ATTACHMENT E

Stormwater Design Report

Columbia River CROSSING

Initial Construction Program (ICP) Stormwater Design Report - Draft Hydraulic Report/Stormwater Management Plan Checklist

WASHINGTON - Department of Ecology (Hydraulic Report Items)	Associated page/section of ICP Stormwater Design Report - Draft	Notes/Comments
Title Page – The following items should be included on the title page: the project number and name, associated State Route (SR) and milepost(s), Type of Report (A, B or Hydraulic Summary), date report was completed, designers name(s) including the Highway Runoff Manual Training Certificate Number and both the project engineers professional engineers stamp and signature.	Volumes I through IV	Project Number and HRM Training Certificate Numbers will be included in the Final Report; Designer and project engineer names, signatures, and stamps are provided on the Signature Sheet
Table of Contents – Both the Hydraulic Report and Appendix contents should be listed in the Table of Contents. Number all pages including maps, figures, and tables both in the report and in the appendices.	Volumes I through IV	Page numbers in the Appendices Table of Contents will be provided in Final Report
1.0 Project Overview		
1.1 Site Location – Note the following: MP limits, Section, Township, Range and reference location from nearest city.	Volume I through IV, Figure 1-1	Mile Post limits will be included in Final Report
1.2 Vicinity Map – Include a vicinity map with the project location clearly shown. Whenever possible, highlight major landmarks, delineate water bodies and label cross streets.	Volume 1 through IV, Figure 1-1	
1.3 Scope of Work – Introduce the hydraulic features of the project and note why they are being installed. Describe project improvements and where they will occur, reference attached plan sheets where applicable. It may be necessary to discuss the overall purpose of the project especially if it is pertinent to some of the decisions made during the design of the hydraulics features. Provide a reference to Appendix A-1 for the areas impacted by the project.	Volume I: Section 1.4, & Volumes II through IV: Section 1.2	Reference to Plan Sheets in Appendices will be provided in the Final Report
2.0 Site Conditions		
2.1 Existing Conditions – Include a discussion on the project site conditions and layout as observed during inspection of the site by the designer. The discussion should serve to confirm what is shown on the maps and site plans and identifies or highlights as well as notes any features that will influence the drainage design.	Volumes I through IV: Section 2	
2.2 Existing Hydraulic Features – Note any existing drainage features and describe how they operate prior to construction. Also note how project improvements could impact their operation and how they will function once construction activities have been completed. If needed, use photographs to describe the site. Identify any bridges or culverts within the project limits and note how the project will impact them or how they will impact the project.	Volumes I through IV: Section 2; Volume I: Figures 2-1.1-2-1.2	
2.3 Threshold Discharge Areas (TDAs) – TDAs are used in stormwater design to determine which Highway Runoff Manual minimum requirements apply. A TDA is a delineation of all the drainage areas that contribute runoff to an on-site single natural or constructed discharge location or multiple natural or constructed discharge locations that combine within ¼ mile downstream (as determined by the shortest flow path) from the highway right of way. A TDA is not the same as a drainage basin. In fact, a TDA may contain portions of multiple drainage basins. See Section 4.1 of this outline for further discussion on drainage basins.	Existing Flow Paths - Volume I: Figures 2-1.1 through 2-1.3, Volumes II-IV: Figures 2-2.	In this report, TDAs are also referred to as Sub-basins, the delineation of these areas for Washington are based on where the water quality facility outlets into the existing I-5 stormwater mainline.
Each TDA must be delineated to account for the full extent of land cover changes that will occur once the project is complete. The delineation should be based on the existing on-site drainage patterns, and the existing outfall from the proposed highway right of way limits. Include TDA maps in Appendix A-2 that clearly delineate the TDA boundaries and show how the drainage areas are tributary to individual outfalls and the flow paths combine to form one TDA. This requires that flow paths downstream of each outfall be shown on the maps.	Volumes I-IV: Appendix A.	See Volumes II though IV: Section 2-3. for discussion on proposed sub-basin delineation assumptions.
For each TDA within the project, provide a complete description of the general drainage systems and flow patterns including any unusual or unique drainage patterns that extend beyond project limits or highway right of way. Each TDA description should list the eventual downstream receiving water body.	Existing Sub-Basins - Volume I: Sections 2.2 & Volume II through IV: Sections 2.3	
2.4 Soils – Discuss the soil testing that has been performed at the site. This includes soil pH and resistivity (to determine acceptable pipe alternatives), soil borings, soil type from SCS Maps, soil infiltration rates, well monitoring, groundwater level, etc. and any other soil testing required for stormwater BMP design.	Volume I: Sections 2.3 & Volume II through IV: Section 2.4	

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2.5 Existing Stormwater Outfalls – All project stormwater outfalls should be noted in this section and entered into the Outfall Database. An outfall is anywhere concentrated stormwater: 1) directly leaves highway right of way via surface flows or underground connections to local storm drain systems; 2) enters state waters within highway right of way; or 3) flows are discharged to groundwater via an infiltration facility including underground injection control, infiltration ponds, and bioinfilration ponds. For more guidance designers should consult the Hydraulic Staff Outfall Inventory Instructions and the Outfall Inventory spreadsheet. Both are located at the website listed below. The information detailed in the spreadsheet should be included in Appendix A-1 of the Hydraulic Report and sent directly to the HQ Environmental Services Office at simonc@wsdot.wa.gov or 360-570-2589.	Volumes I through IV: Appendix A	More detailed information to be provided in the Final Report as a result of 60% design
2.6 Existing Utilities – Note utility conflicts that have been investigated and either are or are not an issue. If there is a conflict, please note resolution. Utilities should be shown on the drainage plan and profile sheets.	Brief discusion is provided the following sections... Volume I: Section 2.6 & Volume II through IV: Section 2.7	Conflicts to be better detailed in the Final Report as a result of the 60% design and efforts from the Utilities team
3.0 Design Standards		
3.1 Design Frequency – Note the appropriate design frequencies used to size hydraulic features on the project and where relevant calculations. Include a discussion of the climate and chosen precipitation values for the project, including copies of Isopluvial and Mean Annual Precipitation maps highlighting the project location. Where applicable, discuss how or if snow was considered in the design. Refer to Section 2-4, Cold Climate Considerations, for further design guidance.	Design Storms - Vol. I, Table 3-5, Vols. II-IV, Table 3-2. Climate - Volume I: Section 1.6, Volumes II-IV, Section 2.8. Precip Values and discussion (Incl. snow) - Vol. I, Table 3-4, Vols. II-IV, Table 3-1. Volume I: Section 3.2.2 & Volumes II through IV: Section 3.1.	Isopluvial and Mean Annual Precipitation Maps to be provided in the Final Report
3.2 Stormwater Management Guidelines – Use the Stormwater Design Documentation Spreadsheet located in Appendix A-1 to document which Minimum Requirements apply. Clearly state which Minimum Requirements apply at both the project and TDA level. Reference the Flow Control and Runoff Treatment selection charts in Figures 5.3.1 and 5.3.2 of the Highway Runoff Manual to describe which BMPs were selected for the project.	Please see discussion in the following sections... Volume I: Section 3.2.1 & Volumes II through IV: Section 3.2	Stormwater Design Documentation Spreadsheet not provided, See discussion regarding how minimum requirements were determined and addressed
3.3 Stormwater Retrofit Analysis – Document all project related stormwater retrofit activity where an existing structure or facility will be renovated to meet changed conditions or improve performance. This section should also include discussion regarding equivalent areas, stand alone stormwater retrofits, and/or justification for not providing a retrofit for a replaced impervious surface. Section 3-4 of the Highway Runoff Manual provides additional stormwater retrofit guidance. The Stormwater Design Documentation Spreadsheet noted in Appendix A-1 of this outline will also assist designers in organizing retrofit information required for this section.	Please see a brief discussion in the following sections... Volume I: Section 3.2.4 & Volumes II through IV: Section 5.10	Any retrofit will be addressed in the Final Report as a result of the 60% design
3.4 Other Requirements – Note any requirements used in the hydraulic calculations that are in addition to those found in the Hydraulics and Highway Runoff Manuals. This would include: local agency guidelines, TMDL and Local Area Ordinances, and/or other agreements or commitments that affect the hydraulic analysis. Provide a list of references for the guidelines, manuals, basin plans, local agency code, technical documents or Memoranda of Agreement or Understanding used to develop the hydraulic scope of work and the Hydraulics Report. In addition, it should be clearly documented how each of these other requirements will be addressed in the Hydraulic Design. Where applicable, include a web link to the reference.	Please see a brief discussion in the following sections... Volume I: Section 3.2.3 & Volumes II through IV: Section 3.3	
3.5 Hydraulics Manual Deviations – Clearly state the year the manual used for design was published. Any deviation from this manual requires approval by the State Hydraulic Engineer and should be summarized in this section. Refer to Section 1-3.2 for additional guidance.	*no deviations noted at 30% design*	Any Deviations will be addressed in the Final Report as a result of the 60% design
3.6 Highway Runoff Manual Deviations – Clearly state the year the manual used for design was published. Any deviation to the HRM requires an Engineering and Economic Feasibility (EEF) evaluation and approval from the DAT (see Appendix 2A of the HRM). Include a summary of the deviation and the outcome of the EEF in this section. A copy of the EEF along with any correspondence should be included in Appendix A-11 of this outline.	*no deviations noted at 30% design*	Any Deviations will be addressed in the Final Report as a result of the 60% design
3.7 Pipe Alternatives – Note all acceptable schedule pipe alternatives (see Division 7-04 of the WSDOT Standard Specifications) for the project and provide engineering justification for any alternatives that are excluded. Refer to Section 8-2 for further guidance.	Please see a brief discussion in the following sections... Volumes II through IV: Section 3.4	

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3.8 Downstream Analysis – Summarize what impact, if any, a project will have on the hydraulic conveyance systems downstream of the project section. The analysis should be broken into three sections: 1) Review of Resources; 2) Inspection of Drainage Conveyance Systems in the Site Area; and 3) Analysis of Offsite Effects. Refer to Section 4-7 for further guidance on when a Downstream Analysis is required and what should be included in the report.	Please see a brief discussion in the following sections... Volumes II through IV: Section 5.9	
3.9 New Stormwater Outfalls – Follow the directions listed in Section 2.5 of this outline.	Volumes II: Section 5.3.9	No new stormwater outfalls are currently proposed for design described in Vols. III or IV
4.0 Developed Conditions		
This section should serve to confirm what is shown on the (current or future) PS&E drainage plans, profiles and details. Note that PS&E level plans may not yet be completed but will be checked against the hydraulic report during the PS&E review.		
4.1 Drainage Basins – The size of each drainage basin is one of the most important parameters in sizing hydraulic and stormwater features. Drainage basins are the areas that contribute runoff to a point of interest such as catch basins, inlets, culverts, drainage ditches, detention ponds, bioswales, etc. These areas may include both on-site and off-site runoff and areas that extend outside of highway right of way and beyond the project.	Please see discussion in the following sections... Volume I: Section 3.1 & Volumes II through IV: Section 4.1 and Appendix A	
Each drainage basin should be described in this section including: land cover, size, slope, and general drainage patterns. Include drainage basin maps in Appendix A-2 with each drainage basin clearly delineated and showing the flow direction arrows. It should be clear on the drainage basin maps which basins contribute runoff to which hydraulic or stormwater features. All new and permanent stormwater BMPs should also be located on the maps and clearly labeled. The drainage basin designations should be held consistent in all subsequent calculations in the hydraulic report. Maps should always be of an adequate and noted scale to allow reviewers to verify all calculations.	Please see discussion in the following sections... Volume I: Section 3.1 & Volumes II through IV: Section 4.1 and Appendix A	
4.2 Post Developed Drainage Patterns – As a general rule, flow patterns within a TDA should not change as a result of project improvements. However, there are unique situations from time to time that can result in runoff being diverted from one TDA to another TDA in the proposed condition. Such cases include an outfall that has been eliminated or moved or when runoff from one TDA has been combined with runoff from another TDA. For example, consider a bridge deck that uses existing downspouts to discharge runoff directly into a river. In order for the proposed project to meet runoff treatment requirements the bridge runoff may need to be captured and conveyed to another TDA for treatment. This situation would require the designer to modify or combine the runoff from these TDAs. Another example is a roadway that is widened next to a wetland. The roadway runoff that previously sheet flowed into the wetland might need to be captured and conveyed to a treatment facility before being discharged from the project site. If that roadway runoff is shifted to a different TDA to receive runoff treatment, the design will have to account for this additional flow.	Volume I: Flow routes can be observed in the sub-basin figures 3-1.1 through 3-1.4	
In the report appendix include TDA maps that clearly delineate any modified drainage patterns and/or discharge locations. If a project modifies the existing flow patterns, the designer will have to show the impacts of these changes through the downstream analysis (see Section 3.6 of this outline for further guidance). If there is a change in the amount of area contributing runoff to a TDA, the minimum requirements are still based on the existing TDA delineations and appropriate measures must be taken to ensure that full compliance with flow control and runoff treatment requirements occurs. TDA mapping of any modified drainage patterns are for future project use.	Volume I through IV: Appendix A; Proposed Flow Paths - Volume I: Figures 3-1.1 through 3-1.3, Volumes II-IV: Figures 4-1	In this report, TDAs are also referred to as Sub-basins, the delineation of these areas for Washington are based on where the water quality facility outlets into the existing I-5 stormwater mainline.

