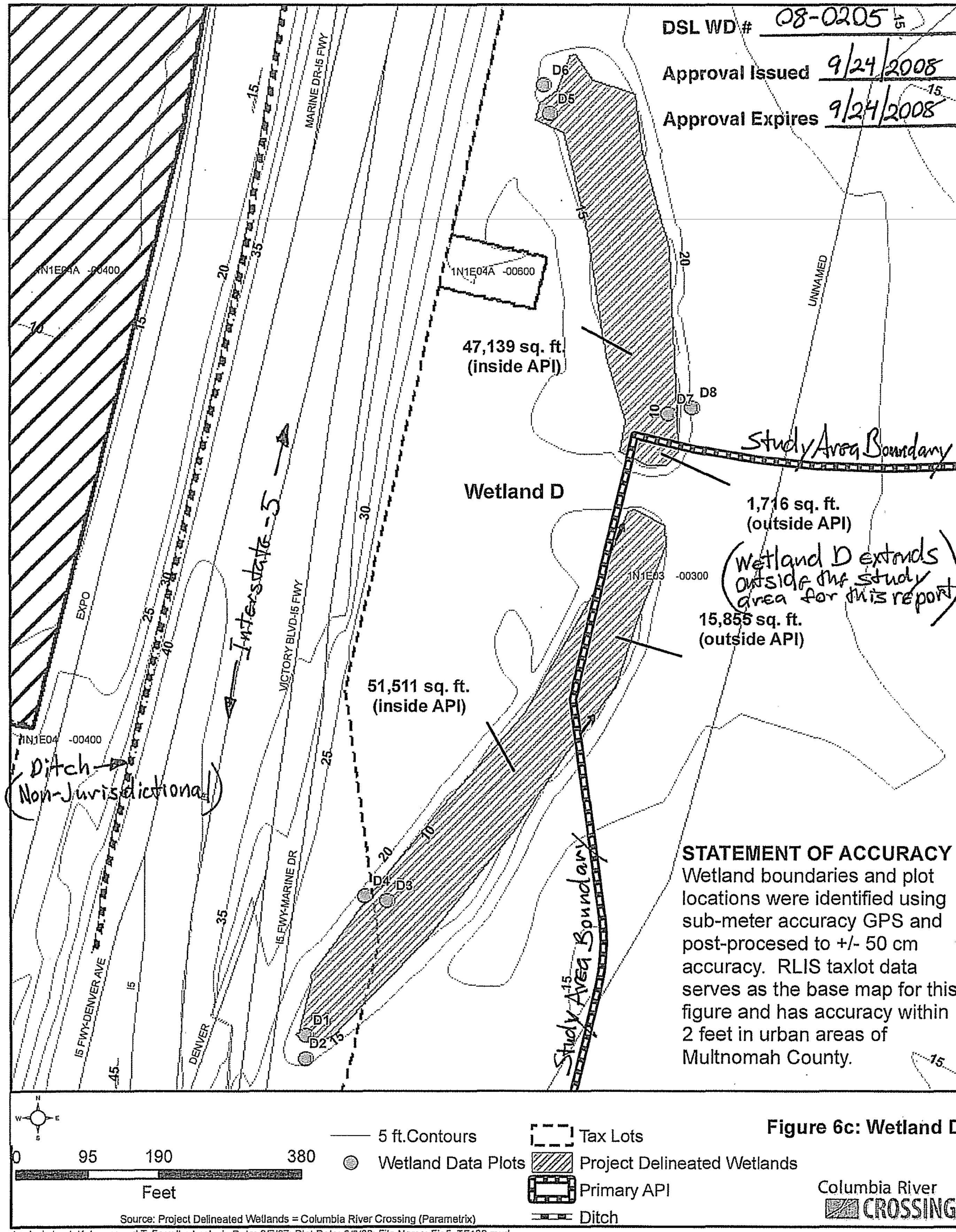
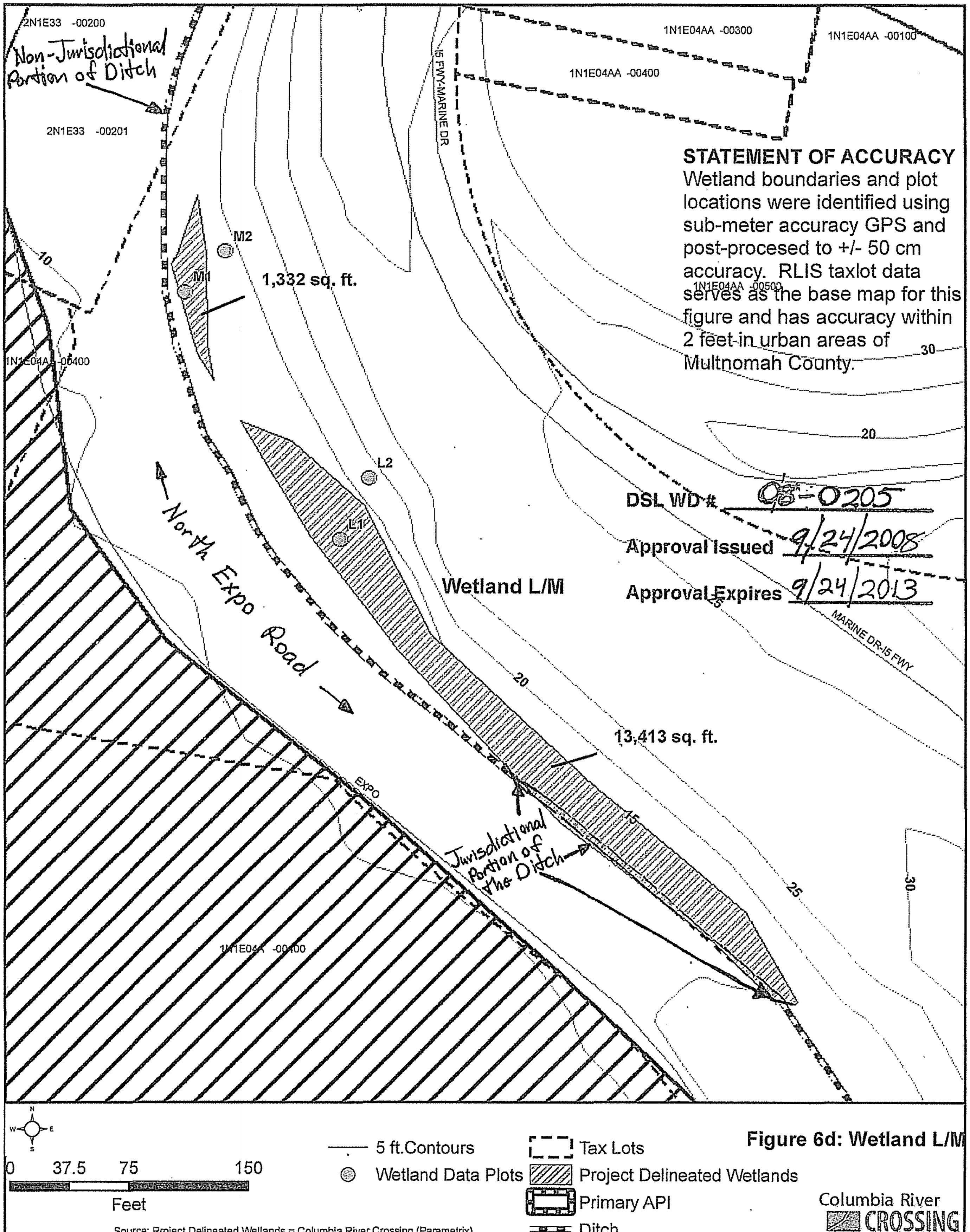


Figure 6c: Wetland D

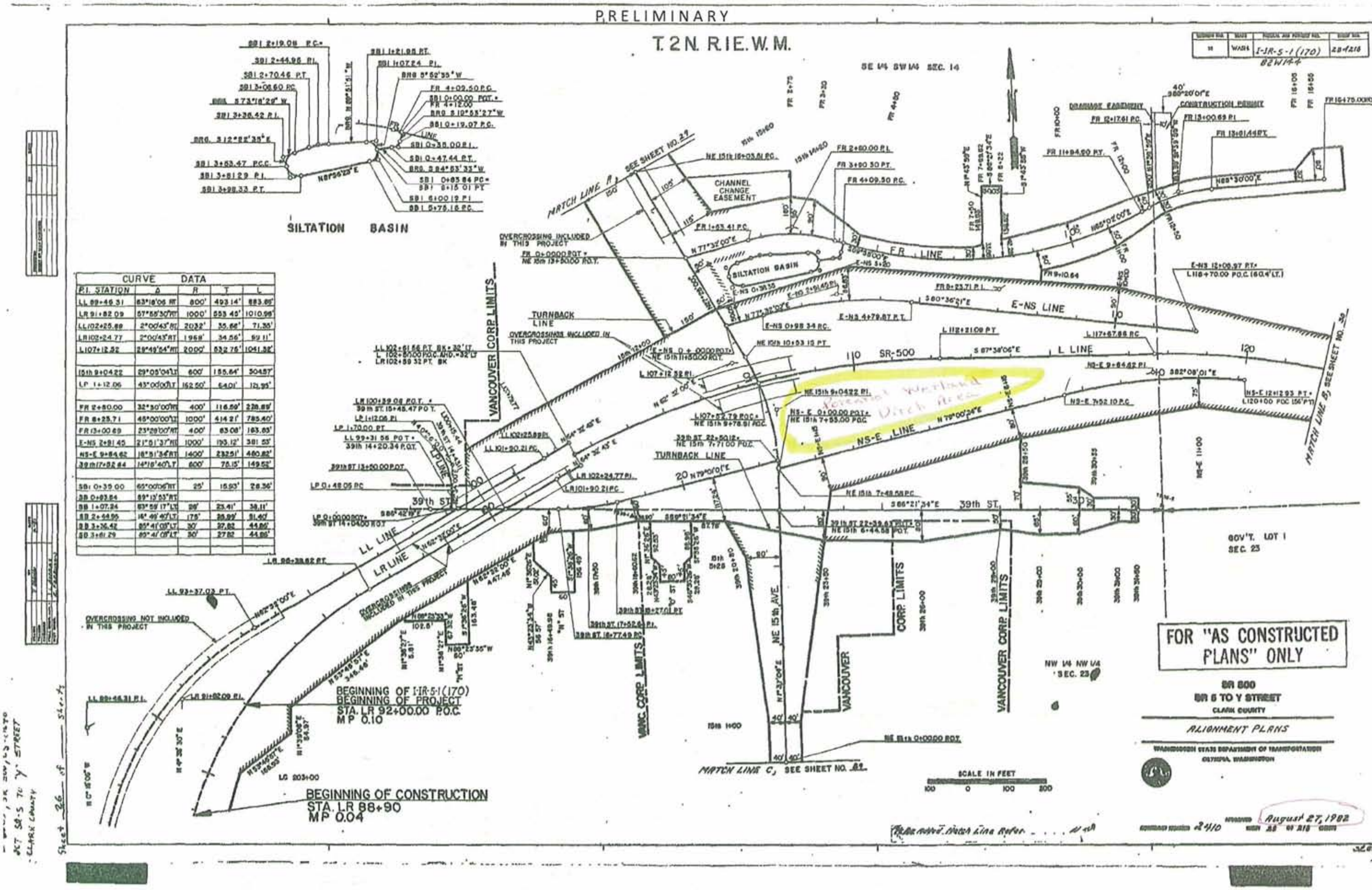
Analysis by J. Koloszar and T. Farrelly; Analysis Date: 8/7/07; Plot Date: 9/9/08; File Name: Fig5_TF120.mxd



Analysis by J. Koloszar and T. Farrelly; Analysis Date: 8/7/07; Plot Date: 9/9/08; File Name: Fig5_TF120.mxd

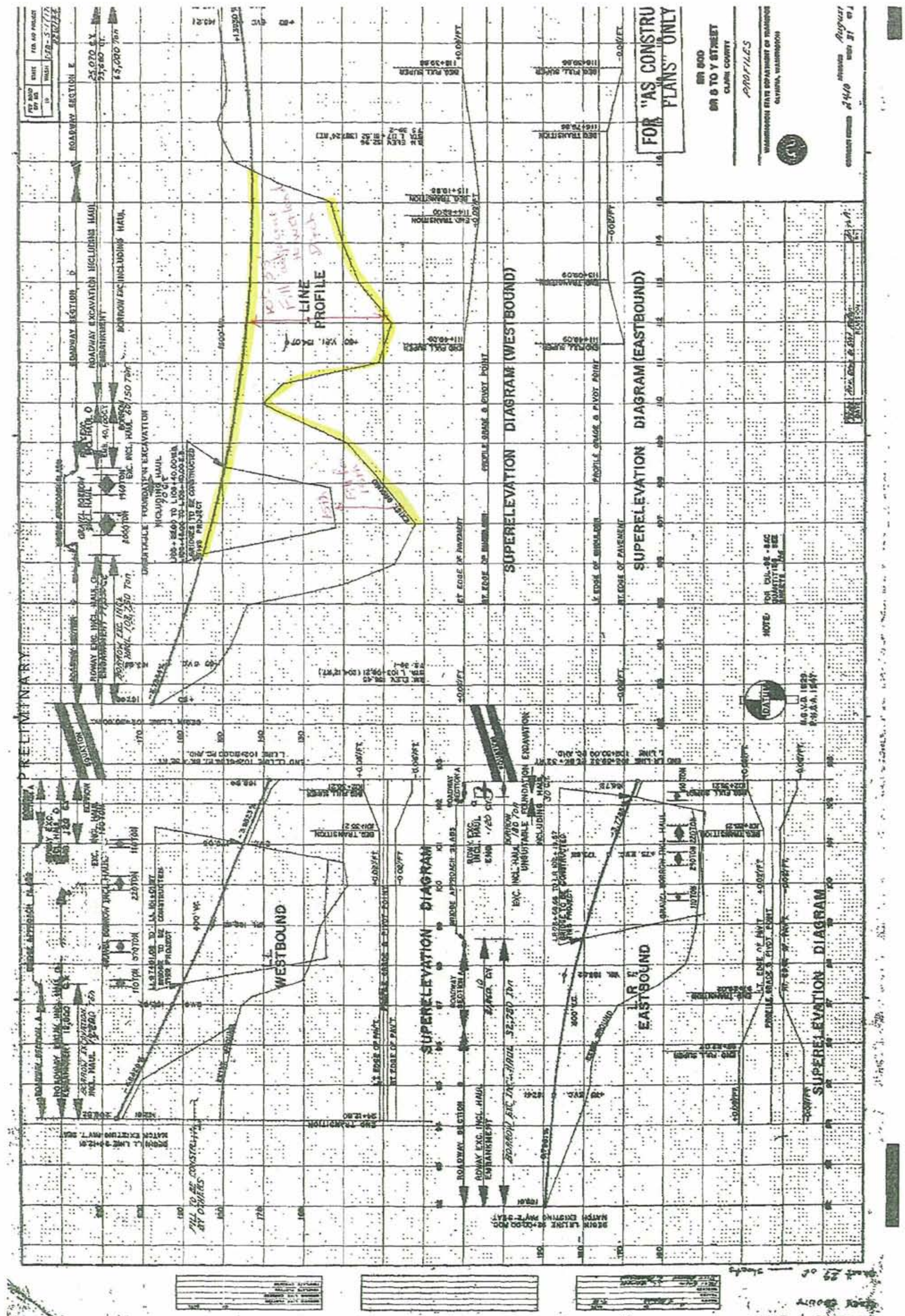
APPENDIX B

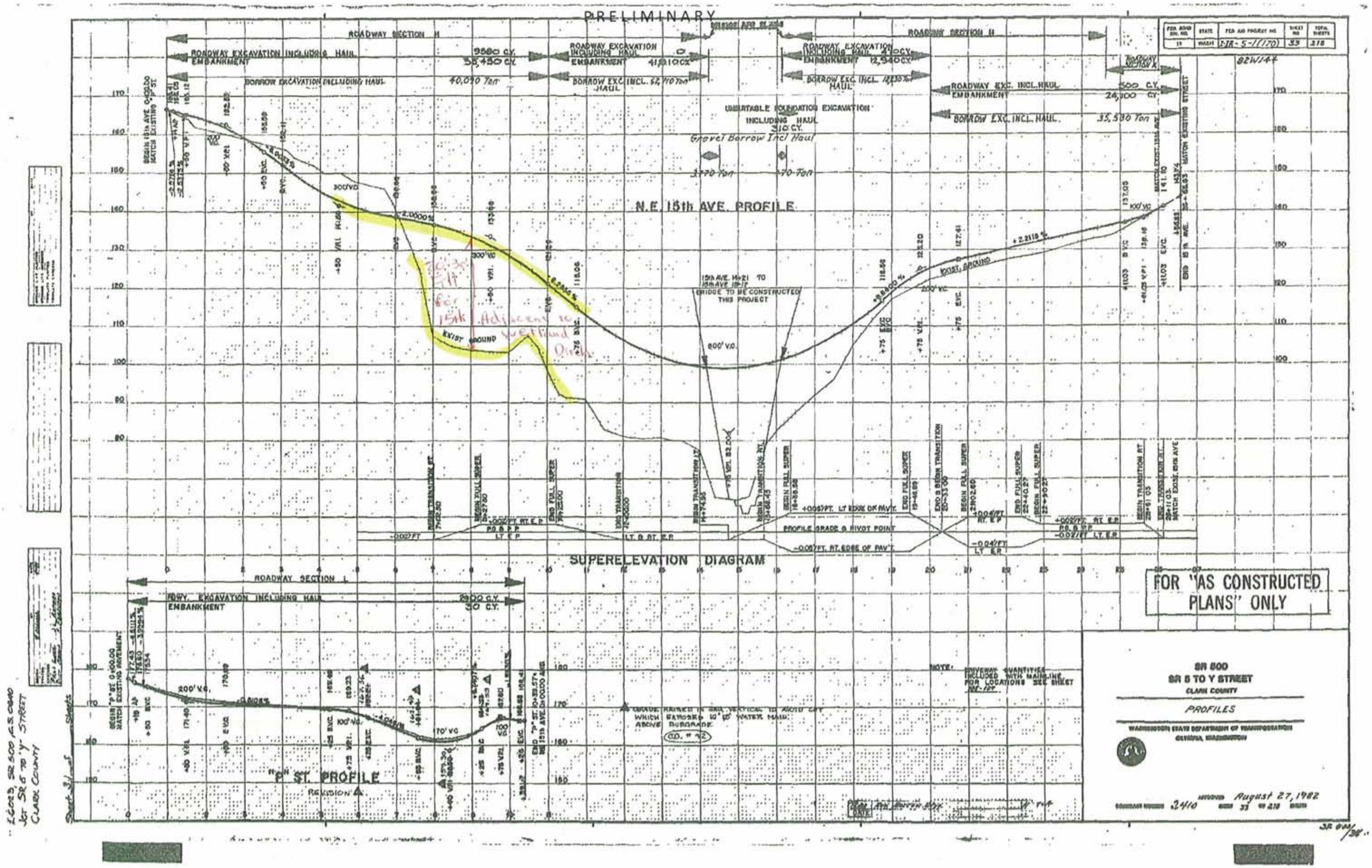
SR 500 As-built Plans from August 1982



CURVE DATA				
P.I. STATION	Δ	R	T	L
LL 89+46.31	63°18'06" RT	800'	493.14'	883.85'
LR 91+82.09	57°55'30" RT	1000'	553.45'	1010.96'
LL 102+25.89	2°00'43" RT	2032'	35.68'	71.35'
LR 102+24.77	2°00'43" RT	1968'	34.56'	69.11'
L 107+12.52	29°49'54" RT	2000'	532.76'	1041.32'
15th 9+04.22	29°05'04" LT	600'	155.64'	304.57'
LP 1+12.06	43°00'00" RT	162.50'	64.01'	121.95'
FR 2+80.00	32°30'00" RT	400'	116.59'	226.89'
FR 8+25.71	45°00'00" LT	1000'	414.21'	785.40'
FR 13+00.69	23°28'00" RT	400'	83.08'	163.85'
E-NS 2+81.45	21°51'37" RT	1000'	193.12'	381.53'
NS-E 9+64.62	18°51'34" RT	1400'	232.51'	460.82'
39th 17+52.64	14°16'40" LT	600'	75.15'	149.52'
SB1 0+35.00	65°00'06" RT	25'	15.93'	28.36'
SB 0+83.84	89°13'53" RT			
SB 1+07.24	83°59'17" LT	26'	23.41'	38.11'
SB 2+44.95	16°49'40" LT	175'	25.89'	51.40'
SB 3+36.42	85°41'05" LT	30'	27.82	44.86'
SB 3+61.29	85°41'05" LT	30'	27.82	44.86'

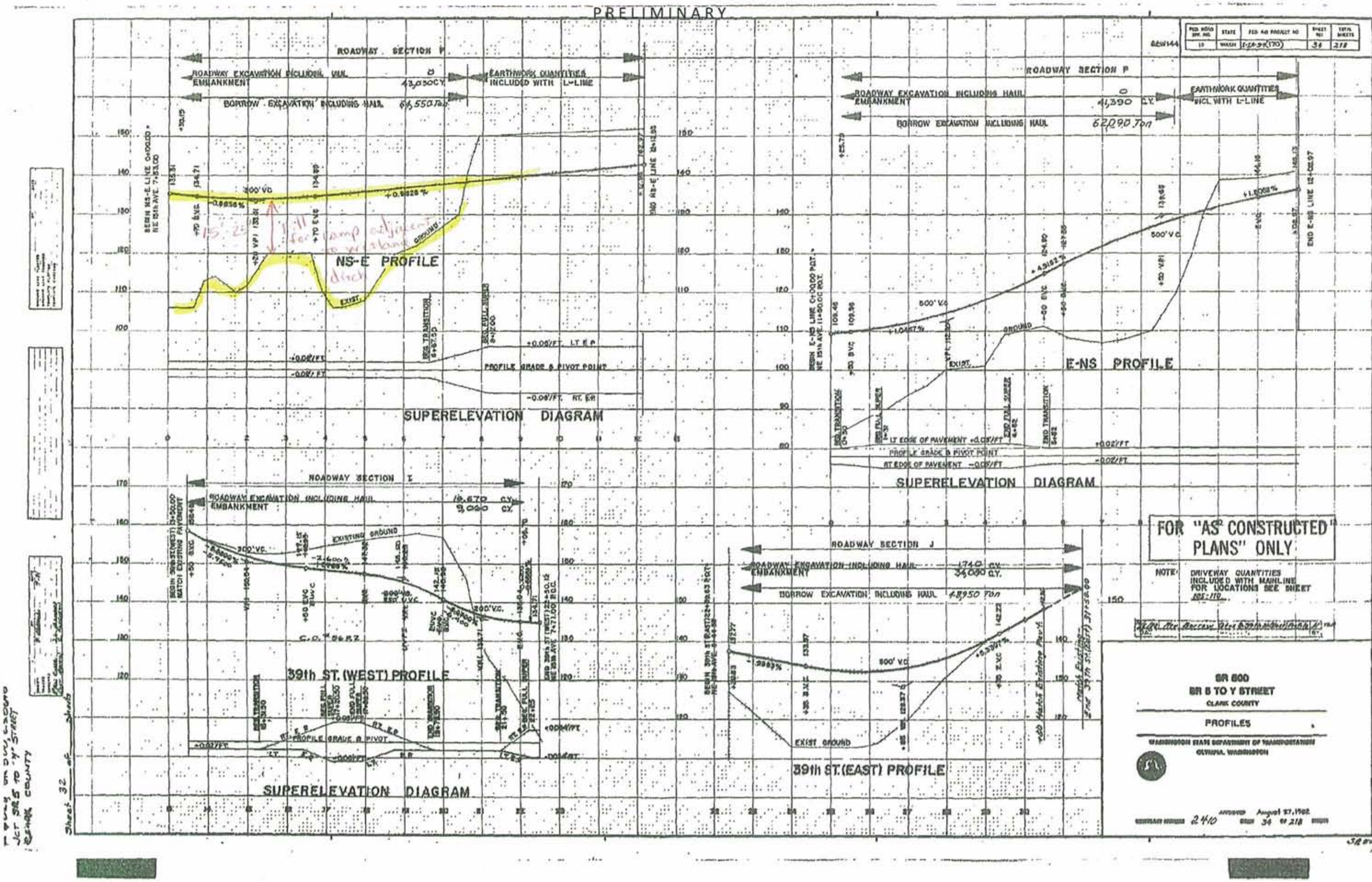
4701


PRELIMINARY
ROADWAY SECTION A
BRIDGE APPROACH SLABS
ROADWAY SECTION D
ROADWAY SECTION E
ROADWAY EXCAVATION INCLUDING HAUL
EMBANKMENT
BORROW EXC INCLUDING HAUL
25,070 C.Y.
65,000 Ton
UNSUITABLE FOUNDATION EXCAVATION
BRIDGES TO BE CONSTRUCTED THIS PROJECT
FILL TO BE CONSTR. BY OTHERS
L.L. WESTBOUND
L.R. EASTBOUND
LINE PROFILE
SUPERELEVATION DIAGRAM
SUPERELEVATION DIAGRAM (WESTBOUND)
SUPERELEVATION DIAGRAM (EASTBOUND)
PROFILE GRADE & PIVOT POINT
RT. EDGE OF PAVEMENT
DATUM
FOR "AS CONSTRU PLANS" ONLY
SR 500
SR 5 TO Y STREET
CLARK COUNTY
PROFILES



PRELIMINARY
N.E. 15th AVE. PROFILE
SUPERELEVATION DIAGRAM
"P" ST. PROFILE
ROADWAY SECTION H
ROADWAY SECTION L
ROADWAY EXCAVATION INCLUDING HAUL
EMBANKMENT
BORROW EXCAVATION INCLUDING HAUL
9880 C.Y.
35,450 C.Y.
40,090 Ton
UNSUITABLE FOUNDATION EXCAVATION INCLUDING HAUL
310 C.Y.
Gravel Borrow Incl Haul
3770 Ton
170 Ton
ROADWAY EXC. INCL. HAUL
BORROW EXC. INCL. HAUL
500 C.Y.
24,100 C.Y.
35,530 Ton
15th AVE. 14+21 TO 15th AVE. 16+17 BRIDGE TO BE CONSTRUCTED THIS PROJECT
EXIST. GROUND
800' V.C.
PROFILE GRADE & PIVOT POINT
FOR "AS CONSTRUCTED PLANS" ONLY
SR 500
SR 5 TO Y STREET
CLARK COUNTY
PROFILES
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
August 27, 1982
82W144
FAI-5-1(170)
33
218
2900 C.Y.
30 C.Y.
20.3' - 7 ft
for 15th
Adjacent to wetland

4704


PRELIMINARY
ROADWAY SECTION P
ROADWAY EXCAVATION INCLUDING HAUL
EMBANKMENT
43,030 CY
EARTHWORK QUANTITIES INCLUDED WITH L-LINE
BORROW EXCAVATION INCLUDING HAUL 66,550 Ton
500' VC
NS-E PROFILE
EXIST.
GROUND
PROFILE GRADE & PIVOT POINT
SUPERELEVATION DIAGRAM
ROADWAY SECTION P
ROADWAY EXCAVATION INCLUDING HAUL
EMBANKMENT
41,390 C.Y.
EARTHWORK QUANTITIES INCL WITH L-LINE
BORROW EXCAVATION INCLUDING HAUL 62,090 Ton
E-NS PROFILE
SUPERELEVATION DIAGRAM
ROADWAY SECTION I
ROADWAY EXCAVATION INCLUDING HAUL 16,670 C.Y.
EMBANKMENT 3,000 C.Y.
EXISTING GROUND
39th ST. (WEST) PROFILE
SUPERELEVATION DIAGRAM
ROADWAY SECTION J
ROADWAY EXCAVATION INCLUDING HAUL 1740 C.Y.
EMBANKMENT 34,090 C.Y.
BORROW EXCAVATION INCLUDING HAUL 48,950 Ton
500' VC
EXIST GROUND
39th ST. (EAST) PROFILE
FOR "AS CONSTRUCTED" PLANS" ONLY
NOTE: DRIVEWAY QUANTITIES INCLUDED WITH MAINLINE FOR LOCATIONS SEE SHEET
SR 500
SR 5 TO Y STREET
CLARK COUNTY
PROFILES
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
August 27, 1982
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WASH
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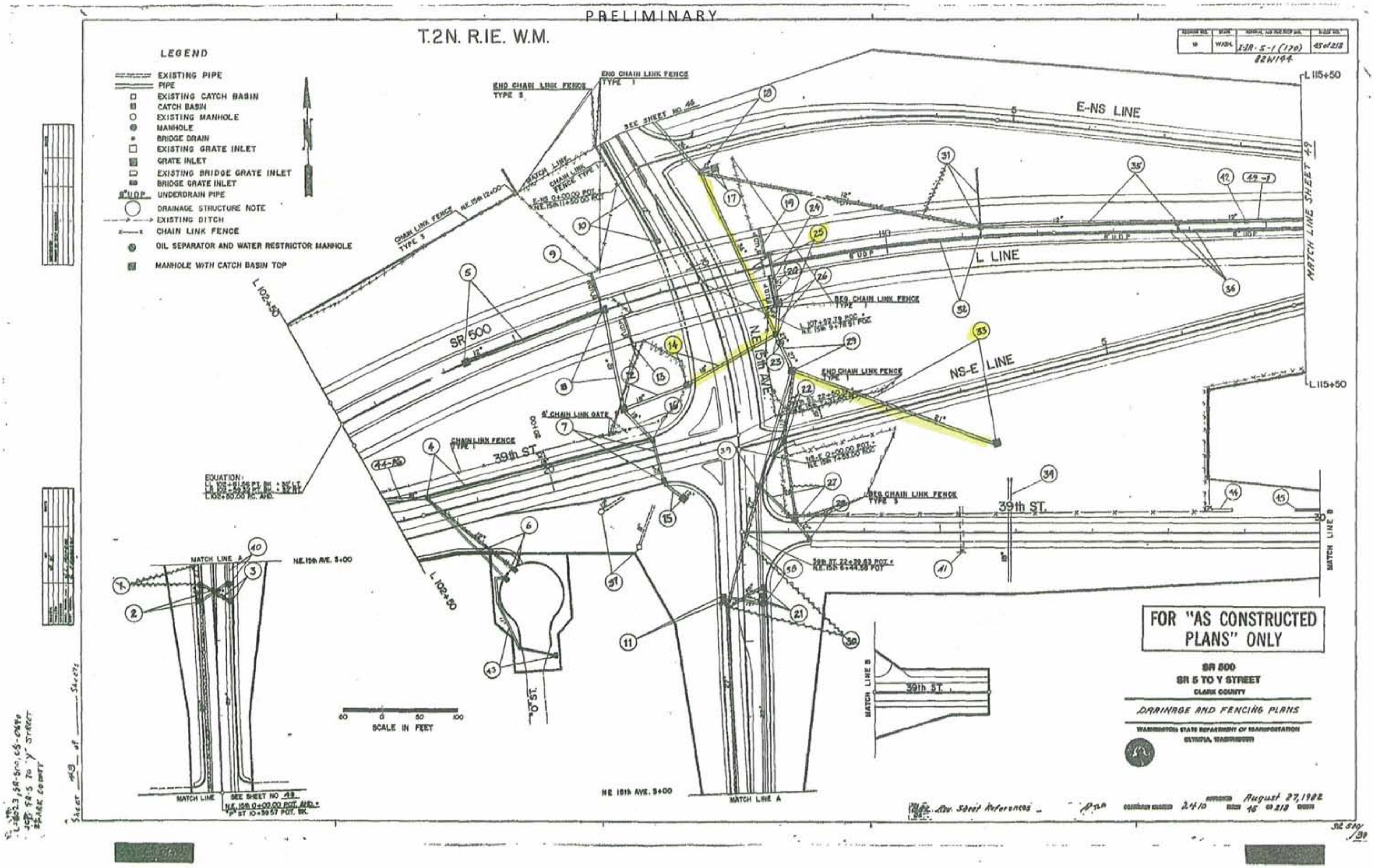
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T.2N. R.1E. W.M.
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EXISTING PIPE
PIPE
EXISTING CATCH BASIN
CATCH BASIN
EXISTING MANHOLE
MANHOLE
BRIDGE DRAIN
EXISTING GRATE INLET
GRATE INLET
EXISTING BRIDGE GRATE INLET
BRIDGE GRATE INLET
8"UDP UNDERDRAIN PIPE
DRAINAGE STRUCTURE NOTE
EXISTING DITCH
CHAIN LINK FENCE
OIL SEPARATOR AND WATER RESTRICTOR MANHOLE
MANHOLE WITH CATCH BASIN TOP
E-NS LINE
L LINE
NS-E LINE
SR 500
39th ST.
N.E. 15th AVE.
END CHAIN LINK FENCE TYPE 3
END CHAIN LINK FENCE TYPE 1
BEG. CHAIN LINK FENCE TYPE 1
BEG. CHAIN LINK FENCE TYPE 3
CHAIN LINK FENCE TYPE 3
CHAIN LINK FENCE TYPE 1
8' CHAIN LINK GATE
SEE SHEET NO. 46
MATCH LINE SHEET 49
MATCH LINE A
MATCH LINE B
L 102+50
L 115+50
EQUATION:
NE 15th AVE. 3+00
"O" ST.
SCALE IN FEET
FOR "AS CONSTRUCTED PLANS" ONLY
SR 500
SR 5 TO Y STREET
CLARK COUNTY
DRAINAGE AND FENCING PLANS
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
I-IR-5-1(170)
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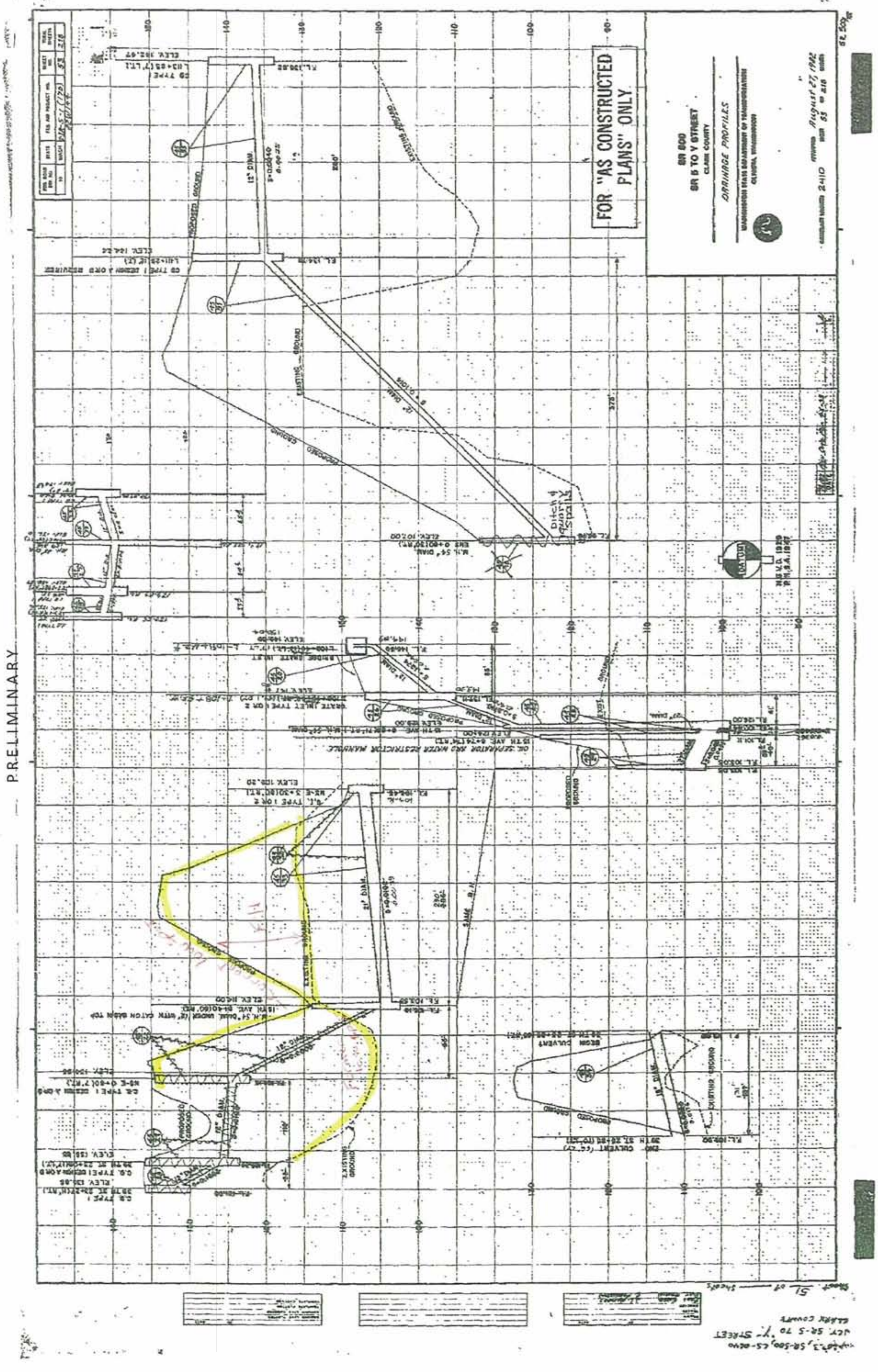
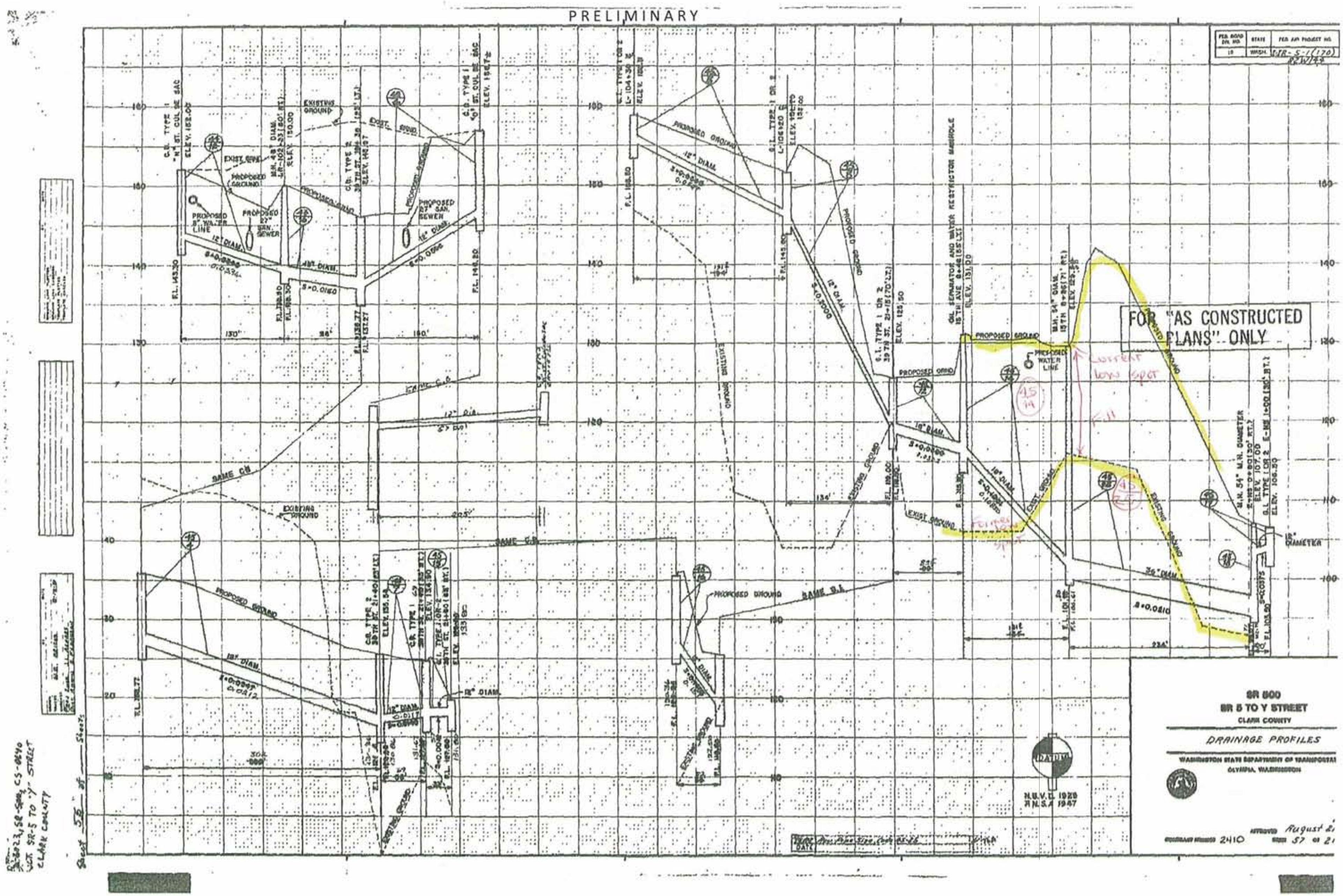
4705

PRELIMINARY

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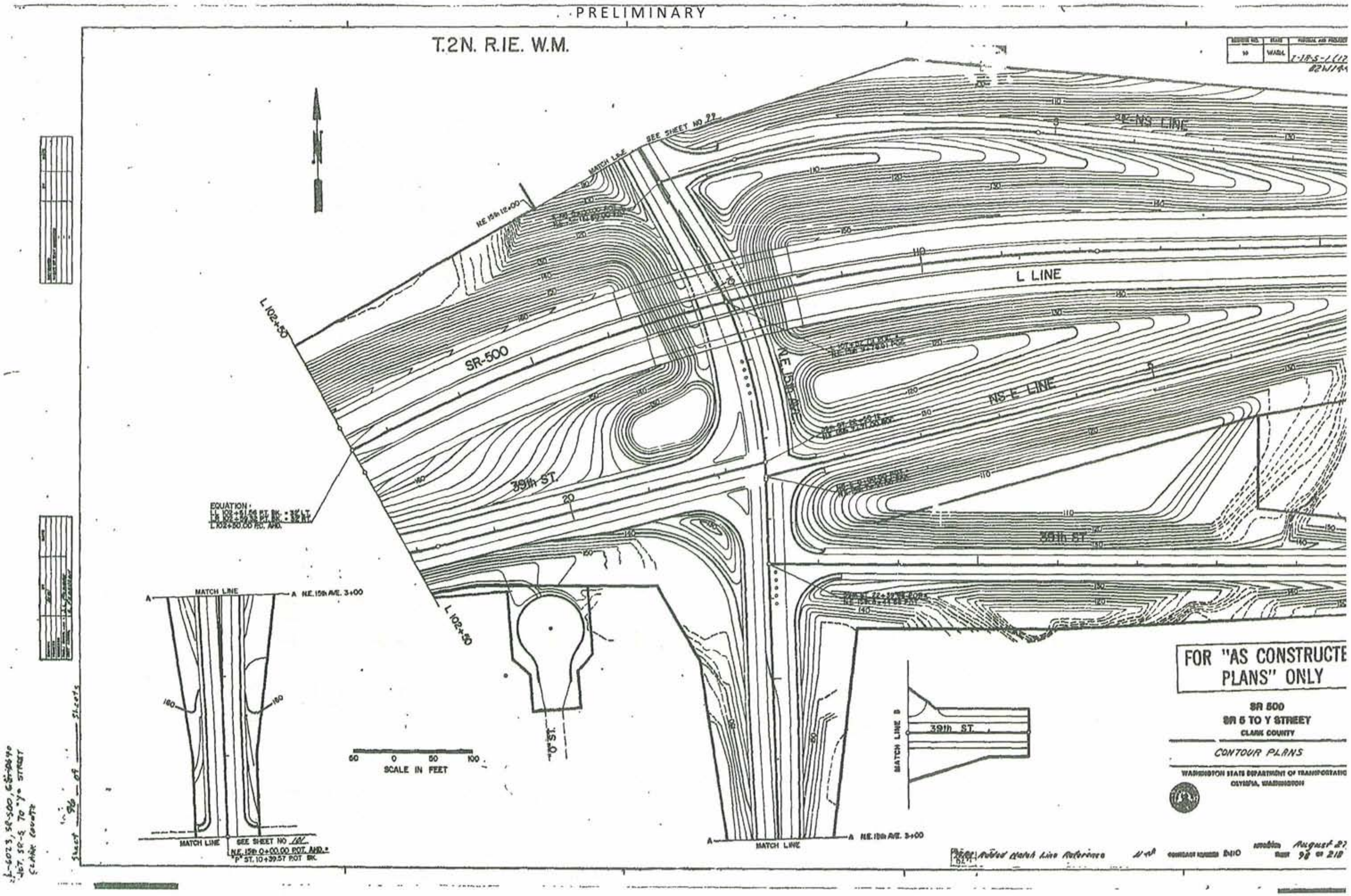
FOR "AS CONSTRUCTED PLANS" ONLY
Current low spot
Fill
SR 500
SR 5 TO Y STREET
CLARK COUNTY
DRAINAGE PROFILES
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
N.G.V.D. 1929
N.A.D. 1927
PROPOSED GROUND
EXISTING GROUND
12" DIAM.
18" DIAM.
36" DIAM.
S=0.0210
S=0.0160
OIL SEPARATOR AND WATER RESTRICTION MANHOLE
15TH AVE 8+48(55'LT)
ELEV. 131.00
M.H. 54" DIAM.
15TH 8+96(71' RT.)
M.H. 48" DIAM.
PROPOSED 8" WATER LINE
PROPOSED 27" SAN. SEWER
SAME C.B.
FED. ROAD DIV. NO.
STATE
FED. AID PROJECT NO.
10
WASH.
August 2
57 of 21
2410

4708



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NE 15th 12+00
L 102+50
SR-500
L LINE
NS-E LINE
39th ST.
N.E. 15th AVE
EQUATION:
L 102+50.00 RD. AHD.
MATCH LINE
A NE 15th AVE. 3+00
SEE SHEET NO 101
N.E. 15th 0+00.00 POT. AHD. =
"P" ST. 10+39.57 POT. BK.
"O" ST.
SCALE IN FEET
50 0 50 100
MATCH LINE B
39th ST.
FOR "AS CONSTRUCTED PLANS" ONLY
SR 500
SR 5 TO Y STREET
CLARK COUNTY
CONTOUR PLANS
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
Added Match Line Reference
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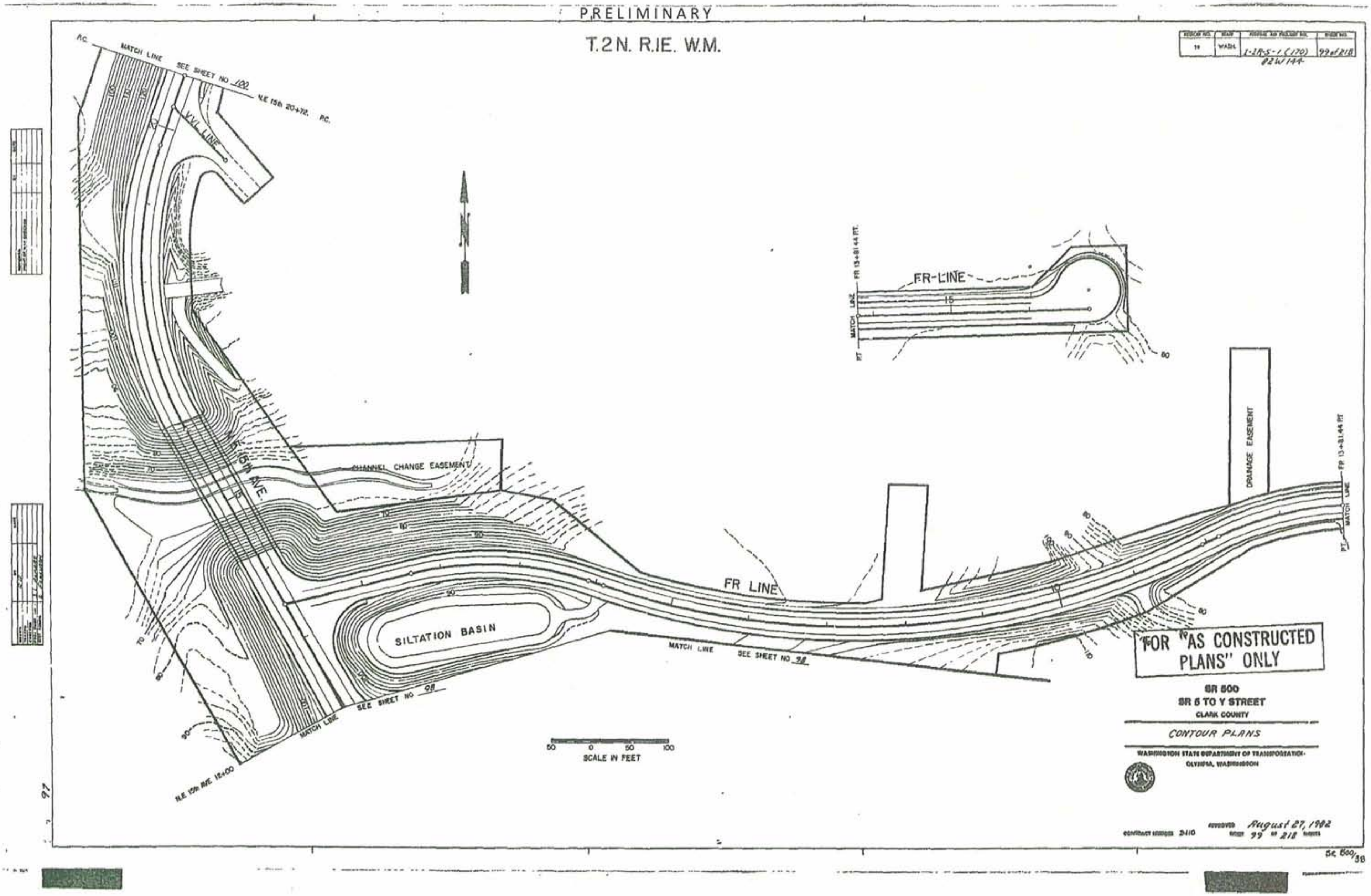
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VVL LINE
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CHANNEL CHANGE EASEMENT
SILTATION BASIN
FR LINE
FR-LINE
DRAINAGE EASEMENT
MATCH LINE SEE SHEET NO 98
SCALE IN FEET
FOR "AS CONSTRUCTED PLANS" ONLY
SR 500
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CLARK COUNTY
CONTOUR PLANS
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
OLYMPIA, WASHINGTON
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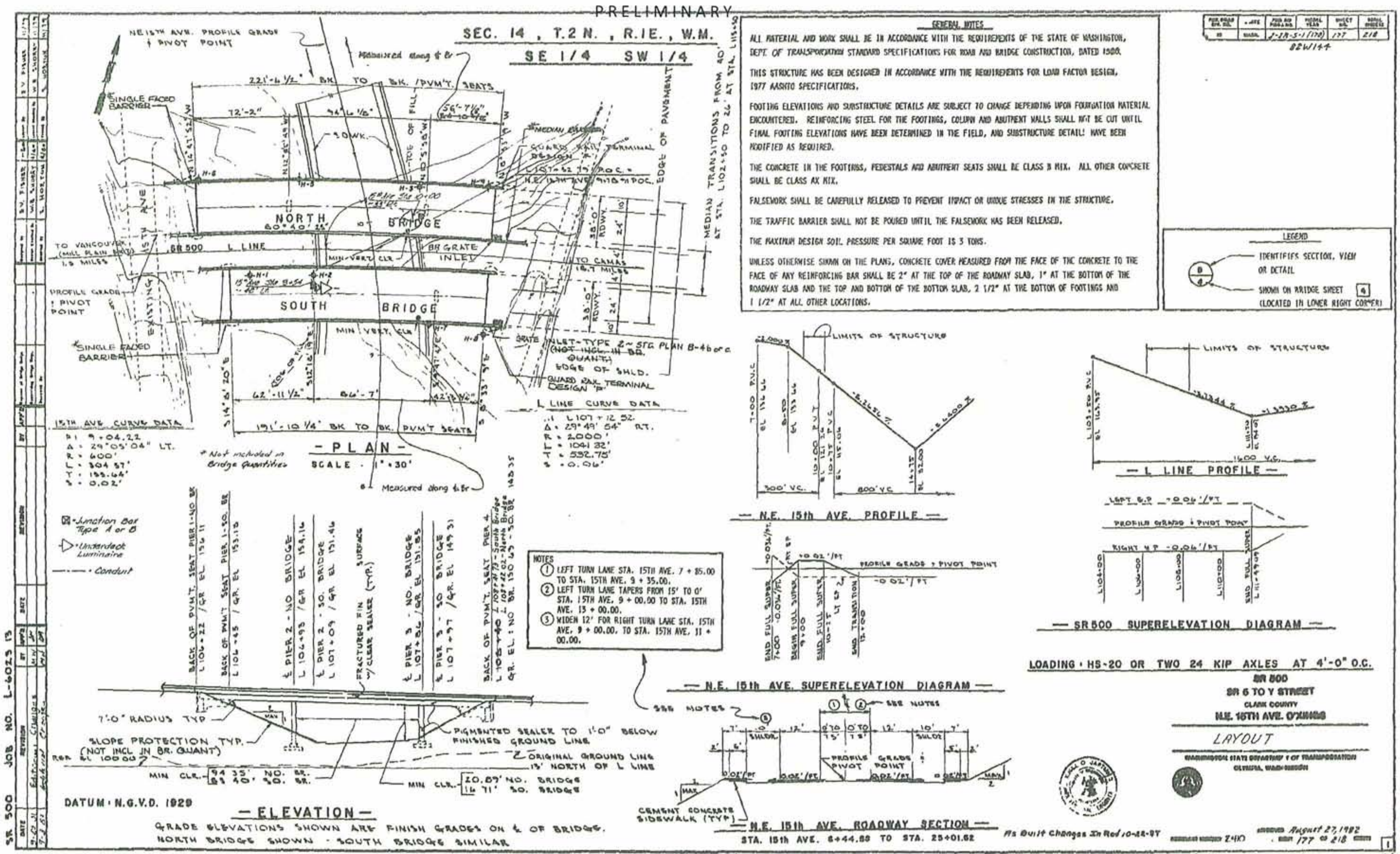
PRELIMINARY
SEC. 14, T.2 N., R.1E., W.M.
SE 1/4 SW 1/4
GENERAL NOTES
ALL MATERIAL AND WORK SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE STATE OF WASHINGTON, DEPT. OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, DATED 1980.
THIS STRUCTURE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS FOR LOAD FACTOR DESIGN, 1977 AASHTO SPECIFICATIONS.
FOOTING ELEVATIONS AND SUBSTRUCTURE DETAILS ARE SUBJECT TO CHANGE DEPENDING UPON FOUNDATION MATERIAL ENCOUNTERED. REINFORCING STEEL FOR THE FOOTINGS, COLUMN AND ABUTMENT WALLS SHALL NOT BE CUT UNTIL FINAL FOOTING ELEVATIONS HAVE BEEN DETERMINED IN THE FIELD, AND SUBSTRUCTURE DETAILS HAVE BEEN MODIFIED AS REQUIRED.
THE CONCRETE IN THE FOOTINGS, PEDESTALS AND ABUTMENT SEATS SHALL BE CLASS B MIX. ALL OTHER CONCRETE SHALL BE CLASS AX MIX.
FALSEWORK SHALL BE CAREFULLY RELEASED TO PREVENT IMPACT OR UNDUE STRESSES IN THE STRUCTURE.
THE TRAFFIC BARRIER SHALL NOT BE POURED UNTIL THE FALSEWORK HAS BEEN RELEASED.
THE MAXIMUM DESIGN SOIL PRESSURE PER SQUARE FOOT IS 3 TONS.
UNLESS OTHERWISE SHOWN ON THE PLANS, CONCRETE COVER MEASURED FROM THE FACE OF THE CONCRETE TO THE FACE OF ANY REINFORCING BAR SHALL BE 2" AT THE TOP OF THE ROADWAY SLAB, 1" AT THE BOTTOM OF THE ROADWAY SLAB AND THE TOP AND BOTTOM OF THE BOTTOM SLAB, 2 1/2" AT THE BOTTOM OF FOOTINGS AND 1 1/2" AT ALL OTHER LOCATIONS.
LEGEND
IDENTIFIES SECTION, VIEW OR DETAIL
SHOWN ON BRIDGE SHEET 4 (LOCATED IN LOWER RIGHT CORNER)
NOTES
① LEFT TURN LANE STA. 15TH AVE. 7 + 85.00 TO STA. 15TH AVE. 9 + 35.00.
② LEFT TURN LANE TAPERS FROM 15' TO 0' STA. 15TH AVE. 9 + 00.00 TO STA. 15TH AVE. 13 + 00.00.
③ WIDEN 12' FOR RIGHT TURN LANE STA. 15TH AVE. 9 + 00.00, TO STA. 15TH AVE. 11 + 00.00.
NORTH BRIDGE
SOUTH BRIDGE
SR 500 L LINE
TO VANCOUVER (MILL PLAIN BLVD) 1.5 MILES
TO CAMAS 16.7 MILES
- PLAN -
SCALE 1" = 30'
L LINE CURVE DATA
15TH AVE CURVE DATA
- ELEVATION -
GRADE ELEVATIONS SHOWN ARE FINISH GRADES ON ℄ OF BRIDGE. NORTH BRIDGE SHOWN - SOUTH BRIDGE SIMILAR
DATUM - N.G.V.D. 1929
— N.E. 15th AVE. PROFILE —
— L LINE PROFILE —
— SR500 SUPERELEVATION DIAGRAM —
— N.E. 15th AVE. SUPERELEVATION DIAGRAM —
— N.E. 15th AVE. ROADWAY SECTION —
STA. 15th AVE. 6+44.88 TO STA. 25+01.62
LOADING - HS-20 OR TWO 24 KIP AXLES AT 4'-0" O.C.
SR 500
SR 6 TO Y STREET
CLARK COUNTY
N.E. 15TH AVE. O'XING
LAYOUT
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
As Built Changes In Red 10-22-87
August 27, 1982
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SR 500 JOB NO. L-6023 13

INTERSTATE 5 COLUMBIA RIVER CROSSING

Water Quality and Hydrology Technical Report for the Final Environmental Impact Statement

Columbia River CROSSING

May 2011

Title VI

The Columbia River Crossing project team ensures full compliance with Title VI of the Civil Rights Act of 1964 by prohibiting discrimination against any person on the basis of race, color, national origin or sex in the provision of benefits and services resulting from its federally assisted programs and activities. For questions regarding WSDOT's Title VI Program, you may contact the Department's Title VI Coordinator at (360) 705-7098. For questions regarding ODOT's Title VI Program, you may contact the Department's Civil Rights Office at (503) 986-4350.

Americans with Disabilities Act (ADA) Information

If you would like copies of this document in an alternative format, please call the Columbia River Crossing (CRC) project office at (360) 737-2726 or (503) 256-2726. Persons who are deaf or hard of hearing may contact the CRC project through the Telecommunications Relay Service by dialing 7-1-1.

¿Habla usted español? La informacion en esta publicación se puede traducir para usted. Para solicitar los servicios de traducción favor de llamar al (503) 731-4128.

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Cover Sheet

Interstate 5 Columbia River Crossing

Water Quality and Hydrology Technical Report for the Final Environmental Impact Statement

Submitted By:

Elisabeth Kay Bowers

Parametrix

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TABLE OF CONTENTS

List of Exhibits

Appendices

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ACRONYMS

Acronym	Description
ADT	Average Daily Traffic
API	Area of Potential Impact
BES	City of Portland Bureau of Environmental Services
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
BPA	Bonneville Power Administration
CD	collector-distributor
cfs	cubic feet per second
CIA	contributing impervious area
CMA	calcium magnesium acetate
CRC	Columbia River Crossing
CTR	Commute Trip Reduction (Washington)
C-TRAN	Clark County Public Transportation Benefit Area
CWA	Clean Water Act
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEIS	Draft Environmental Impact Statement
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
DOT	U.S. Department of Transportation
DSL	Oregon Department of State Lands
ECO	Employee Commute Options (Oregon)
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESCP	erosion and sediment control plan
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
InterCEP	Interstate Collaborative Environmental Process
JARPA	Joint Aquatic Resource Permits Application
LPA	Locally Preferred Alternative
LRV	light rail vehicle

MAX	Metropolitan Area Express
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
ODOT	Oregon Department of Transportation
OHW	ordinary high water line
OTC	Oregon Transportation Commission
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PDX	Portland International Airport
PGIS	pollutant-generating impervious surface
PIR	Portland International Raceway
PNS	Pacific Northwest Snowfighters
RM	River mile
ROD	Record of Decision
RTC	Regional Transportation Commission
SDWA	Safe Drinking Water Act
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SPUI	Single-Point-Urban Interchange
sq.ft.	square feet
SSA	sole source aquifer
SWPPP	Stormwater Pollution Prevention Plan
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TDM	transportation demand management
TESCP	Temporary Erosion and Sediment Control Plan
TMDL	Total Maximum Daily Load
TriMet	Tri-County Metropolitan Transportation District
TSM	transportation system management
TSS	Total suspended solids
UIC	underground injection control
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

VMC	Vancouver Municipal Code
WPCF	water pollution control facility
WSDOT	Washington State Department of Transportation
WTC	Washington Transportation Commission

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1. Summary

1.1 Introduction

This Water Quality and Hydrology Technical Report provides and evaluation of two alternatives – the Locally Preferred Alternative (LPA) and the No-Build Alternative. Both of these alternatives are described in this section.

1.2 Description of Alternatives

This technical report evaluates the CRC project's locally preferred alternative (LPA) and the No-Build Alternative. The LPA includes two design options: The preferred option, LPA Option A, which includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge; and LPA Option B, which does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor (CD) lanes on the two new bridges that would be built adjacent to I-5. In addition to the design options, if funding availability does not allow the entire LPA to be constructed in one phase, some roadway elements of the project would be deferred to a future date. This technical report identifies several elements that could be deferred, and refers to that possible initial investment as LPA with highway phasing. The LPA with highway phasing option would build most of the LPA in the first phase, but would defer construction of specific elements of the project. The LPA and the No-Build Alternative are described in this section.

1.2.1 Adoption of a Locally Preferred Alternative

Following the publication of the Draft Environmental Impact Statement (DEIS) on May 2, 2008, the project actively solicited public and stakeholder feedback on the DEIS during a 60-day comment period. During this time, the project received over 1,600 public comments.

During and following the public comment period, the elected and appointed boards and councils of the local agencies sponsoring the CRC project held hearings and workshops to gather further public input on and discuss the DEIS alternatives as part of their efforts to determine and adopt a locally preferred alternative. The LPA represents the alternative preferred by the local and regional agencies sponsoring the CRC project. Local agency-elected boards and councils determined their preference based on the results of the evaluation in the DEIS and on the public and agency comments received both before and following its publication.

In the summer of 2008, the local agencies sponsoring the CRC project adopted the following key elements of CRC as the LPA:

- A replacement bridge as the preferred river crossing,
- Light rail as the preferred high-capacity transit mode, and
- Clark College as the preferred northern terminus for the light rail extension.

The preferences for a replacement crossing and for light rail transit were identified by all six local agencies. Only the agencies in Vancouver – the Clark County Public Transit Benefit Area Authority (C-TRAN), the City of Vancouver, and the Regional Transportation Council (RTC) – preferred the Vancouver light rail terminus. The adoption of the LPA by these local agencies does not represent a formal decision by the federal agencies leading this project – the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) – or any federal funding commitment. A formal decision by FHWA and FTA about whether and how this project should be constructed will follow the FEIS in a Record of Decision (ROD).

1.2.2 Description of the LPA

The LPA includes an array of transportation improvements, which are described below. When the LPA differs between Option A and Option B, it is described in the associated section. For a more detailed description of the LPA, including graphics, please see Chapter 2 of the FEIS.

1.2.2.1 Multimodal River Crossing

Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River would be replaced by two new parallel bridges. The eastern structure would accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path underneath; the western structure would carry southbound traffic, with a two-way light rail guideway below. Whereas the existing bridges have only three lanes each with virtually no shoulders, each of the new bridges would be wide enough to accommodate three through-lanes and two add/drop lanes. Lanes and shoulders would be built to full design standards.

The new bridges would be high enough to provide approximately 95 feet of vertical clearance for river traffic beneath, but not so high as to impede the take-offs and landings by aircraft using Pearson Field or Portland International Airport to the east. The new bridge structures over the Columbia River would not include lift spans, and both of the new bridges would each be supported by six piers in the water and two piers on land.

North Portland Harbor Bridges

The existing highway structures over North Portland Harbor would not be replaced; instead, they would be retained to accommodate all mainline I-5 traffic. As discussed at the beginning of this chapter, two design options have emerged for the Hayden Island and Marine Drive interchanges. The preferred option, LPA Option A, includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge. LPA Option B does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor lanes on the two new bridges that would be built adjacent to I-5.

LPA Option A: Four new, narrower parallel structures would be built across the waterway, three on the west side and one on the east side of the existing North Portland Harbor bridges. Three of the new structures would carry on- and off-ramps to mainline I-5. Two structures west of the existing bridges would carry traffic merging onto or exiting off of I-5 southbound. The new structure on the east side of I-5 would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include a two-lane arterial bridge for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

LPA Option B: This option would build the same number of structures over North Portland Harbor as Option A, although the locations and functions on those bridges would differ, as described below. The existing bridge over North Portland Harbor would be widened and would receive seismic upgrades.

LPA Option B does not have arterial lanes on the light rail/multi-use path bridge. Direct access between Marine Drive and the island would be provided with collector-distributor lanes. The structures adjacent to the highway bridge would carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges.

1.2.2.2 Interchange Improvements

The LPA includes improvements to seven interchanges along a 5-mile segment of I-5 between Victory Boulevard in Portland and SR 500 in Vancouver. These improvements include some reconfiguration of adjacent local streets to complement the new interchange designs, as well as new facilities for bicyclists and pedestrians along this corridor.

Victory Boulevard Interchange

The southern extent of the I-5 project improvements would be two ramps associated with the Victory Boulevard interchange in Portland. The Marine Drive to I-5 southbound on-ramp would be braided over the I-5 southbound to the Victory Boulevard/Denver Avenue off-ramp. The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Denver Avenue. The current merging ramp would be extended to become an add/drop (auxiliary) lane which would continue across the river crossing.

Potential phased construction option: The aforementioned southbound ramp improvements to the Victory Boulevard interchange may not be included with the CRC project. Instead, the existing connections between I-5 southbound and Victory Boulevard could be retained. The braided ramp connection could be constructed separately in the future as funding becomes available.

Marine Drive Interchange

All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5 at this location. The interchange configuration would be a single-point urban interchange (SPUI) with a flyover ramp serving the east to north movement. With this configuration, three legs of the interchange would converge at a point on Marine Drive, over the I-5 mainline. This configuration would allow the highest volume movements to move freely without being impeded by stop signs or traffic lights.

The Marine Drive eastbound to I-5 northbound flyover ramp would provide motorists with access to I-5 northbound without stopping. Motorists from Marine Drive eastbound would access I-5 southbound without stopping. Motorists traveling on Martin Luther King Jr. Boulevard westbound to I-5 northbound would access I-5 without stopping at the intersection.

The new interchange configuration changes the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard and to northbound I-5. These two streets would access westbound Martin Luther King Jr. Boulevard farther east. Martin Luther King Jr. Boulevard would have a new direct connection to I-5 northbound.

In the new configuration, the connections from Vancouver Way and Marine Drive would be served, improving the existing connection to Martin Luther King Jr. Boulevard east of the interchange. The improvements to this connection would allow traffic to turn right from Vancouver Way and accelerate onto Martin Luther King Jr. Boulevard. On the south side of

Martin Luther King Jr. Boulevard, the existing loop connection would be replaced with a new connection farther east.

A new multi-use path would extend from the Bridgeton neighborhood to the existing Expo Center light rail station and from the station to Hayden Island along the new light rail line over North Portland Harbor.

LPA Option A: Local traffic between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel via an arterial bridge over North Portland Harbor. There would be some variation in the alignment of local streets in the area of the interchange between Option A and Option B. The most prominent differences are the alignments of Vancouver Way and Union Court.

LPA Option B: With this design option, there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island would travel on the collector-distributor bridges that would parallel each side of I-5 over North Portland Harbor. Traffic would not need to merge onto mainline I-5 to travel between the island and Martin Luther King Jr. Boulevard/Marine Drive.

***Potential phased construction option*:** The aforementioned flyover ramp could be deferred and not constructed as part of the CRC project. In this case, rather than providing a direct eastbound Marine Drive to I-5 northbound connection by a flyover ramp, the project improvements to the interchange would instead provide this connection through the signal-controlled SPUI. The flyover ramp could be constructed separately in the future as funding becomes available.

Hayden Island Interchange

All movements for this interchange would be reconfigured. The new configuration would be a split tight diamond interchange. Ramps parallel to the highway would be built, lengthening the ramps and improving merging speeds. Improvements to Jantzen Drive and Hayden Island Drive would include additional through, left-turn, and right-turn lanes. A new local road, Tomahawk Island Drive, would travel east-west through the middle of Hayden Island and under the I-5 interchange, improving connectivity across I-5 on the island. Additionally, a new multi-use path would be provided along the elevated light rail line on the west side of the Hayden Island interchange.

LPA Option A: A proposed arterial bridge with two lanes of traffic, one in each direction, would allow vehicles to travel between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island without accessing I-5.

LPA Option B: With this design option there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that parallel each side of I-5 over North Portland Harbor.

SR 14 Interchange

The function of this interchange would remain largely the same. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Downtown Vancouver I-5 access to and from the south would be at C Street rather than Washington Street, while downtown connections to and from SR 14 would be made by way of Columbia Street at 4th Street.

The multi-use bicycle and pedestrian path in the northbound (eastern) I-5 bridge would exit the structure at the SR 14 interchange, and then loop down to connect into Columbia Way.

Mill Plain Interchange

This interchange would be reconfigured into a SPUI. The existing "diamond" configuration requires two traffic signals to move vehicles through the interchange. The SPUI would use one efficient intersection and allow opposing left turns simultaneously. This would improve the capacity of the interchange by reducing delay for traffic entering or exiting the highway.

This interchange would also receive several improvements for bicyclists and pedestrians. These include bike lanes and sidewalks, clear delineation and signing, short perpendicular crossings at the ramp terminals, and ramp orientations that would make pedestrians highly visible.

Fourth Plain Interchange

The improvements to this interchange would be made to better accommodate freight mobility and access to the new park and ride at Clark College. Northbound I-5 traffic exiting to Fourth Plain would continue to use the off-ramp just north of the SR 14 interchange. The southbound I-5 exit to Fourth Plain would be braided with the SR 500 connection to I-5, which would eliminate the non-standard weave between the SR 500 connection and the off-ramp to Fourth Plain as well as the westbound SR 500 to Fourth Plain Boulevard connection.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including bike lanes, neighborhood connections, and access to the park and ride.

