CITY OF GRESHAM

Stormwater Management Manual

An Implementation Guide for Development Projects

October 2019

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Finalized October 2018
Revised October 2019, January 2021, December 2021, and November 2022

Effective January 2023

Stormwater management is a toolbox of methods used to improve water quality and reduce the quantity and rate of stormwater runoff to protect streams, aquatic life and human health.

The 2018 SWMM updates and consolidates stormwater management requirements previously located in the following documents:

- Water Quality Manual (2003)
- Green Development Practices Manual (2007)
- The detention standards, conveyance guidance, and Erosion Prevention and Sediment Control Manual from the Public Works Standards (2006)

CITY OF GRESHAM

Department of Environmental Services
Water Resources Division

Revisions:

October 2019:

- **Submittals**. Updated name of document where site plan requirements in section 2.4.3 are listed from *Public Works Standards* to CAD Manual.
- **Downspout Disconnection**. Removed from Simple Sizing Form and updated section 3.2.4 to only allow this to be used for retrofit projects. New construction should install an actual structure to manage stormwater, even residential downspouts (e.g. mini-drywell)
- **Porous Pavement**. Corrected text in section 3.1.1 to accurately describe ODOT's porous asphalt mix. Also added info about edge restraints needed for porous pavers.
- **Ponds/Centralized Facilities**. In section 3.2.5, clarified outlet design requirements to ensure ponds have secondary outlet to allow outflow in case of thatching. Added more detail about installation of and maintenance vehicle access to pre-treatment structures (sedimentation manhole, sedimentation forebay). Clarified fencing requirements to ensure safety, while allowing facilities to be a public amenity whenever feasible.
- **Drywells.** Added information to section 3.3.1 about mini drywells, which can be used for small drainage areas (up to 500 sf of roof area).
- **Public Storm Pipes.** Updated section 4.5.1 so that all public system design directed to *Public Works Standards*, which were updated/clarified to ensure consistency with goals for public and private connections.
- **Bridges and Culverts**. Clarified sizing for new versus existing stream crossing structures in Table 4-1 and section 4.8
- **O&M Form.** Minor clarifications added to be consistent
- **Appendix B.** Added mini drywell to the list of details included with the single-family residential guidance.
- **Appendix D.** The hydrologic soil group for Aloha-Urban land complex in Table D-2a was corrected to be type C instead of B.
- **Appendix F.** Added in details for structural soils for projects that may choose to install Stormwater Tree Wells, which are being added as a typical detail to the *Public Works Standards*.
- **Appendix H.** Updated several of the standard details to ensure consistency with Oregon Plumbing Specialty Code. Primary changes were removing upturned outlet to ensure sediment doesn't clog outlet and ensuring that trapped silt basin guidance aligned with catch basin design specifications in OPSC 1101.11.1 - 1101.11.5. Also added a mini drywell detail that single family home builders can submit with their plans.

January 2021:

- **Emergency Escape Route**. Requires facility design to demonstrate that excess flows not requiring a conveyance system will not cause property damage or otherwise violate Oregon Drainage Law.
- **Trapped Silt Basin.** Updated pretreatment requirements for underground infiltration facilities (drywells, soakage trenches and infiltration vaults). With DEQ concurrence, a trapped silt basin is considered adequate pretreatment for most roof runoff, not just roofs that are exempt from DEQ registration.
- **Stormwater Tree Well**. Added facility description to section 3.2.6 to provide details about these facilities that are included in the Green Street details of the *Public Works Standards*.
- **Conveyance**. Updated language to ensure consistency with updated City code, as well as requirements from state and federal agencies for work in and around waterways

- **Source Control**. Removed requirement to have a valve for spill containment for areas outside fueling station cover
- **Erosion Control Details.** Drawings cleaned up to ensure consistent with CAD standards

December 2021:

- **Porous pavement.** Updated reference to ODOT's mix in section 3.1.1
- **Ponds/centralized facilities**. Clarified design to be surface ponding only, as well as adding additional details on access requirements for maintenance.
- **Subsurface infiltration facilities.** Revised text in sections 3.3.1, 3.3.2 and 3.3.3 to reflect DEQ requirements to register any UIC that doesn't drain single family residential roofs. Pedestrian-only plazas and duplexes may only require a trapped silt basin for pre-treatment, but DEQ requires these UICs to be registered
- **Waste storage.** Updated section 5.5 to specify that individual food carts need to have a cover over their waste storage area, but do not need to meet the pavement and drainage requirements.
- **Appendix C.** Corrected the GRC code reference in C.2. Added revision dates to erosion control drawings to be consistent with other Gresham CAD details
- **Appendix F**. Corrected proportions of materials in F.10.2 for mixing structural soil
- **Appendix H**. Added revision dates to typical detail drawings to be consistent with other Gresham CAD details

November 2022:

- **Requirements**. Added clarifying language in section 1.1 and Appendix C (Erosion Control Manual) that flow control is required when water is released from site during construction
- **Porous pavement**. Changed a few references to pervious pavement for consistency
- **Ponds/Centralized Facilities.** Updated the vegetation/planting information in section 3.2.5 and Appendix G to clarify planting requirements, particularly for wet ponds that have more than 2-feet of permanent water depth.
- **Temporary Sedimentation Basins.** Updated information in section 3.2.5 and Appendix C to highlight that when erosion control facilities are converted to post-construction ponds prior to construction activity being completed, the developer may need remove sediment and replace planting media and/or plants prior to city acceptance.
- **Tree protection.** Updated EPSC-2 drawing and Appendix C to ensure that requirements are consistent with development code for tree protection during construction
- **Appendix E.** Added drywell capacity testing procedure, which had formerly been in Public Works Standards
- **Appendix H.** Simplified the drywell sizing table on ST-170, made the pre-treatment silt basin optional on ST-171, and made silt basin language on ST-190 consistent with other subsurface infiltration facilities.

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1.0 Requirements

The goal of this Stormwater Management Manual is to protect water quality, reduce stormwater volumes to below a threshold that negatively impact streams, and provide other standards that meet the intent of requirements from DEQ and relevant City policies and goals.

Any activity within the City of Gresham that disturbs 1,000 square feet or more of land is required to control erosion and install structures to manage stormwater quality and quantity unless specifically exempted under section 1.2.1. Stormwater shall be retained/infiltrated on-site to the maximum extent feasible.

