Section 401 Water Quality Certification
Post-Construction Stormwater Management Plan
Submission Guidelines

March 2018
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A. Purpose

This document provides guidelines for applicants and Department of Environmental Quality (DEQ) staff regarding when a post-construction stormwater management plan (SWMP) must be submitted to the DEQ 401 Water Quality Certification (WQC) Program and the information that must be included in the post-construction SWMP. This document does not relieve applicants from the responsibility of complying with any other local, state, or federal requirements.

B. Requirements

See Figure 1 for a flowchart showing how to determine whether the DEQ 401 WQC Program requires a post-construction SWMP and whether review is deferred to another agency or permit authority. For any portion of a project where post-construction stormwater runoff is regulated by the following permit and/or agency, the DEQ 401 WQC Program defers post-construction SWMP review to the applicable agency and/or permit authority:

- A 1200-Z National Pollutant Discharge Elimination System (NPDES) permit and/or
- The City of Eugene, Clean Water Services, and/or the City of Portland, provided there is no nexus with DEQ Cleanup and no structural stormwater control for treating stormwater runoff is located within a water of the state.

Applicants for any project requiring a 401 WQC that adds or re-constructs any impervious surface outside of the above-listed deferred areas must submit a post-construction SWMP to the DEQ 401 WQC Program unless the applicant demonstrates to the satisfaction of the DEQ 401 WQC Program that the water quality impacts from post-construction stormwater runoff are minor. Below are examples of projects where the DEQ 401 WQC Program considers the water quality impacts from post-construction stormwater runoff to be minor:

- Utility line installation with no new impervious surface area;
- Small, localized repairs with no new impervious surface area;
- Pavement preservation that does not expose gravels, aggregate, or soil (see Figure 2);
- Exterior remodeling with no new impervious surface area; and
- Some projects with a small contributing impervious area (CIA) where post-construction stormwater runoff is routed to vegetated areas (evaluated on a case-by-case basis).

The post-construction SWMP must demonstrate post-construction stormwater runoff generated by the water quality storm event on the CIA will receive any necessary treatment prior to discharge to waters of the state unless the applicant adequately demonstrates that site constraints make this infeasible (e.g., a highway along a cliff). If infeasible, the applicant must demonstrate that post-construction stormwater runoff from an equivalent offsite area will be treated to offset the water quality impacts from the project’s post-construction stormwater runoff. Within 30 days of project completion, the applicant must submit to the DEQ 401 WQC Program as-builds or red-lined construction drawings of all structural stormwater controls.
**Figure 1: Determining Whether a Post-Construction Stormwater Management Plan is Required and Whether the DEQ 401 WQC Program Defers Review**

1. Is all of the project’s post-construction stormwater runoff covered by a 1200-Z NPDES permit?
   - yes: Submit a copy of the SWMP to DEQ’s 401 WQC Program. Review is deferred to DEQ’s Stormwater Program.
   - no: For any portion of the project not covered by a 1200-Z NPDES permit, is all of the post-construction stormwater runoff regulated by the City of Portland, Clean Water Services, and/or the City of Eugene?

2. Does the project increase net impervious surface area?
   - yes: Describe to the satisfaction of DEQ’s 401 WQC Program how post-construction stormwater impacts are minor.
   - no: Is there a nexus with DEQ Cleanup and/or is there any structural stormwater control for treating stormwater runoff located within a water of the state?

3. Is re-construction limited to installing utility lines, small localized repairs, exterior remodeling, nonstructural pavement preservation, or similar work?
   - yes: Describe to the satisfaction of DEQ’s 401 WQC Program how the project meets these conditions and how the post-construction stormwater runoff impacts are minor.
   - no: Explain to the satisfaction of DEQ’s 401 WQC Program why stormwater treatment is infeasible (e.g., a highway along a cliff) and submit a SWMP to DEQ’s 401 WQC Program that provides compensatory offsite stormwater treatment.

4. Is stormwater treatment feasible?
   - yes: Submit a SWMP to DEQ’s 401 WQC Program.
   - no: Do all of the following apply: 1) any increase in impervious surface area is small (e.g., a signpost or safety pullout), 2) stormwater runoff from the CIA will be directed to vegetated areas, and 3) there is no nexus with DEQ Cleanup?

5. Submit a copy of any SWMP to DEQ’s 401 WQC Program. Review is deferred to the local jurisdiction and, if there is a 1200-Z NPDES permit, to DEQ’s Stormwater Program.
Figure 2: Paved Impervious Cross Section – Determining Which Activities Trigger a Stormwater Review

Development and redevelopment activities that do not reach or exceed depth “a” leave impervious surfaces in place and do not trigger stormwater requirements. Development and redevelopment activities that expose gravels, aggregates or soil (depths “b” and “c”) do trigger stormwater requirements.

© City of Portland, courtesy Bureau of Environmental Services
C. Background

Section 401 of the Federal Water Pollution Control Act (aka Clean Water Act) gives states the authority to certify, waive, or deny applications for projects requiring a federal license or permit that may result in any discharge into the waters of the United States. ¹ DEQ has the authority to require modifications to and impose conditions on such projects to ensure they meet state water quality standards and other applicable water quality laws. DEQ also has the authority to deny 401 WQCs for such projects; if a 401 WQC is denied, the federal permit or license will not be issued for the project.

State water quality standards are established in Oregon Administrative Rules (OARs) Chapter 340 Division 41. DEQ requires the use of all available and reasonable methods necessary for the project to meet state water quality standards. ² This includes protecting designated beneficial uses (see Appendix F.3), meeting narrative and numeric water quality criteria, and complying with the antidegradation policy.

Stormwater runoff that may cause or tend to cause pollution is a waste. ³ As stated in Oregon Revised Statutes (ORS) Chapter 468B, it is the public policy of the state to provide that no waste be discharged into any waters of this state without first receiving the necessary treatment or other corrective action to protect the legitimate beneficial uses of such waters and to provide for the prevention, abatement and control of new or existing water pollution. ⁴ State water quality standards require, in part, that the highest and best practicable treatment and/or control of wastes be provided to maintain overall water quality at the highest possible levels. ⁵

Except where water quality impacts from post-construction stormwater runoff are minor, post-construction stormwater runoff from new or reconstructed impervious surfaces may cause or tend to cause pollution. The DEQ 401 WQC Program requires applicants submit a post-construction SWMP for projects where post-construction stormwater runoff may cause or tend to cause pollution. To meet the 401 WQC requirements, post-construction SWMPs must demonstrate that post-construction stormwater runoff receives the highest and best practicable treatment and/or control.

This document provides guidelines for compiling and evaluating post-construction SWMPs to ensure they demonstrate the use of available and reasonable methods to provide the highest and best practicable treatment and/or control of post-construction stormwater runoff. On a case-by-case basis, additional information may be required to ensure compliance with state water quality standards and other applicable water quality laws.

¹ Clean Water Act Sections 401(a)(1) and 502(7)
² Oregon Revised Statutes (ORS) 468B.020(2)(b)
³ See the Glossary (Appendix F.1) for the definitions of “pollution” (from ORS 468B.005(5)) and “waste” (from Oregon Administrative Rule (OAR) 340-041-00069)
⁴ ORS 468B.015(3),(4)
⁵ OAR 340-041-0007
### D. Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>BMPs</td>
<td>Best Management Practices</td>
</tr>
<tr>
<td>CIA</td>
<td>Contributing Impervious Area</td>
</tr>
<tr>
<td>DEQ</td>
<td>Oregon Department of Environmental Quality</td>
</tr>
<tr>
<td>HUC4</td>
<td>4th field Hydrologic Unit Code</td>
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<tr>
<td>LA</td>
<td>Load Allocation</td>
</tr>
<tr>
<td>LID</td>
<td>Low Impact Development</td>
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<tr>
<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
</tr>
<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>NRCS</td>
<td>Natural Resource Conservation Service</td>
</tr>
<tr>
<td>OAR</td>
<td>Oregon Administrative Rule</td>
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<tr>
<td>ODOT</td>
<td>Oregon Department of Transportation</td>
</tr>
<tr>
<td>ORS</td>
<td>Oregon Revised Statute</td>
</tr>
<tr>
<td>PAHs</td>
<td>Polycyclic Aromatic Hydrocarbons</td>
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<tr>
<td>SWMP</td>
<td>Stormwater Management Plan</td>
</tr>
<tr>
<td>TAPE</td>
<td>Technology Assessment Protocol - Ecology</td>
</tr>
<tr>
<td>TMDL</td>
<td>Total Maximum Daily Load</td>
</tr>
<tr>
<td>UIC</td>
<td>Underground Injection Control</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
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<tr>
<td>WLA</td>
<td>Waste Load Allocation</td>
</tr>
<tr>
<td>WQC</td>
<td>Water Quality Certification</td>
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<tr>
<td>WRD</td>
<td>Water Resources Department (of Oregon)</td>
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</tbody>
</table>
E. Elements of a Post-Construction Stormwater Management Plan

Refer to Appendix F.2 for a checklist of the necessary elements of a post-construction SWMP. A complete post-construction SWMP includes the elements listed below, each of which is more fully described in steps E.1-E.9, plus any additional information requested by DEQ.