SR 500 Interchange

Improvements would be made to the SR 500 interchange to add direct connections to and from I-5. On- and off-ramps would be built to directly connect SR 500 and I-5 to and from the north, connections that are currently made by way of 39th Street. I-5 southbound traffic would connect to SR 500 via a new tunnel underneath I-5. SR 500 eastbound traffic would connect to I-5 northbound on a new on-ramp. The 39th Street connections with I-5 to and from the north would be eliminated. Travelers would instead use the connections at Main Street to connect to and from 39th Street.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including sidewalks on both sides of 39th Street, bike lanes, and neighborhood connections.

***Potential phased construction option*:** The northern half of the existing SR 500 interchange would be retained, rather than building new connections between I-5 southbound to SR 500 eastbound and from SR 500 westbound to I-5 northbound. The ramps connecting SR 500 and I-5 to and from the north could be constructed separately in the future as funding becomes available.

1.2.2.3 Transit

The primary transit element of the LPA is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo Center in North Portland, where it currently ends, to Clark College in Vancouver. The transit element would not differ between LPA and LPA with highway phasing. To accommodate and complement this major addition to the region's transit system, a variety of additional improvements are also included in the LPA:

- Three park and ride facilities in Vancouver near the new light rail stations.
- Expansion of Tri-County Metropolitan Transportation District's (TriMet's) Ruby Junction light rail maintenance base in Gresham, Oregon.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Operating Characteristics

Nineteen new light rail vehicles (LRV) would be purchased as part of the CRC project to operate this extension of the MAX Yellow Line. These vehicles would be similar to those currently used by TriMet's MAX system. With the LPA, LRVs in the new guideway and in the existing Yellow Line alignment are planned to operate with 7.5-minute headways during the "peak of the peak" (the two-hour period within the 4-hour morning and afternoon/evening peak periods where demand for transit is the highest) and 15-minute headways during off-peak periods.

Light Rail Alignment and Stations

Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains would be constructed to extend from the existing Expo Center MAX station over North Portland Harbor to Hayden Island. Immediately north of the Expo Center, the alignment would curve eastward toward I-5, pass beneath Marine Drive, then rise over a flood wall onto a light rail/multi-use path bridge to cross North Portland Harbor. The two-way guideway over Hayden Island would be elevated at approximately the height of the rebuilt mainline of I-5, as would a new station immediately west of I-5. The alignment would extend northward on Hayden Island along the western edge of I-5, until it transitions into the hollow support structure of the new western bridge over the Columbia River.

Downtown Vancouver Light Rail Alignment and Stations

After crossing the Columbia River, the light rail alignment would curve slightly west off of the highway bridge and onto its own smaller structure over the Burlington Northern Santa Fe (BNSF) rail line. The double-track guideway would descend on structure and touch down on Washington Street south of 5th Street, continuing north on Washington Street to 7th Street. The elevation of 5th Street would be raised to allow for an at-grade crossing of the tracks on Washington Street. Between 5th and 7th Streets, the two-way guideway would run down the center of the street. Traffic would not be allowed on Washington between 5th and 6th Streets and would be two-way between 6th and 7th Streets. There would be a station on each side of the street on Washington between 5th and 6th Streets.

At 7th Street, the light rail alignment would form a couplet. The single-track northbound guideway would turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway would continue on Washington Street. Seventh Street will be converted to one-way traffic eastbound between Washington and Broadway with light rail operating on the north side of 7th Street. This couplet would extend north to 17th Street, where the two guideways would join and turn east.

The light rail guideway would run on the east side of Washington Street and the west side of Broadway Street, with one-way traffic southbound on Washington Street and one-way traffic northbound on Broadway Street. On station blocks, the station platform would be on the side of the street at the sidewalk. There would be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

East-west Light Rail Alignment and Terminus Station

The single-track southbound guideway would run in the center of 17th Street between Washington and Broadway Streets. At Broadway Street, the northbound and southbound alignments of the couplet would become a two-way center-running guideway traveling east-west on 17th Street. The guideway on 17th Street would run until G Street, then connect with McLoughlin Boulevard and cross under I-5. Both alignments would end at a station east of I-5 on the western boundary of Clark College.

Park and Ride Stations

Three park and ride stations would be built in Vancouver along the light rail alignment:

- Within the block surrounded by Columbia, Washington 4th and 5th Streets, with five floors above ground that include space for retail on the first floor and 570 parking stalls.
- Between Broadway and Main Streets next to the stations between 15th and 16th Streets, with space for retail on the first floor, and four floors above ground that include 420 parking stalls.
- At Clark College, just north of the terminus station, with space for retail or C-TRAN services on the first floor, and five floors that include approximately 1,910 parking stalls.

Ruby Junction Maintenance Facility Expansion

The Ruby Junction Maintenance Facility in Gresham, Oregon, would need to be expanded to accommodate the additional LRVs associated with the CRC project. Improvements include additional storage for LRVs and other maintenance material, expansion of LRV maintenance bays, and expanded parking for additional personnel. A new operations command center would also be required, and would be located at the TriMet Center Street location in Southeast Portland.

Local Bus Route Changes

As part of the CRC project, several C-TRAN bus routes would be changed in order to better complement the new light rail system. Most of these changes would re-route bus lines to downtown Vancouver where riders could transfer to light rail. Express routes, other than those listed below, are expected to continue service between Clark County and downtown Portland. The following table (Exhibit 1-1) shows anticipated future changes to C-TRAN bus routes.

Exhibit 1-1. Proposed C-TRAN Bus Routes Comparison

C-TRAN Bus Route	Route Changes
#4 - Fourth Plain	Route truncated in downtown Vancouver
#41 - Camas / Washougal Limited	Route truncated in downtown Vancouver
#44 - Fourth Plain Limited	Route truncated in downtown Vancouver
#47 - Battle Ground Limited	Route truncated in downtown Vancouver
#105 - I-5 Express	Route truncated in downtown Vancouver
#105S - I-5 Express Shortline	Route eliminated in LPA (The No-Build runs articulated buses between downtown Portland and downtown Vancouver on this route)

Steel Bridge Improvements

Currently, all light rail lines within the regional TriMet MAX system cross over the Willamette River via the Steel Bridge. By 2030, the number of LRVs that cross the Steel Bridge during the 4-hour PM peak period would increase from 152 to 176. To accommodate these additional trains, the project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail speed over the bridge from 10 to 15 mph. To accomplish this, additional work along the Steel Bridge lift spans would be needed.

1.2.2.4 Tolling

Tolling cars and trucks that use the I-5 river crossing is proposed as a method to help fund the CRC project and to encourage the use of alternative modes of transportation. The authority to toll the I-5 crossing is set by federal and state laws. Federal statutes permit a toll-free bridge on an interstate highway to be converted to a tolled facility following the reconstruction or replacement of the bridge. Prior to imposing tolls on I-5, Washington and Oregon Departments of Transportation (WSDOT and ODOT) would have to enter into a toll agreement with U.S. Department of Transportation (DOT). Recently passed state legislation in Washington permits WSDOT to toll I-5 provided that the tolling of the facility is first authorized by the Washington legislature. Once authorized by the legislature, the Washington Transportation Commission (WTC) has the authority to set the toll rates. In Oregon, the Oregon Transportation Commission (OTC) has the authority to toll a facility and to set the toll rate. It is anticipated that prior to tolling I-5, ODOT and WSDOT would enter into a bi-state tolling agreement to establish a cooperative process for setting toll rates and guiding the use of toll revenues.

Tolls would be collected using an electronic toll collection system: toll collection booths would not be required. Instead, motorists could obtain a transponder that would automatically bill the vehicle owner each time the vehicle crossed the bridge, while cars without transponders would be tolled by a license-plate recognition system that would bill the address of the owner registered to that license plate.

The LPA proposes to apply a variable toll on vehicles using the I-5 crossing. Tolls would vary by time of day, with higher rates during peak travel periods and lower rates during off-peak periods. Medium and heavy trucks would be charged a higher toll than passenger vehicles. The traffic-related impact analysis in this FEIS is based on toll rates that, for passenger cars with transponders, would range from $1.00 during the off-peak to $2.00 during the peak travel times (in 2006 dollars).

1.2.2.5 Transportation System and Demand Management Measures

Many well-coordinated transportation demand management (TDM) and transportation system management (TSM) programs are already in place in the Portland-Vancouver Metropolitan region and supported by agencies and adopted plans. In most cases, the impetus for the programs is from state-mandated programs: Oregon's Employee Commute Options (ECO) rule and Washington's Commute Trip Reduction (CTR) law.

The physical and operational elements of the CRC project provide the greatest TDM opportunities by promoting other modes to fulfill more of the travel needs in the project corridor. These include:

- Major new light rail line in exclusive right-of-way, as well as express bus and feeder routes;

- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians, and improve connectivity, safety, and travel time;
- Park and ride lots and garages; and
- A variable toll on the highway crossing.

In addition to these fundamental elements of the project, facilities and equipment would be implemented that could help existing or expanded TSM programs maximize capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs or other traveler information systems in the CRC project area;
- Expanded incident response capabilities;
- Queue jumps or bypass lanes for transit vehicles where multi-lane approaches are provided at ramp signals for entrance ramps;
- Expanded traveler information systems with additional traffic monitoring equipment and cameras, and
- Active traffic management.

1.2.3 LPA Construction

Construction of bridges over the Columbia River is the most substantial element of the project, and this element sets the sequencing for other project components. The main river crossing and immediately adjacent highway improvement elements would account for the majority of the construction activity necessary to complete this project.

1.2.3.1 Construction Activities Sequence and Duration

The following table (Exhibit 1-2) displays the expected duration and major details of each element of the project. Due to construction sequencing requirements, the timeline to complete the initial phase of the LPA with highway phasing is the same as the full LPA.

Exhibit 1-2. Construction Activities and Estimated Duration

Element	Estimated Duration	Details
Columbia River bridges	4 years	• Construction is likely to begin with the bridges. • General sequence includes initial preparation, installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
Hayden Island and SR 14 interchanges	1.5 - 4 years for each interchange	• Each interchange must be partially constructed before any traffic can be transferred to the new structure. • Each interchange needs to be completed at the same time.
Marine Drive interchange	3 years	• Construction would need to be coordinated with construction of the southbound lanes coming from Vancouver.
Demolition of the existing bridges	1.5 years	• Demolition of the existing bridges can begin only after traffic is rerouted to the new bridges.
Three interchanges north of SR 14	4 years for all three	• Construction of these interchanges could be independent from each other or from the southern half of the project. • More aggressive and costly staging could shorten this timeframe.

Element	Estimated Duration	Details
Light rail	4 years	• The river crossing for the light rail would be built with the bridges. • Any bridge structure work would be separate from the actual light rail construction activities and must be completed first.
Total Construction Timeline	6.3 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work, weather, materials, and equipment, could all influence construction duration. • This is also the same time required to complete the smallest usable segment of roadway – Hayden Island through SR 14 interchanges.

1.2.3.2 Major Staging Sites and Casting Yards

Staging of equipment and materials would occur in many areas along the project corridor throughout construction, generally within existing or newly purchased right-of-way or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Suitable sites must be large and open to provide for heavy machinery and material storage, must have 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 must have roadway or rail access for landside transportation of materials by truck or train.

Three sites have been identified as possible major staging areas:

1. Port of Vancouver (Parcel 1A) site in Vancouver: This 52-acre site is located along SR 501 and near the Port of Vancouver's Terminal 3 North facility.
2. Red Lion at the Quay hotel site in Vancouver: This site would be partially acquired for construction of the Columbia River crossing, which would require the demolition of the building on this site, leaving approximately 2.6 acres for possible staging.
3. Vacant Thunderbird hotel site on Hayden Island: This 5.6-acre site is much like the Red Lion hotel site in that a large portion of the parcel is already required for new right-of-way necessary for the LPA.

A casting/staging yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, including either a slip or a dock capable of handling heavy equipment and material; a large area suitable for a concrete batch plant and associated heavy machinery and equipment; and access to a highway and/or railway for delivery of materials.

Two sites have been identified as possible casting/staging yards:

1. Port of Vancouver Alcoa/Evergreen West site: This 95-acre site was previously home to an aluminum factory and is currently undergoing environmental remediation, which should be completed before construction of the CRC project begins (2012). The western portion of this site is best suited for a casting yard.
2. Sundial site: This 50-acre site is located between Fairview and Troutdale, just north of the Troutdale Airport, and has direct access to the Columbia River. There is an existing barge slip at this location that would not have to undergo substantial improvements.

1.2.4 The No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2030 if the CRC project is not built. This alternative makes the same assumptions as the build alternatives regarding population and employment growth through 2030, and also assumes that the same transportation and land use projects in the region would occur as planned. The No-Build Alternative also includes several major land use changes that are planned within the project area, such as the Riverwest development just south of Evergreen Boulevard and west of I-5, the Columbia West Renaissance project along the western waterfront in downtown Vancouver, and redevelopment of the Jantzen Beach shopping center on Hayden Island. All traffic and transit projects within or near the CRC project area that are anticipated to be built by 2030 separately from this project are included in the No-Build and build alternatives. Additionally, the No-Build Alternative assumes bridge repair and continuing maintenance costs to the existing bridge that are not anticipated with the replacement bridge option.

1.3 Long-term Effects

Three surface waters, the Columbia Slough, Columbia River, and Burnt Bridge Creek, lay within the drainage area of the main project area and receive stormwater runoff from the project corridor directly. Both Burnt Bridge Creek and the Columbia Slough ultimately drain to the Columbia River. Fairview Creek, which will not receive stormwater runoff from the project corridor directly, is a tributary to the Columbia Slough. Therefore, any hydrologic or water quality impacts within these drainages may ultimately lead to a long-term effect on the Columbia River.

The water quality of each of these watersheds is impaired in some way as shown Exhibit 1-3.

Exhibit 1-3. Water Quality-Limited Waterways within the Project Area

Waterway	303(d) Listing Factors	Established TMDLs
Columbia Slough	Toxics (lead, iron, manganese) Temperature	Toxics (lead, PCBs, DDE/DDT, dieldrin, dioxin) Eutrophication (pH, dissolved oxygen, phosphorus, and chlorophyll *a*) Bacteria
Columbia River (includes North Portland Harbor)	**In Oregon:** Toxics (PCBs, PAHs, DDT/DDE, arsenic) Eutrophication (dissolved oxygen) Temperature **In Washington:** Toxics (PCBs) Eutrophication (dissolved oxygen) Temperature	Dioxin Total Dissolved Gas
Burnt Bridge Creek	Eutrophication (dissolved oxygen) Bacteria Temperature	None
Fairview Creek	E. Coli Fecal Coliform	Toxics (lead, PCBs, DDE/DDT, dieldrin, dioxin) Eutrophication (pH, dissolved oxygen, phosphorus, and chlorophyll *a*) Bacteria Temperature

Note: TMDL = total maximum daily load

Long-term effects from the No-Build Alternative may include effects to water quality and stormwater. Long-term effects to hydrology are not anticipated as a result of the No-Build Alternative. If the CRC project were not constructed, the hydrologic regime of project waterways would remain unchanged. The No-Build Alternative would adversely affect the quality of receiving waters in the long-term. Pollutant-loading of project waterways is currently influenced by a high percentage of untreated stormwater across the project corridor. If the LPA were not constructed this stormwater would likely remain untreated. Refer to Section 4.3 for further detail. The No-Build Alternative would not increase impervious surface and therefore, not increase stormwater volumes. However, average daily traffic (ADT) would increase with the No-Build Alternative and pollutant loads and concentrations would increase, though quantification is not possible. Yet, as previously stated, the majority of the stormwater would remain untreated.

Without mitigation in the form of required and updated stormwater treatment, the potential long-term effects from the construction of the LPA to the water quality and hydrology of surface waters would be attributed primarily to increased stormwater volumes from expanded impervious surfaces. Increased impervious surface would also increase the pollutant load and may increase pollutant concentrations.

An overall increase in impervious surfaces within the project area is likely to result in increased stormwater runoff rates and volumes. Without mitigation, this would affect the hydrology of project waterways. The Columbia River and Columbia Slough are large, tidally influenced waterbodies, and the project-related increase in stormwater quantity would not result in a measurable increase of flows in these surface waters. Burnt Bridge Creek and Fairview Creek are smaller waterbodies and more prone to be affected by increased stormwater quantity resulting from increased impervious surfaces. However, engineered water quality facilities would also be designed to reduce the rate of runoff from the project to these two waterbodies to pre-development conditions.

Oregon requires runoff from the entire contributing impervious area (CIA) be treated to reduce pollutants regardless of degree to which the surfaces would contribute pollutants to runoff. Using this approach, runoff from bike-pedestrian paths would be required to be treated in the same manner as runoff from highways. In contrast, Washington State focuses on requiring treatment for runoff from the pollutant-generating impervious surfaces (PGIS).

ODOT defines the CIA as consisting of all impervious surfaces within the strict project limits, and impervious surface owned or operated by ODOT outside the project limits that drain to the project via direct flow or discrete conveyance. The National Marine Fisheries Service (NMFS) has expanded this definition for the project to include impervious areas that are not owned by ODOT but drain onto the project footprint.

WSDOT and Washington State Department of Ecology (Ecology) define PGIS as surfaces that are considered a significant source of pollutants in stormwater runoff, including:

- highways, ramps and non-vegetated shoulders;
- light rail transit guideway subject to vehicular traffic;
- streets, alleys, and driveways; and
- bus layover facilities, surface parking lots, and the top floor of parking structures.

The following types of impervious area are considered non-PGIS:

- light rail transit guideway not subject to vehicular traffic except the occasional use by emergency or maintenance vehicles (referred to as an exclusive guideway);

- light rail transit stations; and
- bicycle and pedestrian paths.

An exclusive light rail transit guideway is considered non-PGIS for two reasons: LRVs are electric; and other potential sources of pollution such as bearings and gears are sealed to prevent the loss of lubricants. Light rail vehicle braking is almost exclusively accomplished via regenerative (power) braking, which avoids any friction or wear on the vehicle brake pads. Consequently, very few pollutants are generated. In Washington State, NMFS and USFWS concurred with Sound Transit's conclusion that this type of guideway is considered non-PGIS (NMFS No.WSB-01-457). Therefore, the stormwater runoff generated from the guideway did not require treatment before being discharged to the receiving water. In Oregon, runoff from exclusive guideways would require treatment before being released.

In addition, Washington State differentiates between stormwater runoff treatment requirements for new and rebuilt versus resurfaced impervious surface, while state and local jurisdictions in Oregon do not. In Washington State, water quality treatment is only required for runoff from new and rebuilt PGIS, while the state of Oregon requires treatment for all impervious surfaces, PGIS or non-PGIS, for the CRC project.

LPA Option A would increase the total impervious area by approximately 42 acres not including the Ruby Junction facility. Option B would increase this figure by an additional 0.7 acres. Not including the Ruby Junction facility, the LPA Option A would result in approximately 204 acres (203 acres for Option B) of new and rebuilt impervious surface and 34 acres of resurfaced pavement. This could reduce natural infiltration rates and increase stormwater pollutant loads of suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear from brake pads, bearings, metal plating, and engine parts. However, with the construction of new conveyance systems and water quality facilities, untreated PGIS would be reduced from the current 219 acres to approximately 8 acres for both LPA options.

Improvements to stormwater treatment on new and resurfaced impervious surfaces, including the I-5 and North Portland Harbor bridges, would result in a net improvement for water quality in the Columbia River, North Portland Harbor, Burnt Bridge Creek, and Fairview Creek, with the exception of a slight increase in dissolved copper levels at the Columbia Slough. Most of the runoff generated by the existing highway corridor is not treated before being discharged. All new and rebuilt impervious surfaces, as well as most resurfaced and existing pavement within the CIA, would be treated in accordance with current stormwater treatment standards before being discharged to project area receiving streams. On the Washington side of the alignment, the project would exceed state stormwater treatment standards.

The LPA would install a number of stormwater treatment facilities to reduce pollutants (including sediment and metals) and to provide flow control for runoff discharged to Burnt Bridge and Fairview Creeks; flow control is not required for discharges to Columbia Slough, North Portland Harbor or Columbia River. Although the Columbia Slough is exempt from flow control, the discharge of runoff from the project area to the water body is regulated by the operation of drainage district pump stations. At present, the project area provides infiltration for only about 21 acres of existing impervious surface within the existing project CIA. The completed LPA would provide treatment or infiltration for a total of 290 acres of impervious surface. Treatment would comply with current standards before being discharged to project area water bodies. Added treatment of existing impervious surface that is not currently treated would result in a net benefit to water quality and water quantity in the project area water bodies.

In addition, traffic congestion on the I-5 and North Portland Harbor bridges and the roadways in the project area would be decreased. Traffic analysis of the LPA projected that the 2030 average weekday traffic across the I-5 crossing is expected to be 178,500 vehicles. This is lower than the 184,000 daily vehicle trips predicted under the No-Build Alternative because of the introduction of high-capacity transit and a toll on the I-5 crossing. Consequently, with the construction of the LPA, idling and brake pad wear are expected to decrease, as would the amount of total copper and other pollutants generated.

1.4 Temporary Effects

Temporary effects are generally associated with construction activities. Therefore, no temporary effects to water quality and hydrology due to project construction would occur as a result of the implementation of the No-Build Alternative. However, there may be temporary effects related to land use changes and traffic projects that are planned within the project area as part of the No-Build Alternative.

Temporary effects of the LPA are those immediate impacts resulting from construction, demolition, and associated activities. Temporary effects would result from construction activities such as soil-mixing, in-water work, ground disturbance, pile driving, demolition of the existing bridge structure, installation of cofferdams and other temporary construction activities. Temporary effects to hydrology include placing obstructions in the water column and altering groundwater flows by pumping during depressed roadway construction. Temporary water quality impacts include turbidity due to sediment disturbance associated with in-water work, toxic contamination due to disturbance of hazardous sediments during in-water work, and toxic contamination due to accidental equipment leaks or spills in the vicinity of project waterways. Temporary effects to stormwater include turbid overland flows due to soil disturbance and installation and maintenance of treatment facilities along the project corridor and in staging and casting areas.

Sediment disturbance during in-water work would result from several components of in-water work. Barges would be used at the Columbia River and North Portland Harbor during new bridge construction and demolition of the existing structure for transportation of materials and waste disposal. Barges would be stabilized by spuds or temporary piles that are driven into the riverbed's alluvium using pushing or vibratory methods. Temporary piles would also be driven in the alluvium of the Columbia River and North Portland Harbor to support temporary work bridges utilizing vibratory methods. During in-water work, cofferdams would be installed that would contain turbid water produced by the installation of the permanent drilled shafts or permanent piles to support the bridge superstructure. Sediment may be disturbed during the removal of the cofferdams. During the demolition of the existing structures, riverbanks may be disturbed and riverbed sediments would be disturbed when the timber piles of the I-5 bridges and the steel piles of the North Portland Harbor Bridge are either extracted or cut off below the mudline.

There are no known records of contaminated sediments in the Columbia River portion of the project area (USACE 2009). Therefore, there is very little risk that in-water work in the Columbia River would resuspend contaminated sediments. At North Portland Harbor, contaminated sediments have been identified, but they are likely outside of the project footprint. Disturbance to river sediments in general would be minimized by debris removal as opposed to dredging. There would be limited targeted sediment disturbance related to potential removal of riprap or concrete within North Portland Harbor. A diver-assisted clamshell bucket would be used to remove the material. The total amount of material removed would be up to 90 cubic yards over approximately 2,433 square feet occurring up to 7 days during construction. Material would likely be large riprap and concrete; therefore, some disturbance of sediments would occur. If it is found that there is potential for in-water work to disturb contaminated sediments, they would be analyzed in accordance with regulatory criteria, removed from the river, and disposed of properly. Removed sediments would be disposed of in a permitted upland disposal site, if required.

Potential sources of toxic contaminants associated with the proposed action include refueling track-mounted equipment located on the barges or work bridges, lead-based paint from the existing bridge, turbidity and concrete debris from wire-saw-cut concrete during demolition, "green" concrete (concrete that has not fully cured) associated with bridge construction, and potential spills from any construction equipment, and materials accidentally entering the Columbia River and North Portland Harbor during over-water work. Full containment of fuel, other hazardous materials, and green concrete would be required to prevent these materials from entering the Columbia River and North Portland Harbor in accordance with project specifications described in Section 6.3.

Without proper management, land-based construction activities may create temporary adverse effects on water quality in nearby water bodies. Adverse impacts may result from the erosion of disturbed areas, the accidental release of fuels and soluble or water-transportable construction materials, the use of fertilizers, pesticides, and herbicides during restoration activities following construction, and sediment and contaminants migrating to the ground or surface water from pressure or steam cleaning of equipment prior to or following construction activities.

Exhibit 1-4 summarizes the areas that could be disturbed during construction by watershed. The table includes all areas within the LPA right-of-way but does not include potential areas of construction in or over water or additional land that could be required outside the right-of-way for casting or staging. While potential casting and staging sites have been identified, the project is not at the level of design development where such areas can be quantified.

Exhibit 1-4. Areas of Potential Disturbance during Construction

Watershed	Potential Area of Temporary Disturbance
Columbia Slough	105 acres
Columbia River - Oregon	70 acres
Columbia River - Washington State	170 acres
Burnt Bridge Creek	55 acres
Fairview Creek	15 acres

National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Discharge Permits would regulate the discharge of stormwater from construction sites. Currently, standards with regards to turbidity are based on in-stream turbidity increases resulting from construction. New U.S. Environmental Protection Agency (EPA) regulations that are anticipated to be in effect when the project would be constructed require that stormwater discharges meet an effluent standard of 280 NTU. These permits include discharge water quality standards, runoff monitoring requirements, and provision for preparing a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP contains all the elements of a Temporary Erosion and Sediment Control Plan (TESCP) and Spill Prevention Control and Countermeasures Plan (SPCCP). These are described in further detail in Section 6.3.

A recent EPA decision designates the Troutdale Aquifer in the Vancouver region as a Sole Source Aquifer (SSA). This project uses federal funds and must, therefore, produce an SSA report discussing potential groundwater impacts. An SSA report was prepared and submitted to the EPA in 2009.

1.5 Proposed Mitigation

Conservation and mitigation measures would be employed for the LPA so that hydrology, water quality, and stormwater impacts associated with road, bridge, or transit construction are largely avoided or minimized. The LPA would not be constructed until state, federal, and local agencies approve the proposed conservation and mitigation measures. The following summarizes the measures that would be taken to avoid long-term and temporary adverse effects.

1.5.1 Hydrology

The LPA would increase the impervious surface area along the project corridor, which may reduce land infiltration. However, increased infiltration opportunities offered by the project in the form of stormwater facilities are anticipated to be more than double the increase in new, rebuilt, or resurfaced impervious surface area post-project. Furthermore, the extent of impervious surfaces added by the project would be minimized to the greatest extent practicable during the design phase of the CRC project.

Impacts to groundwater hydrology would be minimized by pumping groundwater only where dewatering is necessary to complete construction.

To minimize long-term impacts to hydrology, further hydraulic analysis and a flood-rise analysis for the Columbia River structures would be conducted to ensure that there are no adverse effects of the project to the Columbia River's hydrologic regime. If flood-rise exceeds the allowable limit, the rise would be mitigated through floodplain excavation (cut/fill balance) activities. However, at this time, preliminary calculations indicate that no floodway impacts are expected to occur as a result of construction. Therefore, floodway mitigation is not anticipated.

1.5.2 Water Quality

To minimize long-term effects to water quality, a stormwater conveyance and treatment system would be developed in final design of the LPA. The stormwater design would meet the requirements of ODOT and WSDOT for those portions of the project within DOT right-of-way, and would meet city of Portland and Vancouver regulations for those portions of the project along city-managed roads. In addition, the project has agreed to adopt the requirements of the NMFS for water quality facilities, which means that the project must treat stormwater runoff from the entire CIA regardless of whether it is considered pollutant-generating or whether it is new, rebuilt, resurfaced, or existing impervious surface. If any impervious surface cannot be treated due to geographic constraints, mitigation will be required to offset for water quality impacts to project waterways. Stormwater treatment is discussed in more detail in Section 1.5.3.

Re-vegetation with native plants of construction easements and other areas related to LPA construction would occur after the project is completed. A 5-year monitoring plan of re-vegetated areas would be implemented to ensure the survival of the restored vegetation.

For temporary impacts to water quality, the contractor would prepare a TESCP, and a Source Control Plan would be implemented for all projects requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. The Best Management Practices (BMPs) in the plans would be used to control sediments from all vegetation removal or ground disturbing activities. The TESCP would be implemented to prevent construction water and turbid overland flow from entering receiving waters.

The contractor would prepare a SPCCP prior to beginning construction. The SPCCP would identify the appropriate spill containment materials as well as the method of implementation. Spill containment materials would be kept onsite. All elements of the SPCCP would be available at the project site at all times. Please refer to Section 6.3.3.2 for further detail. The SPCCP would be designed and utilized to prevent the toxic contamination of receiving waters in the project corridor.

Short-term groundwater pumping in depressed road sections may create a cone of depression that increases the risks of contamination from nearby contaminated sites. Sites with existing soil or groundwater contamination near construction areas would be further studied and tested before any groundwater pumping occurs, in order to avoid causing such contamination to spread. For each contaminated site that poses a threat to groundwater quality, remedial actions would be determined and implemented to prevent the spread of contaminants. Design elements may be altered based on site conditions if deemed necessary to prevent contaminant spreading.

During in-water construction in the Columbia River and North Portland Harbor, the LPA would use appropriate BMPs to minimize turbidity and release of pollutants. Disturbance to river sediments would be minimized by debris removal as opposed to dredging. Potential removal of riprap or concrete within North Portland Harbor would be accomplished with a clamshell bucket. In addition, the contractor would prepare a Water Quality Sampling Plan for conducting water quality monitoring for all parts of the LPA occurring in water to ensure that water quality limits are not exceeded as a result of construction. Operation of construction equipment used for in-water work activities would occur from a floating barge, work bridge deck, existing roads, or the streambank (above the ordinary high water line [OHW]) in order to implement proper containment practices. Only the operational portion of construction equipment would enter the active stream channel (below OHW). Process water generated on site from construction, demolition, or washing activities would be contained and treated to meet applicable water quality standards before entering or re-entering surface waters. Section 6.3.3.4 provides more detail.

1.5.3 Stormwater

A conceptual stormwater management approach has been developed that specifies the stormwater treatment and flow control necessary to minimize long-term stormwater impacts from the LPA. Stormwater treatment is summarized for each of the receiving waters below. Flow control is required for both Burnt Bridge and Fairview creeks.

For the Columbia Slough drainage, water quality facilities are proposed for the majority of 51.6 acres of new, rebuilt, and resurfaced PGIS (0.3 more acres for Option B), 4.3 acres of new sidewalk and bike/pedestrian paths, and 2.1 acres that currently comprises the existing bridge over North Portland Harbor. Runoff from the bridge currently drains via scuppers to the water surface or ground below. At this time, no options have been identified to treat runoff from about 7.1 acres of new and resurfaced I-5 impervious surface immediately north of Victory Boulevard. The primary issue is that the proximity of the outfall in this location to the highway embankment does not leave adequate space to construct a water quality facility such as a bioretention pond or swale. As design work progresses, the project team will continue to develop and evaluate options to treat runoff from this area.

For the LPA footprint on the Oregon side of Columbia River, water quality facilities are proposed for about 52.8 acres of the PGIS area (0.4 more acres for Option B) and for approximately 2.2 acres of existing PGIS. Water quality facilities are also proposed for 7.6 acres that consists of the new bicycle and pedestrian path across Hayden Island, sidewalks, and light rail transit guideway, all of which are non-PGIS.

For the LPA footprint on the Washington side of the Columbia River, water quality facilities are proposed for approximately 97.8 acres of new and rebuilt PGIS and 36.9 acres of resurfaced and existing PGIS. Water quality facilities are also proposed for 13.3 acres of new sidewalks and bike-pedestrian paths and 5.0 acres of existing non-PGIS.

Within the Burnt Bridge Creek drainage, two new bioretention ponds are proposed to treat runoff from approximately 8.2 acres of new, rebuilt, and resurfaced PGIS, 1.9 acres of existing PGIS, and 0.2 acres of new non-PGIS sidewalks and bike-pedestrian paths. An existing infiltration pond at the Main Street interchange would not be modified by the construction of the LPA. The LPA would reduce the total impervious surface draining to this facility by about 1.7 acres.

Within the Fairview Creek drainage, redevelopment of the Ruby Junction facility would result in a net decrease in impervious area of 0.5 acres. Since the City of Gresham's requirements for stormwater treatment and flow control would need to be met, runoff from impervious areas would be either infiltrated or treated to reduce pollutants of concern before being released to Fairview Creek.

To minimize temporary effects to stormwater, a TESCP and SPCCP would be designed and implemented throughout the construction of the LPA. These are summarized above in Section 1.7.2 and further detail is included in Section 6.3.3.

2. Methods

2.1 Introduction

This evaluation has been applied two geographic study areas for determining environmental effects: the primary area of potential impact (API) and secondary APIs. The primary API addresses direct temporary and long-term impacts. The secondary API addresses indirect impacts primarily related to traffic flow and development patterns. The secondary API is addressed in the Indirect Effects Technical Report included in the FEIS.

2.2 Study Area

The evaluation of the direct effect on water quality and hydrology for the LPA applied one geographic study area for determining environmental effects: the primary API (Exhibit 2-1), which was then divided into receiving waters: the Columbia Slough, Columbia River and North Portland Harbor, Burnt Bridge Creek, and Fairview Creek.

2.2.1 Primary API

The primary API is the area where direct impacts from construction and operation of proposed project alternatives would occur. Most physical project changes would occur in this area, although mitigation could still occur outside of it.

As currently defined, the primary API extends about five miles from north to south. It starts north of the I-5/Main Street interchange in Washington, and runs south to the I-5/Victory Boulevard interchange in Oregon. North of the river, the API expands west into downtown Vancouver, and east near Clark College to include potential high capacity transit alignments and park and ride locations. Around the actual river crossing, the eastern and western sides each extend 0.25 miles from the I-5 right-of-way. South of the river crossing, this width narrows to 300 feet on each side.

2.2.2 Ruby Junction Maintenance Facility

Ruby Junction is an existing TriMet Operations and Maintenance Facilities located in Gresham, Oregon, along NW Eleven Mile Avenue and south of E Burnside (Exhibit 2-2). This facility would be expanded by approximately 10.4 acres over several construction phases to support additional LRVs required by the proposed CRC and Portland-Milwaukie Light Rail projects. Portions of three of the 14 parcels that would be added to the maintenance facility are located within the 100-year floodplain of Fairview Creek. This site is not part of the primary API but is discussed in this technical report in terms of the effects on Fairview Creek due to the expansion of the facility.

2.2.3 Watersheds

Watersheds (or portions of watersheds) have been used as the fundamental geographic area for the evaluation of project alternatives. Water bodies and their associated watersheds located in the primary and secondary APIs demonstrate varying levels of water quality, different designated uses, and various management scenarios.

Waterbodies and their drainage areas were delineated using GIS data, Gazetteer maps (DeLorme 2004), information from local governments, the Ecology Watershed Planning Program, local drainage districts, and the Columbia Slough Watershed Council.

Watersheds and sub-watersheds that would be directly affected by project construction and generated runoff are those found in the primary API and near Ruby Junction and include: Columbia Slough, Columbia River (which includes North Portland Harbor), the Columbia Slope (which drains directly to the Columbia River), Burnt Bridge Creek, and Fairview Creek.

Watersheds and sub-watersheds that may be indirectly affected by project operation and potential growth-inducing impacts are found within the secondary API and include: Willamette River, Columbia Slough, Columbia Slope, and Burnt Bridge Creek.

2.2.4 Contributing Impervious Area

The CIA, which encompasses both PGIS and non-PGIS, includes new and rebuilt impervious surfaces created by the project and existing impervious areas that would contribute runoff to those newly created surfaces. The CIA does not include runoff from impervious areas outside the project footprint that flow through the project to outfalls that would not be modified by the project.

The total CIA for the project is estimated to be 298 acres and comprises:

- Approximately 204 acres of new and rebuilt PGIS created by the project within the project footprint. Runoff from about 201 acres would be treated or infiltrated.
- Approximately 34 acres of existing PGIS within the project footprint would be resurfaced. Runoff from approximately 29 acres would be treated or infiltrated.
- Runoff from approximately 4 acres comprising the existing North Portland Harbor Bridge would be directed to new water quality facilities at the adjacent interchanges.
- Runoff from about 29 acres of existing PGIS would contribute stormwater runoff to the project from outside the footprint. All 29 acres would be treated or infiltrated by project stormwater treatment facilities.
- Approximately 26 acres of new non-PGIS exclusive light rail guideway, bike-pedestrian paths and sidewalks would be created within the project footprint and approximately 5 acres of existing non-PGIS outside the project footprint would contribute runoff to the project primarily via gutter flow. Runoff from the whole 31 acres of non-PGIS area would be treated or infiltrated in project stormwater treatment facilities.

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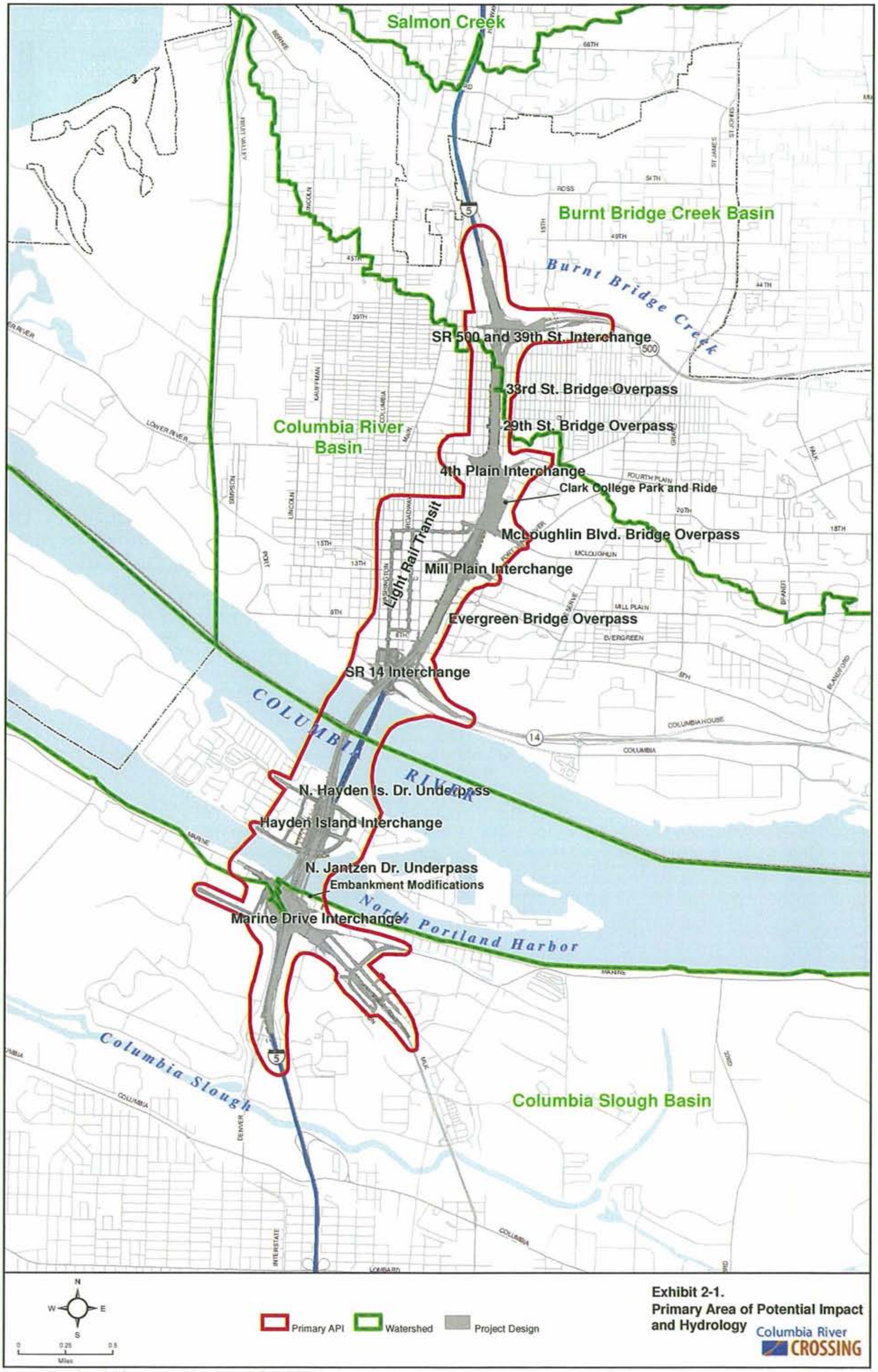

Exhibit 2-1.
Primary Area of Potential Impact and Hydrology

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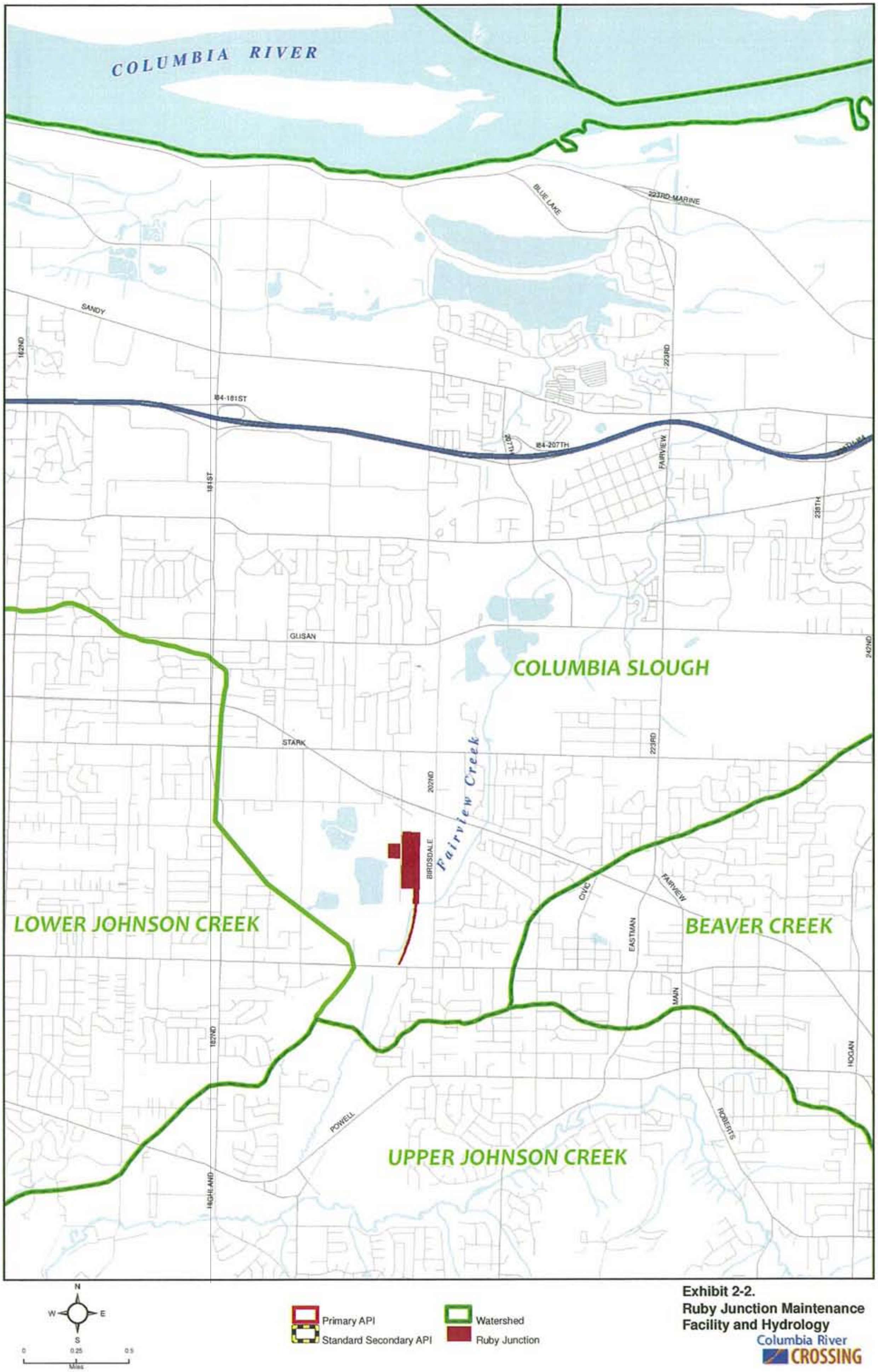

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Exhibit 2-2.
Ruby Junction Maintenance Facility and Hydrology

Columbia River CROSSING

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2.3 Effects Guidelines

The following guidelines from the Federal Transit Administration (FTA) were used to evaluate both water quality and stormwater system impacts:

1. If the proposed project would violate a National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges;
2. If the proposed project is likely to contaminate surface or ground waters that would result in an exceedance of federal, state, or local water quality standards;
3. If the proposed project is noncompliant with an approved Water Quality Management Plan or Total Maximum Daily Load (TMDL); or
4. If the proposed project area would become flooded or induce flooding as a result of stormwater increases or floodplain constriction.

2.4 Data Collection Methods

Potential cumulative effects from this project are evaluated in the Cumulative Effects Technical Report. Please refer to this report for an evaluation of possible cumulative effects.

The project team used the following methods and data sources to identify existing conditions and provide the required information for the alternatives analysis.

1. The following studies and plans from local, state, and federal agencies were obtained and reviewed. Those sources identified with an asterisk were found to be the most useful sources of information given their comprehensiveness, more recent data, and overall reliability. Sources included the following:
    - *Burnt Bridge Creek Water Quality Data Trend Analysis, 1998
    - Burnt Bridge Creek Regional Wetland Bank and Greenway Trails Project Biological Evaluation, 2003
    - Burnt Bridge Creek Water Quality Monitoring Report, 1994
    - Burnt Bridge Creek TMDL Quarterly Progress Reports, 2008
    - Burnt Bridge Creek Water Quality Monitoring – Quality Assurance Plan, 2008
    - Comprehensive Conservation and Management Plan for the Lower Columbia River, 1999
    - Columbia Slough Background Report, 1989
    - Columbia Slough Implementation Plan, 1992
    - *Columbia Slough TMDL, 1998
    - *Columbia Slough Revitalization Report and Program EA, 1995
    - Columbia Slough Sediment Project Annual Report, 2006
    - Columbia Slough Watershed Action Plan, 2003
    - *Columbia Slough Watershed Characterization, 2005
    - Columbia Slough Watershed Water Quality Technical Report, 2003
    - Columbia River Crossing Hydrographic and Geophysical Investigation: High Resolution Bathymetric Mapping, River Bed Imaging and Subbottom Investigation, 2006

- Environmental Contaminants and their Effects on Fish in the Columbia River Basin, 2004
- Columbia River Basin National Stream Quality Accounting Network (NASQAN) Program
- Columbia Slope Basin Comprehensive Stormwater Management Plan, 1993
- Columbia River Estuary Water Quality Data, 2006
- Interim Salmon Recovery Plan for the Lower Columbia River Subbasin
- Water Quality of the Lower Columbia River Basin: Analysis of Current and Historical Water-Quality Data through 1994, 1996
- Total Dissolved Gas TMDL for the Lower Columbia River, 2002
- TMDL for 2,3,7,8-TCDD in the Columbia River Basin, 1991
- ESA Recovery Planning for Salmon and Steelhead in the Willamette and Lower Columbia River Basins, 2005
- City of Portland Watershed Management Plan, 2005
- U.S. Geological Survey (USGS) NASQAN Program water quality data for the Columbia Basin
- Lower Columbia River Bi-State Water Quality Program – The Health of the River 1990-1996 Integrated Technical Report, 1996
- Water-quality data, Columbia River Estuary, 2004-2005: USGS Data Series 213
- Biomonitoring of Environmental Status and Trends (BEST): Environmental Contaminants and their Effects on Fish in the Columbia River Basin, 2004
- Portland International Raceway Natural Resources Management Plan
- Ducks Unlimited/City of Portland Science Fish and Wildlife Program
- Willamette River Basin Water Quality Study – Oregon Department of Environmental Quality, 1995
- Washington State's Water Quality Assessment [303(d)], Washington Department of Ecology
- Oregon's 2004/2006 Integrated Report Online Database, Oregon Department of Environmental Quality

2. The project team reviewed maps and GIS data, including those showing topography, soils, and floodplains during the analysis used to develop the DEIS.
    - *Infrastructure*: This information was used to develop impervious area estimates and evaluate runoff potential from project alternatives.
    - *Topography*: Topographic maps were used to delineate drainages in areas where as-built and infrastructure records providing drainage information were not available.
    - *Flood Insurance Rate Maps (FIRM, Floodway Maps, and flood insurance study reports)*: This information was used to identify 100-year floodplains and floodways located in the project's APIs.

- *Land use maps*. The project team coordinated with land use map reviews conducted as part of the Land Use Technical Report to obtain necessary information regarding land use in each of the project area watersheds.

3. The project team reviewed available water quality characterization studies, Section 303(d) listings, TMDLs, municipal water quality management plans and regulations, and other water quality, water quantity, and floodplains data to determine if streams located in the project area would be affected directly or indirectly by the proposed alternatives. Specific data reviewed includes the following:
   - Existing and proposed drainage patterns at the proposed project site.
   - Designated beneficial uses of project area streams.
   - Water quality status in project area receiving waters including existing and anticipated 303(d) listings, TMDLs, and Water Quality Management Plans.
4. The project team reviewed the conceptual stormwater design, which proposes how stormwater may be conveyed, treated, and discharged.
5. The project team consulted with local, state, and federal water quality and stormwater agency representatives and interested parties.
6. The project team made field visits to project area waterways, road alignments and stormwater outfall locations. During site reconnaissance surveys, the project team collected data on existing conditions of project area waterways and existing stormwater facilities and proposed locations for such facilities.
7. The project team calculated new and existing impervious surfaces using CAD and GIS mapping.
8. The project team calculated total disturbed area related to both in-water and out-of-water construction to assess short-term impacts.

Annual pollutant load estimates were conducted using *Method 1: WSDOT Data-FHWA Method* as outlined in the Washington State Department of Transportation's (WSDOT) guide entitled "Quantitative Procedures for Surface Water Impact Assessment (WSDOT 2009a)." This method was selected because it provides estimates of pollutant loading for a wide range of ADT volume highways (1,700-93,000) using data derived from observations made on highways in Western Washington since 2001. It is directly applicable to the project location and is based on recently collected WSDOT data. Existing impervious area data was obtained from CRC's Stormwater Management Technical Memorandum (Appendix A).

2.5 Analysis Methods

2.5.1 Long-term Operational Impacts

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

- *Floodplain Impacts*. Floodplain impacts of the various alternatives were compared by estimating the approximate footprint of each alternative in local floodplains (e.g., loss of storage) and the extent of potential conveyance constrictions created by bridge crossings.
- *Stream Shading Impacts*. The location and extent of vegetation removal within 50 feet of a waterway was considered for each alternative.

- *Groundwater Infiltration Impacts*. Increased impervious area can result in reduced groundwater recharge which in some cases can impact groundwater. For this project these impacts are minor. They were assessed by accounting for the total area of impervious surface over land resulting from new construction. Bridge segments directly over North Portland Harbor and the Columbia River were not included in the impervious tally for this particular impact analysis. Impervious surface area was further distinguished by drainage basin.
- *Surface Water Quality Impacts*. Long-term surface water quality impacts were assessed based on comparisons of impervious surface areas requiring stormwater collection and by proximity to surface waters. Roadway located underneath another roadway, such as an overpass, was not included in the total for impervious surface area for the impact analysis in the DEIS. However, because these roadways are pollutant-generating, they were added to the impact analysis for the FEIS. Where new construction replaces existing impervious surface, the effectiveness of treating the existing road runoff was accounted for. Existing runoff characteristics were determined from topographic maps and field observations. The drainage basins for the impervious discharge of additional runoff were determined to assess the extent of interbasin transfers of stormwater runoff. A pollutant load analysis was performed for key constituents found in road runoff using *Method 1: WSDOT Data-FHWA Method*. Potential erosion impacts were assessed through examination of topographic maps, proximity of ground disturbance to drainage channels/streams, and vegetation loss.
- *Groundwater Quality Impacts*. Long-term groundwater impacts were assessed generally in all areas affected by construction and more specifically in those areas lying in proximity of federal, state, and locally designated groundwater/wellhead protection zones.
- *Existing Drainage System Constraints*. Local jurisdictions were contacted for information about existing drainage system constraints.
- *Beneficial Impacts*. Since stormwater treatment would be provided in areas not currently receiving treatment, beneficial impacts are discussed.

2.5.2 Short-term Construction Impacts

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

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

Potential short-term construction impacts were determined by evaluating the total area of demolition and construction activities of each project alternative, the total area of below-grade construction for each alternative, and implementation of impact minimization measures.

The short-term construction analysis focuses on the:

- Area of total disturbance;
- Impacts from fine sediment and contaminants (such as hydraulic oil, fuel, etc.);
- Erosion/soil characteristics;
- Streambank/slope steepness; and
- Amount of in-water work.

2.6 Coordination

The CRC project team, together with state and federal resource agencies, FHWA and FTA, formed the Interstate Collaborative Environmental Process (InterCEP) Agreement, in order to coordinate various state and federal environmental regulatory issues through the National Environmental Policy Act of 1969 (NEPA) process. Through the InterCEP, coordination with representatives of Oregon Department of Environmental Quality (DEQ), Ecology, and the EPA, among others, occurred over several meetings between 2005 and the present.

The InterCEP process also gave these agencies the opportunity to review and comment on, and ultimately concur with project Evaluation Criteria used to screen alternatives, and the Range of Alternatives carried into the DEIS and FEIS.

On July 7, 2009, a meeting at the CRC office in Vancouver, Washington was held to discuss the FEIS LPA design and provide a coordination opportunity for FEIS technical report writers and their ODOT and WSDOT technical reviewers. The goals of the discussion about the LPA design, was to note changes from the LPA design included in the DEIS.

On July 14, 2010, the CRC team met with agency representatives from the DEQ and NMFS to discuss the appropriate guidance to use for designing the project's stormwater facilities in order to gain NMFS approval and Clean Water Act 401 Certification from DEQ. As a result of this meeting and further coordination with these agencies, the approach to stormwater treatment was changed and treatment of nearly the entire CIA was incorporated into the project design.

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3. Affected Environment

3.1 Introduction

Resources in the CRC project area are divided into two APIs, primary and secondary. The secondary API is discussed in the Indirect Effects Technical Report included in the FEIS. For purposes of this technical report, the API is further broken down by receiving waters. The following discussion describes the baseline conditions of those receiving waters in terms of hydrology, water quality, and stormwater.

3.2 Regional Conditions

3.2.1 Surface Water Hydrology

The Columbia River and North Portland Harbor dominate the topography of the project area. The North Portland Harbor is part of the same body of water as the Columbia River; it is named differently to distinguish that part of the water body south of Hayden Island (North Portland Harbor) from that part of the water body north of the island (Columbia River). The project corridor lies within the Columbia River main valley, with the exception of a small area north of the SR 500 interchange that is located in the Burnt Bridge Creek watershed (Exhibit 2-1). Burnt Bridge Creek flows into Vancouver Lake before discharging to the Columbia River. In addition, runoff from the Delta Park area between North Portland Harbor and the lower Columbia Slough, which used to be part of the Columbia River floodplain, is now discharged to the lower Columbia Slough via pump stations. The Columbia Slough is part of the Lower Willamette River watershed.

The Ruby Junction maintenance facility that would be expanded as part of the project is located in Gresham, Oregon, east of the project corridor. Some of the parcels included in the expansion lie within the 100-year floodplain of Fairview Creek. Fairview Creek discharges into the upper Columbia Slough further downstream of the maintenance facility.

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

The secondary API for the project contains eight mapped surface water features (Exhibit 2-1). Three of these surface waters, including the Columbia Slough, Columbia River, and Burnt Bridge Creek, lay within the drainage area of the main project area and would receive project runoff directly. Both Burnt Bridge Creek and the Columbia Slough ultimately drain to the Columbia River. Therefore, any hydrologic or water quality impacts within these drainages may lead to a long-term effect on the Columbia River.

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

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

Month	Columbia Slough at Portland (USGS 14211820)[a]	Columbia River at Vancouver (USGS 14144700)[b]	Burnt Bridge Creek near Mouth (USGS 14211902)[c]
January	162	156,000	46
February	151	163,000	53
March	135	170,000	39
April	85	204,000	21
May	29[d]	286,000	19
June	65[e]	415,000	14
July	79	291,000	9.1
August	74	153,000	7.4
September	63	117,000	7.0
October	96	116,000	9.8
November	112	122,000	34
December	123	138,000	41

a USGS 2010a.
b USGS 2010b.
c USGS 2010c.
d Average monthly reverse flow from the Willamette River was recorded in 1997, 2006, and 2008.
e Average monthly reverse flow from the Willamette was recorded in 1990.

North Portland Harbor, a branch of the Columbia River, and the Columbia River mainstem are the only watercourses that cross under I-5 within the primary API. Burnt Bridge Creek crosses I-5 north of the primary API.

Federal Emergency Management Agency (FEMA) designated floodplains located within the project's primary API include the Columbia Slough, the Columbia River, and Burnt Bridge Creek (Exhibit 2-1). As shown, these floodplains are confined to the immediate vicinity of project streams due to levees, or in the case of Burnt Bridge Creek, steeper slopes.

3.2.2 Local Climate

The climate within the project area is characterized by short, dry and warm summers, with a typically cool and wet spring, fall, and winter. The Coast Range offers limited shielding from the Pacific Ocean storms while the Cascades provide an orographic lift of moisture-laden westerly winds, resulting in moderate rainfall. Nearly 90 percent of the average annual rainfall of 36.3 inches occurs from October through May. The maximum 24-hour rainfall of 4.44 inches occurred in October 1994. Snowfall accumulations are rarely more than 2 inches, and usually melt within a couple of days (NOAA 2009). The 2-year, 24-hour rainfall event that is utilized as a water quality design storm is 2.5 inches (NOAA 1973) for the City of Portland.

Average monthly temperatures taken at Portland International Airport (PDX) vary from 39.6 °F in January to 68.6 °F in August. The maximum and minimum recorded temperatures are 107 °F and -3 °F. These temperatures occurred in August 1981 and February 1950, respectively. Surface winds seldom exceed sustained wind speeds of 50 mph and have rarely exceeded 75 mph (NOAA 2009).

3.2.3 Groundwater

Within the Portland Basin Aquifer System on the Oregon side of the project corridor, the project area is located on the unconsolidated sedimentary aquifer of the upper sedimentary subsystem (McFarland and Morgan 1996). This aquifer consists primarily of late Pleistocene catastrophic flood deposits and Columbia River alluvium. Recharge of the aquifer is primarily by direct infiltration of precipitation, though injection wells and wastewater from septic systems are locally important. Median hydraulic conductivity (the rate at which groundwater flows through soil and bedrock) of the aquifer is high, approximately 200 feet per day.

South of the Columbia River, several wells have been identified within the primary API and are likely screened within the unconsolidated sedimentary aquifer. These wells are used for a variety of industrial, irrigation, and municipal purposes. For further details on these wells, refer to the Section 4.6 of the Geology and Soils Technical Report.

North of the Columbia River, the I-5 corridor and other project facilities are underlain by the unconsolidated sedimentary aquifer and the Troutdale Aquifer. The Troutdale Aquifer is a water supply for the City of Vancouver and has been designated by the EPA as an SSA. An SSA is an aquifer "which supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, and for which there is no alternative source or combination of alternative drinking water sources which could physically, legally and economically supply those dependent upon the aquifer." Under this designation, proposed federal financially assisted projects which have the potential to contaminate the aquifer are subject to EPA notification and review. Therefore, an SSA report for the project was already prepared and submitted to the EPA in 2009.

Consistent with the SSA designation and with critical areas management dictated by Washington state law, Special Wellhead Protection Areas have been designated within the Washington portion of the project. As shown in Exhibit 3-2 "contribution" zones are delineated based on the amount of time that groundwater contamination would take to spread into each zone. There are two Special Wellhead Protection Areas within the secondary API and one that overlaps with the primary API.

The City of Vancouver has designated the entire area within the city boundary as a Critical Aquifer Recharge Area. Therefore, certain actions are prohibited and are listed in the Vancouver Municipal Code (VMC) 14.26.120. These actions include such things as hazardous material municipal waste disposal. Exhibit 3-2 shows the two Special Wellhead Protection Areas designated by Vancouver, one of which overlaps with the primary API. These areas are surrounded by 1,000- and 1,900-foot buffers and are subject to the prohibitions of the Critical Aquifer Recharge Area. In addition, the Special Wellhead Protection Areas are subject to further provisions.

3.2.4 Relevant Land Use Issues

South of the Columbia River, land west and east of I-5 between Victory Boulevard and North Portland Harbor generally has an Industrial and Open Space zoning designation, respectively. On Hayden Island, land in the vicinity of the project corridor is zoned Commercial.

North of the Columbia River, areas on the west side of I-5 have extensive residential and commercial development. Pearson Field, Clark College, and Fort Vancouver Historic Reserve, which are low density developments, are located east of I-5, between SR 14 and Fourth Plain Boulevard.

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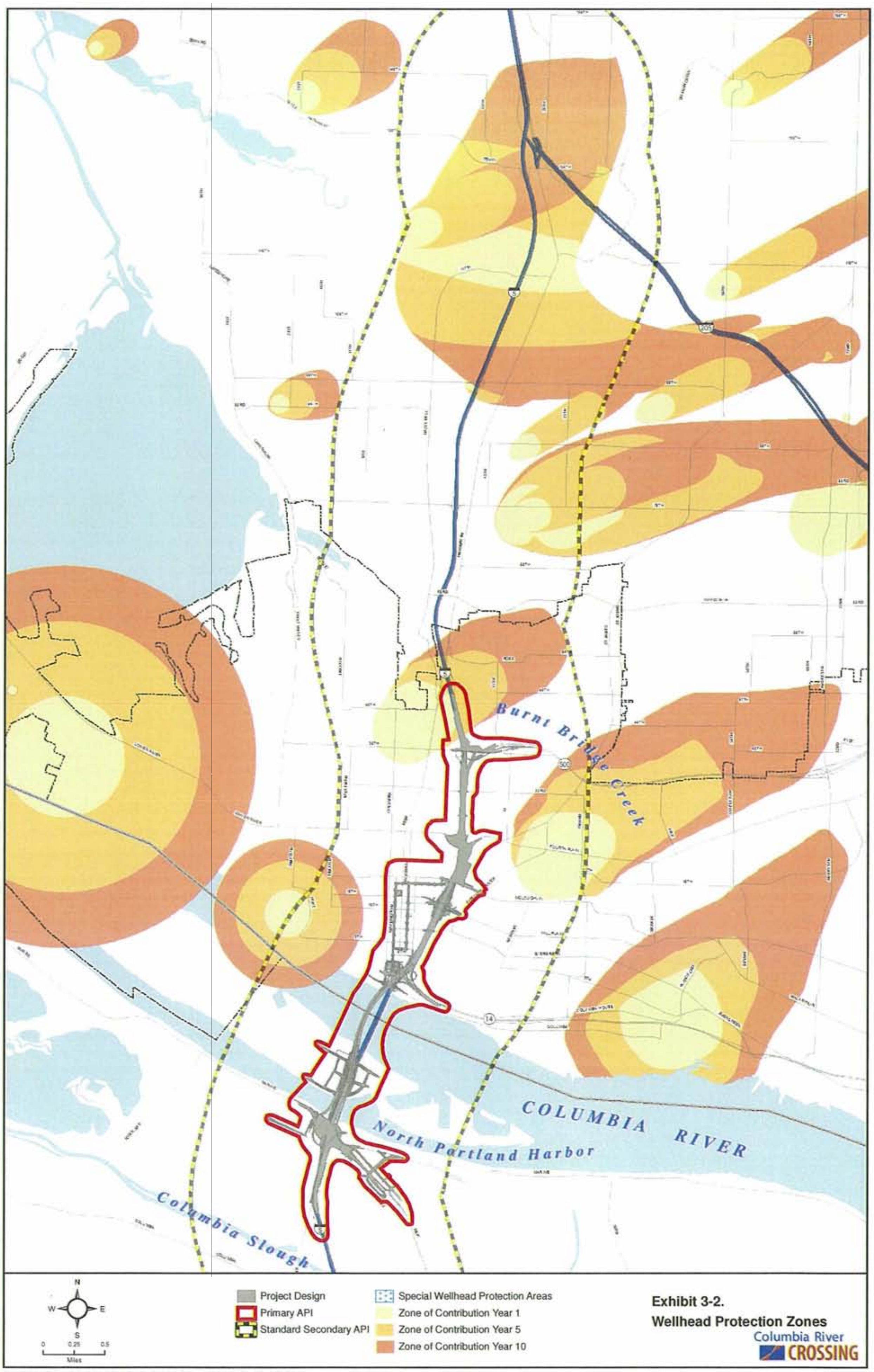

Exhibit 3-2.
Wellhead Protection Zones

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3.2.5 Storm Drainage

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

The intent of project stormwater management strategies is to reduce the potential impact on water quality and discharge from project-related changes in impervious area. Existing stormwater treatment within the project's drainage area occurs in only a few areas. At the Victory Boulevard interchange there is currently a stormwater quality manhole that reduces sediment load in runoff in the Columbia Slough drainage area. Sediment reduction alone would not provide adequate reduction in pollutants (especially dissolved metals reduction) to meet the requirements of the DEQ and the City of Portland for the Columbia Slough. For this reason, stormwater runoff from the impervious area served by the manhole is not considered to be treated as the site currently exists. An infiltration pond in the Burnt Bridge Creek drainage area reduces sediment, metals (includes dissolved metals) and other pollutants from runoff, which is considered to be adequate treatment. However, overflows from this infiltration pond are discharged to a wet pond in this vicinity that provides only sediment reduction (Appendix A). Therefore, the wet pond is not considered to be adequate stormwater treatment. Exhibit 3-3 shows the existing conditions of the stormwater treatment along the project corridor by watershed.

Exhibit 3-3. Existing Stormwater Drainage

Receiving Waterbody	Location Along the LPA Corridor	Total Impervious Area	Impervious Area Infiltrated	Treated Impervious Area Draining to Outfall(s)	Untreated Impervious Area Draining to Outfall(s)
Columbia Slough	Victory Boulevard interchange to the Southwest Marine Drive interchange	44.4	3.0	0.0	41.4
Columbia River – Oregon State	Marine Drive west of I-5 to the Columbia River bridges	62.4	0.0	0.0	62.4
Columbia River – Washington State	Columbia River bridges to Downtown Vancouver	132.9	3.0	0.0	129.9
Burnt Bridge Creek	I-5 near SR 500	16.5	14.5	0.0	2.0
Fairview Creek	Ruby Junction Maintenance Facility	16.8	15.3	1.5	0.0
	Totals:	**273.0**	**35.8**	**1.5**	**235.7**

Note: Table Information provided in Appendix A, Stormwater Management Technical Memo.

3.3 Watersheds within the Affected Area

3.3.1 Columbia Slough

The Columbia Slough is a slow-moving, low-gradient drainage channel running nearly 19 miles from Fairview Lake in the east to the Willamette River in the west. The Slough is a remnant of the historic system of lakes, wetlands, and channels that dominated the south floodplain of the Columbia River. The Slough and areas to its north are now intensively managed to provide drainage and flood control with pumps, weirs, and levees (CH2M HILL 2005). The Columbia Slough Watershed drains approximately 37,741 acres of land in portions of Troutdale, Fairview, Gresham, Maywood Park, Wood Village, and Multnomah County. The Slough and surrounding area was historically used by Native Americans for fishing, hunting, and gathering food (BES 2006).

In July 2005, an ROD was issued in regards to a cleanup program devised by the DEQ and the City of Portland. The Columbia Slough Sediment Program aims to remediate widespread sediment contamination through source control contamination reduction, contaminant removal by dredging "hot spots," and long-term monitoring to ensure the program's effectiveness (BES 2006). On October 4, 2010, a news release was published stating that the DEQ and the City of Portland have agreed to extend the cleanup program through 2015. This program includes specific tasks to control sources of pollution, treat stormwater runoff, and clean up contaminated sediments in the Lower Columbia Slough, Whitaker Slough, and Buffalo Slough. DEQ has also signed agreements with ODFW and the Multnomah County Drainage District in regards to cleanup activities in the Columbia Slough (DEQ 2010).

The Slough is divided into upper, middle, and lower reaches. The Upper and Middle Sloughs receive water inputs from Fairview Lake, groundwater, and stormwater from PDX and other industrial, commercial, and residential neighborhoods in the surrounding area. Flows and water levels in the Upper and Middle Sloughs are managed to ameliorate low dissolved oxygen issues, while allowing for withdrawals, flood control, and recreation (City of Portland 2009).

The project area crosses the Lower Slough at river mile (RM) 6.5 (CH2M HILL 2005). The Lower Slough extends from the Peninsula Drainage Canal to the Willamette River, less than 1 mile south of its confluence with the Columbia River. It experiences from 1 to 2 feet of tidal fluctuation in its water surface elevation. Water levels are generally unmanaged, but are affected by the management of the dams on the Columbia and Willamette Rivers. The channel bottom in the Lower Slough ranges from elevation 2.0 to 4.5 feet NGVD and the water surface elevation has been known to be as low as 3.1 feet NGVD and as high as 28.8 feet NGVD (USGS 2010a). The channel is generally between 100 and 200 feet wide. The Lower Slough receives water inputs from combined sewer overflows, stormwater, Smith and Bybee Wetlands, leachate from the St. John's Landfill, and the Upper Columbia Slough (City of Portland 2009). The majority (99 percent) of combined sewer overflows to the Columbia Slough have been controlled. However, thirteen combined sewer overflow outfall pipes remain, and may overflow into the Columbia Slough once every 10 years in summer and once every five years in winter on average (BES 2010).

The I-5 crossing of the Columbia Slough is in a highly urbanized area. Riparian habitat along the Slough has been largely replaced by buildings and paved surfaces, though grasses, trees, and shrubs are present, especially along the south bank. However, riparian areas along the Slough are generally not adequate to provide shade, bank stabilization, sediment control, pollution control, or streamflow moderation. The predominant land use around the Slough in the project vicinity is light industrial, with some residential. The Slough connects to the Willamette River approximately 6.5 miles west of the project area, within a mile of the confluence of the Columbia and Willamette Rivers (City of Portland 2009).

Historically, the Columbia Slough consisted of multiple channels in a braided floodplain of wetlands, lakes, and waterways. However, much of the Slough's wetland habitat has been filled, dredged, channelized, and/or degraded by current and past land uses. There are remnant wetlands and restored wetland in the Slough watershed that provide some thermoregulation and nutrient removal. DEQ has listed irrigation, domestic and industrial water supply, livestock watering, anadromous fish passage, salmonid fish rearing, salmonid fish spawning, resident fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, and hydropower as beneficial uses of the Columbia Slough (City of Portland 2009).