1.0.1 Background

As urban areas develop over time, modifying the landscape by removing trees and vegetation and adding impervious surfaces such as roadways, buildings, and parking lots, the natural water cycle (hydrology) is altered. Rainwater that was once captured by trees and topsoil and evaporated or infiltrated, now collects on these impervious surfaces as stormwater and quickly runs off, taking with it pollutants such as lead (from sources such as automobile brakes), nutrients (phosphorus or nitrogen from fertilizers), bacteria (from animal waste), and sediments. These pollutants, along with alterations to the natural hydrology, contribute to the degradation of local streams and waterways.

With increased development there is increased stormwater runoff. Streams, ditches, and stormwater pipes that were once able to convey stormwater may now become overwhelmed, causing erosion and localized flooding which in turn leads to hazardous situations and property damage. In addition, impacts to stream channels due to increased runoff, often referred to as "hydromodification," is something the Oregon Department of Environmental Quality (DEQ) requires the City to control through:

1) using green development practices, or
2) utilizing methods of flow control to mimic pre-development hydrology.

Stormwater management includes techniques to mitigate these issues by both improving stormwater quality (remove pollutants) and reducing the quantity and rate of runoff, thereby protecting downstream natural resources as well as helping to prevent flooding. The purpose of this manual is to provide the development community, Gresham residents, and City staff with clear direction on stormwater management requirements within the City, how to select appropriate practices for different development scenarios, how to design them, and how they should be maintained to operate effectively.

1.0.2 Authority

Authority for the requirements in this Stormwater Management Manual come from the *Gresham Community Development Code* and the *Gresham Revised Code*.

1.1 Erosion Control

The City of Gresham requires erosion prevention and sediment control (EPSC) on all land-disturbing activities, regardless of whether that property is involved in a construction or development activity. The standard for all land in Gresham is that sediment must not leave a site, even projects that do not otherwise require a city permit. Larger development sites that need to discharge sediment-free stormwater must not exceed the flow control thresholds in **section 1.2.5**.

Construction activities disturbing 1,000 square feet or more will be subject to EPSC inspection procedures. At the City's discretion, permitted development less than 1,000 square feet may also be inspected.

Construction sites disturbing more than one acre, or are part of a common plan of development that will ultimately disturb one or more acres, are required to obtain a DEQ 1200-C Construction Stormwater Permit, in addition to a City EPSC permit. If City staff become aware of a project subject to DEQ 1200-C requirements, staff will inform the project owner of the requirement and will refer the project to DEQ within 7 days of making such a determination or applicable timeframe as required by the City's Stormwater Permit from DEQ.

See **Appendix C** for erosion prevention and sediment control (EPSC) requirements and Best Management Practice (BMP) descriptions.

1.2 Stormwater Management

Projects that develop or redevelop over 1,000 square feet of impervious surface are required to comply with stormwater management requirements for the new or redeveloped impervious area at the site, unless specifically exempt under **section 1.2.1**. Stormwater management requirements apply to projects on both private and public property or right-of-way with existing or new impervious area, including, but not limited to, all roofs, patios, walkways, parking lots, streets, alleys, driveways, and sidewalks. Stormwater management requirements include managing stormwater 1) quantity/volume, 2) quality, and 3) conveyance.

Redevelopment projects on sites that met previous stormwater management requirements must upgrade or demonstrate that existing controls meet the requirements in this manual.

Unless approved by the City, stormwater generated from impervious area on a property should be managed on the same property in facilities maintained by the property owner. Stormwater that is generated within the public right-of-way must be managed in publicly maintained facilities. Stormwater facilities required as a condition of development or redevelopment in the right-of-way must be sized to manage stormwater from the contributing impervious area within the right-of-way, including sidewalks and driveway aprons. Stormwater facilities in the right-of-way shall be sized to treat stormwater from private driveways, unless they can be graded to a private treatment facility.

The most effective method for reducing the impact of stormwater flow on our waterways is the retention of stormwater on-site. This can be achieved in a number of different ways, including:

- Reducing or eliminating impervious surfaces,
- Enhancing tree canopy,
- Infiltration of stormwater into the ground,
- Storage of water in layers of topsoil and evaporation or evapotranspiration into the atmosphere.

1.2.1 Exemptions

Certain development or project conditions are exempt from meeting stormwater management requirements. (Note: no project is exempt from erosion control requirements.) All exemptions are subject to City review and must still identify a discharge location. Exemptions are not allowed in circumstances where regulatory permits or other municipal regulations may be violated if the exemption is allowed.

The following circumstances are exempt from meeting stormwater management requirements:

- Residential structures being re-built following fire damage, flooding, earthquake, or other natural disaster, as long as the structure is re-built at the same scale and discharging to the same disposal point. **Expansions to the original footprint, such as an addition or alteration to the original structure, trigger stormwater management requirements for the new impervious area.**
- Interior remodeling projects, tenant improvements, or re-roofing.
- Pavement repair and maintenance activities that do not alter the subgrade or add additional impervious area, including:
    - Pothole and square cut patching
    - Crack sealing
    - Resurfacing with in-kind material without expanding the area of coverage
    - Overlaying existing asphalt or concrete pavement with bituminous surface treatment, chip seal, asphalt, or concrete without expanding the area of coverage
- Standalone projects that consist solely of safety improvements to stairs, ramps, curbs, corners, and medians that install accessibility and pedestrian safety features. Examples include rapid flash beacons or concrete curb extensions for pedestrian safety.
- Standalone projects that consist solely of utility trenching in paved areas in public rights-of-way or on private property.
- Replacing catch basins or inlets that discharge to the same storm or drainage system are not considered a new connection or a new offsite discharge, as long as the cumulative impact to the receiving system remains the same following project completion.

1.2.2 Infiltration Feasibility Criteria

Stormwater facilities should be designed to infiltrate stormwater to the maximum extent feasible. A filtration, versus infiltration, facility should be used for sites meeting one or more of the following conditions:

1. Sites on unconsolidated fill;
2. Sites on slopes >20% or slope stability concerns. A geotechnical engineering or geologist report and City approval is required for infiltration facilities on slopes of 10-20%, for areas on the top of slopes, and within the Hillside & Geologic Risk Overlay;
3. Sites where the seasonally high groundwater level is within 3 feet of ground surface. A seasonal high groundwater level assessment should consider the proposed bottom elevation of stormwater infiltration facilities;
4. Sites with contaminated soils. Sites that have contaminated soil conditions must be evaluated by DEQ and/or the U.S. Environmental Protection Agency to determine if areas on the property are suitable for infiltration;
5. Areas which require source controls and are categorized as high-risk sites (e.g. hazardous transportation route at Groundwater Protection regulated businesses).