E.1. The water quality storm event;

E.2. A site map showing pre- and post-construction topography, flow patterns, buffers, and any features that could impact the siting and design of structural stormwater controls;

E.3. Documentation that post-construction stormwater runoff generated by the water quality storm event on the CIA within each of the project’s drainage basins:

- Will be routed to one or more regional structural stormwater controls with sufficient capacity to accommodate this stormwater runoff without discharging to surface waters or polluting groundwater and the owner(s) accept(s) this runoff, and/or
- Will fully infiltrate (after any necessary treatment), evapotranspirate, and/or be reused onsite, and/or
- Cannot fully infiltrate, evapotranspirate, and/or be reused onsite, but will be treated prior to discharging to receiving waters and infiltration (after any necessary treatment), evapotranspiration, and/or reuse will be maximized;

E.4. A description of the design elements used to reduce post-construction stormwater runoff, and any related details and calculations;

E.5. A description of how the project will meet any applicable restrictions or goals from a water quality management plan for the basin, how onsite materials could impact the water quality of post-construction stormwater runoff, and how trees and shading to waters of the state will be preserved (if applicable);

E.6. A description of how post-construction stormwater runoff generated by the water quality storm event on the CIA will be managed to minimize water quality impacts, including site plans showing the structural stormwater controls and drainage basins;

E.7. Design calculations and design details of the structural stormwater controls, citing any stormwater manuals, equations, models, and/or peer-reviewed articles used;

E.8. Details for construction practices; and

E.9. An operations and maintenance plan that identifies the responsible party.
E.1 Determine the Water Quality Storm Event

DEQ’s 401 WQC Program defines the water quality storm event as the greater of 1) the storm event at which 80% of the average annual rainfall comes from storms that are equal to or smaller than that event or 2) the first flush event (assumed to be 0.7 inches of rainfall over 24 hours).  

E.1.1 Determine the Water Quality Storm Event Depth

Option 1: Approximate using Statewide Datasets

1) Find the site’s 2-year, 24-hour precipitation. The 2-year, 24 hour precipitation can be found using the National Oceanic and Atmospheric Administration (NOAA) Atlas 2 Precipitation Frequency Estimates (http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm) or the Oregon Department of Transportation (ODOT) Precipitation Data Viewer (ftp://ftp.odot.state.or.us/techserv/geo-environmental/Hydraulics/Precip/ODOT_Precipitation_Data_V viewer.pdf).

2) Multiply the 2-year 24-hour precipitation by the appropriate water quality design storm factor: 0.67 for Zone 9 (Malheur County) and Zone 4 (the Northern Cascades), 0.75 for Zone 5 (the High Plateau) and 0.5 for the rest of the state. See Figure 4 for the zone map.

3) If the results are less than 0.7 inch, use 0.7 inch.

Option 2: Calculate using Local Data

Calculate the depth of a 24-hour storm event that represents at least 80% of the cumulative rainfall using at least 20 contiguous years of rainfall data, beginning in 1996 or earlier to the most recent verified data. If the results are less than 0.7 inch, use 0.7 inch.

E.1.2 Consider Rainfall Rates

Option 1: Continuous Simulation

Use a continuous simulation program with at least 20 contiguous years of local rainfall, beginning in 1996 or earlier to the most recent verified data to demonstrate at least 80% percent of the average annual rainfall will be treated.

Option 2: Hydrograph Method

Use a single 24-hour storm hydrograph method using an appropriate design storm distribution (such as NRCS Type 1A or Type II) as shown in Figure 3 and multiple these values by the water quality storm event depth found in step E.1.1.

Option 3: Local Stormwater Manual’s Rate

Use the local jurisdiction’s water quality design rainfall intensity for the time of concentration to rate-based structural stormwater controls if this treats at least 80% of the average annual rainfall.

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6 This is from ODOT’s April 9, 2008 Water Quality Design Storm Evaluation Memorandum.
7 This figure is from the USDA’s Urban Hydrology for Small Watersheds, TR-55, June 1986
This figure is from ODOT’s April 9, 2008 Water Quality Design Storm Evaluation Memorandum; the zones are the Oregon Climate Service zones, and the factors are set to approximate 85% of the cumulative annual rainfall. The close-ups are from Special Reports 916 and 917 of the Oregon State University Agricultural Experiment Station.
E.2 Evaluate Site Constraints

Site conditions and features can influence the siting and design of structural stormwater controls. Evaluate the pre- and post-construction topography and flow patterns and identify any features that impact the siting and design of structural stormwater controls, as described below.

E.2.1 Identify Areas Not Recommended for Siting Structural Stormwater Controls

Post-construction stormwater runoff from the water quality storm event must be treated prior to discharge to a water of the state. Structural stormwater controls for treating stormwater runoff should not be located within a waterway. Avoid siting structural stormwater controls in sensitive areas (e.g., wetlands, natural buffers, floodplains) or provide justification to the satisfaction of DEQ’s 401 WQC Program why this cannot be avoided. If siting structural stormwater controls in wetlands or natural buffers is unavoidable, demonstrate that Oregon Department of State Lands’ mitigation requirements will be met. If siting structural stormwater controls in floodplains is unavoidable, address how sediment will be stabilized or removed prior to flood events and how the project will conform to federal, state, and local floodplain regulations.

E.2.1.1 Protection for Waterbodies

Preserve at least a 50-foot natural buffer around waters of the state to remain onsite, unless infeasible.

E.2.2 Identify Areas where Excavation and/or Infiltration May be Precluded

Check for areas where infiltration and/or excavation may be precluded, including the areas listed below, and document and follow the advice of the appropriate certified professional or authority. Lined structural stormwater controls may still be permissible where infiltration is precluded.

- **Areas with Steep Slopes or Landslide Risk**
  Check the topography and Oregon Department of Geology and Mineral Industries’ Statewide Landslide Information Database [http://www.oregongeology.org/sub/slido/index.htm](http://www.oregongeology.org/sub/slido/index.htm). Consult with an Oregon-registered geotechnical engineer or engineering geologist in areas with steep slopes or landslide risk to see if excavation and/or infiltration should be avoided.

- **Drinking Water Sources Areas**
  Check the DEQ’s Drinking Water Protection Interactive Map Viewer [http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx](http://www.oregon.gov/deq/wq/programs/Pages/DWP-Maps.aspx) and relevant local data. If the project is within a drinking water source area or groundwater 2-year time of travel, check with the local jurisdiction or the Oregon Health Authority to see if infiltration should be avoided or if structural spill control might be required to protect the resource.

- **Areas with Soil or Groundwater Contamination**
  Check historical records and DEQ’s Environmental Cleanup Site Information database [http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/ecsi.aspx](http://www.oregon.gov/deq/Hazards-and-Cleanup/env-cleanup/Pages/ecsi.aspx) and Facility Profiler-Lite [http://hdcgcx1.deq.state.or.us/Html5viewer291/?viewer=FacilityProfilerLite](http://hdcgcx1.deq.state.or.us/Html5viewer291/?viewer=FacilityProfilerLite). If the site has known or suspected contamination, check with DEQ Cleanup to see if excavation and/or infiltration should be avoided to prevent mobilizing contamination.
• **Areas within any Setbacks**
  Check with the local jurisdiction regarding setback requirements (e.g., property lines, domestic wells, utilities, retaining walls, berms, structures, basements). To protect infrastructure, a partially or fully lined structural stormwater control might be required.

**E.2.3 Check Depth to Groundwater**

If groundwater is too shallow, it can interfere with the effective functioning of structural stormwater controls. If not considered in the design of a structural stormwater control, shallow groundwater can take up volume that was intended for stormwater retention and/or treatment. Additionally, for infiltration structural stormwater controls, shallow groundwater can reduce the infiltration rate. Any of the above can result in a structural stormwater control that is undersized. Poor design of structural stormwater controls can also impact groundwater by inadvertently draining groundwater through outlets and, if unlined, by discharging insufficiently treated stormwater runoff to groundwater. To reduce the likelihood of adverse water quality impacts, the following elevations should be considered in the design of the structural stormwater control:

• **Outlets**
  The invert elevation of any outlets should be above the highest anticipated seasonal groundwater to prevent draining groundwater.

• **Infiltration Structural Stormwater Control Bottom**
  Avoid siting infiltration structural stormwater controls in areas where shallow groundwater will prevent the structural stormwater control from draining between storm events. Generally the available storage volume within the soil pores should be sufficient to store the volume of post-construction stormwater runoff the structural stormwater control is designed to infiltrate (see step E.7.2.1).

The highest anticipated groundwater elevation can be estimated by reviewing data during the wet season from piezometers, wells, or boring logs and/or checking soil properties for conditions associated with saturation. See the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) 2017 *Field Indicators of Hydric Soils in the United States* for field indicators of soil conditions associated with saturation [https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs142p2_053171.pdf](https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcs142p2_053171.pdf).


Unless the project is small, such as a rain garden for a residential house, a qualified professional such as a soil scientist, engineering geologist, or registered geotechnical engineer should estimate the depth to groundwater.
E.3 Justify the Level of Infiltration

NOTE: If any of the following apply, provide documentation to DEQ’s 401 WQC Program demonstrating which are applicable and then skip to step E.4:

— All of the post-construction stormwater runoff generated by the water quality storm event on the CIA will be routed to one or more regional structural stormwater controls that have a combined capacity sufficient to accommodate this stormwater runoff without discharging to surface waters or polluting groundwater and the owner(s) accept(s) this stormwater runoff.
— There is no onsite area to locate infiltration structural stormwater controls per step E.2.
— There is a high likelihood of spills and structural spill control is not feasible.