3.3.1.1 Hydrology

The Columbia Slough area is highly urbanized and contains a complex system of roadways, including I-5, state highways, local access roads, residential streets, parking lots, and other impervious surface. The Columbia Slough has undergone profound hydrologic alteration. Originally, the Columbia Slough was a side channel of the Columbia River. Today, the Columbia Slough's original inlet is blocked at the upstream end, and it no longer receives flows from the Columbia River. Numerous dikes, pumps, and weirs regulate flows to, from, or within in the stream.

The USGS monitors flows of the Columbia Slough within the Lower Slough at RM 0.6. Average discharge recorded by USGS during the 7 years of the most recent monitoring, ending in 2008, was 97.8 cubic feet per second (cfs). Maximum daily discharge occurred December 5, 1995 and was 2,400 cfs. Minimum daily discharge occurred February 7, 1996, and was 6,700 cfs. Flows of the Lower Slough are tidally influenced. Average monthly discharges are shown in Exhibit 3-1. Tides can cause flow direction to be reversed (USGS 2008a). The levee (at RM 8.5) between the Lower Slough and Middle Slough prevents reverse flows from entering the Middle Slough (BES 2009). Above the Lower Slough flows are regulated by piped water, levees, and pumps (BES 2010).

3.3.1.2 Water Quality

The City of Portland Bureau of Environmental Services (BES) has undertaken intensive water quality monitoring on the Columbia Slough since 1994. BES collects water quality data from three sites in the Lower Slough, including continuous measurements of temperature, pH, dissolved oxygen, and conductivity.

DEQ placed the Slough on the state's 303(d) list in 1994/1996. The Columbia Slough is 303(d) listed for lead, iron, manganese, and temperature. TMDLs have been established for pH, dissolved oxygen, phosphorous, chlorophyll *a*, bacteria, lead, PCBs, DDE/DDT, dieldrin, and dioxin (DEQ 1998, DEQ 2010).

Temperature

Although there is no established TMDL for temperature in the Columbia Slough, a draft Columbia Slough TMDL is in preparation (BES 2005). This draft TMDL applies a 20.0°C salmonid rearing criterion to the Lower Slough, which is hydrologically connected to the Willamette River. Water temperature in the Lower Slough does not meet this standard during the summer. The main cause of elevated water temperatures is likely the installation of levees which alter the Slough's physical features. Elevated water temperatures are also likely due to the lack of shade sources, long water residence time in a shallow channel, the altered hydrological cycle with reduced aquifer recharge and groundwater inflow during summer months, and tidal influence from the Willamette River (bringing cooler water in the summer and warmer water in the fall and early winter) (City of Portland 2009).

Sediment/Turbidity

The in-stream target for total suspended solids (TSS) is 25 mg/L in the Columbia Slough, calculated from a DEQ-established benchmark of 50 mg/L of TSS for stormwater discharges to the Slough (NPDES 1200-COLS permit). Downstream of the project vicinity, in the Portland International Raceway (PIR) area, less than 50 percent of BES sampling met the target. Generally, however, TSS improves as one moves upstream of the confluence with the Willamette River. Upstream of the project area, near the Vancouver Avenue crossing of the Slough, greater than 90 percent of sampling met the target.

The Slough contains fine, silty sediment with a relatively high organic matter content. It gradually accumulates sediment, a process known as aggrading. Major sources of TSS in the Slough include stormwater from streets, parking lots, driveways, agricultural runoff (in the Upper and Middle Slough), construction activities, sediment resuspension, and bank erosion (City of Portland 2009).

Water quality is somewhat compromised by excessive sediment and turbidity. The Columbia Slough near the project area is considered not properly functioning for suspended sediment and turbidity. Appropriate erosion and sediment control BMPs would be implemented to minimize and avoid sediment discharges and elevated turbidity.

Chemical Contamination/Nutrients

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

Low levels of sediment contamination are found throughout the Slough, with the main risks being PCBs and pesticides in fish tissues. There were no sources of PCBs identified within the Columbia Slough Watershed (City of Portland 2009).

The Lower Slough consistently exceeds the upper pH limit of the water quality standard in the spring and summer and the chlorophyll *a* standards in the spring, summer, and fall (City of Portland 2009).

Transportation, land uses, stormwater runoff, industrial discharges, contaminated sites, auto wrecking yards, sediments, and air emissions are the main contributors to lead in the Columbia Slough. Other sources of chemical contamination and nutrients include illegal dumping and hazardous spills (City of Portland 2009). Lead samples taken in the lower Slough met the dissolved lead standard, and 70 to 90 percent of the samples taken in the project area also met the total lead standard (City of Portland 2009).

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

3.3.1.3 Stormwater Drainage

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

Based on data available from NRCS, surficial soils in this area are mainly comprised of the Sauvie-Rafton-Urban land complex. These soils belong to Hydrologic Group D and have a low infiltration rate and high runoff potential. A soil survey conducted for Multnomah County indicates that water tables in this area are at a depth of less than one foot. While borehole logs available for the project area confirm the high groundwater table, they also indicate that the soils can be highly variable. Land west of I-5 generally has an industrial zoning designation while land to the east is generally designated as open space. Open space includes sports facilities such as baseball diamonds.

In this stormwater drainage area, I-5, Marine Drive, and Martin Luther King Jr. Boulevard are elevated on embankments or structures. The stormwater conveyance systems that serve these elevated roadways do not convey runoff from outside the right-of-way. These embankments are also part of a levee system. Surface runoff from I-5 and roads within the project footprint is generally confined to the roadway surface by continuous concrete barriers or curbs, and is collected almost entirely by closed gravity drainage systems with inlets and stormwater pipes. The one notable exception is Martin Luther King Jr. Boulevard east of I-5 where runoff is conveyed from the south shoulder. Stormwater runoff from the project area in this vicinity drains to a system of sloughs before being discharged to the Columbia Slough via PIR, Schmeer Road, or Pen 2 - NE 13th pump stations. These pump stations, which are sized to handle the 1 in 100-year runoff, have installed capacities of 19,700, 40,000, and 32,000 gallons per minute, respectively. Note that Marine Drive west of I-5, while within the confines of the levee system, drains to outfalls along North Portland Harbor and is included in the Columbia River South stormwater drainage area.

The existing impervious area within the project footprint in this watershed is approximately 44 acres. Runoff from about 3 acres (Martin Luther King Jr. Boulevard and Union Court) is dispersed and infiltrated. There are no flow control measures for runoff within the project footprint beyond the regulation of discharges to Columbia Slough provided by pump station operation. In addition, there are no engineered water quality facilities except for a manhole sediment trap located at the Victory Boulevard interchange that treats runoff from approximately 6 acres of impervious surfaces at the interchange (not within the project footprint).

3.3.2 Columbia River and North Portland Harbor

The I-5 bridges are located at RM 106 of the Columbia River. Shallow and near-shore habitat is present in the action area on both the Oregon and Washington shores and is influenced by flow and sediment input from tributaries and the mainstem river, which eventually settles to form shoals and shallow flats (USACE 2001).

The Columbia River is highly constrained within the project area: landform and bridge footings are the dominant and subdominant floodplain constrictions, respectively. Ten bridge footings are currently located below OHW. A flood control levee runs along the south bank of North Portland Harbor and forms a boundary between the adjacent neighborhoods and the harbor. Sandy beaches created by dredge disposal are also present along the Lower Columbia River. Shoreline erosion rates are likely slower than they were historically due to flow regulation and river bank protection. The river channel is deeper and narrower than historical conditions (USACE 2001).

The North Portland Harbor is a large side channel of the Columbia River located along the southern bank of Hayden Island. The channel branches off the Columbia River approximately 2 river miles upstream (east) of the existing bridge site, and flows approximately 5 river miles downstream (west) before rejoining the mainstem Columbia River.

For the stormwater analysis of the Columbia River watershed, the watershed has been divided into the south and north sides of the river. The south side entails the entire project CIA in Oregon, including Hayden Island, the North Portland Harbor bridges, and the Columbia River bridges south of the Oregon-Washington state line. The north side entails the entire project CIA in Washington and the Columbia River bridges north of the Oregon-Washington state line.

3.3.2.1 Hydrology

Development of the hydropower system on the Columbia River has significantly influenced peak seasonal discharges and the velocity and timing of flows in the river. The Columbia River estuary historically received annual spring freshet flows that were 75 to 100 percent higher on average than current freshet flows. Historical winter flows (October through March) also were approximately 35 to 50 percent lower than current flows (ISAB 2000).

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

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

3.3.2.2 Water Quality

Temperature

Within the project area, the Columbia River does not meet DEQ standards for temperature and is 303(d) listed. Year-round water temperatures in the project vicinity exceed the standard for salmon and steelhead migration corridors of a 20 °C average 7-day maximum. No Total Maximum Daily Load (TMDL) for temperature has been proposed at this time (DEQ 2009).

Upstream river flows are highly controlled by dams and diversions on the mainstem Columbia and its tributaries, contributing to elevated water temperatures in the action area. Riparian vegetation that could play a role in regulating water temperatures is lacking in the vicinity of the project area. However, due to the size of the Columbia River the role riparian vegetation could play in temperature regulation would be minor if at all.

Sediment/Turbidity

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

Turbidity in the project area is very low. From October 2002 to September 2007, Ecology conducted water quality sampling in the project vicinity approximately 3 miles upstream of the I-5 bridges (Ecology 2009c). Of 36 samples, all were 12 nephelometric turbidity units (NTU) or under. Twenty-eight were 5 NTUs or under. This is extremely low turbidity.

Chemical Contamination/Nutrients

The Columbia River and North Portland Harbor do not meet the Oregon DEQ standards and are 303(d) listed for the following parameters: temperature, polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), dichloro-diphenyl-trichloroethane (DDT) metabolites (e.g., DDE), arsenic, and dissolved oxygen (DEQ 2009b). The Columbia River is on the Washington Department of Ecology's 303(d) list for temperature, PCBs, and dissolved oxygen (Ecology 2009b). In addition to the 303(d) listings, EPA has issued a TMDL for the Columbia River for dioxin (EPA 1991) and approved a TMDL for the Lower Columbia River for total dissolved gas (DEQ and Ecology 2002).

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

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

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

3.3.2.3 Columbia River South Stormwater Drainage (Oregon)

Surficial soils on Hayden Island comprise the Pilchuck-Urban land complex based on available NRCS data. They are Hydrologic Group A soils that have a high infiltration rate and consist mainly of deep, well-drained to excessively-drained sands or gravelly sands. Available borehole information confirms this description. While limited peizometer data indicates that the groundwater table is about 15 feet below ground, the phreatic surface is expected to respond to changes in river level given the highly permeable nature of the soils. The land on either side of

I-5 on Hayden Island is highly developed and comprises service-related businesses such as retail stores and restaurants, and their parking lots.

As in the Columbia Slough drainage, I-5 is elevated on an embankment across Hayden Island in the Columbia River watershed on the Oregon side. Surface runoff from the I-5 and local roads within the project footprint is generally confined to the roadway surface by continuous concrete barriers or curbs. Except for the North Portland Harbor and Columbia River bridges, runoff is collected entirely by closed gravity drainage systems with inlets and stormwater pipes that discharge directly to the North Portland Harbor or Columbia River. Runoff from the bridges is discharged through scuppers directly to the water surface below. The existing impervious area within the project footprint in this stormwater drainage area is approximately 62 acres; there are no flow control measures or engineered water quality facilities. There is a manhole sediment trap located at the Victory Boulevard interchange that treats runoff from approximately 6 acres of impervious surfaces at the interchange. The sediment trap is located outside of the project footprint, but within the CIA.

As in the Columbia Slough drainage area, the project footprint within this watershed is located in what was part of the Columbia River floodplain. The portion south of North Portland Harbor is protected against flooding by a levee system while material dredged from the Columbia River has been used to raise the overall ground surface on Hayden Island east of the BNSF railroad tracks above the 1 in 100-year flood elevation.

3.3.2.4 Columbia River North Stormwater Drainage (Washington)

This drainage area comprises the project footprint from the Oregon-Washington state line in the south to the SR 500 interchange in the north. It comprises the current I-5 corridor as well as Vancouver city streets on which the light rail guideway would be located. The existing impervious area within the project footprint is approximately 133 acres and there are no flow control measures or engineered water quality facilities with the exception of approximately 3 acres of SR 14 from which runoff is dispersed or infiltrated.

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

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

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

3.3.3 Burnt Bridge Creek

Burnt Bridge Creek is a small tributary to the lower Columbia River. It originates in an area east of Vancouver, Washington, near the Vancouver suburb of Mill Plain, and flows west (roughly paralleling SR 500 for approximately 5 miles) to its outlet at Vancouver Lake. The lake then drains into the Lower Columbia River via Lake River.

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

Burnt Bridge Creek enters the project area east of 15th Avenue near Leverich Park, northeast of the SR 500/I-5 interchange. In the park area, the creek has substantial overhead cover from large-diameter trees and shrubs in some areas, and sparse cover by widely spaced large-diameter trees in areas maintained by park staff. In the more open areas within the park, the banks are highly eroded by regular visitor usage and mowing of herbaceous vegetation in the vicinity of the channel. Substrate within the park consists of fine sediments and gravels (WDFW/MHCC 1999).

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

Approximately 500 feet north of the culvert, Leverich Park Way bends to the west and the Burnt Bridge Creek channel passes under the roadway through a large corrugated metal pipe culvert. The channel continues north through a densely vegetated, privately owned area for about 200 feet. No permission to enter this area was granted during field visits to assess habitat and site characteristics. The channel continues north with a WSDOT wetland mitigation site bounding the channel to the west and Bonneville Power Administration (BPA) property and private land bounding the channel to the east. From the concrete culvert under Leverich Park Way downstream to where Burnt Bridge Creek exits the project area, the channel is dominated by fine sediments (PBS 2003) and has moderate to dense overhanging vegetation consisting of deciduous and coniferous tree and shrub species.

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

3.3.3.1 Hydrology

Average daily discharge at Burnt Bridge Creek for 1999 and 2000 were 29.8 cfs and 19.9 cfs respectively (USGS 2010c). Burnt Bridge Creek experiences seasonal fluctuation in flow, with seasonal lows occurring between July and October and highs occurring between December and March. During low flow periods, streamflow is primarily fed by groundwater discharge. The project area is highly urbanized and contains a complex system of roadways, including I-5, state highways, local access roads, residential streets, parking lots, and other impervious surfaces. The extensive urbanization of the project area has increased peak flows, reduced base flows, and altered flow timing in comparison to historical conditions. However, flow control elements have been added as part of the Greenway Project.

3.3.3.2 Water Quality

Temperature

Desirable water temperatures for young salmonids during downstream migration range from 6.7 to 13.3°C (44 to 56°F). In freshwater, temperatures greater than 23°C (73.4°F) are lethal for juvenile salmonids, and temperatures greater than 21°C (70°F) are lethal for adult salmonids (USACE 2001). Several listed salmonids are present in Burnt Bridge Creek in the vicinity of the project area, which the Ecosystems Technical Report discusses in more detail. A temperature gauge at Leverich Park (gauge BBC 2.6), within the action area, indicated that from mid-May through late September, 2008, the highest annual running 7-day average of maximum temperatures exceeded 17.5°C (63.5°F) ninety-two times (Ecology 2008). Therefore, water temperatures in the vicinity of the project area likely exceed the NMFS standard of 18 °C (64°F) for salmonid migration and rearing in late summer.

Sediment/Turbidity

Suspended sediment (e.g., sand, silt, and clay particles) is a naturally occurring component of the riverine habitat in the action area, and has historically been influenced by flow and currents, rain events, and geologic events (e.g., earthquakes and volcanic activity). Turbidity within the watershed is lowest between July and August, which coincides with the period when the majority of flow within the stream is contributed via groundwater. In general, turbidity is not considered to be a parameter of concern in Burnt Bridge Creek (Ecology 2009c). Water quality is consequently not compromised by excessive sediment and turbidity; however, habitat-forming processes requiring recruitment of suspended sediments are limited.

Contamination/Nutrients

Burnt Bridge Creek is not listed as having water quality issues related to chemical contaminants. However, the upper reaches of the stream pass through farmland where the use of chemical fertilizers and pesticides is likely. Furthermore, stormwater runoff is routed to the creek in several locations through pipes and ditches (Ecology 2009a).

Water quality in Burnt Bridge Creek has been monitored extensively since the early 1970s and shows impairments typical of urban streams (COV 2007). Sixteen segments of Burnt Bridge Creek are considered impaired by fecal coliform bacteria, dissolved oxygen (DO), and temperature by the 303(d) list (Ecology 2009b). The draft 2008 303(d) list also has 12 segments of Burnt Bridge Creek listed as impaired by pH (Ecology 2009b). Naturally occurring concentrations of phosphorus in the groundwater, coupled with nutrient inputs from urban and agricultural runoff, has supported nuisance growths of algae and further degraded the aquatic habitat (COV 2007).

Nine samples for assessing bacteria, pH, and DO were taken between July and August 2008 at the Leverich Park gauge. Bacteria was above water quality standards in six of the nine samples, pH was above standards in one of the nine samples, and DO was not above standards in any of the samples (Ecology 2009b).

Ecology has not yet approved any TMDLs for Burnt Bridge Creek. However, the Burnt Bridge Creek TMDL Advisory Committee is currently conducting monitoring which would result in the determination of the required pollution reductions and the development of a detailed clean-up plan (Ecology 2009a). The Burnt Bridge Creek Water Quality Improvement Project, coordinated by Ecology, is conducting intensive water quality monitoring of surface water, groundwater, and stormwater.

3.3.3.3 Stormwater Drainage

The project footprint within this watershed includes approximately 17 acres of existing impervious area, including the SR 500 interchange and portions of I-5 to the north and SR 500 to the east. Surficial soils in this area typically consist of Wind River loams. These soils belong to Hydrologic Group B and are considered to have a moderate infiltration rate. Residential developments are located south of the SR 500 interchange. There is a school to the northwest of the SR 500 interchange and a park to the northeast. Available information suggests that the groundwater table in this area is deep.

Typical of an urban environment, surface runoff from the highways and local streets is generally confined to the roadway by continuous curbs and concrete barriers, and is conveyed almost entirely by closed drainage systems. In contrast to the other watersheds, runoff from the entire PGIS within this portion of the project footprint currently contains some form of treatment. Runoff from about 15 acres within the project footprint is conveyed to an infiltration pond at the Main Street interchange, and any runoff that is not infiltrated is conveyed to a wet pond north of SR 500.

The infiltration pond is considered to provide adequate stormwater treatment in terms of water quality (dissolved metals reduction) and flow reduction. The primary stormwater treatment function of the wet pond, however, is to reduce sediment and is therefore not considered to provide adequate stormwater treatment. For this reason, runoff from the area served by this pond is not considered as receiving stormwater treatment according to the CRC project's stormwater treatment analysis.

3.3.4 Fairview Creek

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

The Ruby Junction Maintenance Facility on NW Eleven Mile Avenue in Gresham, Oregon, is the location for a proposed expansion of an existing TriMet transit maintenance facility. The existing facility would be expanded by approximately 10.4 acres (from 22.8 to 33.2 acres) over several construction phases. Portions of three of the 14 parcels that would be added to the maintenance facility are located within the 100-year floodplain of Fairview Creek. These three parcels presently contain several buildings and some paved surfaces. No new structures are planned to be constructed in the floodplain, but some impervious surface would be added and some would be replaced or converted to pervious outside the floodplain. Overall, there would be a net reduction of 0.5 acres of PGIS.

3.3.4.1 Hydrology

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

Average flow in Fairview Creek at the USGS gauging station near Glisan Street, approximately 1.4 miles downstream of the Ruby Junction Operations Facility, was 5.86 cfs from 1993 to 2008. Minimum daily discharge during this period was 0.24 cfs and maximum daily discharge was 119 cfs (USGS 2008b). The 100-year floodplain for Fairview Creek is approximately 1,288 feet wide at its widest point, and covers approximately two parcels of the proposed expansion area (Metro 2003).

3.3.4.2 Water Quality

The DEQ has placed Fairview Creek on its 303(d) list for E. coli (year-round) and fecal coliform (fall/winter/spring); it has approved TMDLs for bacteria and spring/summer temperature (City of Portland 2008; DEQ 2009). In addition, Fairview Creek is included in the TMDLs for the Columbia Slough since it is a tributary. No additional water quality data was available for this creek.

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

3.3.4.3 Stormwater Drainage

The TriMet Ruby Junction Maintenance Facility within the Fairview Creek drainage area has a total approximate area of about 22.8 acres of which 16.8 are existing PGIS. This facility would be expanded to meet the needs of the CRC and TriMet's Portland-Milwaukie Light Rail projects, both of which are expected to be constructed at approximately the same time.

Runoff from the impervious area in the southwest portion of the existing Ruby Junction Maintenance Facility currently drains to Fairview Creek through proprietary cartridge filters. This portion of the site (1.5 acres) comprises a paint booth and body shop and a parking lot. Stormwater from the rest of the existing impervious area (15.3 acres) is infiltrated through the use of dry wells, ultimately recharging the groundwater aquifer and contributing to flows in waterbodies within the Columbia Slough watershed.

4. Long-term Effects

4.1 Introduction

This section describes the long-term effects to occur from the CRC project to the following:

- hydrology,
- water quality, and
- stormwater.

Effects to each of these elements are organized by project waterway and address long-term effects.

"Long-term effects" refers to effects that occur as a result of the project, including those that manifest later in time or are permanent. Long-term effects may impact resources beyond the project footprint.

4.2 Long-term Effects to Hydrology

This section describes potential hydrologic impacts from the project, which includes potential flooding, alterations in peak flows and increased runoff volumes to local receiving waters, and decreased water infiltration and groundwater recharge. Flooding may occur as a result of increases in stormwater discharge and floodplain/channel constriction.

Other than the installation of piers within the Columbia River and North Portland Harbor and the expansion of the Ruby Junction Maintenance Facility, no new or expanded project facilities would encroach upon the 100-year floodplain for any stream or river within the affected project area. New roads within the floodplain would avoid floodplains altogether. No new structures would be constructed in Fairview Creek's 100-year floodplain at the Ruby Junction Maintenance Facility.

The Columbia River and North Portland Harbor would be the only waterways crossed by the project and subject to in-water work. However, long-term hydrologic effects may be realized by the Columbia Slough, Burnt Bridge Creek, and Fairview Creek due to an increase in impervious surfaces in each drainage basin.

An increase in impervious surface area typically increases flow volume fluctuations within receiving waters, and is associated with greater peak flows and increased total runoff volume. Flow volume fluctuations and impacts from greater peak flows and increased runoff are expected to be relatively small within those streams draining the project area because the project drains almost directly to major waterbodies that have relatively high flows. Flow controls for project-generated runoff are required for flows discharged to Fairview Creek and Burnt Bridge Creek, but not for the Columbia River or Columbia Slough. Impacts from increased runoff in the Burnt Bridge Creek drainage would be mitigated by developing a stormwater conveyance and detention system in accordance with water quantity and quality standards in place at the time of construction. All new impervious surfaces at the Ruby Junction Maintenance Facility would be infiltrated.

Project-generated runoff from a few sections of new or modified roadway that currently drain to North Portland Harbor would be conveyed, treated, and discharged to the Columbia Slough. All other runoff generated by the project would be discharged within the watershed in which it is generated. Exhibit 4-1 provides information on total drainage areas of receiving waters and proposed increases to impervious surface areas within these areas.

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

Exhibit 4-1. Impervious Surface Increases Relative to Total Drainage Areas

Watershed	Total Drainage Area (square miles)	Total Increase to Impervious Surface (square miles)	% Increase to Impervious Surface within Drainage Area
Columbia Slough	51	0.021	0.04%
Lower Columbia River	18,000	0.035	0.0002%
Burnt Bridge Creek	28	0.010	0.04%
Fairview Creek[a]	7	-0.00078	-0.01%

a Impervious area would decrease slightly in this watershed.

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

The addition of impervious surface is unlikely to measurably affect base flows of waterways within the project area. The project area is not within the headwaters of project waterways and the drainage areas for these waterways are relatively large, which lessens the effect of decreased infiltration on base flows. This is reflected in regulations that only require flow control for runoff to Fairview and Burnt Bridge Creeks.

Furthermore, increased infiltration opportunities offered by the project in the form of stormwater facilities are anticipated to be more than double the increase in new, rebuilt, or resurfaced impervious surfaces post-project.

Though there would be 0.7 acres of additional impervious surface included in the LPA Option B, long term effects to hydrology are anticipated to be the same as those of Option A.

4.2.1 Columbia Slough

The project would alter the current hydrologic regime to a minor extent of the Columbia Slough through the addition of impervious surface and stormwater treatment. The addition of impervious surface would increase stormwater volumes. However, this would be mitigated through stormwater treatment and management design. The discharge rates of stormwater runoff volumes generated by the project that would flow into the Columbia Slough would be regulated by pumps located downstream of the project area. The Columbia Slough is exempt from flow control requirements (City of Portland 2004).

There would be 0.3 acres of additional impervious area proposed with the LPA Option B for the Columbia Slough watershed, relative to Option A. The long-term effects to hydrology for both of these options are anticipated to be similar.

4.2.2 Columbia River and North Portland Harbor

Six new pier complexes would be built for the Columbia River crossing and the original pier complexes would be removed. New piers for the North Portland Harbor bridges would be added. Given the size of the Columbia River and North Portland Harbor relative to the size of the piers and given that this section of the river is tidally influenced it is extremely unlikely that any backwater effect would be measurable. Regardless, the project would likely require a floodplain permit from the local jurisdictions. Modeling studies would be a requirement of this permit and would be conducted in a later phase. However, preliminary floodway calculations show that the project would not result in any floodway impacts. If results of the final modeling show a backwater effect that exceeds local standards, cut and fill remedies within the floodplain would likely be prescribed.

The project would provide an increased level of infiltration for stormwater runoff. This may have a net (albeit not measurable) benefit to the hydrology of the Columbia River.

In the Columbia River watershed on the Oregon side, there would be 0.4 acres of additional impervious area proposed with the LPA Option B, relative to Option A. However, the long-term effects to the hydrology of the Columbia River for both of these options are anticipated to be similar.

4.2.3 Burnt Bridge Creek

The project may slightly alter the stormwater conveyance network that drains to Burnt Bridge Creek by providing additional stormwater treatment and by rerouting some roadside ditches. This may improve the creek's hydrologic regime by providing infiltration opportunities for runoff from impervious areas. Ecology requires that runoff volumes be reduced to pre-development conditions for peak discharges between 50 percent of the 2-year event and the 50-year event.

Flow controls are required for project-generated runoff discharged to Burnt Bridge Creek. Impacts from increased runoff in Burnt Bridge Creek would be mitigated by the use of two new bioretention ponds in the vicinity of the SR 500 interchange.

Impervious surface areas are the same for both the LPA Option A and B within the Burnt Bridge Creek watershed. Therefore, long-term effects would be the same.

4.2.4 Fairview Creek

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

Since the project would adhere to these flow-control requirements the hydrologic regime of Fairview Creek is not anticipated to be altered by the proposed action long-term.

4.3 Long-term Effects to Water Quality

Increased sedimentation in streams after road construction may occur if slopes are not stabilized as designed or if stormwater facilities do not function effectively in removal of sediment from runoff. Sedimentation due to erosion can be increased by two potential pathways: directly from erosion of the finished roadside embankments or from increased streambank erosion as a result of increased peak flows. The project corridor on the Oregon side of the Columbia River is relatively flat and the portion on the Washington side of the Columbia River has more topographical features. This includes the area around Burnt Bridge Creek. If flooding were to occur, this area would be susceptible to erosion hazards. However, peak flows would be managed by stormwater facilities in the Burnt Bridge Creek drainage area. Stormwater facilities would be designed to effectively remove sediments from runoff before discharging stormwater to the receiving waters along the project corridor.

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

The NPDES permit program, as authorized by the Clean Water Act (CWA), controls water pollution by regulating point sources that discharge pollutants into waters of the United States and compliance with designated TMDLs. Several of the waterways in the project area have TMDLs listed for certain pollutants. Project waterways and their associated 303(d) listings and designated TMDLs are shown in Exhibit 4-2 below.

Exhibit 4-2. Project Waterways with 303(d) Listings and TMDLs

Waterway	303(d) Listing Factors	Established TMDLs
Columbia Slough	• Toxics (lead, iron, manganese) • Temperature	• Toxics (lead, PCBs, DDE/DDT, dieldrin, dioxin) • Eutrophication (pH, dissolved oxygen, phosphorus, and chlorophyll *a*) • Bacteria
Columbia River (includes North Portland Harbor)	**In Oregon:** • Toxics (PCBs, PAHs, DDT/DDE, arsenic) • Eutrophication (dissolved oxygen) • Temperature **In Washington:** • Toxics (PCBs) • Eutrophication (dissolved oxygen) • Temperature	• Dioxin • Total Dissolved Gas

Waterway	303(d) Listing Factors	Established TMDLs
Burnt Bridge Creek	• Eutrophication (dissolved oxygen) • Fecal Coliform Bacteria • Temperature	• None
Fairview Creek	• E. coli • Fecal Coliform	• Toxics (lead, PCBs, DDE/DDT, dieldrin, dioxin) • Eutrophication (pH, dissolved oxygen, phosphorus, and chlorophyll *a*) • Bacteria • Temperature

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

Traffic models projected to the year 2030 indicate that the LPA would substantially decrease traffic congestion within the project corridor as compared to the No-Build Alternative. The reduction of braking would reduce brake pad wear. Copper is a known byproduct of brake pad wear. Therefore, decreasing congestion may potentially reduce the proportionate amount of copper carried by project runoff compared to what would be proportionately carried by the No-Build Alternative.

Annual pollutant load estimates were conducted using Method 1: WSDOT Data-FHWA Method as outlined in the WSDOT's guide entitled "*Quantitative Procedures for Surface Water Impact Assessment*." This method was selected because it provides estimates of pollutant loading for a wider range of ADT volume highways (1,700-93,000) using data derived from observations made on highways in Western Washington since 2001. It is directly applicable to the project location and is based on recently collected WSDOT data. Mean estimated annual pollutant loads, which are constants provided by this method, were used in the calculations of project pollutant loads and are shown in Exhibit 4-3.

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

Pollutant	Mean Load from Untreated Runoff	Mean Load from Treated Runoff
Total Suspended Solids	769	88
Total Copper	0.16	0.04
Dissolved Copper	0.04	0.03
Total Zinc	0.98	0.21
Dissolved Zinc	0.31	0.14

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

WSDOT hasn't yet vetted the data set through a formal QA/QC process. During development of annual loading estimates, apparent discrepancies were noted in the data. If discrepancies are valid, source data and loading rate estimates will be reevaluated.

Exhibit 4-4 shows the annual pollutant load estimates for the entire project corridor for the proposed action and the No-Build Alternative. Areas that are infiltrated, are not factored into the pollutant load calculations since they are assumed to be naturally filtered through ground percolation before entering receiving waters through groundwater.

Exhibit 4-4. Annual Pollutant Load Estimates for Entire Project CIA

	No-Build Alternative	LPA Option A[a]	LPA Option B[a]
Treated PGIS (ac)	0	151.7 (146.2)	152.4 (146.9)
Infiltrated PGIS	20.5	106.8 (101.6)	106.8 (101.6)
Untreated PGIS	218.6	8.1 (8.1)	8.1 (8.1)
Total PGIS	239.1	266.6 (255.9)	267.3 (256.6)
TSS (lbs/year)	168,103.4	19,578.5 (19,094.5)	19,640.1 (19,156.1)
% Change		-88.35% (-88.64%)	-88.32% (-88.60%)
Total Cu (lbs/year)	34.98	7.36 (7.14)	7.39 (7.17)
% Change		-78.95% (-79.57%)	-78.87% (-79.49%)
Dissolved Cu (lbs/year)	8.74	4.88 (4.71)	4.90 (4.73)
% Change		-44.25% (-46.13%)	-44.01% (-45.89%)
Total Zn (lbs/year)	214.23	39.80 (38.64)	39.94 (38.79)
% Change		-81.42% (-81.96%)	-81.36% (-81.89%)
Dissolved Zn (lbs/year)	67.77	23.75 (22.98)	23.85 (23.08)
% Change		-64.95% (-66.09%)	-64.81% (-65.95%)

a Text in parentheses indicates impacts if the LPA options are constructed with Highway Phasing.

Exhibit 4-4 shows that constructing either LPA options would provide stormwater treatment across the project corridor and decrease roadway-derived pollutants. Both factors would beneficially affect the long-term water quality of the receiving waters as compared to the No-Build Alternative. Tables for each basin are included in the following sections and include the pollutant-loading analysis for LPA options A and B and the No-Build Alternative.

Another water quality concern is that the project would involve additional roadway area and, consequently, additional winter maintenance activities. Highway sanding can result in large quantities of particulate making its way into adjacent water bodies, with adverse effects to spawning beds and, occasionally, channel morphology. Chemical de-icers are a potential concern, but are relatively benign. Calcium magnesium acetate (CMA) is currently being used by ODOT in the Portland area, but magnesium chloride is becoming more common across the state. WSDOT also uses CMA in western Washington on bridges and overpasses and magnesium chloride is utilized across the state at higher elevations. CMA reduces oxygen in water, but it is used in low quantities. Studies evaluating the effect of CMA use on a small stream found no detectable change in water chemistry (Tanner and Wood 2000). Therefore, impacts from the potential use of CMA within the project area would be expected to be negligible, particularly since the frequency of use of such chemicals is relatively low. Within the project area, there are only about 20 days a year, on average, with minimum temperatures below freezing (OCS 2004). In many cases the duration of freezing temperatures or ambient conditions are such that CMA is not applied. The water quality benefits of increased highway safety could counteract potential adverse impacts from winter maintenance activities. Fewer accidents would reduce the risk of a hazardous materials spill.

WSDOT has also started making and applying its own anti-icing agent that consists of salt, de-sugared molasses, minerals, and water. This new anti-icer meets the Pacific Northwest

Snowfighters Association's (PNS) specifications for safety, environmental preservation, infrastructure protection, cost-effectiveness and performance in winter maintenance (WSDOT 2009b). However, it is not yet clear what effect this would have on receiving waters in the vicinity of the project corridor.

4.3.1 Columbia Slough

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

The effect of the pollutants found in runoff depends to a large extent on the character of the receiving waters. Given the nature of the Columbia Slough, with its slow moving water and identified water quality problems, TSS and other contaminants found in highway runoff is more of a concern within this stream than in other waterbodies within the project area. This is due to the fact that slower flows, such as at the Columbia Slough, allows water to be exposed to stormwater pollutants for a longer period of time and increases the probability that contaminated sediments would accumulate. In addition to the accumulation of contaminated sediments, slower flows also provide a stable habitat for excessive growth of algae and macrophytes during the summer, which can lead to lower dissolved oxygen levels (BES 2010). These issues compound the water quality deficiencies of the Lower Slough, making it more sensitive to added contamination inputs.

The project would increase the total PGIS in this watershed by approximately 11 acres both LPA options. This increase can largely be due to the project capturing runoff from the bridges across North Portland Harbor. The runoff from the existing bridge structures currently drains directly to the water surface below. Exhibit 4-5 shows the PGIS acreage for the No-Build Alternative and the proposed action as well as a pollutant-loading estimate for each.

Exhibit 4-5. Pollutant-Loading Estimate for the Columbia Slough Basin

	No-Build Alternative	LPA Option A	LPA Option B
Treated PGIS (ac)	0	46.4	46.7
Infiltrated PGIS	3.0	0.0	0.0
Untreated PGIS	39.8	7.1	7.1
Total PGIS	42.8	53.5	53.8
TSS (lbs/year)	30,606	9,543	9,570
% Change[a]		-68.82%	-68.73%
Total Cu (lbs/year)	6.37	2.99	3.00
% Change		-53.02%	-52.83%
Dissolved Cu (lbs/year)	1.59	1.68	1.69
% Change		5.28%	5.84%
Total Zn (lbs/year)	39.00	16.70	16.77
% Change		-57.18%	-57.02%
Dissolved Zn (lbs/year)	12.34	8.70	8.74
% Change		-29.51%	-29.17%

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

As shown in Exhibit 4-5, the construction of the LPA would increase total PGIS and would decrease pollutant-loading for all pollutants shown except for dissolved copper levels where there would be a 5.28 percent increase for Option A and a 5.84 percent increase for Option B. The percentage increase in dissolved copper is much less than the 25 to 26 percent increase in PGIS, demonstrating the effectiveness of the water quality facilities proposed for the project. It should also be noted that the analysis used to produce these pollutant loading estimates are not based on enhanced stormwater treatment alone. Instead, it is based on the average of data collected from 10 basic and 3 enhanced treatment facilities. Because the majority of treatment that will be provided by the project is enhanced treatment (compost-amended vegetated filtration strips or ecology embankments), the results shown in Exhibit 4-5 are likely an overestimation of total suspended solids, total copper, and dissolved copper pollutant loads resulting from the LPA. Runoff concentrations of total zinc and dissolved zinc have not been shown to differ whether treated in basic or enhanced facilities. This analysis also does not include estimates for fecal coliform and lead, it is not clear whether these pollutants, for which there are TMDLs, would be reduced through the construction of the LPA. However, with the addition of stormwater treatment and evidence that shows reduction of several pollutants, it is not likely that there would be a substantial increase in these pollutants and the LPA may actually result in a decrease of these pollutants.

4.3.2 Columbia River and North Portland Harbor

No TMDL has been established for any pollutant associated with highway runoff. However, the Columbia River in the project area is 303(d) listed for temperature. The project would remove approximately 250 feet of vegetation along the north and south shorelines of the river in the vicinity of the new bridge structure and along the north and south shorelines of Hayden Island. Yet, this would not have a significant on the Columbia River water temperatures due to the large size of the river and the very minor role riparian vegetation plays on cooling water temperatures along the river currently. Furthermore, increased highway runoff is not anticipated to increase water temperatures significantly since it generally rains during cooler months when Columbia River water temperatures are not as much a concern.

For the Columbia River pollutant-loading analysis, as in the stormwater analysis, the Oregon and Washington sides of the river were split into separate drainages to simplify the analysis of compliance with local stormwater regulations. The loading rates for all pollutants considered in the analysis presented in Exhibit 4-6 and Exhibit 4-7 would decrease substantially with the proposed action compared to the No-Build Alternative. This reduction is expected due to the proposed reduction of untreated stormwater drainage and increase in stormwater treatment within the Columbia River Basin on both the Oregon and Washington sides.

Exhibit 4-6. Pollutant-Loading Estimate for the Columbia River South (Oregon) Basin

	No-Build Alternative	LPA Option A	LPA Option B
Treated PGIS (ac)	0	55.0	55.4
Infiltrated PGIS	0.0	0.0	0.0
Untreated PGIS	59.4	0.0	0.0
Total PGIS	59.4	55.0	55.4
TSS (lbs/year)	45,679	4,840	4,875
% Change		-89.40%	-89.33%
Total Cu (lbs/year)	9.50	2.20	2.22
% Change		-76.85%	-76.68%
Dissolved Cu (lbs/year)	2.38	1.65	1.66

	No-Build Alternative	LPA Option A	LPA Option B
% Change		-30.56%	-30.05%
Total Zn (lbs/year)	58.21	11.55	11.63
% Change		-80.16%	-80.01%
Dissolved Zn (lbs/year)	18.41	7.70	7.76
% Change		-58.18%	-57.88%

Exhibit 4-7. Pollutant-Loading Estimate for the Columbia River North (Washington) Basin

	No-Build Alternative	LPA Option A	LPA Option B
Treated PGIS (ac)	0	50.3	50.3
Infiltrated PGIS	3.0	84.4	84.4
Untreated PGIS	117.7	1.0	1.0
Total PGIS	120.7	135.7	135.7
TSS (lbs/year)	90,511	5,195	5,195
% Change		-94.26%	-94.26%
Total Cu (lbs/year)	18.83	2.17	2.17
% Change		-88.47%	-88.47%
Dissolved Cu (lbs/year)	4.71	1.55	1.55
% Change		-67.10%	-67.10%
Total Zn (lbs/year)	115.35	11.54	11.54
% Change		-89.99%	-89.99%
Dissolved Zn (lbs/year)	36.49	7.35	7.35
% Change		-79.85%	-79.85%

The project is anticipated to have an overall beneficial long-term effect to the Columbia River and North Portland Harbor's water quality due to stormwater treatment.

4.3.3 Burnt Bridge Creek

Burnt Bridge Creek is on the 303(d) list for fecal coliform bacteria. Highway runoff is not identified in the listing as a source for this pollutant. An existing infiltration pond at the Main Street interchange would not be modified by the project, but the project would reduce the total impervious surface draining to this facility by about 2.2 acres. Currently, overflows from this infiltration pond are discharged to Burnt Bridge Creek during extreme runoff events without receiving adequate treatment. The reduction of stormwater flows to this facility as well as the addition of two bioretention ponds would reduce pollutant-loading. The loading rates for all pollutants considered in the analysis presented in Exhibit 4-8 would be eliminated as shown below for the LPA compared to the No-Build Alternative since infiltration is assumed to remove pollutants entirely according to this analysis.

Exhibit 4-8. Pollutant-Loading Estimate for the Burnt Bridge Creek Basin

	No-Build Alternative	LPA Option A	LPA Option B
Treated PGIS (ac)	0	0	0
Infiltrated PGIS	14.5	22.4	22.4
Untreated PGIS	1.7	0.0	0.0
Total PGIS	16.2	22.4	22.4

	No-Build Alternative	LPA Option A	LPA Option B
TSS (lbs/year)	1,307	0	0
% Change		-100.00%	-100.00%
Total Cu (lbs/year)	0.27	0	0
% Change		-100.00%	-100.00%
Dissolved Cu (lbs/year)	0.07	0	0
% Change		-100.00%	-100.00%
Total Zn (lbs/year)	1.67	0	0
% Change		-100.00%	-100.00%
Dissolved Zn (lbs/year)	0.53	0.78	0.78
% Change		-100.00%	-100.00%

4.3.4 Fairview Creek

DEQ has placed Fairview Creek on its 303(d) list for E. coli (year-round) and fecal coliform (fall/winter/spring); it also has approved TMDLs for bacteria and spring/summer temperature (City of Portland 2008; DEQ 2009b). The source of E. coli bacteria is not thought to be specifically from roadway runoff (DEQ 2006). Fairview Creek is also included in the TMDLs for the Columbia Slough since it is a tributary. These TMDLs include lead and fecal coliform bacteria that are associated with highway runoff. Since the majority of the existing impervious area and the entire impervious area of the expansion are infiltrated, a pollutant loading estimate is not provided. The total impervious area would decrease by 0.5 acres compared to the No-Build Alternative. The project would not have a long-term adverse effect on Fairview Creek's water quality since runoff from the expansion area would be infiltrated and not discharged to Fairview Creek.

4.4 Long-term Effects to Stormwater

Stormwater runoff from highways has elevated levels of contaminants. The project would be replacing and creating new impervious surface. However, improvements to stormwater treatment on new and improved impervious surfaces, including the I-5 and North Portland Harbor bridges, are anticipated to reduce stormwater pollutant loads discharged to Columbia Slough, Columbia River, North Portland Harbor, and Burnt Bridge Creek from the proposed project corridor. Any discharges to Fairview Creek would likely remain the same.

Besides the infiltration pond near Burnt Bridge Creek, the other existing water quality facilities would be replaced with enhanced stormwater treatment that would meet the project's stormwater management requirements.

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

Exhibit 4-9 below presents an overall summary of the anticipated impact of the project on PGIS and non-PGIS from which runoff would be treated or infiltrated. The stormwater drainage areas used in these calculations do not include staging areas outside the project footprint, casting yards that might be required for fabricating bridge elements, nor does it include the area associated with the TriMet Ruby Junction facility. Exhibit 4-9 and subsequent exhibits in this section present acreages in terms of LPA Option A. Where the acreages of Option B differ from those of Option A, differences have been noted.

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

Exhibit 4-9. Summary of Changes to Impervious Area and Stormwater Treatment Across the Entire Project CIA[a]

	Area (acres)			
	Infiltrated	Treated	Untreated	Total
Existing PGIS	20.5	0.0	218.6	239.1
Existing Non-PGIS	0.0	0.0	17.1	17.1
Existing CIA	**20.5**	**0.0**	**235.7**	**256.2**
Post-project PGIS				
Existing PGIS retained as-is	15.0	14.1	0.0	29.1
New, rebuilt, or resurfaced PGIS	91.8	137.8[b]	8.1	237.7[b]
Post-project Non-PGIS	4.7	26.2	0.0	30.9
Post-project CIA	**111.5**	**178.1[b]**	**8.1**	**297.7[b]**
Net change in CIA	**91.0**	**178.1[b]**	**-227.6**	**41.5[b]**

a These numbers do not include the impervious surface numbers for the TriMet Ruby Junction facility.

b Each of these figures would be increased by 0.7 acres for LPA Option B.

Traffic models projected to the year 2030 indicate that the project would substantially improve traffic congestion within the project corridor. Decreasing traffic congestion on the I-5 and North Portland Harbor bridges and associated roadways, would decrease idling and brake pad wear and may consequently reduce the amount of copper and other traffic-related pollutants currently carried by corridor runoff. However, quantifying the effect of reduced traffic congestion on pollutant loads is not feasible.

The proposed project would increase impervious areas by 41.5 acres for Option A and 42.2 acres for Option B, which may reduce natural infiltration rates and increase stormwater pollutants loads of suspended sediments, nutrients, PAHs, oils and grease, antifreeze from leaks, cadmium and zinc from tire wear, and copper from wear and tear from brake pads, bearings, metal plating, and engine parts. However, untreated impervious surface would be reduced by 227.6 acres by the construction of the LPA.

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

4.4.1 Columbia Slough

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

The impervious area in the Columbia Slough watershed would increase by approximately 14 acres as shown in Exhibit 4-10. However, untreated impervious surface would be reduced by approximately 34.3 acres. Most of the increase in total impervious surface can be attributed to the project capturing runoff from the bridges across North Portland Harbor. Stormwater runoff from the existing bridge currently drains directly to the water surface below. The CRC project would create approximately 43.3 acres of new and rebuilt PGIS for the LPA Option A and 43.6 acres for Option B (Appendix A) in the Columbia Slough watershed. While I-5 would generally follow its current alignment and grade, the Marine Drive interchange would be completely rebuilt and would differ significantly from its existing layout. In addition, about 8.3 acres of existing PGIS (primarily I-5 north of Victory Boulevard) would be resurfaced rather than rebuilt. The existing stormwater conveyance system would not be modified where highway resurfacing is proposed and there does not appear to be adequate space between I-5 and Walker Slough to retrofit the existing stormwater conveyance system to treat runoff from approximately 3.7 acres of resurfaced and 3.4 acres of new and rebuilt I-5 PGIS.

Exhibit 4-10. Summary of Changes to Impervious Area and Stormwater Treatment – Columbia Slough Watershed

	Area (acres)			
	Infiltrated	Treated	Untreated	Total
Existing PGIS	3.0	0.0	39.8	42.8
Existing Non-PGIS	0.0	0.0	1.6	1.6
Existing CIA	**3.0**	**0.0**	**41.4**	**44.4**
Post-project PGIS				
Existing PGIS retained as-is	0.0	2.1	0.0	2.1
New, rebuilt, or resurfaced PGIS	0.0	44.5[a]	7.1	51.6[a]
Post-project Non-PGIS	0.0	4.3	0.0	4.3
Post-project CIA	**0.0**	**50.9**[a]	**7.1**	**58.0**[a]
Net change in CIA	**-3.0**	**50.9**[a]	**-34.3**	**13.6**[a]

a This value would increase by 0.3 acres for LPA Option B.

4.4.2 Columbia River and North Portland Harbor

On the Oregon side, the project would rebuild the Hayden Island interchange, retrofit the existing North Portland Harbor bridge with a stormwater collection and conveyance system, and demolish the existing the existing Columbia River bridges. The last two actions would result in eliminating runoff from approximately 8 acres of bridge deck that is presently discharged directly to the water surface below. The project would create approximately 52.8 acres of new and rebuilt PGIS for LPA Option A and 53.2 acres for Option B. Runoff from 2.2 acres of the existing North Portland Harbor Bridge and 7.6 acres of non-PGIS would be treated prior to being released to North Portland Harbor or the Columbia River. Currently, there are no water quality facilities for runoff from the project footprint in this watershed. Exhibit 4-11 summarizes the impact of the project on the impervious area from which runoff would be treated.

	Area (acres)

Stormwater Treatment – Columbia River South (Oregon) Basin	**Infiltrated**	**Treated**	**Untreated**	**Total**
Existing PGIS	0.0	0.0	59.4	59.4
Existing Non-PGIS	0.0	0.0	3.0	3.0
Existing CIA	**0.0**	**0.0**	**62.4**	**62.4**
Post-project PGIS				
Existing PGIS retained as-is	0.0	2.2	0.0	2.2
New, rebuilt, or resurfaced PGIS	0.0	52.8[a]	0.0	52.8[a]
Post-project Non-PGIS	0.0	7.6	0.0	7.6
Post-project CIA	**0.0**	**62.6**[a]	**0.0**	**62.6**[a]
Net change in CIA	**0.0**	**62.6**[a]	**-62.4**	**0.2**[a]

a Each of these values would increase by 0.4 acres for LPA Option B.

This watershed includes existing surface parking that may or may not remain after the project has been completed. It is uncertain at this time how land use in the vicinity of the Hayden Island interchange might change after completion of the CRC project. However, it has been assumed that the land on the west side of the proposed interchange and transit guideway would be used for staging during construction and converted into transit-oriented development following construction. This land comprises an area of about 10.0 acres west of the project and is bounded by the transit guideway, Center Avenue, Hayden Island Drive, and Jantzen Drive. Any redevelopment of these areas would need to comply with the stormwater development and discharge requirements of either ODOT or the City of Portland and is assumed, in the numbers presented in the table above, to receive stormwater treatment.

Constructed treatment wetlands are proposed for the main water quality facilities on Hayden Island, rather than biofiltration ponds, even though the soils belong to the Pilchuck-Urban land complex and are classified as Hydrologic Group A. At locations where such facilities are being considered, the depth to groundwater is only about 15 feet, and may be less depending on the influence of river levels on the phreatic surface. Considering the likely depth of the pond, there may not be adequate separation between the invert and groundwater table for treating runoff. The EPA recommends a "significant separation distance (2 to 5 feet) between the bottom of an infiltration basin and seasonal high groundwater table." Again, no flow control facilities are required or proposed.

On the Washington side, the CIA in this basin would be increased by approximately 21.1 acres, most of which may be attributed to the reconfigured interchanges and increased number and length of merge lanes for I-5. The project would create approximately 97.8 acres of new and rebuilt PGIS and 13.3 acres of new and rebuilt non-PGIS. In addition, 15.0 acres of existing PGIS, mostly on I-5, would be resurfaced. Water quality facilities are proposed for approximately 134.7 acres of PGIS and 18.3 acres of non-PGIS. In contrast, runoff from only 3.0 acres of PGIS is currently treated. Exhibit 4-12 summarizes the impact of the project on the impervious area from which runoff would be treated. There is no difference in proposed impervious area between LPA Options A and B for the Columbia River basin on the Washington side.

Exhibit 4-12. Summary of Changes to Impervious Area and Stormwater Treatment – Columbia River North (Washington) Basin

	Area (acres)			
	Infiltrated	Treated	Untreated	Total
Existing PGIS	3.0	0.0	117.7	120.7
Existing Non-PGIS	0.0	0.0	12.2	12.2
Existing CIA	**3.0**	**0.0**	**129.9**	**132.9**
Post-project PGIS				
Existing PGIS retained as-is	13.1	9.8	0.0	22.9
New, rebuilt, or resurfaced PGIS	71.3	40.5	1.0	112.8
Post-project Non-PGIS	4.0	14.3	0.0	18.3
Post-project CIA	**88.4**	**64.6**	**1.0**	**154.0**
Net change in CIA	**85.4**	**64.6**	**-128.9**	**21.1**

Flow control is not required for this watershed and none is proposed. In addition, no new outfalls are proposed. Exhibit 4-12 demonstrates that the project proposes to treat runoff from the entire CIA with the exception of about 1.0 acre comprising the eastbound lanes of SR 14. Existing and proposed highway super-elevation at this location would result in runoff draining to catch basins located adjacent to the center median. Since this portion of SR 14 is only being resurfaced, the opportunity is limited to reconfigure the conveyance system. In addition, it is not possible to construct a biofiltration swale or media drain at the median and there is not space to provide either a cartridge vault or an end-of-pipe water quality facility.

From about 6th Street in Vancouver, I-5 will generally continue to follow its existing alignment and grade. The SR 14 and Mill Plain interchanges would be reconfigured, which would alter the current interchange footprint. In contrast, the Fourth Plain interchanges would be rebuilt and the interchange footprints would be similar to what currently exists. New streets would be constructed at the SR 14 interchange to improve local connections and the light rail guideway would be constructed primarily along existing streets. Three park and ride structures, Columbia, Mill, and Clark, would be built to serve the extended light rail system.

With the exception of the above-grade guideway between 6th Street and the new southbound Columbia River Bridge, the light rail guideway could be subject to use by buses and would therefore be considered pollutant-generating. This is a conservative determination, and could change should buses be excluded from the guideway during future project design.

4.4.3 Burnt Bridge Creek

The LPA would provide full connectivity between I-5 and SR 500 through the construction of a new ramp from southbound I-5 to eastbound SR 500 and tunnel from westbound SR 500 to northbound I-5. The project would increase the total impervious area in the watershed by about 6.6 acres and would create approximately 10.3 acres of new and rebuilt PGIS and 10.2 acres of existing PGIS would be resurfaced, as shown in Exhibit 4-13. Unlike the other watersheds, runoff to Burnt Bridge Creek must be reduced to pre-development (forested) conditions for peak discharges between 50 percent of the 2-year event and the 50-year event. There is no difference in proposed impervious area between LPA Options A and B in the Burnt Bridge Creek Drainage.

Exhibit 4-13. Summary of Changes to Impervious Area and Stormwater Treatment – Burnt Bridge Creek Drainage	Area (acres)			
	Infilt rate	Tre ate	Untr eate	To tal

	d	d	d	
Existing PGIS	14.5	0.0	1.7	16.2
Existing Non-PGIS	0.0	0.0	0.3	0.3
Existing CIA	**14.5**	**0.0**	**2.0**	**16.5**
Post-project PGIS				
Existing PGIS retained as-is	1.9	0.0	0.0	1.9
New, rebuilt, or resurfaced PGIS	20.5	0.0	0.0	20.5
Post-project Non-PGIS	0.7	0.0	0.0	0.7
Post-project CIA	**23.1**	**0.0**	**0.0**	**23.1**
Net change in CIA	**8.6**	**0.0**	**-2.0**	**6.6**

Soils in this area belong to Hydrologic Group B, which are considered suitable for infiltration. A soil assessment was recently obtained by the project that matches the findings of available soil data. The project design team has therefore integrated bioretention ponds as the primary BMP for this watershed. Two new bioretention ponds are proposed to treat runoff from new, rebuilt, resurfaced, and existing impervious area.

An existing infiltration pond at the Main Street interchange would not be modified by the project. Rather, the project would reduce the total impervious area draining to this facility by about 2.2 acres. Post-project, the infiltration pond will treat approximately 5.6 acres of new and rebuilt PGIS, 6.7 acres of resurfaced PGIS, and 0.5 acres of new and rebuilt non-PGIS. The infiltration pond was constructed as part of the I-5: Burnt Bridge Creek to NE 78th Street Project, which was completed in 2003. Overflows from this pond during extreme runoff events are discharged to Burnt Bridge Creek via a spillway and open channel.

4.4.4 Fairview Creek

The expansion of the Ruby Junction maintenance facility, which is included in both the LPA Option A and B, would result in a slight net decrease of impervious area (0.5 acres). Since the City of Gresham's requirements for stormwater treatment and flow control must be met for this portion of the project, runoff from all new impervious surface would be infiltrated to reduce pollutants of concern. The infiltration techniques would comply with the City of Gresham stormwater management requirements and would protect and/or improve the quality and quantity of existing groundwater flows. Therefore, the water quality of Fairview Creek would not be adversely impacted by the LPA.

4.4.5 LPA with Highway Phasing

The following describes two highway phasing options for the project and what impact these options would have on proposed impervious surface areas.

4.4.5.1 Phasing the Marine Drive Flyover and Victory Boulevard

The braided ramp between Marine Drive and southbound I-5 would be replaced by a shorter ramp merging onto southbound I-5 north of Victory Boulevard. In the full-build scenario, the braided ramp would join I-5 south of Victory Boulevard. In addition, construction of the ramp from eastbound Marine Drive to northbound I-5 would be deferred. This action would result in a net reduction in impervious area within the Columbia Slough watershed of approximately 5.5 acres in relation to the LPA, all of which would be PGIS. As a result, the need for a biofiltration swale would be eliminated and runoff draining to three constructed wetlands would be reduced.

4.4.5.2 Phasing the SR 500 Interchange

Under this option, the ramps from southbound I-5 to eastbound SR 500 and from westbound SR 500 to northbound I-5 would be deferred. Phasing this construction would result in a reduction in impervious area of approximately 5 acres, all of which is in the Burnt Bridge Creek watershed. This deferment would eliminate the need for one of the proposed bioretention ponds. The impervious area draining to the other bioretention pond would be reduced by 0.9 acres, all of which is resurfaced pavement on I-5, and the CIA draining to the existing infiltration pond would be reduced by 1.3 rather than 2.2 acres, which is what is proposed under the LPA Full Build.

5. Temporary Effects

5.1 Introduction

For purposes of this discussion, temporary effects are only those likely to occur during construction and would eventually cease once construction is completed. In some cases, such as the construction of a bridge crossing, temporary effects may last several years. Temporary effects discussed in this section are likely to be avoided or minimized with the proper implementation of measures discussed in Section 6 of this document. The temporary effects of the proposed project would result from construction activities such as soil-mixing, pile driving, demolition of the existing bridge structure, installation of cofferdams and other temporary construction activities. The temporary effects of the project would be the same for both LPA Option A and B.

Temporary effects to hydrology include placing obstructions in the water column and altering groundwater flows by pumping during depressed roadway construction. Temporary water quality impacts include turbidity due to sediment disturbance associated with in-water work, toxic contamination due to disturbance of hazardous sediments during in-water work, and toxic contamination due to equipment leaks or spills in the vicinity of project waterways. Temporary effects to stormwater include turbid overland flows due to soil disturbance and toxic contamination from leaking equipment.

5.2 Temporary Effects to Hydrology

Temporary effects to hydrology due to project construction pertain to the placement of obstructions in the water column at the Columbia River during superstructure construction and groundwater impact during depressed roadway construction across the project corridor.

Groundwater may be temporarily impacted by the construction below-grade and close to or beneath the water table. A detailed analysis of the depth to water table within the project area has not yet been conducted. However, a regional groundwater study indicates that the elevation of the water table is relatively constant over time and follows topographical features (McFarland and Morgan 1996). For instance, the water table within the SR 500 area of the corridor would be further from the surface compared to the water table on Hayden Island. Without a detailed analysis, below-grade construction is conservatively assumed to potentially require groundwater pumping. This pumping may affect the contribution of the surficial aquifer to project waterway flows as well as the groundwater quality of the surficial aquifer and stormwater quantity. Temporary effects to stormwater are discussed in Section 5.4. Since pumping would likely occur when the water table is high (e.g., during winter flows), this is not likely to affect the hydrologic regimes of project waterways significantly.

5.2.1 Columbia Slough

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

5.2.2 Columbia River and North Portland Harbor

There is potential for groundwater pumping during depressed roadway construction within the Columbia River and North Portland Harbor drainage. This would be temporary and is not anticipated to have a significant effect on the hydrologic regime since this waterway is such a high-flow system.

Another temporary hydrologic effect to the Columbia River and North Portland Harbor include placing large temporary structures in the water column. These structures may be in place for several years. The project would use cofferdams at some pier complexes to isolate the work area from active flow in the Columbia River. The purpose of the cofferdams would be to avoid contaminating the Columbia River with work or waste material, contain resuspended sediments, and minimize disturbance of fish. In the Columbia River, up to 11 cofferdams may be installed, 2 for construction of the in-water piers and 9 for the demolition of existing in-water piers. In the Columbia River, cofferdams for construction could cover an anticipated combined area of approximately 15,750 square feet, and cofferdams for demolition could cover an anticipated combined area of approximately 67,500 square feet. (Exhibit 5-1). In North Portland Harbor, cofferdams for construction of the in-water piers are not anticipated and the existing in-water piers would not be demolished. Exhibit 5-1 shows in-water impacts for piles and cofferdams at the Columbia River and North Portland Harbor.

Exhibit 5-1. Summary of Temporary In-water Structural Impacts

	Columbia River			North Portland Harbor		
	Number	Area (sq.ft.)	Duration (days)	Number	Area (sq.ft.)	Duration (days)
In-water Impacts[a]						
Piles required for construction	920	4,247	260-315 each	400	<2,940	10-42 each
Piles required for demolition	304	995	30 each	None	0	0
Cofferdams required for construction	2	15,750	330-469 each	None	0	0
Cofferdams required for demolition	9	67,500	40 each	None	0	0
Total	**1,235**	**88,492**	**30-469**	**400**	**<2,940**	**10-42 each**

Notes: sq.ft = square feet

a Values represent total structures and areas over the entire construction period. Due to the temporary nature of these impacts fewer structures would be in place at any one time.

In addition to cofferdams, a total of approximately 1,500 temporary steel piles would be installed and removed during the multi-year construction of the mainstem Columbia River and North Portland Harbor bridge structures. Due to the heavy equipment and stresses placed on the support structures, many of these temporary piles would need to be load-bearing. The need for piles would be staged over the scheduled three-year construction period so that only 100 to 400 piles would likely be in the water at any given time. At least 300 temporary piles would also be installed to assist in the demolition of the existing bridge structure across the Columbia River.

The hydrologic effect of placing these temporary structures in the Columbia River and North Portland Harbor water column is expected to be minor due to the width of the Columbia River. In addition to the large size of the watershed, there are twelve major dams located in the Columbia Basin that regulate the flow in the project area that would minimize the probability of temporary hydrologic effects. Consequently, the Columbia River, near the project area, is a highly managed stream that no longer resembles its original free-flowing state, though in the immediate vicinity of the project area the river is free-flowing. The Columbia River is also tidally influenced by the Pacific Ocean, which affects flow and stage up to the Bonneville Dam, which includes the project area. The project would require a floodplain permit from local jurisdictions and further hydraulic analysis would be performed to ensure that there are no adverse effects of the project to the Columbia River's hydrologic regime.

5.2.3 Burnt Bridge Creek

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

5.2.4 Fairview Creek

No temporary effects to the hydrologic regime of Fairview Creek are anticipated for the expansion of the facility since the approach to stormwater treatment on-site would entail infiltration for the entire expansion area.

5.3 Temporary Effects to Water Quality

Temporary effects to the water quality of project area waterways include turbidity due to ground disturbance around waterways associated with construction or staging, toxic contamination due to equipment leaks or spills in the vicinity of project waterways, sediment and contaminant migration into ground or surface water from equipment pressure or steam cleaning operations following construction periods, contamination of groundwater due to direct infiltration of toxic contaminants during groundwater pumping, infiltration of contaminated surface water, turbidity due to riverbed disturbance during in-water work, contamination due to disturbance of hazardous riverbed sediments during in-water work, and construction material or other objects falling into the Columbia River and North Portland Harbor during the construction of the new bridges and demolition of the old bridges. Following construction, the use of fertilizers, pesticides, or herbicides during restoration and revegetation activities may affect the water quality of project waterways as well. Temporary effects that are a result of in-water work are applicable only to the Columbia River and North Portland Harbor for this project since in-water work would not be performed at other waterways in the project area.

Throughout the project area, bridge, highway, transit and other related construction and improvements would create ground disturbance activities. These activities may expose soil to erosion from wind, rain, and runoff. Waterbodies receiving sediment-laden runoff by way of stormwater inlets, ditches, or other forms of conveyance may then experience increased turbidity and may be subjected to excessive sediment deposits. This may affect any of the receiving waters occurring in the project area: Columbia Slough, Columbia River, North Portland Harbor, Burnt Bridge Creek, and Fairview Creek.

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

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

Construction equipment operating on land may release contaminants (such as petroleum-based fuel or other fluids) or potentially toxic construction materials may be released, which may enter waterbodies by way of stormwater inlets, ditches, or other forms of conveyance. Also, pressure or steam cleaning of construction equipment prior to or following construction periods could release sediment and contaminants into ground or surface water. These activities could affect any of the water bodies occurring in the project area: Columbia River, North Portland Harbor, Columbia Slough, Burnt Bridge Creek, and Fairview Creek. Although there are numerous sources of chemical contaminants, there is a low risk that chemicals would actually enter the receiving waters. The project would employ numerous containment methods that would greatly minimize the potential for contamination and would ensure that accidental releases are confined to a limited area and cleaned up quickly. In addition to a TESCP, a SPCCP would be developed and implemented for the project to minimize the probability of waterway contamination.

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

The potential sites for staging and bridge assembly/casting areas have been specified and are listed in Section 1.3.3. These sites include Alcoa/Evergreen West, Port of Vancouver, Red Lion, Thunderbird, and Sundial. Each of these sites are adjacent to the Columbia River. The existing conditions on the assembly/casting yard range from a developed and paved port terminal to a currently undeveloped site. The staging and casting/assembly site activities may increase stormwater runoff over existing conditions and may increase pollutant loading. Each staging and casting site would meet all applicable stormwater requirements during and following utilization of the sites. A thorough, site-specific environmental impact analysis would be conducted at each of the sites to ensure that water quality impacts are minimized through the site selection process before the site is utilized during construction. All necessary permits would be secured prior to site development and operations.

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

5.3.1 Columbia Slough

Temporary effects to the water quality of the Columbia Slough includes turbidity due to ground disturbance associated with construction or staging, toxic contamination due to equipment leaks, spills, or cleaning activities in the vicinity of the waterway, toxic contamination of groundwater due to groundwater pumping during depressed roadway construction and infiltration of contaminated surface water, and contamination associated with chemicals utilized during revegetation activities. All temporary effects are described above. These effects would be minimized through the implementation of a TESCP and a SPCCP for the project area.

5.3.2 Columbia River and North Portland Harbor

Temporary effects to the water quality of the Columbia River and North Portland Harbor include turbidity due to ground disturbance associated with construction or staging, toxic contamination due to equipment leaks, spills, or cleaning activities in the vicinity of the river, contamination associated with chemicals utilized during revegetation activities, construction material and other objects falling into the Columbia River and North Portland Harbor during the construction of the new bridge and demolition of the old bridge, toxic contamination of groundwater due to groundwater pumping during depressed roadway construction and infiltration of contaminated surface water, turbidity due to riverbed disturbance during in-water work. Temporary effects of upland construction activities are described above.

There are numerous potential sources chemical contamination associated with in-water work in the Columbia River and North Portland Harbor. Some of these potential sources are listed below:

- Equipment located in or over water (such as barges or equipment operating on barges temporary work platforms, the existing structure, or the new structure) are potential sources of contamination, including petroleum fuel and other fluids.
- Concrete would be placed in numerous locations both in and over water for the construction of the pier footings and columns for the new bridge.
- Construction of the superstructure would involve the use of numerous other potential contaminants such as various petroleum products, adhesives, metal solder, concrete and metal dust, and asphalt.
- Bridge demolition would occur both in and over water and may release contaminants such as concrete debris, concrete dust created by saw cutting, and lead paint.

Dropped construction materials or demolition debris may alter water quality by stirring up sediments. Portions of the existing I-5 bridge contain lead-based paints. Significant modification to the existing bridge without proper implementation of BMPs may contaminate surface waters. Accidental chemical spills from construction machinery may be directly toxic to aquatic life.

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

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

- installation and removal of temporary piles;
- installation and removal of cofferdams;
- drilling shafts;

- removal of old piers and riprap in the channel where new piers would be placed;
- operating and anchoring the barge in shallow water; and
- demolishing the various elements of the existing bridge.

Sediment plumes, as a result of these activities, are expected to be localized and brief because of the implementation of containment measures. Containment measures are outlined in more detail in Section 6.3. In addition, the riverbed within the action area consists primarily of sand, which is anticipated to settle quickly once disturbed. A turbidity monitoring plan would be implemented during in-water work to ensure compliance with water quality permits.

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

There are no known records of contaminated sediments in the Columbia River mainstem portion of the project area. Therefore there is very little risk that in-water work in the Columbia River would resuspend contaminated sediments. In the North Portland Harbor, contaminated sediments have been identified, but they are thought to be outside of the project footprint. If there is potential that in-water work could disturb these sediments, they would be analyzed in accordance with regulatory criteria and removed and disposed of properly. Removed sediments may be disposed of in a permitted upland disposal site if required.

5.3.3 Burnt Bridge Creek

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

5.3.4 Fairview Creek

No temporary effects to the water quality of Fairview Creek are anticipated since runoff is almost completely infiltrated and runoff from the entire facility would be infiltrated as a result of the project. If runoff was conveyed off-site, though this is not anticipated, temporary effects may include turbidity due to ground disturbance around waterways associated with construction or staging, toxic contamination due to equipment leaks, spills, or cleaning activities in the vicinity of project waterways as described above, and contamination associated with chemicals utilized during revegetation activities. These effects would be minimized through the implementation of a TESCP and a SPCCP for the project area regardless of whether construction runoff is treated on-site through infiltration or conveyed off-site for any reason.

5.4 Temporary Effects to Stormwater

Temporary effects to stormwater across the project corridor are directly related to effects discussed in regards to hydrology and water quality, and in many cases the effects overlap. Temporary effects to stormwater include increased turbid runoff across the project corridor related to ground disturbance activities, toxic contamination of stormwater due to equipment or construction components, the potential for increased stormwater volumes due to groundwater pumping during depressed roadway construction, and at Columbia River and North Portland Harbor, an increased exposure of stormwater to contaminants due to surface areas of staging areas, barges, temporary work-bridges, and other structures related to over-water construction.

Ground disturbance activities would occur along the project corridor and in the vicinity of project receiving waters. Turbid runoff is anticipated to occur during rain events around ground disturbing activities such as clearing, grubbing, excavation, grading, stockpiling fill materials, ground improvement activities, and more. A TESCP would be designed and implemented for the project that would prevent turbid runoff from entering receiving waters. This is intended to reduce the probability of turbid runoff entering receiving waters. The site would be monitored by an environmental compliance monitor during construction to ensure turbid runoff is contained onsite. In the event of an accidental turbid discharge into surface waters, the TESCP would provide a framework for reporting and corrective action per project permits.

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

During depressed roadway construction groundwater may be pumped to lower water elevations below construction activities. At this time it is unclear where the groundwater would be discharged to or what treatment would receive before being discharged or returned to groundwater flows. If the groundwater that is pumped is discharged overland, stormwater volumes would increase. In this case, stormwater treatment provided by the TESCP would need to be sized with these volumes accounted for.

