

4. Construction Activities Within the Study Area

This section provides an overview of the construction and locations for the proposed bridge types. Materials (i.e., concrete segmental, steel girder, concrete girder, etc.) and design for bridges and interchanges are not fully known at this time. In addition, detailed design for highway and transit are currently under development. As such, only general construction activities will be described, with the focus on significant below grade earthwork that has the potential to affect the TSSA.

4.1 Crossing Construction

4.1.1 Bridge Design, Construction, and Timing

Two new bridge structures crossing the Columbia River will be constructed downstream (to the west) of the existing Interstate bridges. Five new bridge structures will be constructed in the same general location of the existing structures over North Portland Harbor.

The current bridge design is a two-bridge design, with one carrying northbound I-5 traffic and the other carrying southbound I-5 traffic and LRT in a stacked transit-highway bridge. The multi-use path would be configured in a stacked option with the northbound I-5 structure. Each of the structures would be approximately 99 feet wide, with a gap of approximately 15 feet between them.

Exhibit 4-1. Preliminary Representation of the Stacked Transit/Highway Bridge Configuration

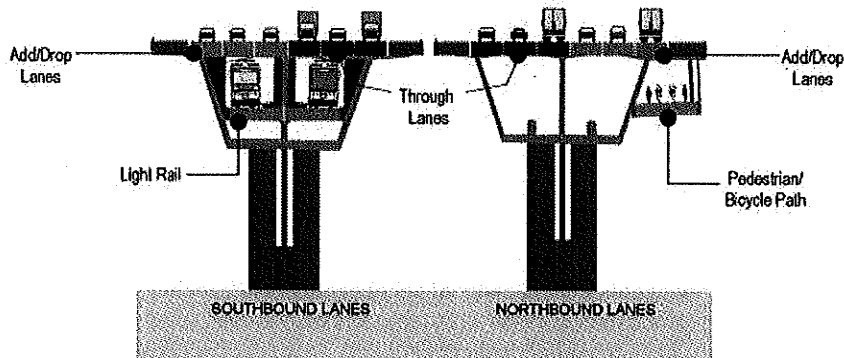


Exhibit 4-2 provides the dimensions of the portions of the bridges over the Columbia River. For specific information on pier size, depth, and other specifications, see Section 4.5.3.

Exhibit 4-2. Bridge Areas Over Water for the Columbia River

Bridge	Length Over Water (feet)	Width (feet)
I-5 Northbound	2,700	Varies 99 to 130
I-5 Southbound (with LRT)	2,650	Varies 99 to 115

4.1.2 Crossing Construction Timeline and Sequencing

The current approved in-water work window (IWW) in the lower Columbia River and North Portland Harbor is November 1 through February 28. In-water work done outside this window will require a variance from state and federal agencies, which has not yet been sought or granted.

Timeline

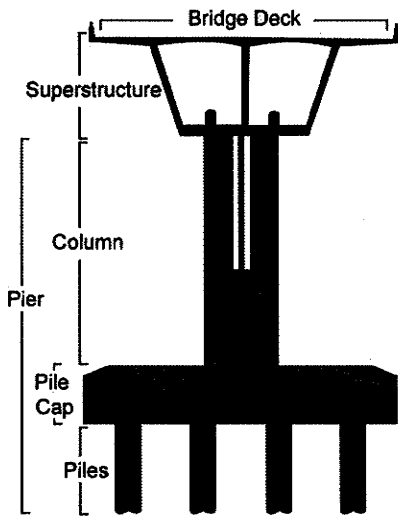
Construction is currently estimated to occur between 2012 and 2018. The project is still working on the overall timeline, including test piles, bridge construction/demolition, roadway work, etc. Specific details of phases, staging, interchange work, etc., will be added as details become available.

Sequencing

The building of 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 ground improvements to approaches for bridge structures.
- Installation of structure foundations – driven piles and/or drilled shafts.
- Bridge piers – construct cap on top of driven piles or drilled shafts; construct columns and pier tables. In-water piers will be constructed using barge and/or temporary work bridge support.
- 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.

1 **Exhibit 4-3. Basic Bridge Components**



NOTE: The bridge type shown is
for display purposes only.

3 **4.1.3 Proposed Crossing Construction Methods**

4 Bridge construction will include the following components. Conceptual staging plans
5 were developed to illustrate that construction of the river crossing could be achieved. The
6 final construction methods will be determined by the contractor once a construction
7 contract is awarded.