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WASHINGTON - Department of Ecology (Hydraulic Report Items)	Associated page/section of ICP Stormwater Design Report - Draft	Notes/Comments
5.0 Hydrologic and Hydraulic Design		
5.1 Calculation Discussion - Hydrologic and hydraulic design calculations for all hydraulic features should be discussed and the results summarized in this section (e.g., culverts, storm drains, stormwater BMPs, inlets, gutters, ditches, streambank stabilization, etc), actual calculations should be included in Appendix A-3. Where applicable, it is recommended that the design be broken down by TDA and discussed in the order shown in Appendix A-3. Calculation locations should be referenced in this section. For large reports, designers should consider using a table summarizing the calculations for clarity.	Volume II through IV: Sections 5.4-5.8 and Appendix B	
Calculations should include: references to manuals that were followed during the design phase and a discussion of what assumptions were made to perform the calculations and how the input parameters were determined. All calculations should include enough supporting information to allow reviewers to completely duplicate the process used through the original design; however, excessive data which duplicates information already provided can often make the calculation process less understandable.	Volume II through IV: Sections 5.4-5.8 and Appendix B	
Whenever possible calculation methodologies described in this manual and the Highway Runoff Manual should be followed including: figures from these manuals, standard WSDOT design forms, and suggested software. If a different method or software is selected, the reason for not using the standard WSDOT method should be explained and approved as part of the 10% milestone for the Hydraulic Report Review Process. Actual calculations, design forms and output from software used in the project design should be included as part of the report appendices. Visit the following web link for a description of current programs and download information. (http://www.wsdot.wa.gov/Design/Hydraulics/ProgramDownloads.htm)	Volume II through IV: Sections 5.4-5.8 and Appendix B	
6.0 Permits and Associated Reports		
6.1 Environmental Issues, Fish and Other Endangered Habitat – Describe any water quality receiving bodies, flood plains, stream crossings, wetlands, steep slopes or other sensitive areas within the project limits, noting project impacts. Describe any fish passage design issues including culverts within the project limits or fish passage barrier removal issues. Note if fish surveys were conducted and what was determined. Also note if there are any threatened or endangered species within the project limits.	Volumes II through IV. Section 6	
6.2 Permits/Approvals – List all permits, variances or approvals required by local jurisdiction or resource agencies that are necessary to complete the project.	Volumes II through IV. Section 6.1	More discussion 60% design
6.3 Easements – Note any drainage or slope easements that may be required for the project, including whether the easement is for construction or maintenance. Highlighting and referencing the easement area on the attached plan sheets is helpful.	Volumes II through IV. Section 6.2	More discussion 60% design
6.4 Specialty Design – If the project requires any specialty design that must be performed by HQ Hydraulics or a consultant (refer to Section 1-2), the nature of the work that was performed should be described in this section and indicate who provided the design. Include any specialty design reports in Appendix A-10.		Not applicable
6.5 Additional Reports or Studies – Where applicable note other reports and studies conducted and prepared for this project. Include correspondence with the Regional Hydraulics Engineer to determine which reports need to be included in the Hydraulics Report and which only need referencing.	Volumes I through IV: Appendices.	Not all documents currently in report.
7.0 Inspection and Maintenance Summary		
Maintenance should be consulted prior to starting a project concerning any existing drainage problems and/or proposed BMPs. All discussion with maintenance, including email correspondence, should be described and included in this section.	Volume I: Section 5 (brief summary) & Volumes II through IV: Appendix L miscellaneous documents (agency requirements).	
Appendices		
A-1 Stormwater Design Documentation Spreadsheet - has been developed to assist designers in organizing the information required in hydraulic report as well as meeting the inventory requirements of the Highway Runoff Manual. The spreadsheet should be completed and placed in this section of the appendix. (http://www.wsdot.wa.gov/NR/rdonlyres/6DE749BC-209C-4BFD-80D9-BCC86DCB868A/0/StormwaterDesignDocumentation.xls)		Not currently in report

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A-2 TDA Maps, Drainage Basin Maps, and Area Calculations – These maps should show those TDAs and drainage basins referenced in Section 2.3, 4.1, and 4.2 of this outline. Refer to Section 4-2.5 in the Highway Runoff Manual for more guidance on delineation of TDAs.	Volumes I through IV: Appendix A	
A-3 Calculations and Program Output – All calculations included in the report should be checked by a qualified individual other than the person who prepared the report. The following is a list of calculations or program output that, where applicable, is needed to complete a hydraulic report. See Section 1-3.3 for requirements on the report format that should be submitted (electronic vs. hard copy).	Volumes II through IV: Appendix B, Design Documentation for Swales	
A-3.1 StormShed		Not applicable.
A-3.2 MGSFlood Output Reports	Volumes II through IV: Appendix B-1	
A-3.3 BMPs Design	Volumes II through IV: Appendix B-2	
A-3.4 Inlet Spreadsheet	Volumes II through IV: Appendix B-3	
A-3.5 Sag Design	Volumes II through IV: Appendix B-4	
A-3.6 Storm Drain Design	Volumes II through IV: Appendix B-5	
A-3.7 Culvert Design (including Fish passage if applicable)		Not applicable.
A-3.8 Ditch Design	Volumes II through IV: Appendix B-6	Not currently in report
A-3.9 Downstream Analysis (if calculations are required)	Volumes II through IV: Appendix B-7	Not currently in report
A-3.10 Special Stream Design/Channel Changes		Not applicable.
A-3.11 Flood Plain Mitigation		Not applicable.
A-3.12 Bridge Scour Evaluation		Not currently in report
A-4 Drainage Plan Sheets and Details (at level applicable when Hydraulic Report is submitted) – For culverts and bridge projects include the WSEL (water surface elevation) and design flow rates for the 25, 100 and (where applicable) 500 year storms.	Volumes II through IV: Appendix C	
A-5 Drainage Profile Sheets (if applicable)	Volumes II through IV: Appendix D	Not currently in report
A-6 Roadway Cross Sections and Profiles (if applicable)	Volumes II through IV: Appendix E	Not currently in report
A-7 Misc. Contract Plan Sheets (if applicable) – Include any plan sheets that will aid the reviewer to completely understand the project, this may include utility plan sheets.	Volumes II through IV: Appendix F	Not currently in report
A-8 Traffic Analysis Data (Design Year ADT)	Volumes II through IV: Appendix G	Not currently in report
A-9 Environmental Documentation – Environmental issues that have not already been discussed should be documented in this section including; why decisions were made, who made them and note any references used. See Appendix A1-2-1 for a copy of a spreadsheet that will assist in the organization of these issues. Additionally, any environmental documentation that has not already been included in this report should be included in this section including relevant emails or other correspondence, etc.	Volumes II through IV: Appendix H	Not currently in report
A-10 Specialty Design Reports – Include any reports requiring the expertise of the HQ Hydraulics office or a consultant to compile.	Volumes II through IV: Appendix I	Not currently in report
A-11 Engineering Economic Feasibility Evaluation – The EEF should be included along with any correspondence and an approval letter from the Demonstrative Approach Team (DAT).		Not applicable.
A-12 UIC Registration Forms	Volumes II through IV: Appendix J	60% design
A-13 Supplements and Revisions		Not applicable at 30% design

Initial Construction Program (ICP)

STORMWATER DESIGN REPORT

DRAFT REPORT

VOLUME I: SUMMARY

Highway	State	Location
Interstate 5	Oregon	MP 306.5 to MP 308.4
Interstate 5	Washington	MP 0.0 to MP 3.1
State Route 14	Washington	MP 0.0 to MP 0.5

October 2012

Columbia River CROSSING

Title VI

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Americans with Disabilities Act (ADA) Information

If you would like copies of this document in an alternative format – large print, Braille, cassette tape, or on computer disk, please call (360) 705-7097. Persons who are deaf or hard of hearing, please call the Washington State Telecommunications Relay Service, or Tele-Braille at 7-1-1, Voice 1-800-833-6384, and ask to be connected to (360) 705-7097.

For reasonable accommodations in Oregon, call (503) 731-3490.

¿Habla usted español? La informacion en esta publicación se puede traducir para usted. Para solicitar los servicios de traducción favor de llamar al (503) 731-3490.

Signature Sheet

Stormwater Design Report

VOLUME I: SUMMARY

Designed By:

Carolyn Sourek, EIT

Signature Date

Laurie Line, P.E.

Signature Date

Submitted By:

Roger Kitchin, P.E., P.Eng.

Signature Date

Reviewed By:

Devin Reck, EIT (for Washington State)

Signature Date

Bruce Council, P.E. (for Oregon)

Signature Date

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Appendices

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ACRONYMS

Acronym	Description
ADA	Americans with Disabilities Act
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railroad
CIA	Contributing impervious area
COP	City of Portland
COV	City of Vancouver
CRC	Columbia River Crossing
C-TRAN	Clark County Public Transit Benefit Area Authority
DEQ	Oregon Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
Expo	Portland Metropolitan Exposition (Center)
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ICP	Initial Construction Program
InterCEP	Interstate Collaborative Environmental Process
LPA	Locally Preferred Alternative
LRT	Light Rail Transit
LRV	Light Rail Vehicle
MAX	Metropolitan Area Express
MCDD	Multnomah County Drainage District
NAVD	North American Vertical Datum
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration for Fisheries
NPH	North Portland Harbor
NRCS	Natural Resources Conservation Service
ODFW	Oregon Department of Fish & Wildlife
ODOT	Oregon Department of Transportation
PCBs	Polychlorinated Biphenyls

Acronym	**Description**
PEN	Peninsula Drainage District
PGIS	Pollutant generating impervious area
PIR	Portland International Raceway
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SSA	Sole Source Aquifer
TMDL	Total Maximum Daily Load
TriMet	Tri-County Metropolitan Transportation District of Oregon
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VMC	Vancouver Municipal Code
WDFW	Washington Department of Fish and Wildlife
WRD	Oregon Department of Water Resources
WSDOT	Washington State Department of Transportation

1. Overview

This Stormwater Design Report, which comprises four volumes, describes the design of the stormwater collection and conveyance systems (inlets, pipes, and ditches), and water quality facilities developed to treat project runoff for the Initial Construction Program (ICP) portion of the Columbia River Crossing (CRC) project. It does not address the effect of proposed bridges on scour or on water surface elevations for the Columbia River, the primary watercourse traversed by the project, nor does it include any temporary erosion and sediment control that may be required during construction.

Volume I, this document, provides an overview of the project, general design considerations, and a summary of the proposed stormwater infrastructure and areas from which runoff will be treated. Volumes II through IV provide a description of the design of stormwater collection, conveyance, and water quality facilities for the three watersheds within which the project is located: Columbia Slough, Columbia River South, and Columbia River North.

1.1 Introduction – Columbia River Crossing Project

The CRC project is a bi-state multimodal initiative which is being led by the Oregon Department of Transportation (ODOT) and Washington State Department of Transportation (WSDOT). The team also includes Metro, Southwest Washington Regional Transportation Council, Tri-County Metropolitan Transportation District of Oregon (TriMet), Clark County Public Transit Benefit Area Authority (C-TRAN), and the cities of Portland and Vancouver. Transportation modes addressed by the project include highway, light rail transit, bicycle, and pedestrian.

The project encompasses a five-mile length of the Interstate 5 (I-5) corridor within the cities of Portland (Oregon) and Vancouver (Washington State) as shown on Figure 1-1. The Columbia River is the only watercourse that the project crosses. Within the corridor, Hayden Island separates the river into two channels; the main channel to the north and North Portland Harbor to the south. The corridor, which extends from North Victory Boulevard in Portland to SR 500 in Vancouver, is located in Sections 3 and 4, Township 1N, Range 1E, WM., and Sections 14, 15, 22, 23, 26, 27, 33, and 34, Township 2N, Range 1E, WM.

The project corridor includes an interchange with two state highways (SR 14 and SR 500), both located in Washington State. The following major roads also cross the corridor:

- N Victory Boulevard (Portland)
- N Marine Drive (Portland)
- NE Martin Luther King Jr. Boulevard (Portland)
- E Mill Plain Boulevard (Vancouver)
- E McLoughlin Boulevard (Vancouver)
- E Fourth Plain Boulevard (Vancouver)

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 Marine Fisheries Service (NMFS)
- U.S. Environmental Protection Agency (EPA)
- Oregon Department of Environmental Quality (DEQ)
- Washington State Department of Ecology (Ecology)
- City of Portland (COP)
- City of Vancouver (COV)

The state and federal agencies listed above are signatories of the Interstate Collaborative Environmental Process (InterCEP) agreement. 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 approach is the adoption of ODOT's technical memorandum on stormwater water quality (ODOT 2009) on a project-wide basis providing a standard approach to determining the types of water quality facilities that provide adequate protection to listed species. The memorandum is the result of a venture by ODOT, Federal Highway Administration (FHWA), and natural resource agencies (NMFS, Oregon DEQ, U.S. Fish and Wildlife Service (USFWS), EPA, and the Oregon Department of Fish and Wildlife (ODFW)). The decision to use this approach on the CRC project has been endorsed by WSDOT and Ecology.

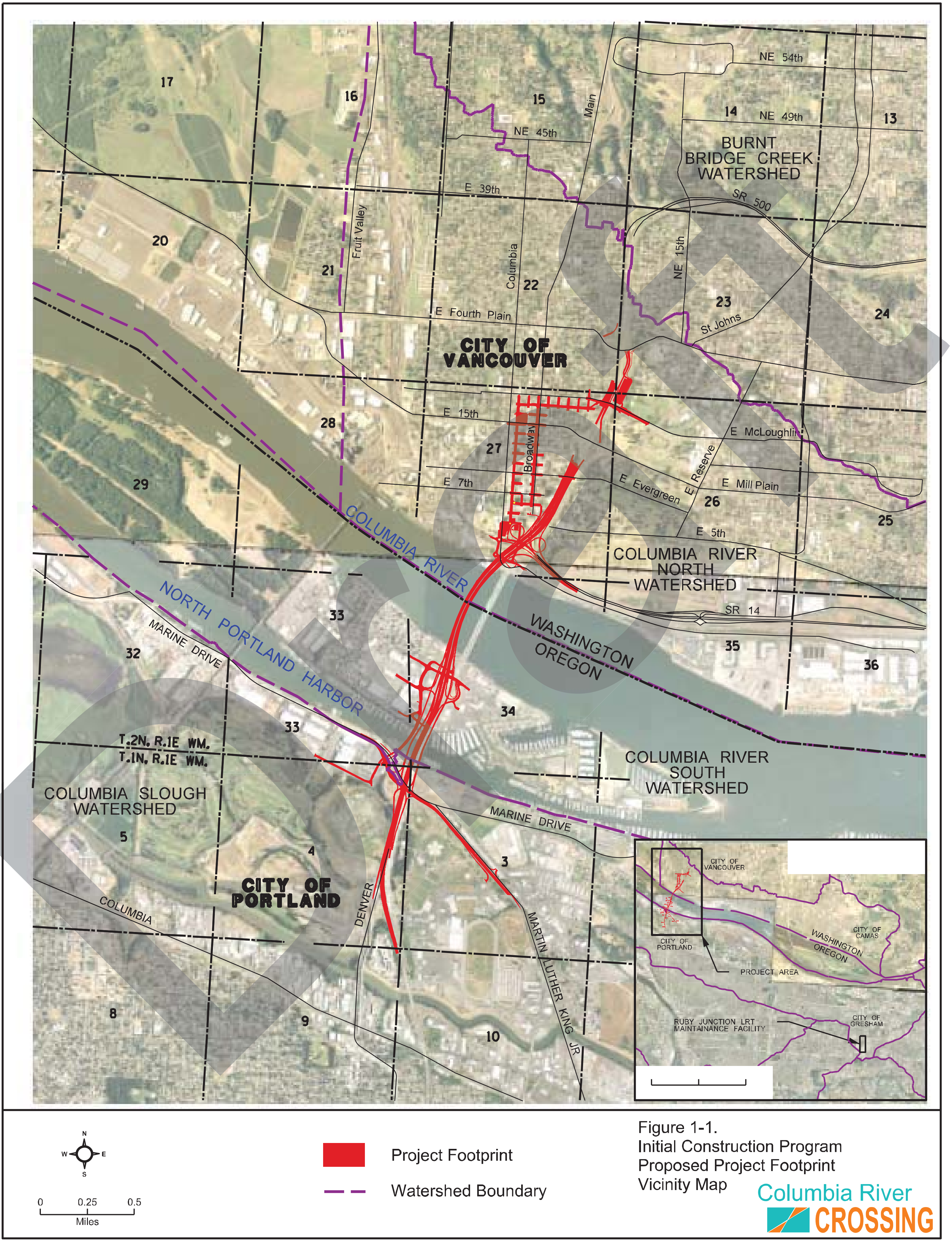

Figure 1-1.
Initial Construction Program
Proposed Project Footprint
Vicinity Map

Columbia River CROSSING

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1.2 Project Description

The CRC project, or Locally Preferred Alternative (LPA), was selected through the alternative analysis and development process. A detailed description of the selected alternative is included in Chapter 2 of the Final Environmental Impact Statement (FEIS). The construction of the selected alternative will be phased to match available funding while providing significant transportation benefits. The first construction phase is referred to as the ICP. The ICP includes the multimodal elements summarized below, while additional project description is included in the subsequent sections as well as a detailed description of the ICP provided in Appendix L.