Infiltration of post-construction stormwater runoff generated by the water quality storm event on the CIA is recommended unless there is 1) both a high likelihood of spills and structural spill control is not feasible or 2) site constraints preclude infiltration. Unless one of the bullets in the box above apply, review soil data for the project site and perform infiltration testing as described below.

E.3.1 Review Soil Data

Review existing soil maps such as USDA NRCS soil maps [https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm](https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) and any other relevant, available information. USDA NRCS soil maps are for planning purposes and are useful to help assess where to take infiltration tests; these maps may or may not reflect actual soil conditions.

<table>
<thead>
<tr>
<th>NRCS Group</th>
<th>Suitability for Infiltration Structural Stormwater Controls</th>
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<tbody>
<tr>
<td>A</td>
<td>Likely to allow infiltration</td>
</tr>
<tr>
<td>B</td>
<td>Likely to allow infiltration</td>
</tr>
<tr>
<td>C</td>
<td>May allow some infiltration</td>
</tr>
<tr>
<td>D</td>
<td>Likely too slow to allow for infiltration</td>
</tr>
</tbody>
</table>

E.3.2 Select Sites for Infiltration Testing

Use the following steps to select onsite areas to perform infiltration testing:

1. Exclude onsite areas where site constraints as identified in step E.2 preclude infiltration structural stormwater controls.

2. Exclude onsite areas where post-construction stormwater runoff will not flow by gravity from impervious areas (i.e., exclude areas upslope of the impervious areas). Multiple onsite structural stormwater controls are encouraged, and each structural stormwater control only needs to be sited downstream of the impervious area from which it will be designed to receive stormwater runoff, not the entire site’s impervious area.

3. Select areas to perform infiltration testing based on which areas have soils that are most likely to allow infiltration (e.g., preferably avoid Group D soils).
E.3.3 Perform Infiltration Testing

Perform at least two infiltration tests on the site, with at least one infiltration test in each area being considered for an infiltration structural stormwater control. At least two business days before digging, call 811 or the One Call Center (http://callbeforeyoudig.org/oregon/index.asp). Follow Oregon Occupational Safety & Health precautions for excavations and do not leave any open excavation unsecured or unmarked. Except for small facilities such as rain gardens serving a single-family residence, an Oregon-registered professional engineer, soil scientist, geologist, or engineering geologist should perform the infiltration tests.

Infiltration tests include percolation, modified percolation, and double-ring infiltrometer tests. “In general…each test involves digging a hole at the approximate location and depth of the proposed infiltration [structural stormwater control], [pre-soaking the hole if recommended], [adding a layer of course sand or fine gravel to the bottom to protect the bottom from scour if recommended], pouring water in an open-bottomed ring or dug hole, and measuring the drop over time from the top…”9 Pre-soaking the soil in western Oregon is generally recommended to simulate soil conditions during the wet season. Only perform the infiltration test when it is not raining, has not rained more than ½ of an inch in the past 24 hours, and the temperature is above freezing. Follow local manuals and refer to the 2011 Infiltration Testing Fact Sheet, by Maria Cahill, Green Girl Land Development Solutions; Derek C. Godwin and Marissa Sowles, and the Oregon Sea Grant Extension (ORESU-G-11-008) (http://seagrant.oregonstate.edu/sites/seagrant.oregonstate.edu/files/sgpubs/onlinepubs/g11008-lid-infiltration-testing.pdf).

Document the method and results of the infiltration tests and convert the results into inches per hour. If the tested infiltration rate is too rapid (e.g., > 9 inches/hour), pretreatment or soil amendments may be required in the structural stormwater control; if too slow, it may be impractical to infiltrate all of the post-construction stormwater runoff generated by the water quality storm event on the CIA. If the infiltration rate is less than 0.5 inch/hour, the infiltration structural stormwater control should be designed by a qualified Oregon-registered professional engineer.10

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9 From the 2011 Infiltration Testing Fact Sheet, Maria Cahill, Green Girl Land Development Solutions; Derek C. Godwin and Marissa Sowles, Oregon Sea Grant Extension.
10 From the Template for LID Stormwater Manual for Western Oregon, Appendix C Infiltration Testing, Maria Cahill, Green Girl Land Development Solutions.
E.4 Reduce Stormwater Runoff Volume

Consider options to reduce post-construction stormwater runoff. If the site has known or suspected contamination, check with and follow the advice of DEQ Cleanup. For each relevant item below, either i) describe how it is used, ii) explain why it is not practicable or iii) document that DEQ Cleanup’s advice precludes its implementation. Evapotranspiration and/or reuse of post-construction stormwater runoff must be given highest priority wherever practicable.\(^{11}\)

- Minimize impervious surface area.
  - Design narrow streets and small building footprints (e.g., build up instead of out).
  - Use porous pavement to infiltrate direct precipitation\(^{12}\) in areas with neither significant windblown sediment,\(^{13}\) nor a high potential for spills,\(^{14}\) nor high groundwater.\(^{15}\)
  - Remove abandoned pavement.
  - Install contained planters over impervious surfaces.
  - Avoid compacting the soil unless necessary.

- Avoid adding impervious surfaces over areas that could be used to infiltrate post-construction stormwater runoff where this would prevent the use of onsite infiltration structural stormwater controls.

- Reuse or infiltrate direct rainfall on roofs (see Figure 5).
  - Use ecoroofs (i.e., green roofs) and infiltrate, evapotranspirate, reuse, or treat the stormwater runoff generated by the water quality storm event on the ecoroof.\(^{16}\)
  - Harvest rainwater from rooftop surfaces (e.g., using a rain barrel or cistern), directing the initial fraction of an inch of each rain event to vegetated areas.\(^{17}\)
  - Disconnect roof drain downspouts to gently sloped or flat vegetated areas.

- Retain and plant trees (especially evergreens) and shrubs onsite.

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\(^{11}\) OAR 340-041-0007(3) and OAR 340-041-0002(69)

\(^{12}\) Permeable pavement should be designed to only infiltrate direct precipitation.

\(^{13}\) Examples of areas with significant windblown sediment include the Summer Lake area.

\(^{14}\) Examples include vehicle wrecking yards, fast food parking lots, and automotive repair places (from the City of Eugene’s 2014 Stormwater Management Manual, pg 2-45).

\(^{15}\) Provide separation between the reservoir’s bottom and highest anticipated groundwater per local guidelines.

\(^{16}\) The load bearing capacity of the roof must be evaluated by an appropriate licensed professional.

Figure 5 shows a sample residential rooftop and a sample commercial rooftop with multiple design elements to reduce the volume of stormwater runoff discharging offsite and to promote infiltration. Simple disconnection of roof drain downspouts to vegetated areas, rainwater harvesting (with rain barrels or cisterns), and green rooftops are all discussed in this section. Rain gardens, french drains, stormwater planters, and bioretention are discussed in step E.6.

Figure 5 is from Low Impact Development in Coastal South Carolina: A Planning and Design Guide 4, page 4-121
E.5 Review Stormwater Runoff Water Quality Impacts

E.5.1 Receiving Water Beneficial Uses and Water Quality Limited Pollutants

1. Identify each receiving water to which post-construction stormwater runoff discharges.

2. List each receiving water’s designated beneficial uses (see Appendix F.3), which are based on the WRD Administration basins (outline in black in Figure 6), except for the Snake and Columbia Rivers, which each have their own designations.

3. List all water quality limited pollutants per the latest EPA-approved Integrated Report Assessment Database. At the time of this publication, this is the 2012 Integrated Report Assessment Database (http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp). The assessment is based on the United States Geological Survey (USGS) 4th field Hydrologic Unit Code basin (HUC4 as outlined in light gray in Figure 6). If the receiving water has any total maximum daily loads (TMDLs), describe any applicable restrictions or goals from the water quality management plan and how these will be addressed (http://www.oregon.gov/deq/wq/tmdls/Pages/TMDLS-Basin-List.aspx).

Figure 6: Oregon’s Basins and Rivers
E.5.2 Onsite Materials that Could Impact Water Quality

Design the site to minimize water quality impacts to receiving waters from the post-construction stormwater runoff generated by the water quality storm event on the CIA. Consider the use of cool pavements to reduce thermal impacts to receiving waters. Also consider alternatives to the following materials that could detrimentally impact water quality:

- Galvanized steel (which releases zinc and lead);
- Copper (which releases copper);
- Pavement sealcoats (which release polycyclic aromatic hydrocarbons (PAHs)); and
- Treated wood (which releases copper and arsenic if chromated copper arsenate-treated, PAHs if creosote-treated, and pentachlorophenol if pentachlorophenol-treated).