8 **Pier and Superstructure Construction**

9 In-water foundations (a.k.a. piles) will be required to support crossing piers. Two types of
10 permanent foundations are being considered: 1) drilled shafts and 2) driven steel piles.
11 The means and methods for shaft and pile installation are presented in Section 4.5.
12 Columns will be constructed after the foundation caps are complete. Barges will be
13 required for cranes, material, and work platforms. Tower cranes will likely be used to
14 erect piers and support superstructure construction. Superstructure will be constructed of
15 structural steel, cast-in-place concrete, or precast concrete.

16 **Permanent Foundations**

17 Permanent foundations will likely be anchored 30 feet or less into the Troutdale
18 Formation (up to -290 feet NAVD88) (Exhibit 3-5). The quantity of permanent
19 piles/shafts required is influenced by numerous factors, many of which are unknown at
20 this stage of bridge design. Unknown factors include pile/shaft type, pile/shaft size,
21 number of bridges, and bridge type. For the purposes of this report, foundations may be
22 built using 96-inch-diameter permanent driven piles or 120-inch-diameter drilled shafts.
23 The crossing would have spans that range from 120 feet to 500 feet, resulting in 16 piers
24 in the water. Four of these piers would be smaller structures for the shorter approach
25 spans. Exhibit 4-4 summarizes permanent piles needed for construction of the new
26 bridges over the Columbia River.

Exhibit 4-4. Number of Permanent Piles/Shafts Required for the Columbia River Bridge

Description (From East to West)	Number of Permanent Piles/Shafts
I-5 Northbound Bridge	104
I-5 Southbound Bridge with LRT	104
Total Permanent Piles for the Columbia River Bridges	208

Temporary Foundations

Temporary foundations will 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 30-inch-diameter piles. It is not known at this stage of engineering design how deep temporary piles will need to be driven. In general, temporary piles will extend only into the alluvium. 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, number of bridges, and bridge type, among others. Several extraction methods are being considered for temporary piles. Possible techniques include direct pull, vibratory extraction, and cutting the piles below the mud line.

Dredging

Some dredging may be required in both the main stem of the Columbia River and in the North Portland Harbor to clear the navigation channels if they are adjusted from their current locations and to allow deep draft work vessels access to the site. If conducted, dredging would likely be limited to the area directly below and adjacent to the new bridge and the footprint of the existing bridges. Additional dredging may also be required in the North Portland Harbor to remove riprap from around the existing bridge foundations and to facilitate easier pile installation for new bridge foundations. Volume, area, location, and contaminant characterization of the dredging are not known at this time.

Cofferdams

Cofferdams may be used throughout the project to support installation of piers. Cofferdams will likely consist of sheet pile sections vibrated into place. Piles or drilled shafts will then be installed while water is still in the cofferdam. After pile or drilled shaft installation is complete, a concrete seal will be placed and the cofferdam will be dewatered. Cofferdams are not watertight and will need to be continuously pumped after dewatering.

4.2 Highway, Interchange, and Bridge Construction

Highway construction activities will require widening I-5 and rebuilding or retrofitting interchanges and bridges. Exhibit 4-5 displays generalized locations of proposed improvements, which include:

- 1 • SR 14 Bridges
- 2 • Evergreen Bridge
- 3 • Mill Plain to 33rd Street Bridges
- 4 • SR 500 and 39th Street Bridges

5 Foundations for these improvements will support abutments, retaining walls, and
6 columns. The existing I-5 right-of-way will likely accommodate most of the common
7 construction staging requirements. However, some construction staging may require
8 temporary easements from property owners.

9 **4.3 Transit Construction**

10 Transit construction activities will be required for supporting light rail transit (LRT) or
11 bus rapid transit (BRT). Transit construction will be completed in separate phases, which
12 include transit bridge, transit guideways, and stations.

13 Construction methods and schedules for the transit guideway and stations would depend
14 upon the location, major alignment, and transit mode chosen. Even with these variables,
15 the transit guideway on land would likely be completed prior to finishing the transit
16 bridge.

17 The transit guideway would be on an elevated structure over the North Portland Harbor,
18 Hayden Island, and the Columbia River. The guideway would touch down on
19 Washington Street, where it would be constructed at-grade on local streets through
20 downtown. North of downtown, the Vancouver alignment would continue at-grade on
21 local streets.