- A new river crossing over the Columbia River and I-5 highway improvements, including major improvements to three interchanges, as well as associated enhancements to the local street networks in Vancouver and Portland. Minor improvements will also be done to the I-5 Mill Plain and Fourth Plain interchanges.
- Extension of light rail from the Expo Center in Portland to Clark College in Vancouver, and associated transit improvements, including transit stations, park-and-rides, bus route and station changes, and expansion of a light rail transit (LRT) maintenance facility.
- Upgrades and modifications to the Steel Bridge and transit command center.
- Purchase of 19 light rail vehicles (LRVs), public art, and other transit-related procurements.
- Bicycle and pedestrian improvements throughout the project corridor that connect to the transit system.
- Toll system for the river crossing.
- Transportation demand and system management measures to be implemented with the project.

1.2.1 River Crossings

1.2.1.1 Columbia River Bridges

- Demolish the existing Interstate (I-5) Bridge structures.
- Construct new northbound and southbound bridges over the Columbia River. The existing Interstate (I-5) Bridge structures will be replaced by two parallel bridges slightly downstream and to the west of the existing crossing. The proposed bridge type is a composite deck truss in which the diagonal steel members allow for an open-sided, covered passage for the light rail guideway and multiuse path. The southbound bridge will carry highway traffic on the upper bridge deck with a two-way light rail guideway on the lower bridge deck. The northbound bridge will carry highway traffic on the upper bridge deck and a bicycle and pedestrian path on the lower deck.
- Construct LRT approach structures to the Columbia River Bridges from Hayden Island and Vancouver.

- On the lower deck of the southbound bridge, the Oregon LRT approach structure, and the Washington LRT approach structure, construct and install all transit civil, track, and systems components. All track on the main river bridge and approach structures will be direct fixation. The maximum grade will be 6% on the Washington LRT approach structure from the Burlington Northern Santa Fe (BNSF) crossing to touchdown at 5th Street and Washington Street in Vancouver.

1.2.1.2 North Portland Harbor Bridges

- Construct a mainland connector bridge to Hayden Island over North Portland Harbor (NPH). The NPH bridges are multimodal and will accommodate local vehicle traffic, LRT, and bicycle and pedestrian facilities, and will connect to a new local street on Hayden Island and to N Expo Road on the mainland.
- Realign the shared-use path adjacent to NPH to go over the LRT line and the connecting street between the mainland and Hayden Island, running parallel and adjacent to Marine Drive. On either side of the grade separation, the path will reconnect to the existing path.
- Re-stripe I-5 and reallocate the width of the NPH Bridges to allow for an additional southbound lane.
- Relocate the function of the NPH shared-used path to the sidewalk and bike lanes on the new mainland connector multimodal bridge.

1.2.2 Interchange Improvements

1.2.2.1 Marine Drive Interchange

- Elevate, realign, and reconstruct Marine Drive and modify the Marine Drive ramp terminal intersection and connecting ramps. Elevating Marine Drive provides a grade separation of the LRT from the local road mainland connector bridge to Hayden Island.
- Construct a new single-point interchange at Marine Drive and I-5 and associated ramps. This will require demolition of the existing structure that crosses I-5 and construction of a new structure over I-5 to carry Marine Drive. The Marine Drive alignment constructed with the mainland connector bridge will be adjusted in grade and alignment to match the new single point interchange.
- Construct a new driveway on the extension of N Expo Road as a replacement access point for Diversified Marine Inc. and Ross Island Sand and Gravel.
- Reconstruct the connections from Marine Drive to Union Court and from Vancouver Way to Marine Drive.
- Construct a road on the south end of the Expo Center between N Expo Road and Force Avenue and thus provide a local route between Hayden Island and Marine Drive.
- Widen I-5 northbound from the Victory Boulevard crossing to the NPH Bridges to accommodate the northbound Denver Street entrance ramp as an auxiliary lane.

1.2.2.2 Hayden Island Interchange

- Construct the I-5 mainline from Columbia River Bridges to NPH Bridges.
- Reconstruct ramp connections on the east and west sides of I-5 on Hayden Island in a configuration similar to the existing ramp connections.
- Reconstruct various local roads on Hayden Island.
- Construct shared-use path connections from the Columbia River Bridges to connect to new and existing bicycle and pedestrian facilities on Hayden Island.

1.2.2.3 SR 14 Interchange

- Reconstruct the I-5 mainline from the Columbia River Bridges to Evergreen Boulevard.
- Construct retaining walls on the east and west sides of the I-5 mainline.
- Construct a replacement Evergreen Boulevard Bridge over I-5.
- Construct the community connector over I-5 near the Evergreen Boulevard Bridge.
- Construct a replacement McLoughlin Boulevard Bridge with transitions on I-5 to accommodate the LRT that passes beneath I-5 at this point.
- Reconstruct portions of Columbia Street, Columbia Way, Main Street, and 5th Street.
- Construct a shared-use path from the Columbia River Bridges to Columbia Way.

1.2.2.4 Mill Plain Interchange

- Reconstruct portions of the Mill Plain Boulevard entrance ramp to I-5 southbound.
- Reconstruct portions of the I-5 northbound exit ramp to Mill Plain Boulevard.

1.2.2.5 Fourth Plain Interchange

- Reconstruct portions of the I-5 southbound exit ramp to Fourth Plain Boulevard.
- Reconstruct portions of Fourth Plain Boulevard and the I-5 northbound exit and Fourth Plain to Central Park-and-Ride ramps intersections on the east side of I-5.

1.2.3 Transit

The primary transit element of the ICP, and also the LPA, is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo in North Portland, where it currently ends, to Clark College in Vancouver. To accommodate and complement this major addition to the region's transit system, a variety of additional transit improvements are also proposed:

- Three park-and-ride facilities in Vancouver near the new light rail stations.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Of these improvements, only the park-and-ride facilities are addressed in this report. The other improvements are either being designed by others or will have no effect on permanent stormwater facilities.

1.2.3.1 Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains will 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 will curve eastward toward I-5, passing beneath Marine Drive, and then rising over a flood wall onto the arterial bridge to cross North Portland Harbor. The two-way guideway over Hayden Island will be located on the west side of the Hayden Island interchange and elevated to approximately the height of the rebuilt mainline of I-5, as will a new station immediately west of I-5. The alignment will extend northward on Hayden Island along the western edge of I-5, until it transitions into the lower deck of the new western bridge over the Columbia River.

1.2.3.2 Downtown Vancouver Light Rail Alignment and Stations

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

At 7th Street, the light rail alignment will form a couplet. The single-track northbound guideway will turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway will 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 will extend north to 17th Street, where the two guideways will join and turn east.

The light rail guideway will 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 will be on the side of the street at the sidewalk. There will be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

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

1.2.3.3 East-West Light Rail Alignment and Terminus Station

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

1.2.3.4 Park-and-Ride Stations

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

Columbia Park-and-Ride – located between Columbia Street and Washington Street and between 4th Street and 5th Street, and includes retail/office space frontage facing Columbia Street. This park-and-ride will provide approximately 570 auto parking spaces and 34 bicycle parking spaces, and will have five floors and an exposed height of 68.5 feet.

Mill Park-and-Ride – located between 15th and 16th Streets and between Washington Street and Main Street, and includes retail/office space frontage on both Main and Washington Streets. Washington Street will also have a C-TRAN Customer Service Center and parking on 16th Street to accommodate paratransit vehicles. This park-and-ride will provide approximately 420 auto parking spaces and 30 bicycle parking spaces, and will have five floors and an exposed height of approximately 60 feet.

Central Park-and-Ride – located east of I-5, north of McLoughlin Boulevard, and across from the Marshall Community Center. One access is provided via a loop road, which provides direct access to and from Fourth Plain Boulevard and the I-5 access ramps at the interchange. The loop road wraps around the east side of the building and passes through the south end of the garage before returning north to Fourth Plain Boulevard. The garage can also be accessed via an entrance from McLoughlin Boulevard. This park-and-ride will provide approximately 1,910 auto parking spaces and 81 bicycle parking spaces, and will have five floors and an exposed height of 55.5 feet.

1.2.4 Watersheds

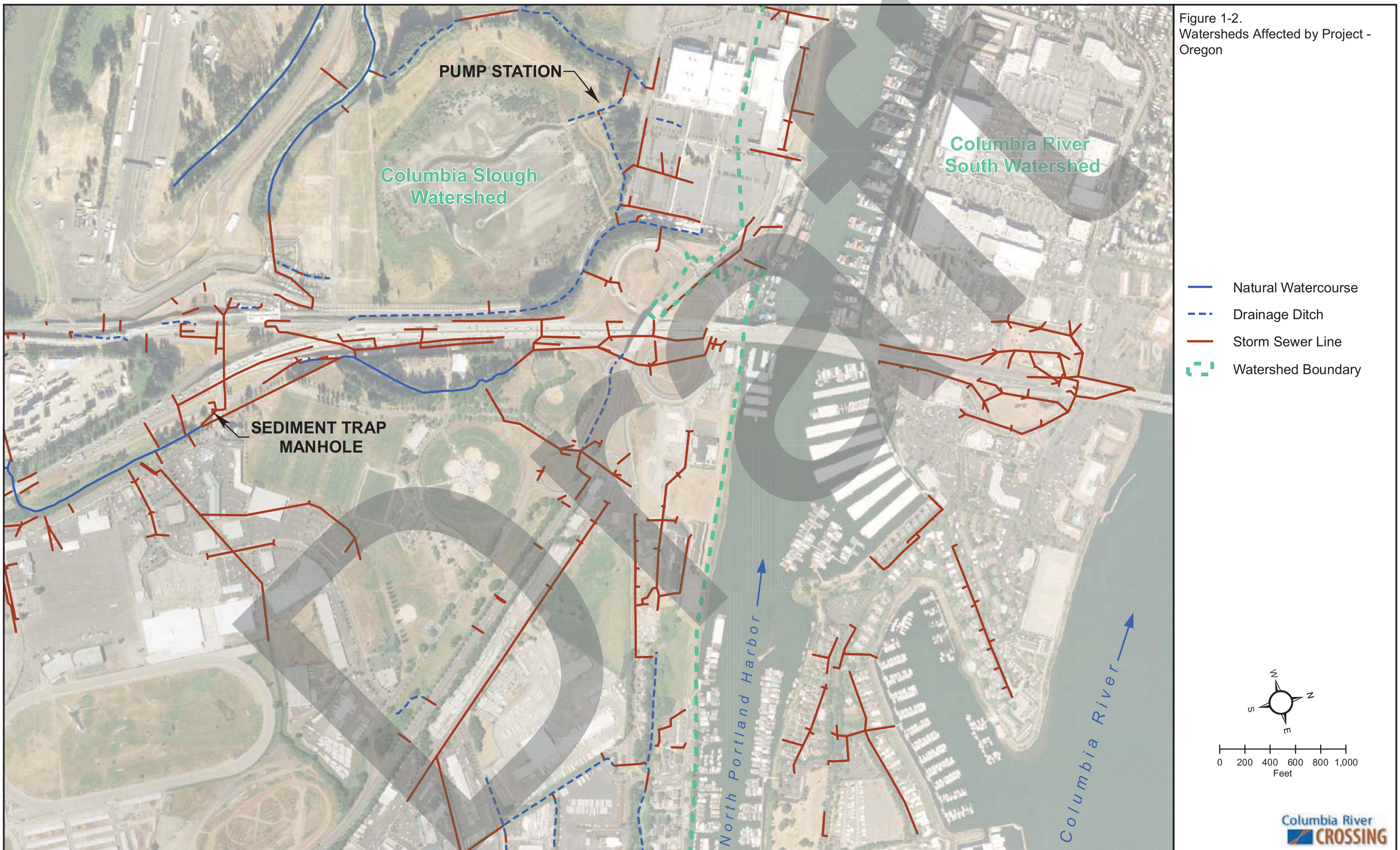
Figure 1-2 and Figure 1-3 show the watershed boundaries and major outfalls in the vicinity of the project footprint. From south to north, the waterbodies to which project runoff will be released are Columbia Slough and Columbia River (including North Portland Harbor). Table 1-1 shows the average monthly discharges for each watercourse based on data available from United States Geological Survey (USGS) gauging stations (see Figure 1-4).

Table 1-1. Mean Monthly Discharge (in cubic feet per second)

Month	Columbia Slough at Portland (USGS 14211820)	Columbia River at Vancouver (USGS 14144700)
January	162	156,000
February	151	163,000
March	135	170,000
April	85	204,000
May	29[1]	286,000
June	65[2]	415,000
July	79	291,000
August	74	153,000
September	63	117,000
October	96	116,000
November	112	122,000
December	123	138,000

1. *Flow from the Willamette River was recorded in 1997, 2006, and 2008.*
2. *Reverse flow from the Willamette was recorded in 1990.*

Figure 1-2.
Watersheds Affected by Project - Oregon



Analysis by J. Koloszar; Analysis Date: Oct. 21, 2010; File Name: Ex3_13-1Stormwater_RK251.mxd

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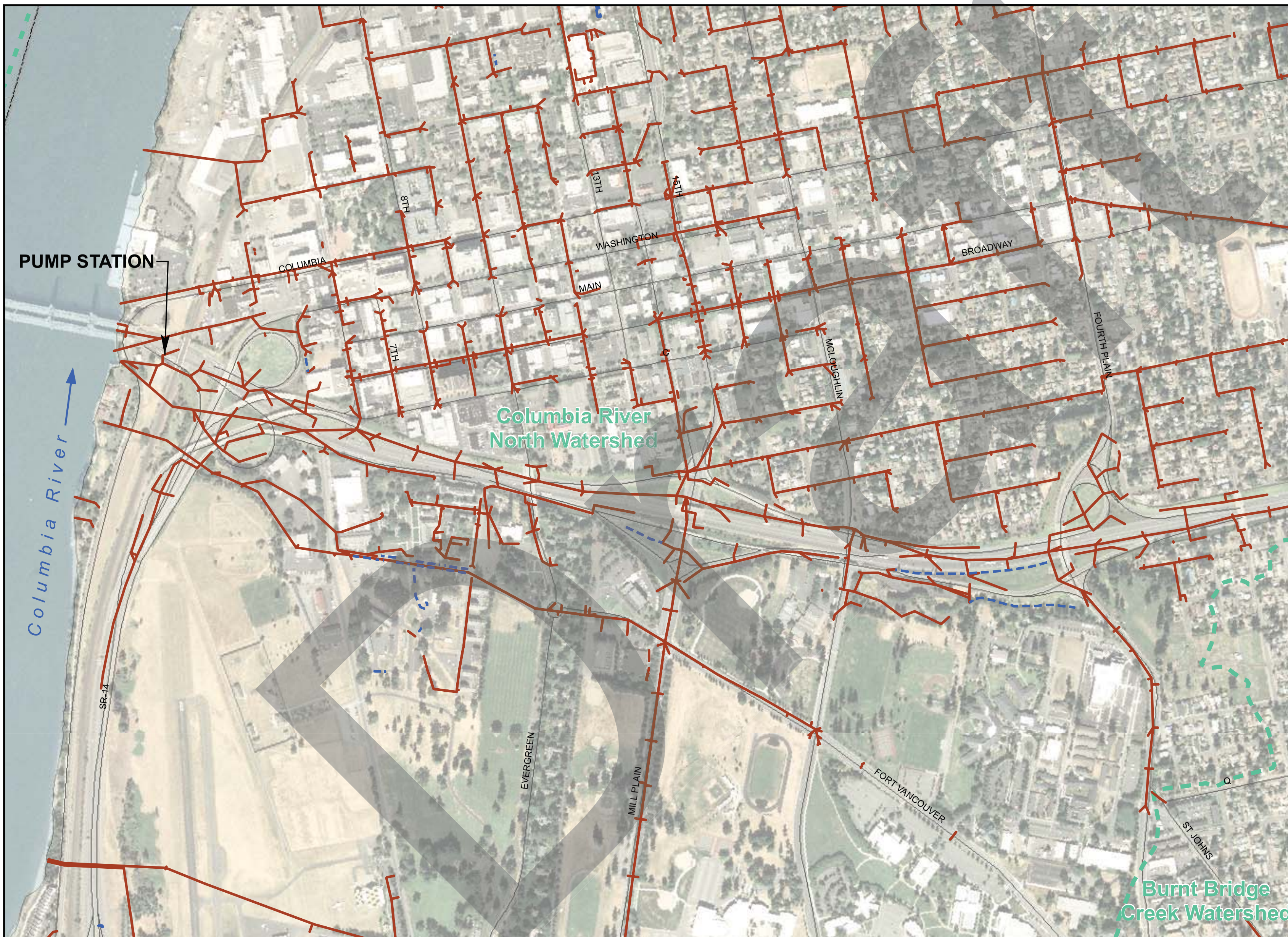