A geotechnical report is required for the first 3 conditions.

In areas where one of the above factors deems infiltration infeasible, water quality treatment (filtration) using vegetated facilities shall be maximized. If site constraints, such as steep slopes (identified in the geotechnical report) or grade to get flows in/out of a vegetated facility would make a surface facility infeasible, one of the "Other Facilities" described in **section 3.4** may be proposed.

1.2.3 Stormwater Quality Treatment

The pollutant reduction requirement for stormwater treatment is 80 percent of the average annual runoff. The stormwater quality design storm is 1.2 inches during a 24-hour period, which is equivalent to 80% of the average annual rainfall in Gresham.

Stormwater facilities must be capable of reducing total suspended solids (TSS) by 70%, as well as treating any other pollutants of concern identified by DEQ in established Total Maximum Daily Loads (TMDLs) or that are on DEQ's 303(d) list of impaired waters. Installation of the infiltration and green infrastructure facilities described in **section 3.0** are assumed to meet both the TSS and TMDL/303(d) pollutant reduction goals. Any alternative facility being proposed must meet or exceed both of those pollutant reduction requirements.

Facilities following the Simple Method may use the sizing factor on the Simple Sizing Form for Type A soils to meet the on-site water quality treatment requirement.

1.2.4 Stormwater Management Options

Infiltrating stormwater as close to the impervious surface being treated (roof, driveway, street, etc.) should occur whenever feasible. **Section 1.2.2** provides guidance on feasibility for infiltration. Porous pavement and ecoroofs receive full credit for water quality and flow control, and also result in a reduction of monthly stormwater utility rate.

The stormwater management proposed for any project shall prioritize the use of green development practices following **section 1.2.4.1** for single taxlot developments or **section 1.2.4.2** for subdivisions and partitions. All development projects that will create new public streets or infrastructure must follow **section 1.2.4.3**.

Throughout this section, "most localized scale possible" means stormwater management is occurring immediately adjacent to, or within 100' away from, the impervious surface requiring treatment.

If the following options are deemed infeasible, the City may allow other options, including an off-site centralized facility, "gray infrastructure" (e.g. proprietary filters, detention pipes/vaults), or payment of an in-lieu fee. Stormwater management techniques that are cited as "cost prohibitive" will not be accepted as "infeasible."

1.2.4.1 Single Lot Developments

Commercial, industrial and residential lots shall manage stormwater on the same parcel treating the water quality event (**section 1.2.3**) and meet the flow control requirements in **section 1.2.5**.

Green practices that infiltrate and/or are vegetated shall be used to the maximum extent practicable for all single lot facilities, as well as any public streets or improvements required as part of the development (see **section 1.2.4.3**).

1.2.4.2 Subdivisions and Partitions

Multi-lot subdivision or minor partitions can select from any of the following options:

A. **Dispersed.** Infiltrate/retain the 10-year storm event in a private facility located on the same residential taxlot as the impervious surface being treated. Conveyance must be provided, but no further downstream detention/flow control required.
B. **Hybrid.** Infiltrate or manage the water quality event (**section 1.2.3**) at most localized scale possible, then meet the flow control requirements (**section 1.2.5**) at a downstream centralized facility. Can assume impervious surfaces treated for water quality are 50% pervious for sake of downstream facility detention/flow control calculations.
C. **Centralized.** Use centralized facility to treat both water quality (**section 1.2.3**) and flow control (**section 1.2.5**) for all impervious surface within development.

Green streets shall be used to the maximum extent practicable for any public streets or improvements within development per **section 1.2.4.3**.

Unless approved by the City, centralized facilities shall be located in a separate tract within the parent parcel. For developments that are primarily single family residential, this tract shall have an easement or dedication to the City for public stormwater management and maintenance per **section 6.1**. Approval for locating a facility off-site will consider criteria such as ownership, access, impacts to adjacent resources (e.g. other properties, existing or planned utilities, environmental resource areas, etc.)

1.2.4.3 Streets and Public Infrastructure

All development projects that will create new public streets or infrastructure shall prioritize green infrastructure (i.e. street-side stormwater planters) at the most localized scale possible to the maximum extent practicable (MEP). MEP is assumed to be achieved when stormwater planters and stormwater tree wells are sized at 5% (or swales/rain gardens sized at 6%) of the contributing impervious area. When the developer can demonstrate that site specific constraints (e.g. gradient, utility conflicts) make it infeasible to achieve MEP, the assumed 50% pervious assumption shall be proportionally decreased (e.g. stormwater planters sized at 3% can assume 30% of treated street surface is pervious, instead of 50%).

1.2.5 Flow Control

For facilities that cannot retain the 10-year storm event on-site, flow control is required to prevent stream channel erosion (also called hydromodification). Sites where the 10-year event can be stored in an on-site facility, but would not fully draw down/infiltrate within 48-hours, need to ensure that overflow conveyance (**section 4.0**) is provided to safely convey larger storm events.

Sites where there is not an off-site conveyance system (e.g. designated drywell area) must size facilities to manage the 25-year storm event. Sites retaining the 25-year storm event on-site may be eligible for a reduction in the on-site portion of the monthly stormwater fee. All sites managing less than the 100-year event on-site must ensure there is an emergency escape route to ensure any excess flow avoids damage to the parcel being developed and adjacent properties.

For subdivisions that manage the water quality event on-lot (**section 1.2.3**), any downstream detention facility must be sized to detain the 25-year storm event and meet the City's flow control requirements to ensure that post-development storm flows leaving the site:

- mimic the storm flows of the site prior to development, to the maximum extent possible;
- do not exceed the capacity of the receiving system or water body;

- do not increase the potential for stream bank and stream channel erosion; and
- do not create or increase any upstream or downstream flooding problems.

The flow volume causing hydromodification varies from stream to stream. Unless more specific data is available, the City assumes that channel-eroding flow begins to occur when one-half of the 2-year, 24-hour pre-development design storm peak flow is exceeded**.** To prevent hydromodification of the channel and mimic predevelopment hydrology, stormwater facilities shall be sized to retain the 25-year event and control post-development peak flows to the pre-development levels in **Table 1-1**.