Provide a map that clearly shows the site’s existing impervious surface areas, proposed impervious surface areas, and the CIA and describe all of the applicable items listed below:

- The materials comprising the CIA (e.g., pavement types, roadway sealcoats, roofing materials, exposed treated wood) and their respective areas;
- The materials through which stormwater runoff will be routed prior to entering the structural stormwater control (e.g., architectural features, gutters);
- Any other onsite materials with potential water quality concerns (e.g., community garbage cans (preferably covered by a rooftop));
- Any materials proposed to be directly applied to the site (e.g., fertilizers, pesticides) that could adversely impact water quality and their proposed quantities (preferably minimizing the use of fertilizers and pesticides);
- Any materials that are likely to be left on the ground that could adversely impact water quality (e.g., pet waste in residential areas, litter along highways, lead bullets at shooting ranges) and if pickup is proposed, a description of the type and frequency of pickup;
- The anticipated and design annual average daily traffic of any roadways;
- Any toxic substances that will be transported or stored onsite and any proposed method of spill containment (e.g., structural spill control, spill response plan); and
- Any other activity that could adversely impact water quality (e.g., pressure-washing homes to strip lead paint, car washing).

E.5.3 Shade Preservation

Avoid loss of shading to waters of the state; this is especially critical in areas that are water quality impaired due to high temperature. Shade loss can be avoided through the preservation of buffers around waters of the state.
E.6 Select Stormwater Treatment Method(s)

Stormwater treatment should mimic natural hydrology as much as feasible. Low impact development (LID), such as preserving buffers and trees and providing smaller structural stormwater controls distributed throughout the site, is encouraged.

E.6.1 Provide Structural Stormwater Control(s) for Each Drainage Basin

Divide the site into drainage basins, such that all post-construction stormwater runoff generated by the water quality storm event on the CIA from each drainage basin will be infiltrated and/or treated by a structural stormwater control, suited to treat the constituents of concern. If a structural stormwater control exists onsite, consider retrofitting it, if necessary. Site each structural stormwater control such that it is accessible for maintenance and post-construction stormwater runoff flows to it. Demonstrate the following steps were adhered to in the design:

1. Infiltrate as much of the post-construction stormwater runoff generated by the water quality storm event on the CIA as feasible, unless not recommended due to site constraints or spill potential. Include treatment (e.g., filtration through filter media) unless stormwater runoff has already been treated or unlikely to have contaminants (e.g., some rooftops, pedestrian-only areas). Examples of infiltration structural stormwater controls include the following:

   - With treatment (e.g., bioretention basins, stormwater planters, rain gardens, bioslopes, and sand filters) and
   - Without treatment (e.g., soakage trenches, french drains, and drywells).

If the structural stormwater control is deeper than its largest surface dimension, or uses piping that emplaces stormwater in subsurface soils (see Figure 7 below), the requirements of the Underground Injection Control (UIC) Program apply. UICs must be permitted in Oregon. UIC permittees are required to show that UICs are protective of groundwater. To prevent groundwater pollution, stormwater runoff directed to UICs should either 1) be from areas that are not anticipated to cause pollution or 2) be properly treated prior to discharging to the UIC. To apply for a UIC permit, contact the DEQ UIC Program.

Figure 7: Determining if a Structural Stormwater Control is a UIC

![Diagram of structural stormwater control](image_url)

This is not a UIC, since it is not deeper than it is wide and does not use piping that emplaces stormwater in subsurface soils.

If the pipe outside of the drain rock (circled above) is perforated, this is a UIC as it uses piping that emplaces stormwater in subsurface soils; otherwise this is not a UIC.
2. For any portion of a site where post-construction stormwater runoff generated by the water quality storm event on the CIA will discharge to a receiving water via pipes and/or overland flow, use vegetated structural stormwater controls if practicable (or if the local climate precludes vegetated structural stormwater controls, use unvegetated structural stormwater controls such as sand filters) and identify both the discharge location(s) and the receiving water(s). Note that detention ponds are not considered to be a sufficient stand-alone treatment method and should be combined with other structural stormwater controls. Examples of structural stormwater controls include:

- Swales and filter strips\(^\text{19}\) (e.g., vegetated swales, grassy swales, filter strips);
- Filters (e.g., bioretention basins, stormwater planters, bioslopes, and sand filters, all with underdrains); and
- Ponds (e.g., wet ponds, extended wet ponds, and constructed wetlands).

3. If site constraints prevent the above structural stormwater controls (e.g., a highly urbanized area), use proprietary devices that have a general use level designation by the Department of Washington Ecology’s Technology Assessment Protocol (TAPE).\(^\text{20}\)

**E.6.2 Erosion Control**

The above steps are for post-construction stormwater runoff generated by the water quality storm event on the CIA. Post-construction stormwater runoff generated by many different storm events (including those larger than the water quality storm event) on the CIA may contribute to erosion along or within the receiving water. Local jurisdictions typically require larger storm events be detained onsite and released at or below the pre-construction rate for flood control purposes; this detention may alleviate some erosion impacts, but not necessarily all erosion impacts.

On a case-by-case-basis, the DEQ 401 WQC Program may require the applicant for a 401 WQC to evaluate, and if necessary reduce or address, the erosion impacts to receiving waters caused by post-construction stormwater runoff generated by different storm events (including those larger than the water quality storm event).

\(^{19}\) Swales and filter strips also can serve as alternatives to conventional curb and gutter.

E.7 Design the Structural Stormwater Control(s)

Demonstrate each structural stormwater control is appropriately sized and designed to protect the receiving water’s designated beneficial uses and existing water quality. Provide plans, cross-sections, and design details of each structural stormwater control and cite any studies and any stormwater manuals followed. Unless the structural stormwater control is small, such as a rain garden for a residential house, the design should be stamped by a qualified Oregon-registered professional engineer. For small rain gardens, see the 2010 Oregon Rain Garden Guide (Sea Grant, Oregon): [http://seagrant.oregonstate.edu/sgpubs/oregon-rain-garden-guide](http://seagrant.oregonstate.edu/sgpubs/oregon-rain-garden-guide). See Appendix F.4 for example details of some post-construction stormwater controls.

E.7.1 Note Any Special Considerations

Design the structural stormwater control(s) for any conditions that merit special water quality considerations, including the conditions listed in Table 2, as applicable.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Special water quality consideration</th>
</tr>
</thead>
</table>
| Shallow groundwater                | — Locate outlets above the highest anticipated seasonal groundwater.  
|                                    | — Size structural stormwater controls assuming groundwater is at its highest anticipated seasonal elevation.  
|                                    | — Size infiltration structural stormwater controls such that there is sufficient depth to groundwater to facilitate drainage (e.g., soil pore storage volume ≥ volume of stormwater designed to infiltrate). |
| Water quality limited for temperature | — Shade areas designed for standing water.  
|                                    | — Limit exposure of the discharge to heated surfaces such as rip rap.  
|                                    | — Preferably infiltrate, evapotranspirate, or reuse the 2-year, 24-hour summertime storm event. |
| Water quality limited for bacteria/pathogens | — Avoid ponds and swales as the final step in the treatment train.  
|                                    | — Provide best management practices (BMPs) to limit bacteria sources (e.g., discourage waterfowl, encourage pet waste pickup). |
| Water quality limited for algae, nitrogen, phosphorus, or dissolved oxygen | — Avoid underdrains below nutrient-leaching filter media that discharge to surface waters.  
|                                    | — Consider including subsurface storage.  
|                                    | — Consider providing a longer residence time. |
| Floodplain                         | — Stabilize or remove accumulated sediment before flood events. |
| Wetlands                           | — Mitigate for any impacts to wetlands. |
| Cold climate                       | — Avoid ponds and swales in areas with frequent ice or snow events. |
| Saline/brackish waters             | — Limit direct freshwater discharges. |
| Low hardness\(^2\)                 | — Provide additional treatment, such as a longer residence time. |

\(^2\) Note that freshwaters in coastal basins and the Cascades tend to have especially low hardness.
E.7.2 Appropriately Size the Structural Stormwater Control(s)

Design each structural stormwater control to ensure it:

- Protects public safety (e.g., has adequate freeboard, is fenced or avoids standing water for extended periods and has no retaining walls, has overflow for the 100-year storm event);

- Avoids creating mosquito breeding habitat (e.g., fully drains within 72 hours) if feasible or is managed to prevent mosquitoes (e.g., stocking with mosquito fish, removing cattails); and

- Treats (or for some UICs, passes) the water quality design storm event and accommodates the subsequent storm event, when groundwater is at its highest anticipated seasonal level:
  
  o Design volume-based structural stormwater controls\textsuperscript{22} to store the post-construction stormwater runoff volume generated by the water quality storm event on the CIA;

  o Design combination rate/volume-based structural stormwater controls\textsuperscript{23} using the hydrograph method or the continuous simulation method (see step E.1.2); and

  o Design rate-based structural stormwater controls\textsuperscript{24} to provide the minimum residence time, and to not exceed the maximum depth and velocity per protective local guidelines.

E.7.2.1 Additional Sizing Requirements for Infiltration Structural Stormwater Controls

The bottom of the structural stormwater control should be sufficiently above the highest anticipated seasonal groundwater to facilitate drainage. Generally, the volume of post-construction stormwater runoff the structural stormwater control is designed to infiltrate should not exceed the storage volume within the soil pores of the subgrade (see Figure 8 below).\textsuperscript{25}

Figure 8: Depth to Groundwater for Infiltration Structural Stormwater Controls

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\textsuperscript{22} Examples include constructed wetlands, wet ponds, and extended wet ponds.

\textsuperscript{23} Examples include planters, filtration basins, infiltration basins, rain gardens, and sand filters.

\textsuperscript{24} Examples include swales, filter strips, and bioslopes.