22 Light rail would require utilities (water, sewer, stormwater, electrical, and
23 communications) underneath the roadway to be relocated before building the road surface
24 and the track. This is necessary so that the weight of a two-car train is supported.

25 Additionally, light rail would utilize a park and ride structure at Clark Community
26 College. The structure will likely be constructed using spread footings, but may also use
27 shallow piles for foundation.



4.4 Driven Pile and Drilled Shafts

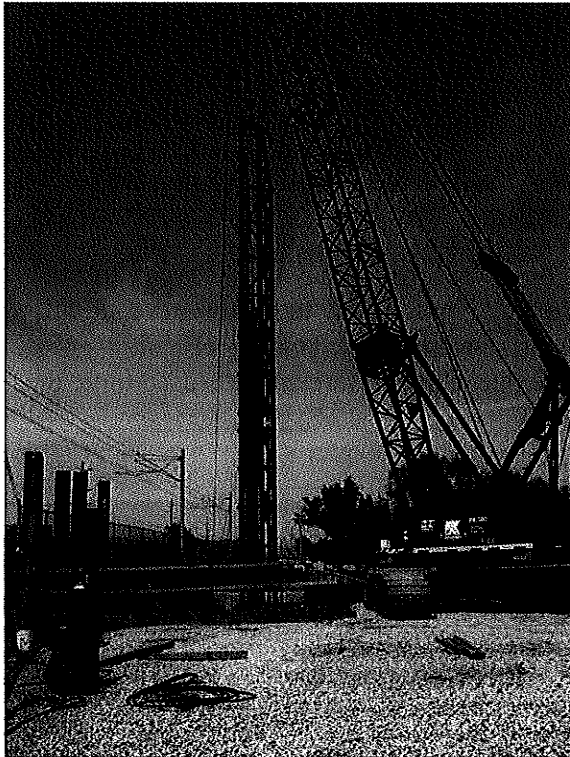
Driven piles and drilled shafts will generally be used as foundation elements to anchor supporting bridge abutments, retaining walls, and bridge piers.¹⁰

4.4.1 Driven Piles

Some of the foundation options proposed for this project involve the driving of small- or large-diameter piles using an impact pile hammer. A typical driven pile installation is shown in Exhibit 4-6. A soil plug usually forms in the pile, leaving the upper length of the pile hollow. In some cases, if the soil plug does not form, it may be necessary to remove soil from inside the piles to a predetermined depth (likely to the top of or slightly into the Troutdale Formation). After the pile is driven and cleaned out, steel reinforcement and concrete are placed inside the pile. The reinforcement is used to tie the pile to the structure it is supporting (Exhibit 4-7).

¹⁰ Spread footings may also be used for foundation structures instead of pile or shafts, when appropriate conditions exist. The use of spread footing would reduce the amount of subsurface disturbance, and reduce project costs.

1 **Exhibit 4-6. Typical Driven Pile Installation**



2

3

4 **Exhibit 4-7. Driven Pile Installation Reinforcement**



5

6

1 **4.4.2 Drilled Shafts**

2 Some of the foundation options proposed for this project involve the drilling of small- or
3 large-diameter shafts using an auger. A typical drilled shaft installation is shown on
4 Exhibit 4-8. Drilled shafts will require installation using either temporary or permanent
5 casings to prevent sloughing and caving of soils. Casings would likely be installed using
6 an oscillator, which rotates the casing back and forth, driving it downward, until it
7 reaches the required tip elevation. Other potential methods of casing installation, such as
8 rotator (rotates the pile as it is driven downward) or vibratory hammer, are also possible.
9 After the casings are installed, the pile is cleaned out to its full depth. The rock sockets
10 can then be drilled. After a final cleanout of the casings, reinforcing steel is installed and
11 shaft concrete is placed (Exhibit 4-9).