Figure 1-3.1
Watersheds Affected by Project - Washington

Analysis by J. Koloszar; Analysis Date: Feb. 12, 2010; File Name: Ex3_13-2Stormwater_RK251.mxd

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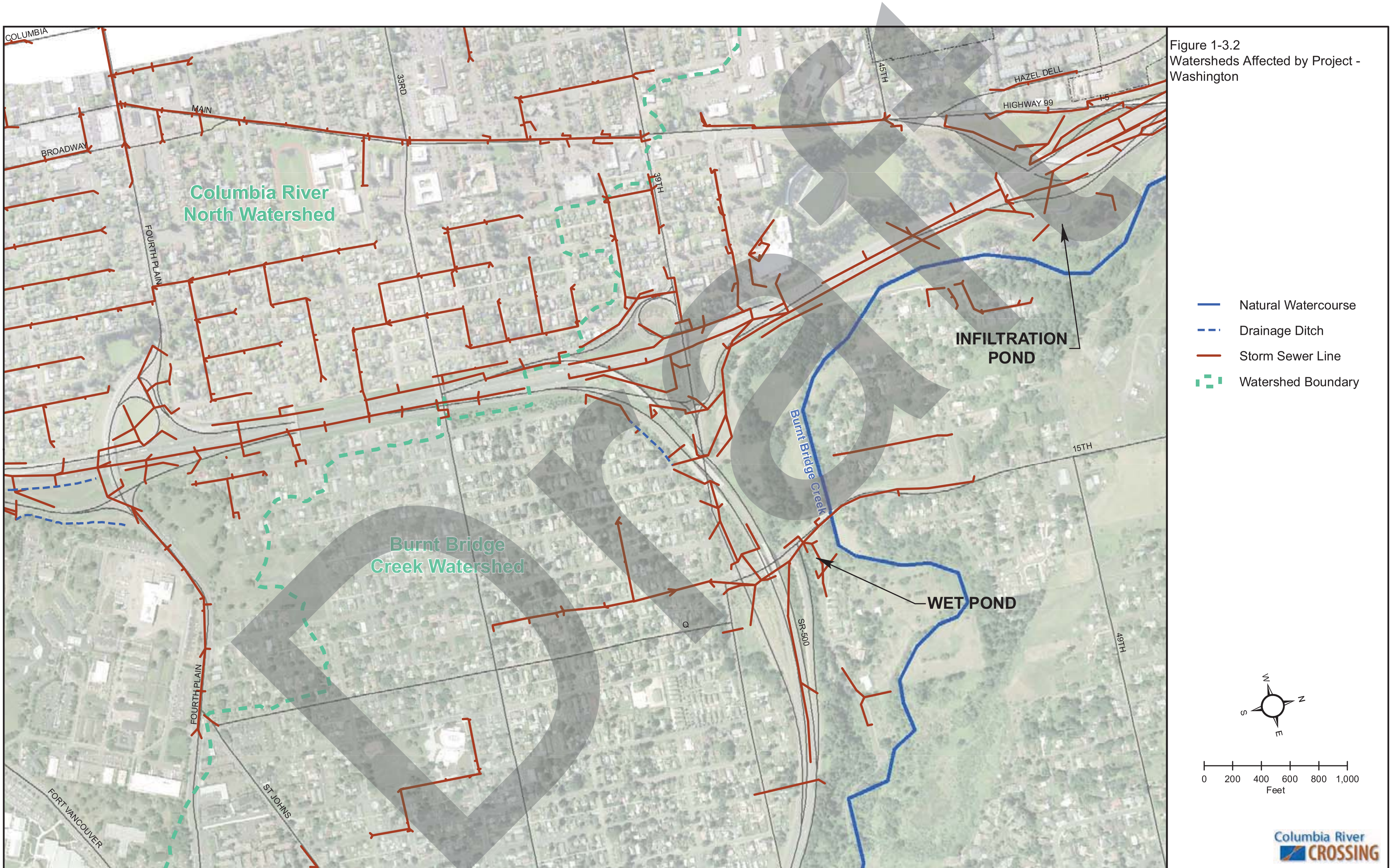
Figure 1-3.2
Watersheds Affected by Project - Washington



Analysis by J. Koloszar; Analysis Date: Feb. 03, 2010; File Name: Ex3_13-3Stormwater_RK251.mxd

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USGS Surface Water Gauging Station

Figure 1-4.
USGS Gauging Station Locations

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Dec. 22, 2010; File Name: Ex_13-4Stormwater_RK251.mxd

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The following sections outline watersheds affected by the project as well as existing drainage systems and patterns. They are organized South to North.

1.2.4.1 Columbia Slough Watershed

Columbia Slough, located south of the CRC project footprint, discharges to the Willamette River. Its watershed 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. Before the construction of a levee system and pump stations, it would have been subjected to frequent inundation. In the vicinity of I-5, the original ground is below the Ordinary High Water Level for the Columbia River (21.2 ft. NAVD88[1]) and groundwater levels are relatively close to the surface.

There are two drainage districts within the project footprint: Peninsula Drainage Districts No.1 and No.2. I-5 and Denver Avenue comprise 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 No.1 (MCDD).

Much of I-5, Marine Drive, and MLK Boulevard are elevated on embankments or structures, and the drainage systems that serve these and local roads do not include runoff from outside the right-of-way (ROW). These embankments are also part of the 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 MLK Boulevard east of I-5 where runoff is shed off the southern shoulder.

As shown on Figure 1-2, runoff from the project area drains to a system of sloughs before discharging to the Columbia Slough via the Portland International Raceway (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. It should be noted that Marine Drive west of I-5, while within the confines of the levee system, drains to North Portland Harbor via outfalls through the ring levee and is included in the Columbia River South Watershed. The stormwater discussion for this watershed is provided in Volume II.

1.2.4.2 Columbia River Watershed

For ease of presentation, the areas draining to the Columbia River are divided into two separate watersheds, those within Oregon and those within Washington State.

The Columbia River Watershed in Oregon, or Columbia River – South, includes the portion of the project area south of North Portland Harbor that drains to that waterway, North Portland Harbor Bridge, Hayden Island, and the Interstate (I-5) Bridge south of the bridge high point. It should be noted that the bridge high points are north of the state line by approximately 300 feet.

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[1] Memorandum from Kris Westersund (DEA) to Jim Burke (CRC) dated July 16, 2008. See Appendix C.

Similar to the Columbia Slough Watershed, the project footprint within this watershed is also located in what was part of the Columbia River floodplain. As described in Section 1.2.4.1, the portion south of North Portland Harbor is protected against flooding by the levee system. On Hayden Island, material dredged from the Columbia River has been used to raise the overall ground surface east of the BNSF railroad tracks above the 100-year flood elevation.

The Columbia River Watershed in Washington State, or Columbia River – North, comprises the project footprint from the Interstate (I-5) Bridge highpoint (just north of the state line) to the south and SR 500 interchange to the north. It includes the current I-5 corridor, as well as, COV streets where the LRT guideway will be located.

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 enclosed drainage systems. The only exceptions are the North Portland Harbor and Interstate (I-5) Bridges and a few short ditches adjacent to the highway. These closed systems discharge runoff to the Columbia River via stormwater pipe outfalls in the vicinity of the existing Interstate (I-5) Bridge, while runoff from the existing bridge discharges runoff through bridge scuppers directly to the river below. A pump station located southeast of the SR 14 interchange (see Figure 1-3) discharges runoff from lower lying portions of the interchange to the Columbia River during high river levels.

1.3 Project-Wide Considerations

Following is a description of important considerations that affect stormwater design on a project-wide basis. Further discussion may be found in Volumes II through IV for each of the watersheds.

1.3.1 Key Concerns

The key stormwater-related issues include:

1. Regulatory agency concerns:
    a. Protection of resources listed under the Endangered Species Act (ESA), notably the presence of salmonids in the Columbia River[2]. Specifically, NMFS has requested stormwater management focus on avoiding and minimizing impacts on listed species and provide mitigation for unavoidable impacts. Dissolved metals are the primary pollutants of concern, especially dissolved copper. The agency requests that runoff from all contributing impervious surfaces within the project be treated. The agency also recommends single design standards be used for the Columbia River bridges.
    b. The COP Bureau of Environmental Services (BES) also urged avoiding and minimizing impacts to natural resources[3]. The agency expects the project to meet the requirements of the Portland Stormwater Management Manual.

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2 Letter from Kim Kratz (NMFS) to Heather Gunderson (CRC) dated August 6, 2008. See Appendix C.

3 Letter from Dean Marriott (BES) to Heather Gunderson (CRC) dated February 28, 2007. See Appendix C.

   c. North of the Columbia River, the project corridor lies above the Troutdale Aquifer. The Environmental Protection Agency (EPA) recently designated this aquifer a Sole Source Aquifer, and stormwater facilities will need to be designed to eliminate the likelihood of contamination from polluted runoff.
2. Multi-agency jurisdiction and differing design standards and methodologies.
3. The need to collect and treat runoff from bridges across North Portland Harbor and Columbia River. Runoff from the existing bridges currently discharge, untreated, directly to the waterbodies below.
4. The difficulty of incorporating stormwater treatment facilities within a confined, highly developed, urban environment.

1.3.2 Stormwater Management Goals

The CRC Project is a bi-state initiative and it is important to note that the implementation of stormwater management goals differs significantly between Oregon and Washington States. 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 size of water quality facilities required. This impact is notable for projects like the CRC, which involve significant areas of impervious pavement.

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 highways would be required to be treated in the same manner as runoff from bike-pedestrian paths. In contrast, Washington State focuses on requiring treatment for runoff from the pollutant-generating impervious surfaces (PGIS).

ODOT defines 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 (ODOT 2011). NMFS 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

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 LRVs are electric, and that other potential sources of pollution such as bearings and gears are sealed to prevent the loss of lubricants. In addition, LRV braking is almost exclusively accomplished via (power) regenerative braking, which avoids any friction or wear on the vehicle brake pads and resulting generation of pollutants such as particulate copper. In Washington State, NMFS and USFWS 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 (Sound Transit 1999). In Oregon, runoff from this area would require treatment before being released.

Finally, Washington State 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 State, 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, SLOPES IV (NMFS 2008), a programmatic biological opinion and incidental take statement for projects undertaken in Oregon by the U.S. Army Corps of Engineers (COE), 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, NMFS 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[6]" 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 goals for the CRC project are:

1. Provide flow control for new and replaced impervious areas in accordance with state and local requirements. It should be noted that discharges to the Columbia Slough, North Portland Harbor, and Columbia River are exempt from flow control.
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.

For goals 2 and 3, the CRC project has agreed to adopt the requirements of NMFS for permanent water quality facilities. These requirements are that the project treats runoff from the entire CIA

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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 E-mail from Devin Simmons dated July 26, 2010. See Appendix C.

in both Oregon and Washington regardless of whether it is considered pollutant-generating or whether it is new, rebuilt, resurfaced, or existing.

1.3.3 Pollutants of Concern

The waterbodies to which runoff will 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), and Columbia River mainstem. Columbia Slough, North Portland Harbor, and the Columbia River contain species listed under the Endangered Species Act (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 (TMDLs).

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[7]:

- 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 National Oceanic and Atmospheric Administration for Fisheries (NOAA Fisheries). Dissolved copper is known to have a detrimental effect on the olfactory senses of young salmonids.

Table 1-2 summarizes 303(d)-listed parameters and TMDLs for each receiving waterbody. The following paragraphs describe existing water quality characteristics for each receiving waterbody. Further discussion may be found in the FEIS (CRC 2011).

Table 1-2. Listed Pollutants and TMDLs

Waterbody	303(d) Listed Pollutants	Established TMDLs
Columbia Slough **Oregon DEQ**	Toxics (lead, iron, manganese) Temperature	Toxics (lead, PCBs, DDE/DDT, dieldrin, dioxin) Eutrophication (pH, dissolved oxygen, phosphorus and chlorophyll *a*) Bacteria
Columbia River and North Portland Harbor		
Oregon DEQ	Toxics (PCBs, PAHs, DDT/DDE, arsenic) Eutrophication (dissolved oxygen) Temperature	Dioxin Total dissolved gas
Washington State Ecology	Toxics (PCBs) Eutrophication (dissolved oxygen) Temperature	

[7] *Stormwater Management Plan Submission Guidelines for Removal/Fill Permit Applications Which Involve Impervious Surfaces.* State of Oregon Department of Environmental Quality. July 2005, 2008, 2012.

1.3.3.1 Columbia Slough

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). The Lower Slough (to which project runoff will be discharged) 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 (COP 2009). In addition, 50 percent of BES sampling in the Lower Slough immediately downstream of the project met the target of 25 mg/L for total suspended solids (TSS).

1.3.3.2 Columbia River and North Portland Harbor

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 2009). The Columbia River is also on the Washington State Ecology's 303(d) list for temperature, PCBs, and dissolved oxygen (Ecology 2009a). 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).

1.3.4 Airspace Related Restrictions

Airports have specific concerns related to stormwater ponds and hazards to airport operations. Stormwater flow control and treatment ponds are considered hazardous wildlife attractants and may create the potential for collisions between birds and aircrafts approaching and departing from airports.

While this is not likely to be an issue with Portland International Airport, it is a consideration for Pearson Airfield. For airports like Pearson that normally serve piston-powered aircrafts, the Federal Aviation Administration (FAA) recommends a separation distance of 5,000 feet between any hazardous wildlife attractant, such as a stormwater pond. The Pearson Airfield Hazardous Wildlife Exclusion Zone is shown on Figure 1-5.