\textsuperscript{25} The storage volume within the soil pores is the volume available for stormwater between the soil particles from the bottom of the structural stormwater control to highest anticipated groundwater and can be calculated as follows: \[\text{[(soil porosity) – (initial water content (by volume))] \times (distance between the bottom of the structural stormwater control and highest anticipated groundwater) \times (bottom area of the structural stormwater control)}\]
E.7.3 Design the Components of the Structural Stormwater Control

Do not use toxic substances in the design of the structural stormwater control (e.g., do not include chemically treated railroad ties and lumber, recycled crushed asphalt, copper, or galvanized metals). Design to local requirements and the plumbing code, where applicable.

E.7.3.1 Route and Possibly Pre-treat Stormwater Runoff into the Structural Stormwater Control

Route post-construction stormwater runoff from the CIA to the structural stormwater control(s):

— Consider swales or filter strips, in lieu of “curb and gutter” systems.
— Consider installing a gross pollutant trap to collect sediment, trash and debris.
— Consider providing a settling basin to remove coarse sediment and debris.
— Consider bypassing large flows to minimize erosion and wash-out of contaminants.
— Design any inlet to ensure stormwater runoff enters the structural stormwater control.
— Either grade to ensure sheet flow to the structural stormwater control (required for filter strips), distribute the inflow\textsuperscript{26} or provide energy dissipation\textsuperscript{27} for erosion control.

E.7.3.2 Select the Vegetation (for vegetated structural stormwater controls)

Develop a planting plan for the entire structural stormwater control; vegetation should:

— Not be dormant in the wet season.
— Preferably target the constituents of concern.
— Be consistent with local low-height requirements for visibility and safety.
— Not be invasive.
— Be suitable for the post-construction environment, including the wet and dry zones of the structural stormwater control (based on the bottom of any outlets or the top of any check dams) such that minimal maintenance is required and long-term irrigation is not required.

E.7.3.3 Design Filter Media (for structural stormwater controls that include filtration)

Add the appropriate thickness of a filter media (e.g., growing media). Onsite soils may be used if suitable; otherwise import soils or amend soils in place (e.g., tilling in compost or sand). This filter media should:

— Be capable of supporting plant growth (for vegetated structural stormwater controls).
— Preferably target the constituents of concern.
— Not be over-fertilized (test prior to applying fertilizer or compost).
— Have sufficient long-term infiltration capacity to accommodate the design capacity.

E.7.3.4 Determine the Type and Thickness of Any Drainage Layer

Except for some structural stormwater controls in well-drained soils and filter strips, generally include a drainage layer (e.g. drain rock) for structural stormwater controls that include filtration, to prevent ponding in flow rate-based structural stormwater controls with shallow slopes and/or to provide subsurface storage. If a drainage layer is used, a separation layer (e.g., aggregate) should divide the filter media from the drainage layer.

\textsuperscript{26} Examples of flow distribution include a level spreader, filter strip, or grading.
\textsuperscript{27} Examples of erosion control include rock, a concrete splash pad, or a riprap stilling basin.
E.7.3.5 Determine Whether Underdrains and Drain Pipe are Needed
Determine if a drain pipe is necessary within the drainage layer and if it needs to serve as an underdrain (i.e., connect to a system that discharges offsite). Underdrains below nutrient-leaching filter media should not discharge to waters impaired for nutrients.

- Choose an appropriate diameter pipe to accommodate the flow.
- Include observation well(s)/cleanout(s).
- Consider installing a valve on the drain pipe near the downgradient end so that water may be retained during the dry season for vegetation and drained as needed.

E.7.3.6 Determine the Type of Liner, if Needed
Provide a liner only if lined structural stormwater controls are required or recommended.

E.7.3.7 Consider Stormwater Runoff Routing and Containment
Consider how post-construction stormwater runoff within the structural stormwater control will be contained and routed. Consider check dams or baffles to slow the flow of stormwater runoff.

- Check local manuals to ensure adequate freeboard.
- Generally design for shallow side slopes (except for stormwater planters).
- Check dams should be integrated into the grading, installed perpendicular to the flow path and generally include an orifice for low flows and to minimize long-term ponding.

E.7.3.8 Outflow
Provide an outlet unless the structural stormwater control is designed to infiltrate all of the post-construction stormwater runoff that can enter through the inlet (including any storms larger than the water quality storm event up to the 10-year, 24-hour storm event, if these can enter through the inlet). Consider the following:

- Provide conveyance for the 100-year storm event, considering public safety.
- Either distribute the outflow or provide energy dissipation.  
- Provide a screen (e.g., trash rack) on outfalls.
- Set the invert elevation of the outlet such that the post-construction stormwater runoff generated by the water quality storm event on the CIA in the drainage basin either does not discharge through it or discharges only after receiving adequate treatment.
- Size the outflow pipe to ensure an adequate residence time, if applicable.

E.7.3.9 Access
Design the site to ensure there is maintenance access to the structural stormwater control. For underground detention, provide access to the upstream side of any outlets from underground detention. To prevent public access and protect public safety, fencing may be needed (e.g., if there are retaining walls, steep slopes, and/or standing water for more than 24 hours). Any fencing near a wildlife corridor should be wildlife-friendly.

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28 Examples of energy dissipation include riprap, energy dissipaters, or orienting the discharge pipe to prevent erosion on the opposite bank (when discharging to a channel).
E.8 Provide Details for Construction Practices

Construction methods can impact the long-term functioning of structural stormwater controls. Clearly explain how each structural stormwater control will be constructed, including the type of equipment and fuel to be used and provide the following construction practice details, as appropriate, both in the application and in the construction specifications and drawings.

E.8.1 Provide Construction Quality Assurance
Before construction, test any filter media (e.g., growing media) to ensure it meets the specifications and, for infiltration structural stormwater controls, test the subbase to ensure it meets the design rate. After construction, check structural stormwater control elevations (including the inlets and outlets and the bottom of the structural stormwater controls), and the dimensions and slopes. For infiltration structural stormwater controls, also check the infiltration rate after construction.

E.8.2 Protect Structural Stormwater Controls and Trees
Describe how areas proposed to be structural stormwater controls will be clearly marked off (e.g., with orange constructing fencing or a covering) before site work begins to prevent compaction. Do not allow staging areas or vehicles (except those specifically authorized to construct the structural stormwater control) within 10 feet of areas proposed to be infiltration structural stormwater controls. Describe how trees to be preserved will be protected.

E.8.3 Prevent Sediment Inundation within the Structural Stormwater Control
Prevent structural stormwater controls from being inundated with sediment from construction. Remove any construction-related sediment from all structural stormwater controls.

E.8.4 Prevent Erosion into and within the Structural Stormwater Control
Protect any exposed areas of structural stormwater controls (e.g., with jute matting, tackified mulches (in low velocity areas), biodegradable blankets or nets, or turf reinforcement mats) until plants have become fully established. Plants must be established prior to routing concentrated flows to the structural stormwater control.

E.8.5 Establish Plants for Long-Term Success
- Salvage onsite plants for later planting, as appropriate.

- Prepare the site prior to planting:
  - For constructed wetlands, after excavation, keep the excavation flooded until planting, and then drain the excavation just before planting.
  - For infiltration structural stormwater controls, scarify native soil within 24-hours before planting and after all machinery work and debris removal, when rain is not forecasted.

- Schedule planting during the growth season and time seeding to avoid rain wash-off.

- Install an irrigation system only if necessary to establish plants and remove any irrigation system after plants are established.
E.9 Provide an Operations and Maintenance Plan

Provide an operations and maintenance plan that includes the items described below:

E.9.1 Best Management Practices (BMPs) at the Site
Describe BMPs used to reduce pollution at the source (e.g., pet waste pickup, roof-covered community garbage cans, a street sweeping schedule).

E.9.2 Structural Stormwater Control Upkeep
Provide an inspection schedule that includes an annual inspection in the spring, fall and after large storm events. The plan should describe the following items, as appropriate.

E.9.2.1 Debris and Sediment Removal
Remove sediment build-up (e.g., clogged inlets/outlets, pretreatment areas, splash pads) and remove trash, leaf litter, and other debris. Consider sending clippings to a composting facility.

E.9.2.2 Vegetation Maintenance (for vegetated structural stormwater controls)
Remove invasive plants (e.g., Himalayan blackberry). Weed the structural stormwater control, minimizing pesticides and herbicides. Reseed bare areas and replace dead plants semi-annually. If mowing is required, consider requiring a retractable-arm mower to avoid compaction.

E.9.2.3 Replace Filter Media (if used)
Periodically check for standing water after storms to determine if the filter media is clogged. Conduct infiltration tests and replace the top 1-2 inches of the filter media, as needed.

E.9.2.4 Check for Operational Problems and Damages
Repair damaged surfaces (e.g. damaged by erosion, rodents, tree roots), correct operational problems (e.g., rill formation), and, if there are embankments, check for embankment stability issues (e.g., cracking, leaking).

E.9.2.5 Other
Clean and flush risers, as needed. Provide mosquito control (e.g., restock mosquito fish, remove cattails) as needed if the structural stormwater control has standing water for four or more days.

E.9.3 Identify Prohibited Activities
Prohibit heavy equipment and stockpiling materials in infiltration structural stormwater controls. Prohibit applying sealcoats to, stockpiling materials in, and routing stormwater runoff to porous pavement. Prohibit applying sand to porous pavement (except porous concrete during the first year, where it must be swept and vacuumed after each application of sand).