12 **Exhibit 4-8. Typical Drilled Shaft Installation**

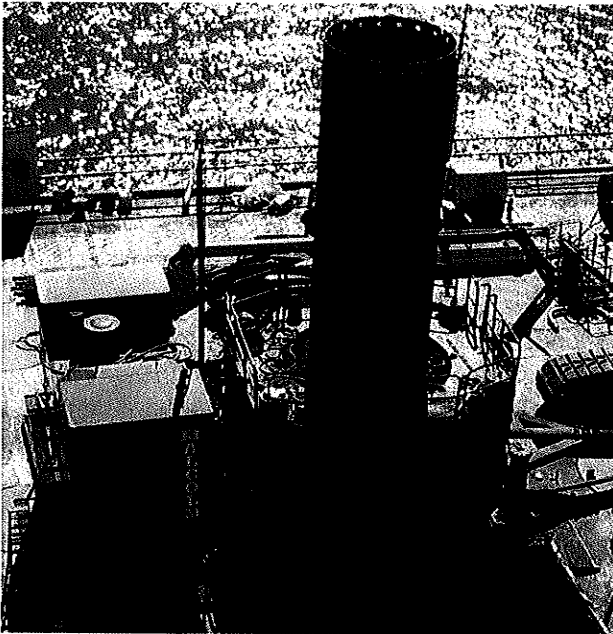
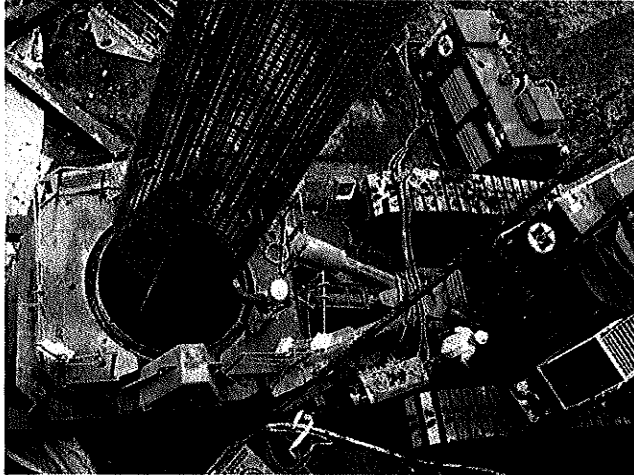


Exhibit 4-9. Drilled Shaft Installation



4.4.3 Estimated Depths

Foundation construction for the bridges will require the transfer of vertical loads from weak near-surface soils to rock or stronger soil at depth. Exhibit 4-10 contains estimated pile and shaft depths using conceptual 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 depth to material adequate to support the anticipated vertical loads occurs at the Troutdale Formation. The Troutdale Formation is located between 110 and 260 feet below the ground surface for foundations over the Columbia River.¹¹ Foundations will likely be driven to these depths for the Columbia River Crossing, SR-14 Bridge, and the Mill Plain to 33rd Street Bridges. Shallower foundation depths within the USA will likely be used for the more northern SR-500 and 39th Street Bridges.

Exhibit 4-10. Estimated Pile and Shaft Depths

Bridges	Foundation Type ^b		Area of Structure (square feet x 1,000)	Estimated Pile Tip Depth Below Existing Ground/ Mudline ^c (feet bgs)	Estimated Number of Piles	Approximate Depth to Groundwater ^d (feet bgs)	Occurrence of Excavations
	Shafts	Piles					
Columbia River Crossing ^a	X	X	1,032	110 to 260	60 to 120 piles 50 to 100 shafts	10	High
SR-14 Bridges ^b	X		494	120 to 130	170 to 210 shafts	10	High

¹¹ Dependent on geotechnical conditions.

	Foundation Type ^b		Area of Structure (square feet x 1,000)	Estimated Pile Tip Depth Below Existing Ground/ Mudline ^c (feet bgs)	Estimated Number of Piles	Approximate Depth to Groundwater ^d (feet bgs)	Occurrence of Excavations
Bridges	Shafts	Piles					
Evergreen Bridge ^b	X	X	20	50 to 70	90 to 160 piles 10 to 30 shafts	90	Low
Mill Plain to 33rd Street Bridges ^b	X	X	178	80 to 90	130 to 240 shafts 440 to 740 piles	150	Moderate
SR-500 Interchange & 39th Street Bridges ^b	X	X	66	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 Contours were created by computer model of data originating from various sources in the 1990s.

4.4.4 Concrete Work

Pilings will be constructed of structural steel with cast-in-place concrete. Concrete consists of two general components: gravel aggregates and a cement matrix. The cement consists of calcium silicates and calcium aluminates in various proportions depending on the type of the cement. Further information on the cement type will be developed during the preliminary engineering or specified by the subcontractor.