5.4.1 Columbia Slough

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

5.4.2 Columbia River and North Portland Harbor

In addition to the temporary effects discussed above that pertain to the whole project, the Columbia River and North Portland Harbor would experience an increase in stormwater volumes due to the impervious surfaces of staging areas, barges, temporary work-bridges, and other structures related to over-water construction. Stormwater from these structures would be conveyed and treated before being discharged to the river. The TESCP and SPCCP would address these temporary over-water construction components and prescribe methods for stormwater conveyance, treatment, monitoring, reporting, and emergency response.

5.4.3 Burnt Bridge Creek

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

5.4.4 Fairview Creek

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

6. Proposed Mitigation

6.1 Introduction

Mitigation measures to avoid or reduce the impact to water resources have been considered during the development of the LPA. There are many mitigation measures contained in state and local regulations that are designed to avoid and minimize the long-term impacts associated with construction. Regulations are in place to control the runoff generated from land development projects. Both ODOT and WSDOT have guidance measures for providing stormwater management for highways, and Portland, Vancouver, and Gresham have stormwater management requirements. A summary of the CRC project's approach to stormwater management is included in Section 1.3. Further detail is included in Appendix A. Therefore, most of the mitigation measures identified in the following sections are measures required by law and the project would not be constructed until all pertinent jurisdictions and regulations are satisfied with the measures enumerated in required plans. In addition to measures required by law, the project would implement mitigation measures that would exceed those required. For example, the project would add stormwater treatment along existing and resurfaced impervious areas within the project corridor, which is not required by current stormwater regulations.

6.2 Proposed Mitigation for Long-term Adverse Effects

6.2.1 Hydrology Mitigation Measures

The LPA would involve new bridge piers within the Columbia River. The potential long-term impact of a rise in the flood elevation would be addressed in a later design phase by conducting a flood-rise analysis. Such an analysis is a regulatory requirement. If flood-rise exceeds that allowed, the rise would be mitigated through floodplain excavation (cut/fill balance) activities.

The LPA would increase impervious surface area, which would reduce natural infiltration and increase stormwater runoff volumes. Although there are no regulations that address this potential impact, the effects of this increase would be minimized through the infiltration of stormwater runoff so that groundwater recharge continues to occur and so that stormwater flows are controlled.

6.2.2 Water Quality Mitigation Measures

Additional impervious surface area would induce additional project-generated runoff. Pollutants carried in the runoff could adversely affect receiving waters. One requirement of stormwater regulations is that total dissolved sediments must be reduced by treating stormwater prior to its discharge to receiving waters. In addition, stormwater must be treated to the maximum extent practicable and must comply with applicable water quality standards. The CRC project team has prepared a conceptual design to demonstrate the feasibility of proposed mitigation measures and water quality effects associated with the build alternatives. The conceptual design was prepared to meet the requirements of the ODOT and WSDOT for those portions of the project along I-5 and with cities of Portland and Vancouver regulations for those portions of the project along city-managed roads. In addition, the conceptual design demonstrates treatment and infiltration of the CIA to the maximum extent possible, in response to the requirements of NMFS and DEQ. Water quality BMPs for the design were chosen based on their effectiveness in reducing suspended solids, particulates, and dissolved metals.

The conceptual design prepared for FEIS analysis entails gravity pipe drainage systems that would collect and convey runoff from the new bridges, transit guideway, and road improvements. Stormwater treatment facilities would reduce TSS, particulates, and dissolved metals to the maximum extent practicable before runoff reaches surface waters (Appendix A).

Re-vegetation of construction easements and other areas would occur after the project is completed. All disturbed riparian vegetation would be replanted with species native to geographic region. A 5-year monitoring plan of re-vegetated areas would be implemented to ensure 100 percent survival of vegetation by stem count at the end of one year and 80 percent survival by stem count at the end of the 5-year monitoring period. For additional detail, consult ODOT Standard Specifications 01040.00 to 01040.90 and/or WSDOT Standard Specification 8-02 "Roadside Restoration."

Specific stormwater management concepts are described in the following subsections.

6.2.2.1 Potential Stormwater Mitigation in Columbia Slough Watershed

Overall, the project would increase the total PGIS in this watershed by approximately 14 acres. This increase may be attributed to new streets connecting areas on either side of the Marine Drive interchange and the addition of runoff from the North Portland Harbor Bridge. The following paragraphs describe individual proposed water quality facilities and the areas they serve.

A biofiltration swale would be located south of Victory Boulevard and west of I-5 and would be sized to handle runoff from the south end of the ramp from Marine Drive to southbound I-5. Outflows would be discharged to Schmeer Slough via an existing or new stormwater pipe located on Victory Boulevard.

A constructed treatment wetland would be located within the existing loop ramp from Martin Luther King Jr. Boulevard to Union Court. The ramp would be removed as part of the project. This facility would serve a portion of the realigned Martin Luther King Jr. Boulevard east of I-5 and south of the end of the ramp from westbound Martin Luther King Jr. to northbound I-5. Outflows would be released via an existing City of Portland stormwater pipe to Walker Slough.

A biofiltration swale is proposed to treat runoff from 1.2 acres of the ramp from northbound I-5 to westbound Marine Drive. Outflows would be released to Walker Slough via an outfall.

A constructed treatment wetland is proposed to treat runoff from about 3.1 acres comprising the majority of the ramp from Martin Luther King Jr. Boulevard to northbound I-5. Outflows would be discharged to the upstream end of Walker Slough.

The largest water quality facility proposed in the Columbia Slough watershed is a constructed treatment wetland that takes advantage of the relatively open area in the southwest quadrant of the Marine Drive interchange. It would be sized to treat runoff from approximately 18.4 acres of impervious surface. This area comprises I-5, including approximately 2.1 acres of the existing North Portland Harbor bridge and ramps on the west side of the highway. Outflows from this facility would be released to the drainage channel located immediately south of the Expo Center. The channel and associated pump station may need to be enlarged to handle the additional flows. Alternatively, the wetland could be enlarged to provide detention storage and reduce peak outflows provided that the long-term survival of the wetland plants would not be affected.

The project would construct new connections between Martin Luther King Jr. Boulevard and Vancouver Way. Runoff from about 1.6 acres of new and resurfaced pavement would be treated at a biofiltration swale adjacent to the connection between Martin Luther King Jr. and Vancouver Way. Outflows would drain to the existing City of Portland stormwater conveyance system under Vancouver Way. Additional water quality improvements are expected as runoff in this system flows through over 7,000 feet of open channel before being pumped to Columbia Slough via the Pen 2–NE 13th Pump Station.

Runoff from 2.0 acres of impervious surface, comprising Martin Luther King Jr. and the new connection to Union Court and associated sidewalks, would be discharged to a constructed wetland, located between the two roadways. Outflows from this wetland would be released to an existing City of Vancouver conveyance system on Union Court and would be ultimately be pumped to Columbia Slough via the Schmeer Road Pump Station. Alternatively, the project may elect to shed a portion of the runoff across the each shoulder, where it would infiltrate or evaporate.

Runoff from about 0.5 acres of the new merge lane south of Victory Boulevard for the ramp from Marine Drive to southbound I-5 would be conveyed to a water quality swale constructed as part of the I-5 Delta Park project. This swale has adequate capacity to handle the additional runoff.

Runoff from approximately 16.9 acres of proposed new, rebuilt, and existing local streets and contiguous sidewalks within the CIA would be treated using a mix of semi-continuous biofiltration swales and proprietary systems, such as catch basins with built-in cartridge filters.

Runoff from about 1.1 acres of the bike-pedestrian pathway that is physically separated from the street network would likely be shed to adjacent landscaped areas where it would infiltrate or evaporate.

6.2.2.2 Potential Stormwater Mitigation in Columbia River South Watershed (Oregon)

The project would rebuild the Hayden Island interchange, retrofit the existing North Portland Harbor bridge with a stormwater collection and conveyance system, and demolish the existing the existing Columbia River bridges. The last two actions would result in eliminating runoff from approximately 8 acres of bridge deck that is presently discharged directly to the water surface below. The project would increase the CIA within this part of the Columbia River watershed by 0.2 acres and create approximately 52.8 acres of new, rebuilt, and resurfaced PGIS. Runoff from these areas, 7.6 acres of non-PGIS, and 2.2 acres of the existing North Portland Harbor Bridge would be treated prior to being released to North Portland Harbor or the Columbia River. Currently, there are no water quality facilities for runoff from the project footprint in this watershed. Below, is a summary of the proposed stormwater facilities for this watershed.

Grades are such that it would be difficult to convey runoff from Marine Drive west of the light rail transit track to the constructed treatment wetland in the Columbia Slough drainage. Instead, runoff from this area (approximately 2.6 of new impervious surface) would be conveyed to a biofiltration swale located immediately north of Marine Drive. Flows from the swale would be discharged to an existing outfall on North Portland Harbor via an existing City of Portland stormwater system.

A constructed treatment wetland is proposed at the south end of the proposed light rail arterial bridge across North Portland Harbor. It would be sized to handle runoff from 2.7 acres of impervious surface on the bridge, which includes 1.2 acres of light rail guideway, sidewalk, and bike path, and about 1.5 acres of PGIS acres immediately west of the south end of the bridge. Outflows from the wetland would be conveyed to North Portland Harbor via an existing City of Portland stormwater pipe under Marine Drive.

Runoff from 17.5 acres of new I-5 mainline between the Tomahawk Island Drive extension and the high point across the Columbia River and a portion of Hayden Island Drive east of I-5 would be conveyed to a constructed treatment wetland located along the east side of the interchange. It will also treat 0.1 acres of non-PGIS. Outflows from the facility would be released to the Columbia River via one of the two existing ODOT both of which are located under the south end of the existing bridges over the Columbia River.

Another constructed wetland is proposed to be located east of I-5 and south of the Tomahawk Island Drive extension. It would be sized to handle about 13.9 acres of new ramps and I-5 pavement between North Portland Harbor and Tomahawk Island Drive extension under I-5, the Tomahawk Island Drive extension, and a portion of the realigned North Jantzen Drive under I-5. It would also handle runoff from the north half of the existing I-5 bridge over North Portland Harbor. Proposed grades are such that drainage from Tomahawk Island Drive and Jantzen Drive would need to be pumped to the wetland. Outflows from the facility would be released to the Columbia River.

Runoff from approximately 4.9 acres of impervious pavement, including 2.4 acres of transit-only structure and bike-pedestrian path, would be conveyed to a constructed wetland located west of I-5 and immediately south of Hayden Island Drive. Outflows from the facility would likely be released to the Columbia River.

Runoff from approximately 10.5 acres of proposed new, rebuilt, and existing local streets and contiguous sidewalks within the CIA would be treated using a mix of semi-continuous biofiltration swales and proprietary systems such as catch basins with built-in cartridge filters.

As previously stated, approximately 10.0 acres of future transit-oriented development has been assumed on the west side of I-5 in this watershed. Runoff would be treated according to either ODOT or City of Portland standards.

Runoff from about 0.4 acres of the bike-pedestrian pathway west of the south end of the light rail/multi-use path bridge over North Portland Harbor will likely be shed to adjacent landscaped areas where it will infiltrate and evaporate. This path is physically separated from the street network.

6.2.2.3 Potential Stormwater Mitigation in Columbia River North Watershed (Washington)

In the project-related part of the Columbia River watershed in Washington State, the CIA would be increased by 21.1 acres, most of which may be attributed to the reconfigured interchanges and increased number and length of merge lanes for I-5. The project would create 112.8 acres of new, rebuilt, and resurfaced PGIS and 13.3 new and rebuilt non-PGIS, while reducing existing untreated impervious area by about 128.9 acres. Water quality facilities are proposed for 134.7 acres of new, rebuilt, and resurfaced PGIS and 18.3 acres of non-PGIS. Runoff from about 3 acres of PGIS is currently treated. Flow control is not required for the Washington side of the watershed and none is proposed. In addition, no new outfalls are proposed.

The following paragraphs describe individual proposed water quality facilities and the areas they serve. Since this watershed represents approximately 50percent of the total project footprint, the water quality facilities proposed for the highway elements are grouped by interchange.

SR 14 Interchange

Runoff from about 17.9 acres of southbound I-5, ramps on the west side of the interchange, and the west side of the Evergreen Boulevard bridge over I-5 would be conveyed to a bioretention pond. The pond is located on the west side of the SR 14 interchange, east of the Main Street extension. Any overflow from this bioretention pond would be released to the Columbia River at an outfall through the existing stormwater conveyance system.

Another bioretention pond would be located within the loop ramps on the east side of the SR 14 interchange. It would be sized to handle runoff from approximately 18.7 acres of northbound I-5, ramps on the east side of the interchange, and the east side of the Evergreen Boulevard bridge over I-5. Again, any overflow from the bioretention pond would be released to the Columbia River at an outfall via the existing stormwater conveyance system.

Runoff from about 3.2 acres of new impervious area on SR 14 and Main Street would be directed to one or two biofiltration swales located adjacent to the intersection of Main Street and SR 14. Outflows would be released to the Columbia River at an outfall through the existing stormwater conveyance system.

Runoff from approximate 3.9 acres comprising the new, rebuilt, and resurfaced westbound lanes of SR 14 east of the SR 14 interchange would be conveyed to a biofiltration swale located on the north side of the highway. Alternatively, runoff from the resurfaced westbound lanes may be shed to the highway shoulder where it would be infiltrated, which is similar to existing conditions. Outflows from the swale would be conveyed to an outfall along the Columbia River through an existing 6-foot by 6-foot culvert. CRC project staff have not yet identified any options for treating runoff from the eastbound lanes.

Mill Plain Interchange

Two biofiltration ponds are proposed in the northeast and southeast quadrants of the reconfigured Mill Plain interchanges. They would be sized to handle runoff from approximately 25.4 acres of new ramps, new, rebuilt, and resurfaced highway, a new collector-distributor road to the north, and Mill Plain Boulevard to the east. Any overflow from the ponds would be conveyed to an outfall through the existing stormwater conveyance system under I-5.

Runoff from approximately 0.8 acres of the ramp from southbound I-5 to Mill Plain Boulevard would be directed to a biofiltration swale west of the ramp. Discharge from the swale would be discharged to an outfall through the existing stormwater trunk main under I-5.

The proposed street grade for Mill Plain Boulevard under I-5 is too low to permit runoff from about 6.2 acres to be conveyed to either of the bioretention ponds mentioned above. Instead, runoff would be conveyed to proprietary cartridge filter vault and, if necessary, an oil-water separator pre-treatment facility. Based on available data, there appears to be adequate vertical distance between the low point on Mill Plain Boulevard and the invert of the existing stormwater conveyance system under I-5 to install this type of facility. Discharge from the vault would be discharged to an outfall through the existing stormwater trunk main under I-5.

Fourth Plain Interchange

The Fourth Plain interchange would be replaced, access would be provided from Fourth Plain Boulevard to the proposed Clark Park and Ride structure, and existing pavement would be resurfaced between the Fourth Plain and SR 500 interchanges. The existing stormwater conveyance systems north of Fourth Plain would likely be retained by the project. Available data indicate that the main stormwater pipe under I-5 is shallow enough to permit flows to be redirected to water quality facilities located in the interchange.

Drainage from the top surface of the Clark Park and Ride and associated paths, which entails 3.9 acres, would be conveyed to a biofiltration swale located on the east side of the structure. An oil-water separator would pretreat runoff from the park and ride.

Runoff from 11.2 acres of I-5 and the access road to the Clark Park and Ride, which includes 5.6 acres of resurfaced highway, would be conveyed to a bioretention pond located in the southeast quadrant of the interchange.

Another bioretention pond is proposed to be located in the northwest quadrant of the Fourth Plain interchange would be sized to handle runoff from an impervious area of approximately 14.3 acres. This area includes approximately 4.0 acres of new and rebuilt pavement and sidewalks as well as about 10.3 acres of existing streets and sidewalks in the Shumway neighborhood northwest of the interchange.

Runoff from approximately 1.8 acres of new and rebuilt pavement and sidewalks on Fourth Plain Boulevard, east of I-5, as well as about 0.8 acres of existing impervious area further east of the project area would be conveyed to a proposed biofiltration swale south of Fourth Plain Boulevard and east of the collector-distributor road.

Outflow from the biofiltration swales and any overflow from the bioretention ponds would be released to the Columbia River via the existing stormwater conveyance system under I-5.

Other Water Quality Facilities

The proposed approach to constructing the light rail guideway along Vancouver city streets is to excavate a slot within the existing pavement to facilitate single-track guideway construction. For single-track guideways, it was assumed that the remaining pavement would be resurfaced within each block. For double-track guideways, it is assumed that the entire street would need to be replaced. The pavement at intersections would likely need to be completely rebuilt, whether it is a single- or double-track guideway.

Runoff from approximately 41.9 acres of proposed light rail transit guideway, new, rebuilt, and existing local streets, and contiguous sidewalks within this watershed's CIA, would be treated using a mix of semi-continuous biofiltration swales and proprietary systems such as catch basins with built-in cartridge filters.

Runoff from about 2.1 acres comprising the top floors of the Columbia Street and Mill District park and ride structures would be conveyed to the existing City of Vancouver stormwater conveyance systems via proprietary cartridge filter vaults. Pretreatment would be provided using oil-water separators.

Runoff from about 0.9 acres of the bike-pedestrian pathway that is physically separated from the street network would likely be shed to adjacent landscaped areas where it would infiltrate and evaporate.

6.2.2.4 Potential Stormwater Mitigation in Burnt Bridge Creek Watershed

The project would increase the impervious area by approximately 6.6 acres. The total project CIA would be about 23.1 acres of which approximately 20.5 acres would be new, rebuilt, and resurfaced PGIS and about 0.7 acres would be new sidewalks and bike-pedestrian paths. The remaining 1.9 acres consists of an existing portion of SR 500.

Flow control is required for stormwater runoff discharged to Burnt Bridge Creek. No new outfalls are proposed. Soils in this area belong to Hydrologic Group B and are considered suitable for infiltration. Therefore, the primary proposed water quality facilities in this watershed are bioretention ponds.

Runoff from approximately 3.4 acres of new, rebuilt, and resurfaced eastbound lanes of SR 500 and 39th Street and 1.9 acres of existing westbound lanes that would not be affected by the project would be conveyed to a bioretention pond south of SR 500. Runoff from 0.2 acres of non-PGIS would also be treated by this facility. Overflows from the pond would be conveyed to an existing outfall to Burnt Bridge Creek.

Runoff from about 2.5 acres of new and rebuilt pavement and 2.3 acres of resurfaced pavement would be conveyed to another proposed bioretention pond, which would be located immediately east of I-5 and south of 39th Street. The majority of the impervious area comprises a section of I-5 that currently drains to an existing infiltration pond at the Main Street interchange, which is described in the next paragraph. Overflows from this new bioretention pond would be conveyed to Burnt Bridge Creek through an existing outfall.

There is an existing infiltration pond at the Main Street interchange, which would not be modified by the project since this type of facility is considered to provide adequate runoff treatment. Although approximately 12.3 acres of new, rebuilt, and resurfaced project pavement and 0.5 acres of non-PGIS would be conveyed to this pond, the total impervious area served by it would be decreased by about 2.2 acres in relation to existing conditions. Overflows from the pond are currently and would continue to be released to Burnt Bridge Creek through an existing outfall.

6.2.2.5 Potential Stormwater Mitigation in Fairview Creek

The expansion of the Ruby Junction facility would result in a net decrease in impervious area (0.5 acres). The City of Gresham's requirements for stormwater treatment and flow control would be met by infiltrating stormwater runoff from impervious surfaces within the expansion area to reduce pollutants of concern and control stormwater flows to Fairview Creek.

6.3 Proposed Mitigation for Temporary Adverse Effects

6.3.1 Introduction

State and local regulations require conservation and mitigation measures so that hydrology, water quality, and stormwater impacts associated with road, bridge, or transit construction are largely avoided or minimized. Construction impacts include potential sedimentation and erosion hazards, contaminated or sediment-laden stormwater discharges, and accidental spills generally associated with land disturbance activities. State, federal, and local permits require the development and implementation of an ESCP.

6.3.2 Hydrology

Temporary effects to hydrology due to project construction pertain to the placement of obstructions in the water column at the Columbia River during superstructure construction and groundwater impact during depressed roadway construction across the project corridor.

The project would require a floodplain permit from local jurisdictions and further hydraulic analysis would be performed to ensure that effects of the project to the Columbia River's hydrologic regime are minimized. If adverse effects are realized through the analysis, project design would be modified to minimize effects to the greatest extent possible.

Impacts to groundwater hydrology would be minimized by limiting areas where groundwater would be pumped to areas where pumping cannot be avoided in order to complete construction.

6.3.3 Water Quality

Temporary effects to the water quality of project area waterways include:

- Turbidity resulting from erosion of ground disturbed by construction or staging.
- Toxic contamination due to equipment leaks or spills in the vicinity of project waterways.
- Toxic contamination of groundwater due to groundwater pumping during depressed roadway construction and infiltration of contaminated surface water.
- Turbidity due to riverbed disturbance during in-water work.
- Toxic contamination due to disturbance of hazardous riverbed sediments during in-water work.
- Foreign objects falling into the Columbia River and North Portland Harbor during the construction of the new bridge and demolition of the old bridge.
- Toxic contamination due to concrete curing or discharge of process water.

All work would be performed according to the requirements and conditions of the regulatory permits issued by federal, state and local governments (Section 7). State DOT policy and construction administration practice in Oregon and Washington is to have a DOT inspector on site during construction. The role of the inspector would be to ensure contract and permit requirements are met. ODOT and WSDOT environmental staff would provide guidance and instructions to the onsite inspector to ensure the inspector is aware of permit requirements.

6.3.3.1 Erosion and Sediment Control

The contractor would prepare a TESCP and a Source Control Plan would be implemented for all projects requiring clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation. Erosion and sediment control plans are generally developed as follows: plan design/preparation; implementation before ground-breaking; inspection of BMPs; repair and maintenance of BMPs as needed; and modification of plan as needed with approval of the project engineer.

The BMPs in the plans would be used to control sediments from all vegetation removal or ground disturbing activities. The engineer may require additional temporary erosion and sediment control measures beyond the approved TESCP if it appears pollution or erosion may result from weather, nature of the materials or progress on the work. For additional detail, consult ODOT Standard Specifications Section 00280.00 to 00280.90 and/or WSDOT Standard Specification 8-01. For transit construction, consult TriMet Standard Specification 02276.

As part of the TESCP, the contractor would delineate clearing limits with orange barrier fencing wherever clearing is proposed in or adjacent to a stream/wetland or its buffer, and install perimeter protection/silt fence as needed to protect surface waters and other critical areas. Location would be specified in the field, based upon site conditions and the TESCP. For additional silt fence detail, consult ODOT Standard Specifications Section 00280.16(c) and/or WSDOT Standard Specification 8-01.3(9)A.

The contractor would identify at least one employee as the erosion and spill control lead at pre-construction discussions and the TESCP. The contractor would meet the requirements of and follow the process described in ODOT Standard Specifications Section 00280.30 and/or WSDOT Standard Specification 8-01.3(1)B. The ESC lead would be listed on the Emergency Contact List as part of ODOT Standard Specifications Section 00290.20(g) and/or WSDOT Standard Specification 1-05.13(1). The erosion and spill control lead would also be responsible for ensuring compliance with all local, state, and federal erosion and sediment control requirements.

All TESCP measures would be inspected on a weekly basis. Contractor would follow maintenance and repair as described in ODOT Standard Specifications Section 00280.60 to 00280.70 and/or WSDOT Standard Specification 8-01.3(15). Inspection of erosion control measures would immediately occur after each rainfall, and at least daily, during for precipitation events of more than 0.5 inches in a 24-hour period.

For landward construction and demolition, project staging and material storage areas would be located a minimum of 150 feet from surface waters, in currently developed areas such as parking lots or managed fields. Excavation activities (dredging not included) would be accomplished in the dry. All surface water flowing towards the excavation would be diverted through utilization of cofferdams and/or berms. Cofferdams and berms must be constructed of sandbags, clean rock, steel sheeting, or other non-erodible material.

Bank shaping would be limited to the extent as shown on the approved grading plans. Minor adjustments made in the field would occur only after engineer's review and approval. Bio-degradable erosion control blankets would be installed on areas of ground-disturbing activities on steep slopes (1V:3H or steeper) that are susceptible to erosion and within 150 feet of surface waters. Areas of ground-disturbing activities that do not fit the above criteria would implement erosion control measures as identified in the approved TESCP. For additional erosion control blanket detail, consult ODOT Standard Specifications 00280.14(e) and/or WSDOT Standard Specification 9-14.5(2) and 8-01.3(3).

Erodible materials (material capable of being displaced and transported by rain, wind, or surface water runoff) that are temporarily stored or stockpiled for use in project activities would be covered to prevent sediments from being washed from the storage area to surface waters. Temporary storage or stockpiles must follow measures as described in ODOT Standard Specifications Section 00280.42 and/or WSDOT Standard Specification 8-01.3(1).

All exposed soils would be stabilized as directed in measures prescribed in the TESCP. For additional detail consult ODOT Standard Specifications 01030.00 to 01030.90 and 00280.42 and/or WSDOT Standard Specification 8-01.3(1).

Where site conditions support vegetative growth, native vegetation indigenous to the location would be planted in areas disturbed by construction activities. Re-vegetation of construction easements and other areas would occur after the project is completed. All disturbed riparian vegetation would be replanted. Trees would be planted when consistent with highway safety standards. Riparian vegetation would be replanted with species native to geographic region. Planted vegetation would be maintained and monitored to meet regulatory permit requirements. For additional detail, consult ODOT Standard Specifications 01040.00 to 01040.90 and/or WSDOT Standard Specification 8-01.3(2)F.

6.3.3.2 Spill Pollution/Prevention Control

The contractor would prepare an SPCCP prior to beginning construction. The SPCCP would identify the appropriate spill containment materials; as well as the method of implementation. All elements of the SPCCP would be available at the project site at all times. For additional detail, consult ODOT Standard Specifications Section 00290.00 to 00290.90 and/or WSDOT Standard Specification 1-07.15(1). For transit construction in Oregon, consult TriMet Standard Specification 01450{1.04}).

The contractor would designate at least one employee as the ESC lead. The ESC lead would be responsible for the implementation of the SPCCP. The contractor would meet the requirements of; and follow the process described in ODOT Standard Specifications Section 00290.00 through 00290.30 and/or WSDOT Standard Specification 8-01.3(1)B. The ESC lead would be listed on the Emergency Contact List as part of ODOT Standard Specifications Section 00290.20(g) and/or WSDOT Standard Specification 1-07.15(1).

All equipment to be used for construction activities would be cleaned and inspected prior to arriving at the project site, to ensure no potentially hazardous materials are exposed, no leaks are present, and the equipment is functioning properly. Identify equipment that would be used below the ordinary high water (OHW) line. Outline daily inspection and cleanup procedures that would insure that identified equipment is free of all external petroleum based products. Should a leak be detected on heavy equipment used for the project, the equipment would be immediately removed from the area and not used again until adequately repaired. Where off-site repair is not practicable, the implemented SPCCP would prevent and/or contain accidental spills in the work/repair area to insure no contaminants escape containment to surface waters and cause a violation of applicable water quality standards.

Operation of construction equipment used for project activities shall occur from on top of floating barge or work decks, existing roads or the streambank (above OHW). Any equipment operating in the water shall use only vegetable based oils in hydraulic lines.

All stationary power equipment or storage facilities would have suitable containment measures outlined in the SPCCP to prevent and/or contain accidental spills to insure no contaminants escape containment to surface waters and cause a violation of applicable water quality standards. These facilities would also have spill containment materials kept on hand.

Process water generated on site from construction, demolition or washing activities would be contained and treated to meet applicable water quality standards before entering or re-entering surface waters.

No paving, chip sealing, or stripe painting would occur during periods of rain or wet weather.

For projects involving concrete, the implemented SPCCP would establish a concrete truck chute cleanout area to properly contain wet concrete as part of ODOT Standard Specifications Section 00290.30(a)1 and/or WSDOT Standard Specification 1-07.15(1). The SPCCP may include requirements for pH monitoring during concrete work with specific obligations of the contractor enumerated if the pH level changes within receiving waters by more than 0.2 pH units.

6.3.3.3 Groundwater Quality

Short-term groundwater pumping may create a cone of depression that increases the risks of contamination from nearby contaminated sites either through direct infiltration of these contaminants or through infiltration of contaminated surface water. Sites with existing soil or groundwater contamination near construction areas would be further studied and tested before any groundwater pumping occurs. From that analysis, further action, to avoid causing such contamination to spread, would be determined and implemented during the design and construction phase. These actions may include the following: remediation of contaminated areas;

removal of contaminants; or design changes that avoid ground disturbance in the vicinity of contaminated areas.

6.3.3.4 In-water Work

The project would use best management practices to minimize turbidity and release of pollutants during in-water construction in the Columbia River and North Portland Harbor. The project team would prepare applications for dredging and fill activities under Section 404 of the Clean Water Act, administered by the U.S. Army Corps of Engineers (USACE), and would seek water quality certification under Section 401 of the CWA, administered by the DEQ and Ecology.

In-water work would be conducted only during in-water work periods for the Columbia River as approved by WDFW, ODFW, NMFS, and USFWS. Because bed disturbance would result in temporary increases in turbidity, limiting the duration of dredging activities may be required by project permits. A mandatory "rest" period between dredging periods may be required as well.

If in-water dredging is required outside of a cofferdam, a clamshell bucket would be used. Dredged material would be disposed of in accordance with relevant permits and approvals.

The contractor would prepare a Water Quality Sampling Plan for conducting water quality monitoring for all projects occurring in-water. The Plan would identify a sampling methodology as well as method of implementation to be reviewed and approved by the engineer. If, in the future, a standard water quality monitoring plan is adopted by ODOT and/or WSDOT, this plan, with the agreement of NMFS and USFWS, may replace the contractor plan.

Operation of construction equipment used for in-water work activities would occur from a floating barge, work bridge deck, existing roads, or the streambank (above OHW). Only the operational portion of construction equipment would enter the active stream channel (below OHW). Process water generated on site from construction, demolition, or washing activities would be contained and treated to meet applicable water quality standards before entering or re-entering surface waters.

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7. Permits and Approvals

7.1 Federal Permits

7.1.1 NPDES

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

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

Existing construction NPDES permits held by ODOT and WSDOT may also require modification to address project construction.

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

7.1.2 Section 404/10

A Section 404 and Section 10 permit would be required for in-water work within the Columbia River and North Portland Harbor. The Section 404 permit would also cover the loss of wetlands.

7.1.3 Flood Control Facilities Disturbance

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

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

7.2 State Permits

7.2.1 Water Quality Certification

Section 401 state water quality certification approval would be required in association with the Section 404/10 permit application process. Section 401 requires an applicant for a federal license or Section 404 permit who plans to conduct an activity that may result in a discharge to waters of the state or U.S. to obtain certification that the activity complies with state water quality requirements and standards. Applicants must submit a Section 404 application form to the

USACE, who then forwards the application to the certifying state agency. The state agency certifies whether the project meets state water quality standards and does not endanger waters of the state/U.S. or wetlands. These certifications are issued by DEQ in Oregon and by Ecology in Washington. DEQ and Ecology would also review and approve the project's stormwater management plan as well as the project's overall effect on water quality.

7.2.2 Safe Drinking Water Act Permits

Both Washington and Oregon implement the federal Safe Drinking Water Act (SDWA) within their jurisdictions. For the CRC project, this law would only apply if infiltration basins or underground injection control (UIC) measures were incorporated into the preferred stormwater management design.

7.2.3 Wetland/Waters Removal-Fill Permit

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

In Oregon, removal or fill in jurisdictional wetlands or other waters of the state (including some ditches) requires a Removal-Fill permit from the Department of State Lands (DSL). DSL requires a wetland delineation and compensatory mitigation plan as part of the permit application. A Joint Permit Application is submitted to the DSL and the USACE (Portland Regional Office). DEQ reviews the permit application for 401 water quality certification.

7.2.4 Waste Discharge General Permit

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

7.2.5 NPDES

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

In Oregon the DEQ issues and enforces NPDES and Water Pollution Control Facility (WPCF) permits. However, a WPCF permit is not generally required for stormwater treatment facilities and therefore not anticipated to be necessary for this project. For the CRC project, compliance with the 1200-CA and MS4 permit would be required for: (1) the construction, installation, or operation of any activity that would cause an increase in the discharge of wastes into the waters of the state or would otherwise unlawfully alter the physical, chemical, or biological properties of any waters of the state; (2) an increase in volume or strength of any wastes in excess of the discharges authorized under an existing permit; and (3) the construction or use of any new outlet for the discharge of any wastes into the waters of the state. ODOT has an NPDES General Construction 1200-CA Stormwater Permit to cover ODOT construction activities on sites covering more than 1 acre. This permit requires a TESCP.

7.3 Local Permits

7.3.1 Vancouver Municipal Code (VMC). 2005. "Stormwater Management." VMC 14.09

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

7.3.2 Vancouver Municipal Code. 2005. "Erosion Control." VMC 14.24

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

7.3.3 Vancouver Municipal Code. 2005. "Water Resources Protection." VMC 14.26

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

7.3.4 City of Portland Administrative Rule ENB-4.01, Stormwater Management Manual. September 2004

The City of Portland requires stormwater mitigation for any development that increases impervious surface area by more than 500 square feet.

7.3.5 City of Portland Code (CPC). 2004. "Stormwater Management." CPC 33.653. Portland, OR

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

7.3.6 City of Portland Code (CPC). 2010. "Drainage and Water Quality." CPC 17.38. Portland, OR

This portion of the City of Portland code provides guidelines for the effective management of stormwater, groundwater, and drainage, and to maintain and improve water quality in the watercourses and water bodies within the City of Portland.

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APPENDIX A

Stormwater Management Memorandum

Columbia River CROSSING

Memorandum

January 21, 2011

TO: Heather Wills

FROM: Roger Kitchin

SUBJECT: STORMWATER MANAGEMENT

COPY: Andrew Beagle; Jeff Heilman

This memorandum presents proposed stormwater management strategies for the Columbia River Crossing (CRC) project. Figure 1 shows the proposed footprint and location of Ruby Junction, the proposed site for the light rail vehicle (LRV) maintenance facility. The memo does not provide an evaluation of the potential impacts from the strategies; these are addressed in the Biological Assessment and Final Environmental Impact Statement (FEIS) Water Quality Technical Report.

Note that all figures are located at the end of this memorandum.

Introduction

Background

There are a number of federal, state and local agencies with direct jurisdiction over or significant input to the stormwater aspects of the CRC project. These include:

- National Oceanic & Atmospheric Administration (NOAA) Fisheries
- U.S. Environmental Protection Agency (EPA)
- Oregon Department of Environmental Quality (DEQ)
- Washington State Department of Ecology (Ecology)
- City of Portland
- City of Vancouver
- City of Gresham (Ruby Junction only)

The state and federal agencies listed above are signatories of the Interstate Collaborative Environmental Process (InterCEP) agreement with the exception of Gresham. The agreement defines a process for coordinating their involvement, and streamlining regulatory reviews and permits agencies and through this process, the team engages in an ongoing dialogue with the necessary state and federal agencies prior to making major decisions.

One result of this collaborative approach is the adoption of the Oregon Department of Transportation's (ODOT) recent technical memorandum on stormwater water quality [1] on a project-wide basis to provide a standard approach to determining types of water quality facilities that would provide adequate protection to listed species. The memorandum is the result of a collaborative venture by ODOT, the Federal Highway Administration (FHWA), and natural resource agencies (NOAA Fisheries, DEQ, U.S. Fish and Wildlife Service, EPA, and the Oregon Department of Fish and Wildlife). The decision to use this

[1] Stormwater Management Program, Geo-Environmental Bulletin GE09-02(B). Prepared by the Oregon Department of Transportation. January 27, 2009.

approach on the CRC project has been endorsed by the Washington State Department of Transportation (WSDOT) and Ecology.

The water management strategies presented in this report are based on the Option A full build presented in the FEIS. This option includes:

- Rebuilding and resurfaced approximately 6 miles of Interstate 5 (I-5) between Victory Boulevard interchange in Portland and the Main Street interchange in Vancouver.
- Rebuilding the Victory Boulevard, Marine Drive, Hayden Island, SR 14, Mill Plain, Fourth Plain and SR 500 interchanges.
- Replacing the existing highway bridges across the Columbia River by two 10-lane bridges. The structure will also accommodate light rail and bike-pedestrian facilities.
- Extending the existing MAX Yellow Line light rail transit (LRT) from the Portland Metropolitan Exposition Center (Expo) to Clark College in Vancouver.
- Improvements to bike-pedestrian facilities and local streets. Street improvements include an arterial connection across North Portland Harbor, between Hayden Island and the Marine Drive interchange area. The arterial lanes would be located on the LRT bridge.
- Expanding the maintenance facilities at the existing TriMet facility in the City of Gresham, the design of which is being performed by TriMet.

A discussion is also included for the anticipated differences should Option B or a phased approach be adopted. Option B does not have arterial lanes on the LRT bridge across North Portland Harbor, but instead provides direct access between Marine Drive and Hayden Island with collector-distributor lanes on two new bridges that would be built adjacent to I-5. A phased approach, which could be adopted for either option, would defer construction of part of the Victory Boulevard and Marine Drive interchanges, and most of the SR 500 interchange.

Should these assumptions change, the project team will revisit and revise strategies as necessary to meet project requirements.

Stormwater Management Goals

The CRC project is a bi-state initiative and it is important to note that the implementation of water management objectives differ significantly between Oregon and Washington. The primary differences involve how areas that require pollutant reduction are calculated. These differences, which are described in the following paragraphs, can have an impact of the sizes of water quality facility required, especially for projects like the CRC that involve significant areas of impervious pavement.

Oregon requires runoff from the entire contributing impervious area (CIA) be treated to reduce pollutants regardless of the degree to which the surfaces would contribute pollutants to runoff. Using this approach, runoff from highways would be required to be treated in the same manner as runoff from bike-pedestrian paths. In contrast, Washington focuses on requiring treatment for runoff from the pollutant-generating impervious surfaces (PGIS).

ODOT defines the CIA as consisting of all impervious surfaces within the strict project limits, plus impervious surface owned or operated by ODOT outside the project limits that drain to the project via direct flow or discrete conveyance.[2] NOAA Fisheries has expanded this definition to also include impervious areas that are not owned by ODOT but drain onto the project footprint.

WSDOT and Ecology define PGIS as surfaces that are considered a significant source of pollutants in stormwater runoff including:

- Highways, ramps and non-vegetated shoulders
- LRT guideway subject to vehicular traffic
- streets, alleys and driveways
- bus layover facilities, surface parking lots and the top floor of parking structures

[2] http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/storm_management_program_cia.shtml

The following types of impervious area are considered non-PGIS:

- LRT guideway not subject to vehicular traffic except the occasional use by emergency or maintenance vehicles (referred to as an exclusive guideway)
- LRT stations
- bicycle and pedestrian paths

Exclusive LRT guideway is considered non-PGIS because light rail vehicles are electric, and that other potential sources of pollution such as bearings and gears are sealed to prevent the loss of lubricants. Light rail vehicle braking is almost exclusively accomplished via (power) regenerative braking, which avoids any friction or wear on the vehicle brake pads and, thus, very few pollutants are generated. In Washington, NOAA Fisheries and U.S. Fish and Wildlife concurred with Sound Transit's conclusion that this type of guideway was non-polluting and, as such, the runoff did not require treatment before being discharged to the receiving waterbody[3]. In Oregon, runoff from this area would require treatment before being released.

In addition, Washington differentiates between stormwater runoff treatment requirements for new and rebuilt[4] versus resurfaced[5] pavement while state and local jurisdictions in Oregon do not. In Washington, water quality treatment is only required for runoff from new and rebuilt PGIS while Oregon does not differentiate; requiring treatment for all impervious surfaces. However, this approach is not consistently applied within Oregon. For example, the Standard Local Operating Procedures for Endangered Species (SLOPES IV)[6], a programmatic biological opinion and incidental take statement by NOAA Fisheries for projects undertaken in Oregon by the U.S. Army Corps of Engineers states that "actions that merely resurface pavement by placing a new surface, or overlay, directly on top of existing pavement with no intervening base course and no change in the subgrade shoulder points, are not subject to these [pollution reduction and flow control] requirements". Regardless, NOAA Fisheries has determined that resurfaced pavement within a project cannot be handled differently from rebuilt pavement unless the resurfacing is conducted within a "hydrologically isolated basin"[7] even though the potential impediments to retrofitting water quality facilities for resurfaced pavement are the same whether the resurfacing is a stand-alone undertaking or within a larger project. These impediments include very limited or non-existent ability to change existing conveyance systems and possible lack of physical space to install a water quality facility.

Since the early stages of development, the overall permanent stormwater management objectives for the CRC project have been:

1) Provide flow control for new and replaced impervious areas in accordance with state and local requirements. Note that flow control is only required for stormwater discharges to Burnt Bridge Creek. Discharges to the Columbia Slough, North Portland Harbor, and Columbia River are exempt.
2) Select and provide water quality facilities for new and rebuilt existing PGIS in accordance with the most restrictive requirements of the agencies that have authority over the drainage area being considered.
3) Where practical and cost-effective, provide water quality facilities for resurfaced and existing PGIS.

Flow control is only required for stormwater discharges to Burnt Bridge and Fairview Creeks: discharges to the Columbia Slough, North Portland Harbor and Columbia River are exempt from flow control

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[3] Central Link Light Rail transit Project, Sound Transit Biological Assessment. Prepared by Sound Transit. November 1999.

[4] Rebuilt impervious surfaces are existing impervious areas that are excavated to a depth at or below the top of the subgrade.

[5] Resurfaced impervious surfaces are those existing impervious surfaces where the asphalt or concrete is not removed down to or below the top of the subgrade.

[6] Revisions to Standard Local Operating Procedures for Endangered Species to Administer Maintenance or Improvement of Road, Culvert, Bridge and Utility Line Actions Authorized or Carried Out by the U.S. Army Corps of Engineers in the Oregon (SLOPES IV Roads, Culverts, Bridges and Utility Lines). National Marine Fisheries Service, Northwest Region. August 13, 2008

[7] Email from Devin Simmons dated July 26, 2010.

requirements. Runoff to Burnt Bridge Creek must be reduced to pre-development (forested) conditions for peak discharges between 50 percent of the 2-year event and the 50-year event. For Fairview Creek, which is associated with the Ruby Junction facility and runoff to which would be under the jurisdiction of the City of Gresham, flow control is currently required only to the extent necessary to ensure that existing flows in the creek would not be increased. Gresham, however, is in the process of revising the Public Works Standards[8] to require runoff for storm events with a recurrence interval less than or equal to 25-years be reduced to what would have occurred prior to any development having taken place (for example, forested conditions).

For objectives 2) and 3), the project has agreed to adopt the requirements of NOAA Fisheries for water quality facilities even though, in our opinion, the additional measures are not expected to provide any measurable increase in the level of protection of listed species. These requirements are that the project treats runoff from the entire CIA in both Oregon and Washington regardless of whether it is considered pollutant-generating or whether it is new, rebuilt, resurfaced, or existing.

The sizing and detailed design of individual water quality facilities will be in accordance with the specific requirements of the state or local agency that has jurisdiction over that facility. For example, water quality facilities within the WSDOT right-of-way will be sized and designed in accordance with the WSDOT Highway Runoff Manual. In Oregon, single rainfall events are used to size water quality facilities. ODOT uses rainfall events that would result in about 85 percent of the cumulative runoff being treated while the City of Gresham's and the City of Portland's design rainfall would result in about 80 and 90 percent of the average annual runoff being treated, respectively. In Washington, the types of water quality facility being proposed would be sized to treat at least 91 percent of the runoff volume regardless of where the facility is located. Unlike Oregon, design flows and volumes for water quality facilities in Washington are estimated using continuous rainfall-runoff simulation models. It should be noted that many of the water quality facilities being proposed rely on infiltration as the primary mechanism for treatment and disposal. Depending on the infiltration rates available at a particular site, these facilities could result in an even higher percentage of runoff treatment.

Existing Conditions

Watersheds

Following is a brief description of watersheds within which the project is located and the waterbodies to which runoff would be discharged. From south to north, the waterbodies are Columbia Slough, Columbia River (including North Portland Harbor) and Burnt Bridge Creek. Fairview Creek, which receives runoff from the Ruby Junction facility, is located east of the project corridor. Figures 2 through 4 show the existing drainage systems, watershed boundaries and outfalls within the project corridor. Figure 5 shows the existing Ruby Junction LRT maintenance facility and Fairview Creek.

Table 1 shows the average monthly discharges for each watercourse based on data available from United States Geological Survey (USGS) gauging stations. See Figure 6 for locations (except Fairview Creek). The information provides an indication of the relative size of each waterbody. Note that discharges in Columbia Slough are influenced by backwater effects from the Willamette River to the extent that the recorded mean monthly discharge was actually negative three times in May (1997, 2006 and 2008) and once in June (1960).

Columbia Slough Watershed

Columbia Slough, located south of the CRC project, discharges to the Willamette River. Its watershed[9] is a 51-square-mile area that extends from Kelly Point to the west to Fairview Lake and Fairview Creek to the east, and comprises the former Columbia River floodplain and before the construction of a levee system and pump stations, would have been subjected to frequent inundation. In the vicinity of I-5, the original ground surface is below the ordinary high water (OHW) level for the Columbia River. There are two drainage districts within the project footprint: Peninsula Drainage Districts No.1 and No.2. I-5 is the boundary between the two districts with No.1 located to the west and No.2 to the east. Day-to-day operations of both districts are managed by the Multnomah County Drainage District (MCDD).

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[8] Public Works Standards. Prepared by the Department of Environmental Services, City of Gresham, Oregon. January 1, 2006.

[9] *Draft 2005 Portland Watershed Management Plan.* Bureau of Environmental Services, City of Portland. October 2005.

Land west of I-5 generally has an Industrial zoning designation while land to the east is generally designated as Open Space. The latter area includes sports facilities such as baseball diamonds.

TABLE 1

Mean Monthly Discharge (in cubic feet per second)

Month	Fairview Creek at Glisan Street (USGS 14211814)	Columbia Slough at Portland (USGS 14211820)	Columbia River at Vancouver (USGS 14144700)	Burnt Bridge Creek near Mouth (USGS 14211902)
January	11	162	156,000	46
February	9.1	151	163,000	53
March	8.6	135	170,000	39
April	6.3	85	204,000	21
May	5.1	29	286,000	19
June	4.0	65	415,000	14
July	2.4	79	291,000	9.1
August	2.0	74	153,000	7.4
September	2.1	63	117,000	7.0
October	3.4	96	116,000	9.8
November	6.5	112	122,000	34
December	10	123	138,000	41

I-5, Marine Drive and Martin Luther King, Jr. (MLK) Boulevard are elevated on embankments or structures and the drainage systems that serve these and roads do not handle runoff from outside the right-of-way. These embankments are also part of the levee system. Surface runoff from the I-5 and roads within the project footprint is generally confined to the roadway surface by continuous concrete barriers or curbs, and is collected almost entirely by closed gravity drainage systems with inlets and stormwater pipes; The one notable exception is MLK Boulevard east of I-5 where runoff is shed off the south shoulder. As shown on Figure 7, runoff from the project area drains to a system of sloughs before being discharged to Columbia Slough via the Portland International Raceway (PIR), Schmeer Road or Pen 2 - NE 13th pump station. These pump stations, which are sized to handle the 1 in 100 year runoff, have installed capacities of 19,700, 40,000 and 32,000 gallons per minute, respectively. Note that Marine Drive west of I-5, while within the confines of the levee system, drains to outfalls on North Portland Harbor and is included in the Columbia River South Watershed.

Within the project CIA, there is approximately 42.8 and 1.6 acres of existing PGIS and non-PGIS, respectively. Runoff from about 3 acres (MLK Boulevard and Union Court) of existing PGIS is dispersed and infiltrated. There are no flow control measures for runoff within the project footprint beyond the regulation of discharges to Columbia Slough provided by pump station operation. In addition, there are no engineered water quality facilities except for a manhole sediment trap located at the Victory Boulevard interchange (see Figure 2) that treats runoff from approximately 6 acres of impervious surfaces at the interchange (not within the project footprint).

Columbia River South Watershed

For convenience, the areas draining to the Columbia River are divided into those within Oregon and those within Washington. The Columbia River South Watershed includes the portion of the project area south of North Portland Harbor (a side channel of the Columbia River) that drains to that waterbody, North Portland Harbor Bridge, Hayden Island and the Columbia River Bridges south of the state line (see Figure 2).

Like the Columbia Slough Watershed, the project footprint within this watershed is located in what was part of the Columbia River floodplain. The portion south of North Portland Harbor is protected against flooding by a levee system, while material dredged from the Columbia River has been used to raise the overall ground surface on Hayden Island east of the Burlington Northern Santa Fe Railway (BNSF) railroad tracks above the 1 in 100-year flood elevation.

Land either side of I-5 on Hayden Island is highly developed and comprises service-related businesses such as retail stores and restaurants, and their parking lots.

Similar to the Columbia Slough Watershed, I-5 is elevated on an embankment across Hayden Island. Surface runoff from the I-5 and local roads within the project footprint is generally confined to the roadway surface by continuous concrete barriers or curbs. Except for the North Portland Harbor and Columbia River Bridges, runoff is collected entirely by closed gravity drainage systems with inlets and stormwater pipes that discharge directly to North Portland Harbor or Columbia River. Runoff from the bridges is discharged through scuppers directly to the water surface below. The project CIA within this watershed contains approximately 59.4 and 3.0 acres of existing PGIS and non-PGIS, respectively. There are no flow control measures or engineered water quality facilities.

Columbia River North Watershed

This watershed comprises the project footprint from the state line in the south to the SR 500 interchange in the north. It comprises the current I-5 corridor as well as Vancouver city streets on which the LRT guideway will be located. Existing impervious surfaces in the CIA comprise about 120.7 and 12.2 acres of PGIS and non-PGIS. There are no flow control measures or engineered water quality facilities with the exception of approximately 3 acres of SR 14 from which runoff is dispersed and infiltrated.

Land west of I-5 comprises downtown Vancouver and residential neighborhoods to the north. The area east of I-5 and south of Fourth Plain Boulevard contains the Pearson Airpark and Fort Vancouver Historic Park, both of which are low density. North of Fourth Plain Boulevard, land east of the highway comprises residential development.

Surface runoff from I-5 and local streets is generally confined to the roadway by continuous curbs and concrete barriers, and is collected almost entirely by closed drainage systems. The only exceptions are the Columbia River Bridges and a few ditches adjacent to the highway. These closed systems discharge runoff directly to the Columbia River via outfalls in the vicinity of the existing highway bridges while runoff from the bridges themselves drains through scuppers to the river below. A pump station located southeast of the SR 14 interchange (see Figure 3) discharges runoff from lower lying portions of the interchange to the Columbia River during high river levels.

The vertical grade of I-5 is generally below the surrounding areas and as a result, the drainage system serving the highway also handles runoff from built-up areas outside the highway right-of-way as shown on Figures 3 and 4. These areas, which are extensive, are estimated to comprise over 50 percent of the total drainage area served by this system, and their contribution to flows was an important consideration when developing the approach to stormwater management in this watershed.

Burnt Bridge Creek Watershed

The CIA within this watershed includes the SR 500 interchange and portions of I-5 to the north and SR 500 to the east. Within the project footprint, the CIA includes about 16.2 and 0.3 acres of existing PGIS and non-PGIS, respectively. Residential developments are located south of the SR 500 interchange and there is a school to the northwest of the SR 500 interchange and a park to the northeast.

Typical of an urban environment, surface runoff from the highways and local streets is generally confined to the roadway by continuous curbs and concrete barriers, and is collected almost entirely by closed drainage systems. In contrast to the other watersheds, runoff from the entire PGIS within the project footprint currently contains some form of treatment. Runoff from about 14.5 and 0.2 acres of PGIS and non-PGIS within the project footprint is conveyed to an infiltration pond at the Main Street interchange and the balance is conveyed to a wet pond north of SR 500 (see Figure 4 for both locations).

The infiltration pond would be considered to provide protection for Endangered Species Act (ESA)-listed species that might be found in Burnt Bridge Creek in terms of water quality (dissolved metals reduction) and flow reduction. The primary water quality function of the wet pond, however, is to reduce sediment and, as such, would not provide adequate protection for ESA species. For this reason, runoff from the area served by this pond is not included in this report as receiving water quality treatment.

Fairview Creek Watershed

The project CIA within this watershed comprises the Ruby Junction LRT operations and maintenance facility which would be expanded to meet the needs of the CRC and TriMet's Milwaukie project, both of which are expected to be constructed at about the same time. The expansion will extend the existing maintenance bays and constructing a new LRV storage yard.

Based on information provided by TriMet, runoff from about 1.5 acres comprising the parking area adjacent to the paint/body shop at the south end of the site (adjacent to Fairview Creek) is treated using proprietary cartridge filters before being conveyed to Fairview Creek. Elsewhere, runoff is infiltrated.

Surficial Soils

Figure 8 shows the approximate areal extent of the surficial soils in the vicinity of the project corridor (excluding Ruby Junction). The descriptions below are from the National Resources Conservation Service (NRCS) website.[10]

The Sauvie-Rafton-Urban land complex belongs to Hydrologic Soil Group D, the Pilchuck-Urban land complex belongs to Group A, and the Wind River and Lauren soils belong to Group B. A soil survey[11] indicates that water tables are at a depth of less than one foot for the Sauvie-Rafton-Urban land complex, and between two and four feet for the Pilchuck-Urban land complex. While the depths for the Sauvie-Rafton-Urban complex south of North Portland Harbor are confirmed by borehole logs available for the project area, they also indicate that the soils can be highly variable. For the Pilchuck-Urban soils on Hayden Island, available geotechnical data suggests that the water table is approximately 15 feet below ground level. It should also be noted that the phreatic surface is expected to respond to changes in river level given the highly permeable nature of these soils. While depths to water table are not provided for the Wind River and Lauren soils[12] north of the Columbia River, borehole logs for property in downtown Vancouver and the recently-constructed Land Bridge across SR 14 indicate that groundwater levels in that area are close to water levels in the Columbia River.

Soils at the Ruby Junction facility comprise the Multnomah-Urban land complex belonging to Hydrologic Group A. While the NRCS soil survey indicates a depth to groundwater in excess of 80 inches, TriMet personnel have advised that the water table is shallow at the south end of the site, adjacent to Fairview Creek.

The hydrologic properties of the three Groups referenced above are:

- Group A soils have a high infiltration rate and consist mainly of deep, well drained to excessively drained sands or gravelly sands.
- Group B soils have a moderate infiltration rate and consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture.
- Group D soils have a low infiltration rate and high runoff potential. They consist primarily of clay soils that have high swelling potential, a permanent high water table, or a clay layer at or near the surface, and shallow soils over nearly impervious material.

Based on available data, there are no Group C soils within the project area.

Given the predominance of poorly drained soils and high groundwater table south of North Portland Harbor, infiltration (the preferred method for stormwater management) is not currently recommended for this area. As noted above, soils are variable and future site investigations may reveal locations where infiltration might be feasible.

On Hayden Island, infiltration is not currently proposed even though the soils are classified as being in Hydrologic Group A. Considering the likely depth of any ponds, there may not be adequate separation

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[10] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

[11] Soil Survey of Multnomah County, Oregon. United States Department of Agriculture, Soil Conservation Service, in cooperation with Oregon Agricultural Experiment. August 1983.

[12] Soil Survey of Clark County, Washington. United States Department of Agriculture, Soil Conservation Service, in cooperation with the Washington Agricultural Experiment Station. November 1972.

between the pond invert and groundwater table for treating runoff. The EPA recommends a "significant separation distance (2 to 5 feet) between the bottom of an infiltration basin and seasonal high groundwater table." Recently installed piezometers are being monitored to determine groundwater elevations and their response to changes in Columbia River water levels.

Pending the results of an ongoing investigation program to determine site-specific infiltration rates and groundwater levels at other proposed pond locations, infiltration is considered feasible for highway-related elements of the project north of the Columbia River. Again, underdrains could be provided should the assumed infiltration rate not be achievable and no options exist for expanding the pond. Infiltration, however, is not recommended for the LRT guideway and associated construction in downtown Vancouver because of the presence of building basements and lack of available sites.

Temporary Construction Activities

Without proper management, construction activities could create temporary adverse affects on water quality in nearby water bodies. Adverse impacts could result in the erosion of disturbed areas, and the accidental release of fuels and soluble or water-transportable construction materials.

As shown in Table 2, up to about 415 acres could be disturbed during construction. The table, which shows potential areas of disturbance on a watershed basis, includes all areas within the rights-of-way proposed for the project but does not include potential areas of construction in or over water or additional land that could be required outside the rights-of way for staging or laydown.

While Table 2 includes temporary construction easements and potential staging areas adjacent to the project footprint, it does not include potential casting/fabrication yards and staging areas identified further away from the project. These include two bridge casting/fabrication yard sites adjacent to the Columbia River, a 95-acre parcel at the Port of Vancouver and a 51-acre parcel north of the Portland-Troutdale Airport (Sundial Site), and a 52-acre staging area in the Port of Vancouver. Although these sites have been identified by the project team, construction contractors may elect to use other locations. In such circumstances, the contractor(s) would typically be required to obtain the necessary permits and comply with any conditions attached by regulatory agencies to those permits.

TABLE 2

Areas of Potential Disturbance during Construction

Watershed	Potential Area of Temporary Disturbance
Columbia Slough	105 acres
Columbia River - Oregon	70 acres
Columbia River – Washington	170 acres
Burnt Bridge Creek	55 acres
Fairview Creek	15 acres

National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Discharge Permits will regulate the discharge of stormwater from construction sites. These permits include discharge water quality standards, runoff monitoring requirements, and provision for preparing a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP contains all the elements of a Temporary Erosion and Sediment Plan and Spill Prevention Control and Countermeasures Plan.

The SWPPP and its adoption by construction personnel are essential for ensuring water quality standards are met during construction, and a single, comprehensive plan would ensure project-wide consistency. Contractors would be required to have a certified Erosion and Sediment Control Lead on staff to ensure proper implementation of the SWPPP. In addition, the agency or agencies responsible for providing construction oversight would also have one or more staff assigned to monitor SWPPP implementation.

An SWPPP typically contains the following elements:

1. Project information
2. Existing site conditions.

3. Potential erosion problem areas.
4. Descriptions and drawings of pollution-prevention measures and best management practices (BMP) for:
   - Preserving vegetation
   - Sequence of clearing operations, including limitations on areas cleared at the same time
   - Construction access, including wheel wash facilities
   - Flow control (where required)
   - Sediment control, including check dams, silt fences and sediment ponds
   - Soil stabilization, including temporary seeding
   - Slope protection
   - Existing drain inlet protection
   - Channel and outlet stabilization
   - Pollution control (including spill prevention)
   - Street cleaning
   - Dewatering control
   - BMP maintenance, inspection and monitoring
   - Construction phasing and implementation schedule for BMPs.
5. Compliance assurance procedures and corrective actions in case performance goals are not achieved.
6. Spill response procedures.
7. Engineering calculations.

Water quality standards, which include turbidity and pH, are usually monitored at the point(s) of discharge. There may also be special requirements in addition to turbidity and pH for discharges to since all receiving watercourses are 303(d) listed watercourses.

The selection of construction BMPs is dependent on the specific site layout and sequence of construction activities and, as such, is beyond the scope of this report.

Permanent Water Quality Facilities – Full Build

This section describes the proposed stormwater management plan for constructing Option A full build. There are alternatives still being considered including Option B and deferring construction of parts of the Victory Boulevard, Marine Drive and SR 500 interchanges to a later date (which could be applied to either option). The potential effect of these alternatives on stormwater management is discussed in a subsequent section.

The waterbodies to which runoff would be discharged are Columbia Slough (via the Peninsula Drainage District No.1 and No.2 surface water systems and associated pump stations), North Portland Harbor (a side channel of the Columbia River), Columbia River mainstem, Burnt Bridge Creek, and Fairview Creek. Columbia Slough, North Portland Harbor and the Columbia River contain species listed under the ESA, and all receiving watercourses are 303(d) listed. Note that although a watercourse may be 303(d) listed, the parameters listed may not necessarily have EPA-approved Total Maximum Daily Loads (TMDL).

To address ESA and TMDL issues, the overall approach to stormwater management from a water quality perspective is to treat runoff to reduce the following pollutants that are typically associated with transportation projects:

- Debris and litter
- Suspended solids such as sand, silt and particulate metals
- Oil and grease
- Dissolved metals

The last criterion, especially dissolved copper, is of particular concern to NOAA Fisheries. Dissolved copper is known to have a detrimental effect on the olfactory senses of young salmonids.

Based on the ODOT memorandum,[13] the following water quality BMPs are effective in reducing sediments, and particulate and dissolved metals; pollutants of concern for ESA-listed species observed in the waterbodies to which stormwater will be discharged:

- **Bioretention Ponds** are infiltration ponds that use an engineered (amended) soil mix to remove pollutants as runoff infiltrates through this zone to the underlying soils. The primary mechanisms for pollutant reduction are filtration, sorption, biological uptake and microbial activity. While this BMP is best-suited to sites with Hydrologic Group A and B soils, it may be used for Group C and D Hydrologic Group soils with the addition of an underdrain system to collect infiltration and convey it to a stormwater conveyance system. When estimating the size of these facilities, an infiltration rate of 1 inch per hour was assumed. If the soils cannot sustain this rate and there is insufficient space to increase the pond size to accommodate a lower value, underdrains would be installed.
- **Constructed Treatment Wetlands** are shallow, permanent, vegetated ponds that function like natural wetlands. They remove pollutants through sedimentation, sorption, biological uptake and microbial activity.
- Soil-amended **Biofiltration Swales** are trapezoidal channels with mild slopes and shallow depths of flow. The channels are dry between storm events and are typically grassed. They treat runoff by filtration and sorption as runoff flows through the vegetated surface and amended soils. Amended soils, especially compost-amended, is an excellent filtration medium. Compost-amended soils have a high cation exchange capacity that will bind and trap dissolved metals. Similar to bioretention ponds, an underdrain system is recommended for sites with Group C and D Hydrologic Group soils.
- Soil-amended **Filter Strips** are intended to treat sheet runoff from an adjacent roadway surface. In a confined urban setting such as the project corridor, opportunities to use this BMP are limited. Similar to grass swales, filter strips treat runoff by filtration and sorption as runoff flows through the vegetated surface and amended soils.
- Bioslopes, like filter strips, are intended to treat sheet runoff from an adjacent roadway surface. They comprise a vegetated filter strip, infiltration trench and underdrain, and reduce pollutants through sorption and filtration. Bioslopes are also known as Ecology Embankments. The percolating runoff flows through a special mixture of materials, including dolomite and gypsum, which promotes the adsorption of pollutants.

These BMPs would be constructed for the sole purpose of improving stormwater runoff quality and infiltration is the preferred method of runoff treatment. The location of such facilities in the proximity of well-travelled roads and transit systems combined with ongoing maintenance would discourage their use as habitat by wildlife.

Other water quality approaches, including Dispersal, Drywells and Proprietary Systems (such as cartridge filters), have been considered on a case-by-case basis where the BMPs listed above would not be practical or feasible.

Oil control pretreatment may be required at high-traffic intersections and park and ride facilities where high concentrations of oil and grease are expected in stormwater runoff. **Baffle Type Oil-Water Separators** and **Coalescing Plate Oil-Water Separators** are considered to be suitable types of treatment facility.

As the project design progresses, the team will continue to assess new technologies and whether they should be added to the suite of acceptable BMPs. For example, Ecology recently approved[14] Americast's Filterra® system for reducing, among other pollutants, dissolved metals. This system uses engineered bioretention filtration incorporated into a planter box to treat runoff.

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[13] Stormwater Management Program, Geo-Environmental Bulletin GE09-02(B). Prepared by the Oregon Department of Transportation. January 27, 2009.

[14] General Use Level Designation for Basic (TSS), Enhanced, & Oil Treatment & Conditional Use Level Designation for Phosphorus Treatment for Americast's Filterra®. Washington State Department of Ecology. November 2006 (Revised December 2009).

Proposed water management strategies are presented for runoff to outfalls on a watershed basis. As described previously, the strategies present one set of approaches to water management; approaches that might change as design work progresses. They demonstrate the level of stormwater quality improvements that the project would achieve. As design work progresses, the project will identify and evaluate options for low impact development and the use of more localized water quality facilities that treat runoff closer to its source, thereby reducing the size of the stormwater management facilities currently proposed.

The strategies presented rely in part on "as built" information provided by ODOT, WSDOT, and the cities of Portland and Vancouver. While this information has been accepted on an as-is basis, the data is in the process of independently verified through field measurements.

Columbia Slough Watershed

The project footprint in this watershed comprises highway, local street and LRT improvements south of North Portland Harbor. Overall, the project will increase the total CIA in this watershed by approximately 13.6 acres. The increase may be attributed to new local streets and the addition of runoff from new and existing bridges across the North Portland Harbor.

The project will create approximately 51.6 acres of new, rebuilt and resurfaced PGIS and about 4.3 acres of new sidewalk and bike-pedestrian paths. The remaining 2.1 acres comprises the existing bridge over North Portland Harbor: runoff currently drains via scuppers to the water below. While I-5 will generally follow its current alignment and grade, the Marine Drive interchange will be completely rebuilt and will differ significantly from its existing layout.

Table 3 summarizes the impact of the project on CIA and the areas from which runoff will be treated, and the paragraphs following the table describe the individual water quality facilities, the locations of which are shown on Figure 9. Note that the areas shown on the table do not include a potential staging area in the Expo parking lot since construction contractors may elect to use other locations for temporary staging. Regardless, it is likely that this area will be returned to parking after construction.

TABLE 3

Contributing Impervious Areas[a] for Columbia Slough Watershed

Outfall	Water Quality Facility	Impervious Area Draining to Outfall (acres)					
		PGIS			Non-PGIS		
		New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	Total CIA
CS-01	CS-A	0.9					0.9
	Total area treated	0.9					0.9
	Total area untreated						
	Total CIA	0.9					0.9
CS-02	N/A						
	Total area treated						
	Total area untreated	3.4	3.7				7.1
	Total CIA	3.4	3.7				7.1
CS-03	CS-B	5.2					5.2
	Total area treated	5.2					5.2
	Total area untreated						
	Total CIA	5.2					5.2

Outfall	Water Quality Facility	Impervious Area Draining to Outfall (acres)					
		PGIS			Non-PGIS		
		New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	Total CIA
CS-04	CS-C	1.2					1.2
	CS-D	3.1					3.1
	Total area treated	4.3					4.3
	Total area untreated						
	Total CIA	4.3					4.3
CS-05	CS-E	11.7	4.6	1.9		0.2	18.4
	Total area treated	11.7	4.6	1.9		0.2	18.4
	Total area untreated						
	Total CIA	11.7	4.6	1.9		0.2	18.4
CS-06	CS-F	1.6					1.6
	Total area treated	1.6					1.6
	Total area untreated						
	Total CIA	1.6					1.6
CS-07	CS-G	1.4			0.6		2.0
	Total area treated	1.4			0.6		2.0
	Total area untreated						
	Total CIA	1.4			0.6		2.0
Other		14.8			3.7		18.5
	Total area treated	14.8			3.7		18.5
	Total area untreated						
	Total CIA	14.8			3.7		18.5
TOTAL AREA		**43.3**	**8.3**	**1.9**	**4.3**	**0.2**	**58.0**

a Includes the area of impervious surfaces under bridges. Such duplicate areas would not be included when sizing water quality facilities.

As shown in Table 3, no options have been identified to treat runoff from about 7.1 acres of new and resurfaced I-5 pavement immediately north of Victory Boulevard (see Outfall CS-02). The primary issue is that the proximity of the outfall CS-02 to the highway embankment does not leave adequate room to construct a water quality facility such as a bioretention pond or swale, and the acquisition of additional property at this location would introduce 4f issues. It would also be extremely difficult modify the existing stormwater conveyance system and direct runoff to another location where a water quality facility could be constructed. It should be noted that some runoff treatment would take place as runoff flows through Schmeer Slough before being discharged to Columbia Slough via the Schmeer Road Pump Station. The project team will, however, continue to develop and evaluate options to treat runoff from this area.

Flow control is not required for runoff discharged to Columbia Slough and no new outfalls are proposed. The stormwater management plan for this watershed reflects a request by the MCDD to minimize runoff from the project to the Peninsula Drainage District No.2 surface water system to provide greater flexibility for handling increased runoff from a potential redevelopment of the Hayden Meadows race track.

As described earlier, soils in this area are generally poorly drained and, for this reason, the primary BMP proposed for water quality facilities in this watershed is a constructed treatment wetland. However, boreholes in the area show that the soils can be quite variable and, as the project design advances, site-specific geotechnical investigations may prove that one or more of the locations proposed for water quality facilities may be suitable for infiltration.

A new conveyance system, constructed as part of the CRC project, will enable some of the runoff that currently flows to the outlet CS-04 to be re-routed to CS-05; most of the runoff being re-routed would be from the I-5 mainline. The primary reasons for this strategy are:

1. The west side of the proposed interchange provides the largest uninterrupted open area for water quality facilities.
2. MCDD has requested CRC minimize runoff from the project to the Peninsula Drainage District No.2 surface water system to provide greater flexibility for handling increased runoff from potential redevelopment of the Hayden Meadows race track.

A ballasted LRT track is proposed between the existing Expo station and south end of the combined LRT-arterial bridge across North Portland Harbor. Since the track is pervious, it is not included in Table 3. Perforated underdrains serving existing ballasted track at the Expo station would be extended to collect runoff from the new guideway: the existing track underdrain system discharges to the channel located immediately south of the Expo Center.

Following is a description of the water quality facilities listed in Table 3.

Water Quality Facility CS-A

CS-A would be sized to handle runoff from the south end of the ramp from Marine Drive to southbound I-5. It is a biofiltration swale located south of Victory Boulevard and west of I-5 and outflows would be discharged to Schmeer Slough at outfall CS-01 via an existing or new stormwater pipe located on Victory Boulevard.

Water Quality Facility CS-B

CS-B is a constructed wetland located within the existing loop ramp from MLK Boulevard to Union Court: the ramp will be removed as part of the project. The pond will serve a portion of the realigned MLK Boulevard east of I-5 and south end of the ramp from westbound MLK to northbound I-5. Outflows will be released via an existing City of Portland stormwater pipe to Walker Slough at outfall CS-03.

Water Quality Facility CS-C

The grades are such that it would be difficult to convey about 1.2 acres of the ramp from northbound I-5 to westbound Marine Drive to the water quality facility CS-D described below. A biofiltration swale, CS-C, is proposed to treat runoff from this area, the flows from which would be released to Walker Slough via Outfall CS-04.

Water Quality Facility CS-D

A constructed treatment wetland CS-D is proposed to treat runoff from about 3.1 acres comprising most of the ramp from MLK Boulevard to northbound I-5. Outflows would be discharged to the upstream end of Walker Slough at outfall CS-02.