An Advisory Circular (FAA 2004) provides guidance on land uses that have the potential to attract hazardous wildlife on or near public-use airports. In general, semi-permanent or permanent ponds and wetlands within this exclusion zone are strongly discouraged unless they are designed and operated to ensure that standing water is continuously present for no more than 48 hours, and the facility is dry between storm events. If these constraints cannot be achieved, the FAA recommends that a facility be placed underground or physical barriers such as netting used to prevent access by birds.

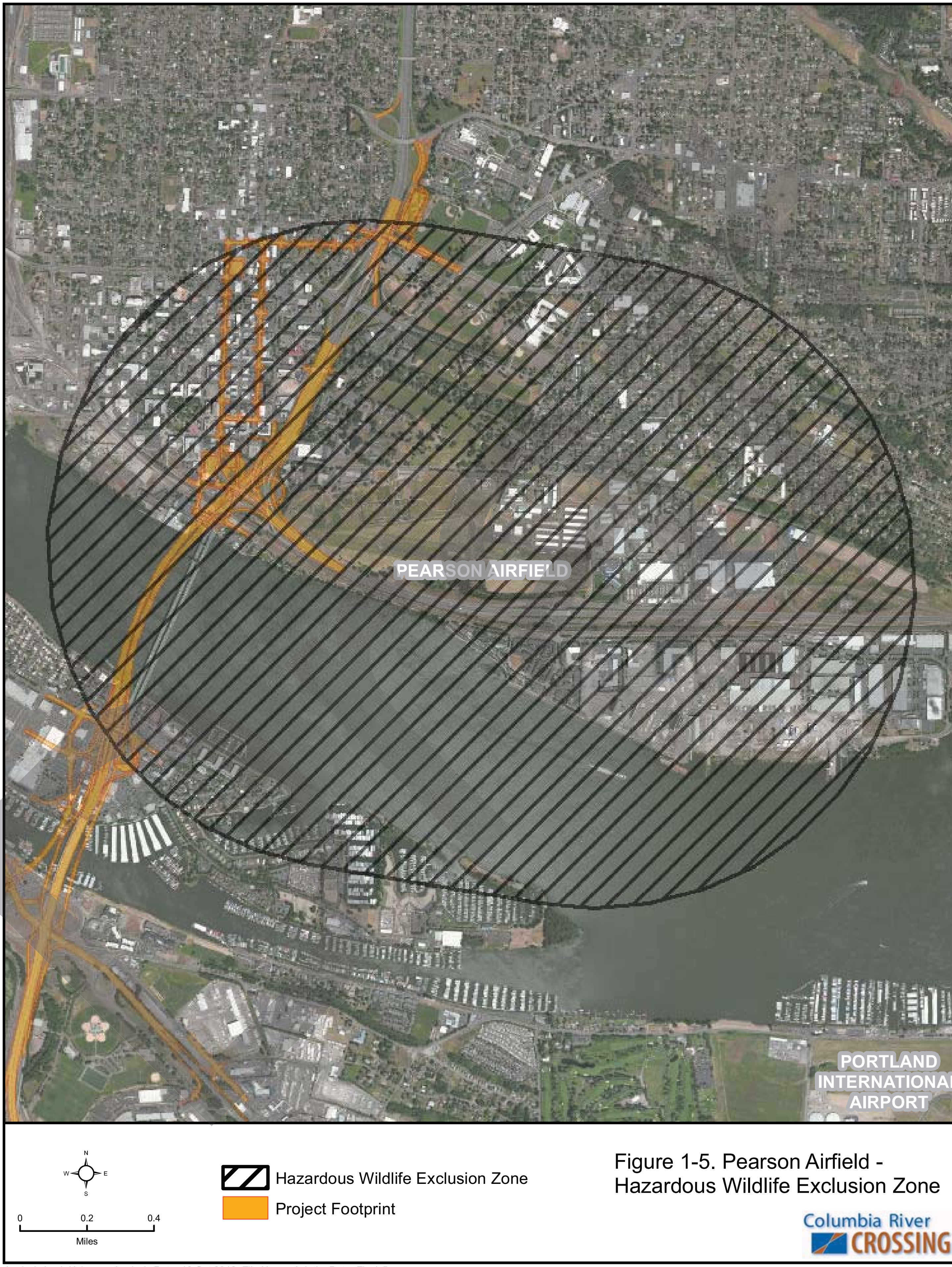

Figure 1-5. Pearson Airfield - Hazardous Wildlife Exclusion Zone

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: AviationData_Fig 1-5

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1.4 Scope of Work

As listed in Section 1.2, the project has multiple improvements that require stormwater treatment and conveyance systems. The hydraulic features for the project include collection, conveyance, and stormwater treatment facilities. The stormwater management goals for the CRC project is to collect, convey, and treat stormwater runoff from surfaces within, or running onto, the project footprint.

The project has agreed to adopt Best Management Practices (BMPs) which are effective in reducing sediments, and particulate and dissolved metals. These agreements will be met. Further discussions of specific BMP facilities proposed for the project are described in Volumes II through IV of this report.

Based on the ODOT memorandum (ODOT 2009), 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.
- **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 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 and Media Filter Drains. 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 the water quality of stormwater runoff. Infiltration is the preferred method of runoff treatment. The location of these facilities would be located within the proximity of the interstate highway and transit systems, this combined with routine maintenance would discourage the potential for wildlife habitat.

Other water quality approaches, including **Dispersal**, **Drywells,** and **Proprietary Systems** (such as cartridge filters), would be implemented where the BMPs listed above would not be practical or feasible.

As the stormwater design progresses, new technologies will be assessed to determine whether they should be added to the suite of acceptable BMPs. For example, Ecology recently approved (Ecology 2009c) 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. The multi-media filter drain, currently under review by the Ecology, will also be considered for use by the project.

1.5 Areas Affected

The areas affected by the project are located in Columbia Slough and Columbia River watersheds. The Columbia River South and North sub-watersheds are divided by the bridge high point (just north of the state line).

The following sections summarize the areas affected by the project per watershed. Table 1-3 provides an overview of impervious area changes from the existing project footprint to the proposed design footprint. The tables within the subsequent sections break down watersheds into CIA from the proposed design footprint only draining to individual water quality facilities. Additional details can be found in Volumes II through IV. Basic contributing impervious outlines can be found by proposed water quality facility in Appendix A.

Table 1-3. Impervious Areas By Watershed

Watershed	Existing			Proposed			Net Changes		
	PGIS	Non-PGIS	Total	PGIS	Non-PGIS	Total	PGIS	Non-PGIS	Total
Columbia Slough	28.8	1.2	30.0	34.8	1.5	36.3	6.0	0.3	6.3
Columbia River South	49.0	10.1	59.0	51.8	3.3	55.1	2.8	-6.8	-4.0
Columbia River North	68.7	6.6	75.3	83.2	15.3	98.5	14.5	8.7	23.2
Project Totals	**146.5**	**17.9**	**164.3**	**169.8**	**20.1**	**189.9**	**23.3**	**2.5**	**25.5**

Notes: Numbers may change with project design progression. Pervious surfaces will be included in the next phase of design.

1.5.1 Columbia Slough Watershed

The project footprint within this watershed comprises the Marine Drive interchange, which includes highway, local streets, and LRT improvements south of North Portland Harbor. Overall, the project will increase the total CIA in this watershed by approximately 6.3 acres. The increase may be attributed to new local streets, new ramp connections, and/or widening of Marine Drive.

The project will create approximately 31.2 acres of new, rebuilt, and resurfaced PGIS, and about 1.5 acres of new sidewalk and bike-pedestrian paths within this watershed. While I-5 will generally follow its current alignment and grade, the Marine Drive interchange will be rebuilt and will differ from its current configuration resulting from modifications to existing ramp connections, as well as, the construction of the new LRT guideway and arterial bridge. Table 1-4 summarizes the project CIA surface areas from which runoff will receive water quality treatment. The areas shown on the table do not include potential staging areas since.

Table 1-4. Columbia Slough Watershed: Water Quality Facilities and Contributing Impervious Areas[1]

	Impervious Area Draining to Outfall (acres)					
	PGIS			Non-PGIS		
Water Quality Facility	New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	Total CIA
CS-H	0.8					0.8
CS-C	2.0					2.0
CS-B	4.7					4.7
CS-D	2.3					2.3
CS-ICP-E	4.5	7.1				11.6
CS-F	1.5					1.5
CS-G	5.2					5.2
Transit South	0.5					0.5
Delta Park Swale	0.3		3.7			3.9
LID	2.4			1.5		3.9
TOTAL AREA	**24.1**	**7.1**	**3.7**	**1.5**	**0.0**	**36.3**

1 Includes the area of impervious surfaces under bridges.

1.5.2 Columbia River South Watershed – Oregon State

Table 1-5 summarizes the project CIA surface areas from which runoff will receive water quality treatment. The project will create approximately 51.8 acres of new, rebuilt, and resurfaced PGIS with about 3.3 acres of new sidewalk and bike-pedestrian paths. While I-5 will follow its current alignment, the existing interchange will be rebuilt and differ from its current configuration resulting from modifications to existing ramp connections, as well as, the construction of the new LRT guideway and arterial bridge. The existing impervious area within the watershed consists of 4.5 acres comprised of the existing bridge over North Portland Harbor, which currently drains via bridge scuppers to the water below. New inlets and conveyance will be added to the existing structure where necessary to eliminate existing scuppers and manage runoff spread along the travelway.

Table 1-5. Columbia River South Watershed: Water Quality Facilities Contributing Impervious Areas[1]

Water Quality Facility	Impervious Area Draining to Outfall (acres)					
	PGIS			Non-PGIS		
	New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	Total CIA
NPH-A	2.8			0.1		2.9
NPH-B	8.6	1.7		0.2		10.5
CR-ICP-A	11.1					11.1
CR-ICP-B	9.6			0.3		9.9
CR-ICP-C	8.5			0.3		8.8
Transit South	0.7					0.7
LID	8.9			2.4		11.2
TOTAL AREA	**50.2**	**1.7**	**0.0**	**3.3**	**0.0**	**55.1**

[1] Includes the area of impervious surfaces under bridges.

1.5.3 Columbia River North Watershed – Washington State

Table 1-6 summarizes the project CIA surface that will receive water quality treatment for its stormwater runoff. The project will increase the impervious area within this watershed by approximately 23.2 acres. The project will create approximately 77.0 acres of new, rebuilt, and resurfaced PGIS with about 12.0 acres of new sidewalk and bike-pedestrian paths. The existing impervious area within the watershed consists of 9.6 acres comprised of the off-site impervious area, both pollutant and non-pollutant generating, draining onto the project.

Table 1-6. Columbia River North Watershed: Water Quality Facilities Contributing Impervious Areas[1]

Water Quality Facility	Impervious Area Draining to Outfall (acres)					
	PGIS			Non-PGIS		Total CIA
	New/Rebuilt	Resurfaced	Existing	New/Rebuilt	Existing	
CR-Ca	0.9					0.9
CR-Cc	2.0					2.0
CR-Cd/Ce	8.3	1.3		0.2		9.7
CR-D	12.9	1.2		0.1		14.2
CR-E	3.3					3.3
CR-ICP-Ga	5.7	0.1	0.2			6.0
CR-ICP-H	1.1	0.1				1.2
CR-J (2)	5.1			0.3		5.4
CR-Lb	0.5					0.5
CR-P	3.8					3.8
LID	3.5	0.4		2.4		6.3
CR-F	5.0			0.6		5.6
Transit North	22.0		6.1	8.4	3.3	39.8
TOTAL AREA	**73.9**	**3.0**	**6.3**	**12.0**	**3.3**	**98.5**

[1] Includes the area of impervious surfaces under bridges.

1.6 Climate

The climate within the project area is characterized by short, dry, and warm summers, with typically cool and wet springs, falls, and winters. 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% 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.

Average monthly temperatures taken at Portland International Airport (PDX) vary from 39.6 ºF in January to 68.6 ºF in August. The maximum and minimum recorded temperatures are 107 ºF and -3 ºF. 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).

1.7 Vertical Datum

Elevations presented in this report are referenced to the North American Vertical Datum of 1988 (NAVD88). It is important to note that jurisdictions and other projects in the area may reference another vertical datum, the most commonly used being the National Geodetic Vertical Datum of 1929 (NGVD29). In order to obtain an approximate elevation to NAVD88, add 3.5 feet to the elevation in NGVD.

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2. Existing Conditions

2.1 Hydraulic Features

As shown on Figure 1-1, the Columbia River dominates the project area. The project corridor lies within the Columbia River valley. Elevations in the project corridor 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.

In the vicinity of the project, the Columbia River is confined along the north side of the floodplain. South of the Columbia River, the project is located entirely in the relatively flat and low-lying floodplain. Note that Columbia Slough, which is located at the south edge of the floodplain, actually discharges into the Willamette River. Within the floodplain, I-5 is elevated on an embankment that separates two drainage districts. While not designed for this purpose, the drainage districts consider this embankment to be part of an internal levee system that protects the area from all but extreme flooding. North of the Columbia River, the project is located on the gently sloped valley side.

Outfalls for the project are according to watershed. More specific information for each can be found in Volumes II through IV. Columbia Slough has three outfalls, which correspond to the pump stations located on Schmeer Rd, at NE 13th Ave, and at the PIR. Columbia River South has four outfalls which drain to the Columbia River, through an enclosed drainage system, or via the North Portland Harbor. Columbia River North has three main outfalls which drain to the Columbia River. Two outfalls drain adjacent to the existing I-5 bridge, and the third outfall is located east of the SR-14 interchange.

2.2 Drainage Basins

For the purpose of this report, the three major watersheds within the project are defined as the drainage basins. These include, from south to north, Columbia Slough, Columbia River South and Columbia River North. Within the drainage basins are multiple sub-basins.

The drainage basins are discussed in general in the following sub-sections, more detailed information is provided in Volumes II through IV. Figures 2-1.1 through 2-1.4 present the existing drainage sub-basins delineation and their associated flow paths.

2.2.1 Columbia Slough Watershed

The limits of the existing drainage sub-basins within the Columbia River Slough are determined by the area draining to an outfall, whether on site or off site area is contributing. In this watershed, outfalls are based on the existing pump stations located adjacent to the Columbia Slough channel and outfalls located along North Portland Harbor. The Expo Pump station is considered part of the PIR Pump station. Figure 2-1.1 presents the existing sub-basins, where delineated, and their associated flow paths. Descriptions of each outfall and their drainage basins are provided below:

2.2.1.1 PIR Pump Station

The area west of I-5 corridor and south of Marine Drive, including Expo drains to the PIR pump station. The basin drains southwesterly to the existing pump station west of Expo, which releases into the natural watercourse that outflows to PIR pump station.

PIR pump station is located within Peninsula Drainage District No. 1. The PIR pump station receives flows from nearby natural watercourses and flows routed through the Expo pump station via a series of drainage ditches and culverts. The pump releases outflows into the Columbia Slough. The pump station is sized to handle runoff from the 100-year storm event (typically occurs on average once within 100 years), and has an installed capacity of 19,700 gallons per year.

2.2.1.2 NE 13th Pump Station

The area on the east side of MLK Boulevard and Vancouver Way drains to the northeast and outflows into an enclosed drainage system on Vancouver Way. The enclosed system releases into the downstream drainage ditch that outflows to the NE 13th pump station.