Water quality can be affected when cement-based material comes in contact with groundwater. Water quality effects can occur during initial placement of the concrete slurry or can result over time due to leaching of the concrete. Effects to water quality can manifest as increases in alkalinity, pH, major cations such as calcium, and trace metals such as barium. Based on a limited literature review, only a few studies have information on effects of concrete leaching. Review of these studies suggests that the water quality effects are relatively short-lived (Guo et al. 1998, and Féd Int. du Béton 2003).

Effects to water quality from concrete are thought to be minimal where driven steel pile casings are permanently left in place in the borehole. The steel casing limits the amount of direct contact that the concrete has with groundwater. This type of piling construction may be used for in-water piers and for piles where borehole stability issues can occur. However, piles may also be constructed in open boreholes where stability is not an issue. In these instances, effects to water quality from concrete can occur. The use of open boreholes will likely be employed in the northern portion of the LPA.

4.5 Stormwater

4.5.1 Stormwater and Erosion Controls Measures During Construction

Stormwater runoff in construction areas with ground disturbances can lead to soil erosion and adversely affect the quality of receiving waters. As such, stormwater and erosion controls practices will be necessary in construction areas where ground disturbance occurs.

Erosion control best management practices (BMPs) are required during all ground disturbing activity until permanent site ground covers are in place. A best management practice (BMPs) are a physical, chemical, structural or managerial practice that prevents, reduces or treats contamination of water or which prevents or reduces soil erosion. Specific practices will be developed for each construction area under a stormwater control and pollution prevention plan (SCPPP) prepared by a licensed engineer.

Temporary Stormwater Controls may include:

- Interceptor swales that divert and convey runoff to sediment traps or ponds
- Check dams that reduce velocities in ditch or swales to promote sedimentation
- Stormwater barriers which are portable materials such as hay bales that impound stormwater and sediment
- Sedimentation traps or ponds control sediment laden flows leaving the site.

4.5.2 Permanent Stormwater Conveyance, Management and Treatment Facilities

Stormwater from newly constructed impervious surfaces is required to be managed and treated under applicable city, state and federal regulations. These include Vancouver Municipal Code, Washington State Pollution Control Act, and Federal Clean Water Act. Construction must comply with WSDOT Stormwater National Pollutant Discharge Elimination Systems (NPDES) General Permit, and be consistent with the Highway Runoff Manual (HRM)(WSDOT 2008). The NPDES General Permit contains WSDOT 2008 Stormwater Management Plan (SWMP) in effort to streamline permitting with implementation of performance measures outlined in the SWMP. The updated HRM is consistent with Ecology's stormwater management manual for western Washington (Ecology 2005).

Federal, state, and local agencies with direct jurisdiction over aspects of stormwater management in the study area include National Oceanic & Atmospheric Administration (NOAA) Fisheries, EPA, Washington State Department of Ecology (Ecology), and the City of Vancouver.

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 (PGIS)¹² in accordance with the agency requirements

¹² PGIS are defined as surfaces that are considered a significant source of pollutants in stormwater runoff.

- 1 • Provide flow control for new and replaced impervious areas in accordance with
- 2 state and local requirements.
- 3 • Conduct maintenance on water quality treatment facilities and flow controls to
- 4 ensure they performing as intended.

5 For the permanent project facilities, this comprises:

- 6 • Highways and ramps, including non-vegetated shoulders
- 7 • Light rail transit (LRT) guideway subject to vehicular traffic (referred to as a
- 8 semi-exclusive guideway where the tracks are subject to cross-traffic or non-
- 9 exclusive where vehicles such as buses can travel along the guideway)
- 10 • Streets, alleys and driveways
- 11 • Bus layover facilities, surface parking lots and the top floor of parking structures

12 The following types of impervious area are not considered pollution-generating:

- 13 • LRT guideway not subject to vehicular traffic except the occasional use by
- 14 emergency or maintenance vehicles (referred to as an exclusive guideway)
- 15 • LRT stations
- 16 • bicycle and pedestrian paths, and sidewalks

17 **4.5.3 Stormwater Source Control**

18 Stormwater source controls are designed to prevent pollutants from entering stormwater
19 by eliminating the source of pollution or by preventing the contact of pollutants with
20 rainfall and runoff. Source control BMPs include, but are not limited to, street sweeping,
21 deicing and spill control. BMPs apply to:

- 22 • Maintenance, repair, and storage of vehicles and equipment
- 23 • Spills of oil and hazardous substances
- 24 • Landscaping
- 25 • Dust and deicing control
- 26 • Fueling stations

27 **4.5.4 Water Quality Treatment and Flow Control Systems**

28 Runoff treatment BMPs designed to remove pollutants contained in runoff use a variety
29 of mechanisms, including sedimentation, filtration, plant uptake, ion exchange,
30 adsorption, precipitation, and bacterial decomposition. The overall approach to
31 stormwater management from a water quality perspective is to treat runoff by reducing
32 the following pollutants that are typically associated with PGIS:

- 33 • 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.

The following types of water quality BMPs are effective in reducing sediments, particulates and dissolved metals, and providing flow controls:

1. **Bio-retention Ponds** are 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 to collect infiltration and convey it to a stormwater conveyance system.
2. **Constructed Wetlands** are shallow, permanent, vegetated ponds that function like natural wetlands. They remove pollutants through sedimentation, sorption, biological uptake, and microbial activity.
3. **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, are an excellent filtration medium. They also have a high cation exchange capacity that will bind and trap dissolved metals. Similar to bio-retention ponds, an underdrain system is recommended for sites with Group C and D Hydrologic Group soils.
4. **Soil-amended Filter Strips** are intended to disperse and treat sheet runoff from an adjacent roadway surface. In a confined urban setting such as the CRC 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.
5. **Bioslopes**, like filter strips, are intended to disperse and 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. The percolating runoff flows through a special mixture of materials, including dolomite and gypsum, which promotes the adsorption of pollutants.

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

1 and grease are expected in stormwater runoff. Baffle Type Oil-Water Separators and
2 Coalescing Plate Oil-Water Separators are considered to be suitable types of treatment
3 facilities.

4 Infiltration is considered feasible for highway-related elements of the project north of the
5 Columbia River. Based on data available from the National Resources Conservation
6 Service website¹³, surficial soils in the project area north of the Columbia River are
7 comprised of the Wind River and Lauren soils (Group B soils). These soils have a
8 moderate infiltration rate, are moderately deep, and have a fine to moderately coarse
9 texture. An investigation program is pending to determine site-specific infiltration rates
10 and groundwater levels at proposed bio-infiltration swale locations. If infiltration can not
11 be achieved at proposed swale locations and the swales can not be expanded, an
12 underdrain system or bio-retention ponds may be used to increase storage.

13 **4.5.5 Permanent Water Quality Management Strategies**

14 The strategies presented below comprise an approach to water management based on
15 current project understanding. As design work progresses, the project will identify and
16 evaluate options for low impact development and the use of localized water quality
17 facilities that treat runoff closer to its source. This will help reduce the size of the
18 stormwater management facilities currently proposed. In addition, the extent of
19 resurfacing versus rebuilding will continue to be reviewed with an aim to minimizing the
20 extent of existing pavement that required complete reconstruction.

21 Management will be conducted under two watersheds, the Columbia River Watershed
22 and the Burnt Bridge Creek Watershed. Details describing upgrades to the stormwater
23 system for each watershed are provided below.

24 **Management in the Columbia River Watershed**

25 In the Columbia River Watershed the proposed project will create 89 acres of PGIS and
26 26 acres of resurface PGIS. The project would increase PGIS approximately 28 acres
27 from the no-build alternative. The project proposes to treat stormwater from all 115 acres
28 of PGIS. The project would also manage and treat a portion of non-PGIS from LRT
29 guideways and station platforms.

30 In general, the SR 14 interchange will be reconstructed with the resulting footprint being
31 larger than the current footprint. As such, I-5 mainline from SR 14 to Mill Plain would be
32 widened with the existing pavement being replaced or resurfaced. During reconstruction
33 of this roadway and the SR 14 interchange new conveyance systems will be installed.
34 New systems will separate runoff from I-5 from runoff from the urban areas to the west.
35 Water quality facilities would be installed at the SR 14 and Mill Plain interchanges.
36 Urban areas west of I-5 would continue to use the existing stormwater conveyance
37 systems.