Table 1-1: Flow control targets. Post-development peak runoff must match or be lower than the pre-development flow rate targets

Post-Development Peak Flow Rate	Pre-Development Peak Flow Rate Target
2-year, 24-hour	50% of 2-year, 24-hour
5-year, 24-hour	5-year, 24-hour
10-year, 24-hour	10-year, 24-hour
25-year, 24-hour	25-year, 24-hour

Pre-development is assumed to be conditions that existed at the site prior to any grading and land clearing activity related to the current development. The most frequently occurring pre-developed conditions are listed in **section 2.3.2.1** (e.g. forest, brush, grass, or paved/impervious surface). A weighted value should be calculated to reflect the portion of the site covered by each pre-existing surface condition.

1.2.6 Conveyance

A conveyance system must be designed to route stormwater into and away from any stormwater facility that cannot fully infiltrate water on-site. An overflow conveyance system is required for any site retaining less than a 10-year event. An emergency escape route that will direct water to a location that will not cause property damage, or adequate on-site storage, must be demonstrated for all sites that cannot retain the 100-year event. Emergency escape routes do not need to meet the conveyance requirements in Section 4.0, unless a piped system would be required. **Section 4.0** has requirements for sizing pipes and open channel conveyance systems for on-site and sub-basin drainage.

1.3 Source Control

All businesses within the City whose activities result in recurring sources of pollution as defined in GRC 3.23.025, shall be subject to the Stormwater Pollution Prevention for Businesses Program inspections, technical assistance and pollution prevention factsheets of policies and best practices for preventing, controlling, and cleanup of pollutants.

Certain business classifications/end uses have additional requirements to meet during site development to ensure that pollutants do not leave the site and enter the stormwater system to protect local waterways. The uses, activities, and materials requiring additional measures to protect stormwater on-site include:

- Fuel Dispensing Facilities and Surrounding Traffic Areas (**Section 5.3**)
- Above-Ground Storage of Liquid Materials (**Section 5.4**)
- Solid Waste Storage Areas, Containers, and Trash Compactors (**Section 5.5**)
- Exterior Storage of Bulk Materials (**Section 5.6**)
- Material Transfer Areas/Loading Docks (**Section 5.7**)

- Equipment and/or Vehicle Washing Facilities (**Section 5.8**)
- Equipment and/or Vehicle Repair Facilities (**Section 5.9**)
- Stormwater and Groundwater Management for Development on Land with Suspected or Known Contamination (**Section 5.10**)
- Multilevel Parking Structures (**Section 5.11**)

2.0 Stormwater Facility Sizing and Submittals

Successful design of stormwater facilities and conveyance features requires careful planning. Where and how stormwater management will occur for any development should be integrated as the site plan is being developed, rather than trying to figure out where it will fit after the site has already been planned.

The following section describes 1) the methods available for sizing stormwater facilities, 2) the submittals required to demonstrate compliance with the stormwater requirements in **section 1.0**, and 3) the process for getting submittals reviewed and approved by the City.

2.1 Development Process

For most development projects, the following steps should be followed to plan and construct stormwater facilities that meet the requirements in this manual.

1. **Evaluate the Site.** Identify surface water, drainages, wetlands, and groundwater features; existing utilities (water, sanitary, storm, other); and delineate trees to be preserved.
2. **Determine All Requirements.** Development code may have requirements that apply beyond stormwater, such as habitat buffers, setbacks, screening requirements, cut and fill, etc.
3. **Characterize Site Drainage and Runoff.** Determine soil type (or measure infiltration rate); determine depth to groundwater; determine if/where discharge will occur.
4. **Develop a Conceptual Design.** Develop site grading plan, proposed structures to be added, and ensure that water from impervious area added to site will be treated by stormwater facilities.
5. **Develop Landscape Plan.** Integrate stormwater facilities with site landscape plan
6. **Finalize Stormwater Report.** Confirm that stormwater facility sizing is adequate for the proposed development.
7. **Determine Operation and Maintenance Needs.** Facilities must be maintained according to the requirements in this manual (see Chapter 6). Stormwater facilities not described in **section 3.0** will require development of a maintenance plan and agreement
8. **Submit Final Plans and Obtain Permits**. Submit site plan, stormwater facility sizing form or calculations, and other submittal requirements listed in **section 2.4**
9. **Construct and Inspect.** Construct structures and facilities according to permit and call for City inspections to ensure facilities meet approval.

2.2 Submittal Review and Approval

Any large development or project that will create or alter public infrastructure (e.g. street frontage improvements) must go through the City of Gresham's Development Engineering (DE) group.

Development which isn't required to install public improvements can fill out the required forms and work directly with the City's Permit Center/Building Department on obtaining permits for grading, erosion control and construction.

City plan review and approval will consider whether the following goals were considered in the proposed development:

- Ensure that the existing topography, tree canopy, riparian buffers and drainage conditions are considered before streets, parking lots, buildings, and other man-made structures are constructed;

- Optimize site design and reduce or eliminate potential conflicts between planned development and required stormwater management systems;
- Reduce new impervious surfaces to minimize stormwater requirements;
- Integrate site attributes to mimic natural hydrology and preserve natural resources;
- Optimize multifunctional uses such as neighborhood greenways and wildlife habitat.

2.3 Stormwater Facility Sizing

There are two methods that can be used to size facilities to meet the water quality and flow control requirements in **section 1.2**, the Simple Method and the Engineered Method.

2.3.1 Simple Method

The Simple Method uses pre-defined sizing factors to size stormwater facilities based on the amount of impervious area being added or replaced; this includes the building roof area and any other structures or hardened surfaces (e.g. driveway, patio, walkways, etc.) that will be included in the final site design.

To size stormwater facilities, the project designer quantifies the amount of new or redeveloped impervious area that is proposed and multiplies that area by the sizing factor for the stormwater facility being proposed. The sizing factors are listed on the Simple Sizing Form, which is described in **section 2.4.2** and included at the end of this section (page 2-8).