E.9.4 Identify Maintenance Responsibility
Operation and maintenance responsibility must be assigned to an existing person or entity. Provide the name and contact information and the process for transferring maintenance responsibility in the future (e.g., delegated to homeowners associations, or contracted out to management entities). The applicant is responsible for maintenance unless documentation is provided to DEQ that demonstrates another entity has agreed to be the responsible party.
F. Appendices
F.1 Glossary

The following definitions apply for the purposes of this document.

2-year, 24-hour precipitation: The amount of rainfall over a 24-hour period that has a 50% probability of occurring in a given year. The 2-year, 24 hour precipitation can be found using the NOAA Atlas 2 Precipitation Frequency Estimates (http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm) or the ODOT Precipitation Data Viewer (ftp://ftp.odot.state.or.us/techserv/geo-environmental/Hydraulics/Precip/ODOT_Precipitation_DataViewer.pdf).

10-year, 24-hour storm event: The amount of rainfall over a 24-hour period that has a 10% probability of occurring in a given year.

401 Water Quality Certification (WQC): A determination made by DEQ that a dredge and fill activity, private hydropower facility, or other federally licensed or permitted activity that may result in a discharge to waters of the state has adequate terms and conditions to meet state water quality standards and other applicable water quality laws. The federal permit in question may not be issued without this state determination in accordance with the Federal Clean Water Act, section 401 (33 USC 1341).29

Amend: The process of adding material to the soil or growing media to improve its characteristics for plant growth, water quality treatment, or infiltration purposes.

Amendment: The material added to the soil or growing media to improve its characteristics for plant growth, water quality treatment, or infiltration purposes.

Baffle: A structure designed to slow and/or redirect flow within a structural stormwater control.

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of “waters of the United States.” BMPs also include treatment requirements, operating procedures, and practices to control [project] site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.30

Bioretention Basin: A structural stormwater control that is comprised of a shallow, landscaped depression with growing media and vegetation that allows stormwater runoff to pond in a designated area, then filter through the filter media (e.g., growing media) and vegetation and possibly infiltrate to groundwater. Small-scale bioretention basins are also known as rain gardens.31 See Appendix F.4 for example details of bioretention basins.

Bioslope: A structural stormwater control that is comprised of a trench filled with aggregate at the top, filter media in the middle, and a drain layer at the bottom. Bioslopes are typically

29 From the Clean Water Act Section 401 and OAR 340-041-0002(1)
30 40 Code of Federal Regulations 122.2.
31 From EPA’s website https://www.epa.gov/greeningepa/stormwater-management-practices-epa-facilities
preceded by filter strips that provide pretreatment. See Appendix F.4 for a design detail of a bioslope.

**Check Dam**: A small dam or weir located across an open channel within a structural stormwater control to slow down the flow.

**Cistern**: A container to which stormwater runoff is directed and stored for later use. Cisterns are generally for larger applications than rain barrels. See also the definition for “Rain Barrel”.

**Cleanout**: A pipe fitting that allows access to a pipe for maintenance purposes (e.g., inspecting and clearing clogs).

**Combination rate/volume-based structural stormwater control**: A structural stormwater control where there is a combination of ponding and flow-through (e.g., filtering through media). Examples include stormwater planters, bioretention basins, rain gardens, and sand filters.

**Compost**: A substance derived primarily or entirely from the decomposition of vegetative or animal organic material that is distributed for the purpose of promoting or stimulating plant growth and to which no fertilizer, agricultural amendment, agricultural mineral or lime product is added other than to promote decomposition.\(^{32}\)

**Concentrated Flow**: Stormwater runoff that has converged and accumulated.

**Constructed Wetlands**: A structural stormwater control designed to mimic natural wetlands, with growing media and vegetation that provides for standing water or saturated conditions within a foot of the ground surface.

**Contained Planter**: A vegetated container placed over impervious surface.

**Contributing Impervious Area (CIA)**: All impervious surface areas within the project boundaries plus impervious surface areas owned or managed by the same entity from which stormwater runs overland or via discrete conveyance (e.g., piped) to an area within the project boundaries. The area outside of the project boundaries that is considered to be part of the CIA may be negotiated for public works projects if necessary to make the project economically feasible.

**Designated Beneficial Use**: The purpose or benefit to be derived from a water body as designated by the Water Resources Department or the Water Resources Commission.\(^{33}\) See Appendix F.3 for a list of designated beneficial uses.

**Detention Pond**: A structural stormwater control that is comprised of a depression that stores and slowly releases stormwater runoff.

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\(^{32}\) ORS 633.311(5)

\(^{33}\) OAR 340-041-0002(17)
**Drainage Basin:** All of the area that contributes post-construction stormwater runoff to the structural stormwater control.

**Drywell:** A structural stormwater control that is comprised of a deep, vertical underground structure with perforations that stores stormwater runoff until it can infiltrate out the sides.\(^{34}\)

**Ecoroof:** A type of rooftop that includes vegetated growing media over a drainage layer all overlying a waterproof membrane to protect the roof.

**Energy Dissipation:** A design feature to prevent erosion from stormwater runoff.

**Erosion:** The movement of soil particles or rock fragments by water or wind.

**Evapotranspirate:** Evaporation from surfaces (e.g., soils, water surfaces, and vegetative surfaces) plus transpiration through vegetative surfaces (e.g., leaves).

**Extended Wet Pond:** A structural stormwater control that is comprised of a depression that provides a permanent pool of water with growing media and vegetation and an outlet. Extended wet ponds are wet ponds that have additional storage above the permanent pool of water to meet flow control requirements for storm events larger than the water quality storm event.

**Feasible:** Technologically possible and economically practicable and achievable in light of best industry practices.

**Filter Strip:** A structural stormwater control that is comprised of gently sloping dense vegetation that receives sheet flow from impervious surfaces. See Appendix F.4 for an example detail of a filter strip.

**Filtration:** The physical straining of suspended particles (and pollutants that adhere to these particles) in stormwater runoff through filter media (e.g., growing media). The size of the voids in the filter media and the rate of flow impact the size and shape of the particles that will be filtered.

**First Flush Event:** The initial stormwater runoff with a higher pollutant concentration than stormwater runoff later in the storm event. For purposes of determining the water quality event, the “first flush” event is assumed to be 0.7 inches over a 24-hour period.

**Floodplain:** An area along a waterway subject to flooding when the stream overflows its banks.

**Foundation Planter:** See the definition for “Stormwater Planter”.

**Freeboard:** The vertical distance between the highest point of the structural stormwater control that is capable of fully storing water and the highest design water elevation.

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**French Drain:** A structural stormwater control that is comprised of a trench filled with aggregate and a perforated pipe.

**Green Roof/Green Rooftop:** See the definition for “Ecoroof”.

**Gross Pollutant Trap:** A structure that physically separates out of stormwater runoff, large pollutants (e.g., litter, debris, coarse sediment) and/or pollutants less dense than water (e.g., oils, floatables). Examples include water quality manholes (with a sump) and catch basin inserts.

**Groundwater:** Water beneath the land surface where the soil is fully saturated.

**Growing Media:** A soil or other base that supports vegetation.

**Highest Anticipated Seasonal Groundwater:** The highest elevation that groundwater is anticipated to typically reach annually.

**Impervious Surface:** Any surface resulting from development activities that prevents the infiltration of water or results in more stormwater runoff than in the undeveloped condition. Common impervious surfaces include building roofs; traditional concrete or asphalt paving on walkways, driveways, and parking lots; gravel lots and roads; and packed earthen materials.

**Infiltration:** Flow of rainfall or stormwater runoff into the soil through soil pores.

**Infiltration Rate:** The velocity at which stormwater runoff flows into the soil through soil pores.

**Infiltration Structural Stormwater Control:** A structural stormwater control designed to infiltrate stormwater into the soil beneath the structural stormwater control.

**Level Spreader:** A design feature to evenly distribute stormwater runoff.

**Low Impact Development (LID):** A land development approach that mimics natural hydrology by preserving natural resources and infiltrating stormwater runoff close to where it falls.

**Minimize:** Reduce and/or eliminate, or both, to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practice.

**Natural Buffer:** An area of undisturbed natural cover surrounding surface waters within which construction activities are restricted. Natural cover includes the natural vegetation, exposed rock, and barren ground that existed prior to commencement of earth-disturbing activities.

**Nutrients:** Substances necessary for the growth and maintenance of life; notably nitrogen and phosphorus.

**Observation Well:** A well (e.g., pipe) that allows subsurface drainage to be monitored.
**Pollution**: Such alteration of the physical, chemical or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, silt or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state, which will or tends to, either by itself or in connection with any other substance, create a public nuisance or which will or tends to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational or other legitimate beneficial uses or to livestock, wildlife, fish or other aquatic life or the habitat thereof.35

**Porous Pavement**: Also known as permeable pavement. This is a special type of pavement that allows rainwater and snowmelt to pass through it, thereby reducing the stormwater runoff from a site. In addition, porous pavement filters some pollutants from the infiltrated rainwater and snowmelt. Porous pavement includes porous asphalt and pervious concrete.36

**Pretreatment**: Initial stormwater treatment prior to entering the main part of the structural stormwater control; this typically involves settling or screening stormwater runoff to remove coarse sediment, debris, and/or trash, thereby minimizing maintenance requirements and extending the life of the structural stormwater control.