Water Quality Facility CS-E

This is the largest water quality facility proposed in the Columbia Slough watershed and takes advantage of the relatively open area in the southwest quadrant of the Marine Drive interchange. It would be a constructed wetland sized to treat runoff from approximately 18.4 acres of impervious surface. This area comprises I-5, including approximately 2.1 acres of the existing North Portland Harbor bridges, and ramps on the west side of the highway.

Outflows from the wetland would be released to the drainage channel located immediately south of Expo at outlet CS-03. The channel and associated pump station may need to be enlarged to handle the additional flows: alternatively, the wetland could be enlarged to provide detention storage and reduce peak outflows provided the water balance would still be conducive to the long-term survival of wetland plants.

Water Quality Facility CS-F

The project would construct new connections between MLK Boulevard and Vancouver Way. Runoff from about 1.6 acres of new and resurfaced pavement would be treated at a biofiltration swale, water quality facility CS-F, adjacent to the connection between MLK and Vancouver Way. Flows from the swale areas would drain to the existing City of Portland stormwater conveyance system under Vancouver Way at outlet CS-06. Additional water quality improvements are expected as runoff flows through over 7,000 feet of open channel before being pumped to Columbia Slough via the Pen 2 – NE 13th Pump Station (see Figure 7).

Water Quality Facility CS-G

Runoff from 2.0 acres of impervious surface comprising MLK, the new connection to Union Court and associated sidewalks would be discharged to constructed wetland, CS-E, located between the two roadways. Flows from the wetland would be released to an existing City of Portland conveyance system on Union Court at outlet CS-07 and would be ultimately be pumped to Columbia Slough via the Schmeer Road Pump Station.

Alternatively, the project may elect to shed runoff (or at least part of the runoff) across the each shoulder, as currently happens, where it would infiltrate and/or evaporate.

Other Water Quality Facilities

Following is a summary of the proposed water quality facilities that comprise this category on Table 3:

- Runoff from the new merge lane south of Victory Boulevard (about 0.5 acre) for the ramp from Marine Drive to southbound I-5 would be conveyed to a water quality swale constructed as part of the I-5 Delta Park project. This swale has adequate capacity to handle the additional runoff.
- Runoff from approximately 16.9 acres of proposed new, rebuilt and existing local streets and contiguous sidewalks within the CIA would be treated using a mix of semi-continuous biofiltration swales and proprietary systems such as cartridge filters.
- Runoff from about 1.1 acres of the bike-pedestrian pathway that is physically separated from the street network will likely be shed to adjacent landscaped areas where it will infiltrate and/or evaporate.

Columbia River South Watershed

The project-related part of the Columbia River watershed in Oregon is comprises Hayden Island and Marine Drive west of I-5. Although this part of Marine Drive is located within the level system protecting the Delta Park area, runoff is discharged to North Portland Harbor via stormwater pipes located under the levee and floodwall.

The existing impervious area within watershed would be increased by approximately 0.2 acre. On Hayden Island, I-5 will start to deviate from its current alignment and profile immediately north of the existing North Portland Harbor bridges, which will be retained. The Hayden Island interchange would be completely rebuilt, local streets will be reconfigured and the LRT guideway will be extended across the island to the proposed new southbound highway bridge across the Columbia River.

Table 4 summarizes the areas from which runoff will be treated, and the paragraphs following the table describe the individual water quality facilities, the locations of which are shown on Figure 9. This watershed includes existing surface parking that may or may not remain after the project has been completed. While it is uncertain at this time how land use in the vicinity of the Hayden Island interchange might change after completion of the CRC project, it has been assumed that land on the west side of the proposed interchange and transit guideway that might be purchased for staging during construction would be converted into transit-oriented development. This land comprises an area of about 10.0 acres west of the project and bounded by the transit guideway, Center Avenue, Hayden Island Drive and Jantzen Drive. Any redevelopment would need to meet ODOT or City of Portland stormwater requirements and, as such, runoff would either be infiltrated or treated before being released to the Columbia River or North Portland Harbor: Table 4 assumes the latter. This is considered to be a reasonable approach as the areas immediately east of I-5 are currently identified as potential sites for water quality facilities.

TABLE 4

Contributing Impervious Areas[a] for Columbia River South Watershed

Outfall	Water Quality Facility	Impervious Area Draining to Outfall (acres)					
		PGIS			Non-PGIS		
		New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	Total CIA
NPH-01	NPH-A	2.5			0.1		2.6
	NPH-B	1.5			1.2		2.7
	Total area treated	4.0			1.3		5.3
	Total area untreated						
	Total CIA	4.0			1.3		5.3
CR-01/02	CR-A	17.5			0.1		17.6
	CR-B	10.4		2.2	1.1	0.2	13.9
	CR-C	2.5			2.4		4.9
	Total area treated	30.4		2.2	3.6	0.2	36.4
	Total area untreated						
	Total CIA	30.4		2.2	3.6	0.2	36.4
Other		18.4			2.5		20.9
	Total area treated	18.4			2.5		20.9
	Total area untreated						
	Total CIA	18.4			2.5		20.9
TOTAL AREA		**52.8**		**2.2**	**7.4**	**0.2**	**62.6**

a Includes the area of impervious surfaces under bridges. Such duplicate areas would not be included when sizing water quality facilities.

Flow control is not required for runoff discharged to North Portland Harbor or Columbia River and no new outfalls are proposed. Although soils in this area belong to Hydrologic Group A, the primary BMP proposed for water quality facilities in this watershed is a constructed treatment wetland due to the assumed lack of separation between the bottom of proposed water quality facilities and groundwater table. This assumption will be revisited as more groundwater data becomes available.

Note that between structures, the LRT guideway will be on pervious ballast and, as such, those areas are not included in Table 4.

Following is a description of the water quality facilities listed in Table 4.

Water Quality Facility NPH-A

The grades are such that it would be difficult to convey runoff from Marine Drive west of the proposed bridge over LRT guideway extension to the constructed treatment wetland CS-E (see previous section). It is proposed to convey runoff from 2.6 acres of new pavement and sidewalk to a biofiltration swale, NPH-A, located immediately north of Marine Drive. Outflows from the swale would be released to North Portland Harbor at outlet NPH-01 via an existing City of Portland stormwater system.

Water Quality Facility NPH-B

Water quality facility NPH-B, a constructed wetland, is proposed at the south end of the proposed LRT-arterial bridge across North Portland Harbor. It would be sized to handle runoff from approximately 2.0 acres of impervious surface on the bridge, including 1.2 acres of transit guideway, sidewalk and bike path, and about 0.7 acres comprising a local street immediately west of the south end of the bridge: runoff from the street will drain towards the proposed constructed wetland.

Outflows from the wetland would be conveyed to North Portland Harbor at outlet NPH-01 via an existing City of Portland stormwater pipe under Marine Drive.

Water Quality Facility CR-A

Runoff from about 17.5 acres of new I-5 mainline between Tomahawk Island Drive extension and the high point across the Columbia River, and a portion of Hayden Island Drive east of I-5 would be conveyed to a constructed treatment wetland located along the east side of the interchange. Outflows from the facility would be released to the Columbia River via one of the two existing ODOT outfalls CS-01 or CS-02, both of which are located under the south end of the existing bridges over the Columbia River.

Water Quality Facility CR-B

This water quality facility would be a constructed wetland located east of I-5 and south of the Tomahawk Island Drive extension. It would be sized to handle about 13.9 acres of new ramps and I-5 pavement between North Portland Harbor and Tomahawk Island Drive extension under I-5, the Tomahawk Island Drive extension, and a portion of the realigned Jantzen Drive under I-5. It would also handle runoff from the north half of the existing North Portland Harbor bridges. Proposed grades are such that drainage from Tomahawk Island Drive and Jantzen Drive would need to be pumped to the wetland.

Outflows from the facility would likely be released to the Columbia River via outfall CS-01 or CS-02.

Water Quality Facility CR-C

Runoff from approximately 4.9 acres of impervious pavement, including 1.2 acres each of transit-only structure and bike-pedestrian path, would be conveyed to a constructed wetland located west of I-5 and immediately south of Hayden Island Drive. Outflows from the facility would likely be released to the Columbia River via outfalls CS-01 or CS-02.

Other Water Quality Facilities

Following is a summary of the proposed water quality facilities that comprise this category on Table 4:

- Runoff from approximately 10.5 acres of proposed new, rebuilt and existing local streets and contiguous sidewalks within the CIA would be treated using a mix of semi-continuous biofiltration swales and proprietary systems such as cartridge filters.
- Approximately 10.0 acres of future transit-oriented development has been assumed on the west side of I-5. Runoff would be treated to either ODOT or City of Portland standards.
- Runoff from about 0.4 acres of the bike-pedestrian pathway west of the south end of the transit-arterial bridge over North Portland Harbor will likely be shed to adjacent landscaped areas where it will infiltrate and/or evaporate. This path is physically separated from the street network.

Columbia River North Watershed

This is the largest watershed from the project perspective and comprises the project footprint from the state line in the south to the SR 500 interchange in the north. It includes the current I-5 corridor as well as Vancouver city streets on which the LRT guideway would be located.

From about 6th Street, I-5 will generally follow its existing alignment and grade. The SR 14 and Mill Plain interchanges would be reconfigured and while the Fourth Plain interchanges would be rebuilt, the footprint will be similar to what currently exists. New streets would be constructed at the SR 14 interchange to improve local connections, and the LRT guideway would be constructed primarily along existing streets. In addition, three park and ride structures would be built to serve the extended LRT system. With the exception of the above-grade guideway between 6th Street and new southbound Columbia River Bridge, the LRT track could be subject to use by buses and would not be considered non-polluting. This is a conservative determination, and one that could change should buses be excluded from the guideway.

The project would increase the impervious area within this watershed by approximately 21.1 acres. The total project CIA would be about 154.0 acres of which approximately 112.8 acres would be new, rebuilt and resurfaced PGIS and about 13.3 acres would be new sidewalk and bike-pedestrian paths. The 27.9-acre balance comprises existing impervious areas, mostly city streets, from which runoff would flow onto the project footprint.

Table 5 summarizes the impact of the project on CIA and the areas from which runoff will be treated, and the paragraphs following the table describe the individual water quality facilities, the locations of which are shown on Figures 10 and 11.

TABLE 5

Contributing Impervious Areas[a] for Columbia River North Watershed

Outfall	Water Quality Facility	Impervious Area Draining to Outfall (acres)					
		PGIS			Non-PGIS		Total CIA
		New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	
CR-03	CR-C	16.1	1.6		0.2		17.9
	CR-D	16.5	2.0		0.2		18.7
	CR-E (2)	2.6			0.6		3.2
	CR-G (2)	16.7	3.9	4.1	0.1	0.6	25.4
	CR-H	0.8					0.8
	CR-I	5.3			0.9		6.2
	CR-J	2.9			1.0		3.9
	CR-K	5.3	5.6		0.3		11.2
	CR-L	3.6		9.0	0.4	1.3	14.3
	CR-M	1.7		0.8	0.1		2.6
	Total area treated	71.5	13.1	13.9	3.8	1.9	104.2
	Total area untreated						
	Total CIA	71.5	13.1	13.9	3.8	1.9	104.2
CR-05	CR-F	3.0	0.9				3.9
	Total area treated	3.0	0.9				3.9
	Total area untreated		1.0				1.0
	Total CIA	3.0	1.9				4.9
Other		23.3		9.0	9.5	3.1	44.9
	Total area treated	23.3	-	9.0	9.5	3.1	44.9
	Total area untreated						
	Total CIA	23.3	-	9.0	9.5	3.1	44.9
TOTAL AREA		**97.8**	**15.0**	**22.9**	**13.3**	**5.0**	**154.0**

a Includes the area of impervious surfaces under bridges. Such duplicate areas would not be included when sizing water quality facilities.

Table 5 demonstrates that the project proposes to treat runoff from the entire CIA with exception of about 1.0 acre comprising the eastbound lanes of SR 14. Existing and proposed highway super-elevation at this location will result in runoff draining to catch basins located adjacent to the center median. Since this portion of SR 14 is only being resurfaced, there are very limited opportunities, if any, to reconfigure the conveyance system. In addition, there are no opportunities to construct a biofiltration swale or media drain at the median and no room to provide either a cartridge vault or an end-of-pipe water quality facility: the outfall CR-05 discharges directly into the Columbia River, and the limited distance between the highway and river is occupied by the BNSF railroad embankment and Columbia Way.

New stormwater conveyance systems are proposed for I-5 and associated interchanges. The existing stormwater trunk main serving I-5 also receives runoff from urban areas to the west, none of which is currently treated. The new conveyance systems will allow runoff from the highway and ramps to collected and treated before being released to the stormwater trunk main.

Flow control is not required for runoff discharged to the Columbia River and no new outfalls are proposed. Soils in this area belong to Hydrologic Group B, which are considered suitable for infiltration; an assessment that is confirmed by soils data recently obtained by the project. Therefore, the primary BMP assumed for water quality facilities in this watershed is a biofiltration pond. This assumption may need to be revisited for facilities in the SR 14 interchange area due to the potential presence of a shallow groundwater table. Regardless of infiltration rates, constructed treatment wetlands would not be considered south of Fourth Plain Boulevard because of the proximity to Pearson Airfield. Such facilities would be regarded as hazardous wildlife attractants and could pose a threat to the safety of planes landing or departing from the airfield.[15]

Following is a description of the water quality facilities listed in Table 5.

Water Quality Facility CR-C

- Runoff from about 17.9 acres of southbound I-5 (including 1.6 acres of resurfaced pavement), ramps on the west side of the interchange, and west side of the Evergreen Boulevard bridge over I-5 would be conveyed to this bioretention pond located on the west side of the SR 14 interchange and east of the Main Street extension.

Any overflow from bioretention pond would be released to the Columbia River at outfall CR-03 via the existing stormwater conveyance system.

Water Quality Facility CR-D

- The water quality facility is located within the loop ramps on the east side of the SR 14 interchange. It would be sized to handle runoff from approximately 18.7 acres of northbound I-5 (including 2.0 acres of resurfaced pavement), ramps on the east side of the interchange, and east side of the Evergreen Boulevard bridge over I-5.

Again, any overflow from the bioretention pond would be released to the Columbia River at outfall CR-03 via the existing stormwater conveyance system.

Water Quality Facility CR-E

Runoff from about 3.2 acres of new impervious area on SR 14 and Main Street would be directed to one or two biofiltration swales located adjacent to the intersection of Main Street and SR 14. Outflows would be released to the Columbia River at outfall CR-03 via the existing stormwater conveyance system.

Water Quality Facility CR-F

Runoff from approximate 3.9 acres comprising the new, rebuilt and resurfaced westbound lanes of SR 14 east of the SR 14 interchange would be conveyed to a biofiltration swale located on the north side of the highway, Alternatively, runoff from the resurfaced westbound lanes may be shed to the shoulder where it would be infiltrated, similar to what currently occurs. Outflows from the swale would be conveyed to outfall CS-05 on the Columbia River via an existing 6-foot by 6-foot culvert.

As mentioned in the preamble to this section, project staff have not yet identified any options for treating runoff from the eastbound lanes.

Water Quality Facility CR-G

CR-G comprises two biofiltration ponds proposed in the northeast and southeast quadrants of the reconfigured Mill Plain interchanges. They will be sized to handle runoff from approximately 25.4 acres of new ramps, new, replaced and resurfaced highway, new collector-distributor road to the north, and Mill Plain Blvd to the east would be conveyed to two bioretention ponds located within the interchange footprint.

The contributing area includes about 3.9 acres of resurfaced highway and approximately 4.7 acres of existing pavement and sidewalk on Mill Plain Boulevard east of the project footprint. Runoff from the latter would drain towards the project. Any overflow from the ponds would be conveyed to outfall CR-03 via the existing stormwater conveyance system under I-5.

Water Quality Facility CR-H

Runoff from approximately 0.8 acre of the ramp from southbound I-5 to Mill Plain Boulevard would be directed to a biofiltration swale west of the ramp. Discharge from the swale would be discharged to outfall CR-03 via the existing stormwater trunk main under I-5.

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[15] *Hazardous Wildlife Attractants on or near Airports, Advisory Circular 150/5200-33A*. U.S. Department of Transportation, Federal Aviation Administration. July 27, 2004

Water Quality Facility CR-I

Proposed street grade for Mill Plain Boulevard under I-5 is too low to permit runoff from about 6.2 acres to be conveyed to either of the CR-G bioretention ponds. Instead, runoff would be conveyed to proprietary cartridge filter vault and, if necessary, an oil-water separator pre-treatment facility. Based on available data, there appears to be adequate vertical distance between the low point on Mill Plain Boulevard and invert of the existing stormwater conveyance system under I-5 to install this type of facility. Discharge from the vault would be discharged to outfall CR-03 via the existing stormwater trunk main under I-5.

Water Quality Facility CR-J

- Drainage from the top surface of the Clark College Park and Ride and associated paths (about 3.9 acres) would be conveyed to a biofiltration swale located on the east side of the structure. An oil-water separator would pretreat runoff from the park and ride. Outflow from the swale would be conveyed to outfall CR-03 via the existing stormwater conveyance system under I-5.

Water Quality Facility CR-K

- Runoff from about 11.2 acres of I-5 mainline and access road to the Clark College Park and ride (including 5.6 acres of resurfaced highway) would be conveyed to a bioretention pond located in the southeast interchange area. Any overflows from the pond would be conveyed to outfall CR-03 via the existing stormwater conveyance system under I-5.

Water Quality Facility CR-L

- A bioretention pond proposed in the northwest quadrant of the Fourth Plain interchange would be sized to handle runoff from an impervious area of approximately 14.3 acres. This area includes approximately 4.0 acres of new and rebuilt pavement and sidewalk as well as about 10.3 acres of existing streets and sidewalk in the Shumway neighborhood to the northwest of the interchange. Again, any overflows from the pond would be conveyed to outfall CR-03 via the existing stormwater conveyance system under I-5.

Water Quality Facility CR-M

- Runoff from approximately 1.8 acres of new and rebuilt pavement and sidewalk on Fourth Plain Boulevard east of I-5 and about 0.8 acres of existing impervious area further east would be conveyed to a biofiltration swale south of Fourth Plain Boulevard and east of the collector-distributor road. Outflow from the swale would be conveyed to outfall CR-03 via the existing stormwater conveyance system under I-5.

Other Water Quality Facilities

Following is a summary of the proposed water quality facilities that comprise this category on Table 5:

- Runoff from approximately 41.9 acres of proposed LRT guideway, new, rebuilt and existing local streets, and contiguous sidewalks within the CIA would be treated using a mix of semi-continuous biofiltration swales and proprietary systems such as cartridge filters.
- Runoff from about 2.1 acres comprising the top floors of the Columbia Street and Mill District Park and Ride structures will be conveyed to existing City of Vancouver stormwater conveyance systems via proprietary cartridge filter vaults. Pretreatment would be provided using oil-water separators.
- Runoff from about 0.9 acre of the bike-pedestrian pathway that is physically separated from the street network will likely be shed to adjacent landscaped areas where it will infiltrate and/or evaporate.

Burnt Bridge Creek Watershed

The full-build scenario would provide full connectivity between I-5 and SR 500 through the construction of a new ramp from southbound I-5 to eastbound SR 500 and tunnel from westbound SR 500 to northbound I-5. Available information indicated that it would be feasible to redirect runoff from about 2.2 acres of the existing highway south of 39th Street from the existing infiltration pond at the Main Street interchange (BBC-C) to a new biofiltration pond proposed as part of the CRC project (BBC-B). There are no transit-related facilities proposed in this watershed.

The project would increase the impervious area by approximately 6.6 acres. The total project CIA would be about 23.1 acres of which approximately 20.5 acres would be new, rebuilt and resurfaced PGIS and about 0.7 acre would be new sidewalk and bike-pedestrian paths. The balance comprises an existing portion of SR 500.

Table 6 summarizes the impact of the project on CIA and the areas from which runoff will be treated, and the paragraphs following the table describe the individual water quality facilities, the locations of which are shown on Figure 11. The table demonstrates that the project proposes to treat runoff from the entire CIA.

TABLE 6

Contributing Impervious Areas[a] for Burnt Bridge Creek Watershed

Outfall	Water Quality Facility	Impervious Area Draining to Outfall (acres)					
		PGIS			Non-PGIS		Total CIA
		New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	
BBC-01	BBC-A	2.2	1.2	1.9	0.2		5.5
	BBC-B	2.5	2.3				4.8
	Total area treated	4.7	3.5	1.9	0.2		10.3
	Total area untreated						
	Total CIA	4.7	3.5	1.9	0.2		10.3
BBC-02	BBC-C	5.6	6.7		0.5		12.8
	Total area treated	5.6	6.7		0.5		12.8
	Total area untreated						
	Total CIA	5.6	6.7		0.5		12.8
TOTAL AREA		**10.3**	**10.2**	**1.9**	**0.7**		**23.1**

a Includes the area of impervious surfaces under bridges. Such duplicate areas would not be included when sizing water quality facilities.

As stated above, flow control is required for runoff discharged to Burnt Bridge Creek. No new outfalls are proposed. Soils in this area belong to Hydrologic Group B, which are considered suitable for infiltration; an assessment that is confirmed by soils data recently obtained by the project. Therefore, the primary BMP assumed for water quality facilities in this watershed is a biofiltration pond.

Following is a description of the water quality facilities listed in Table 6.

Water Quality Facility BBC-A

Runoff from approximately 3.6 acres of new, rebuilt eastbound lanes of SR 500 and 39th Street, and 1.9 acres of existing westbound lanes that would not be affected by the project would be conveyed to a bioretention pond south of the highway. Overflows from the pond would be conveyed to an existing outfall, BBC-01.

Water Quality Facility BBC-B

Runoff from about 2.5 acres of rebuilt and new pavement and approximately 2.3 acres of resurfaced pavement would be conveyed to a bioretention pond, BBC-B, located immediately east of I-5 and south of 39th Street. Most of the impervious area comprises I-5 that currently drains to the existing infiltration pond (BBC-C) at the Main Street interchange. Overflows from the pond would be conveyed to an existing outfall, BBC-01.

Water Quality Facility BBC-C

BBC-C is the existing infiltration pond at the Main Street interchange. We do not propose to modify this pond since this type of facility is considered to provide an adequate runoff treatment. Although approximately 12.8 acres of new, rebuilt and resurfaced project pavement would be conveyed to this pond, the total impervious area served by it would be decreased by about 2.2 acres as stated above.

Overflows from the pond are released to Burnt Bridge Creek at outfall BBC-02.

Fairview Creek Watershed

TriMet's Ruby Junction operations and maintenance facility, which is located in this watershed, would be expanded to meet the needs of both the CRC and Milwaukie projects. The expansion would comprise extending the existing maintenance bays and constructing a new storage yard. To facilitate construction, property west and south of the existing facility would be acquired and the south end of NW Eleven Mile Avenue would be vacated. The expansion would result in a net reduction in impervious of about 0.5 acre.

The design of the Ruby Junction expansion is being undertaken independently of the CRC. Based on information provided by TriMet, runoff from existing and proposed impervious areas would be infiltrated; there would be no provision for overflow to Fairview Creek, even in the case of an extreme storm event.Although infiltration has been assumed, it should be noted that other methods of water quality treatment may be selected by TriMet. Regardless, the facility will need to comply with the City of Gresham's water quality requirements[16]. Since the receiving watercourse, Fairview Creek, is 303(d) listed and has TMDLs, these requirements would result in a suite of acceptable stormwater BMPs that would be similar to those proposed elsewhere for the CRC project.

Permanent Flow Control Management Strategies

As stated elsewhere, flow control is only required for discharges to Burnt Bridge Creek. Based on the current project layout, additional flow control measures would not be required for the existing infiltration pond at the Main Street interchange since the total impervious area draining to this facility would be reduced by the project. Preliminary sizing for the proposed new biofiltration ponds is based on ensuring that inflows up to the 1 in 100-year event or greater would be infiltrated.

Facility Maintenance and Inspection

Continued inspection and maintenance of the permanent water quality and flow control facilities is vital to the long-term protection of receiving water bodies. While detailed procedures will be developed as part of final design and associated design reports, appendices at the back of this memorandum contain general inspection and maintenance requirements contained in the ODOT Hydraulics Manual[17] and WSDOT Highway Runoff Manual.[18]

SUMMARY

OPTION A – FULL-BUILD

Overall, the project will increase the total impervious area by approximately 38 acres. Not including the Fairview Creek watershed, the current full build design would result in approximately 225 acres of new and rebuilt impervious surface, and 39 acres of resurfaced pavement. The total CIA of 298 acres also includes about 34 acres of existing pavement and sidewalk that will not be affected by the project. The existing impervious surfaces within the CIA include the North Portland Harbor bridges and Vancouver streets not affected by the project, but from which runoff would drain to proposed water quality facilities.

At this time, the project team has not determined approaches to treat runoff from approximately 8 acres, or about 3 percent of the CIA. This area comprises approximately 7 acres of I-5 pavement immediately north of Victory Boulevard and 1 acre of the eastbound lanes on SR 14. As mentioned elsewhere in this document, project staff are continuing to investigate options to collect and treat runoff from these areas.

PROJECT OPTIONS AND PHASING

This section describes the differences should project or phasing be implemented. Project options being considered and elements that could be constructed at a later date and the overall changes in stormwater-related impacts are:

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[16] Water Quality Manual. Prepared by the Stormwater Division, Department of Environmental Services, City of Gresham. Summer 2003.

[17] Hydraulics Manual, Chapter 14 (Draft). Prepared by the Oregon Department of Transportation, Highway Division. 2007.

[18] Highway Runoff Manual. Prepared by Washington State Department of Transportation. Publication M31-16.01. June 2008.

1) Option B – Full Build

   Under this scenario, the proposed arterial connection over North Portland Harbor would be eliminated and the vehicle movements accommodated by highway ramps. The changes would result in nominal increases of 0.3 acre and 0.4 acre in the Columbia Slough Watershed and Columbia River Watershed – Oregon, respectively.

2) Options A and B – with Highway Phasing

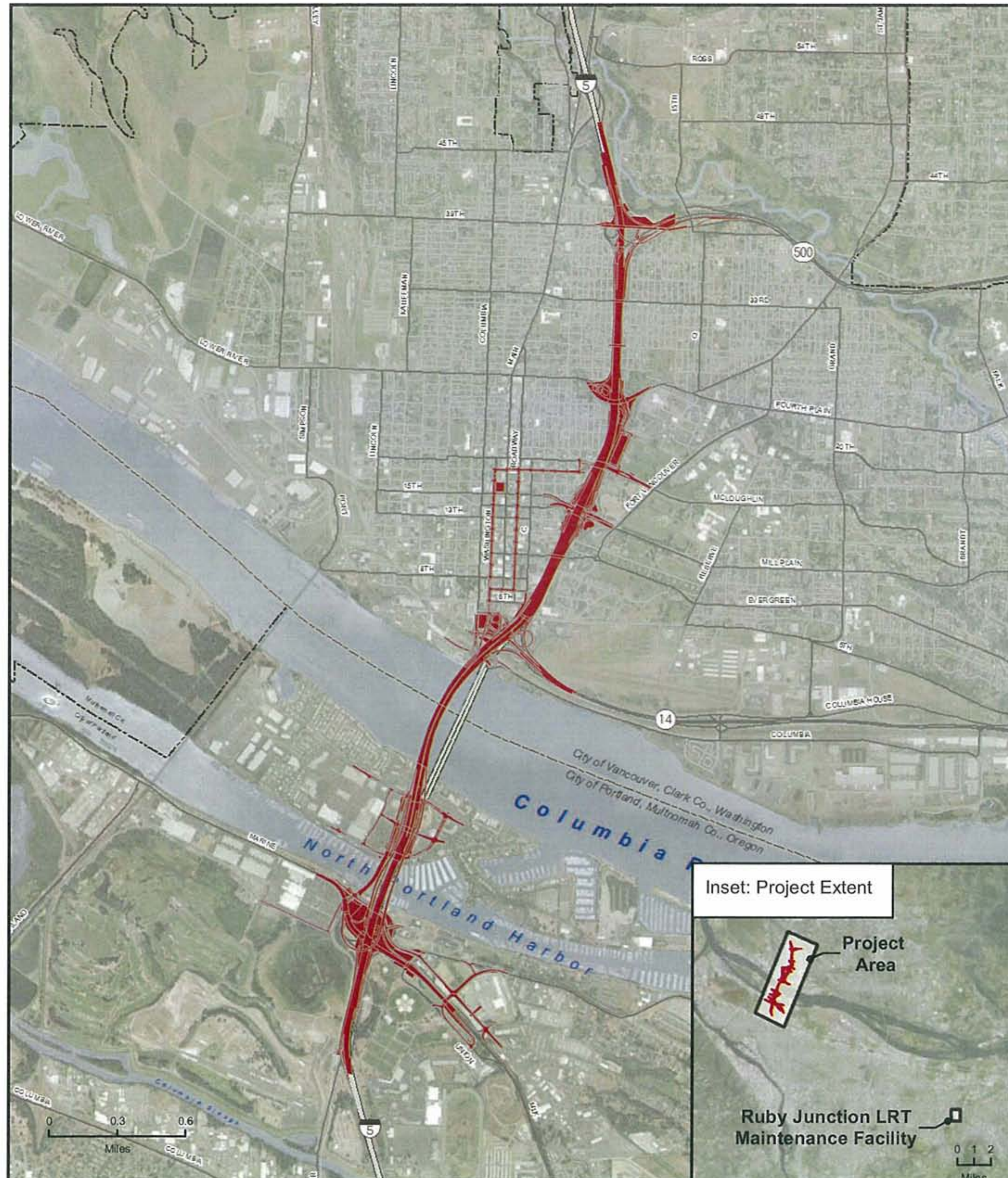
   The braided ramp between Marine Drive and southbound I-5 would be replaced by a shorter ramp merging onto southbound I-5 north of Victory Boulevard and construction of the ramp from eastbound Marine Drive to northbound I-5 would be deferred. In the full-build scenarios, the braided ramp would join I-5 south of Victory Boulevard. This would result in a net reduction in CIA within the Columbia Slough watershed of approximately 5.5 acres, all of which would be PGIS. The 0.9 acre of new impervious surface draining to the proposed biofiltration swale CS-A would be eliminated as would the 0.5 acre merge south of Victory Boulevard (the latter would be conveyed to a swale constructed as part of the Delta Park project). In addition, the new impervious areas draining to constructed wetlands CS-B, CS-D and CS-E would be reduced by 0.8, 0.2, and 3.1 acres, respectively.

   The ramps from southbound I-5 to eastbound SR 500 and from westbound SR 500 to northbound I-5 would be deferred. Phasing this construction would result in a reduction in impervious area of approximately 5 acres, all of which is in the Burnt Bridge Creek watershed, and eliminate the need for water quality facility BBC-A. The CIA draining to water quality facility BBC-B would be reduced by 0.9 acre, all of which is resurfaced pavement on I-5, and the CIA draining to the existing infiltration pond BBC-C would be reduced by 1.3 rather than 2.3 acres.

These alternatives would only affect the impervious area from which runoff would be treated: the untreated area of about 8 acres would remain unchanged.

FIGURES

PRELIMINARY



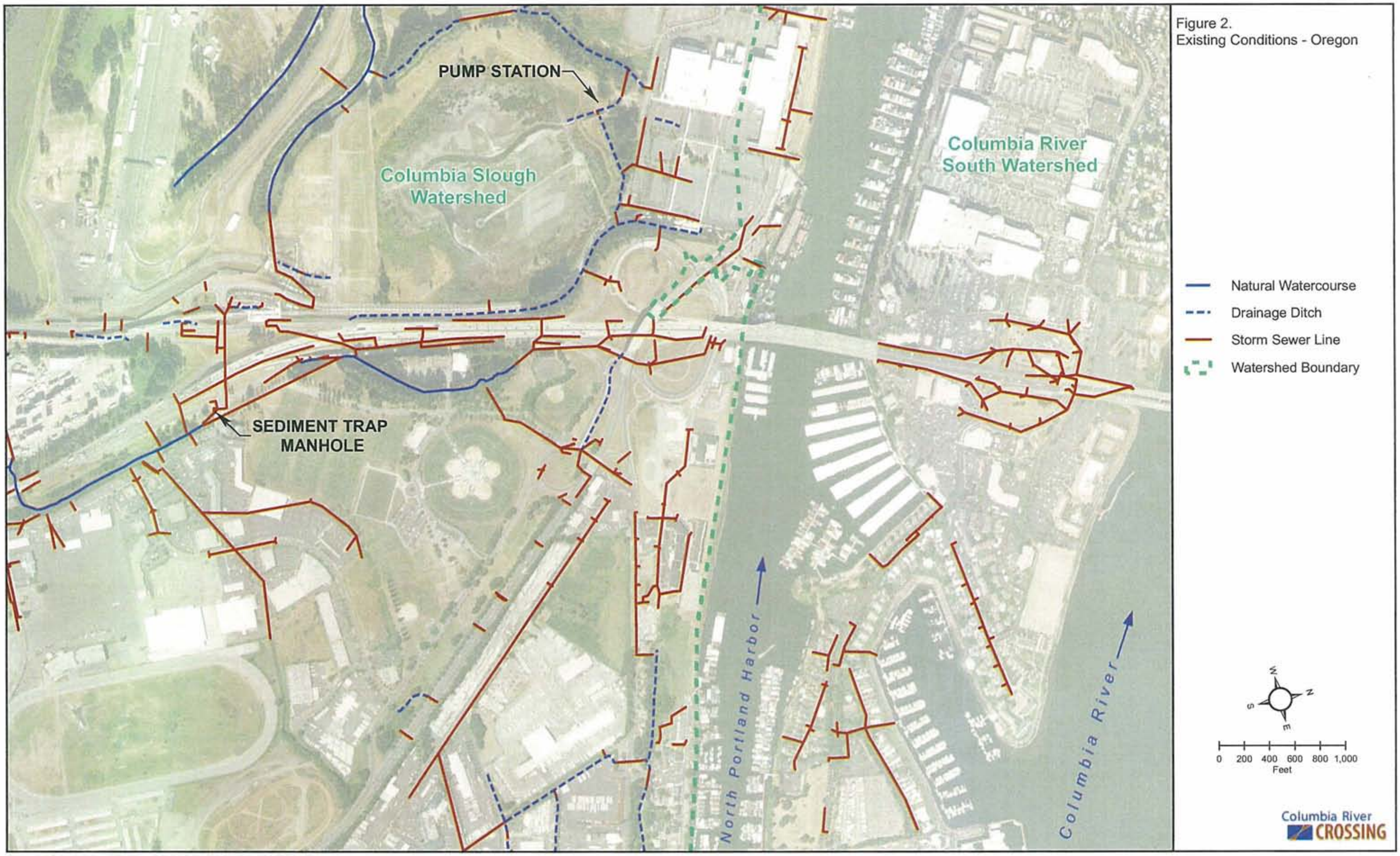
N
W E
S

Project Footprint

Figure 1. Proposed Project Footprint

Columbia River CROSSING

PRELIMINARY



4845

Figure 3.
Existing Conditions - Washington State (Sheet 1 of 2)

PRELIMINARY

PRELIMINARY

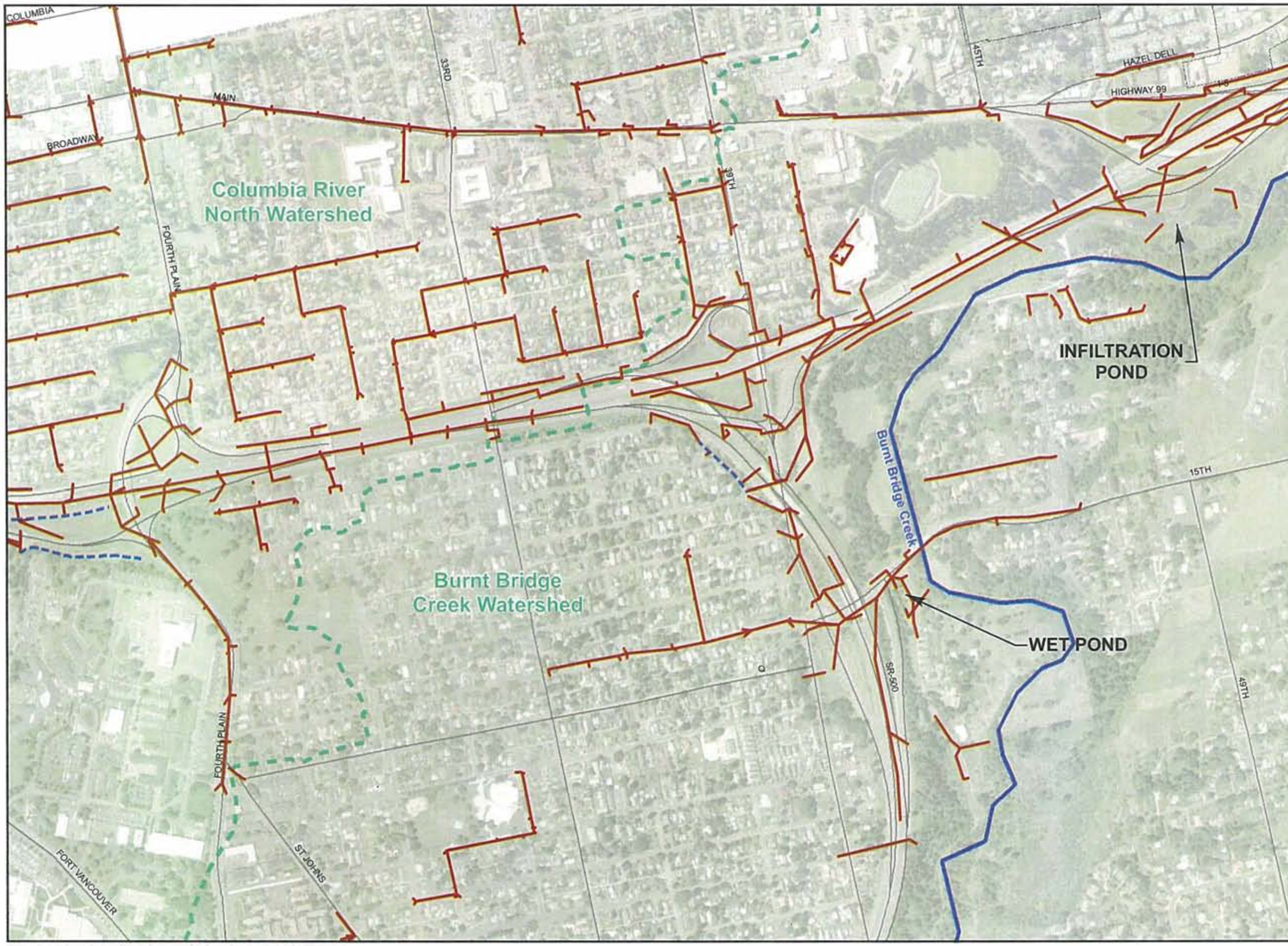


Figure 4.
Existing Conditions - Washington State (Sheet 2 of 2)

Natural Watercourse
Drainage Ditch
Storm Sewer Line
Watershed Boundary

W N S E

0 200 400 600 800 1,000
Feet

Columbia River CROSSING

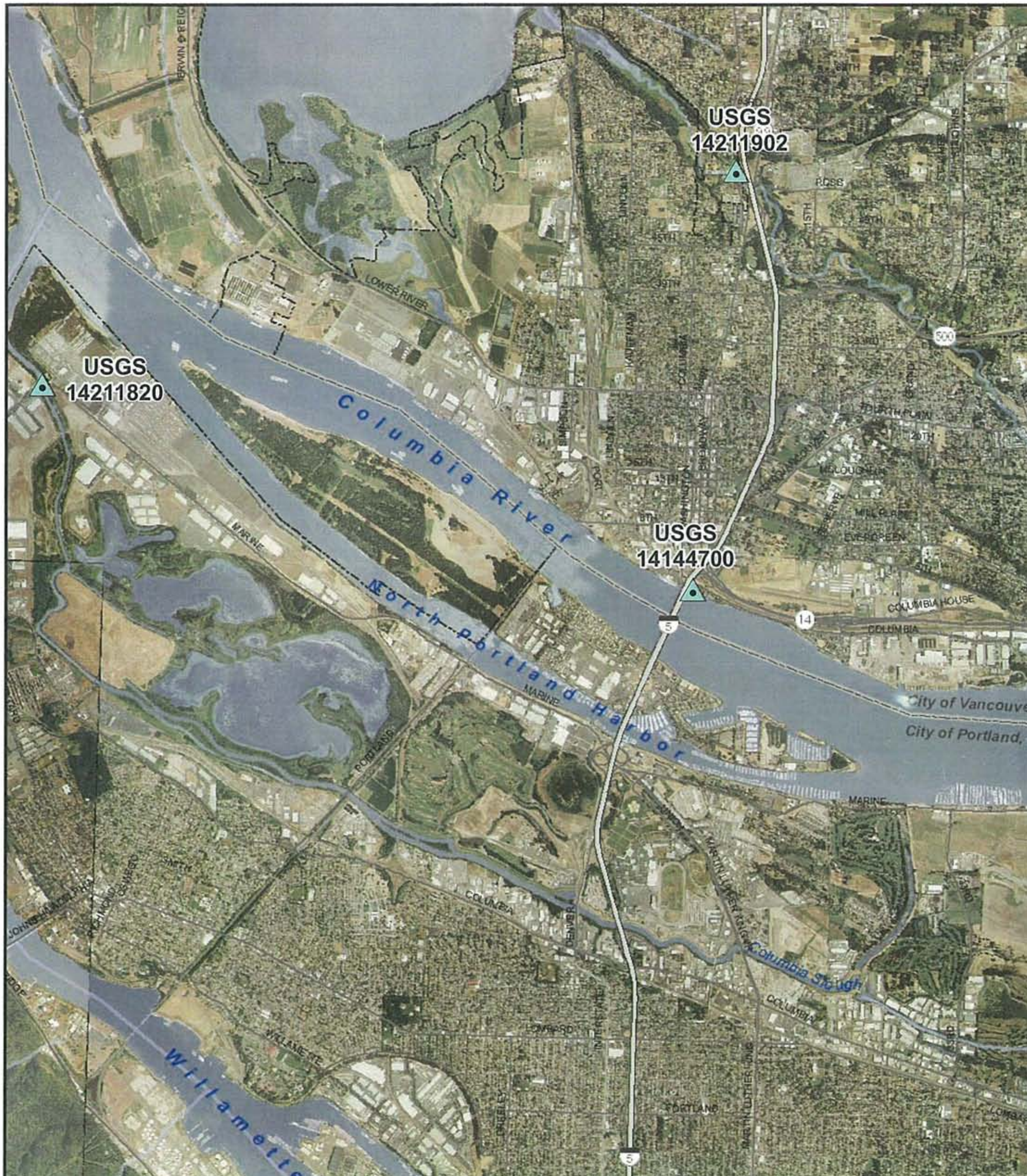
4849

PRELIMINARY

Figure 5.
Threshold Discharge Areas - Ruby Junction

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Oct. 05, 2010; File Name: Fig5_RubyJun_Stormwater_RK251.mxd



USGS Surface Water Gauging Station

0 0.5 1
Miles

Figure 6.
USGS Gauging Station Locations

Columbia River CROSSING

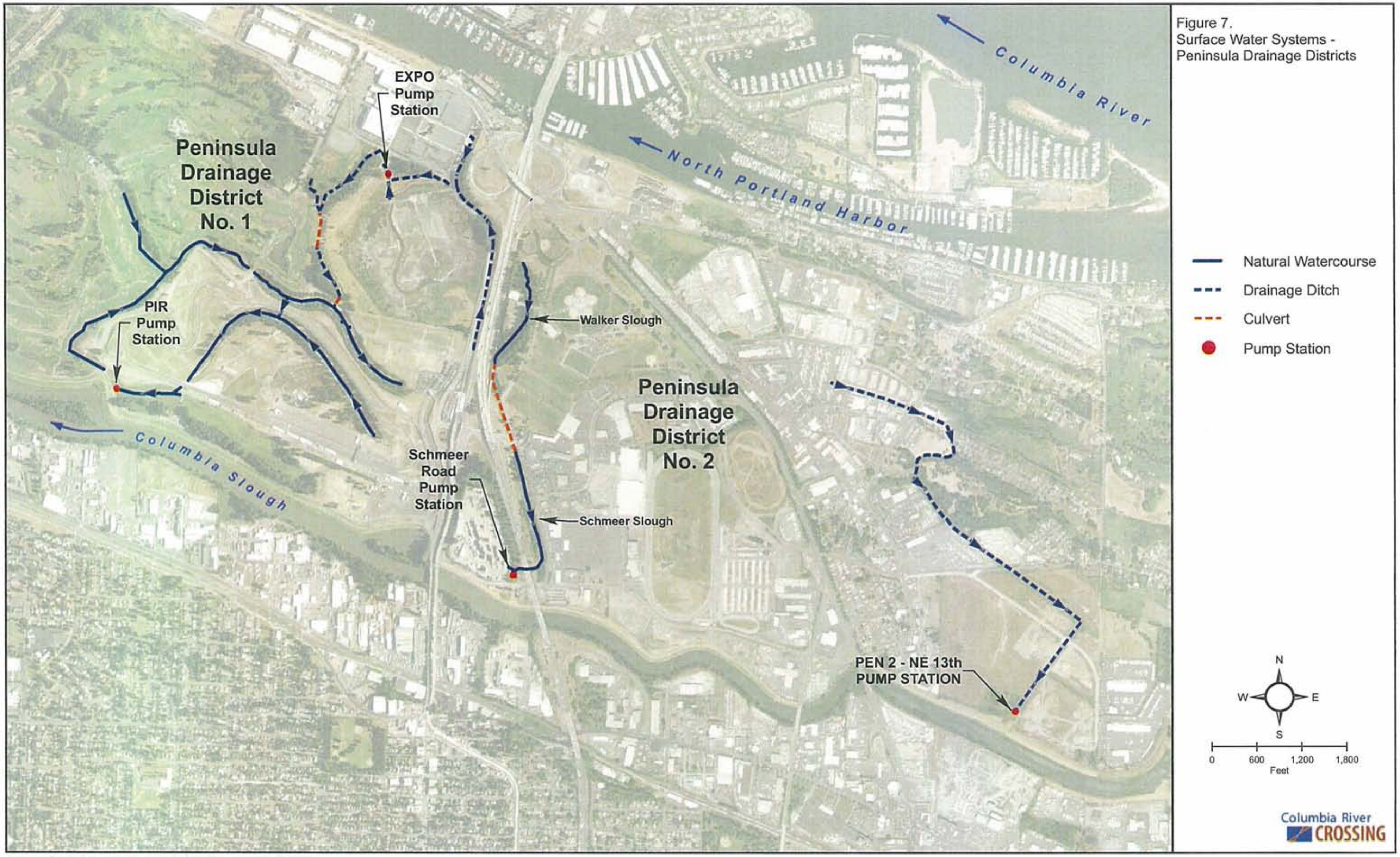


Figure 7.
Surface Water Systems - Peninsula Drainage Districts

PRELIMINARY

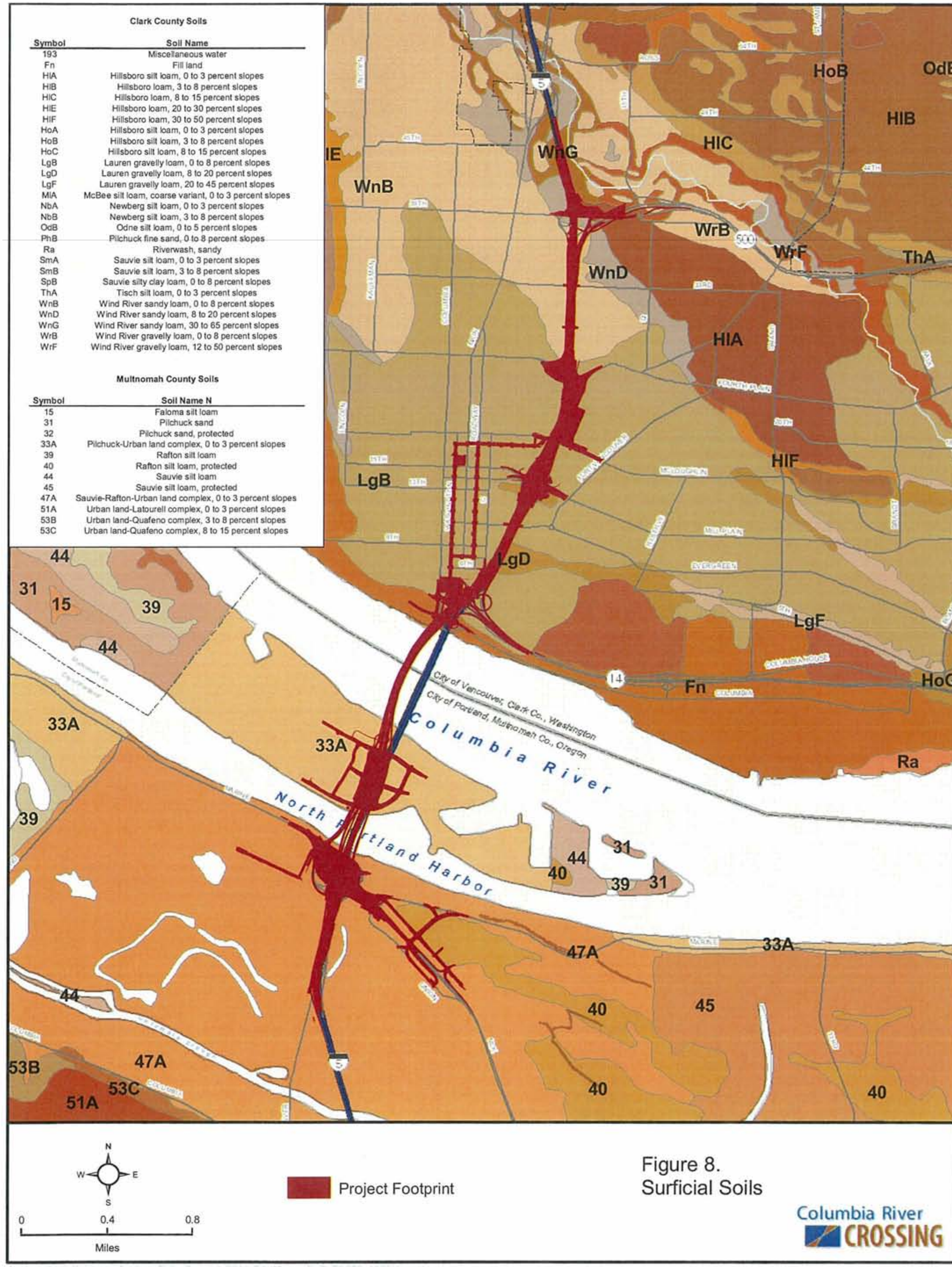


Figure 8.
Surficial Soils

PRELIMINARY

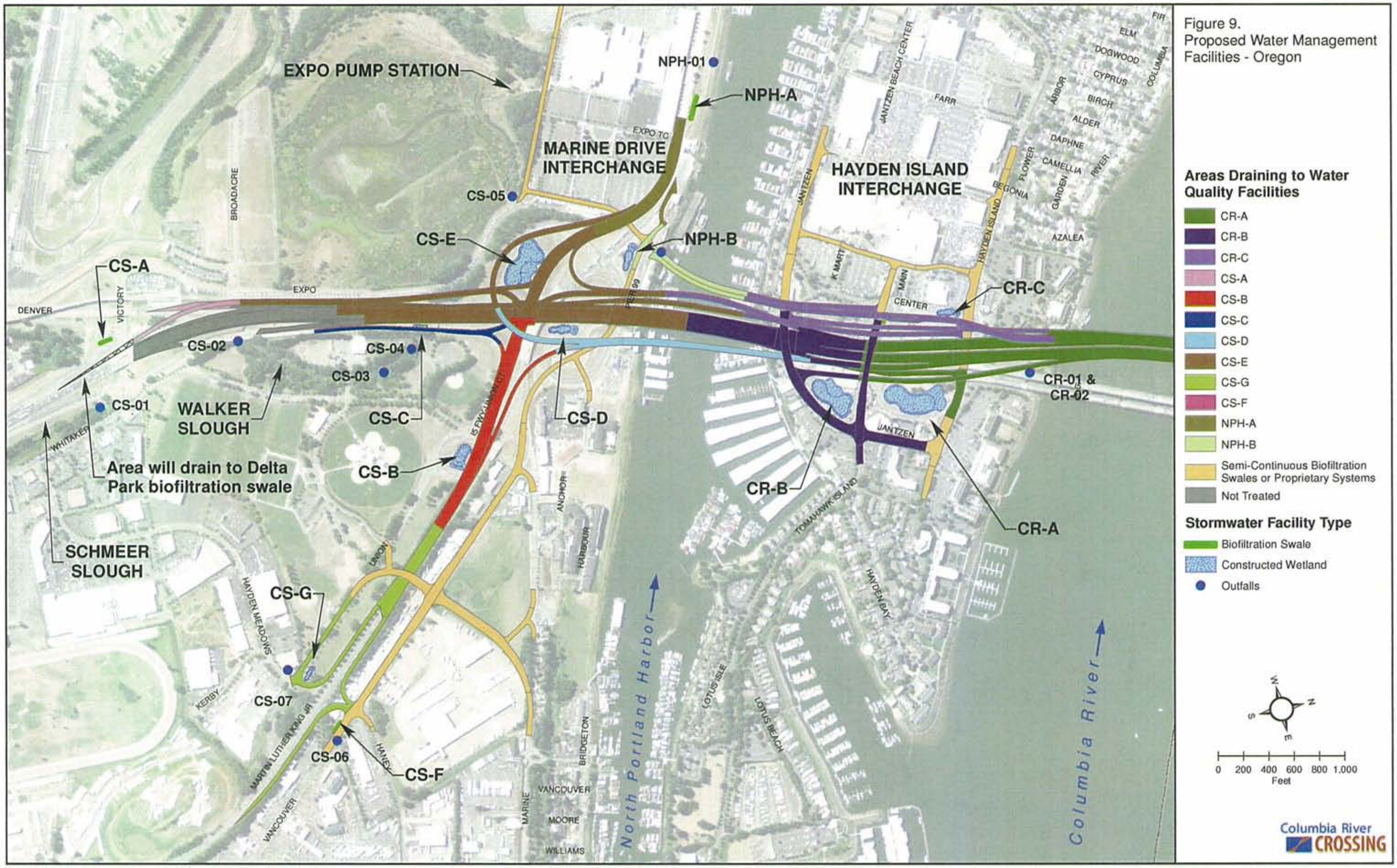


Figure 9.
Proposed Water Management Facilities - Oregon

4859

PRELIMINARY

PRELIMINARY

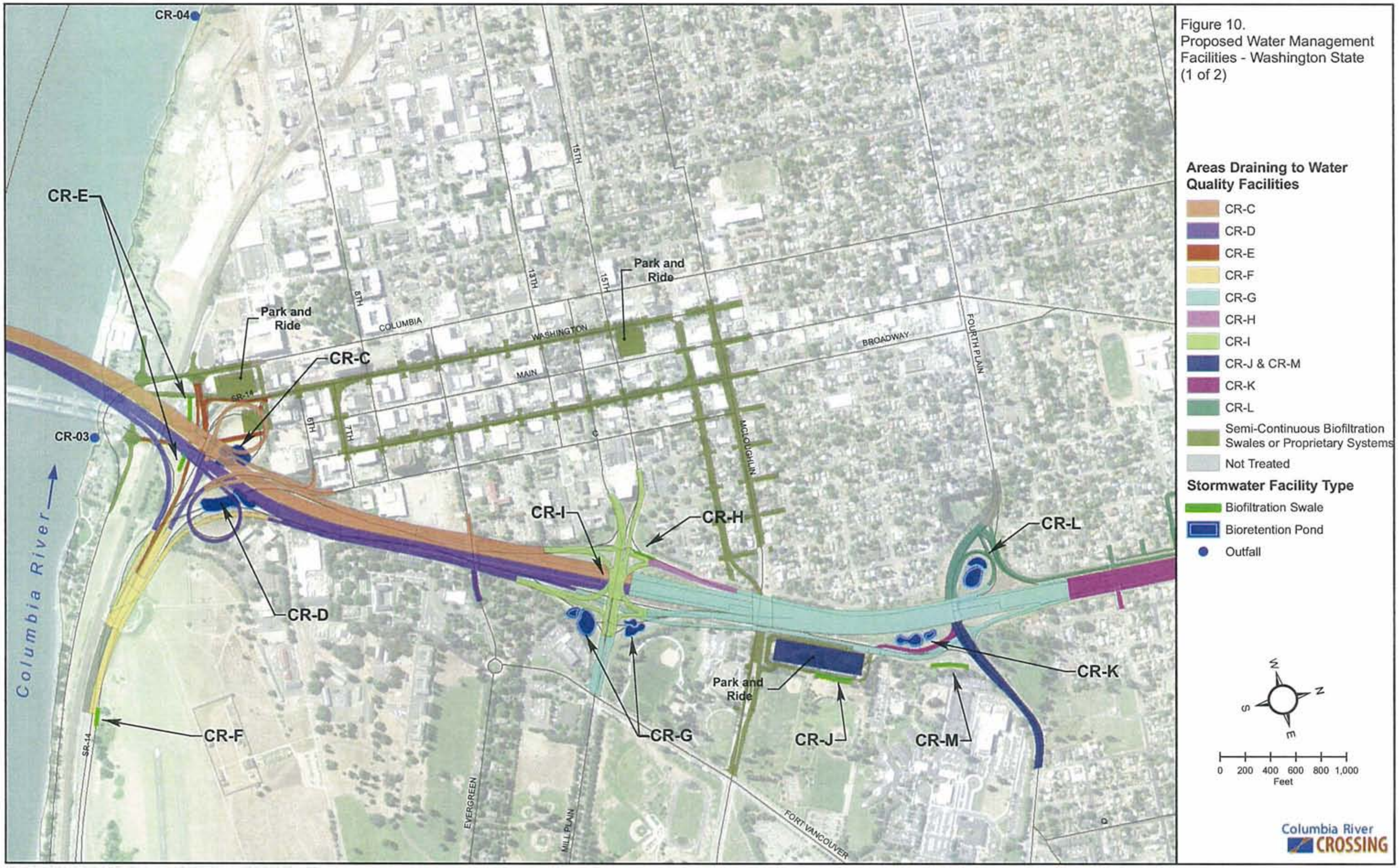
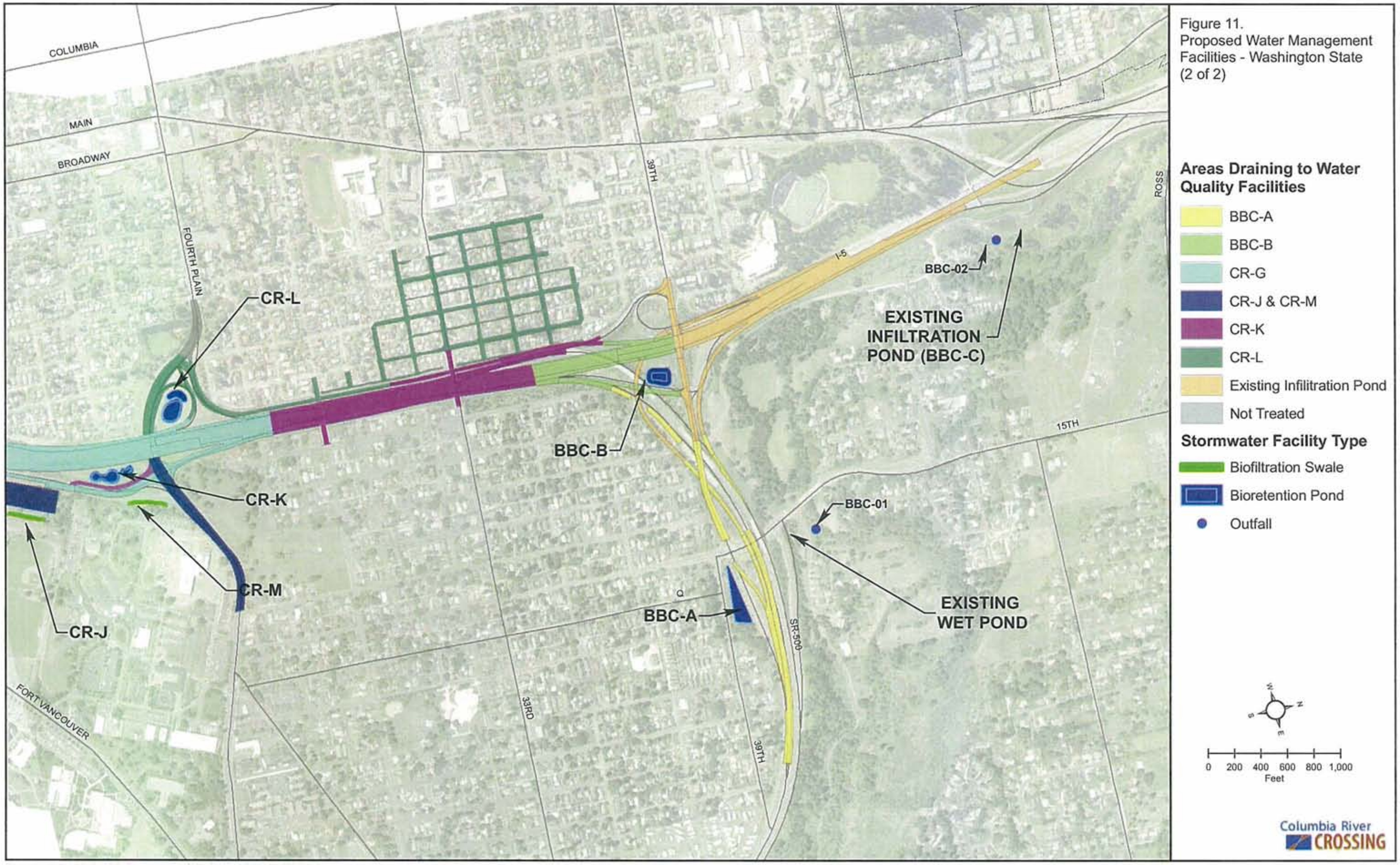


Figure 10.
Proposed Water Management Facilities - Washington State
(1 of 2)

4861

PRELIMINARY

PRELIMINARY



4863

PRELIMINARY

WSDOT MAINTENANCE STANDARDS

5-5 Operation and Maintenance

Inadequate maintenance is a common cause of failure for stormwater control facilities. All stormwater facilities require routine inspection and maintenance and thus must be designed so that these functions can be easily conducted.

5-5.1 Typical BMP Maintenance Standards

The facility-specific maintenance standards contained in this section (see Tables 5.5.1 through 5.5.13) are intended to be used for determining when maintenance actions are required for conditions identified through inspection. They are not intended to be measures of a facility's required condition at all times between inspections. In other words, exceeding these conditions at any time between inspections or maintenance does not automatically constitute a need for immediate maintenance. Based upon inspection observations, however, the inspection and maintenance schedules must be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

5-5.2 Natural and Landscaped Areas Designated as Stormwater Management Facilities

Maintenance of natural and landscaped areas designated as stormwater management facilities requires special attention. Generally, maintenance in these areas should be performed with light equipment. Heavy machinery and vehicles with large treads or tires can compact the ground surface, decreasing the effectiveness of the BMPs.

PRELIMINARY

Table 5.5.1. Maintenance standards for detention ponds.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris	Accumulations exceed 5 cubic feet (about equal to the amount of trash needed to fill one standard-size garbage can) per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold, all trash and debris will be removed as part of the next scheduled maintenance.	Trash and debris are cleared from site.
	Poisonous vegetation and noxious weeds	Poisonous or nuisance vegetation may constitute a hazard to maintenance personnel or the public. Noxious weeds as defined by state or local regulations are evident. (Apply requirements of adopted integrated pest management [IPM] policies for the use of herbicides).	No danger is posed by poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department.) Complete eradication of noxious weeds may not be possible. Compliance with state or local eradication policies is required.
	Contaminants and pollution	Oil, gasoline, contaminants, or other pollutants are evident. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants are present.
	Rodent holes	For facilities acting as a dam or berm: rodent holes are evident or there is evidence of water piping through dam or berm via rodent holes.	Rodents are destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies.)
	Insects	Insects such as wasps and hornets interfere with maintenance activities.	Insects are destroyed or removed from site. Insecticides are applied in compliance with adopted IPM policies.
	Tree growth and hazard trees	Tree growth does not allow maintenance access or interferes with maintenance activity (slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove. Dead, diseased, or dying trees are observed. (Use a certified arborist to determine health of tree or removal requirements.)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (such as alders for firewood). Hazard trees are removed.
Side slopes of pond	Erosion	Eroded damage is over 2 inches deep and cause of damage is still present, or there is potential for continued erosion. Erosion is observed on a compacted berm embankment.	Slopes are stabilized using appropriate erosion control measures (such as rock reinforcement, planting of grass, and compaction). If erosion is occurring on compacted berms, a licensed civil engineer should be consulted to resolve source of erosion.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage area	Sediment	Accumulated sediment exceeds 10% of the designed pond depth, unless otherwise specified, or affects inletting or outletting condition of the facility.	Sediment is cleaned out to designed pond shape and depth. Pond is reseeded if necessary to control erosion.
	Liner (if applicable)	Liner is visible and has more than three ¼-inch holes in it.	Liner is repaired or replaced. Liner is fully covered.
Pond berms (dikes)	Settlements	Any part of berm has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Water flow is discernible through pond berm. Ongoing erosion is observed, with potential for erosion to continue. (Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping is eliminated. Erosion potential is resolved.
Emergency overflow/ spillway and berms over 4 feet high	Tree growth	Tree growth on emergency spillways reduces spillway conveyance capacity and may cause erosion elsewhere on the pond perimeter due to uncontrolled overtopping. Tree growth on berms over 4 feet high may lead to piping through the berm, which could lead to failure of the berm and related erosion or flood damage.	Trees should be removed. If root system is small (base less than 4 inches), the root system may be left in place; otherwise, the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	Water flow is discernible through pond berm. Ongoing erosion is observed, with potential for erosion to continue. (Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping is eliminated. Erosion potential is resolved.
Emergency overflow/ spillway	Spillway lining insufficient	Only one layer of rock exists above native soil in area 5 square feet or larger, or native soil is exposed at the top of outflow path of spillway. (Riprap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.

Table 5.5.2. Maintenance standards for bioinfiltration ponds/infiltration trenches/basins.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
	Poisonous/noxious vegetation	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
	Contaminants and pollution	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
	Rodent holes	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
Storage area	Sediment	Water ponds in infiltration pond after rainfall ceases and appropriate time has been allowed for infiltration. (A percolation test pit or test of facility indicates facility is working at only 90% of its designed capabilities. If 2 inches or more of sediment present, remove sediment).	Sediment is removed or facility is cleaned so that infiltration system works according to design.
Rock filters	Sediment and debris	By visual inspection, little or no water flows through filter during heavy rainstorms.	Gravel in rock filter is replaced.
Side slopes of pond	Erosion	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
Emergency overflow/spillway and berms over 4 feet high	Tree growth	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
	Piping	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
Emergency overflow/spillway	Rock missing	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
	Erosion	See Table 5.5.1 (wet ponds).	See Table 5.5.1 (wet ponds).
Presettling ponds and vaults	Facility or sump filled with sediment or debris	Sediment/debris exceeds 6 inches or designed sediment trap depth.	Sediment is removed.

Table 5.5.3. Maintenance standards for closed treatment systems (tanks/vaults).

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Storage area	Plugged air vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents are open and functioning.
	Debris and sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for ½ length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank requires cleaning when sediment reaches depth of 7 inches for more than ½ the length of the tank.)	All sediment and debris are removed from storage area.
	Joints between tank/pipe section	Openings or voids allow material to be transported into facility. (Will require engineering analysis to determine structural stability.)	All joints between tank/pipe sections are sealed.
	Tank/pipe bent out of shape	Any part of tank/pipe is bent out of shape for more than 10% of its design shape. (Review required by engineer to determine structural stability.)	Tank/pipe is repaired or replaced to design specifications.
	Vault structure: includes cracks in walls or bottom, damage to frame or top slab	Cracks are wider than ½ inch and there is evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault is replaced or repaired to design specifications and is structurally sound.
		Cracks are wider than ½ inch at the joint of any inlet/outlet pipe, or there is evidence of soil particles entering the vault through the walls.	No cracks are more than ¼-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover not in place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than ½ inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover difficult to remove	One maintenance person cannot remove lid after applying normal lifting pressure. *Intent: To prevent cover from sealing off access to maintenance.*	Cover can be removed and reinstalled by one maintenance person.
	Ladder unsafe	Ladder is unsafe due to missing rungs, misalignment, insecure attachment to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch basins	See Table 5.5.5 (catch basins).	See Table 5.5.5 (catch basins).	See Table 5.5.5 (catch basins).

Table 5.5.4. Maintenance standards for control structure/flow restrictor.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris (includes sediment)	Accumulation exceeds 25% of sump depth or is within 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris are removed.
	Structural damage	Structure is not securely attached to manhole wall.	Structure is securely attached to wall and outlet pipe.
		Structure is not in upright position; allow up to 10% from plumb.	Structure is in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are watertight; structure is repaired or replaced and works as designed.
		Holes other than designed holes are observed in the structure.	Structure has no holes other than designed holes.
Cleanout gate	Damaged or missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice plate	Damaged or missing	Control device is not working properly due to missing, out-of-place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Trash, debris, sediment, or vegetation blocks the plate.	Plate is free of all obstructions and works as designed.
Overflow pipe	Obstructions	Trash or debris blocks (or has the potential to block) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table 5.5.3 (closed treatment systems).	See Table 5.5.3 (closed treatment systems).	See Table 5.5.3 (closed treatment systems).
Catch basin	See Table 5.5.5 (catch basins).	See Table 5.5.5 (catch basins).	See Table 5.5.5 (catch basins).