The Simple Sizing Form was developed assuming retention of the 10-year/24-hour storm event using generalized infiltration rates based on hydrologic soil types (see **Table D-2** in **Appendix D** for values assumed for each soil type). Based on the mapped soils at the development site, a stormwater facility sized using the factors on the Simple Sizing Form is assumed to comply with the City's flow control and pollution reduction requirements. On-site and off-site conveyance (**section 4.0**) needs to be addressed for pipes, outfalls and channels based on **Table 4-1**.

Stormwater facilities designed using the Simple Method are not required to be stamped by an engineer unless the project will be going through the Development Engineering review process.

Development projects that are adding or altering public infrastructure can utilize the Simple Sizing Form for sizing on-site stormwater facilities, but a Stormwater Report completed by a licensed engineer must be submitted to Development Engineering to demonstrate that water quality, flow control and conveyance requirements are being met.

Development projects in Type A and B soils should be able to fully manage stormwater on-site using a facility following sizing factors on the Simple Sizing Form. When on-site infiltration is not feasible, an on-site facility meeting the sizing requirements for Type A soils may be installed (assumed to treat the water quality event), and then the Engineered Method must be used to design a downstream centralized facility to detain and provide flow control to meet the requirements in **section 1.2.5**.

Projects in Type C and D soils that use the Simple Sizing Form to size lot-level facilities for water quality (using the Type A soil sizing factor) must then use the Engineered Method to size a facility to provide detention and flow control. Facilities designed in this manner can assume a 50% reduction in impervious area draining from water quality treated areas for hydrological calculations.

2.3.2 Engineered Method

The Engineered Method uses hydraulic and hydrologic engineering calculations to determine the facility size required. Any project is allowed to use the Engineered Method, which requires design by a licensed engineer. Detailed engineering calculations must be provided in a Stormwater Report (described in **section 2.4.4**) as evidence of the proposed design's performance with respect to the stormwater requirements provided in this manual.

Facilities sized by routing a hydrograph through the facility (rate-based facilities with a storage volume component) may use a continuous simulation program (using a minimum of 20 years of Gresham rainfall data) or a single-storm hydrograph-based analysis method, such as the Santa Barbara Urban Hydrograph (SBUH), to demonstrate treatment of 80 percent of the average annual runoff volume. The SBUH is preferred, but the Natural Resource Conservation Service (NRCS) TR-55 method, or Stormwater Management Model (SWMM) may also be used to generate the hydrograph. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all single storm hydrograph methods.

For projects following the Engineered Method, the engineer or qualified design professional must demonstrate that the proposed stormwater management meets or exceeds all stormwater requirements in this manual.

Appendix D has additional details about the Engineered Approach, but the overview of details and assumptions that should be made using this method are outlined below:

2.3.2.1 Pre-developed Surface Conditions

The pre-developed condition Runoff Coefficients (C) and Runoff Curve Numbers (CN) shall be based on conditions that existed at a site prior to any grading and land clearing activities related to the current development. The most common CN and C values for pre-developed conditions are listed in **Tables 2-1** and **2-2**.

Table 2-1. Common Curve Number (CN) values for Pre-developed conditions

Hydrologic Soil Type:	**A**	**B**	**C**	**D**
CN values for Forest/Woods	30	55	70	77
CN values for Woods/Grass combination	32	58	72	79
CN values for Pasture or Grass	39	61	74	80
CN values for Impervious Surfaces	98	98	98	98

Table 2-2. Common Runoff Coefficient (C) values for Pre-developed conditions

Site slope:	**Flat 0% to 2%**	**Rolling 2% to 10%**	**Hill Over 10%**
C values for Woodland and Forest	0.1	0.15	0.2
C values for Meadow, Pasture or Farm	0.25	0.3	0.35
C values for Mixed (Forest/Grass)	0.15	0.2	0.25
C values for Impervious Surfaces	0.9	0.9	0.9

For modeling other pre-development surfaces, see the Runoff Curve Number, CN, table (**Table D-3**) and the Runoff Coefficient, C, table (**Table D-6**) in **Appendix D**.

2.3.2.2 Post-developed Surface Conditions

The Runoff Curve Numbers (CN) used for post-developed surface conditions shall be based on conditions that will exist after development. The most common CN values for post-developed conditions are listed in **Table 2-3**. For developments doing stormwater quality treatment at the localized scale and treating 50% of the impervious surface as pervious, the CN value for "lawn/landscaped areas with amended soils" shall be used.

Table 2-3. Common Curve Number (CN) values for Post-developed conditions

Hydrologic Soil Type:	**A**	**B**	**C**	**D**
CN values for lawn/landscaped areas with un-amended soils	68	79	86	89
CN values for lawn/landscaped areas with amended soils	39	61	74	80
CN values for Impervious Surfaces	98	98	98	98
CN values for Porous Pavement	76	85	89	91
CN values for Green Roof	61	61	61	61
CN values for Infiltration and Filtration Stormwater Planter	30	48	65	73

2.3.2.3 Time of Concentration

Time of concentration (Tc) calculations shall consist of three segments: sheet flow, shallow concentrated flow, and channel/pipe flow. Total time of concentration should be a minimum of 10 minutes for pre-developed conditions and a maximum of 10 minutes for post-developed conditions. However, if the portion of the contributing area within 300' upstream of the developed site will remain in an undeveloped condition and is 50% or more of the total contributing area, the post-developed Tc shall be determined by the engineer of record and may exceed 10 minutes.

2.3.2.4 Rainfall Depths

Table 2-4 lists the 24-hour rainfall depths that shall be used for sizing stormwater facilities and determining conveyance.

Table 2-4. Gresham 24-hour rainfall depths

Recurrence Interval (Years):	**WQ**	**2**	**5**	**10**	**25**	**50**	**100**
24-Hour Rainfall Depth (inches)	1.2	2.8	3.2	3.6	4.0	4.4	4.9

2.4 Submittal Plans, Forms and Reports

In order to demonstrate compliance with the stormwater requirements in this manual, the forms, plans and information listed in **Table 2-5** are required to be included with permit application materials submitted to the City.