**Rain Barrel**: A barrel to which stormwater runoff is directed and stored for later use. Rain barrels are typically for smaller applications than cisterns. See also the definition for “Cistern”.

**Rain Garden**: A “sunken garden bed” with gentle side slopes and vegetation that collects and ponds stormwater runoff and passes it through filter media (e.g., growing media). Rain gardens are small-scale bioretention areas. See Appendix F.4 for an example detail of a rain garden.

**Rainfall Intensity**: The rate at which rain falls over a given period of time. In a given storm event, the rainfall intensity will vary, as there may be short bursts of heavy rainfall.

**Rainwater Harvesting**: Collecting, storing, and using rainwater or stormwater runoff.

**Rate-Based Structural Stormwater Control**: A structural stormwater control where stormwater runoff is not ponded, but instead flows through the control. Examples include filter strips, bioslopes, and some swales (swales can also be designed as combination rate/volume based structural stormwater controls, with check dams ponding stormwater runoff).

**Receiving Water**: The waterbody into which stormwater runoff discharges.

**Residence Time**: The average time it takes for stormwater runoff to travel though the structural stormwater control.

**Rill**: A shallow channel formed by concentrated flow.

35 ORS 468B.005(5)
36 EPA Stormwater Technology Fact Sheet- Porous Pavement, EPA 832-F-99-023
**Riser:** A vertical structure within a structural stormwater control with one or more openings that allow treated stormwater runoff to flow to the outlet pipe for discharge.

**Sand Filter:** A structural stormwater control that is comprised of a depression that temporarily stores water with sand or sand and gravel as the filter media. Vegetation is optional in a sand filter. See Appendix F.4 for an example detail of a sand filter.

**Scarify:** Loosen and make less dense near the surface.

**Settling Basin:** A structural stormwater control that is comprised of a depression to collect stormwater runoff and slow it down sufficiently to provide the time for suspended particles in the stormwater runoff to fall through the water column by gravity and accumulate at the bottom.

**Sheet Flow:** Stormwater runoff over the surface as a uniform film of water, before it has converged into concentrated flow.

**Soakage Trench:** An excavated trench filled with aggregate that receives stormwater runoff and stores it until it infiltrates.

**Soil Pore:** Open space (i.e., voids) between soil particles.

**Soil Porosity:** The ratio of the volume of the voids in the soil (i.e., soil pore volume) to the total volume of the soil.

**Stormwater:** Water from precipitation or snowmelt that collects on or runs off outdoor surfaces such as buildings, roads, paved surfaces and unpaved land surfaces.\(^3\)

**Stormwater Planter:** A structural stormwater control with vertical side slopes and a flat bottom that includes growing media and vegetation. Stormwater planters pond stormwater runoff and provide filtration through the filter media (e.g., growing media). See Appendix F.4 for example details of stormwater planters.

**Structural Spill Control:** A structure that contains spills so that they can be effectively cleaned up. Examples include spill control manholes and secondary containment.

**Structural Stormwater Control:** A physical feature to which stormwater runoff is directed and that is designed to infiltrate or slow down stormwater runoff. Unless all of the stormwater runoff directed to the structural stormwater control is from an area unlikely to introduce contaminants (e.g., some rooftops) the structural stormwater control should provide treatment through a combination of settling, flotation, screening, filtration, adsorption, photodegradation, microbial degradation and/or biological uptake.

**Swale:** A structural stormwater control that is comprised of a vegetated channel with a shallow slope or check dams to provide a low velocity through the channel. Grassy swales are planted

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\(^3\) OAR 340-044-0005(41)
with grasses; vegetated swales are planted with other vegetation. See Appendix F.4 for example details of vegetated swales.

**Time of Concentration:** The travel time from the hydraulically most distant point in the drainage basin (or the CIA) to the point of interest (i.e., the time it takes for stormwater runoff from all parts of the drainage area to contribute to flow at the point of interest). In designing structural stormwater controls, the point of interest is the inlet to the structural stormwater control.

**Total Maximum Daily Load (TMDL):** The sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and background. If the receiving water has only one point source discharger, the TMDL is the sum of that point source WLA plus the LAs for any nonpoint sources of pollution and natural background sources, tributaries, or adjacent segments. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. If Best Management Practices (BMPs) or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent. Thus, the TMDL process provides for nonpoint source control tradeoffs.38

**Toxic Substance:** Those pollutants or combinations of pollutants, including disease-causing agents, that after introduction to waters of the state and upon exposure, ingestion, inhalation or assimilation either directly from the environment or indirectly by ingestion through food chains will cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations in any organism or its offspring.39

**Underdrain:** A portion of a structural stormwater control filled with aggregate and a perforated pipe that discharges stormwater runoff to a point outside of the footprint of the structural stormwater control. Underdrains are located beneath any vegetation and growing media.

**Underground Injection Control (UIC):** A structural stormwater control that is deeper than its largest surface dimension or uses piping that emplaces stormwater in subsurface soils.

**Unvegetated Structural Stormwater Control:** A structural stormwater control that does not rely on vegetation as part of the treatment process.

**Vegetated Structural Stormwater Control:** A structural stormwater control that relies on vegetation as part of the treatment process.

**Volume-Based Structural Stormwater Control:** A structural stormwater control that is sized to store and treat a specific volume of stormwater runoff. Examples include wet ponds, extended wet ponds, and constructed wetlands.

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38 OAR 340-041-0002(65)
39 OAR 340-041-0002 (66)
**Waste:** Sewage, industrial wastes, and all other liquid, gaseous, solid, radioactive, or other substances that may cause or tend to cause pollution of any water of the state.\(^{40}\)

**Water Content (by Volume):** The ratio of the volume of the water in the soil to the total volume of the soil.

**Water Quality Storm Event:** The design storm event used to size structural stormwater controls. The DEQ 401 WQC Program defines this as the rainfall depth or flow rate that corresponds to eighty percent of the annual average rainfall, or the “first flush” event, whichever is greater. See step E.1 for instructions regarding how to determine the water quality storm event.

**Waters of the State:** Lakes, bays, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Pacific Ocean within the territorial limits of the State of Oregon, and all other bodies of surface or underground waters, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface or underground waters) that are located wholly or partially within or bordering the state or within its jurisdiction.\(^{41}\) Structural stormwater controls are not waters of the state provided they neither were originally created in waters of the state nor resulted from the impoundment of waters of the state.\(^{42}\)

**Well:** A bored, drilled, driven or dug hole whose depth is greater than its largest surface dimension, an improved sinkhole, a sewage drain hole, or a subsurface fluid distribution system.\(^{43}\)

**Wetlands:** Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.\(^{44}\)

**Wet Pond:** A structural stormwater control that is comprised of a depression that provides a permanent pool of water with growing media and vegetation and an outlet. Wet ponds with extra storage above the permanent pool of water to provide flow control for storm events larger than the water quality storm event are called ‘extended wet ponds’.

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\(^{40}\) OAR 340-041-0002 (69)
\(^{41}\) OAR 340-041-0002(72)
\(^{42}\) Adapted from 40 Code of Federal Regulations 122.2
\(^{43}\) OAR 340-044-0005(51)
\(^{44}\) From USACE and EPA definitions
F.2 Post-Construction SWMP Checklist

Provide, at a minimum, the following plus any information specifically requested by DEQ.

☐ A cover page, including:
  ☐ Date
  ☐ Project name and number (e.g., U.S. Army Corps of Engineers number, if applicable)
  ☐ Plan preparer’s name and contact information
  ☐ An Oregon-registered engineer’s stamp and signature *(unless the structural stormwater control is small, such as a rain garden for a single family residence)*

☐ Site plans showing the following:
  ☐ Reference information (e.g., title, north arrow, scale bar, legend, and date)
  ☐ The pre- and post-construction topography
  ☐ Any features that impact the siting and design of structural stormwater controls
  ☐ Buffers for waters of the state to remain onsite (50-ft minimum unless infeasible)
  ☐ Existing, new, removed, and contributing impervious surface areas
  ☐ The locations of any infiltration tests
  ☐ The drainage basin for each structural stormwater control
  ☐ The stormwater conveyance system
  ☐ Structural stormwater controls
  ☐ The discharge point(s) from the structural stormwater controls
  ☐ The route stormwater flows from the structural stormwater control to the receiving waters
  ☐ The name(s) and flow direction(s) of the receiving waters

☐ A description of how post-construction stormwater runoff generated by the water quality storm event on the CIA from each drainage basin will be managed to minimize impacts to water quality, and avoid sensitive areas (or provide justification why this is infeasible, along with the necessary mitigation) including documentation that this stormwater runoff either be:

  ☐ Routed to one or more regional structural stormwater controls with a combined capacity sufficient to accommodate this runoff without discharging to surface waters or polluting groundwater (provide documentation that the owner(s) accept(s) this runoff) and/or
  ☐ Infiltrated (after any necessary treatment), evapotranspirated, and/or reused onsite (if infiltrated, include results of infiltration tests) and/or
  ☐ Treated prior to discharge to receiving waters as there is either insufficient or no onsite area to locate infiltration structural stormwater controls or there is both a high likelihood of spills and structural spill control is not feasible (provide justification, including a description of site constraints and the results of any infiltration tests).