Table 5.5.5. Maintenance standards for catch basins.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris	Trash or debris is immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris is immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) exceeds 60% of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case is clearance less than 6 inches from the debris surface to the invert of the lowest pipe.	No trash or debris is in the catch basin.
		Trash or debris in any inlet or outlet pipe blocks more than ⅓ of its height.	Inlet and outlet pipes are free of trash or debris.
		Dead animals or vegetation could generate odors that might cause complaints or dangerous gases (such as methane).	No vegetation or dead animals are present within the catch basin.
	Sediment	Sediment (in the basin) exceeds 60% of the sump depth as measured from the bottom of the basin to invert of the lowest pipe into or out of the basin, but in no case is clearance less than 6 inches from the sediment surface to the invert of the lowest pipe.	No sediment is in the catch basin.
	Structure damage to frame and/or top slab	Top slab has holes larger than 2 square inches or cracks wider than ¼ inch. *Intent: To make sure no material is running into basin.*	Top slab is free of holes and cracks.
		Frame is not sitting flush on top slab (separation of more than ¾ inch of the frame from the top slab). Frame is not securely attached.	Frame is sitting flush on the riser rings or top slab and is firmly attached.
	Fractures or cracks in basin walls/bottom	Maintenance person judges that structure is unsound.	Basin is replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe, or there is evidence that soil particles have entered catch basin through cracks.	Pipe is regrouted and secure at the basin wall.
	Settlement/ misalignment	Failure of basin has created a safety, function, or design problem.	Basin is replaced or repaired to design standards.
	Vegetation	Vegetation is growing across and blocking more than 10% of the basin opening.	No vegetation blocks the opening to the basin.
		Vegetation growing in inlet/outlet pipe joints is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth is present.
	Contamination and pollution	Oil, gasoline, contaminants, or other pollutants are evident. (Coordinate removal/cleanup with local water quality response agency.)	No pollution is present.
Catch basin cover	Cover not in place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than ½ inch of thread.	Mechanism opens with proper tools.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Catch basin cover (continued)	Cover difficult to remove	One maintenance person cannot remove lid after applying normal lifting pressure. *Intent: To prevent cover from sealing off access to maintenance.*	Cover can be removed by one maintenance person.
Ladder	Ladder unsafe	Ladder is unsafe due to missing rungs, insecure attachment to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance staff safe access.
Metal grates (if applicable)	Grate opening unsafe	Grate opening is wider than ⅞ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris block more than 20% of grate surface inletting capacity.	Grate is free of trash and debris.
	Damaged or missing	Grate is missing or components of the grate are broken.	Grate is in place and meets design standards.

Table 5.5.6. Maintenance standards for debris barriers (such as trash racks).

Maintenance Components	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris	Trash or debris plugs more than 20% of the openings in the barrier.	Barrier is cleared to design flow capacity.
Metal	Damaged/missing bars	Bars are bent out of shape more than 3 inches.	Bars are in place with no bends more than ¾ inch.
		Bars are missing or entire barrier is missing.	Bars are in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier is replaced or repaired to design standards.
	Inlet/outlet pipe	Debris barrier is missing or not attached to pipe.	Barrier is firmly attached to pipe.

Table 5.5.7. Maintenance standards for energy dissipaters.

Maintenance Components	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock pad	Missing or moved rock	Only one layer of rock exists above native soil in area 5 square feet or larger, or native soil is exposed.	Rock pad is replaced to design standards.
	Erosion	Soil erosion is evident in or adjacent to rock pad.	Rock pad is replaced to design standards.
Dispersion trench	Pipe plugged with sediment	Accumulated sediment exceeds 20% of the design depth.	Pipe is cleaned/flushed so that it matches design.
	Not discharging water properly	There is visual evidence of water discharging at concentrated points along trench—normal condition is a "sheet flow" of water along trench. *Intent: To prevent erosion damage.*	Trench is redesigned or rebuilt to standards.
	Perforations plugged	Over ½ of perforations in pipe are plugged with debris and sediment.	Perforated pipe is cleaned or replaced.
	Water flows out top of "distributor" catch basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm, or water is causing (or appears likely to cause) damage.	Facility is rebuilt or redesigned to standards.
	Receiving area over-saturated	Water in receiving area is causing (or has potential of causing) landslide problems.	There is no danger of landslides.
Internal:			
Manhole/chamber	Worn or damaged post, baffles, side of chamber	Structure dissipating flow deteriorates to ½ of original size or any concentrated worn spot exceeds 1 square foot, which would make structure unsound.	Structure is replaced to design standards.
	Other defects	See entire contents of Table 5.5.5 (catch basins).	See entire contents of Table 5.5.5 (catch basins).

Table 5.5.8. Maintenance standards for biofiltration swale.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits on grass treatment area of the swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
	Standing water	Water stands in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages; improve grade from head to foot of swale; remove clogged check dams; add underdrains; or convert to a wet biofiltration swale.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed through entire swale width.	Level the spreader and clean so that flows are spread evenly over entire swale width.
	Constant baseflow	Small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low-flow pea gravel drain the length of the swale, or bypass the baseflow around the swale.
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals; or reseed into loosened, fertile soil.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches. Mowing is not required for wet biofiltration swales. However, fall harvesting of very dense vegetation after plant die-back is recommended.
	Excessive shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Inlet/outlet	Inlet/outlet areas are clogged with sediment/debris.	Remove material so there is no clogging or blockage in the inlet and outlet area.
	Trash and debris	Trash and debris have accumulated in the swale.	Remove trash and debris from bioswale.
	Erosion/scouring	Swale bottom has eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large (generally greater than 12 inches wide), the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.

Table 5.5.9. Maintenance standards for vegetated filter strip.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment accumulation on grass	Sediment depth exceeds 2 inches.	Remove sediment deposits. Relevel so slope is even and flows pass evenly through strip.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow grass and control nuisance vegetation so that flow is not impeded. Grass should be mowed to a height between 3 and 4 inches.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Remove trash and debris from filter.
	Erosion/scouring	Areas have eroded or scoured due to flow channelization or high flows.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the vegetated filter strip should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

Table 5.5.10. Maintenance standards for media filter drain.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment accumulation on grass filter strip	Sediment depth exceeds 2 inches or creates uneven grading that interferes with sheet flow.	Remove sediment deposits on grass treatment area of the embankment. When finished, embankment should be level from side to side and drain freely toward the toe of the embankment slope. There should be no areas of standing water once inflow has ceased.
	No-vegetation zone/flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire embankment width.	Level the spreader and clean so that flows are spread evenly over entire embankment width.
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the grass strip surface area.	Consult with roadside vegetation specialists to determine why grass growth is poor and correct the offending condition. Replant with plugs of grass from the upper slope or reseed into loosened, fertile soil or compost.
	Vegetation	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Mow vegetation or remove nuisance vegetation so that flow is not impeded. Grass should be mowed to a height of 6 inches.
	Media filter drain mix replacement	Water is seen on the surface of the media filter drain mix from storms that are less than a 6-month, 24-hour precipitation event. Maintenance also needed on a 10-year cycle and during a preservation project.	Excavate and replace all of the media filter drain mix contained within the media filter drain.
	Excessive shading	Grass growth is poor because sunlight does not reach embankment.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
	Trash and debris	Trash and debris have accumulated on embankment.	Remove trash and debris from embankment.

Table 5.5.11. Maintenance standards for permeable pavement.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment accumulation	Collection of sediment is too coarse to pass through pavement.	Remove sediment deposits with high-pressure vacuum sweeper.
	Accumulation of leaves, needles, and other foliage	Accumulation on top of pavement is observed.	Remove with a leaf blower or high-pressure vacuum sweeper.
	Trash and debris	Trash and debris have accumulated on the pavement.	Remove by hand or with a high-pressure vacuum sweeper.
	Oil accumulation	Oil collection is observed on top of pavement.	Immediately remove with a vacuum and follow up by a pressure wash or other appropriate rinse procedure.
Visual facility identification	Not aware of permeable pavement location	Facility markers are missing or not readable.	Replace facility identification where needed.
Annual minimum maintenance			Remove potential void-clogging debris with a biannual or annual high-pressure vacuum sweeping.

Table 5.5.12. Maintenance standards for dispersion areas (natural and engineered).

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Sediment accumulation on dispersion area	Sediment depth exceeds 2 inches.	Remove sediment deposits while minimizing compaction of soils in dispersion area Relevel so slope is even and flows pass evenly over/through dispersion area. Handwork is recommended rather than use of heavy machinery.
	Vegetation	Vegetation is sparse or dying; significant areas are without ground cover.	Control nuisance vegetation. Add vegetation, preferably native ground cover, bushes, and trees (where consistent with safety standards) to bare areas or areas where the initial plantings have died.
	Trash and debris	Trash and debris have accumulated on the dispersion area.	Remove trash and debris from filter. Handwork is recommended rather than use of heavy machinery.
	Erosion/scouring	Eroded or scoured areas due to flow channelization, or high flows are observed.	For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel/compost mix (see Section 5-4.3.2 for the compost specifications). The grass will creep in over the rock mix in time. If bare areas are large (generally greater than 12 inches wide), the dispersion area should be reseeded. For smaller bare areas, overseed when bare spots are evident. Look for opportunities to locate flow spreaders, such as dispersion trenches and rock pads.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Level the spreader and clean so that flows are spread evenly over entire filter width.

Table 5.5.13. Maintenance standards for wet ponds.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	Water level	First cell is empty, doesn't hold water	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Trash and debris	Accumulations exceed 1 cubic foot per 1000 square feet of pond area.	Remove trash and debris from pond.
	Inlet/outlet pipe	Inlet/outlet pipe is clogged with sediment or debris material.	Unclog and unblock inlet and outlet piping.
	Sediment accumulation in pond bottom	Sediment accumulations in pond bottom exceed the depth of sediment zone plus 6 inches, usually in the first cell.	Remove sediment from pond bottom.
	Oil sheen on water	Oil sheen is prevalent and visible.	Remove oil from water using oil-absorbent pads or Vactor truck. Locate and correct source of oil. If chronic low levels of oil persist, plant wetland species such as *Juncus effusus* (soft rush), which can uptake small concentrations of oil.
	Erosion	Pond side slopes or bottom show evidence of erosion or scouring in excess of 6 inches and the potential for continued erosion is evident.	Stabilize slopes using proper erosion control measures and repair methods.
	Settlement of pond dike/berm	Any part of the pond dike/berm has settled 4 inches or lower than the design elevation, or the inspector determines dike/berm is unsound.	Repair dike/berm to specifications.
	Internal berm	Berm dividing cells are not level.	Level berm surface so that water flows evenly over entire length of berm.
	Overflow/spillway	Rock is missing and soil exposed at top of spillway or outside slope.	Replace rocks to specifications.

ODOT MAINTENANCE STANDARDS

10.11 Operation and Maintenance

The proper operation, performance, structural integrity, and aesthetics of a stormwater treatment facility are dependent on routine inspection and adequate maintenance. Facility inspection schedule and maintenance guidelines are summarized in an Operation and Maintenance Manual prepared to assist personnel who maintain the facility.

General requirements include:

- All facilities must have an operation and maintenance manual prepared and a copy must be distributed to the appropriate district maintenance office and Geo-Environmental's Senior Hydraulics Engineer.
- All stormwater treatment facility structures should be accessible by foot and vactor truck for inspection and maintenance.
- Outline an inspection schedule. Inspection schedule guidelines are summarized in Table 6. Include schedule in the facility's Operation and Maintenance Manual.
- Outline maintenance requirements depending on the type of facility and its facility components. General maintenance requirements for extended dry ponds, biofiltration swales, filter strips, and bioslopes are provided in Tables 7 through 10. General maintenance requirements for proprietary structures should be obtained from the appropriate manufacturers. Include any additional requirements needed to maintain proper operation and performance. Include maintenance requirements in the facility's Operation and Maintenance Manual.

Table 6 Inspection Schedule to Determine and Perform Maintenance

Type of Treatment Facility	Additional Inspection	Annual Inspection
Extended Detention Dry Pond	As needed	Required
Bioretention Pond	As needed	Required
Biofiltration Swale	As needed	Required
Filter Strip	As needed	Required
Bioslopes	As needed	Required
Proprietary Structures	See manufacturer's literature	See manufacturer's literature

PRELIMINARY

Table 7 Maintenance Requirements for Stormwater Ponds

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and debris	Trash and debris has accumulated in the pond.	Trash and debris are removed from site.
	Contaminants and pollution	Oil, gasoline, contaminants, or other pollutants are evident following any hazmat spill event. (Additional information is provided in the waste material handling section of the operation and maintenance manual).	No contaminants or pollutants are present.
	Rodent holes	For facilities acting as a dam or berm: rodent holes are evident or there is evidence of water piping through dam or berm via rodent holes.	Rodents are removed from site.
	Beaver dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate regulatory agencies).
	Insects	Insects such as wasps and hornets interfere with maintenance activities.	Insects are removed from site.
	Vegetation growth	Excessive growth does not allow maintenance access, interferes with maintenance activity, or weeds are out of control.	Side slopes are mowed so that vegetation growth does not hinder maintenance activities. Noxious weeds are removed following state or local policies. Herbicides should not be used to control vegetation.
	Tree growth and hazard trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove. Dead, diseased, or dying trees are observed. (Use a certified arborist to determine health of tree or removal requirements).	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard trees.
	Conveyance piping	Conveyance piping is clogged with sediment or debris material.	Conveyance piping are not clogged or blocked.
	Sediment accumulation in pond bottom,	Sediment accumulations exceed the depth of 12 inches.	Sediment is removed.

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	manhole, catch basin or other structure		
	Erosion	Pond side slopes or bottom show evidence of erosion in excess of 4 inches and the potential for continued erosion is evident.	Slopes are stabilized using proper erosion control measures and repair methods.
	Bioretention mix failure	Ponding for (7) consecutive days or longer from May through October. Contact a Region Hydraulics Engineer to evaluate condition of bioretention pond.	The bioretention mix is excavated and replaced with new mix that meets design standard.
Pond berms	Settlement	Any part of the pond dike/berm has settled 4 inches or lower than the design elevation.	Berm is repaired to design standards.
	Piping	Water flow is apparent through pond berm. Ongoing erosion is observed, with potential for erosion to continue. (Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping is eliminated. Erosion potential is resolved.
Split flow Manhole, Outlet Control Structure, and Auxiliary Outlet	Orifice assembly/Riser pipe damage or missing	Assembly is not working properly due to not securely attached, bent or other apparent damage.	Assembly is repaired or replaced to design standards.
	Obstruction	Trash, debris, sediment, or vegetation is clogging the assembly.	Assembly is free of all obstructions and design function is restored.
	Auxiliary outlet spillway lining insufficient	Minimal layer of spillway rip rap exists or native soil is exposed.	Rip rap depth is restored to design standards
Outfall	Bank armoring insufficient	Minimal layer of rip rap exists or native soil is exposed.	Rip rap depth is restored to design standards

Modified from reference 19.

Table 8 Maintenance Requirements for Biofiltration Swales

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation along bottom of swale	Sediment depth exceeds 2 inches.	Sediment deposits removed along bottom of swale. Swale slope and geometry restored to design standards. Areas with minimal grass cover reseeded. There should be no areas of standing water once inflow has ceased.
	Ponding water	Ponding water in the swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages; improve grade from head to foot of swale; or add an under drain
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed through entire swale width.	Spreader is re-leveled and cleaned to restore sheet flow conditions along the swale.
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches occur in more than 10 percent of the swale bottom.	Poor grass growth is corrected and bare areas reseeded.
	Vegetation growth	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Vegetation is mowed and nuisance vegetation removed so that flow is not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings. Noxious weeds are removed following state or local policies. Herbicides should not be used to control vegetation.
	Excessive shading	Grass growth is poor because the lack of sunlight.	Overhanging limbs are trimmed. Brushy vegetation on adjacent slopes is removed.
	Inlet/outlet conveyance piping and structures	Inlet/outlet areas are clogged with sediment and/or debris.	Material removed so there is no clogging or blockage in the inlet and outlet area.
	Trash and debris	Trash and debris have accumulated in the swale.	Trash and debris removed from swale.
	Erosion	Swale bottom has eroded due to flow channelization or high flows.	Bare areas are regarded and reseeded.

Modified from reference 19.

Table 9 Maintenance Requirements for Filter Strips

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation along filter strip	Sediment depth exceeds 2 inches.	Sediment deposits removed, uneven areas are regarded and bare areas are reseeded.
	Vegetation growth	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Vegetation is mowed and nuisance vegetation removed so that flow is not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings. Noxious weeds are removed following state or local policies. Herbicides should not be used to control vegetation.
	Excessive shading	Grass growth is poor because the lack of sunlight.	Overhanging limbs are trimmed. Brushy vegetation on adjacent slopes is removed.
	Trash and debris	Trash and debris have accumulated on the vegetated filter strip.	Trash and debris removed along filter strip.
	Erosion	Areas have eroded or scoured due to flow channelization or high flows.	Bare areas are re-garded and reseeded.
	Flow spreader	Flow spreader is uneven or clogged so that flows are not uniformly distributed over entire filter width.	Spreader is re-leveled and cleaned so that flows are spread evenly over entire filter width.

Modified from reference 19.

Table 10 Maintenance Requirements for Bioslopes

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Sediment accumulation	Sediment depth exceeds 2 inches	Sediment deposits removed, uneven areas are regarded and bare areas are reseeded.
	Poor vegetation coverage	Grass is sparse or bare, or eroded patches are observed in more than 10% of the vegetated filter strip surface area.	Poor grass growth is corrected and bare areas reseeded.
	Vegetation growth	Grass becomes excessively tall (greater than 10 inches); nuisance weeds and other vegetation start to take over.	Vegetation is mowed and nuisance vegetation removed so that flow is not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings. Noxious weeds are removed following state or local policies. Herbicides should not be used to control vegetation.
	Ecology mix failure	Low and medium flows are seen bypassing the bioslope. Contact a Region Hydraulics Engineer to evaluate condition of bioslope.	The ecology mix is excavated and replaced with new mix that meets design standard.
	Excessive shading	Grass growth is poor because the lack of sunlight.	Overhanging limbs are trimmed. Brushy vegetation on adjacent slopes is removed.
	Trash and debris	Trash and debris have accumulated along the bioslope.	Trash and debris removed from the bioslope.

Modified from reference 19.

INTERSTATE 5 COLUMBIA RIVER CROSSING

Hazardous Materials Technical Report for the Final Environmental Impact Statement

Columbia River CROSSING

May 2011

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COVER SHEET

Interstate 5 Columbia River Crossing

Hazardous Materials Technical Report for the Final Environmental Impact Statement:

Submitted By:

Eric A. Roth, RG, LHG

Parametrix

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LIST OF EXHIBITS

APPENDICES

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ACRONYMS

Acronym	Description
µg	micrograms
AAI	all appropriate inquiry
AASHTO	American Association of State Highway and Transportation Officials
ACM	asbestos-containing material
AIRS	EPA Aerometric Information Retrieval System
AST	above ground storage tank
ASTM	American Society of Testing and Materials
AVS	acid-volatile sulfide
bgs	below ground surface
BMP	best management practice
BNSF	Burlington Northern Santa Fe Railroad
BTEX	Benzene, toluene, ethylbenzene, and xylene
C-TRAN	Clark County Public Transportation Benefit Authority
CD	collector-distributor
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information System
CFR	Code of Federal Regulations
CMMP	Contaminated Media Management Plan
CORRACTS	RCRA Corrective Action Sites
CPC	City of Portland Code
CPU	Clark Public Utilities
CRBG	Columbia River Basalt Group
CRC	Columbia River Crossing
CSCS	Confirmed and Suspected Contaminated Sites
CTR	Commute Trip Reduction (Washington)
CU1	Confining Unit 1
CU2	Confining Unit 2
CVOC	Chlorinated volatile organic compound
CWA	Clean Water Act
DDT	Trichlorodiphenyldichloroethane
DEIS	Draft Environmental Impact Statement
DEQ	Oregon Department of Environmental Quality
DMEF	Dredge Material Evaluation Framework
DOT	U.S. Department of Transportation

ECO	Employee Commute Options (Oregon)
Ecology	Washington Department of Ecology
EDR	Environmental Data Resources
EIM	Environmental Information Management System
EMAP	Environmental Management and Assessment Program
EPA	United States Environmental Protection Agency
ERNS	Emergency Response Notification System
ERTS	Environmental Report Tracking System
ESA	Environmental Site Assessment
ESCI	Environmental Site Cleanup Information
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act of 1972
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report
FTA	Federal Transit Administration
FTTS	FIFRA/TSCA Tracking System
g	gram
gpd/ft	gallons per day per foot
HASP	Health and Safety Plan
HAZMAT	Hazardous Materials/Incidents
HMIRS	Hazardous Materials Information Reporting System
HRM	Highway Runoff Manual
HSIS	Hazardous Substance Information Survey
HSWA	Hazardous and Solid Waste Amendments
I-5	Interstate 5
ICIS	Integrated Compliance Information System
kg	kilogram
LPA	Locally Preferred Alternative
LQG	large quantity generator
LRV	light rail vehicle
LUST	leaking underground storage tank
MCL	Maximum contaminant limit
MDR	Methods and Data Report
mg/kg	milligrams per kilograms
Mi	mile
mm	millimeter
MSL	Mean sea level

MTCA	Model Toxics Control Act
NAVD88	North American vertical datum 1988
NEPA	National Environmental Policy Act
NFA	no further action
NFRA	no further remedial action
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OAR	Oregon Administrative Rule
ODOT	Oregon Department of Transportation
OHW	ordinary high water
ORS	Oregon Revised Statute
OTC	Oregon Transportation Commission
PADS	PCB Activity Database
PAHs	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PGIS	pollutant-generating impervious surface
POV	Port of Vancouver
PRP	potentially responsible party
PS&E	Plans, Specifications, and Estimates
Qfc	coarse-grained facies
Qff	fine-grained facies
RAATS	RCRA Administration Action Tracking System
RCRA-NLR	Resource Conservation and Recovery Act - No Longer Regulated
RCRIS	Resource Conservation and Recovery Information System
RCW	Revised Code of Washington
REC	recognized environmental condition
RGS	reporter gene system
RM	river mile
ROD	Record of Decision
RTC	Regional Transportation Council
SARA Title III	Superfund Reauthorization Act
SDWA	Safe Drinking Water Act
SEF	sediment evaluation framework
SGA	sand and gravel aquifer
SHWS	State Hazardous Waste Sites
SMCL	Secondary maximum contaminant limit

SPCC	Spill Prevention, Control & Countermeasure plan
SPILLS	spill data
SPUI	single-point urban interchange
SQG	small quantity generator
SR	state route
STHB	stacked transit highway bridge
SVOC	Semi-volatile organic compound
SWF-LF	Solid Waste Facilities List
SWPPP	Stormwater Pollution Prevention Plan
TBT	Tributyltin
TCE	Temporary Construction Easement
TDA	Threshold drainage area
TDM	transportation demand management
TGA	Troutdale gravel aquifer
TriMet	Tri-County Metropolitan Transportation District
TRIS	Toxic Chemical Release Inventory System
TSA	Troutdale Sandstone Aquifer
TSCA	Toxic Substances Control Act of 1976
TSM	transportation system management
TSSA	Troutdale Sole Source Aquifer
TVS	total volatile solids
USA	unconsolidated sedimentary aquifer
USACE	United States Army Corps of Engineers
USC	United States Code
USGS	United States Geological Survey
UST	underground storage tank
VCP	Voluntary Cleanup Program
VOC	Volatile organic compound
VMC	Vancouver Municipal Code
VNHR	Vancouver National Historic Reserve
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
WTC	Washington Transportation Commission

1. Summary

1.1 Introduction

Without proper precautions, hazardous materials can adversely affect project construction worker and public safety, agency and public relations, and the quality of natural resources, as well as delay project schedules and increase project costs. Conversely, identifying and remediating hazardous materials can have long-term benefits to human health and the environment. This report identifies, describes and evaluates potential short-term and long-term effects related to hazardous materials resulting from the construction and operation of the Interstate 5 (I-5) Columbia River Crossing (CRC) project, and describes measures to help avoid or mitigate these potential effects.

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

The objectives of this report are to:

- Define the project study area (Section 1).
- Describe project elements and proposed construction and operation activities (Section 1).
- Describe methods of data collection and analysis (Section 2).
- Describe existing conditions and the environmental setting (Section 3).
- Identify hazardous materials sites within the study area (Section 3).
- Screen and evaluate identified hazardous materials sites (Section 4).
- Summarize potential significant short-term effects (Section 5).
- Summarize potential significant long-term effects (Section 6).
- Describe avoidance and mitigation measures to help prevent, eliminate or minimize environmental consequences (Section 7).
- Describe applicable permits and approvals (Section 8).

1.2 Description of Alternatives

This technical report evaluates the CRC project's locally preferred alternative (LPA) and the No-Build Alternative. The LPA includes two design options: The preferred option, LPA Option A, which includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge; and LPA Option B, which does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor (CD) lanes on the two new bridges that would be built adjacent to I-5. In addition to the design options, if funding availability does not allow the entire LPA to be constructed in one phase, some roadway elements of the project would be deferred to a future date. This technical report identifies several elements that could be deferred, and refers to that possible initial investment as LPA with highway phasing. The LPA with highway phasing option would build most of the LPA in the first phase, but would defer construction of specific elements of the project. The LPA and the No-Build Alternative are described in this section.

1.2.1 Adoption of a Locally Preferred Alternative

Following the publication of the Draft Environmental Impact Statement (DEIS) on May 2, 2008, the project actively solicited public and stakeholder feedback on the DEIS during a 60-day comment period. During this time, the project received over 1,600 public comments.

During and following the public comment period, the elected and appointed boards and councils of the local agencies sponsoring the CRC project held hearings and workshops to gather further public input on and discuss the DEIS alternatives as part of their efforts to determine and adopt a locally preferred alternative. The LPA represents the alternative preferred by the local and regional agencies sponsoring the CRC project. Local agency-elected boards and councils determined their preference based on the results of the evaluation in the DEIS and on the public and agency comments received both before and following its publication.

In the summer of 2008, the local agencies sponsoring the CRC project adopted the following key elements of CRC as the LPA:

- A replacement bridge as the preferred river crossing,
- Light rail as the preferred high-capacity transit mode, and
- Clark College as the preferred northern terminus for the light rail extension.

The preferences for a replacement crossing and for light rail transit were identified by all six local agencies. Only the agencies in Vancouver – the Clark County Public Transit Benefit Area Authority (C-TRAN), the City of Vancouver, and the Regional Transportation Council (RTC) – preferred the Vancouver light rail terminus. The adoption of the LPA by these local agencies does not represent a formal decision by the federal agencies leading this project – the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) – or any federal funding commitment. A formal decision by FHWA and FTA about whether and how this project should be constructed will follow the FEIS in a Record of Decision (ROD).

1.2.2 Description of the LPA

The LPA includes an array of transportation improvements, which are described below. When the LPA differs between Option A and Option B, it is described in the associated section. For a more detailed description of the LPA, including graphics, please see Chapter 2 of the FEIS. Exhibits 1-1a through 1-1c present the location of some LPA elements.

1.2.2.1 Multimodal River Crossing

Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River would be replaced by two new parallel bridges. The eastern structure would accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path underneath; the western structure would carry southbound traffic, with a two-way light rail guideway below. Whereas the existing bridges have only three lanes each with virtually no shoulders, each of the new bridges would be wide enough to accommodate three through-lanes and two add/drop lanes. Lanes and shoulders would be built to full design standards.

PRELIMINARY

Exhibit 1-1a: Fourth Plain to SR 500
McLoughlin Transit Option
Project Element Locations

Columbia River CROSSING

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Exhibit 1-1b: SR 14 to McLoughlin Boulevard McLoughlin Boulevard Transit Option Project Element Locations

Columbia River CROSSING

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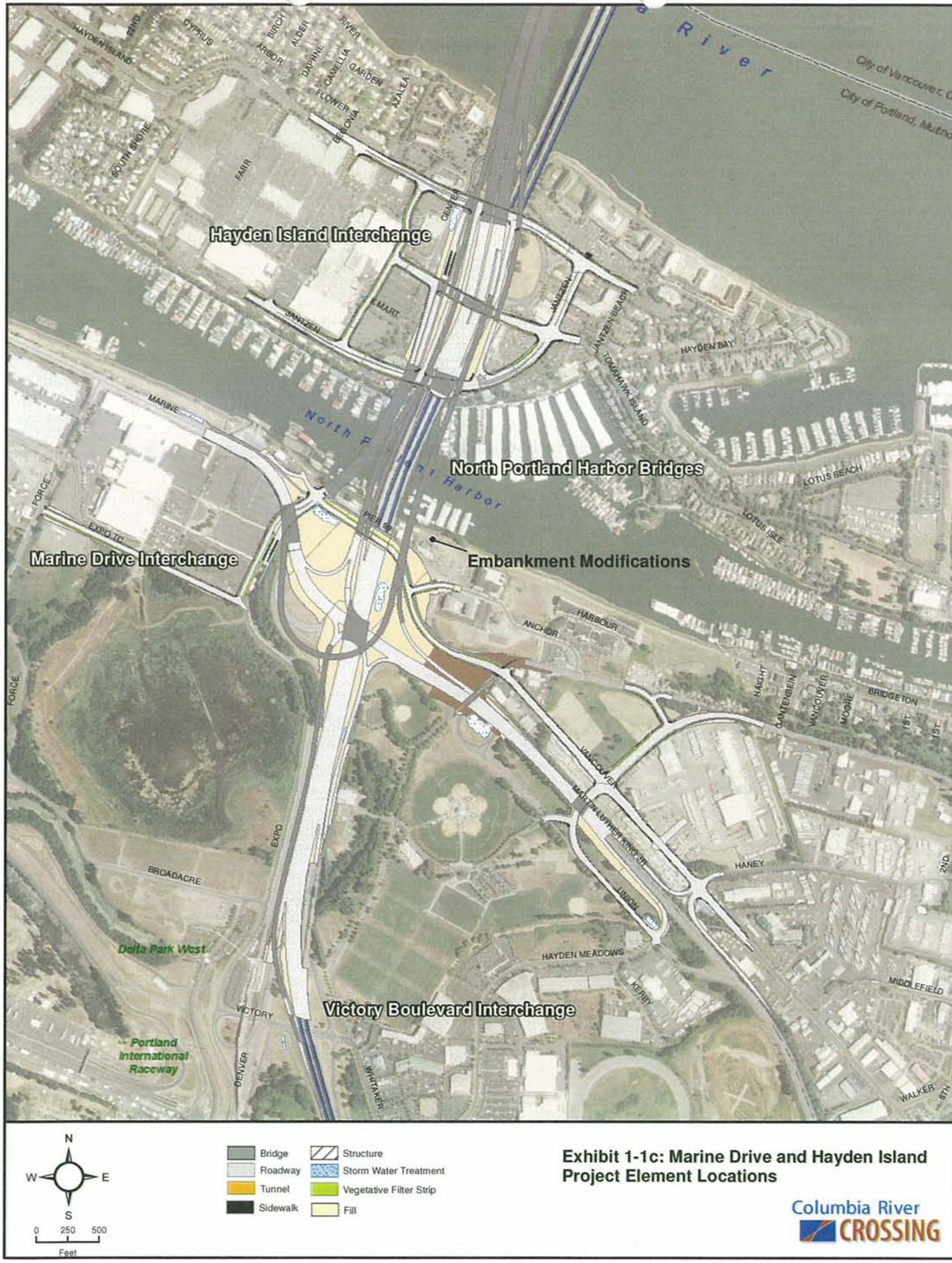

Exhibit 1-1c: Marine Drive and Hayden Island Project Element Locations

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The new bridges would be high enough to provide approximately 95 feet of vertical clearance for river traffic beneath, but not so high as to impede the take-offs and landings by aircraft using Pearson Field or Portland International Airport to the east. The new bridge structures over the Columbia River would not include lift spans, and both of the new bridges would each be supported by six piers in the water and two piers on land.

North Portland Harbor Bridges

The existing highway structures over North Portland Harbor would not be replaced; instead, they would be retained to accommodate all mainline I-5 traffic. As discussed at the beginning of this chapter, two design options have emerged for the Hayden Island and Marine Drive interchanges. The preferred option, LPA Option A, includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge. LPA Option B does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor lanes on the two new bridges that would be built adjacent to I-5.

LPA Option A: Four new, narrower parallel structures would be built across the waterway, three on the west side and one on the east side of the existing North Portland Harbor bridges. Three of the new structures would carry on- and off-ramps to mainline I-5. Two structures west of the existing bridges would carry traffic merging onto or exiting off of I-5 southbound. The new structure on the east side of I-5 would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include a two-lane arterial bridge for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

LPA Option B: This option would build the same number of structures over North Portland Harbor as Option A, although the locations and functions on those bridges would differ, as described below. The existing bridge over North Portland Harbor would be widened and would receive seismic upgrades.

LPA Option B does not have arterial lanes on the light rail/multi-use path bridge. Direct access between Marine Drive and the island would be provided with collector-distributor lanes. The structures adjacent to the highway bridge would carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges.

1.2.2.2 Interchange Improvements

The LPA includes improvements to seven interchanges along a 5-mile segment of I-5 between Victory Boulevard in Portland and SR 500 in Vancouver. These improvements include some reconfiguration of adjacent local streets to complement the new interchange designs, as well as new facilities for bicyclists and pedestrians along this corridor.

Victory Boulevard Interchange

The southern extent of the I-5 project improvements would be two ramps associated with the Victory Boulevard interchange in Portland. The Marine Drive to I-5 southbound on-ramp would be braided over the I-5 southbound to the Victory Boulevard/Denver Avenue off-ramp. The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Denver Avenue. The current merging ramp would be extended to become an add/drop (auxiliary) lane which would continue across the river crossing.

Potential phased construction option: The aforementioned southbound ramp improvements to the Victory Boulevard interchange may not be included with the CRC project. Instead, the existing connections between I-5 southbound and Victory Boulevard could be retained. The braided ramp connection could be constructed separately in the future as funding becomes available.

Marine Drive Interchange

All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5 at this location. The interchange configuration would be a single-point urban interchange (SPUI) with a flyover ramp serving the east to north movement. With this configuration, three legs of the interchange would converge at a point on Marine Drive, over the I-5 mainline. This configuration would allow the highest volume movements to move freely without being impeded by stop signs or traffic lights.

The Marine Drive eastbound to I-5 northbound flyover ramp would provide motorists with access to I-5 northbound without stopping. Motorists from Marine Drive eastbound would access I-5 southbound without stopping. Motorists traveling on Martin Luther King Jr. Boulevard westbound to I-5 northbound would access I-5 without stopping at the intersection.

The new interchange configuration changes the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard and to northbound I-5. These two streets would access westbound Martin Luther King Jr. Boulevard farther east. Martin Luther King Jr. Boulevard would have a new direct connection to I-5 northbound.

In the new configuration, the connections from Vancouver Way and Marine Drive would be served, improving the existing connection to Martin Luther King Jr. Boulevard east of the interchange. The improvements to this connection would allow traffic to turn right from Vancouver Way and accelerate onto Martin Luther King Jr. Boulevard. On the south side of Martin Luther King Jr. Boulevard, the existing loop connection would be replaced with a new connection farther east.

A new multi-use path would extend from the Bridgeton neighborhood to the existing Expo Center light rail station and from the station to Hayden Island along the new light rail line over North Portland Harbor.

LPA Option A: Local traffic between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel via an arterial bridge over North Portland Harbor. There would be some variation in the alignment of local streets in the area of the interchange between Option A and Option B. The most prominent differences are the alignments of Vancouver Way and Union Court.

LPA Option B: With this design option, there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that would parallel each side of I-5 over North Portland Harbor. Traffic would not need to merge onto mainline I-5 to travel between the island and Martin Luther King Jr. Boulevard/Marine Drive.

Potential phased construction option: The aforementioned flyover ramp could be deferred and not constructed as part of the CRC project. In this case, rather than providing a direct eastbound Marine Drive to I-5 northbound connection by a flyover ramp, the project improvements to the interchange would instead provide this connection through the signal-controlled SPUI. The flyover ramp could be constructed separately in the future as funding becomes available.

Hayden Island Interchange

All movements for this interchange would be reconfigured. The new configuration would be a split tight diamond interchange. Ramps parallel to the highway would be built, lengthening the ramps and improving merging speeds. Improvements to Jantzen Drive and Hayden Island Drive would include additional through, left-turn, and right-turn lanes. A new local road, Tomahawk Island Drive, would travel east-west through the middle of Hayden Island and under the I-5 interchange, improving connectivity across I-5 on the island. Additionally, a new multi-use path would be provided along the elevated light rail line on the west side of the Hayden Island interchange.

LPA Option A: A proposed arterial bridge with two lanes of traffic, one in each direction, would allow vehicles to travel between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island without accessing I-5.

LPA Option B: With this design option there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that parallel each side of I-5 over North Portland Harbor.

SR 14 Interchange

The function of this interchange would remain largely the same. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Downtown Vancouver I-5 access to and from the south would be at C Street rather than Washington Street, while downtown connections to and from SR 14 would be made by way of Columbia Street at 4th Street.

The multi-use bicycle and pedestrian path in the northbound (eastern) I-5 bridge would exit the structure at the SR 14 interchange, and then loop down to connect into Columbia Way.

Mill Plain Interchange

This interchange would be reconfigured into a SPUI. The existing "diamond" configuration requires two traffic signals to move vehicles through the interchange. The SPUI would use one efficient intersection and allow opposing left turns simultaneously. This would improve the capacity of the interchange by reducing delay for traffic entering or exiting the highway.

This interchange would also receive several improvements for bicyclists and pedestrians. These include bike lanes and sidewalks, clear delineation and signing, short perpendicular crossings at the ramp terminals, and ramp orientations that would make pedestrians highly visible.

Fourth Plain Interchange

The improvements to this interchange would be made to better accommodate freight mobility and access to the new park and ride at Clark College. Northbound I-5 traffic exiting to Fourth Plain would continue to use the off-ramp just north of the SR 14 interchange. The southbound I-5 exit to Fourth Plain would be braided with the SR 500 connection to I-5, which would eliminate the non-standard weave between the SR 500 connection and the off-ramp to Fourth Plain as well as the westbound SR 500 to Fourth Plain Boulevard connection.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including bike lanes, neighborhood connections, and access to the park and ride.

SR 500 Interchange

Improvements would be made to the SR 500 interchange to add direct connections to and from I-5. On- and off-ramps would be built to directly connect SR 500 and I-5 to and from the north, connections that are currently made by way of 39th Street. I-5 southbound traffic would connect to SR 500 via a new tunnel underneath I-5. SR 500 eastbound traffic would connect to I-5 northbound on a new on-ramp. The 39th Street connections with I-5 to and from the north would be eliminated. Travelers would instead use the connections at Main Street to connect to and from 39th Street.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including sidewalks on both sides of 39th Street, bike lanes, and neighborhood connections.

Potential phased construction option: The northern half of the existing SR 500 interchange would be retained, rather than building new connections between I-5 southbound to SR 500 eastbound and from SR 500 westbound to I-5 northbound. The ramps connecting SR 500 and I-5 to and from the north could be constructed separately in the future as funding becomes available.

1.2.2.3 Transit

The primary transit element of the LPA is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo Center in North Portland, where it currently ends, to Clark College in Vancouver. The transit element would not differ between LPA and LPA with highway phasing. To accommodate and complement this major addition to the region's transit system, a variety of additional improvements are also included in the LPA:

- Three park and ride facilities in Vancouver near the new light rail stations.
- Expansion of Tri-County Metropolitan Transportation District's (TriMet's) Ruby Junction light rail maintenance base in Gresham, Oregon.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Operating Characteristics

Nineteen new light rail vehicles (LRV) would be purchased as part of the CRC project to operate this extension of the MAX Yellow Line. These vehicles would be similar to those currently used by TriMet's MAX system. With the LPA, LRVs in the new guideway and in the existing Yellow Line alignment are planned to operate with 7.5-minute headways during the "peak of the peak" (the two-hour period within the 4-hour morning and afternoon/evening peak periods where demand for transit is the highest) and 15-minute headways during off-peak periods.

Light Rail Alignment and Stations

Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains would be constructed to extend from the existing Expo Center MAX station over North Portland Harbor to Hayden Island. Immediately north of the Expo Center, the alignment would curve eastward toward I-5, pass beneath Marine Drive, then rise over a flood wall onto a light rail/multi-use path bridge to cross North Portland Harbor. The two-way guideway over Hayden Island would be elevated at approximately the height of the rebuilt mainline of I-5, as would a new station immediately west of I-5. The alignment would extend northward on Hayden Island along the western edge of I-5, until it transitions into the hollow support structure of the new western bridge over the Columbia River.

Downtown Vancouver Light Rail Alignment and Stations

After crossing the Columbia River, the light rail alignment would curve slightly west off of the highway bridge and onto its own smaller structure over the Burlington Northern Santa Fe (BNSF) rail line. The double-track guideway would descend on structure and touch down on Washington Street south of 5th Street, continuing north on Washington Street to 7th Street. The elevation of 5th Street would be raised to allow for an at-grade crossing of the tracks on Washington Street. Between 5th and 7th Streets, the two-way guideway would run down the center of the street. Traffic would not be allowed on Washington between 5th and 6th Streets and would be two-way between 6th and 7th Streets. There would be a station on each side of the street on Washington between 5th and 6th Streets.

At 7th Street, the light rail alignment would form a couplet. The single-track northbound guideway would turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway would continue on Washington Street. Seventh Street will be converted to one-way traffic eastbound between Washington and Broadway with light rail operating on the north side of 7th Street. This couplet would extend north to 17th Street, where the two guideways would join and turn east.

The light rail guideway would run on the east side of Washington Street and the west side of Broadway Street, with one-way traffic southbound on Washington Street and one-way traffic northbound on Broadway Street. On station blocks, the station platform would be on the side of the street at the sidewalk. There would be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

East-west Light Rail Alignment and Terminus Station

The single-track southbound guideway would run in the center of 17th Street between Washington and Broadway Streets. At Broadway Street, the northbound and southbound alignments of the couplet would become a two-way center-running guideway traveling east-west on 17th Street. The guideway on 17th Street would run until G Street, then connect with McLoughlin Boulevard and cross under I-5. Both alignments would end at a station east of I-5 on the western boundary of Clark College.

Park and Ride Stations

Three park and ride stations would be built in Vancouver along the light rail alignment:

- Within the block surrounded by Columbia, Washington 4th and 5th Streets, with five floors above ground that include space for retail on the first floor and 570 parking stalls.
- Between Broadway and Main Streets next to the stations between 15th and 16th Streets, with space for retail on the first floor, and four floors above ground that include 420 parking stalls.
- At Clark College, just north of the terminus station, with space for retail or C-TRAN services on the first floor, and five floors that include approximately 1,910 parking stalls.

Ruby Junction Maintenance Facility Expansion

The Ruby Junction Maintenance Facility in Gresham, Oregon, would need to be expanded to accommodate the additional LRVs associated with the CRC project. Improvements include additional storage for LRVs and other maintenance material, expansion of LRV maintenance bays, and expanded parking for additional personnel. A new operations command center would also be required, and would be located at the TriMet Center Street location in Southeast Portland.

Local Bus Route Changes

As part of the CRC project, several C-TRAN bus routes would be changed in order to better complement the new light rail system. Most of these changes would re-route bus lines to downtown Vancouver where riders could transfer to light rail. Express routes, other than those listed below, are expected to continue service between Clark County and downtown Portland. The following table (Exhibit 1-2) shows anticipated future changes to C-TRAN bus routes.

Exhibit 1-2. Proposed C-TRAN Bus Routes Comparison

C-TRAN Bus Route	Route Changes
#4 - Fourth Plain	Route truncated in downtown Vancouver
#41 - Camas/Washougal Limited	Route truncated in downtown Vancouver
#44 - Fourth Plain Limited	Route truncated in downtown Vancouver
#47 - Battle Ground Limited	Route truncated in downtown Vancouver
#105 - I-5 Express	Route truncated in downtown Vancouver
#105S - I-5 Express Shortline	Route eliminated in LPA (The No-Build runs articulated buses between downtown Portland and downtown Vancouver on this route)

Steel Bridge Improvements

Currently, all light rail lines within the regional TriMet MAX system cross over the Willamette River via the Steel Bridge. By 2030, the number of LRVs that cross the Steel Bridge during the 4-hour PM peak period would increase from 152 to 176. To accommodate these additional trains, the project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail speed over the bridge from 10 to 15 mph. To accomplish this, additional work along the Steel Bridge lift spans would be needed.

1.2.2.4 Tolling

Tolling cars and trucks that use the I-5 river crossing is proposed as a method to help fund the CRC project and to encourage the use of alternative modes of transportation. The authority to toll the I-5 crossing is set by federal and state laws. Federal statutes permit a toll-free bridge on an interstate highway to be converted to a tolled facility following the reconstruction or replacement of the bridge. Prior to imposing tolls on I-5, Washington and Oregon Departments of Transportation (WSDOT and ODOT) would have to enter into a toll agreement with U.S. Department of Transportation (DOT). Recently passed state legislation in Washington permits WSDOT to toll I-5 provided that the tolling of the facility is first authorized by the Washington legislature. Once authorized by the legislature, the Washington Transportation Commission (WTC) has the authority to set the toll rates. In Oregon, the Oregon Transportation Commission (OTC) has the authority to toll a facility and to set the toll rate. It is anticipated that prior to tolling I-5, ODOT and WSDOT would enter into a bi-state tolling agreement to establish a cooperative process for setting toll rates and guiding the use of toll revenues.

Tolls would be collected using an electronic toll collection system: toll collection booths would not be required. Instead, motorists could obtain a transponder that would automatically bill the vehicle owner each time the vehicle crossed the bridge, while cars without transponders would be tolled by a license-plate recognition system that would bill the address of the owner registered to that license plate.

The LPA proposes to apply a variable toll on vehicles using the I-5 crossing. Tolls would vary by time of day, with higher rates during peak travel periods and lower rates during off-peak periods. Medium and heavy trucks would be charged a higher toll than passenger vehicles. The traffic-related impact analysis in this FEIS is based on toll rates that, for passenger cars with transponders, would range from $1.00 during the off-peak to $2.00 during the peak travel times (in 2006 dollars).

1.2.2.5 Transportation System and Demand Management Measures

Many well-coordinated transportation demand management (TDM) and transportation system management (TSM) programs are already in place in the Portland-Vancouver Metropolitan region and supported by agencies and adopted plans. In most cases, the impetus for the programs is from state-mandated programs: Oregon's Employee Commute Options (ECO) rule and Washington's Commute Trip Reduction (CTR) law.

The physical and operational elements of the CRC project provide the greatest TDM opportunities by promoting other modes to fulfill more of the travel needs in the project corridor. These include:

- Major new light rail line in exclusive right-of-way, as well as express bus and feeder routes;
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians, and improve connectivity, safety, and travel time;
- Park and ride lots and garages; and
- A variable toll on the highway crossing.

In addition to these fundamental elements of the project, facilities and equipment would be implemented that could help existing or expanded TSM programs maximize capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs or other traveler information systems in the CRC project area;
- Expanded incident response capabilities;
- Queue jumps or bypass lanes for transit vehicles where multi-lane approaches are provided at ramp signals for entrance ramps;
- Expanded traveler information systems with additional traffic monitoring equipment and cameras, and
- Active traffic management.

1.2.3 LPA Construction

Construction of bridges over the Columbia River is the most substantial element of the project, and this element sets the sequencing for other project components. The main river crossing and immediately adjacent highway improvement elements would account for the majority of the construction activity necessary to complete this project.

1.2.3.1 Construction Activities Sequence and Duration

The following table (Exhibit 1-3) displays the expected duration and major details of each element of the project. Due to construction sequencing requirements, the timeline to complete the initial phase of the LPA with highway phasing is the same as the full LPA.

Exhibit 1-3. Construction Activities and Estimated Duration

Element	Estimated Duration	Details
Columbia River bridges	4 years	• Construction is likely to begin with the bridges. • General sequence includes initial preparation, installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
Hayden Island and SR 14 interchanges	1.5 - 4 years for each interchange	• Each interchange must be partially constructed before any traffic can be transferred to the new structure. • Each interchange needs to be completed at the same time.
Marine Drive interchange	3 years	• Construction would need to be coordinated with construction of the southbound lanes coming from Vancouver.
Demolition of the existing bridges	1.5 years	• Demolition of the existing bridges can begin only after traffic is rerouted to the new bridges.
Three interchanges north of SR 14	4 years for all three	• Construction of these interchanges could be independent from each other or from the southern half of the project. • More aggressive and costly staging could shorten this timeframe.
Light rail	4 years	• The river crossing for the light rail would be built with the bridges. • Any bridge structure work would be separate from the actual light rail construction activities and must be completed first.

Element	Estimated Duration	Details
Total Construction Timeline	6.3 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work, weather, materials, and equipment, could all influence construction duration. • This is also the same time required to complete the smallest usable segment of roadway – Hayden Island through SR 14 interchanges.

1.2.3.2 Major Staging Sites and Casting Yards

Staging of equipment and materials would occur in many areas along the project corridor throughout construction, generally within existing or newly purchased right-of-way or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Suitable sites must be large and open to provide for heavy machinery and material storage, must have 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 must have roadway or rail access for landside transportation of materials by truck or train.

Three sites have been identified as possible major staging areas:

1. Port of Vancouver (Parcel 1A) site in Vancouver: This 52-acre site is located along SR 501 and near the Port of Vancouver's Terminal 3 North facility.
2. Red Lion at the Quay hotel site in Vancouver: This site would be partially acquired for construction of the Columbia River crossing, which would require the demolition of the building on this site, leaving approximately 2.6 acres for possible staging.
3. Vacant Thunderbird hotel site on Hayden Island: This 5.6-acre site is much like the Red Lion hotel site in that a large portion of the parcel is already required for new right-of-way necessary for the LPA.

A casting/staging yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, including either a slip or a dock capable of handling heavy equipment and material; a large area suitable for a concrete batch plant and associated heavy machinery and equipment; and access to a highway and/or railway for delivery of materials.

Two sites have been identified as possible casting/staging yards:

1. Port of Vancouver Alcoa/Evergreen West site: This 95-acre site was previously home to an aluminum factory and is currently undergoing environmental remediation, which should be completed before construction of the CRC project begins (2012). The western portion of this site is best suited for a casting yard.

Sundial site: This 50-acre site is located between Fairview and Troutdale, just north of the Troutdale Airport, and has direct access to the Columbia River. There is an existing barge slip at this location that would not have to undergo substantial improvements.

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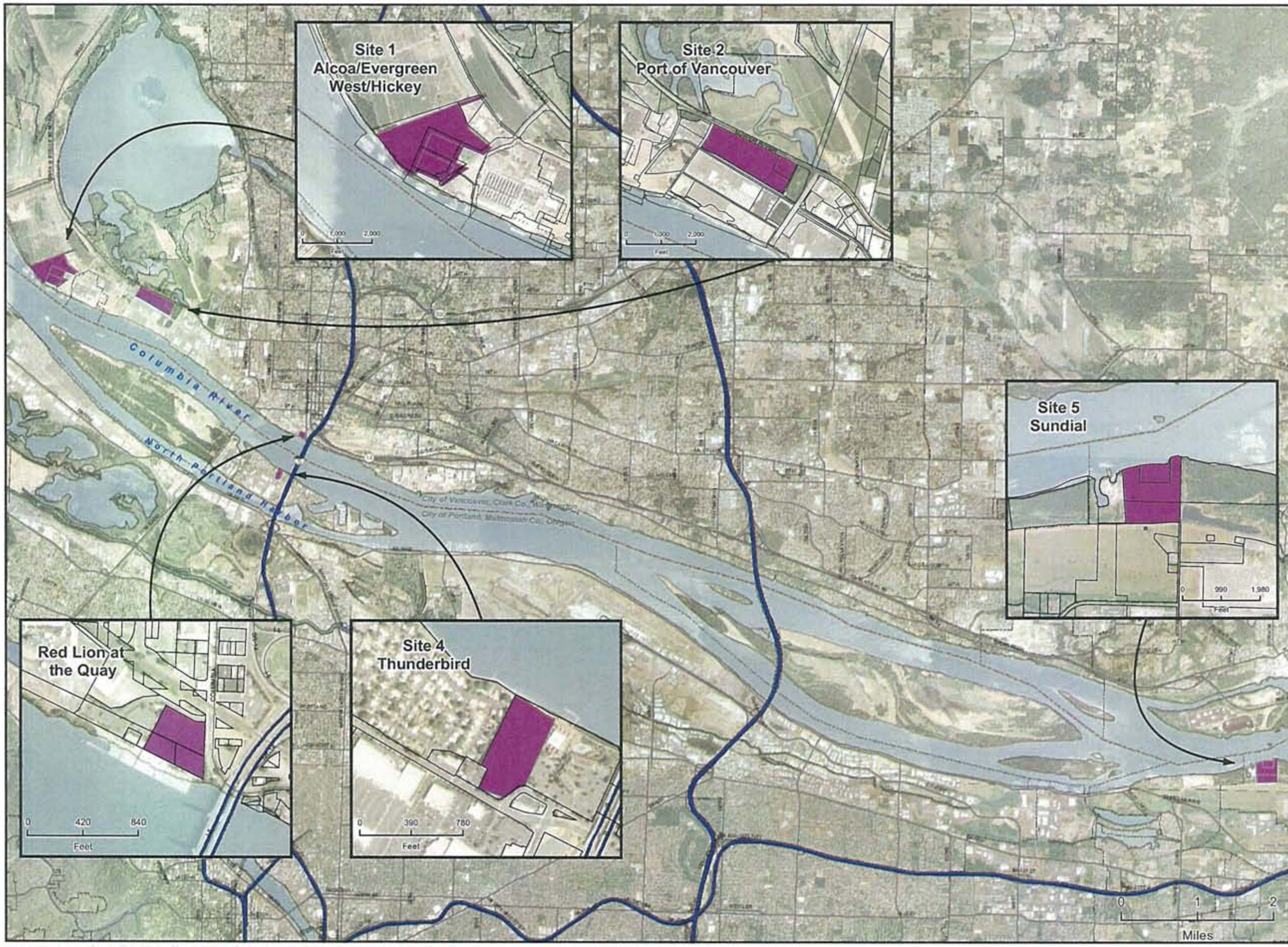

Exhibit 1-4. Proposed Staging and Casting Areas

Parcel Boundaries

Proposed Staging and Casting Areas

Columbia River CROSSING

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1.2.4 The No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2030 if the CRC project is not built. This alternative makes the same assumptions as the build alternatives regarding population and employment growth through 2030, and also assumes that the same transportation and land use projects in the region would occur as planned. The No-Build Alternative also includes several major land use changes that are planned within the project area, such as the Riverwest development just south of Evergreen Boulevard and west of I-5, the Columbia West Renaissance project along the western waterfront in downtown Vancouver, and redevelopment of the Jantzen Beach shopping center on Hayden Island. All traffic and transit projects within or near the CRC project area that are anticipated to be built by 2030 separately from this project are included in the No-Build and build alternatives. Additionally, the No-Build Alternative assumes bridge repair and continuing maintenance costs to the existing bridge that are not anticipated with the replacement bridge option.

1.3 Proposed Construction Activities

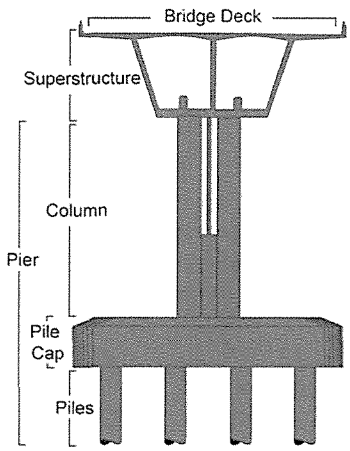
This section describes proposed construction techniques that would likely be used during the CRC project. The type, methods and specifications of these construction activities would be determined in preliminary engineering (PE) design reports and by the selected contractors.

1.3.1 Columbia River Crossing (Main Line) Construction

Bridge construction would include the following components: piles or shafts, pile caps, column, superstructure and bridge deck (Exhibit 1-5). The building of the new bridges over the Columbia River requires multiple phases of work. The general sequence for construction is:

- Initial preparation – mobilize construction materials, heavy equipment and crews.
- Conduct soil stabilization to approaches for bridge structures. Stabilization techniques include the use of compaction grouting, jet grouting, or the use of stone columns.
- Installation of structure foundations – driven piles, drilled shafts and/or spread footings.
- Bridge piers – construct cap on top of drilled shafts; construct columns and pier tables. In-water piers would be constructed using barge and/or temporary work bridge support. Temporary work bridges would be constructed using driven piles.
- Bridge superstructure – build or install the horizontal structure of the bridge spans between the bridge support columns.
- Bridge deck – construct the bridge deck on top of the superstructure.

Exhibit 1-5. Basic Bridge Components



NOTE: The bridge type shown is for display purposes only.

1.3.1.1 Pier and Superstructure Construction

In-water foundations (shafts) would be required to support crossing piers. Columns would be constructed after the foundation (pile) caps are complete. Barges would be required for cranes, material, and work platforms. Tower cranes would likely be used to construct columns and support superstructure construction. The superstructure would be constructed of structural steel, cast-in-place concrete, or precast concrete.

1.3.1.2 Permanent Foundations

Permanent foundations would likely be anchored 30 feet or less into consolidated portions of the Troutdale Formation (up to 260 feet below ground surface [bgs] and/or elevation of -290 feet NAVD88). The quantity of permanent piles/shafts required is influenced by numerous factors, many of which are unknown at this stage of bridge design. Unknown factors include pile/shaft type, pile/shaft size, and bridge type. For the purposes of this report, foundations may be built using 120-inch-diameter drilled shafts. The Main Line Crossing is anticipated to have spans that range from 270 feet to 500 feet, resulting in 6 new in-water pier complexes. The transit bridge and northbound and southbound bridges over North Portland Harbor are anticipated to have 13 new in-water piers. No new pier complexes are anticipated for the Main Line Crossing in North Portland Harbor; however, existing pier complexes would likely have seismic upgrades. Exhibit 1-6 summarizes permanent piles needed for construction of the new bridges over the Columbia River.

Exhibit 1-6. Estimated Number of Permanent Piles/Shafts Required for the Columbia River Bridge Multimodal Crossing

Description (From East to West)	Number of Permanent Piles/Shafts	Estimated Depth Below ground surface
I-5 Northbound Bridge	95/75	110 to 260 feet
I-5 Southbound Bridge with light rail	95/75	110 to 260 feet
Total Permanent Piles for the Columbia River Bridges	**190/150**	

1.3.1.3 Temporary Foundations

Temporary foundations would likely be required to support contractor operations. These operations include work and equipment barge moorings, and construction of temporary work bridges. Temporary piles are expected to range between 12 and 48 inches in diameter, with the majority of piles consisting of 24- to 48-inch-diameter piles. It is not known at this stage of engineering design how deep temporary piles would need to be driven. In general, temporary piles would extend only into the shallow soil. The quantity of temporary piles required is influenced by numerous factors, many of which are unknown at this stage of bridge design. Unknown factors include pile type, pile/shaft size, and bridge type, among others. Several extraction methods are being considered for temporary piles, including direct pull, vibratory extraction, and cutting the piles below the mud line.

1.3.1.4 Cofferdams

Cofferdams may be used throughout the project to support installation of piers. Cofferdams would likely consist of sheet pile sections vibrated into place. Piles or drilled shafts would then be installed while water is still in the cofferdam. After pile or drilled shaft installation is complete, a concrete seal (false work) would be placed and the cofferdam would be dewatered. Cofferdams are not watertight and would need to be continuously pumped after dewatering, although the concrete seal would limit the need for this action.

1.3.2 Foundation and Structural Support for Interchanges, Bridge Overpasses, Transit, and Roadways

Interchanges, bridge overpasses, and portions of transit and roadways would be structurally supported by foundations and abutments. These structures would be in turn constructed using shallow footings, piles and shafts, and retaining walls. Subsurface conditions may also be modified by soil stabilization techniques such as jet grouting, compaction grouting, and/or stone columns.

1.3.2.1 Geotechnical Borings

Geotechnical boreholes would be used to characterize subsurface soil and water table conditions in areas where potential shafts, piles, footings, and/or retaining walls are needed to support project construction. Geotechnical information is typically used to evaluate material strength and compressibility to help determine the type and specifications for structural support. Further information on geotechnical boring is provided in the technical reports provided by Shannon and Wilson (2008) and Parsons Brinckerhoff (2009).

1.3.2.2 Shallow Footings

Shallow footings would be installed when appropriate for project elements such as bridge overpasses and light rail stations that do not require a high degree of structural support. Depending on location and structure type, shallow footings may extend up to 15 feet below grade and may be composed of precast concrete forms. Where possible, shallow footings are preferred to be used instead of piles to reduce cost. Shallow footings would likely be used for all park and ride structures and light rail stations.

1.3.2.3 Drilled Shaft and Driven Pile

Driven piles and drilled shafts would generally be used as foundation elements to anchor supporting bridge abutments, retaining walls, and bridge piers.[1] Drilled shafts would be used for in-water piers, with driven piles used to support construction equipment and activities for the Columbia River and North Portland Harbor bridges. A summary of estimated number and depths of piles and shafts for the interchanges and bridges is presented in Exhibit 1-7.

Some of the foundation options proposed for this project involve the driving of small- or large-diameter piles using an impact pile hammer. After the pile is driven, steel reinforcement and concrete may be placed inside the pile's annulus. The reinforcement is used to tie the pile to the structure it is supporting.

Some of the foundation options proposed for this project involve the drilling of small- or large-diameter shafts using an auger. Drilled shafts would require installation using either temporary or permanent casings to prevent sloughing and caving of soils. Casings would likely be installed using an oscillator, which rotates the casing back and forth, driving it downward, until it reaches the required tip elevation. Other potential methods of casing installation, such as rotator (rotates the pile as it is driven downward) or vibratory hammer, are also possible. Drilled shafts would likely be proofed using an impact hammer prior to final construction. Reinforcing steel is installed in the annulus of the shaft and the shaft is concreted into place. It is likely that steel casing would be left in place at in-water and deep shaft locations.

Foundation construction for the interchanges would require the transfer of vertical loads from weak near-surface soils to stronger material at depth. Exhibit 1-7 contains estimated pile and shaft depths using preliminary geotechnical recommendations for the bridge and interchange locations. All depths and elevations shown are subject to change.

Based on geotechnical boreholes completed within the study area, the deep foundations would likely extend into the Troutdale Formation. The Troutdale Formation is located between approximately 110 and 260 feet bgs for foundations over the Columbia River.[2] Foundations would likely be constructed to these depths for the Columbia River Crossing and the SR 14 and Mill Plain interchanges. Shallower foundation depths would likely be used for the Marine Drive and SR 500 interchanges and would not encounter the Troutdale Formation.

Exhibit 1-7. Estimated Number and Depths of Piles/Shafts Required for Interchanges and Associated Bridge Overpasses

	Foundation Type[b]		Area of Structure	Estimated Pile Tip Depth Below Existing Ground/ Mudline[c]	Estimated Number of Piles	Approximate Depth to Groundwater[d]	Occurrence of Excavations
Bridges	Shafts	Piles	(square feet x 1,000)	(feet bgs)		(feet bgs)	
Victory to Marine Drive Bridges [a]	X	X	430	125 to 160	140 to 240 shafts 1,000 to 2,000 piles	25	High

[1] Spread footings may also be used for foundation structures instead of piles or shafts, when appropriate conditions exist. The use of spread footing would reduce the amount of subsurface disturbance, and reduce project costs.

[2] Dependent on geotechnical conditions.

	Foundation Type[b]		Area of Structure	Estimated Pile Tip Depth Below Existing Ground/ Mudline[c]	Estimated Number of Piles	Approximate Depth to Groundwater[d]	Occurrence of Excavations
Bridges	Shafts	Piles	(square feet x 1,000)	(feet bgs)		(feet bgs)	
North Portland Harbor Bridge	X		460	130 to 160	90 to 130 shafts 900 to 1,500 piles	10	High
Hayden Island Bridge	X	X	310	180 to 260	220 to 310 shafts 1,900 to 2,500 piles	10	High
SR 14 Bridges [b]	X		530	120 to 130	170 to 210 shafts	10	High
Evergreen Bridge [b]	X	X	30	50 to 70	90 to 160 piles 10 to 30 shafts	90	Low
Mill Plain to 33rd Street Bridges [b]	X	X	180	80 to 90	130 to 240 shafts 440 to 740 piles	150	Moderate
SR 500 Interchange and 39th Street Bridges [b]	X	X	130	50 to 80	20 to 40 shafts 150 to 260 piles	150	Low

a Foundation data from Shannon & Wilson "Geotechnical Data Columbia River Crossing," March 5, 2008.

b Foundation data from WSDOT Geotechnical Division, "I-5, XL-2268, MP 0.0 to 3.0 Columbia River Crossing project Washington Landside Structures and Retaining Walls Conceptual Geotechnical Recommendations for Biological Assessment" Memorandum, November 5, 2008.

c Columbia River pile depths assume 30 feet embedment into the Troutdale Formation.

d Clark County water level contour map (Clark County 2005). Contours were created by computer model of data originating from various sources in the 1990s.

1.3.2.4 Retaining Walls

Retaining walls would be constructed to provide support for soil where vertical or near vertical grade changes are necessary for bridge approach abutments and underpasses. Proposed retaining walls would be constructed partially below the ground surface. Trenching and excavation activities are anticipated in the immediate vicinity of proposed wall locations.

1.3.2.5 Ground Stabilization

Subsurface soils would need to be stabilized or strengthened to support ground improvements such as bridge abutments at Hayden Island, Marine Drive and Victory Boulevard, Tomahawk Island, and along river embankment areas of Hayden Island and North Portland Harbor, and in upland areas such as Burnt Bridge Creek. Ground stabilization is necessary based on geotechnical information suggesting soil liquefaction and lateral displacement potential under a design earthquake (Shannon and Wilson 2008; Parsons Brinkerhoff 2009; FEIS 2010). Estimated areas for stabilization are up to 600 feet from the shore line and 50 feet from the structure dripline or abutment. The depth of soil stabilization is estimated to occur at or above the ordinary high water (OHW) line (approximately 21.2 feet NAVD88) to a depth of up to 90 feet below ground surface. Soil stabilization and strengthening may be conducted using a variety of methods, including but not limited to compaction grouting, jet grouting, and/or stone columns.

In addition, the levee system along the southern embankment of the North Portland Harbor may be modified for construction of transit and roadway. Modification may require a portion of the levee to be removed and rebuilt as part of this effort.

1.3.2.6 Excavation and Fill, and Dewatering

Cut and fill soil moving techniques would be used to support construction of transit and roadways. In general, cut would be used to lower the grade of roadway and transit, where fill would be used to elevate roadway or track bed and/or increase the feature's load-bearing capacity. Exhibit 1-1a through Exhibit 1-1c displays the locations of proposed cut and fill.

Dewatering of excavations may occur for structures that extend below the water table. These structures include but are not limited to tunnels and retaining walls (Exhibit 1-1a through Exhibit 1-1c). Dewatering techniques may employ the use of sheet piles to limit groundwater flow into the excavation.

1.3.2.7 Limited Debris Removal

Some disturbance to in-water river sediments will occur from limited debris removal of riprap or concrete within North Portland Harbor. Removal is necessary for the installation of drilled shafts for new bridge foundations. Removal will likely occur using a clamshell bucket and barge support. The project estimates that it will take seven days to remove up to 90 cubic yards of material. Material will be characterized and disposed at an approved uplands facility.

1.3.2.8 Utility Corridors

New underground utility corridors will be placed to support the operation of light rail. Utilities include but are not limited to electrical and phone lines. Utilities will be generally installed in lined trenches approximately 3 feet bgs.

1.3.2.9 Over-water Bridge Demolition

Columbia River Bridges

The existing Columbia River bridges will require demolition of the structure and removal of the debris. Bridge components would need to be cut out and removed in pieces. These components include but are not limited to the bridge deck, the counterweights for the lift span, towers, deck, trusses, piers, and piles. The counterweights would likely be removed first, followed by the lift towers and concrete deck. The trusses could then be cut into manageable pieces and removed. Final pier removal will depend on site-specific considerations, safety, phasing constraints, and impacts to aquatic species. Bridge piers could be removed by either installing cofferdams around the piers or by using a diamond wire/wire saw to cut the piers into manageable chunks to be transported off-site. During demolition, containment of debris is necessary and will be part of contract requirements. Temporary piles would be required to support work and provide containment. Material barges may be necessary to install and remove cofferdams and move equipment during bridge demolition.

North Portland Harbor Bridges

The concrete decks of the North Portland Harbor bridges would need to be cut up and removed in pieces. Deck removal would be done using the methods described above. The deck could be cut and the pieces transported away by barge or truck; or the sections may be demolished using a breaker with a barge below to catch and contain debris. Containment of debris is necessary and will be part of contract requirements. Once the deck is removed, then girders could be cut and removed to a barge for demolition off-site. Alternately, girders could be demolished onto a barge below.

The same two methods described above could be used to remove the existing bridge piers for the North Portland Harbor bridge. Extraction methods could include use of a vibratory extractor, direct pull, or a clam shell dredge. To minimize turbidity, cofferdams may be installed around the existing piers once the superstructure is removed. With either method, the pieces of the piers would likely be removed via barge.

1.3.2.10 Demolition of Acquired Structures

A number of land-based structures will be acquired and demolished to accommodate the project. These properties are identified in the Acquisitions Technical Report. Demolition materials from these structures will need to be managed, recycled and/or disposed of accordingly. Acquired structures may include asbestos-containing material (ACM), lead-based paint, equipment containing polychlorinated biphenyls (PCBs) and/or mercury, or other hazardous materials.

1.3.2.11 Stormwater Management and Treatment Facilities

Federal, state, and local agencies with direct jurisdiction over aspects of stormwater management in the study area include National Oceanic & Atmospheric Administration (NOAA) Fisheries, U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), Oregon State Department of Environmental Quality (DEQ), the City of Vancouver, and the City of Portland.

Stormwater generated during construction activities must comply with WSDOT's Stormwater National Pollutant Discharge Elimination Systems (NPDES) General Permit and ODOT's 1200-CA permit, and must be consistent with WSDOT's Highway Runoff Manual (HRM, WSDOT 2008).

Stormwater from newly constructed permanent impervious surfaces is required to be managed and treated under applicable city, state and federal regulations. These include the Federal Clean Water Act (CWA), the Washington State Pollution Control Act, Vancouver Municipal Code (VMC) Chapter 14, and City of Portland Code (CPC) Title 17.

Objectives for permanent stormwater management include:

- Provide source control to prevent pollutants entering into stormwater.
- Provide water quality treatment facilities for new or existing pollution-generating impervious surfaces[3] (PGIS) in accordance with the agency requirements. PGIS include:
  - Highways and ramps, including non-vegetated shoulders.
  - Light rail guideway subject to vehicular traffic. Guideway is referred to as a *semi-exclusive* if the tracks are subject to cross-traffic, or *non-exclusive* if vehicles such as buses can travel along the guideway.
  - Streets, alleys and driveways.
  - Bus layover facilities, surface parking lots, and the top floor of parking structures.
- Provide flow control for new and replaced impervious areas in accordance with state and local requirements.

[3] A pollution-generating impervious surface (PGIS) is defined as a surface that is considered a significant source of pollutants in stormwater runoff.

- Conduct maintenance on water quality treatment facilities and flow controls to ensure they are performing as intended.

Exhibits 1-8a through 1-8c displays the locations of proposed stormwater conveyance system and treatment facilities. The stormwater system will manage and treat water within the Columbia River and Burnt Bridge Creek watersheds.

In the Columbia River watershed the proposed project will create 89 acres of PGIS and 26 acres of resurfaced PGIS. The project would increase PGIS approximately 28 acres from the No-Build Alternative. The project proposes to treat stormwater from all 115 acres of PGIS. The project would also manage and treat a portion of non-PGIS from light rail guideways and station platforms. Additional information on the proposed stormwater conveyance system and treatment facilities is provided in the Water Quality and Hydrology Technical Report.