Table 2-5. List of Stormwater Plans and Submittals

Section	Plan, Form or Report	Simple Method	Engineered Method
2.4.1	Erosion Prevention and Sediment Control Plan	X	X
2.4.2	Simple Sizing Form	X	
2.4.3	Site Plan	X	X
2.4.4	Stormwater Report		X
2.4.5	Infiltration Testing		If required
2.4.6	Facility Planting Plan	For vegetated facilities	For vegetated facilities
2.4.7	Operation and Maintenance Plan		If required

2.4.1 Erosion Prevention and Sediment Control Plan

Prior to any ground clearing activity or work being conducted on site, an erosion prevention and sediment control (EPSC) plan shall be submitted and approved by the City. There are 9 erosion control requirements which need to be addressed in the EPSC plan:

1. Preserve Vegetation/Mark Clearing Limits
2. Construction Entrance Protection
3. Perimeter Control
4. Storm Drain Inlet Protection
5. Soil and Slope Protection
6. Control Runoff (may not apply for Single-Family/Duplex Sites)
7. Sediment Containment and Removal (not applicable for Single-Family/Duplex Sites)
8. Soil Stockpile Management (may not apply for Single-Family/Duplex Sites)
9. Construction Site Pollution Prevention

The Erosion Prevention and Sediment Control Manual in **Appendix C** contains details on what needs to be included in the EPSC plan and best management practices (BMPs) to address the 9 minimum requirements.

2.4.2 Simple Sizing Form

For projects following the Simple Method, the Simple Sizing Form (included at the end of this section) provides the sizing factors for proposed stormwater facilities. The formulas on this form allow the project designer to determine whether the stormwater facilities they propose will be adequate to manage stormwater (quality and quantity) from impervious area they will be adding or replacing.

2.4.3 Site Plan

All projects must submit a site plan that shows the location of the proposed stormwater facility and any piping to and from the facilities, as well as addressing the site plan requirements in the *City of Gresham CAD (Computer Aided Drafting) Manual.*

2.4.4 Stormwater Report

Development proposals that will be following the Development Engineering process must submit a Stormwater Report to DE for review and approval.

The Stormwater Report shall include the Site Plan components in **section 2.4.3**, as well as the following:

1. Name of the professional civil engineer who prepared the report
2. Calculations used to determine stormwater facility and conveyance system sizing.
    a. A map and calculations showing the drainage area and estimated run-off of the area being served by any drainage facility within the proposed grading and drainage plan.
    b. Indication of the undeveloped peak discharge rate of surface water currently entering and leaving the subject property due to the design storm(s) as set forth in this manual.
    c. Indication of developed peak discharge rate of run-off which will be generated from the subject property due to the design storm(s) as set forth in this manual.
    d. Determination of the developed peak discharge of water that will be generated by the design storm at various sub-basins on the subject property; and
    e. A discussion of the drainage management facilities and/or techniques which may be necessary to rectify drainage problems.

2.4.5 Infiltration Testing

Infiltration testing is required for any project proposing to use the Engineered Method. Sites permitted to use the Simple Sizing Form can use the assumed infiltration rates based on the hydrologic soil type, unless the project will be going through the Development Engineering (DE) process. It is recommended, but not required unless following the DE process, that projects following the Simple Method that will be adding more than 10,000 sf of impervious perform an infiltration test. An infiltration test is also required for sites trying to demonstrate that on-site infiltration is infeasible per **section 1.2.2**.

For sites needing to perform infiltration testing, **Appendix E** has instructions and forms. The most reliable infiltration rates are determined using either the falling head percolation test procedure (EPA 1980) or the double ring infiltrometer test (ASTM D3385), and follow the following guidance:

- Test must be conducted or observed by a qualified Professional Engineer, Registered Geologist, or Certified Engineering Geologist licensed in the State of Oregon;
- The test must be performed in the location of the proposed facility. At least one infiltration test is required for any potential location where a stormwater facility will be sited. Unless the professional performing the testing recommends differently, additional tests should be considered every 100 feet for linear facilities, or every 10,000 sf of project area;
- The test shall be made at the bottom elevation of the proposed facility;
- Test must be performed at saturated conditions. If test is performed during dry conditions, the test shall be performed 3 times, with the final test providing the best measure of infiltration rate;
- A minimum factor of safety of 2 shall be used for any measured infiltration rate.

2.4.6 Facility Planting Plan

Landscape specifications and plans are required with all permits that include at least one vegetated stormwater facility. The facility planting plan for any proposed vegetated stormwater facility must meet the plant density and size requirements in **Appendix G**.

Landscape specifications and plans must address all elements that ensure plant survival and overall stormwater facility functional success. At a minimum, landscape specifications and plans must include:

- A planting plan that indicates existing vegetation to be preserved, the location of all landscape elements, and the size, species and location of all proposed plantings. The plant species should be selected and placed in accordance with proper delineation of Zone A (wet zone) and Zone B (moderate to dry zone), where appropriate.

- A plant list or table, including botanical and common names, size at time of planting, quantity, spacing, type of container, evergreen or deciduous, and other information related to the facility-specific planting, in accordance with landscape industry standards.
- A soil analysis may be requested for the stormwater facility growing medium. The source of the growing medium must be provided.
- The location of all stockpiles must be indicated on plans, including erosion protection measures per the City's Erosion Prevention and Sediment Control Manual (**Appendix C**).
- The method of irrigation to be used for the establishment period and if planned for permanent long-term irrigation. Public stormwater management facilities must be designed so permanent long-term irrigation systems are not needed.

2.4.7 Operations and Maintenance Plan

The Operations and Maintenance requirements in **Section 6.0** apply to all stormwater facilities installed in the City.

Stormwater facilities designed in accordance with the facility design requirements in **section 3.0** do not need to submit an O&M Plan, but must still follow the typical maintenance activities listed in **section 6.3**.

If a stormwater facility is proposed that does not meet the standard facility design specifications described in **section 3.0**, then a custom O&M Plan must be developed and submitted. Stormwater facilities requiring a custom O&M Plan must develop an agreement following the requirements in **section 6.2** and complete the Operations and Maintenance Agreement Form in **section 6.3** – both must be developed and recorded with the County prior to final permit approval or any issuance of certificate of occupancy for the site being served by the facility.

Simple Sizing Form

This form is to be used to size stormwater facilities following the Simple Method. The following table contains acceptable stormwater sizing factors for facilities described in the Stormwater Management Manual that will be managing stormwater within 100 feet of the impervious surface being treated.