¹³ <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>

North of the Mill Plain interchange, I-5 would be resurfaced or rebuilt. Due to the extent of resurfacing, it is assumed that the existing stormwater system along this length of I-5 would be retained as-is. As such, the existing conveyance system under I-5 would continue to be used for highway runoff. The existing conveyance system between Mill Plain and Fourth Plain interchanges is too deep to permit retrofitting with water quality facilities. There is, however, a portion of resurfaced pavement north of the Fourth Plain interchange where the existing conveyance system is shallow enough to allow retrofitting with water quality facilities.

The following present permanent stormwater management strategies for the project in the Columbia Watershed. Water quality facilities are currently proposed at the SR 14, the Mill Plain and the Fourth Plain interchanges, and along the LRT guideway.

SR 14 Interchange

Runoff from PGIS at the SR 14 interchange, the I-5 mainline and collector-distributor roads between the SR 14 and Mill Plain interchanges, the Evergreen Blvd. bridge, and park & ride structure at the SR 14 interchange would be conveyed to water quality facilities located within the SR 14 interchange footprint. An oil-water separator would be provided to pre-treat runoff from the parking structure.

Water quality facilities are proposed for all new and replaced PGIS as follows:

- runoff from southbound I-5, ramps on the west side of the interchange, park & ride, and Evergreen Blvd. bridge over I-5 would be conveyed to a bio-retention pond located immediately east of the park & ride
- runoff from northbound I-5 and ramps on the east side of the interchange would be conveyed to a bio-retention pond located inside the loop ramp from northbound I-5 to C Street
- runoff from SR 14 and Main Street in the vicinity of the interchange would be directed to a biofiltration swale located between the eastbound and westbound lanes of SR 14
- runoff from new and rebuilt SR 14 pavement east of the interchange SR 14 interchange, would be discharged to one or more biofiltration swales located north of the highway

Any overflow from bio-retention ponds and outflow from the biofiltration swale would be released to the Columbia River via existing stormwater conveyance systems.

Constructed wetlands are not recommended at this location 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 airfield¹⁴.

¹⁴ *Hazardous Wildlife Attractants on or near Airports, Advisory Circular 150/5200-33A*. U.S. Department of Transportation, Federal Aviation Administration. July 27, 2004

Columbia Way would be realigned as part of the project and it is proposed that continuous inflow biofiltration swales be constructed on either side of the new street to the maximum feasible extent for water quality treatment.

Mill Plain Interchange

Runoff from new and replaced ramps in the vicinity of this interchange and collector-distributor road to the north would be conveyed to a bio-retention pond located within the interchange footprint. Street grades would render it difficult to convey runoff from a portion of rebuilt Mill Plain Blvd. and 15th Street west of I-5 to the infiltration pond. It is proposed that an "equivalent" area of existing Mill Plain Blvd. east of the interchange be directed to the pond. The ramp from southbound I-5 to Mill Plain Blvd. would be directed to a biofiltration swale west of the ramp. Overflow from the pond and discharge from the swale would be discharged to the existing stormwater conveyance system under I-5. Again, constructed wetlands are not recommended because of the proximity to Pearson Airfield.

The existing stormwater conveyance system serving I-5 north of Mill Plain Blvd. will likely remain as-is, and would be too deep to facilitate retrofitting with water quality facilities.

The proposed street grade for Mill Plain Blvd. immediately under I-5 is too low to permit runoff to be conveyed to the biofiltration pond described above. Based on available information, there appears to be adequate vertical distance between the low point on Mill Plain Blvd. and invert of the existing stormwater conveyance system under I-5 to install a proprietary cartridge filters and, if necessary, an oil-water separator pre-treatment facility.

Fourth Plain Interchange

The Fourth Plain interchange will be replaced, and a new access will be provided from Fourth Plain Blvd. to the Clark College park & ride structure. Construction will require paving additional lanes and resurfacing existing pavement between the Fourth Plain and SR 500 interchanges. Although the existing stormwater conveyance systems north of Fourth Plain would likely be retained by the project, available information indicates 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.