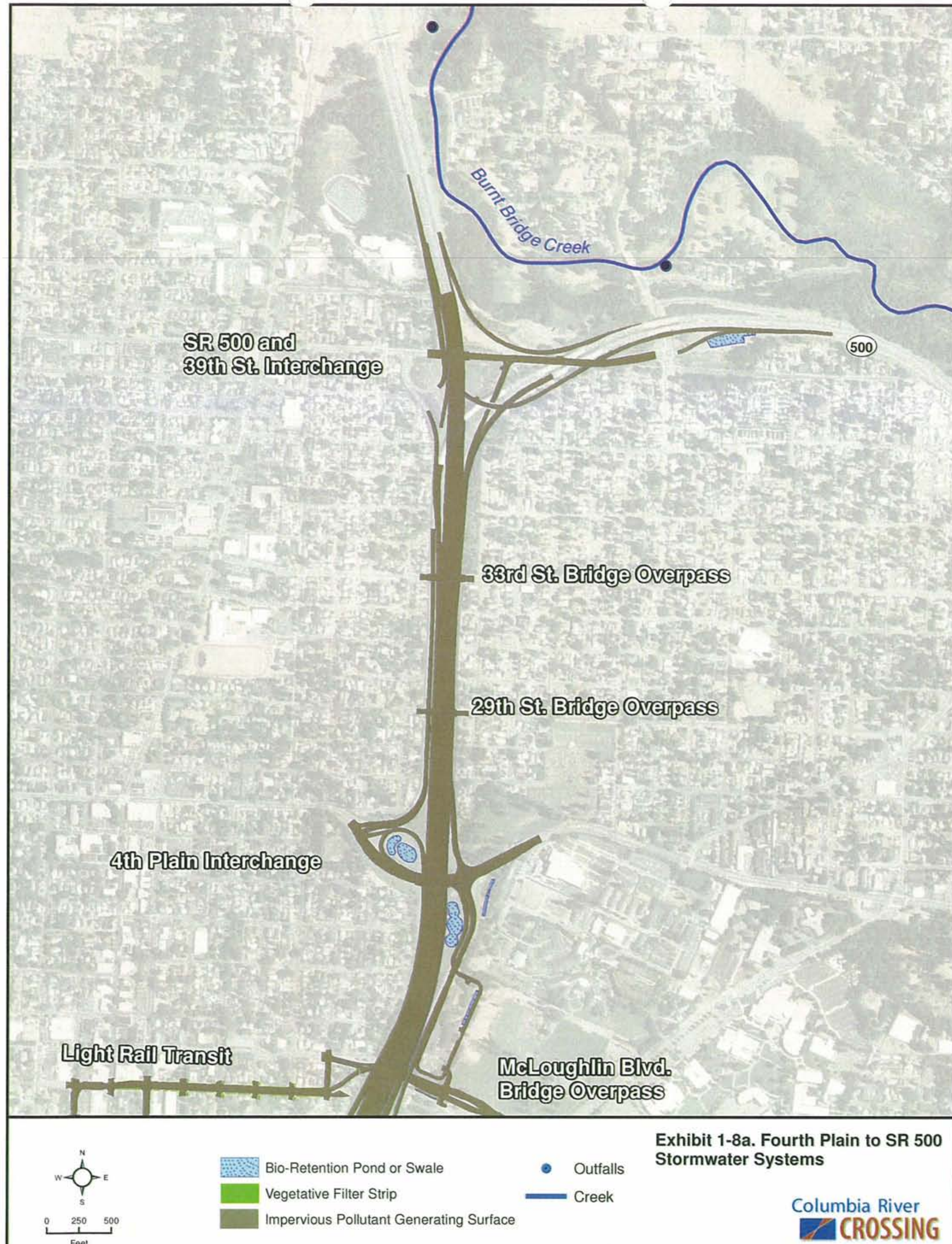


Exhibit 1-8a. Fourth Plain to SR 500 Stormwater Systems

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Exhibit 1-8b. Columbia River to Fourth Plain Stormwater Systems

Columbia River CROSSING

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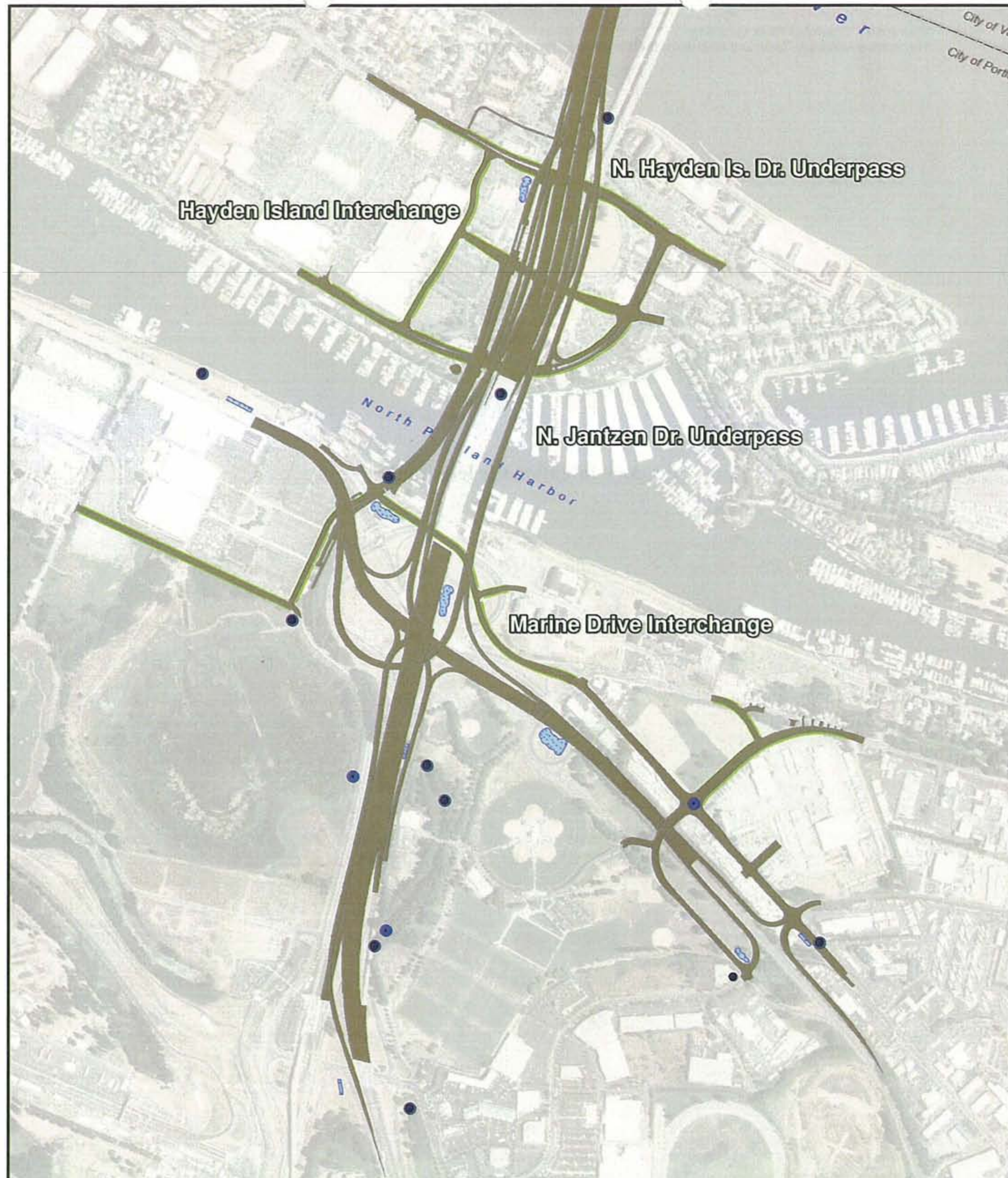

Exhibit 1-8c. Delta Park to Columbia River Stormwater Systems

Columbia River CROSSING

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1.4 Temporary Effects

Temporary effects are potential short-term effects to the locally preferred alternative (LPA) and/or effects to the physical environment from hazardous materials. Such effects are thought to occur in three general categories: 1) Liability to the purchaser in acquiring property with recognized environmental conditions (RECs)[4]; 2) effects on the environment and resources from construction in areas where hazardous materials exist; and 3) effects on construction from presence of hazardous materials.

These potential effects are assessed qualitatively based on the project team's current understanding of the natural and built environments. The significance of the effect to occur without mitigation measures is also stated.[5] For the purposes of this report, no or limited construction activities will be conducted for the No-Build Alternative; therefore, temporary effects for the No-Build Alternative are not discussed.

1.4.1 Property Acquisition Liability

Tax lots have been listed for acquisition in fee for the project. Acquisition of property where RECs have been identified can result in potential liability for the purchaser (i.e., ODOT, WSDOT, or TriMet). Liability issues for acquired property in fee are addressed in different ways under Oregon and Washington State laws.

In Oregon, the standard for liability for remedial actions (cleanup) of a property is pursuant to Oregon Revised Statute (ORS) 465.255. This statute states that "the owner/operator is strictly liable for those remedial action costs incurred by the state or any other person that are attributable to or associated with a facility and for damages for injury to or destruction of any natural resources caused by a release." This statute extends to limit the State's legal liability of an acquired facility or property through condemnation.

In Washington, the standard of liability is pursuant to the Revised Code of Washington (RCW) 70 105D. The code states that "the owner/operator of the facility is liable for remedial cost." Provisions in the code thus allow for the State to inherit legal liability when acquiring the property/facility.

Liability issues can include: 1) restriction in current or future property use; 2) incurring costs for cleanup; 3) schedule delays; 4) work and public safety; and/or 5) increased resource agency oversight. Conducting all appropriate inquiry (AAI) into the previous ownership and uses of the property prior to property transaction is a means of safeguarding and managing potential liability issues. In this way RECs are disclosed prior to the sale of the property and potential issues can be mitigated prior to construction activities. Inquiry may result in responsibility for cleanup by the

[4] The term "recognized environmental condition" is defined by ASTM E-1527 as: "...the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property."

[5] A significant effect can represent a substantial increase in project costs, a substantial delay in project schedule, long-term liability, and/or a substantial change to an environmental resource. As stated in 40 CFR 1502.2, "Effects shall be discussed in proportion to their significance," and "in a finding of no significant effect, there should be only enough discussion to show why more study is not warranted."

owner/operator and/or reduction in the property's value. Further discussion of mitigation measures for property acquisition is provided in Section 7.

Findings

The LPA has a potential for adverse effects from property acquisition liability if not correctly mitigated. Of the sites listed for acquisition in fee, 55 have been identified as hazardous material sites for LPA Option A and 52 for LPA Option B (Exhibit 5-1).

1.4.2 Permanent and Temporary Easements

Permanent and temporary easements will be used to support the project. Types of easements include, but are not limited to, subsurface easement, airspace easements, and property easements. Permanent easements are necessary to construct subsurface utility lines (storm drain, telephone, electrical), roadways, sidewalks, or access. In acquiring permanent easements, the State owns a limited interest in a property. Temporary easements allow the State the right to the property for short-term ground improvements or staging purposes. After fulfilling its intended purpose, the easement is typically returned back to the landowner.

Easements where RECs have been identified can result in potential liability for the operator. Liability issues can come in the form of: 1) incurring cleanup costs; 2) schedule delays; and 3) worker and public safety.

Findings

The LPA has a potential for adverse effects from gaining permanent and temporary easements. Twenty (20) easements have been identified as being priority hazardous material sites. Of the 20 easements, 17 are temporary construction easements, and 3 are permanent easements (Exhibit 5-1).

1.4.3 Adverse Effects on the Environment from Construction

Environmental media – soils, sediments, surface water, stormwater, and groundwater – can be adversely affected by the exacerbation of existing contamination or the release of hazardous substances during construction activities. This may cause a risk to human health or the environment, raise liability issues, increase project costs, and/or cause schedule delays.

The degree to which existing contamination can migrate into the environment depends on the type, intensity and duration of construction activities and on the nature and extent of contamination. Types of construction activities include, but are not limited to: excavation, grading, dewatering, drilling, dredging, utility line trenching, construction stormwater management, and installation of piles and shafts for bridge and interchange foundations; soil stabilization; and demolition. The type, intensity, and duration of these activities will be further defined during the design phase and contractor procurement.

Documented contaminants at identified hazardous materials sites include chlorinated solvents, petroleum hydrocarbons, pollutant metals, pesticides, and PCBs. However, unidentified contamination from historical land use likely also exists within the main project area. Impacts are most likely associated with commercial and industrial properties that may have generated or improperly disposed of hazardous materials (Section 4). The nature and extent of contamination in areas where below-grade construction will be conducted will be evaluated on a site-by-site basis prior to preparing Plans, Specifications, and Estimates (PS&E). Site-by-site evaluation may take the form of physical investigation, sampling, and analysis.

Contaminants that are encountered during construction can migrate into the environment along a variety of pathways (Section 6). Shallow soil contamination can migrate downward into subsurface soils and/or groundwater through drag down from excavation, utility work and drilling, and/or infiltration of stormwater. Groundwater impacts can be exacerbated by dewatering activities. Impacted stormwater can migrate to surface water and sediments. Impacted sediments can be re-suspended into the water column and/or re-deposited from scour or dredging activities.

Alternatively, hazardous substances or petroleum products have the potential to be released into the environment during construction activities. Construction equipment can release petroleum products into the environment from improper transfers of fuels or spills. Other pollutants such as paints, acids for cleaning masonry, solvents, and concrete-curing compounds are present at construction sites and may enter the environment if not managed correctly.

Adverse effects to the environment from contamination is most critical in areas sensitive to human and ecological health, such as surface water bodies, wetlands, floodplains, residential areas, and/or in wellhead protection zones. Within the study area these areas include, but are not limited to, Columbia Slough, North Portland Harbor, Hayden Island, Columbia River, City of Vancouver, and Burnt Bridge Creek drainage.

1.4.3.1 Surface and Subsurface Soils

Surface and subsurface soils often are the most likely media to be affected by an initial contaminant release. Common contaminant release mechanisms include spills, below-ground disposal, leaking underground storage tanks (LUSTs), and soil leaching. Contamination in soil can migrate to other environmental media such as sediments, surface water and groundwater from secondary release mechanisms during construction activities (e.g., excavation, grading, and drilling). Secondary release mechanisms include, but are not limited to drag down, smearing, groundwater leaching, stormwater runoff, and erosion.

Findings

The LPA has a potential for adverse effects from the exacerbation or migration of existing soil contamination during construction activities. A portion of the construction activities occur within the Columbia River floodplain, which is considered a sensitive area for aquatic organisms and fish. Of particular concern is the migration of existing soil contamination from priority hazardous materials sites along the North Portland Harbor and Hayden Island from the construction of Marine Drive, Hayden Island, and SR 14 interchanges and overpasses. Adverse effects from soil contamination on construction activities may be significant if not correctly mitigated.

However, it is recognized that beneficial effects to the environment can be realized by the cleanup of residual soil contamination during construction. This potential cleanup of contaminated soil would not otherwise be realized within the timeline of the LPA.

1.4.3.2 Stormwater

Precipitation events can generate stormwater runoff at construction sites. Without adequate stormwater management and treatment, water quality can be diminished and soil erosion can occur. Stormwater quality can also be affected by a direct release/spill of a hazardous substance to stormwater lines during construction. Adverse effects to stormwater quality can further impact surface water, groundwater, and sediment quality.

In addition, priority hazardous material sites have been identified in the proximity of stormwater treatment facilities located at the Mill Plain interchange, the SR 14 interchange, and Marine Drive interchange (Exhibits 4-2a through 4-2c). Adverse effects to groundwater could occur in these areas if stormwater is infiltrated into contaminated subsurface soils to the water table.

Findings

The LPA has a potential for adverse effects to stormwater quality during construction activities. This may result from erosion of exposed contaminated soil surfaces during precipitation events where stormwater is not controlled or adequately treated, and/or release to stormwater during construction. Adverse effects from diminished stormwater quality are expected to be significant if not correctly mitigated.

1.4.3.3 Surface Water

Surface water quality can be adversely affected by near-water or in-water construction activities. Near-water activities such as embankment modifications have the potential to allow contaminated soils to migrate to surface water. In-water activities such as barge support, pier installation, temporary pile installation and removal, dredging, and scour have the potential to re-suspend contaminated sediments into the water column. Lead-paint abatement and over-water activities such as bridge demolition and construction could also adversely affect surface water quality.

Findings

The LPA has a potential for adverse effects to surface water quality from construction. Adverse effects to surface water quality are expected to be significant if not mitigated correctly. These effects are of most concern in the areas of Marine Drive, North Portland Harbor, and Hayden Island where modifications to the embankments and pile installation and removal are proposed. These construction activities are in proximity to priority hazardous materials sites Nos. 138 (Diversified Marine) and 142 (Pier 99), where known or suspected releases of contamination occurred in soil, sediment and/or groundwater. Unidentified contamination may also be present in these areas due to historical land use.

Installation of pier structures within the Main Channel of the Columbia River is not expected to have adverse effects on surface water quality outside of potential turbidity issues associated with the placement of coffer dams (see the Ecosystems and Water Quality Technical Reports). Laboratory analysis of sediments collected downstream of the I-5 bridges did not detect chemicals of concern and/or were below Sediment Evaluation Framework (SEF) screening levels. However, a supplemental sediment evaluation will occur within the footprint of the pier structures to confirm that sediment quality is acceptable. This is particularly the case near City of Vancouver outfalls where stormwater discharge from PGIS may have locally impacted sediments near proposed near-shore bents.

Potential adverse surface water quality effects to the Columbia Slough and Burnt Bridge Creek from the construction of the LPA would not be significant. Construction activities in the area of the Columbia Slough and Burnt Bridge Creek are minimal in extent and intensity.

1.4.3.4 Sediment

Sediment quality can be adversely affected by exacerbating existing sediment contamination through in-water construction activities. These activities include pier installation, pile installation and removal, dredging, and barge support. Scour from cofferdams and/or piers could also exacerbate contaminated sediments. Exacerbation can occur from re-depositing contaminated sediments or exposing residual contaminated surfaces. Exacerbation of sediment contamination can also lead to impacts on surface water quality through re-suspension into the water column.

Sediment quality within the North Portland Harbor and vicinity of Hayden Island is suspected of being impacted from historical industrial, commercial and residential activities. These activities include boat moorage, boat maintenance and fueling, freight hauling, and miscellaneous activities associated with floating homes. Contaminants including PCBs, tributyltin (TBT), and pollutant metals are suspected in sediments at hazardous materials sites Nos. 138 (Diversified Marine) and 142 (Pier 99). In addition, stormwater from non-point upland sources, including the I-5 bridges and associated roadways, may be contributing to sediment contamination.

Shallow water environment (less than 20 feet deep) occurs in the North Portland Harbor and in proximity to Hayden Island. This environment has a higher likelihood of retaining contaminants due to the prevalence of fine-grained materials (sands and silts) and its low-energy fluvial setting. Shallow water environments of North Portland Harbor and Hayden Island have been identified as a sensitive environment for fish.

Sediments within the main channel of the Columbia River are not thought to be impacted by contaminants. This is based on sediment samples collected downgradient of the I-5 bridges. However, localized impacts to near-shore sediment may have potentially occurred from stormwater discharge associated with the City of Vancouver outfalls (Exhibit 3-3). No in-water construction activities will occur within the Columbia Slough, Vanport wetlands, and/or Burnt Bridge Creek.

Findings

The LPA has a potential for adverse effects to sediment from construction activities. These effects will be significant if not mitigated correctly. Exacerbation of existing sediment contamination is of most concern in near-shore environments (water column less than 20 feet) along North Portland Harbor, Hayden Island, and the Columbia River where pier installation, pile installation and removal, dredging and barge support could occur. These construction activities can re-suspend contaminants into the water column, re-deposit contaminated sediments, or expose residual sediment contamination. Construction activities are in proximity to priority hazardous materials sites Nos. 138 (Diversified Marine) and 142 (Pier 99), where known and/or suspected releases of contamination have occurred in soil, sediment and/or groundwater. Impacts to sediments may have also occurred from the discharge of impacted stormwater from point and non-point sources. Near-shore environments are typically more sensitive for aquatic organisms and fish due to their use for foraging, migration, and rearing.

Potential adverse effects associated with pier installation within the deeper water environment of the Columbia River is thought to be minimal. This is due to the likelihood that contaminated sediments within the deeper water environment are not present due to the high-energy fluvial environment and presence of coarse-grain sediments that tend not to retain contaminants.

1.4.3.5 Groundwater

The Troutdale Aquifer extends throughout the Portland Basin and is used as a municipal water source. It is designated by the EPA as a sole source aquifer in Clark County, Washington. The City of Vancouver recognized its dependence on this aquifer and the importance of protecting it as a resource by designating the area within its boundaries as a Critical Aquifer Recharge Area.

The Troutdale Aquifer can be adversely affected by the exacerbation of existing contamination during construction. Construction activities include, but are not limited to: 1) excavation to accommodate roadway grade changes, tunneling, utility lines, stormwater conveyance systems, and retaining walls; 2) installation of piles and shafts for bridge and interchange foundations; 3) earth stabilization techniques such as placement of stone columns; and 4) dewatering activities for the placement or retaining walls and tunnels.

Mechanisms that could cause existing contamination to migrate to or below the water table during project construction are: 1) drag down of surficial contamination; 2) downward or lateral migration of mobile contamination along conduits or preferential pathways; 3) leaching of exposed contamination; 4) migration of contamination from dewatering activities; 5) infiltration of impacted stormwater and/or infiltration of stormwater into impacted subsurface materials; and 6) accidental release of hazardous substance or petroleum products.

The most significant effects to groundwater quality during construction could occur in areas where: 1) abundant or gross contamination is present in saturated or unsaturated soils; 2) contaminants are soluble in water and/or are in a dense non-aqueous form; 3) the depth to water table is shallow; and/or 4) construction activities extend to or below the water table. These conditions or a combination of these conditions could allow contamination to migrate downward and adversely affect groundwater quality if contamination is not mitigated correctly.

Areas most sensitive to adverse effects to groundwater quality are those where beneficial use of groundwater occurs. Drinking water, irrigation and process water generally derive water from zones approximately 100 to 300 feet below ground surface. Therefore, proposed construction activities that extend into these zones where water is derived have a higher potential to cause adverse effects to the well head. This is particularly the case for municipal wells at water stations WS-1 and WS-3, which hydraulically influence the direction of groundwater flow within the City of Vancouver. Groundwater within these wells' zone of influence is thought to be captured within a 1- to 5-year timeframe. Municipal wells at these stations are currently tested and treated to meet state and federal primary and secondary water quality standards. For WS-1 this includes treatment of groundwater using an air stripping system to remove low-level solvent contamination.

Existing groundwater contamination from hazardous materials sites is present within the main project area. The nature and extent of these impacts are not fully understood, but likely consist of low concentrations dissolved phase solvents, metals, and/or petroleum products within the Unconsolidated Sedimentary Aquifer (USA) and Troutdale Gravel Aquifer (TGA).

Findings

The LPA has a potential to cause adverse effects to groundwater from construction. Construction activities for the LPA are intense and complex, with a higher occurrence of activities that extend to or below the water table in areas where hazardous materials sites were identified and/or unidentified contamination may exist.

Exacerbation of existing contamination in groundwater is of most concern in areas where construction activities in the vicinity of a hazardous materials site require dewatering. Areas where dewatering may occur include the SR 14 interchange, Columbia River Crossing, Hayden Island interchange, North Portland Harbor interchange, and/or Marine Drive interchange. The construction of these project elements requires a high degree of excavation work, deep installation of piles and shafts, and dewatering. Construction will occur in areas where the water table is fairly shallow, and contamination may be present from historical land use. Groundwater in this area is beneficially used for drinking water, process water, and/or irrigation.

Construction activities that encounter dissolved phase groundwater contamination at depth during deep foundation construction will not likely result in adverse effects. The drag down of dissolved phase contaminants during drilled shaft or driven pile construction is thought to be minimal, if any. The potential of downward migration due to the creation of preferential pathways would only be significant if dense non-aqueous phase liquids are encountered.

1.4.4 Adverse Effects to Construction Activities from Hazardous Materials

1.4.4.1 Worker Safety and Public Health

Adverse effects to worker safety and public health from hazardous materials during construction can occur if not correctly mitigated through proper safety precautions. Potential exposure routes include dermal contact and ingestion of contaminated soil and water, and inhalation of contaminated vapors or particulates. Exposure is thought to be the greatest during excavation work, demolition, or application of materials that contain hazardous substances. Potential receptors include construction workers, excavation workers, transients, the travelling public, and residents (adult and child). Health effects are dependent on the type of contaminants, duration, dosage, exposure route, and age of persons exposed. Contaminants such as chlorinated solvents, metals (lead), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), pesticides/herbicides, asbestos, and PCBs are mainly associated with long-term chronic effects to human health. However, these contaminants and other, unidentified contaminants have the potential to cause acute effects to human health. EPA, DEQ, and Ecology provide generic health-based screening concentrations to establish precautions for worker safety.

Findings

The LPA has a potential for adverse effects to worker safety and public health if these effects are not mitigated correctly. Under the LPA, construction activities are relatively intensive and complex, and a number of exposure pathways could be potentially complete. Adverse effects to worker safety are expected to be significant if not mitigated correctly. The potential impacts can be mitigated by following an approved, project-specific Health and Safety Plan (HASP). In general, the plan outlines roles and responsibilities, known physical and chemical hazards, and action levels and establishes exclusion zones and personal protective procedures.

1.4.4.2 Hazardous and Non-hazardous Wastes

Waste can be generated during construction activities when contaminated materials are encountered or generated by construction and demolition. Waste can consist of contaminated soils, sediments, water, and/or building material.

Non-hazardous wastes are those categorized as not hazardous waste and are exempted from or do not apply to Resource Conservation Recovery Act (RCRA) Subtitle C regulations. They are typically called "solid waste." Non-hazardous wastes likely to be encountered are fill, debris, soil, and wood. Non-hazardous wastes require management in accordance with applicable federal and state regulations. Characterizing, managing, storing, and disposing of hazardous waste will likely be a common component of project construction.

A solid waste that is dangerous and/or potentially harmful to human health is considered a hazardous waste. Hazardous waste can have characteristics of toxicity, corrosivity, reactivity, and/or ignitability that are governed by RCRA Subtitle C regulations. Universal wastes include batteries, pesticides, and mercury-containing light bulbs. In addition, wastes that contain PCBs are managed under the Toxic Substance Control Act (TSCA) and under 40 CFR Part 761.

Hazardous wastes and universal wastes require management in accordance with applicable federal and state regulations. Characterizing, managing, storing, and disposing of hazardous waste will likely be a small component of project construction. However, if not mitigated correctly, hazardous wastes can increase project costs and cause schedule delays, and are a source of liability to the project.

Findings

Under the LPA, construction activities will be relatively intensive and complex, and will generate significant quantities of materials that will need to be managed, stored, and characterized for the presence of contamination. The LPA has a high potential to manage, characterize and dispose of non-hazardous wastes. Adverse effects from non-hazardous waste are thought to be significant if not correctly mitigated.

If any material is determined to be a hazardous waste, the material will need to be properly disposed of at a registered facility according to state and federal guidelines. The LPA has a low potential of managing, characterizing and disposing of hazardous waste. However, adverse effects from the hazardous waste are expected to be significant for the LPA if not mitigated correctly.

1.4.4.3 Lead and Asbestos-Containing Materials

Wastes that contain lead and ACMs are managed and disposed of as non-hazardous wastes under 40 CRF Part 261. Lead has the potential to be a hazardous waste if it fails toxic characteristic leaching procedures. Asbestos is treated as an industrial waste and requires special packaging and handling pursuant to OAR 340-248, WAC 269-65, and 40 CFR Part 61 Subpart M.

The existing I-5 bridges, buildings, and other structures that contain lead and/or ACMs will need to have proper abatement conducted prior to any demolition, renovation, or repair activities. Abatement must follow state guidelines and be conducted by licensed abatement firms. Abatement materials must be properly disposed at authorized solid waste facilities. In general, building and structures that were built prior to 1980 have a higher likelihood of containing asbestos. EPA issued a ban and phase out of asbestos in 1989.

Findings

The LPA has a potential for adverse effects to the project from the disturbance of lead and asbestos-containing materials during construction. These effects are expected to be significant if not mitigated correctly. However, it is recognized that the proper removal of lead and ACMs is beneficial to human health and the environment.

Forty-five of the properties being acquired include structures that were built before 1980 and are proposed to be demolished. Structures on these properties have a higher likelihood of containing RECs such as lead and ACM (however, it should be noted that any structures, regardless of age, may have lead or ACM in its construction materials and are suspect until otherwise determined). The number of building displacements is the same for Option A and Option B.

1.4.5 Other Consideration for the LPA

1.4.5.1 Ruby Junction Maintenance Facility

The LPA includes expansion of light rail maintenance infrastructure at the TriMet Ruby Junction Maintenance Facility. Expansion would require 15 properties to be acquired, as well as modifications to the existing building structure. Review of the DEQ facility profiler indicates a number of potential issues of environmental concern at or near the facility. Expansion may result in significant adverse effects if not correctly mitigated. These potential effects include liability issues in property acquisition, and site investigation and cleanup to accommodate modifications to building structures. These effects will be more fully realized as further details on facility expansion come available.

1.4.5.2 Staging Areas

The LPA will consider three staging areas to support construction. These sites are the Port of Vancouver, Red Lion, and the former Thunderbird Hotel. Staging areas will be used for material lay down yards, equipment storage, and fabrication. The areas may require regrading and roadway access, demolition, and utility trenching.

Preliminary review of the staging areas indicates that only the former Thunderbird Hotel has an existing environmental issue likely to affect its immediate use as a staging area. The hotel location was a former landfill site (Site ID 103) and service station (Site ID 107), which may have resulted in impacts to subsurface soils and groundwater.

Adverse effects to the project from acquisition of the former Thunderbird Hotel are expected to be significant if not mitigated correctly. The eastern portion of this property will be permanently acquired for the bridge and the western half is planned for staging. Prior to the use of the site for staging and bridge construction, the structures currently on-site will require demolition and soil stability techniques may be employed. Removal of the debris and fill material may be necessary for the use of the site for bridge construction and work area. These impacts are thought to be significant if not correctly mitigated.

1.4.5.3 Casting Areas

The LPA will consider two areas to pre-cast concrete forms used in bridge and interchange construction. These areas are the Sundial Site and the Alcoa/Evergreen Site.

Preliminary review of the two proposed casting areas indicates that both sites have existing environmental issues that will likely affect their immediate use as casting area. This is based on the understanding that staging areas will be used for barge slips, will have ground disturbances, and will require stormwater management for casting activities.

Adverse effects to the project from acquisition of the Sundial Site or Alcoa/Evergreen Site are expected to be significant if not mitigated correctly. Of the two sites, the Sundial Site appears to be more suitable for future site activities with regard to hazardous material issues. Environmental impacts to soil, sediment and groundwater appear at the Sundial Site to be relatively less significant than those associated with the Alcoa Site. This is particularly the case for in-water sediments at the Alcoa Site, which have known PCB impacts above generic risk-based levels. These impacts are upriver from the proposed staging area. Dredging of sediments for barge ramp installation at the casting area could result in significant environmental issues. An Ecology information review indicates that the Port of Vancouver has been diligent on requiring Alcoa to meet its Model Toxics Control Act (MTCA) requirements.

1.5 Long-term Effects

Long-term effects are future effects on environmental resources from the operation and maintenance of the No-Build Alternative or the LPA, or future effects to the operation and maintenance of the No-Build Alternative or LPA from hazardous materials sites. Long-term effects are thought to occur in three general categories: 1) property acquisition, 2) effects to the environment from operation, and 3) effects to operation from hazardous materials. These potential effects are assessed qualitatively based on the project team's current understanding of the natural and built environment.

1.5.1 Property Acquisition Liability

Long-term liability can result from ownership or from becoming legally and/or financially obligated to a property that is or will be undergoing investigation, cleanup, and/or requirements associated with the long-term operation of a cleanup action.[6]

Findings

Compared to the No-Build Alternative, the LPA has a higher potential for long-term effects from property acquisition. The LPA will acquire 55 properties that have been identified as a hazardous material site for LPA Option A and 52 for LPA Option B. Long-term adverse effects from property acquisitions are thought to be significant because environmental actions on the acquired properties may continue after construction is completed.

1.5.2 Adverse Effects on the Environment from Operation and Maintenance

1.5.2.1 Spills and Releases

Operation of roadway and transit may result in releases of hazardous substances or petroleum products into the environment from accidental spills. These releases can migrate to surface water or groundwater and/or affect properties outside of the right-of-way. Adverse effects include road closures and delays, cleanup costs, and regulatory fines applied to the responsible party.

Findings

Compared to the No-Build Alternative, the LPA has a lower potential for long-term adverse effects from spills and releases. The LPA will have an updated roadway, bridge and stormwater conveyance design, which will allow better response and management of spills. Adverse effects from spills and releases can have significant impacts to surface water and groundwater resources if not correctly mitigated.

1.5.2.2 Stormwater Conveyance System and Treatment Facilities

Water quality can be diminished by stormwater flowing over PGIS (i.e. roadways and bridges carrying automobiles) and by runoff and erosion of contaminated soils exposed during excavation and grading. Typical stormwater pollutants include petroleum products, metals (copper, cadmium, and lead), salts, fecal coliforms, and suspended solids. Contaminants in stormwater can further migrate to surface water, groundwater and sediments.

Long-term operation and maintenance of the stormwater conveyance system and treatment facilities is necessary to meet discharge and water quality regulatory standards. Treatment technologies rely on reduction of stormwater flow velocity to allow for the settling out of suspended solids and pollutant uptake by plants. Pollutant uptake by plants and accumulation of pollutant loading at soil horizons may have limited or diminishing capacities over time.

[6] Under Oregon law ORS 465.255, the owner/operator is liable for remedial costs incurred by the State. The statute limits the State from being legally liable through property acquisition or condemnation.

Long-term evaluation of the effectiveness and performance of the treatment systems would be conducted to ensure that the systems are functioning as intended.

Findings

Compared to the No-Build Alternative, the LPA has a lower potential for adverse effects from impacted stormwater. The LPA is thought to have significant beneficial effects to the environment in regards to stormwater, because it will provide management and treatment of stormwater generated from PGIS (Exhibits 1-8a through c). Updates and enhancement of the stormwater conveyance system and treatment facilities are expected to result in locally improved surface water, sediment, and groundwater quality for both full build and phasing option (see Water Quality Discipline Report). This is considered significant due to the beneficial uses of the Columbia River and Troutdale Aquifer. In addition, groundwater recharge to the Troutdale Aquifer should increase due to direct infiltration of stormwater into bioswales and the management and storage of overflow volumes in retention ponds. The LPA stormwater conveyance system and treatment facilities would be monitored and maintained to ensure they are performing as intended. Stormwater that is not adequately managed or treated is expected to have significant adverse effects to the environment.

1.5.3 Adverse Effects on Operation and Maintenance from Hazardous Materials

1.5.3.1 Legacy Hazardous Material Sites

Legacy sites are hazardous materials sites that are or should be undergoing long-term cleanup actions by the owner, sites where additional investigation and cleanup may be required but where the responsible party has not yet complied, or orphan sites which are being managed by regulatory agencies. In special cases, site cleanup activities may coincide with the operation and maintenance of the No-Build Alternative or LPA. These activities could potentially interfere with the long-term operation and maintenance of the alternative and result in financial liability or access restrictions.

Findings

Compared to the No-Build Alternative, the LPA has a higher potential for long-term adverse effects from legacy sites. Of particular concern are the Diversified Marine Site (Site ID 138), the Pier 99 (Site ID 143), former Hayden Island Landfill (Thunderbird Hotel Site ID 103), Boise Cascade (Site ID 80), Harbor Oil (Site ID 141), and Plaid Pantry Site (Site ID 151). These sites have not been fully characterized, and cleanup actions have not been determined or are currently on-going. Potential legacy issues associated with Diversified Marine and Pier 99 include cleanup actions for soil and sediment along the North Portland Harbor embankment and/or for in-water sediments. Potential future remedial activities that could affect the operation and maintenance of the LPA include soil removal, sediment dredging, capping, groundwater treatment and/or long-term monitoring. In addition, potential legacy sites could be discovered during project construction activities. Adverse effects from legacy sites are expected to be significant if not correctly mitigated.

1.5.3.2 TriMet Ruby Junction Maintenance Facility

Adverse effects to the environment could result from the long-term operation and maintenance of the Ruby Junction Maintenance Facility if not correctly mitigated. Operation and maintenance of the facility requires the use of hazardous substances and the generation and disposal of hazardous waste. Poor management practices or an accidental spill could result in a release to the environment. A potential benefit of the expansion of the facility may include updates in spill prevention and containment systems through new construction.

1.6 Proposed Mitigation

The following presents mitigation measures for identified adverse effects for the LPA. Measures are described for the three general categories used to describe temporary and long-term effects: 1) property acquisition, 2) effects to the environment from construction activities, and 3) effects to construction from hazardous materials.

1.6.1 Property Acquisition and Cleanup Liability

Environmental due diligence is recommended for properties to be acquired and/or for properties that are proposed for substantial construction activities. Environmental due diligence can take many forms. However, typical environmental due diligence includes the completion of Phase I and/or Phase II Environmental Site Assessments (ESAs). These can be completed on a site-by-site basis or completed for blocks of properties, adjacent properties, or within focused areas. The focus of environmental due diligence is to determine the potential for environmental liability (existing contamination, current operational practices, construction worker health and safety, etc.) associated with a particular property.

Phase I ESA– Phase I ESAs may be necessary to help identify liability issues associated with purchasing a facility or property in fee. An adequately completed Phase I ESA through good commercial and customary practice is the first step in the due diligence process by establishing the baseline condition of the property. This allows the purchaser to be in a legally defensible position if financial and legal liabilities are incurred. Under ASTM E 1527-05, parameters are set forth as to how Phase I ESAs are to be performed. A Phase I ESA also can be used to assist in establishing the fair market value of the property. Residential properties that are acquired may only need a less detailed level of study such as a Transaction Screen ASTM E1528-06.

It is anticipated that the majority of properties to be acquired or are located in areas with substantial construction activities will be subject to minimum due diligence in the form of a Phase I ESA or Transaction Screen. The due diligence would be completed prior to acquisition or construction initiation at a site to identify potential environmental issues. These assessments can be completed on a site-by-site basis or completed for blocks of properties, adjacent properties, or within focused areas.

Phase II Environmental Site Assessments – More extensive investigation may be necessary if the Phase I ESA determines that a property has a likelihood of contamination. In this case, a Phase II ESA may be necessary for property acquisition or for construction purposes. Phase II ESAs will be conducted in a manner that is consistent with the MTCA, Oregon Administrative Rules (OAR) for Hazardous Materials, ASTM International, and the American Association of State Highway and Transportation Officials (AASHTO). The Phase II ESA is an intrusive investigation to collect samples of soil, groundwater and/or building materials. The substances most frequently tested for are petroleum hydrocarbons, metals, pesticides, solvents, asbestos, and/or lead-based paint. A Phase II ESA can be simple, such as an investigation of an underground storage tank (UST), or complex, as for a site that has a long, intensive history and multiple environmental issues. Ecology and DEQ may be notified if contamination is encountered during the assessment. Findings will be used to support avoidance strategies or help guide appropriate cleanup actions.

At this time it is not possible to ascertain all properties that may require a Phase II ESA to ensure that potential liability is identified. In general, a Phase II ESA is conducted based on the results of the Phase I ESA or other known or existing information. However, based on the evaluation work completed as part of this report, it is anticipated that at a minimum, Phase II ESAs will be completed for the acquired properties which were identified as priority hazardous material sites (Exhibit 5-1). Supplemental Phase II ESAs will likely be required as additional information is obtained during the environmental due diligence process.

1.6.2 Effects to the Environment from Construction Activities

Focused Site Assessments – Assessments would be conducted prior to construction to assess potential adverse effects to the environment or construction activities. Focused site assessments would characterize and evaluate potential existing impacts to soil, sediment and groundwater that could be exacerbated through the construction process. Areas of focused assessment include, but are not limited to, the Marine Drive Interchange, North Portland Harbor, Hayden Island, Columbia River, SR 14 interchange and the Mill Plain interchange. Findings would be used to support avoidance or mitigation strategies or to help guide appropriate cleanup actions.

Construction Stormwater Pollution Prevention Plans (SWPPPs) – Control plans will be prepared to prevent or minimize soil or sediment from being carried into surface water by stormwater runoff. Plans would be required for all permitted construction sites, are subject to approval by the regulatory agencies, and must comply with CPC Title 10 and Vancouver Municipal Code (VMC) Chapter 14.24. Plans would be prepared in a manner that is consistent with the Stormwater Manual for Western Washington and/or WSDOT Highway Runoff Manual, and would be put in place prior to clearing, grading, or construction.

NPDES Construction General Stormwater Permits – 1200-C and/or 1200-CA permits would be prepared to cover all ODOT and WSDOT construction activities disturbing more than 1 acre. Under the conditions of this permit, ODOT and WSDOT must submit to the regulatory agencies a Notice of Intent to discharge stormwater associated with construction activities and to meet stormwater pollution prevention requirements. Permits are subject to approval by the DEQ pursuant to OAR 340-045 and by Ecology pursuant to WAC 173-220.

Stormwater Conveyance System and Treatment Facilities Monitoring Plan – A stormwater monitoring plan would be prepared to evaluate the long-term performance and effectiveness of the updated stormwater conveyance and treatment systems. Based on the findings, modifications and/or enhancements to the updated system would be conducted to best meet discharge criteria.

Drinking Water Supply and Treatment – In the event that migration of contaminated material has occurred, groundwater at WS-1 and WS-3 is currently treated for microbiological constituents by chlorination, and groundwater at WS-1 is treated for volatile organic compounds (VOCs) by aeration. Groundwater at these stations is monitored to ensure that water quality meets drinking water standards.

1.6.3 Effects on Construction from Hazardous Materials

Health and Safety Plan (HASP) – Site-wide construction HASPs would be prepared to minimize exposure of construction and excavation workers to hazardous materials, and to reduce the risk to human health and the environment. Construction would be conducted under approved site-specific HASPs prepared by the contractors. The HASP would conform to Occupational Safety and Health Administration (OSHA) requirements.

Spill Prevention, Control & Countermeasures (SPCC) plans – SPCCs address three areas: 1) operating procedures the facility implements to prevent oil spills; 2) control measures installed to prevent oil from entering navigable waters or adjoining shorelines; and 3) countermeasures to contain, clean up, and mitigate the effects of an oil spill that has an impact on navigable waters or adjoining shorelines.

SPCCs would be used to limit the generation and migration of hazardous substances or petroleum products, and will outline best management practices (BMPs) to be used by contractors. Plans would be required for all permitted construction sites and would be prepared by the construction contractor. ODOT projects administer SPCCs pursuant to OAR 340.142. WSDOT projects require SPCC plans in accordance with WSDOT Standard Specification 1-07.15(1).

Contaminated Media Management Plans (CMMPs) – CMMPs would be prepared to properly characterize, manage, store, and dispose of contaminated materials encountered during construction activities. The CMMP would outline roles and responsibilities of personnel; health and safety requirements; methods and procedures for characterizing, managing, storing, and disposing of waste; and reporting requirements.

Hazardous Building Material Surveys and Abatement Program – A hazardous building material survey would be conducted, prior to acquisition of building and/or structures and depending on building age and/or suspicion of hazardous building materials. Surveys would be consistent with OAR 248 and WAC 296-65. The survey would inventory lead-based paint, ACM, mercury, and PCB containing equipment, and/or abandoned waste. Based on survey results, abatement would be conducted prior to demolition, renovation, and/or repair. Disposal of identified hazardous building materials would be conducted at suitable Subtitle C or D solid waste facilities.

Well Decommissioning – Two City of Portland process wells located on Hayden Island are within the footprint of the proposed roadway. One well (east of I-5) is abandoned. The other well is not in use and is planned for decommissioning pursuant to Oregon Water Resources Department (OWRD) regulations prior to the start of project construction. Other wells, where encountered, would be decommissioned pursuant to OAR 690-220 or WAC 173-160, as necessary. Where applicable, dry wells would be decommissioned pursuant OAR 340 Division 44 or WAC 173-218.

2. Methods

2.1 Introduction

This section describes the methods by which data is collected and the guidelines by which data is evaluated.

2.2 Study Area

A study area is used to place constraints on the active area in which the evaluation of hazardous materials and hazardous materials sites is conducted. The boundaries of the study area are displayed in Exhibit 2-1. The study area encompasses the main project area of the LPA for the CRC Project. The boundaries of the study area were set using the standard search radius established by ASTM E 1527-05 for conducting environmental site assessments. This distance is defined by a 1.0-mile radius around the main project area boundary.

2.2.1 Main Project Area

The main project area defines the area most likely to have direct impacts from construction and operation of the CRC project. The main project area is based on the designs of the LPA. This area extends 5 miles from north to south between the I-5/Main Street interchange in Vancouver and the I-5 Victory Boulevard interchange and Martin Luther King Boulevard near NE Union in North Portland. North of the river, the API extends west into downtown Vancouver and east to near Clark College, and includes potential transit alignments and park and ride locations.

2.3 Data Collection Methods

Data sources and data collection methodologies presented in this technical report are consistent with those described in the Methods and Data Report (MDR) for hazardous materials (Parametrix 2007). Procedures for this assessment were developed to comply with applicable state and federal environmental policy legislation and guidance. These include the WSDOT Guidance and Standard Methodology for Hazardous Material Discipline Reports (WSDOT 2009), Oregon Department of Transportation (ODOT) HazMat Program Procedures Guidebook (ODOT 2004), and most aspects of ASTM E 1527-05.

Project staff conducted this assessment in accordance with generally accepted industry practices and procedures within the authorized scope of work. Information in this report is based on regulatory environmental database review, literature review, observed site conditions, and the best available information known or made available by the project team and applicable agencies.

2.3.1 Database Search

Appendix A presents a description of federal and state environmental database listings used to identify potential hazardous materials sites within the study area. In general, the database listings are compiled and maintained by agencies for properties and facilities that generate, store, use, transport, or dispose of hazardous substances, and for properties that are known or suspected to have soil, sediment, or groundwater contamination.

For the purposes of this report, a hazardous materials site is a location or facility that potentially contains a recognized environmental condition (REC). The term "recognized environmental condition" is defined by ASTM E-1527 as:

> "...the presence or likely presence of any hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any hazardous substances or petroleum products into structures on the property or into the ground, groundwater or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimus conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies."

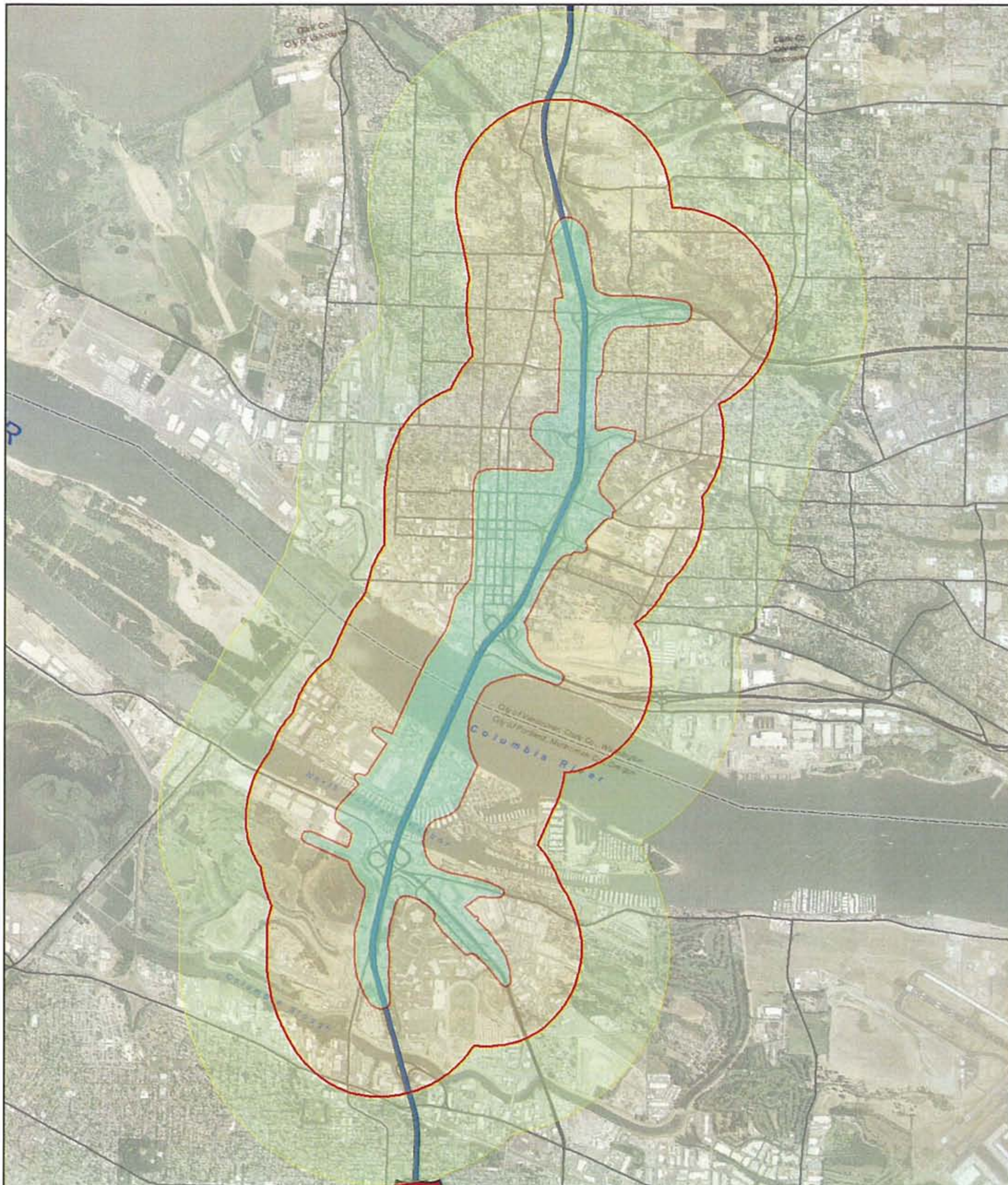
The database search was conducted in part by Parcel Insight, Inc., which compiled database records through May 2009. A copy of Parcel Insight, Inc.'s database search is provided in Appendix B, on CD-ROM. State agency databases were also searched independently by project staff to ensure completeness of the search. Identified sites were given unique project identification numbers.

2.3.2 Historical Land Use Review

Historical land use within the study area was reviewed in regards to RECs with the aid of fire insurance maps (Sanborn Maps®) and historical aerial photographs.

2.3.2.1 Sanborn Fire Insurance Maps

Sanborn fire insurance maps were originally intended to assist insurance companies in assessing fire risk associated with discrete properties. Map information typically includes site address and location, property boundaries and size, building size and construction materials, utility line types and locations, material types stored in the building, building use/function, boiler locations, fuel and oil storage locations, and/or other details about use. Identified sites were given unique ID numbers. This assessment used Sanborn maps for the years 1911 to 1969 (included in Appendix C) to aid in the identification of sites that may have used, stored, or generated hazardous substances or petroleum products. This assessment was not definitive, and sites that were identified are only suspected of using or storing hazardous substances and/or generating or disposing of hazardous substances. In addition, historical use of these sites may have not been identified due to limited information.



N
W E
S

0 0.5 1
Miles

Main Project Area
1/2 Mile
1 Mile

Exhibit 2-1.
Study Area Location Map

Columbia River CROSSING

File Name: P:\GIS\CRC\GIS\MXD\PDF\TECH_REPORTS\HAZMAT\Ex_2-1_StudyAreaLocation.mxd Date: December 2010

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2.3.2.2 Historical Aerial Photographs

Plan view aerial photographs depict the land use and setting for a specific time period. This assessment used aerial photographs at approximately 10-year intervals from the mid-1930s to the present to identify agricultural, commercial, or industrial sites that may have used, stored, or generated hazardous substances or petroleum products. Historical aerial photographs from 1939, 1948, 1955/1956, 1964, 1973, 1980, 1990 and 1998 were reviewed; these photographs are included in Appendix D.

The photographs in Appendix D also include Site ID information from the historic Sanborn maps evaluation. In addition, oblique aerial photographs of downtown Vancouver for 1950 and 1963 are presented in Appendix D. The oblique photographs also depict Sanborn Site ID information.

2.3.3 Site Reconnaissance

Site reconnaissance consisted of drive-by surveys within the study area. Drive-by surveys were generally conducted at sites that were identified by the database search or historical land use review to have had a potential REC. In addition, the drive-by survey also assessed sites within the main project area that were not identified, but that appeared to have a potential REC. However, site reconnaissance information is limited because the drive-by surveys were conducted from the public right-of-way. The project team recorded the following information, if observed:

- Evidence of a UST or above-ground storage tank (AST).
- Evidence of a spill or release.
- Poor housekeeping practices, such as garbage or debris.
- Evidence of dead or distressed vegetation.
- Evidence of the use or storage of petroleum products or hazardous materials.

2.4 Guidelines for Evaluating Potential Effects

Applicable state and federal guidelines were used to collect and screen data and to evaluate potential direct effects to the project from hazardous materials. These guidelines include:

ODOT. 2004. ODOT Hazmat Program Procedures Guidebook. Prepared by the Oregon Department of Transportation. Revised November 11, 2004.

WSDOT. 2009. Guidance on Standard Methodology for WSDOT Hazardous Material Discipline Report. Prepared by the Washington Department of Transportation, Environmental Services Office, Olympia, Washington. January, 2009.

ASTM. 2005. ASTM E 1527-05, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.

AASHTO. 1990. Hazardous Waste Guide for Project Development. Prepared by the AASHTO Special Committee on Environment, Archaeology and Historical Preservation.

2.5 Data Screening Methods

The following methodology was used to screen hazardous materials data.

2.5.1 Methods for Ranking Identified Database Sites

Hazardous materials sites identified in one of the listed databases were ranked qualitatively for their potential to act as a contaminant source. Ranking was based on the following criteria:

- Location of the site (in or out of the study area and/or API).
- Type and number of database listings.
- Occurrence of a known release of a hazardous substance(s) or petroleum product.
- Status of cleanup – Active, Inactive,[7] or unknown.

2.5.1.1 Screening Database Information

Database types were compared to one another on their ability to signify that an adverse environmental condition exists.[8] Comparisons of database types are presented below, with those at the beginning of the list having the greatest potential for adverse effects relative to those at the end of the list. Appendix A provides a summary of databases reviewed and their description.

Sites with a Known Release to the Environment

- NPL, CERCLIS, ROD, TRIS, ECSI, and CSCSL database listings indicate that a relatively significant adverse environmental condition exists at the site. These database listings signify sites that have had one or more confirmed or suspected releases to the environment and may require or are in the process of cleanup.
- IRC, RAATS, VCP, and LUST database listings indicate that an adverse environmental condition exits. These sites have one or more confirmed releases to the environment and may require or are in the process of cleanup. LUST sites associated with fueling stations may pose a greater threat than those associated with home heating oil, due to the use of fuel additives and the quantities stored at fueling stations.
- ENG CONTROLS and INST CONTROLS database listings indicate sites at which a formal control is in place that may pose limitations or constraints to property use.
- Delisted-NPL, CERCLIS-NFRAP, CSCSL-NFA, and Inactive Drycleaners database listings indicate sites that have had or were thought to have an adverse environmental condition; however, these sites have an inactive status.
- SPILLS, HAZMAT, and ERNS database listings indicate incidents of vehicle accidents with fuel spills and transported material spills that may produce environmental consequences, depending on their nature and extent.

Sites with No Reported Release

- UST and AST database listings have limited potential for producing significant adverse environmental conditions. UST sites that are acquired would require proper decommissioning.

[7] All sites are considered active unless identified as having no further action or inactive status.

[8] Comparisons are based on WSDOT guidance, available data, and professional judgment.

- RCRIS, RCRA-TSDF, RCRA-NLR, CORRACTS, TSCA, PADS, FTTS: HIST-FTTS, SSTS, and MANIFEST database listings indicate sites where hazardous substances that are stored, generated, transported and/or disposed. These sites have limited potential for producing significant environmental consequences.
- SWL-LF database listings are solid waste facilities.

Sites Listed on Long-term Environmental Monitoring Databases

- Sites listed in the ICIS, NPDES, and AIRs databases have limited potential for producing significant environmental consequences, depending on industry type. However, adverse environmental consequences may be associated with sites that have multiple NPDES violations.
- FINDS sites have limited potential for producing significant environmental consequences.

2.5.1.2 Description of the Ranking System

Using database information (including listings type[s], site status, and location), historical land use information, site reconnaissance information, and current land use information, identified hazardous materials sites were ranked on a scale of 0 to 5 (low to high) for being a potential source of contamination within the study area. A description of each ranking is provided below. Sites were ranked using available information on database type, site status, and site location.[9]

- #0 – Identified site is located within the study area, but is located greater than 0.5 mile from the main project area and is not known to have had a release.
- #1 – Identified site is located between the main project area and 0.5 mile of the main project area and is not known to have had a release.
- #2 – Identified site is within the main project area and is not known to have had a release.
- #3 – Identified site is outside the main project area and has had a known release.
- #4 – Identified site is within the main project area and has had a known or suspected release; however, no further action is required or pending.
- #5 – Identified site is within the main project area, has had a known or suspected release, and cleanup activities at the site are active.

Sites ranked #4 and #5 have the greatest potential to be a source of contamination within the study area.

[9] A site is considered to be active unless otherwise indicated by the database or file review. Although a site is designated inactive, it may be subject to or be open to further inquiry by state or federal regulators.

2.5.2 Methods for Identifying Hazardous Materials Sites from Historical Land Use Information

2.5.2.1 Screening Sanborn Sites with RECs

Sanborn Fire Insurance maps were used to identify historical sites within the main project area that are suspected of having RECs from the generation, storing, use, and/or disposal of hazardous substances and/or petroleum products. Sites were identified using business title, type, and/or the presence of potential features of concern. As such, the quality of this information is not conclusive, and can only be used to gain a general understanding of current site conditions.

Identified sites fall into three general categories:

1. Automotive services, including service stations, sales and repair;
2. Heavy and light industrial services, including machine shops and factories; and
3. Commercial properties, including laundry and dry cleaners services.

It is recognized that not all sites fit into these general categories, although they act as a means to separate sites by practices or chemicals that may have been used on site. For example, automotive stations and repair facilities are likely to have used and stored petroleum hydrocarbons on site; paint stores and dry cleaners are often sources of spent or stored solvents; and industrial and other small manufacturers and repair sites are often sources of multiple types of hazardous materials, both raw materials and generated waste products. To avoid repetition, sites that were positively correlated with one of the databases discussed above were removed from the Sanborn list.

Based on this information identified sites were screened into:

- Sites that have a high (H) potential of being a contaminant source within the study area.
- Sites that have a low (L) potential of being a contaminant source within the study area.

2.5.2.2 Historical Aerial Photographs

Historical aerial photos for the project area were reviewed in chronological order to establish changes in land use over time. Documented changes in land use are generally on a scale that includes large portions of the project area, although it is possible to discern the appearance of smaller sites such as mills and other industrial sites and, on occasion, smaller sites such as gas stations. Major land use observations include agricultural use of property, a change from rural or agricultural use to residential or commercial use, or any change to or from an industrial use.

2.5.3 State File Review of Priority Sites

A review of updated site information was conducted on priority hazardous materials sites having a ranking of #4 or #5. For each site, information pertaining to status, type, and quantity of contaminant released, and to affected media were reviewed. The DEQ Facility Profiler website and Ecology's Environmental Information Management (EIM) System website were reviewed. In addition, DEQ and Ecology project managers for the identified site were contacted to document any new relevant and available information.

2.6 Methods for Evaluating Short-term and Long-term Effects

2.6.1 Short-term Effects from Project Construction Activities

Short-term effects to the project were evaluated qualitatively by comparing the location of identified priority hazardous materials sites and historical land use with the location and activities associated with:

- Construction of proposed structures, including bridges, interchanges, retaining walls, tunnels, utility corridors, and stormwater treatment facilities.
- Construction activities, including excavation, grading, soil stabilization, dredging, and the storing and use of hazardous substances.

In general, adverse impacts are thought to occur in areas where construction activities are intensive and where priority hazardous materials sites are or were located. In addition, short-term effects are discussed in regards to the liability associated with acquisition of property with RECs.

2.6.2 Long-term Effects from Project Operation and Maintenance

Long-term effects to the project were evaluated qualitatively by assessing activities associated with the long-term operation and maintenance of the project. Activities include HazMat response to roadway spills, and treatment and discharge of stormwater.

2.7 Mitigation Measures

Mitigation measures for short-term adverse effects from hazardous materials initially consist of avoidance of identified hazardous materials sites. In cases where project construction cannot avoid an identified hazardous material site, the approach for mitigation may include conducting due diligence on the property prior to acquisition; coordination and communications with the state environmental agencies and potentially responsible parties (PRPs); conducting focused site investigations; encouraging the PRP to conduct cleanup; and remediation or abatement of contaminated media. In cases where project construction encounters contamination from an unidentified source, the approach for mitigation includes conducting environmental management under an approved work plan(s) that outlines methods for identifying, characterizing, managing and disposing of hazardous materials, and implementing methods for minimizing the exacerbation of contamination.

Mitigation measures for long-term adverse effects from hazardous materials include instituting HazMat emergency responses to releases or spills on roadways and bridges; conducting maintenance and cleaning of roadways, bridges, and tracks; and conducting long-term monitoring of stormwater facilities to ensure they are functioning as intended.

2.8 Coordination

Project coordination and communication were conducted with Tanya Bird and Mike Stevens, WSDOT Hazardous Materials and Solid Waste Program, and Jennie Armstrong and Charles Schwarz, ODOT Region 1 HazMat Group during preparation, review, and finalizing of this Hazardous Materials technical report.

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3. Affected Environment

This section describes the environmental setting and identifies hazardous materials sites within the main project area.

3.1 Physical Setting

3.1.1 Current Land Use

Current land use in the vicinity of the LPA is displayed in Exhibit 3-1. An understanding of both current and historical land use is important in assessing the occurrence and types of hazardous materials. For example, agricultural land is more likely to have a higher occurrence of pesticides and herbicides then residential land and commercial or industrial land is more likely to have higher occurrence of petroleum products and other hazardous materials.

3.1.1.1 Portland

The Marine Drive Interchange area land use is a mix of commercial, industrial, and residential properties. Hayden Island east of I-5 is predominantly commercial and residential. Hayden Island west of I-5 is commercial, including the Jantzen Beach Center (a large shopping mall) and surrounding retailers. Residential uses in the area include condominiums, manufactured homes and floating homes associated with small marinas.

3.1.1.2 Vancouver

The downtown area of Vancouver is located west of I-5 and south of Mill Plain Boulevard and includes the downtown area, residential areas, and the Uptown Commercial district. The large Central Park includes the National Park Service property and the Vancouver National Historic Reserve (VNHR) east of I-5. Land uses are primarily commercial, but include retail, offices, industrial, and residential uses. Commercial uses are concentrated in the downtown area, while industrial uses are generally located in the southern portion near the Columbia River.

North of Mill Plain Boulevard, the land uses and zoning are predominately residential, with major transportation corridors, primarily Fourth Plain Boulevard and Main Street, providing commercial uses. Residential neighborhoods are located west of I-5. The east side of I-5 includes more multi-family housing and zoning, and has more of a suburban form. Clark College, Fort Vancouver, and the Veterans Administration campus occupy the majority of property adjacent to the eastern side of I-5. The current municipal boundaries of the City of Vancouver are at the railroad bridge just south of 63rd Street on Highway 99.

3.2 Environmental Setting

3.2.1 Topography and Drainage

The Columbia River dominates the topography of the study area. The project corridor lies within the Columbia River main valley, with the exception of a small area north of the SR 500 interchange located in the Burnt Bridge Creek watershed (Exhibit 3-2). Burnt Bridge Creek flows into Vancouver Lake before discharging to the Columbia River. Project area elevations vary from approximately 10 feet North American Vertical Datum 1988 (NAVD88) in the Columbia River floodplain to about 220 feet NAVD88 at the drainage divide between the Columbia River and Burnt Bridge Creek valleys. A small area of the southern portion of the main project area in Portland drains to the Columbia Slough. The Columbia Slough runs parallel to the Columbia River to the south and discharges to the Willamette River approximately 5.5 miles west of the main project area.

3.2.2 Fluvial Setting

The Columbia River drains almost 220,000 square miles in seven states and Canada, with land in forest, agricultural, residential, urban, and industrial uses. The Lower Columbia River, that section of the river most pertinent to the impact analysis, flows from Bonneville Dam at River Mile (RM) 146 to the mouth of the river, and drains an area of 18,000 square miles. Adjacent to the study area, Hayden Island divides the Columbia River into the mainstem to the north and a side channel called the North Portland Harbor to the south. The I-5 highway crosses both channels near RM 106.5.

3.2.2.1 Columbia River

Exhibit 3-3 displays Columbia River bathymetry within the main project area. The figure indicates that depth of water in the study area extends from the ordinary high water line[10] at 21.2 feet NAVD88 to approximately -50 feet NAVD88. Shallow water environments (less than 20 feet of water column) are present in North Portland Harbor and in proximity to Hayden Island.

Geotechnical borings and bathymetric surveys completed within the footprint of the proposed crossing indicate that the depth of unconsolidated sediments (alluvial and/or catastrophic flood deposits) in the study area ranges from -40 to -230 feet NAVD88 (DEA 2006; Shannon and Wilson 2008). Underlying these sediments is the top of the Troutdale Formation, which slopes downward from north to south in the project area.

The top layer of river substrate is composed of loose to very dense alluvium (primarily sand, gravel and trace fines). The alluvium is underlain by dense gravel and in turn underlain by the Troutdale Formation. Additional information regarding the characteristics of in-water sediment material in proximity to the study area has been compiled by the U.S. Army Corps of Engineers and geotechnical investigations conducted for the project (USACE 2009, Shannon and Wilson 2009).

Federal, state, and local databases were reviewed for sediment evaluations performed in proximity to the existing I-5 bridges. The EPA Environmental Management and Assessment Program (EMAP) database was searched for sediment evaluations in the study area. Ecology's EIM database was also queried for recent sediment sampling and analyses performed under the State of Washington's jurisdiction. Legacy data were retrieved using SEDQUAL, the predecessor to the EIM database. For evaluations performed under State of Oregon jurisdiction, the USACE Portland District was contacted.

[10] Normally, this is the point on a stream bank to which the presence and action of surface water is so continuous as to leave a district marked by erosion, destruction or prevention of woody terrestrial vegetation, predominance of aquatic vegetation, or other easily recognized characteristics, but may be modeled based on stream elevation gage data to be the elevation of the 2-year flow. In this area of the Columbia River, the OHW has been modeled.

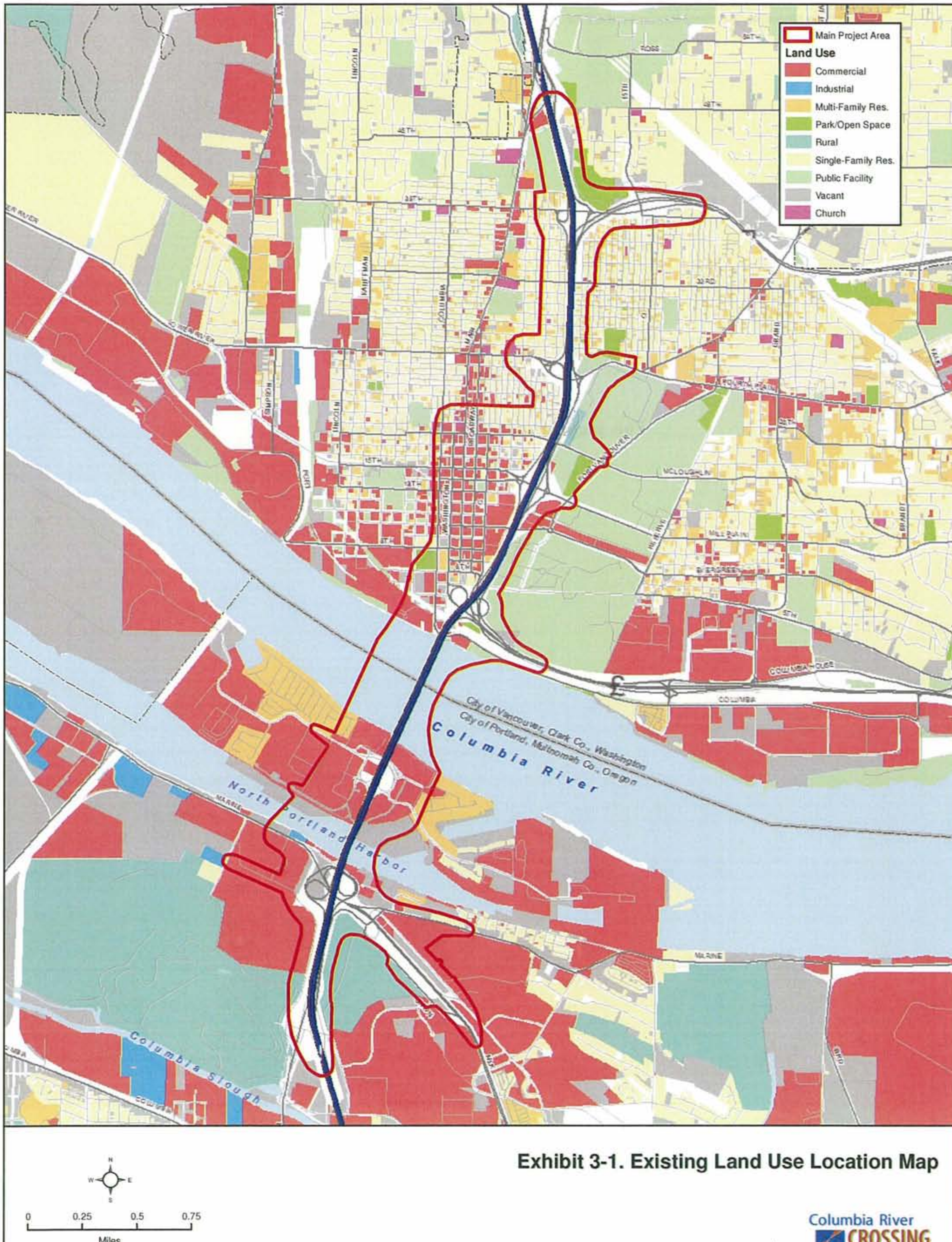

Exhibit 3-1. Existing Land Use Location Map

Columbia River CROSSING

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Exhibit 3-2. Topography and Drainage

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Exhibit 3-3. Columbia River Bathymetry Map

Columbia River CROSSING

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Columbia River Bi-State Program

As part of the Columbia River Bi-State Survey Program, sediment sampling and analysis were performed in 1991 and 1993 (Tetra Tech 1991-1993). Bi-State Program sample collection stations were located within the navigation channel and within 1 mile of the I-5 bridges. Based on the data collected, the concentrations of chemicals of concern in sediment samples were below screening levels established for evaluating the suitability of open water disposal.