Name: _____ Site Address: _____

Impervious Area from Development (sf): _____ Soil Type: A B C D
(circle one)

Instructions:

1. Determine the amount of impervious area (in square feet) to be managed by each stormwater facility
2. Multiply the Impervious Area Managed by the sizing factor for your soil type to determine the Facility Size needed. **If facility is being designed for water quality only, use the sizing factor for Soil Type A**
3. Total Impervious Area Managed must match Impervious Area from Development

Stormwater Facility Type	**Impervious Area Managed (sf)**	**Facility Sizing Factor (by soil type)**				**Facility Size (sf)**
		A	**B**	**C**	**D**	
Rain Garden, Basin, Swale		0.06	0.08	0.20	0.40	
Planter		0.05	0.07	0.15	0.28	
Tree Well		0.04	0.06	0.13	0.21	
Filter Strip (paved areas only)		0.20	0.20	0.20	0.20	
Ecoroof		1:1 ratio				
Porous Pavement		1:1 ratio				
Soakage Trench, Infiltration Vault, or Drywell[1]		Sizing Chart in SWMM				
Total Impervious Area Managed (sf)						

[1] Stormwater generated from anything other than residential roof area must be registered with DEQ. A silt basin is typically adequate pre-treatment for roof runoff, but additional pre-treatment is required for ground level impervious surfaces.

[2]If a filtration rain garden or planter is allowed (per **section 1.2.4**), then use the sizing factor for Type A Soil

3.0 Facility Design

Detailed design requirements for stormwater facilities are provided in the following section. Facility geometry, slope, plumbing, soil amendment/mulch, and planting requirements and specifications are provided. Criteria for the application of stormwater management credit for use of ecoroofs and porous pavements is also provided.

3.0.1 Applicability

Table 3-1. Stormwater facility applicability by impervious surface type. High priority facilities, indicated with an "H", are the stormwater facilities the City prefers. Medium (M) facilities may also be proposed, but may require approvals or additional pre-treatment (e.g. drywell being used for non-roof runoff). Low (L) priority facilities are allowed, but a Stormwater Report must be submitted following the requirements in section 2.4.4, detailing the rationale for proposing these facilities.

	Impervious Surface to be Treated				
Stormwater Facility	**Rooftop**	**Driveway**	**Sidewalk**	**Parking Lot**	**Street**
Porous Pavement	L	H	M	H	M[5]
Ecoroof	H	NA	NA	NA	NA
Planter	M	H	H	H	H
Tree Well	NA	L	H	H	H
Rain Garden/Swale	M	M	M	M	M
Vegetated Filter Strip	L	H	H	L	L
Downspout Extension[1]	M	NA	NA	NA	NA
Drywell[2]	H	M	M	M	M
Soakage Trench[2]	H	M	M	L	L
Infiltration Vault[2]	H	M	M	M	L
Centralized Facility (Dry Detention Pond, Wet Pond)[3]	L	L	L	M	L
Detention Vault/Pipe[4]	L	L	L	L	L
Proprietary Devices[4]	L	L	L	L	L

[1] Only allowed for retrofits in areas with infiltration rates ≥2"/hour

[2] Stormwater generated from anything other than residential roof area must be registered with DEQ. A silt basin is typically adequate pre-treatment for roof runoff, but additional pre-treatment is required for ground level impervious surfaces.

[3] Centralized facilities can be designed for water quality + quantity/flow control on large commercial/industrial sites, or for detention/flow control in subdivisions where lot-level facilities have been implemented to the maximum extent practicable.

[4] These facilities are not considered "green infrastructure," and should not be considered unless infeasibility has been demonstrated per **section 1.2.2**

[5] Use of porous pavement on public streets must be approved by the Transportation Division.

Each stormwater facility has additional applicability criteria related to slopes, soils, setbacks, and geometry included in following design sections.

3.0.2 Setbacks

It is recommended that stormwater facilities follow the setback distances in **Table 3-2**.

Table 3-2. Typical Stormwater Facility Setbacks. Facilities may be located within these setbacks based on recommendation from a Geotech or if approved by the City.

Stormwater Facility Type	Setback from	Distance (feet)
Permeable pavers, porous asphalt, or porous concrete	Property line or foundation. Liner may be required if located within 5 feet of infrastructure	0
Lined facilities	Foundation	0
All infiltration facilities	Property Line	5
All infiltration facilities	Any foundation	10
All infiltration facilities	Upslope from any drainfield	100
Ponds, swales, rain gardens	Slopes 10% or greater	100
Subsurface infiltration facilities (e.g. drywells)	Slopes 20% or greater	100
Drywell	Slope greater than 10' high & steeper than 2h:1v	200
Drywell	Drinking water well	500 (or 2-year time travel)

Setbacks are measured from the center of a drywell or from the outside edge of a soakage trench or any surface stormwater facility to the adjacent boundary, structure, or facility.

3.1 Impervious Area Reduction

Porous pavement and ecoroofs are impervious area reduction techniques that can reduce the overall square footage of impervious area that requires stormwater management. These techniques intercept rainfall directly and should not receive stormwater runoff from other areas.