The NE 13th pump station is located within Peninsula Drainage District No. 2 (PEN 2). The NE 13th pump station receives flows from the upstream drainage ditch and releases outflows into the Columbia Slough. The pump station is sized to handle the 100-year runoff (events that typically occur on average once over 100 years), and has an installed capacity of 32,000 gallons per year.

2.2.1.3 Schmeer Road Pump Station

The area east of Marine Drive, including portions of MLK Boulevard, drains to the southeast through an enclosed drainage system and outflows into Walker Slough. The area surrounding Victory Blvd, including I-5 to the bridge over Denver Avenue entrance ramp drains to the southeast into an enclosed system to the eastern side of I-5.

Schmeer Road pump station is located within Peninsula Drainage District No. 2, which includes the area east of the I-5 corridor. The NE 13th pump station receives flows from the upstream drainage ditch. The pump releases outflows into the Columbia Slough. The Schmeer Road pump station is sized to handle the 100-year runoff (storm events that typically occur on average once over 100 years), and has an installed capacity of 40,000 gallons per year.

2.2.1.4 North Portland Harbor

The existing Marine Drive roadway west of I-5, drains westerly towards its outfall at NPH-01 located in North Portland Harbor. The North Portland Harbor Bridge drains via scuppers within the bridge structure, which outfall to the North Portland Harbor directly below.

2.2.2 Columbia River South Watershed

The limits of the existing sub-basins within the Columbia River South watershed are determined by the area draining to the outfall, whether on site or off site area is contributing. Figure 2-1.1 presents the existing sub-basins, where delineated and their associated flow paths. The existing drainage network includes an enclosed drainage system.

The North Portland Harbor Bridge and Interstate Bridges drain via scuppers within the bridge structure, which outfall directly into North Portland Harbor and Columbia River, respectively.

2.2.2.1 Sub-Basin CR-01

This sub-basin drains commercial properties and local streets, including Jantzen, Tomahawk Island, and Hayden Island Drives. The basin drains towards the I-5 mainline and continues north to outfall CR-01 located on the south embankment of the Columbia River.

2.2.2.2 Sub-Basin CR-02

This sub-basin drains the Hayden Island interchange, including the I-5 mainline and associated ramps and bridges. The basin drains north towards outfall CR-02, located on the south embankment of the Columbia River.

2.2.3 Columbia River North Watershed

The limits of the existing drainage sub-basins within the Columbia River North watershed are determined by the area draining to the outfall, whether on site or off site area is contributing. Within the sub-basins CIAs are broken down by water quality facility to which the stormwater runoff flows. Multiple water quality facilities may outflow to a common outfall, their cumulative areas comprising a single sub-basin, named for this outfall.

Within the Columbia River North watershed two sub-basins are impacted by the project, both are within the SR14 interchange. Figure 2-1.3 presents the existing sub-basins and their associated flow paths.

2.2.3.1 Sub-Basin CR-03

This sub-basin comprises most of the Columbia River North watershed as well as the majority of the CRC project corridor. It encompasses I-5 south from the bridge to a highpoint at approximately the SR 500 southern gores. To the west, this sub-basin's limit is approximately Main Street south of Fourth Plain and approximately F Street north of Fourth Plain. To the east, this sub-basin's limit is approximately Fort Vancouver Way south of McLoughlin. A section of Mill Plain, Fourth Plain, and McLoughlin from the high point east of I-5 is also part of this sub-basin.

Area within this sub-basin is collected and conveyed to a main stormwater pipe located under I-5. This main pipe drains to the Columbia River through two outfalls under the I-5 Bridge.

The local street runoff west of I-5 and south of Mill Plain are collected by inlets. The existing drainage system discharges into a main pipe under Columbia Way. The runoff from this area drains south to the Columbia River through an outfall west of the I-5 Bridge.

2.2.3.2 Sub-Basin CR-05

This sub-basin comprises approximately 2,000 feet of SR14 east of the interchange. Stormwater runoff from this sub-basin is collected and conveyed east to a large culvert which outfalls to the Columbia River.

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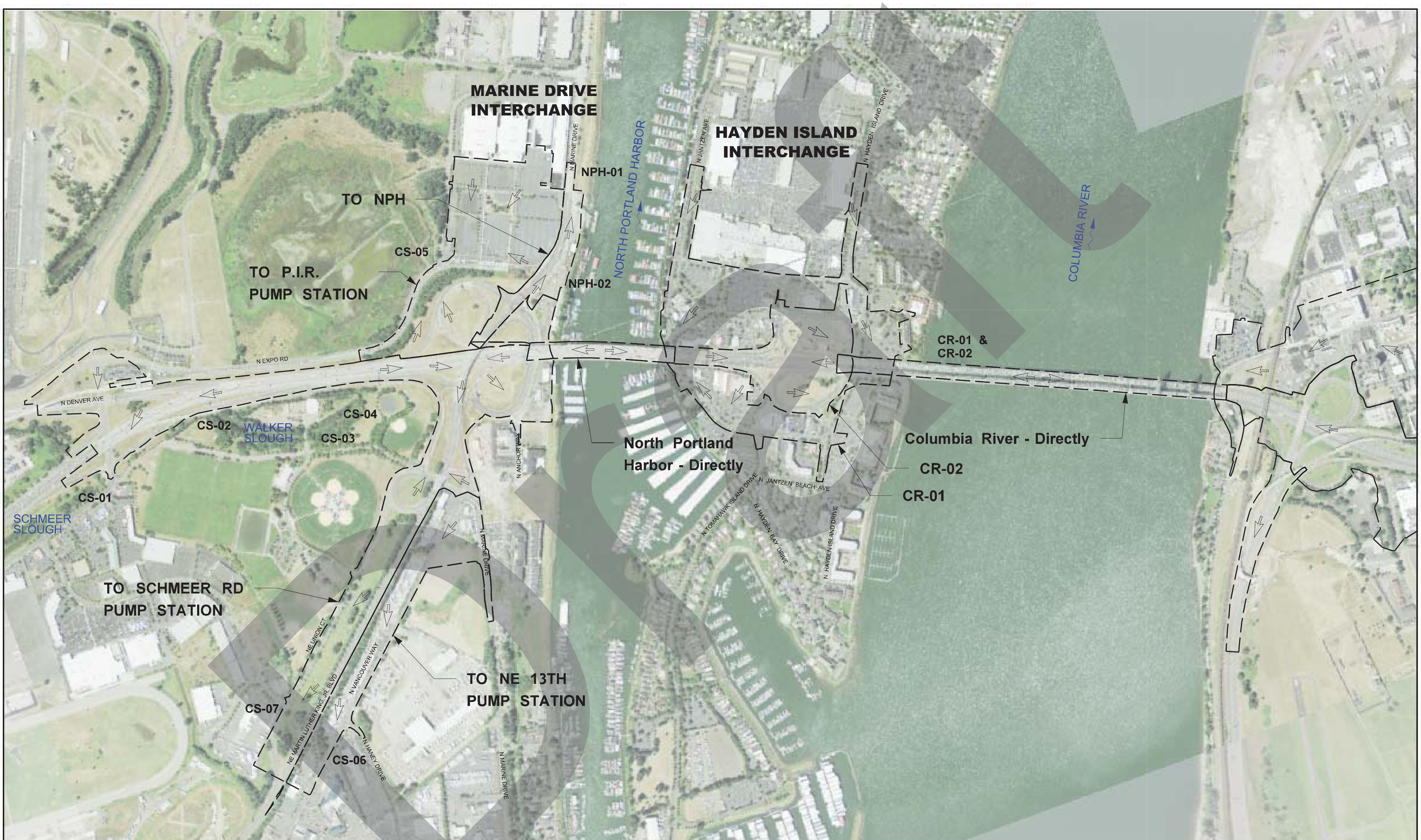

FIGURE 2-1.1.
EXISTING DRAINAGE SUB -BASIN
OREGON STATE

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FIGURE 2-1.2.
EXISTING DRAINAGE SUB-BASIN
WASHINGTON STATE

0 200 400 600 800 1000
SCALE IN FEET

Columbia River CROSSING

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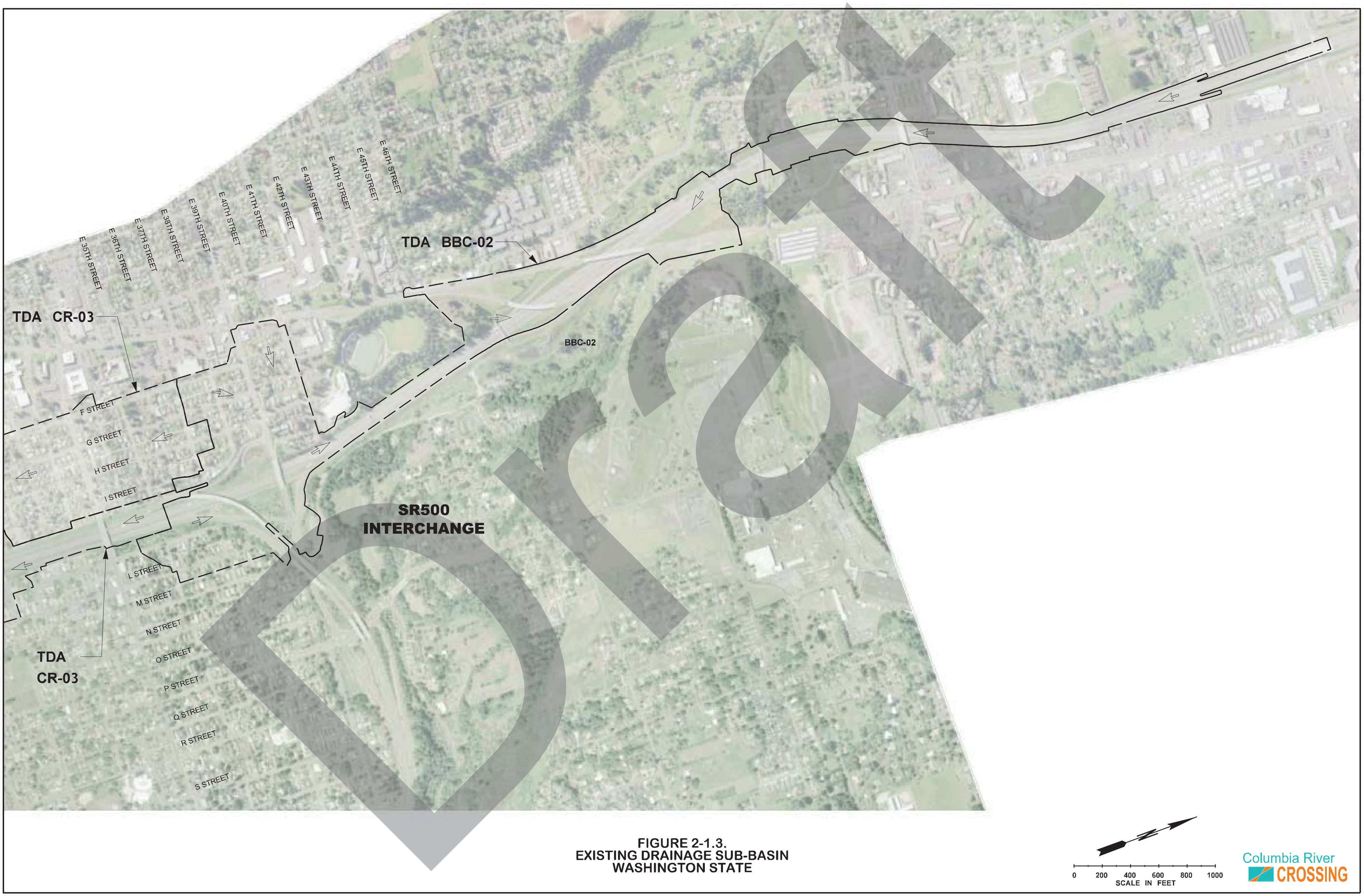

FIGURE 2-1.3.
EXISTING DRAINAGE SUB-BASIN
WASHINGTON STATE

Columbia River CROSSING

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2.3 Surficial Soils

Figure 2-2 presents the approximate aerial extent of the surficial soils in the vicinity of the project corridor. The soil descriptions below are derived from the National Resources Conservation Service (NRCS) website[8]. Site specific soil information to be provided in the discussion of water quality facilities will be based on geotechnical site exploration.

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[9] indicates that water tables are at a depth of less than one foot for the Sauvie-Rafton-Urban land complex, and between 2 and 4 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.

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.
An ongoing investigative program for highway-related elements in Washington and Oregon, involving geotechnical borings and piezometer data logging, is currently being conducted to determine site-specific data for evaluating infiltration rates and groundwater levels. Some of the resultant data has been implemented in the proposed infiltration facilities design and is provided in Table 2-1.

Potential facility sites in Oregon were investigated, but these locations proved to have soils with infiltration characteristics unsuitable for stormwater infiltration ponds. Infiltration is currently not recommended for the LRT guideway and associated construction in downtown Vancouver streets due to the presence of nearby building basements and lack of available ROW.

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[8] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

[9] Soil Survey of Multnomah County, Oregon. United States Department of Agriculture, Soil Conservation Service, in cooperation with Oregon Agricultural Experiment. August 1983.

Table 2-1. Proposed Infiltration Facilities: Infiltration Rates and Groundwater Elevations

Facility	Groundwater Elevation (NAVD ft)	Infiltration Rate (in/hr)
Infiltration Trench at Mill Plain (CR-J)	130.5[1]	0.59
Infiltration Pond at Mill Plain (CR-ICP-Ga)	59.1[1]	3.64[2]
Infiltration Pond at SR 14 (CR-D)	11.9	15.6[2]
Infiltration Trench at SR 14 (CR-F)	11.9	15.6[2]

[1] From piezometer data. Indicated no water influence in year of collection. Elevation assumed to be the lowest depth of the boring.
[2] Where Infiltration Rate was calculated to be greater than 2.4 in/hr a maximum constant rate of 2.4 in/hr was used.

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 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 specifically, infiltration is not currently proposed even though the soils are classified as being in Hydrologic Group A. A study done by the Federal Emergency Management Agency (FEMA) at Hayden Island indicates predicted peak water surface elevation of 25.8 feet[10] at the I-5 bridge during the 10-year storm event. The ground elevation at Hayden Island is approximately 35 feet throughout the interchange, and specifically at the proposed facility locations. Design requirements for infiltration facilities require a 5-foot separation depth between the seasonal highwater mark and the base of the facility. Assuming a 5-foot-deep infiltration facility with the top elevation at 35 feet, the available depth to water table would be limited and result in a lower infiltration rate than the soil classification suggests.

An ongoing analysis is being performed to assess how groundwater levels in interchanges within the project boundaries respond to changes in surface water levels of the Columbia River. Groundwater level data of most interest is currently being collected at multiple piezometers throughout the SR 14 and Hayden Island interchanges. Preliminary charts were generated to illustrate the variation in groundwater levels compared to surface water levels. A brief summary of preliminary findings is addressed in subsequent paragraphs. The piezometer locations and resultant charts are located in Appendix K.

Groundwater level data was collected for each interchange within the project corridor, however only SR 14 and Hayden Island interchanges show any direct correlation to surface water levels in the Columbia River. The groundwater elevations, compiled from May 2010 through April 2011, were plotted against continuous surface water elevation. The data logger records data continuously and will remain in service for an extended period of time to ensure accurate and complete data is analyzed prior to final design completion.