The following water quality facilities are proposed:

- runoff from new, and replaced pavement on Fourth Plain Blvd. and interchange ramps on the west side of the interchange as well as runoff from existing streets in the Shumway neighborhood to the north would be conveyed to a bio-retention pond located within the west interchange footprint
- runoff from I-5 mainline and access road to the Clark College park & ride would be conveyed to a bio-retention pond located in the southeast interchange quadrant
- runoff from Fourth Plain east of I-5, including an "equivalent" PGIS to compensate for rebuilt pavement on the west side of I-5 that would be difficult to

1 treat, would be conveyed to a biofiltration swale south of Fourth Plain Blvd. and
2 east of the collector-distributor road

3 **LRT Guideway**

4 The proposed approach to constructing the LRT guideway along Vancouver city streets is
5 to excavate a slot within the existing pavement to facilitate single track guideway
6 construction. The remaining pavement would be resurfaced within each block and
7 replaced at intersections. The distinction between replaced and resurfaced PGIS is
8 important to note. For double track guideways, it is assumed that the entire street would
9 need to be replaced. It is assumed that sidewalks would be reconstructed for both single
10 and double track construction.

11 The elevated LRT bridge across the Columbia River, the bridge approach and at-grade
12 tracks within each block would be exclusive guideway. These areas and station platforms
13 would be non pollutant-generating and it is proposed that runoff be released, untreated, to
14 the Columbia River via existing stormwater conveyance systems.

15 Runoff from the semi-exclusive guideway at intersections and replaced streets would be
16 collected via track drains and new catch basins located at replaced intersections along the
17 at-grade LRT guideway. With the exception of Washington Street between 10th Street
18 and McLoughlin Boulevard, available data indicated that there is adequate vertical
19 distance between existing grades at intersections and stormwater pipe inverts to install
20 proprietary water quality systems such as cartridge filters. The track drains and new catch
21 basins would intercept runoff from street surfaces graded towards the intersection as well
22 as runoff from the intersection itself.

23 Drainage from the Clark College Park & Ride would be conveyed to an oil-water
24 separator and biofiltration swale located on the east side of the structure.

25 **Management in the Burnt Bridge Creek Watershed**

26 In the Burnt Bridge Creek Watershed, the project would create an additional 13 acres of
27 PGIS. The project would increase PGIS approximately 5 acres from the no-build
28 alternative. The project would treat approximately 10 acres of PGIS.

29 The project would provide full connectivity between I-5 and SR 500 through the
30 construction of a new ramp from southbound I-5 to eastbound SR 500 and tunnel from
31 westbound SR 500 to northbound I-5. There is very little opportunity to expand the
32 existing infiltration pond at the I-5/Main Street interchange. To eliminate the need to
33 modify this facility to accommodate new and reconstructed pavement that would drain to
34 it, an "equivalent" area would be redirected to a new water quality facility located east of
35 the interchange. The new facility, described below, would be sized to handle runoff from
36 this "equivalent" area as well as new and rebuilt pavement at and east of the interchange.

37 The existing wet pond serving the I-5/SR 500 interchange and SR 500 immediately east
38 does not provide the level of water quality treatment required for the CRC project: wet
39 ponds are designed to only reduce sediment. To meet flow control and water quality
40 treatment requirements, it is proposed that runoff from new, rebuilt, "equivalent"

1 resurfaced and existing be conveyed to a bio-retention pond located immediately east of
2 the intersection of 39th Street and 15th Avenue. The "equivalent" pollutant-generating
3 impervious surfaces comprise the I-5 mainline south of 39th Street and 15th Avenue south
4 of 39th Avenue. The latter is required to compensate for the proposed rebuilt 15th Avenue
5 north of 39th Avenue that would be difficult to drain to the proposed pond. Data from
6 boreholes at and adjacent to the pond location indicate that the assumed infiltration rate
7 of 1 inch/hour may be readily achieved.

8 The proposed bio-retention pond location is a jurisdictional wetland, mitigation will be
9 required. As the project design is developed, the CRC team will continue to investigate
10 opportunities to avoid using the existing wetland as a water quality facility.

11 There would be no LRT construction in this watershed and no LRT-related stormwater
12 impacts.

13 **4.5.6 Permanent Flow Control Management**

14 Flow control is only required for discharges to Burnt Bridge Creek. Based on the current
15 project layout, additional flow control would not be required for runoff to the existing
16 pond at the I-5/Main Street interchange since the project would not increase the area
17 draining to this facility. For the proposed bio-retention ponds located east of the
18 interchange, preliminary sizing assumes that inflows up to the 1 in 100 year event would
19 be infiltrated.

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