☐ A description of the design elements to reduce stormwater runoff, including:
  ☐ How impervious surface area is minimized
  ☐ How rainfall on roofs is managed (if applicable)
  ☐ How trees and shrubs are retained and/or planted onsite or why this is infeasible
A description of the water quality impacts of the site and receiving water status:
- Receiving waters’ beneficial uses and water quality limited pollutants
- Materials that could impact water quality (including materials comprising the CIA)
- How any applicable water quality management plan goals and/or restrictions will be met
- How shading is preserved

A description of and design details of each structural stormwater control, including:
- An identification of any UICs
- A description of any pretreatment
- Cross section(s) showing relevant features including
  - Dimensions and slopes
  - Elevation of the bottom of the structural stormwater control
  - Inlet and outlet sizes and invert elevations
  - Thickness of any filter/growing media, drain layer, and separation layer
- Plan view(s) showing relevant features (including dimensions)
- The plantings (including species, locations, and density)
- Filter/growing media specifications (including composition and infiltration rate)
- Drain layer specifications (including the size of any drain rock and any pipes)
- Description of any other relevant features (e.g., liners, energy dissipation)
- How maintenance access will be provided

Design calculations and printouts, including the following:
- The stormwater management manual used
- The models, equations, and/or any studies used and any associated limitations
- The water quality storm event
- The elevation of the highest anticipated seasonal groundwater
- The minimum residence time (if applicable)
- The maximum velocity (if applicable)
- Any special conditions (e.g., cold climate, low hardness receiving waters)
- For infiltration structural stormwater controls, the soil pore storage volume

Construction details, including the following, as appropriate:
- The type of equipment and fuel to be used
- Quality control/quality assurance to be implemented for structural stormwater controls
- How the structural stormwater control(s) and trees will be protected from compaction
- How the structural stormwater control(s) will be protected from inundation with sediment
- How the structural stormwater control(s) will be protected from erosion
- A planting plan to establish plants for long-term success

An operations and maintenance plan, including the following:
- A description of best management practices
- An inspection schedule and list
- A description of any prohibited activities
- An identification of the responsible party
### F.3 Designated Beneficial Uses

<table>
<thead>
<tr>
<th>Basins</th>
<th>Waters</th>
<th>Beneficial Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public Domestic Water Supply</td>
<td>Irrigation</td>
</tr>
<tr>
<td>Columbia River</td>
<td>Columbia River Mouth to RM 86</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Columbia River RM 86 to 309</td>
<td>x</td>
</tr>
<tr>
<td>Deschutes</td>
<td>Deschutes River Main Stem from Pelton Regulating Dam</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Crooked River Main Stem</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Goose and Summer Lakes</td>
<td>Goose Lake</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Highly Alkaline &amp; Saline Lakes</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Grand Ronde</td>
<td>All Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Hood</td>
<td>All Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>John Day</td>
<td>All Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Klamath</td>
<td>Klamath River from Klamath Lake to Keno Dam (RM 255)</td>
<td>x</td>
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<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Malheur Lake</td>
<td>Natural Lakes</td>
<td>x</td>
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<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Malheur</td>
<td>All Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Mid-coast</td>
<td>Estuaries &amp; Adjacent Marine Waters</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>North-coast</td>
<td>Estuaries &amp; Adjacent Marine Waters</td>
<td>x</td>
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<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Owyhee</td>
<td>Designated Scenic Waterway&lt;sup&gt;4&lt;/sup&gt;</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Powder</td>
<td>All Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Rogue</td>
<td>Rogue River Estuary &amp; Adjacent Marine Waters</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Rogue River Main Stem from Estuary to Lost Creek Dam</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Bear Creek Main Stem</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Sandy</td>
<td>Streams Forming Waterfalls Near Columbia River</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Bull Run River and all Tributaries</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Snake River</td>
<td>Snake River RM 176 to 409</td>
<td>x</td>
</tr>
<tr>
<td>South Coast</td>
<td>Estuaries &amp; Adjacent Marine Waters</td>
<td>x</td>
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<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Umatilla</td>
<td>Walla Walla River Main Stem from confluence of N. &amp; S.</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Walla Walla Subbasin Waters</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters&lt;sup&gt;5&lt;/sup&gt;</td>
<td>x</td>
</tr>
<tr>
<td>Umpqua</td>
<td>Umpqua R. Estuary to Head of Tidewater &amp; Adjacent</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Umpqua R. Main from head of tidewater to confluence of</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>All Other Basin Waters</td>
<td>x</td>
</tr>
<tr>
<td>Willamette</td>
<td>Willamette River Tributaries</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Main Stem Willamette River Mouth to Willamette Falls&lt;sup&gt;6&lt;/sup&gt;</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Main Stem Willamette River Willamette Falls to Newberg</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Main Stem Willamette River Newberg to Salem</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Main Stem Willamette River Salem to Coast Fork</td>
<td>x</td>
</tr>
</tbody>
</table>

<sup>1</sup> With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

<sup>2</sup> See also fish use designations ([http://www.oregon.gov/deg/Regulations/Pages/OARDiv41.aspx](http://www.oregon.gov/deg/Regulations/Pages/OARDiv41.aspx)).

<sup>3</sup> For coastal water contact recreation and shellfish harvesting, see also Figures 220C-H, 230C-H, 300C-D and 320C from 340 OAR Div. 41.

<sup>4</sup> The mainstem of the S. F. of the Owyhee River from the Oregon-Idaho river border to Three Forks (the confluence of the N., M. and S. Forks Owyhee River) and the mainstem Owyhee River form Crooked Creek (RM 22) to the mouth of Birch Creek (RM 76).

<sup>5</sup> For the Willow Creek Subbasin, boating applies at the mouth of Willow Creek.

<sup>6</sup> In the Main Stem Willamette River Mouth to Willamette Falls, this is not to conflict with commercial activities in Portland Harbor.
F.4 Details of Stormwater Controls (Examples Only)

The following are details of post-construction stormwater controls to serve as illustrative examples only. The bioslope details are from the April 2014 ODOT Hydraulics Manual; the volume-based controls are from the 2016 King County Surface Water Design Manual and all of the other details are from the City of Portland’s 2016 Stormwater Management Manual. Note that these details come with specifications that are not included here and that minimum requirements may vary.

F.4.1 FLOW-RATE BASED CONTROLS

Swales, filter strips, and bioslopes are designed for stormwater runoff to flow over a sloped surface. Swales and filter strips are both fully vegetated; swales have a limited width with a long flow path within a depression while filter strips have an unlimited width, with a (usually much shorter) flow path that is not within a depression. Bioslopes are designed to have stormwater runoff flow over a filter strip and then over aggregate, which allows the water quality storm event to filter through filter media.

![FILTER STRIP PROFILE](image-url)
Swales can also be sized as combination volume/rate based controls
F.4.2 COMBINATION VOLUME and RATE BASED CONTROLS

Filters are designed for stormwater runoff to pond and then filter through filter media such as a growing media or sand. Some filters allow full infiltration, some partial, and some are lined to prevent infiltration.

**UNLINED BIORETENTION BASIN CROSS SECTION**

**LINED BIORETENTION BASIN CROSS SECTION**

© City of Portland, courtesy Bureau of Environmental Services
UNLINED STORMWATER PLANTER CROSS SECTION

Design professional is responsible for verifying that grades will allow piped conveyance to facility.

TO APPROVED DISCHARGE POINT PER SECTION 1.3.1. SEE SW-190 FOR OVERFLOW CONFIGURATION (IF REQUIRED)

LINED STORMWATER PLANTER CROSS SECTION

ADJACENT TO BUILDING

Design professional is responsible for verifying that grades will allow piped conveyance to facility.

TO APPROVED DISCHARGE POINT PER SECTION 1.3.1. SEE SW-190 FOR OVERFLOW CONFIGURATION
F.4.1 VOLUME-BASED CONTROLS

Wetponds, extended wetponds, and wetlands are designed to store a pool of water (the water quality design storm volume) that gets displaced during storm events.
WETPOND CROSS SECTION

SECTION A-A

SECTION B-B

NOTE:
SEE DETENTION FACILITY REQUIREMENTS FOR LOCATION AND SETBACK REQUIREMENTS

© King County, Washington Surface Water Design Manual
CONSTRUCTED WETLAND

INFLOW

FIRST CELL
(FOREBAY)

WETLAND CELL

PLANT WITH
WETLAND
PLANTS
(SEE TEXT)

ACCESS ROAD

SPILLWAY

PLAN VIEW Option A
NTS

NOTE:
SEE DETENTION FACILITY REQUIREMENTS FOR
LOCATION AND SETBACK REQUIREMENTS.

OUTLET STRUCTURE
(SEE DETAIL
FIGURE 6.4.1.B)

SUBMERGED OUTLET

INLET AND OUTLET SUBMERGED
1' OVER PIPE CROWN

FIRST CELL DEPTH
4' MIN. TO 8' MAX.

2.5' MAX

IF REQUIRED, PLACE LINER IN
SECOND CELL TO HOLD WATER

SLOPE MAY BE 2:1 WHEN
TOP SUBMERGED
1 FT BELOW DESIGN WS

WQ DESIGN WS

SECTION VIEW Option A
NTS

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&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL
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