Preliminary analysis of the data shows a lag in groundwater levels in the SR 14 and Hayden Island interchanges with little to no response in the remaining interchanges. The observable lag in elevation between groundwater and surface water can be quantified as a maximum of approximately 3 feet. It should be noted that the northernmost piezometer in the SR 14

[10] Flood Insurance Study of City of Portland, Oregon. United States Department of Homeland Security, Federal Emergency Management Agency. Study Number 410183V000A. October 2004.

interchange, labeled WB01-02P-10, shows no evidence of dependency on the Columbia River surface water elevations. This may be attributed to a change in soil section and/or distance from the river.

2.4 Aquifers

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 primarily comprises 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 in the vicinity of the project 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 FEIS 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 COV and has been designated by the EPA as a Sole Source Aquifer (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 projects receiving federal funds which have the potential to contaminate the aquifer are subject to EPA notification and review.

The website http://yosemite.epa.gov/r10/water.nsf/Sole+Source+Aquifers/Program provides additional information on the Sole Source Aquifer protection program in EPA's Region 10 (which includes Oregon and Washington).

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 Figure 2-3 "contribution" zones are delineated based on the amount of time that groundwater contamination would take to spread into each zone. The COV has designated the entire area within the city boundary as a Critical Aquifer Recharge Area and certain actions are prohibited as listed in the Vancouver Municipal Code (VMC) 14.26.120. As shown on the figure, there are also two Special Wellhead Protection Areas in the vicinity of the CRC project, one of which overlaps with the project footprint. These areas are surrounded by 1,000- and 1,900-foot buffers and are subject to additional prohibitions.

Groundwater contamination from the project is not expected to be an issue given the depth to the aquifer – water supply wells in this area are typically completed at an elevation of less than 20 feet.

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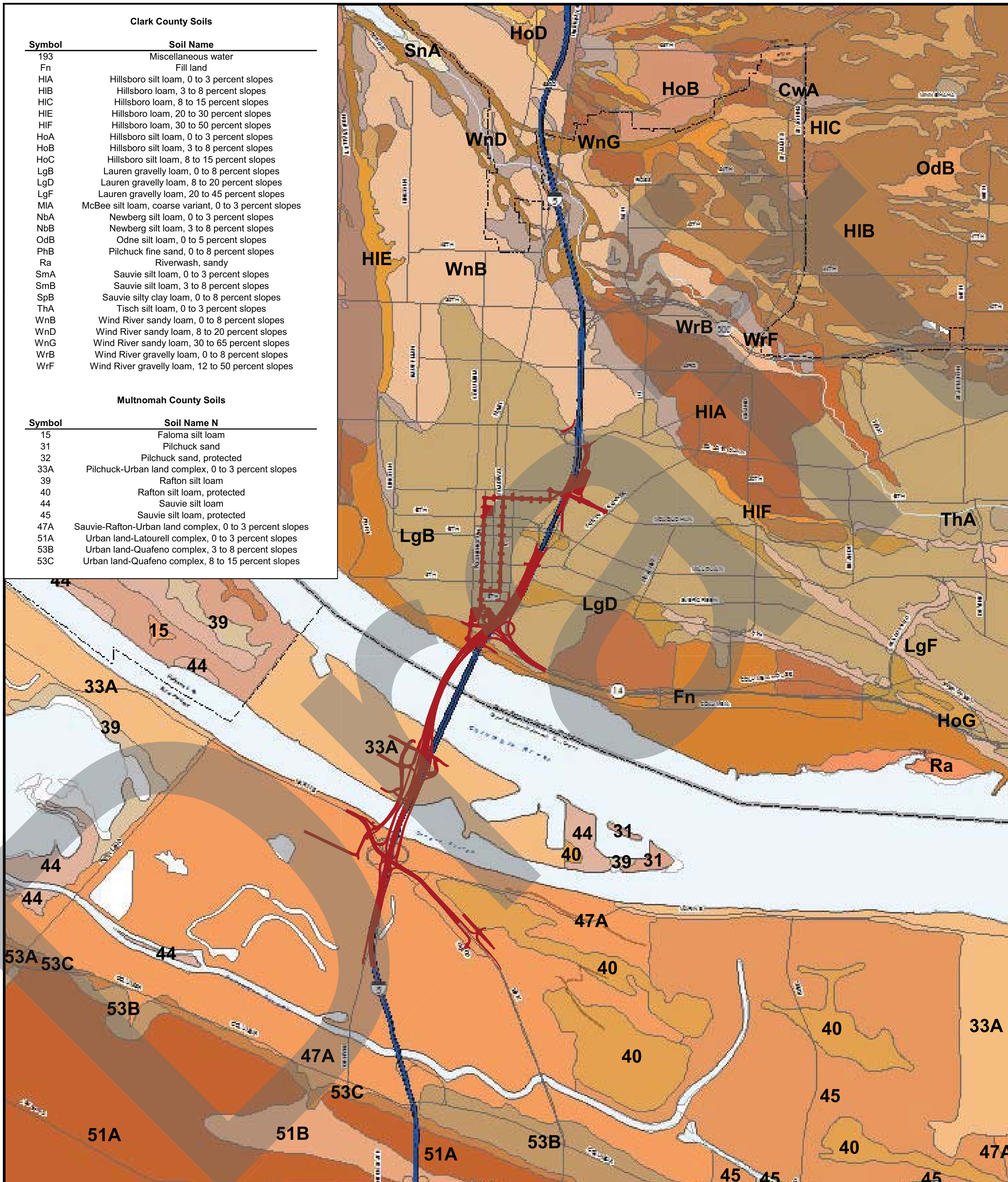

Clark County Soils

Symbol	Soil Name
193	Miscellaneous water
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
HIF	Hillsboro loam, 30 to 50 percent slopes
HoA	Hillsboro silt loam, 0 to 3 percent slopes
HoB	Hillsboro silt loam, 3 to 8 percent slopes
HoC	Hillsboro silt loam, 8 to 15 percent slopes
LgB	Lauren gravelly loam, 0 to 8 percent slopes
LgD	Lauren gravelly loam, 8 to 20 percent slopes
LgF	Lauren gravelly loam, 20 to 45 percent slopes
MIA	McBee silt loam, coarse variant, 0 to 3 percent slopes
NbA	Newberg silt loam, 0 to 3 percent slopes
NbB	Newberg silt loam, 3 to 8 percent slopes
OdB	Odne silt loam, 0 to 5 percent slopes
PhB	Pilchuck fine sand, 0 to 8 percent slopes
Ra	Riverwash, sandy
SmA	Sauvie silt loam, 0 to 3 percent slopes
SmB	Sauvie silt loam, 3 to 8 percent slopes
SpB	Sauvie silty clay loam, 0 to 8 percent slopes
ThA	Tisch silt loam, 0 to 3 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

Multnomah County Soils

Symbol	Soil Name N
15	Faloma silt loam
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
45	Sauvie silt loam, protected
47A	Sauvie-Rafton-Urban land complex, 0 to 3 percent slopes
51A	Urban land-Latourell complex, 0 to 3 percent slopes
53B	Urban land-Quafeno complex, 3 to 8 percent slopes
53C	Urban land-Quafeno complex, 8 to 15 percent slopes

Figure 2-2.
Surficial Soils

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: Fig8_RK080_100510.mxd

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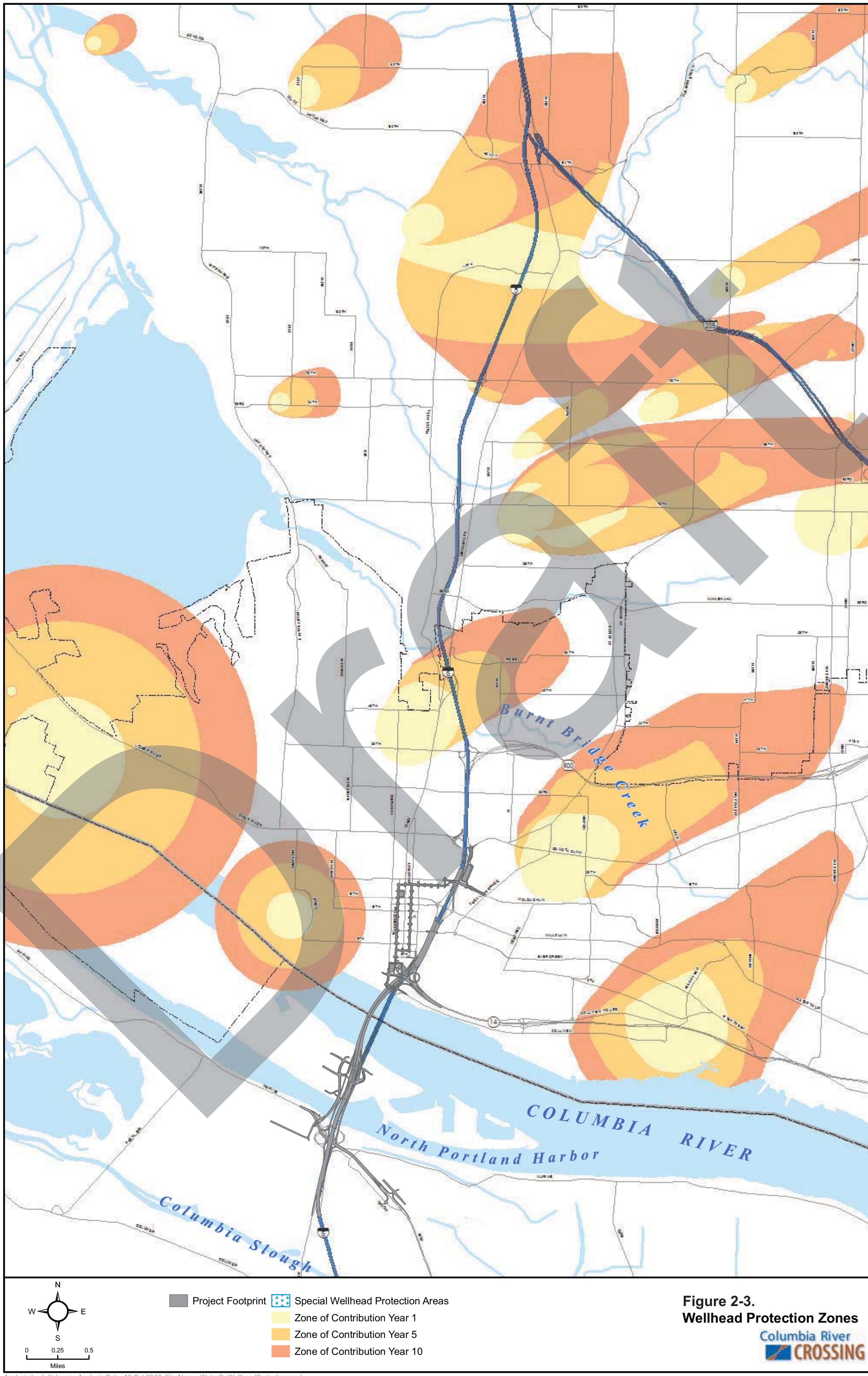

Figure 2-3. Wellhead Protection Zones

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: WaterQ_WellheadProtection.mxd

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2.5 Wetlands

Existing field identified wetlands and wetland inventory areas for the project corridor are delineated in the Wetland and Stormwater Treatment Facilities Figures 1 through 4 located in Appendix K.

2.6 Land Use

Figures 2-4.1 through 2-4.3 present the general land use in the vicinity of the project corridor.

South of the Columbia River, land west of I-5 between Victory Boulevard and North Portland Harbor generally has an Industrial zoning designation while land to the east is generally designated as Open Space. On Hayden Island, land in the vicinity of the project corridor is zoned Commercial.

North of the Columbia River, areas either side of the highway, especially west of I-5, have extensive residential and commercial development. The Pearson Airfield, Clark College, and Fort Vancouver Historic Park, which are low density developments, are located east of I-5, between SR 14 and Fourth Plain Boulevard.

Airports, like Pearson Airfield, have specific stormwater-related issues that should be noted. Ponds typically provided for stormwater flow control and treatment may be an attractant for wildlife considered hazardous to airport operations, specifically collisions between birds and aircraft approaching and departing from airports. While this is not likely to be an issue with Portland International Airport, it is expected to be a consideration for Pearson Airfield. For airports like Pearson that normally serve piston-powered aircraft, the Federal Aviation Administration (FAA) recommends a separation distance of 5,000 feet between any hazardous wildlife attractants such as stormwater ponds. The Air Operations Areas for both airports are shown on Figure 2-5.1 and 2-5.2, Air Operations Areas.

2.7 Utilities

Utility conflicts throughout the project corridor are currently being assessed. Discussions at routine meetings with local agencies are ongoing to determine the extents of conflicts, disruptions to services, and relocations. It is anticipated that much of Marine Drive and SR 14 interchanges existing stormwater conveyance systems will be removed or abandoned in place.

One known issue of particular importance to proposed stormwater management strategies is an existing 60-inch-diameter stormwater trunk main which runs from the Mill Plain interchange under I-5 to the outfall at the Columbia River in the SR 14 interchange. The location of this pipe, within the SR 14 interchange, conflicts with a proposed bridge pier and must be re-routed outside of the bridge pier footprint.

As design for the project advances, the conflicts with local utilities will be further assessed in design and further addressed in this section.