The USACE conducted a study (USACE 2009) to characterize the river sediment for dredging as part of the Columbia River Channel Improvement Project. In June 1997, 89 stations were sampled from the Columbia River channel, between RM 6 and RM 106.2, for physical analysis. Samples from 23 of the 89 stations were further analyzed for chemical contaminants. Analyses for inorganic total metals, polycyclic aromatic hydrocarbons (PAHs), total organic carbon (TOC), acid-volatile sulfide (AVS), pesticides, polychlorinated biphenyls (PCBs), pore water TBT, and the P450 reporter gene system (RGS, a dioxin/furan screen) were performed on selected samples. Two sample collection stations (CR-BC-88 and CR-BC-89) were within 0.5 mile of the I-5 bridges (Exhibit 3-4). All sample results for these stations were below their respective screening level values.

Exhibit 3-4. Columbia River Sediment Quality Table

Analysis	Units	Sample Location		Screening Levels[a]
		CR-BC-88	CR-BC-89	
Physical Analysis				
Water Depth*	feet	39.1	34.1	-
River Mile	Miles	106.2	106.2	-
Grain Size – Mean	mm	0.89	0.59	-
Grain Size – Median	mm	0.73	0.51	-
Sand	%	1.1	2.9	-
Very Fine Sand	%	0.1	0.3	-
Silt	%	0.0	0.3	-
Clay	%	0.0	0.0	-
Volume of Solids	%	0.5	0.6	-
Solids	%	88.9	-	-
TOC	%	<0.05	-	-
Metals				
Arsenic	mg/kg	1.0	-	57
Cadmium	mg/kg	<0.8	-	5.1
Chromium	mg/kg	3.0	-	NA
Copper	mg/kg	5.0	-	390
Lead	mg/kg	2.0	-	450
Mercury	mg/kg	<0.05	-	0.41
Nickel	mg/kg	6.0	-	140
Silver	mg/kg	<0.6	-	6.1
Zinc	mg/kg	31.0	-	410
AVS	%	<0.7	-	-

Analysis	Units	Sample Location		Screening Levels[a]
		CR-BC-88	CR-BC-89	
Pesticides and PCBs				
Aldrin	µg/kg	<2	-	10
DDT	µg/kg	<2	-	-
DDE	µg/kg	<2	-	-
DDD	µg/kg	<2	-	-
Total DDT	µg/kg	ND	-	6.9
Aroclor 1254	µg/kg	<10	-	-
Aroclor 1260	µg/kg	<10	-	-
Total PCBs	µg/kg	ND	-	130
Low Molecular Weight PAHs (LPAHs)				
Napthalene	µg/kg	0.7	-	2,100
2-Methylnapthalene	µg/kg	0.6	-	670
Acenaphthalene	µg/kg	<5	-	560
Acenaphthene	µg/kg	<5	-	500
Fluorene	µg/kg	0.7	-	540
Phenanthrene	µg/kg	2.0	-	1,500
Anthracene	µg/kg	0.8	-	960
Total LPAHs	µg/kg	6.0	-	5,200
High Molecular Weight PAHs (HPAHs)				
Fluroanthrene	µg/kg	2.0	-	1,700
Pyrene	µg/kg	<5	-	2,600
Benzoanthracene	µg/kg	2.0	-	1,300
Chrysene	µg/kg	2.0	-	1,400
Benzo(b,k)fluoranthene	µg/kg	5.0	-	3,200
Benzo(a)pyrene	µg/kg	2.0	-	1,600
Ideno(1,2,3-cd)pyrene	µg/kg	2.0	-	600
Dibenz(a,h)anthracene	µg/kg	1.0	-	230
Benzo(g,h,i)perylene	µg/kg	5.0	-	670
Total HPAHs	µg/kg	21.0	-	12,000
P450 Reporter Gene Assay (Dioxin/Furan Screen)				
6 Hour B(a)P Eq	µg/g	0.60	-	-
6 Hour TEQ	ng/g	0.03	-	-
16 Hour B(a)P Eq	µg/g	0.10	-	-
16 Hour TEQ	ng/g	0.01	-	-
Ratio	-	7	-	-
Primary Contaminates**	-	PAHs	-	-

Notes

AVS - acid-volatile sulfide
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
TEQ - toxicity equivalent
TOC - total organic carbon
DDT - dichlorodiphenyltrichloroethanes
a Table 6-1, Dredged Material Evaluation and Disposal Procedures (USACE, et al. July 2008).
*Corrected to river datum.
**Based on ratio of 6 hr/16 hr where ratio > 5 = PAHs; ration 5 to 1 = both PAHs and chlorinated compounds; and ratio < 1 = chlorinated compounds.
< - Denotes a non-detect at the numerical level listed.

Units

ft - feet
mi - miles
mg/kg - milligrams per kilogram
mm - millimeters
µg/kg - micrograms per kilogram
µg/g - micrograms per gram
ng/g - nanograms per gram

Following the June 1997 sampling event, the Columbia River mile segment nearest the I-5 bridges (RM 99 to 106) was given an "exclusionary" ranking in accordance with the Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area. Exclusionary rank is given to coarse-grain material (greater than 80 percent retained on a No. 230 sieve or approximately 0.063 mm in diameter) with total volatile solids (TVS) less than 5 percent and sufficiently removed from sources of sediment contamination. Under the DMEF guidelines, this ranking authorizes dredged sediment to be suitable for unconfined aquatic disposal without further testing.

Deep-draft federal navigation maintenance dredging in the main Columbia River near the I-5 bridges was completed in 2007 using a hopper dredge. The main channel dredging was authorized from RM 3 to 106.5, but actual dredging extended to only RM 105.5. Mechanical excavation near RM 105 in front of the Port of Vancouver docks was completed in 2008.

In August 2008, a sediment sampling study was conducted in the mainstem Columbia River, similar to the June 1997 sampling effort. The final data and completed data report concluded that based on sampling results all sediment sampled was considered acceptable for open in-water placement without further characterization (Siipola 2009).

3.2.2.2 Burnt Bridge Creek

Burnt Bridge Creek defines a portion of the northern boundary of the study area. The creek originates in East Vancouver from field ditches that drain a large wetland area between NE 112th Avenue and NE 164th Avenue. The creek is approximately 12.9 miles in length and alternates between ditches and natural channels. Except for floodplains, parks, and wetlands, nearly the entire basin is urbanized. In the project area, the creek flows through a small canyon with a narrow floodplain. The creek passes under the existing highway in a culvert north of the project area.

3.2.3 Existing Stormwater Conveyance Systems

The existing stormwater drainage systems in the study area are closed conveyance systems that discharge runoff to either the Columbia River or Burnt Bridge Creek watersheds or to stormwater drywells that infiltrate into the subsurface soil. These watersheds are highly urbanized within the study area. The existing drainage systems are described below based on their receiving waterbody.

3.2.3.1 Columbia River Watershed

The total drainage area included in the analyses of stormwater draining to the Columbia River Watershed is about 486 acres. Of this area, approximately 204 acres (or about 42 percent) is comprised of impervious surfaces that include highways, streets, parking lots, and alleys. The area extends north from the Columbia River to just south of SR 500. The drainage area includes I-5, the western end of SR 14, and downtown Vancouver. With the exception of SR 14, runoff from this drainage area receives no water quality treatment prior to being released to the Columbia River. Runoff from the eastbound lanes of SR 14 (about 3 acres) sheds to the shoulder where it disperses and/or infiltrates to groundwater.

Runoff from the I-5 bridges drains directly from the bridge decks through scuppers to the Columbia River or ground below. North of the Columbia River, conveyance systems collect runoff from I-5, SR 14, and streets in downtown Vancouver. The runoff is discharged directly to the river via several outfalls located from about 0.5 mile east (upstream) of the existing bridges to about 0.5 mile west. Over 80 percent of the total drainage area is served by a single conveyance system that discharges to the Columbia River via a 60-inch diameter outfall located immediately east of the I-5 bridges. Runoff also discharges to the Columbia River via several outfalls located in the immediate vicinity of the existing I-5 bridges (Exhibit 3-3) (Clark County 2005). A small portion of stormwater runoff is captured by basins that drain into dry wells and/or dry well systems. Based on city records it is estimated that for the Columbia River Watershed, 15 dry wells are currently active with the main project area for City of Vancouver, and 16 dry wells are currently active in the main project area for City of Portland.

3.2.3.2 Burnt Bridge Creek Watershed

The total drainage area included in the analyses of stormwater draining to Burnt Bridge Creek is about 190 acres, of which approximately 86 acres (or about 45 percent) comprises highway, streets, parking lots, and alleys. The area includes SR 500, the I-5/SR 500 interchange, I-5 north of the interchange, and adjacent neighborhoods. Runoff from approximately 66 acres of impervious surface is directed to an infiltration pond located immediately south of the I-5/Main Street interchange. Runoff from the remaining area flows to a pond located east of the I-5/SR 500 interchange. A small portion of stormwater runoff is captured by catch basins that drain into dry wells. It is estimated that for the Burnt Bridge Creek Watershed, 3 drywells are currently active within the main project area for the City of Vancouver.

3.2.3.3 Stormwater Quality

Impacts to stormwater quality can occur when precipitation encounters PGIS. PGIS is defined as surfaces that are considered a significant source of pollutants in stormwater runoff and include, but are not limited to:

- highways, including non-vegetated shoulders,
- streets, including contiguous sidewalks, and driveways, and
- bus layover facilities, surface parking lots, and the top floor of parking structures.

Runoff from PGIS is typically associated with a suite of pollutants, including suspended sediments, nutrients (nitrogen and phosphorus), PAHs, oils and grease, road salt and deicing agents, antifreeze from radiator leaks, cadmium, copper, lead and zinc from tires, engine parts, and brake pad wear.[11] Fecal coliform, while not a product of roadway surfaces or activities, is known to be conveyed in road runoff.[12] The concentration and load of these pollutants are affected by a number of factors, including traffic volumes, adjacent land uses, air quality, and the frequency and duration of storms. Additional information on pollutant loading is provided in the Water Quality and Hydrology Technical Report.

3.2.4 Geologic Setting

Geologically recent deposits that fill in the Portland Basin consist of conglomerate, gravel, sand, silt, and some clay from volcanic, fluvial, and lacustrine material (Pratt et al. 2001). Late Pleistocene catastrophic flood deposits cover much of the surface within the study area. Deposits originating from an ancestral Columbia River underlie the catastrophic flood deposits. These

[11] The Columbia River is on the Oregon DEQ 303(d) list for several pollutants, including PAHs which are pollutants associated with highway runoff.

[12] Burnt Bridge Creek and the Columbia River are on the 303(d) list for fecal coliform.

sedimentary deposits overlie Miocene basalt flows of the Columbia River Basalt Group (CRBG) (Swanson et al. 1993). The CRBG overlies lava flows and volcanic breccias of Oligocene age.

Geologic units within the study area are described below by increasing age. Further discussion on the geologic setting is provided in the Geology and Groundwater Technical Report.

3.2.4.1 Artificial Fill (Qaf)

Artificial fill material was used to modify existing topographic relief and typically consists of sand, silt, and clay with some gravel and debris. Fill areas mapped with inferred contacts represent lakes and marshes that may have been drained rather than filled. Fill that is 5 to 15 feet thick is common in developed areas of the Willamette River and Columbia River floodplains (Madin 1994). However, thickness and distribution are highly variable (Beeson et al. 1991).

3.2.4.2 Alluvium (Qal)

Alluvial deposits include material derived from present day streams and rivers, their floodplains, and abandoned channels. The alluvial deposits are typically Holocene to upper Pleistocene in age. Alluvial material consists of unconsolidated gravel, medium to fine sand, silt, and organic-rich clay. Cobble-sized material may be present within existing or abandoned stream channels. Thickness is typically less than 45 feet, but may be up to 150 feet thick locally. Alluvium is exposed at the surface from just south of the Columbia Slough in Oregon to approximately 0.25 mile north of the Columbia River in Washington (Beeson et al. 1991; Phillips 1987).

3.2.4.3 Catastrophic Flood Deposits (Qff/Qfc)

The catastrophic flood deposits resulting from the Pleistocene-aged Missoula Floods are derived from the repeated failure of ice dams located on the Clark Fork River in northwestern Montana (Bretz et al. 1956). Glacial Lake Missoula was created by ice dams from the advancing front of the Cordilleran ice sheet. As flood water velocities were reduced, sediment loads were deposited in foreset bedded gravel and sand similar to delta deposition (Robinson et al. 1980).

This deposit is subdivided into two facies by Madin (1994): a fine-grained facies (Qff) and coarse-grained facies (Qfc). Both are present locally. The finer sediments consist primarily of coarse sand to silt. The fine sand and silt is composed of quartz and feldspar with white mica. The coarser sand is composed primarily of basalt. The Qfc consists of pebble to boulder gravel with a coarse sand to silt matrix.

3.2.4.4 Troutdale Formation (Tt)

The Troutdale Formation (Miocene to Pliocene in age) underlies the catastrophic flood deposits and consists of coarse- to fine-grained fluvial sedimentary rock derived from the ancestral Columbia River (Trimble 1963). The unit is a friable to moderately strong conglomerate with minor sandstone, siltstone, and mudstone. Pebbles and cobbles are composed of CRBG (described below) and exotic volcanic, metamorphic, and plutonic rocks. The matrix and interbeds are composed of feldspathic, quartzo-micaceous, and volcanic lithic and vitric sediments. The formation exhibits cementation mantling on some of the grains (Beeson et al. 1991).

3.2.4.5 Sandy River Mudstone (Tsr)

The Sandy River Mudstone (Pliocene in age) underlies the Troutdale Formation and consists of fine-grained, predominantly fluvial and minor lacustrine sediments. The unit is a friable to moderately strong sandstone, siltstone, and claystone. The mudstone is composed of primarily quartz-feldspathic and white mica sediments (Beeson et al. 1991).

3.2.4.6 Miocene and Older Rocks

The CRBG (late Miocene and early Pliocene in age) consists of numerous basaltic lava flows which cover approximately 63,000 square miles and extend to thicknesses greater than 6,000 feet. The CRBG is composed of dark gray to black, dense, crystalline basalt and minor interbedded pyroclastic material.

3.2.5 Hydrogeologic Setting

As the geologic units described above were deposited in the deforming Portland Basin, hydrogeologic units were also formed. The physical nature and depositional environment of the geologic material will create units of material that possess dissimilar hydraulic properties. Groundwater moving through the material will travel at different rates, depending on the physical properties of the hydrogeologic unit. The physical properties of units in the Troutdale Aquifer are further discussed below.

A 1993 United States Geologic Survey (USGS) report (Swanson et al. 1993) describes eight major hydrogeologic units in the Portland Basin. These units are, from youngest to oldest and increasing depth:

- Unconsolidated Sedimentary Aquifer (USA)
- Troutdale Gravel Aquifer (TGA)
- Confining Unit 1 (CU 1)
- Troutdale Sandstone Aquifer (TSA)
- Confining Unit 2 (CU 2)
- Sand and Gravel Aquifer (SGA)
- Older Rocks

The eighth unit is referred to as undifferentiated fine-grained sediments where the TSA and the SGA appear to have pinched out or there is insufficient information to characterize the aquifer units within the fine-grained Sandy River Mudstone. Where this occurs, CU 1 and CU 2 cannot be separated and have been mapped as undifferentiated fine-grained sediments. The older rocks, consisting of older volcanic and marine sedimentary rocks of generally low permeability, are present at depths estimated to range up to 1,600 feet in the central area of the basin. They are poor aquifers and too deep to be used as a primary source of water in the site region. Due to these conditions, no further discussion is presented regarding the older rock unit.

The Portland Basin aquifer system has also been grouped into three major subsystems:

- Upper sedimentary subsystem (USA and TGA)
- Lower sedimentary subsystem (CU 1, TSA, CU 2, and SGA)
- Older rocks

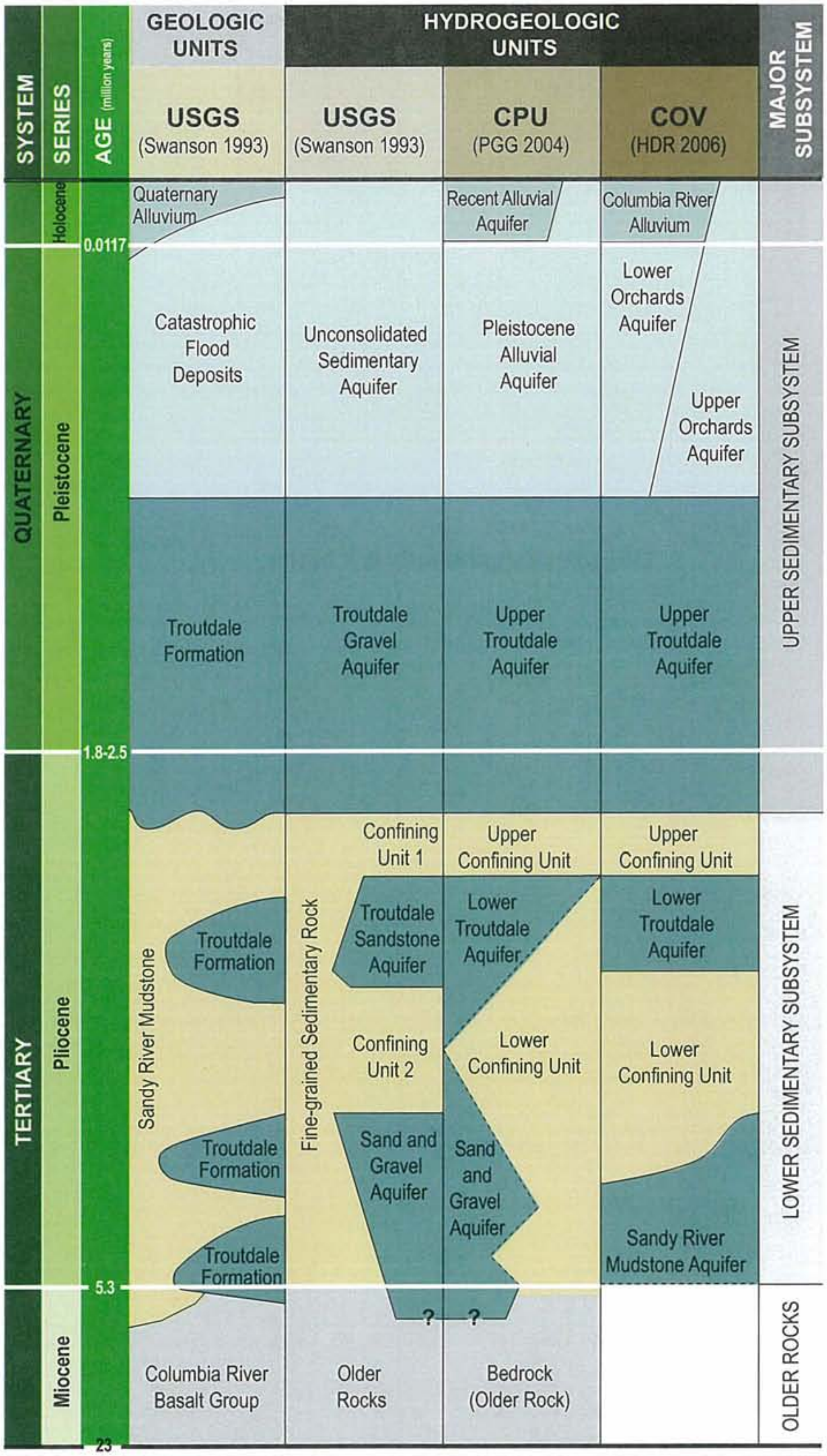

Exhibit 3-5: Geological Units and Comparison of Hydrogeologic Unit Terminology

Columbia River CROSSING

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This grouping is based on regionally continuous contacts between units of different lithologic and hydrogeologic characteristics (Swanson et al. 1993). Exhibit 3-5 presents other nomenclatures used to describe the hydrogeologic units by Clark Public Utilities (CPU) and the City of Vancouver. For the purpose of consistency with EPA's (2006) determination, terminology used by McFarland and Morgan (1996), which was derived from Swanson et al. (1993), will be presented in this report.

Exhibit 3-6 shows cross section orientation lines for selected wells and geologic units near the study area. Hydrogeologic unit cross sections are presented in Exhibits 3-7a through 3-7d.

3.2.6 Unconsolidated Sedimentary Aquifer and Troutdale Gravel Aquifer

EPA (2006) defines the Troutdale Aquifer to include both the upper and lower sedimentary subsystems. For the purposes of this report, the discussion of the Troutdale Aquifer focuses on the USA and TGA because: they are prolific and are the uppermost aquifers within the Portland Basin; they contain a majority of water supply wells in the study area; they are the primary aquifers for drinking water and will likely continue to be the source of water supply as demands increase; and they are hydrogeologically separated from the lower subsystem by a confining layer.[14] This is demonstrated in Clark County where over 90 percent of the 7,111 wells inventoried are completed in the USA or TGA and are less than 300 feet in depth (Gray and Osborne 1996). In addition, a majority of water supply wells for the City of Vancouver are completed in the USA (HDR 2006).

3.2.6.1 Hydrologic Characteristics

The upper sedimentary subsystem is composed of Pleistocene to Quaternary sediments and consolidated to semi-consolidated gravel of the upper Troutdale Formation. The Pleistocene to Quaternary deposits have similar hydrogeologic properties and are grouped as the USA. The upper Troutdale Formation deposits that form the TGA are hydrogeologically isolated from the lower Troutdale Formation by CU 1.

Unconsolidated Sedimentary Aquifer

The USA occurs in the saturated portions of the Quaternary alluvium deposits and the Pleistocene-aged catastrophic flood deposits. The Quaternary alluvium deposits, which overlie the catastrophic flood deposits, consist of very poorly consolidated silt and sand. The alluvium deposits are partially saturated and have a lower permeability than the underlying catastrophic flood deposits. The catastrophic flood deposits mapped by Phillips (1987) were further subdivided into coarse-grained and fine-grained facies. The flood deposits can be very heterogeneous due to the nature of deposition. Deposition under flood conditions allowed for silt and fine sand to fill the interstices of gravel deposits in some areas and remain open in other areas (Robinson et al. 1980).

Public supply and industrial wells completed in the USA near Camas, Washougal, and Vancouver have maximum yields between 1,000 and 6,000 gallons per minute (gpm), with less than 10 feet of drawdown (Mundorff 1964). Wells completed in the fine-grained facies are less productive than wells in the more productive coarse-grained facies of the catastrophic flood deposits.

---

[14] This rationale was used to limit the study area to contain only the USA and TGA. The report did not consider wells screened in the lower sedimentary aquifer.

Mundorff (1964) estimated that the transmissivity portion of the USA ranged from 1.9 million to 3.5 million gallons per day per foot (gpd/ft).[15] The calculated transmissivities for Vancouver Water Stations (WS) WS-1, WS-3 and WS-4, all producing from the USA, were 2 million gpd/ft, 878,900 gpd/ft, and 586,000 gpd/ft, respectively (Robinson et al. 1980).

TGA

The TGA underlies the catastrophic flood deposits and alluvial deposits that make up the USA in the study area. The TGA is composed of partially cemented sandy conglomerate. The transition to the Pleistocene-aged Troutdale Formation is primarily based on a drop in permeability, followed by harder drilling conditions that were encountered and/or where cementation or a silty sandy matrix was encountered.

The elevation of the top of the Troutdale Formation varies noticeably due to an erosional period prior to the deposition of the catastrophic flood deposits and erosion that occurred during the flood events. It has been observed that where the upper Troutdale Formation has been severely weathered, a thick clayey soil may have developed in some areas, thus creating a discontinuous confining unit between the two aquifers (Swanson et al. 1993; PGG 2002).

The permeability and the transmissivity of the TGA have been noted to be at least an order of magnitude lower than the USA (McFarland and Morgan 1996; PGG 2002). This difference in permeability and transmissivity is due to the presence of more fines in the Troutdale Formation, along with lithification and cementation, which ranges from consolidated to semi-consolidated. Although the TGA contains zones of significant cementation, it is sufficiently conductive to produce high-yield wells. Wells completed in the TGA commonly yield up to 1,000 gpm (Swanson et al. 1993). The TGA has historically served as the most productive aquifer in the Salmon Creek drainage.

3.2.6.2 Groundwater Recharge and Discharge Areas

Recharge to the USA and TGA occurs from precipitation, infiltration from the Columbia River and streams, infiltration from pervious surfaces, and contributions from drywells and underground sewage-disposal. Principal precipitation recharge areas for groundwater in the LPA, with the exception of Hayden Island, are the upland areas of the Boring Hills and Western Cascade Mountains (Exhibit 3-2). Groundwater recharge on Hayden Island is primarily from infiltration from the Columbia River. The combined average recharge rate is estimated to be about 22 inches/year (Snyder et al. 1994) for the Portland Basin. The highest rates (up to 49 inches/year) occur in the Cascade Range, and the lowest rates are near 0 inches/year at the Columbia and Willamette Rivers. Seasonal fluctuations in precipitation affect groundwater elevations and aquifer saturated thickness. Whereas heavy spring and winter precipitation increases groundwater elevation and aquifer saturated thickness, lower precipitation in the summer and fall months decreases groundwater elevations and aquifer saturated thickness. Changes in groundwater elevations and saturated thickness affect the rate and direction of groundwater discharge. In general, groundwater is locally discharged to the Columbia and Willamette Rivers and Burnt Bridge Creek.

[15] Transmissivity is the rate at which water travels through an aquifer of unit width under a unit hydraulic gradient. It is a function of the liquid, porous media and its thickness.

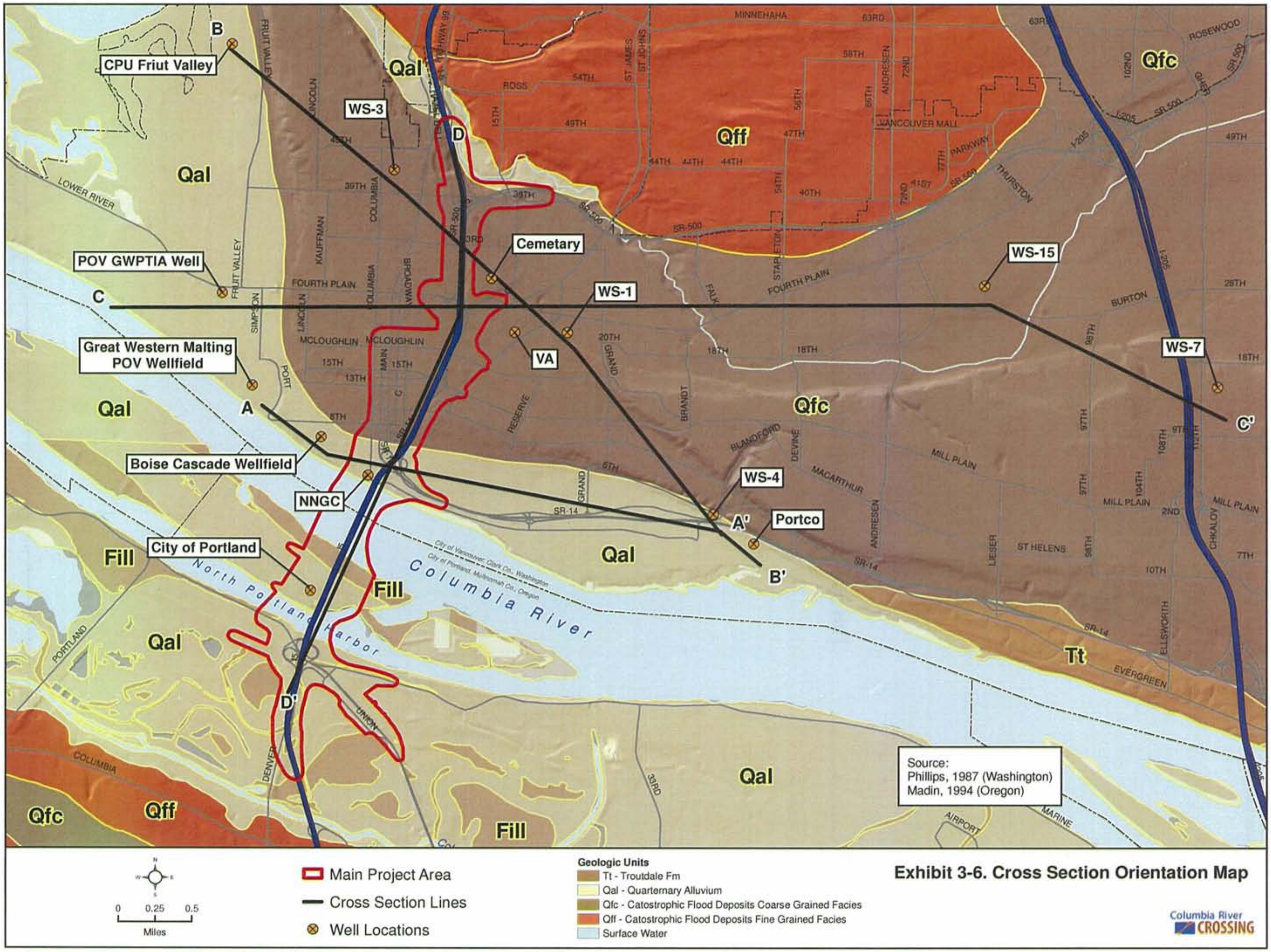

Exhibit 3-6. Cross Section Orientation Map

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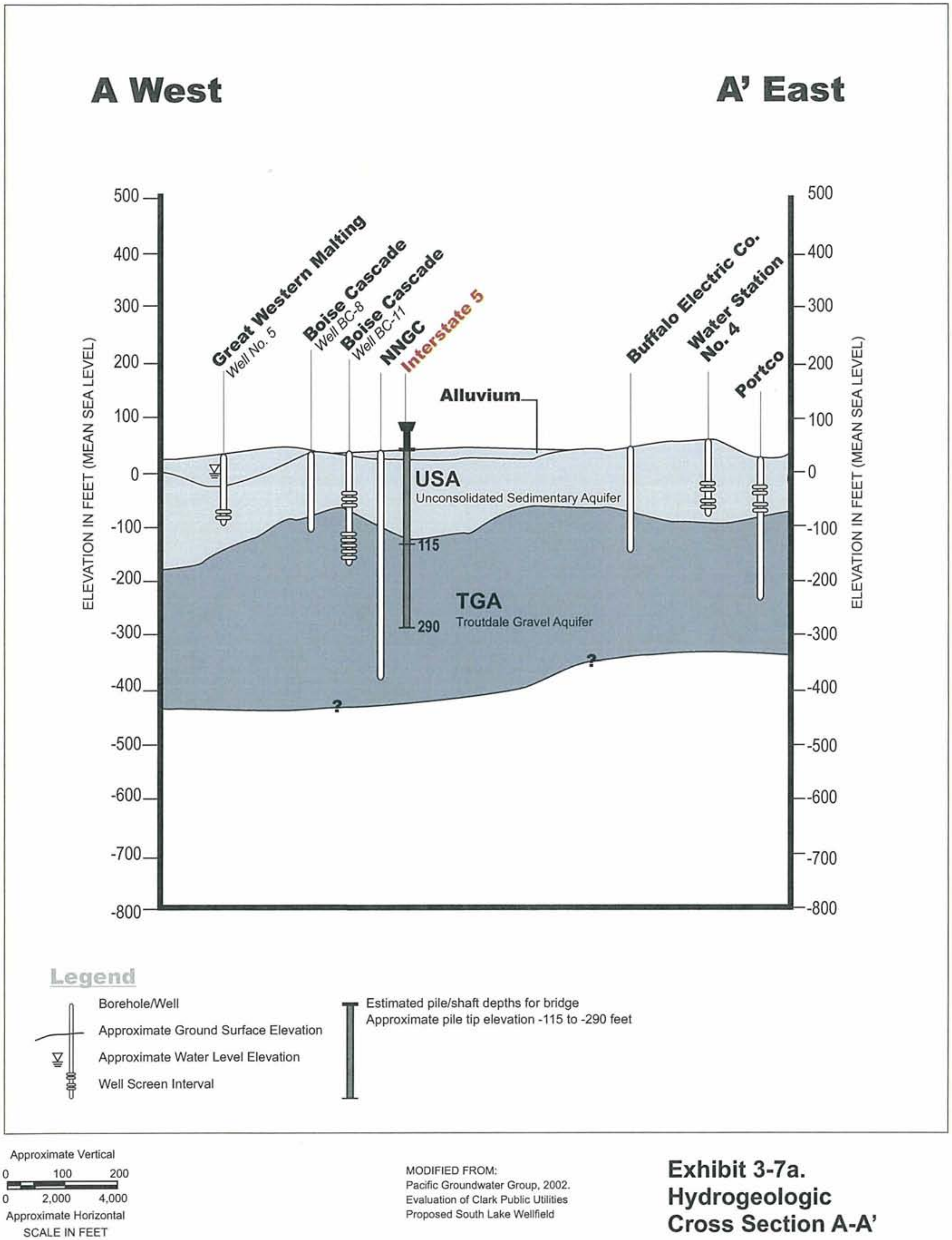

MODIFIED FROM:
Pacific Groundwater Group, 2002.
Evaluation of Clark Public Utilities
Proposed South Lake Wellfield

Exhibit 3-7a.
Hydrogeologic
Cross Section A-A'

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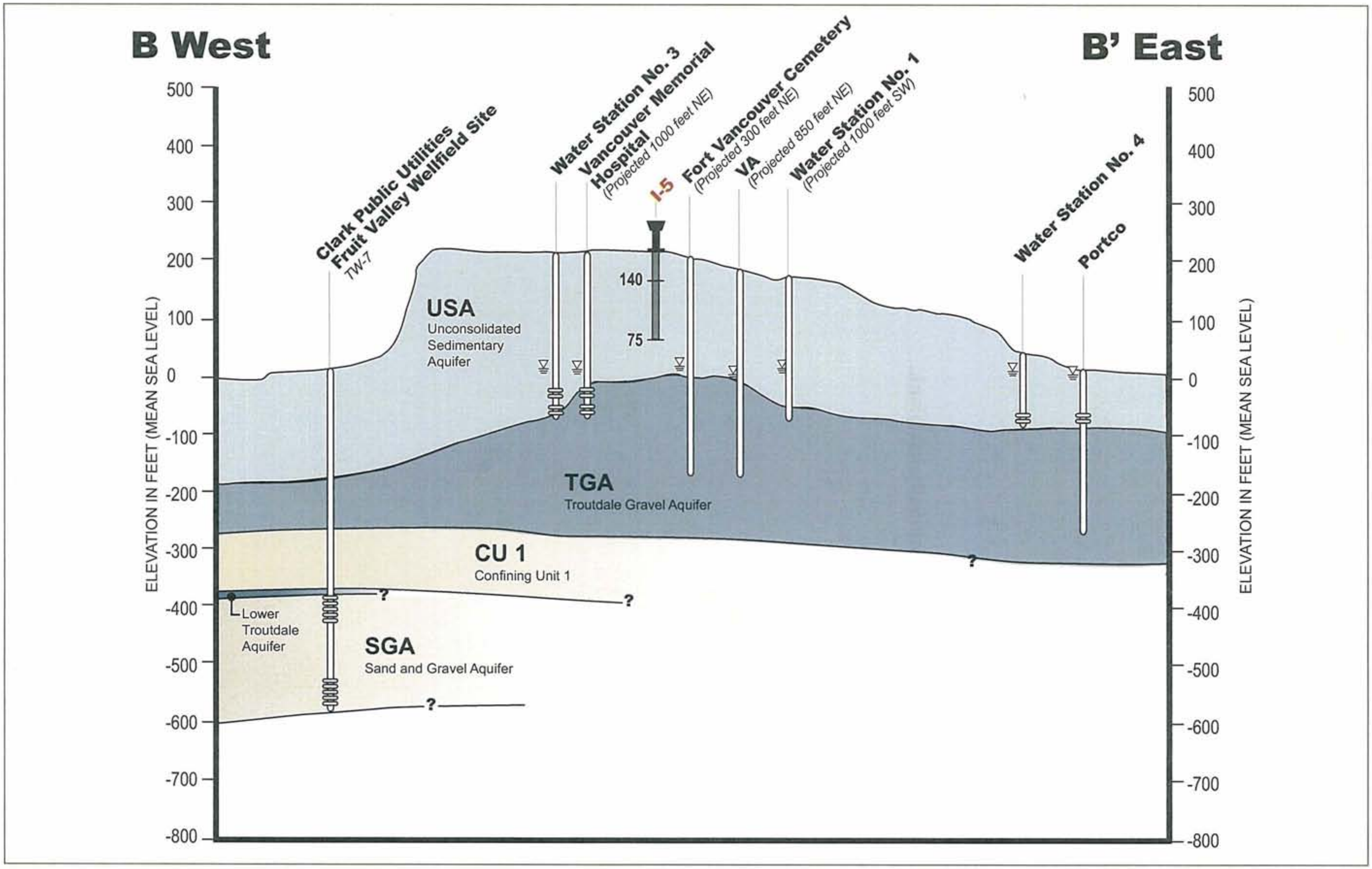

Approximate Vertical
0 100 200
0 2,000 4,000
Approximate Horizontal
SCALE IN FEET

Legend

- Borehole/Well
- Approximate Ground Surface Elevation
- Approximate Water Level Elevation
- Well Screen Interval
- Estimated pile/shaft depths for SR 500 and 39th Street bridges Approximate pile tip elevation 75 to 140 feet

MODIFIED FROM:
Pacific Groundwater Group, 2002.
Evaluation of Clark Public Utilities
Proposed South Lake Wellfield

**Exhibit 3-7b.
Hydrogeologic
Cross Section B-B'**

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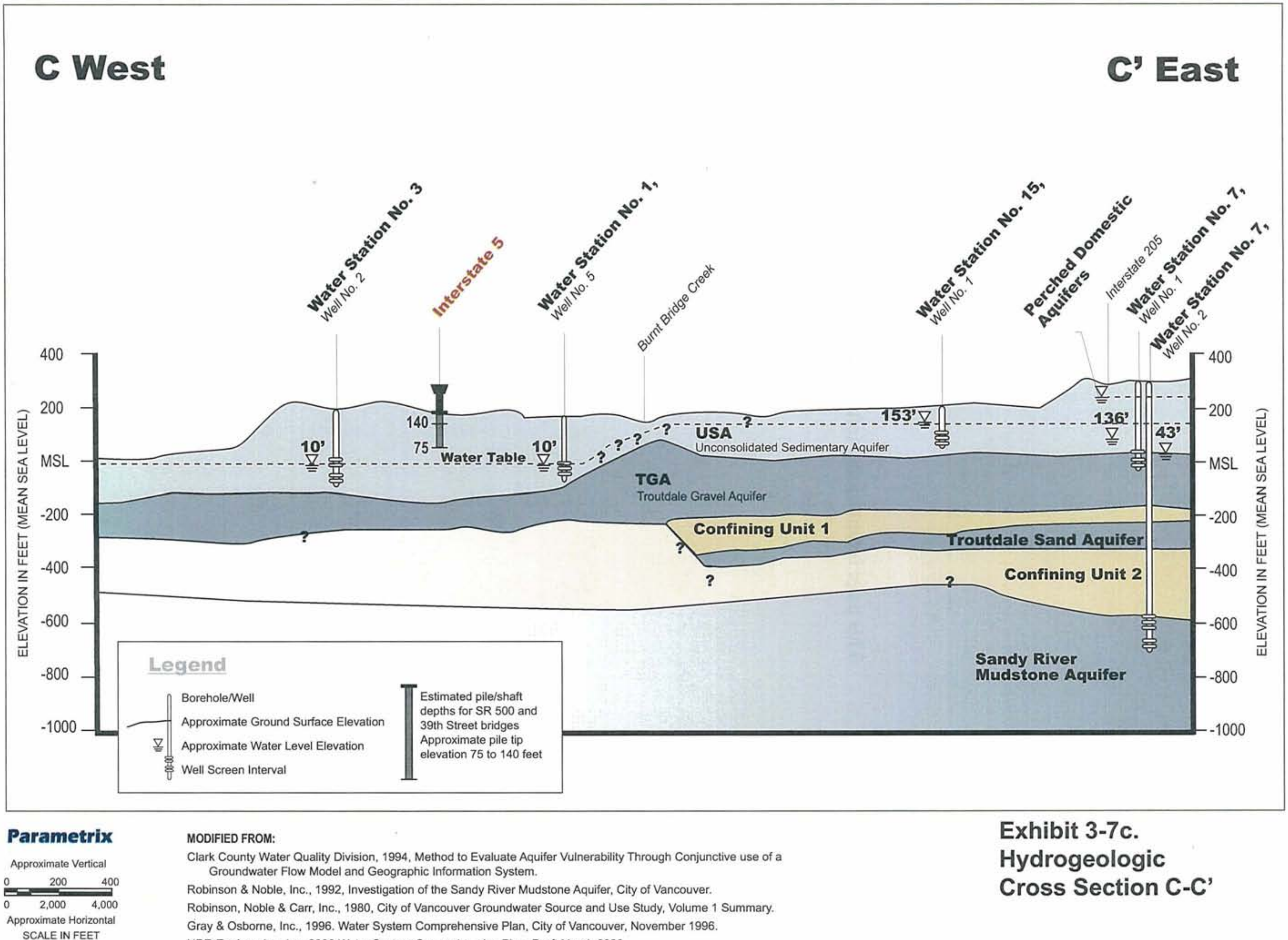

MODIFIED FROM:

Clark County Water Quality Division, 1994, Method to Evaluate Aquifer Vulnerability Through Conjunctive use of a Groundwater Flow Model and Geographic Information System.

Robinson & Noble, Inc., 1992, Investigation of the Sandy River Mudstone Aquifer, City of Vancouver.

Robinson, Noble & Carr, Inc., 1980, City of Vancouver Groundwater Source and Use Study, Volume 1 Summary.

Gray & Osborne, Inc., 1996. Water System Comprehensive Plan, City of Vancouver, November 1996.

HDR Engineering, Inc. 2006 Water System Comprehensive Plan, Draft March 2006.

**Exhibit 3-7c.
Hydrogeologic
Cross Section C-C'**

Columbia River CROSSING

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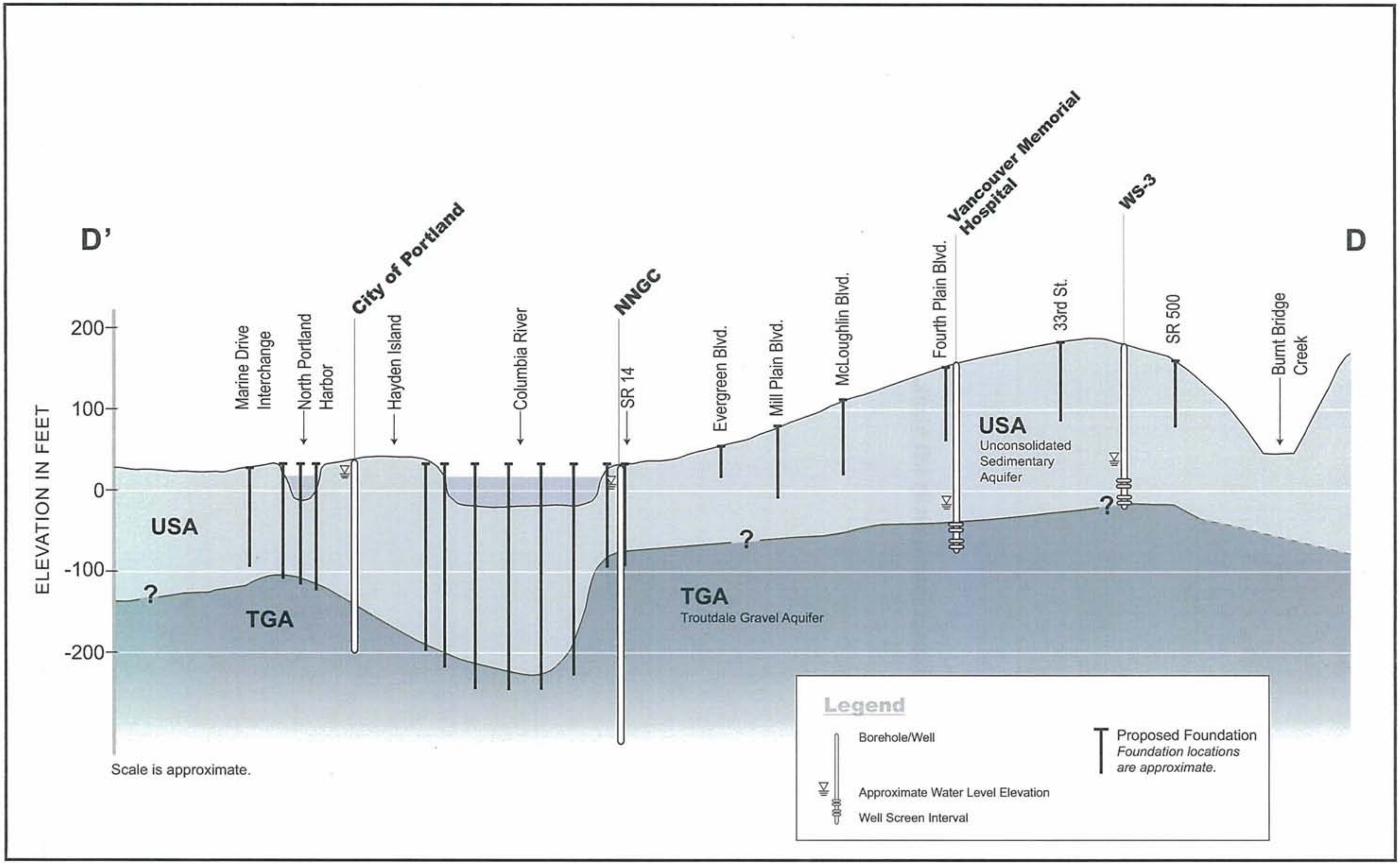

Exhibit 3-7d.
Hyrdogeologic Cross Section D'-D

Columbia River CROSSING

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3.2.6.3 Flow Direction and Gradient

The movement of groundwater (flow direction and gradient) is generally controlled by topography, river levels, and supply well pumping. However, due to the high transmissivity of the USA, groundwater gradients in the project area remain relatively flat. Exhibit 3-8 indicates that at elevations of approximately 250 feet above mean sea level (MSL) near recharge areas at the foothills of the Cascade Mountains east of the project area, groundwater flows west-southwest towards the Columbia or Willamette Rivers.

The groundwater table elevation along the banks of the Columbia River and North Portland Harbor is influenced by tidal fluctuations and upstream dam releases (see the Geology and Groundwater Technical Report) (McFarland and Morgan 1996) (tidal information for Station 14144700 Columbia River, Vancouver, WA). The rapid response between changes in river stage and corresponding changes in groundwater levels indicates a high interconnectivity between the river, the USA, and the upper portion of the TGA. Groundwater table fluctuations due to river stage changes are less significant with increasing distance from the Columbia River and Columbia Slough.

Washington

Groundwater elevations in Washington are typically less than 50 feet MSL just south of the Burnt Bridge Creek drainage and decrease to approximately 20 feet MSL at the Columbia River. Water level elevations sharply increase north of the Burnt Bridge Creek drainage to approximately 150 feet MSL. The large observed drop in groundwater levels south of Burnt Bridge Creek suggests low permeability conditions in the area of the creek. This lower permeability condition functions to reduce the volume of groundwater recharge to the area south of Burnt Bridge Creek.

Oregon

Groundwater elevation on the Oregon side generally ranges between 10 and 30 feet MSL. The generalized groundwater levels within the main project area are typically less than 20 feet in elevation near the Columbia River and Columbia Slough. Water level elevations generally increase with distance from the river and slough (McFarland and Morgan 1996; Snyder 2008).

3.2.6.4 Influence on Groundwater Flow from Pumping

Groundwater flow in the downtown portion of the City of Vancouver is influenced by water supply wells. These wells include Vancouver drinking water supply wells at water stations WS-1 and WS-3; the Port of Vancouver (POV) groundwater pump and treat interim action (GPTIA) well, and Great Western Malting Company supply wells No. 4 and No. 5.

Exhibit 3-9 displays simulated groundwater flow and direction resulting from the pumping of these supply wells. Simulated conditions are based on a numeric groundwater flow model that aids in the future siting of well fields by POV and CPU (Parametrix 2008). Exhibit 3-9 indicates that a majority of the groundwater flow in the downtown Vancouver area is influenced by WS-1 wells, WS-3 wells, Great Western Malting wells, and the GPTIA well. No water supply wells are currently used within the Oregon side of the study area.

Simulated groundwater flow lines have been used to help define the eastern and western boundaries of groundwater capture for activities that occur within the main project area. Specifically, the boundaries are drawn along internal flow lines that represent the hydraulic capture of groundwater movement within the main project area. Stated another way, a particle of water within the main project area will likely be retained within the drawn boundaries and ultimately travel to the WS-1 or WS-3 well head. Model simulations indicate that groundwater within the study area will be primarily captured at the well head for WS-1 or WS-3 (Riley 2010, personal communication). This approach is used to help in evaluating impacts to groundwater from construction activities and/or operation and maintenance of the alternatives.

A number of irrigation and process water wells and a municipal well have been identified on Hayden Island and in North Portland/Delta Park (Exhibit 3-10). The influence on groundwater flow from pumping of wells has not been evaluated. Irrigation wells are thought to be used seasonally, and the two City of Portland's process water wells are not in use (west of I-5) and/or abandoned (east of I-5). Information on the status of the Kernan Livestock water supply well and the ODOT well on N Interstate Avenue could not be obtained using reasonably accessible sources. Withdrawal from these wells likely consists of components of surface water and/or groundwater baseflow from the Columbia River.

City of Vancouver

The City of Vancouver pumps an average of 26 million gallons per day (mgd) from the USA, Troutdale, and Sand and Gravel Aquifers, with peak demands up to approximately 53 mgd in 2003 (HDR 2006). Vancouver maintains 16 water stations but only extracts groundwater from 9 water stations, each with several production wells (Hoiland 2010, personal communication).

Based on the anticipated population growth for the City of Vancouver, average demand on the water system is estimated to increase between approximately 35 mgd by 2012, and to 44 mgd by 2026 (Hoiland 2010, personal communication). These increases in demand will increase stress to the aquifer. Replacement wells will likely be installed and three decommissioned at WS-1. Extraction rates for city water supply wells vary seasonally based on user demands. Water demands on the system are highest during the summer and lowest during the winter (HDR 2006).

WS-1

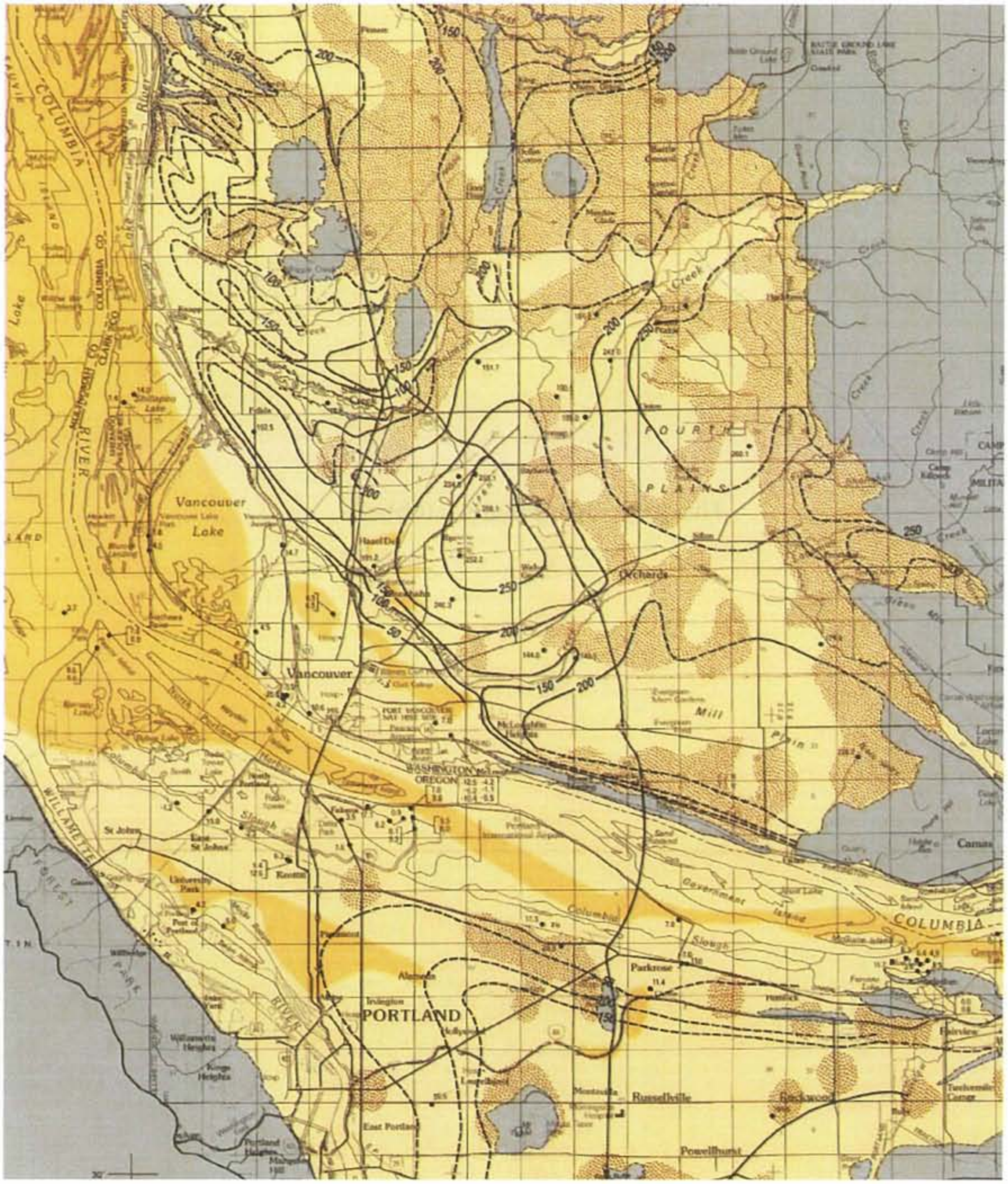
WS-1 is located southeast of the intersection of Fort Vancouver Way and E Fourth Plain and is composed of 12 wells (#1 through #5, and #7 through #13). The wells range in depth from 235 to 280 feet below ground surface (bgs). All wells at this water station extract water from the USA. Each well is capable of producing between 900 and 2,800 gpm, for a total pumping capacity of approximately 22,770 gpm (32.8 mgd). Current water production at this water station is averaging 5.5 mgd (Hoiland, 2010, personal communication). However, production is limited to approximately 27 mgd due to the wellhead treatment system capacity. Treatment consists of aeration/air stripping, chlorination, and fluoridation.

WS-3

WS-3 is located northwest of NW 42nd Street and NW Washington Street and is composed of three wells (#1 through #3). The wells range in depth from 259 to 275 feet bgs. All wells at this water station extract water from the USA. Each well has a pumping capacity of approximately 2,000 gpm, or a total pumping capacity of 6,200 gpm (8.9 mgd). Current water production at this water station is averaging 4.2 mgd (Hoiland, 2010, personal communication,). This water station capacity is limited to 8.6 mgd due to water rights. Water at the well head is treated by chlorination and fluoridation.

Port of Vancouver

Design and placement of the POV GPTIA well is based on a groundwater flow model developed through a combined effort completed on behalf of the POV and CPU (Parametrix 2008). The well was installed to remove and hydraulically control solvent-contaminated groundwater. Start-up of the well occurred in June 2009, with an observed pumping rate of 2,500 gpm (3.6 mgd).



Legend

---100--- GROUNDWATER LEVEL CONTOUR. Shows altitude, in feet, of groundwater level, Spring 1988, in the unconsolidated sedimentary aquifer. Dashed where approximate. Contour is variable. Datum is sea level.

•6.9 FIELD LOCATED WELL. Completed in the USA. Number is altitude in feet above sea level.

N

0 5 miles

Approximate Scale

Source:

McFarland, W.D. and Morgan, D.S. 1996
Description of Ground-Water Flow System in the Portland Basin, Oregon and Washington
U.S. Geological Survey Water Supply Paper 2470-A

Exhibit 3-8 Groundwater Level Contour Map USA, Spring 1988

Troutdale SSA Evaluation

Columbia River CROSSING

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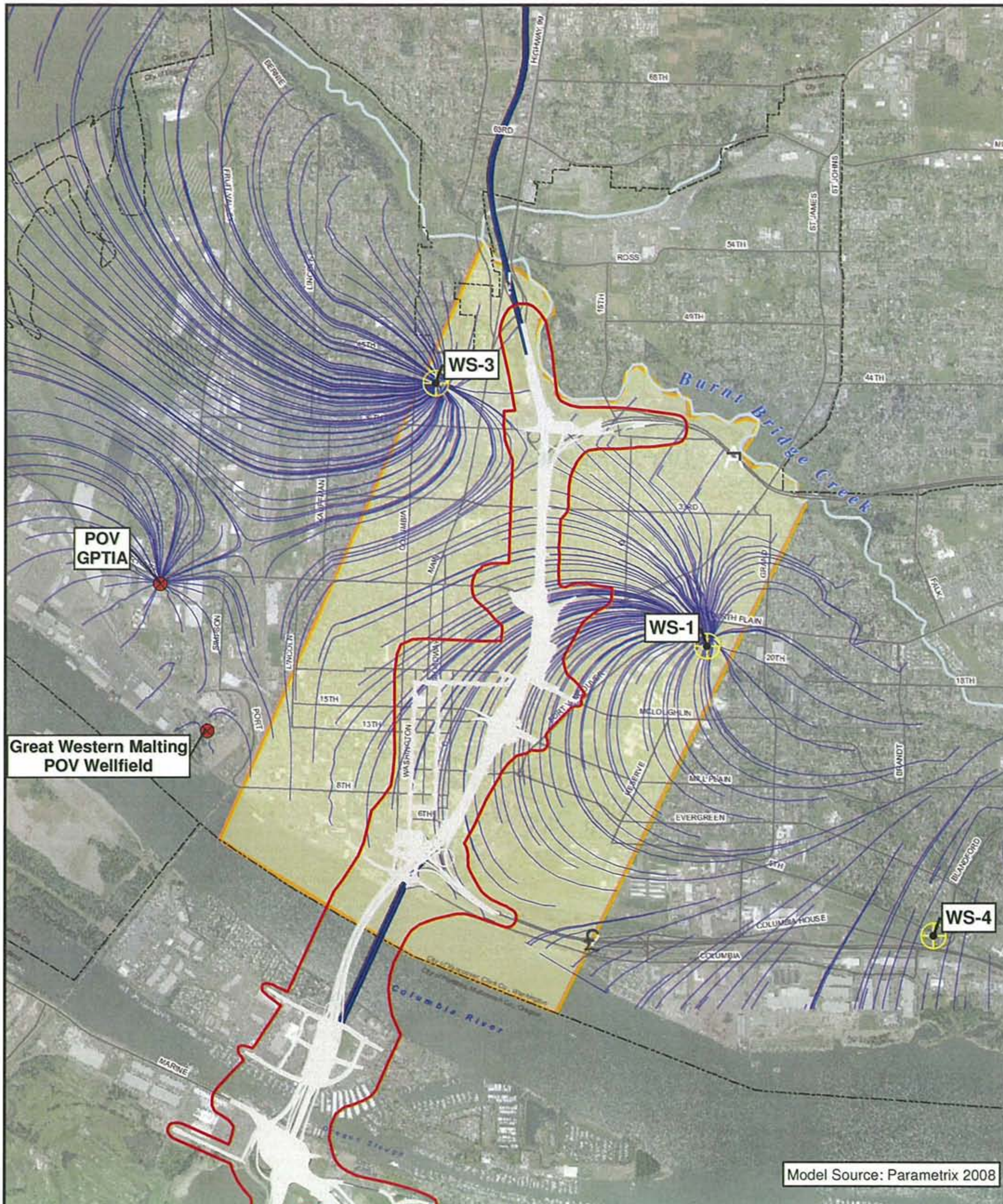

City of Vancouver Water Station
Extraction Well
Extraction Well Flow Lines
Main Project Area
Project Footprint
SSA Study Area

0 0.25 0.5
Miles

Exhibit 3-9. Extraction Well Simulated Flow Path Map for the Troutdale Sole Source Aquifer

Columbia River CROSSING

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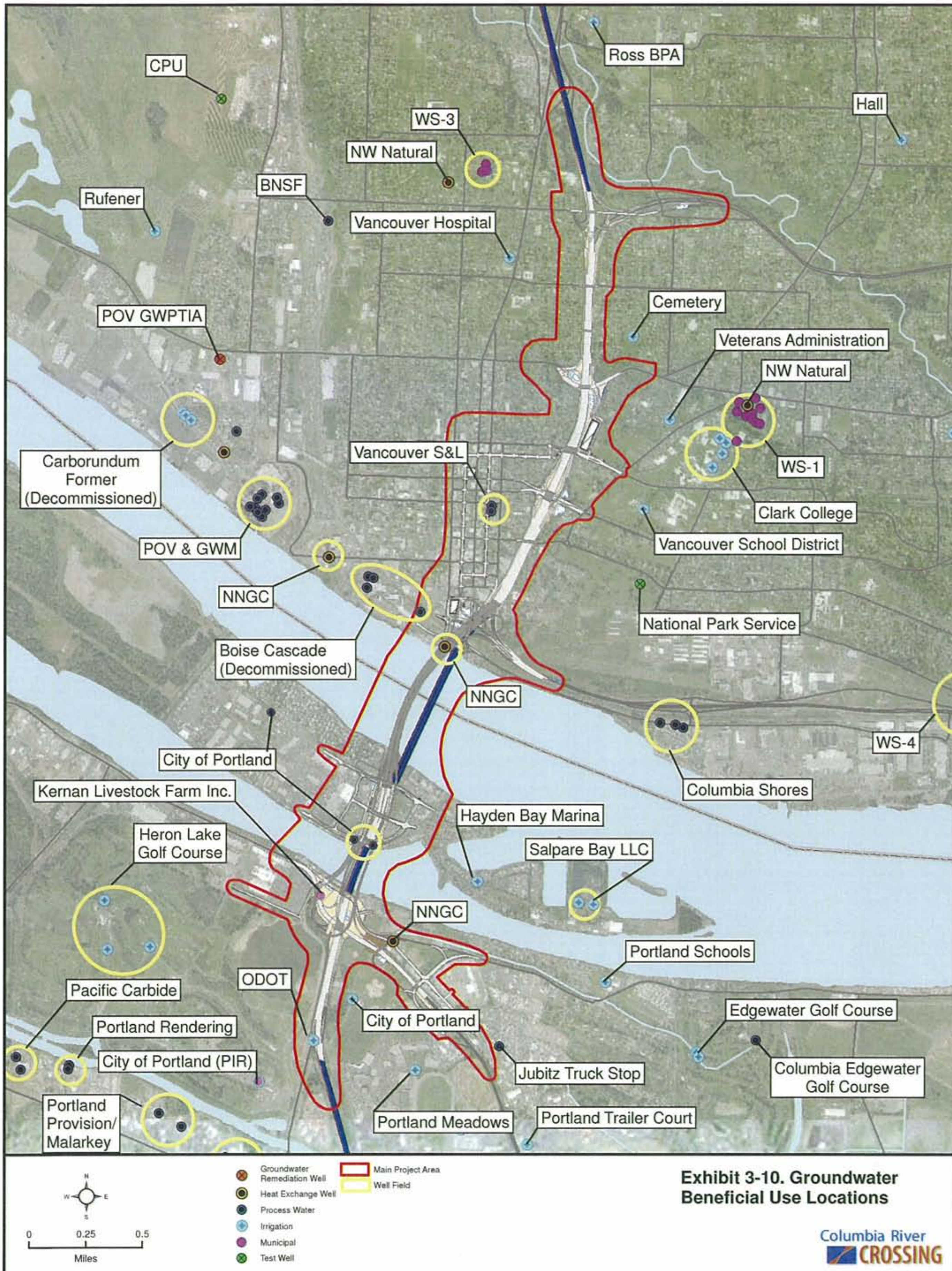

Exhibit 3-10. Groundwater Beneficial Use Locations

Columbia River CROSSING

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Great Western Malting Company

Great Western Malting (a.k.a. ConAgra Malt) currently operates two extraction wells, No. 4 and No. 5, which influence groundwater flow in the western portion of downtown Vancouver. The wells are also being utilized by the POV to help contain and capture a chlorinated solvent plume stemming from the former Swan Manufacturing Company and Cadet Manufacturing sites. As a result, Great Western Malting has been extracting water at a higher capacity than necessary for plant operations, as requested by Ecology and POV. Groundwater from the wells is treated using an air stripper tower. Treated water is used for germination of malt and as process water for cooling. The wells are capable of producing 4,000 gpm, but are currently extracting water at a combined rate of 3,200 gpm. However, the production rate of these wells may be reduced as the POV's GPTIA was activated in June 2009.

3.2.7 Current and Future Groundwater Beneficial Use Survey

The purpose of a beneficial groundwater use survey is to identify the current use of groundwater in the vicinity of the LPA. A review of available supply well information identified approximately 73 water supply wells in Washington and 49 water supply wells in Oregon within 1 mile of the main project area. Verification of the information in the databases is beyond the scope of this work. Current beneficial use includes drinking water supply, agricultural and irrigation, process water, cooling and heat exchange.

Exhibit 3-10 displays the locations of identified supply wells in the vicinity of the main project area. Of these wells, eight appear to fall within the footprint of the main project area.

3.2.7.1 Oregon

The City of Portland primarily uses Bull Run water as a domestic drinking water supply. The Bull Run watershed is a 102-square-mile municipal watershed located about 26 miles east of downtown Portland; it lies within the Mt. Hood National Forest. Rain provides 90-95 percent of the water in the watershed, and precipitation averages 130 inches a year. Occasionally, groundwater from wells of the Columbia South Shore Well Field east of the Portland International Airport augment drinking water supply in summer and early fall, as needed, depending on the Bull Run water supply or when winter storms increase the turbidity levels above acceptable levels.

A number of groundwater beneficial uses have been identified on Hayden Island and in North Portland. These include irrigation, process water, and heat exchange. Information on groundwater demands from these wells is not readily available. Two of these wells are process water wells owned by the City of Portland, one of which is abandoned (east of I-5) and the other is not in use and currently is planned for decommissioning. A third well is a municipal well registered to Kernan Livestock Farms, Inc., which retains its water rights. Review of water rights indicates that the well was used to supply potable water to a Group B water system (less than 15 residents) for a mobile home park. The park currently no longer exists; however, the well may still be used for another beneficial use. A fourth well is owned by ODOT.

3.2.7.2 Washington

The City of Vancouver relies entirely on extracted groundwater for its domestic water supply. Vancouver pumps an average of 26 mgd from the aquifer, with peak demands up to approximately 53 mgd in 2003. Vancouver extracts groundwater from 9 water stations, each with several production wells. This water also supplies public and private systems throughout Clark County. Based on the anticipated population growth for the city, demand on the water system is estimated to increase to between 61 and 71 mgd by 2012 and to between 74 and 90 mgd by 2026 (HDR 2006). These increases in demand will add additional stress to the aquifer.

A number of groundwater beneficial uses have been identified on Hayden Island and in North Portland. These include irrigation, process water, and heat exchange. Information on groundwater demands from these wells is not readily available. A few wells owned by the former Boise Cascade Facility have reportedly been decommissioned west of I-5 near the Columbia River. The Vancouver S&L is also listed with two wells near 13th and C Streets. The current status of these wells is not known.

Sole Source Aquifer Designation and Critical Aquifer Recharge Area

The EPA designated the Troutdale Aquifer System, Clark County, Washington, as a sole source aquifer in July 2006 (EPA 2006). A sole source aquifer is defined by EPA as "an aquifer or aquifer system which supplies at least 50 percent of the drinking water consumed to the area overlying the aquifer and for which there is no alternative source or combination of drinking water sources which could physically, legally and economically act to supply those dependent upon the aquifer" (EPA 2006).

As requested by EPA in a letter to FTA dated July 1, 2008, a separate discipline report was prepared by the CRC project team to address potential impacts to the Troutdale Sole Source Aquifer (TSSA) from construction and operation of the LPA. The TSSA Report (Parametrix 2009) was reviewed by EPA and approved with conditions in July 2010. For the purposes of this report, applicable and appropriate elements of the TSSA report are presented in this report.

Prior to the EPA's designation of the Troutdale Aquifer System as a sole source aquifer, the City of Vancouver recognized its dependence on the aquifer and the importance of protecting the resource. The City of Vancouver has designated the entire area within the city boundaries as a Critical Aquifer Recharge Area, as specified by the Water Resources Protection Ordinance VMC Title 14 Section 26, dated 2002 (VMC 14.26). The ordinance requires minimum standards to protect the critical aquifer, establishes compliance standards for business and industry to manage hazardous materials, and creates special protection areas around city well heads. Special protection areas are defined as areas that are 1,900 radial feet from any municipal water supply well. As such, the city applies development restrictions to activities inside the special protection areas pursuant to VMC 14.26.135. These restrictions mainly address Class I and II Operations, septic systems, and infiltration systems.

3.2.8 Groundwater Quality

Contaminants from historic commercial and industrial activities within the City of Vancouver have resulted in diminishing groundwater quality. Exhibit 3-11 displays posted contaminant concentrations observed in the Troutdale Aquifer System based on communications with Ecology site managers. The exhibit indicates that contaminants such as chlorinated ethenes, petroleum products, and metals are found in groundwater throughout the study area.[16]

As stipulated in the Safe Drinking Water Act (SDWA) and Washington Administrative Code (WAC) Chapter 290, suppliers of drinking water must monitor for and meet primary and secondary drinking water standards. From approximately January 1979, the City of Vancouver has sampled and analyzed groundwater from its wells for the following classes of compounds: inorganics, volatile organic compounds (VOCs), herbicides, pesticides, insecticides,

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[16] No comprehensive study that describes the distribution of contaminants in groundwater for the Vancouver Area is available. Contaminant information was obtained from Ecology Site Managers to help graphically display generalized contaminant impacts.

radionuclides, fumigants, dioxins, and nitrate. Analytical results for WS-1 and WS-3 are tabulated at http://www4.doh.wa.gov/SentryInternet/SingleSystemViews/SamplesSingleSys.aspx.

A review of water quality data by the Washington State Department of Health indicates that no analytes have been detected at or above their respective maximum contaminant limit (MCL) or secondary maximum contaminant limit (SMCL) in groundwater at WS-1, except for tetrachloroethene (PCE) at 9.2 micrograms per liter [μg/L] (MCL = 5 μg/L) in September 1999. However, no exceedance in drinking water standards has been documented in the last 5 years. The most recent available analytical results indicate that PCE and trichloroethylene (TCE) were detected at 1.1 μg/L and 0.94 μg/L at WS-1 in April 2008.

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