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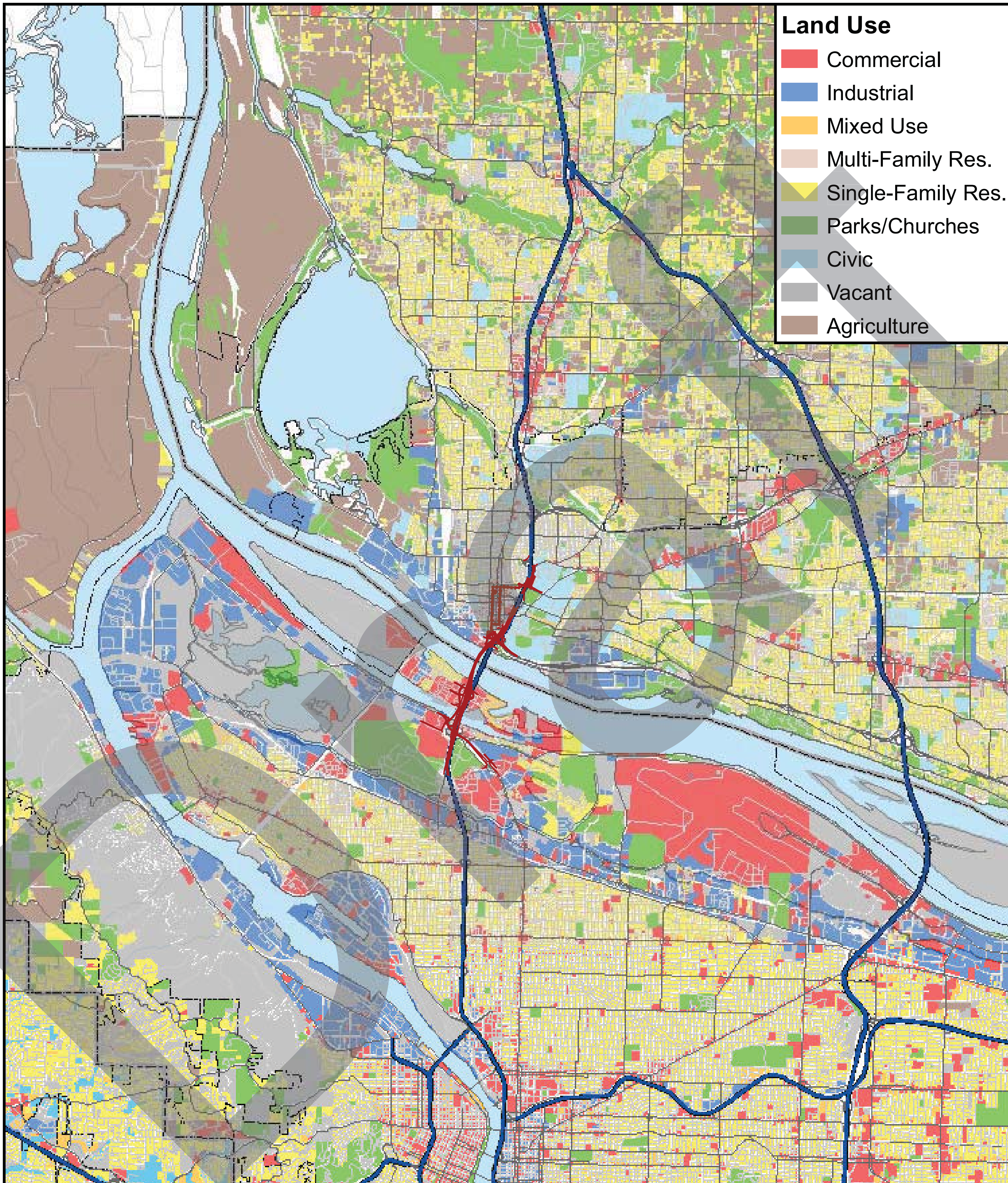

N W E S

0 0.85 1.7
Miles

Project Footprint

Figure 2-4.1
Land Use Designation - Overall

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: Figure 2_4_2_ExistingLandUses.mxd

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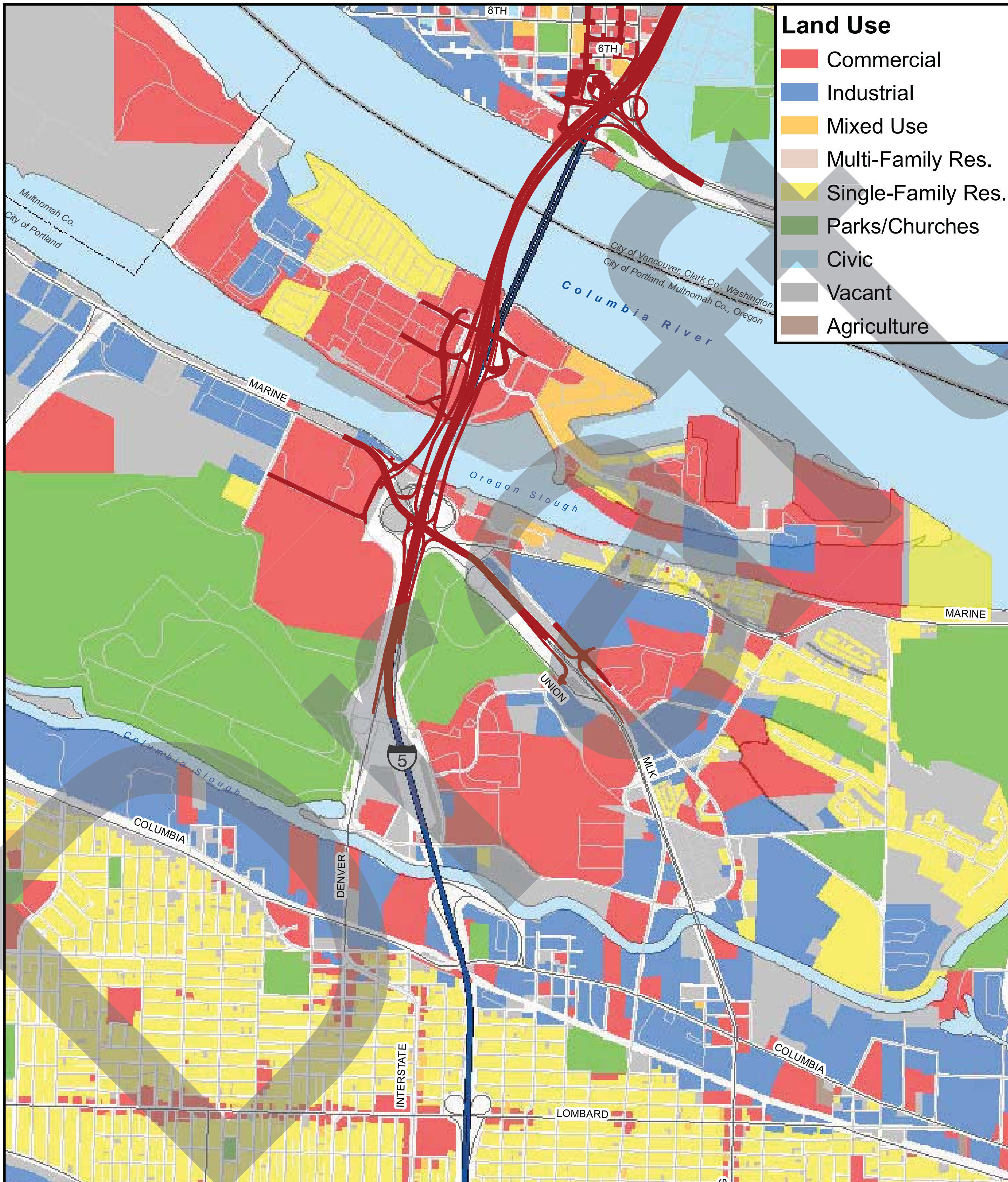

N
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0 0.15 0.3
Miles

Project Footprint

Figure 2-4.2
Land Use Designation - Oregon

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: Figure 2_4_2_ExistingLandUses.mxd

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Figure 2-4.3
Land Use Designation - Washington

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: Figure 2_4_3_ExistingLandUses.mxd

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Figure 2-5.1 Air Operations Areas - Portland International Airport

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: AviationData_Fig 2-4.2.mxd

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W E
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0 0.25 0.5
Miles

Air Operations Areas for Portland International Airport

Project Footprint

Figure 2-5.2 Air Operations Areas - Pearson Airport

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: 16 Oct 2012; File Name: AviationData_Fig 2-4.1.mxd

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3. Developed Conditions

3.1 Proposed Drainage Basins

Figures 3-1.1 through 3-1.3 provide delineation and flow paths of proposed drainage sub-basins within the ICP portion of the project boundary.

- The ICP will result in approximately 164.0 acres of new and rebuilt impervious surface, and 11.8 acres of resurfaced pavement.
- The project will increase the total impervious area by approximately 24.6 acres.
- The total CIA of 189.1 acres includes about 13.3 acres of existing pavement and sidewalk that is not affected by the project.
- The existing impervious surfaces within the CIA include the I-5 Bridge across North Portland Harbor and upstream Vancouver city streets not affected by the project, but from which runoff would drain to proposed water quality facilities.

The following sub-sections provide a summary of the proposed sub-basins.

3.1.1 Columbia Slough

The limits of the drainage sub-basins are determined by the area draining to the outfall, whether on site or off site area is contributing. The outfalls are defined as the existing pump stations located adjacent to the Columbia Slough channel and outfalls located along North Portland Harbor. Note the Expo Pump station is considered to be part of the PIR Pump station. Within the sub-basins, CIAs are delineated according to water quality facility to which the stormwater runoff flows. Multiple water quality facilities may outflow to a common outfall, their cumulative areas comprising a single sub-basin, named for this outfall.

Within the Columbia Slough watershed there are three sub-basins impacted by the project. The outfalls to which these sub-basins drain are pump stations PIR, PEN 2, and Schmeer Road. The description of each outfall and their drainage basins are provided in Volume II.

Table 3-1 summarizes the proposed CIA receiving runoff treatment within The Columbia Slough watershed and North Portland Harbor sub-basins. Note that the areas listed in the table below do not include potential staging areas. The locations of the facilities are shown on Appendix A.

Table 3-1. Proposed Drainage Sub-Basins – Columbia Slough

Sub-Basin	Total Area (acres)	Proposed Impervious Surfaces (acres)	Proposed Pervious Surfaces (acres)
PIR	11.6	11.6	
Schmeer Rd	14.9	14.9	
PEN 2	1.5	1.5	

Notes: Numbers may change with project design progression. Pervious surfaces will be included in the next phase of design.

3.1.2 Columbia River South

The limits of the drainage sub-basins are determined by the area draining to the outfall, whether on site or off site area is contributing. The outfalls are defined as the existing outfalls located along Columbia River's southern embankment and along the North Portland Harbor's northern embankment. Within the sub-basins, CIAs are delineated according to water quality facility to which the stormwater runoff flows. Multiple water quality facilities may outflow to a common outfall, their cumulative areas comprising a single sub-basin, named for this outfall.

Within the Columbia River South watershed there are four sub-basins impacted by the project. The outfalls to which these sub-basins flow are CR-01, CR-02, NPH-1, and NPH-2. The description of each outfall and the drainage sub-basins details are provided in Volume III.

Table 3-2 summarizes the proposed CIA receiving runoff treatment within the Columbia River South watershed sub-basins. Note that the areas listed in the table below do not include potential staging areas. The locations of the facilities are shown on Appendix A.

Table 3-2. Proposed Drainage Sub-Basins – Columbia River South

Sub-Basin	Total Area (acres)	Proposed Impervious Surfaces (acres)	Proposed Pervious Surfaces (acres)
CR 1	11.2	11.2	
CR 2	29.8	29.8	
NPH 1	2.9	2.9	
NPH 2	10.5	10.5	

Notes: Numbers may change with project design progression. Pervious surfaces will be included in the next phase of design.

3.1.3 Columbia River North

The limits of a sub-basin are determined by the area draining to a terminal outfall. The outfalls were defined as the locations where treated water outlets to an existing pipeline from its associated water quality facility. Multiple water quality facilities may outflow to a common outfall (existing pipe), their cumulative areas comprising a single sub-basin. Generally, the sub-basins naming convention is according to interchange.

Within the Columbia River North watershed there are five sub-basins impacted by the project, which are delineated according to interchange. There are two sub-basins at SR-14 interchange, one at Mill Plain, and two at Fourth Plain Boulevard.

The sub-basin encompassing Transit is not part of the previous five and is delineated separately for ease and clarity with regards to the construction packaging assumptions. The description of each outfall and the drainage sub-basins details are provided in Volume IV.

Table 3-3 summarizes the proposed CIA receiving runoff treatment within the Columbia River North watershed sub-basins. Note that the areas listed in the table below do not include potential staging areas. The locations of the facilities are shown on Appendix A.

Table 3-3. Proposed Drainage Sub-Basins – Columbia River North

Sub-Basin	Total Area (acres)	Proposed Impervious Surfaces (acres)	Proposed Pervious Surfaces (acres)
SR14-1	40.1	40.1	
SR14-2	5.5	5.5	
MP-1	7.1	7.1	
4P-1	0.5	0.5	
4P-2	5.4	5.4	
TR	39.8	39.8	

Notes: Numbers may change with project design progression. Pervious surfaces will be included in the next phase of design.

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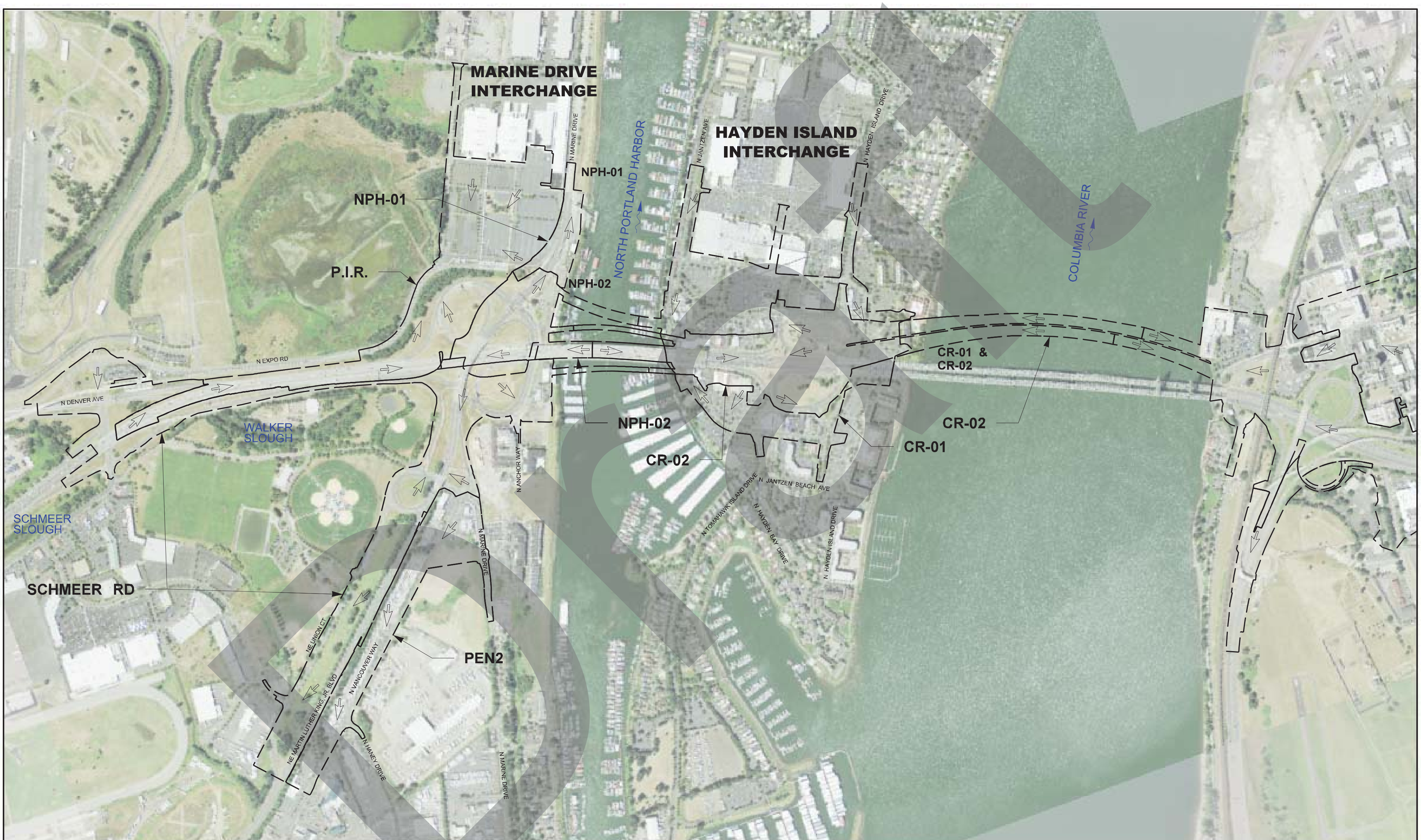

FIGURE 3-1.1.
PROPOSED DRAINAGE SUB BASIN
OREGON STATE - ICP

Columbia River CROSSING