3.1.1 Porous Pavements

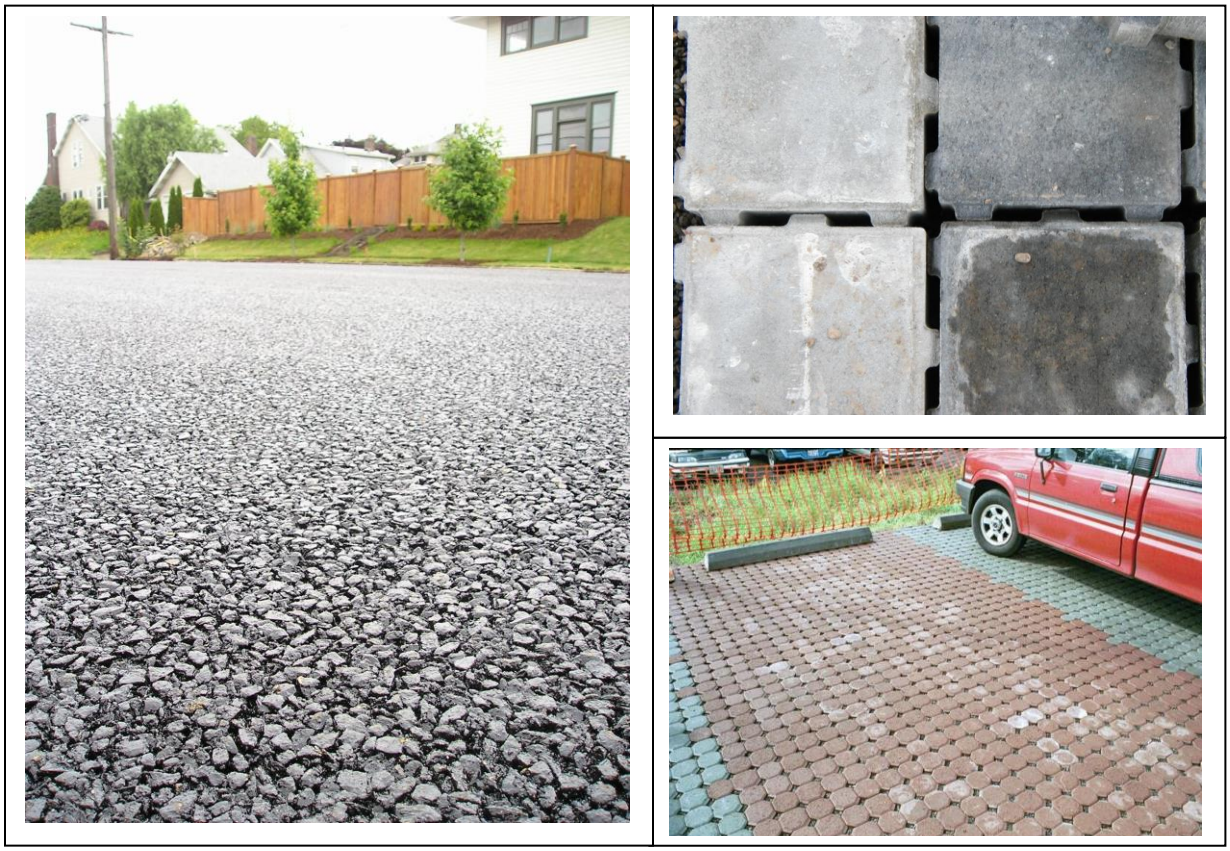
Facility Description

Porous pavements, which may also be referred to as permeable or pervious pavements, allow rainwater to pass directly through the paving surface into gravel layers below, where it slowly infiltrates into the native soils. To avoid confusion with the term impervious, this manual refers to all pervious or permeable pavements as "porous pavement." There are many types of porous pavements available on the market today, including but not limited to porous asphalt mixes, porous concrete mixes, and concrete paver systems designed with gaps or holes to allow water to pass through. The following list includes the types of paving systems that are considered by the City to be porous:

- Porous asphalt mix, open-graded mix placed over an open-graded base rock layer. A polymer modified asphalt cement is required in the wearing course.
- Porous concrete mix, open-graded mix placed over an open-graded base rock layer
- Uni Eco-Stone® pavers placed over an open-graded base rock layer
- Uni Ecoloc® pavers placed over an open-graded base rock layer
- SF RIMA® pavers placed over an open-graded base rock layer
- TurfStone™ paver system, planted with grass or filled with clean gravel

Other paving systems may be reviewed on a case-by-case basis for porous designation and must show the ability to pass water quickly through the pavement layer.

The long-term effectiveness of a porous pavement system to retain and/or infiltrate water depends on the ability and practice of keeping its surface and pavement layer clear of debris and sediment that can cause clogging.



Left: porous asphalt mix. Top-right: SF RIMA™ pavers. Bottom-right: Uni Eco-Stone® pavers

Applicability

Porous pavements that meet all applicable State and City building codes may be used on private property to receive stormwater management credit. Porous pavement proposals in the public right-of-way must be pre-approved by the Transportation Division.

Porous pavement surfaces designed for streets must be designed and stamped by a registered professional engineer in the State of Oregon. Proprietary porous pavement systems must be installed per manufacturer specifications.

Porous pavements shall not be used in areas covered by the 100-year floodplain. Where slopes are greater than 5 percent, the design must be engineered to specifically address under-pavement water retention. If the slope of the area is 10 percent or greater, porous pavement is not allowed.

Design Requirements

Sizing: Porous pavement areas replace impervious surfaces at a 1:1 ratio. Stormwater from adjacent paved surfaces should not be directed to a porous pavement system.

Edge Restraints: Edge restraints for pavers are required to be permanent (cast-in-place or precast concrete curbs) and a minimum of 6 inches wide and 12 inches deep for private streets, public roadways, and commercial pavements. Residential restraints may be plastic and set with spikes.

Base Rock Depth: The depth of open graded aggregate, typically washed, crushed 2- to 3/4"-inch or No. 57 rock, to be placed under the porous pavement top lift can be calculated using the Engineered Approach – depth should be capable of storing the 25-year event without overflow for systems with no underdrain. Minimum rock depth shall be 12".

Underdrain System: Where the native soil is not capable of infiltrating at a rate adequate to keep water from the 25-year, 24-hour storm from filling the gravel layer and backing up into the pavement layer, an underdrain system shall be employed to direct excess water to an approved disposal point. For purposes of receiving pollution reduction credit, underdrain systems will be required where the native soils infiltrate at 0.5"/hr or less (Type C and D soils), or where the slope of the paving surface and gravel base layer may cause water to accumulate and fill the gravel layer quickly in the lower area.

Safety Overflow: Porous pavement systems shall be designed with a safety overflow mechanism to prevent ponding in the event that the surface is clogged with sediment or debris. The overflow mechanism may consist of an inlet drain, catch basin, curb opening, or other method to convey water to an approved disposal point.

3.1.2 Ecoroofs

Facility Description
An ecoroof, also called a green roof, is a lightweight vegetated roof system consisting of waterproofing material, a growing medium, and low growing, drought tolerant plants. An ecoroof can be used in place of a traditional roof as a way to limit impervious site area and to manage stormwater runoff. Ecoroofs reduce post-developed peak runoff rates to near-pre-developed rates and reduce annual runoff volume by about 50 percent. Ecoroofs also help mitigate runoff temperatures by keeping roofs cool and retaining most of the runoff in dry seasons. The design must be self-sustaining.

Applicability
Primarily an option for newly constructed buildings, although retrofits of existing buildings is possible. The structural roof support must be sufficient to hold the additional weight of the ecoroof. For retrofit projects an architect, structural engineer, or roofing consultant can assess the condition of the existing building structure and determine what is needed to support an ecoroof. Alterations might include

additional decking, roof trusses, joists, columns and/or foundations. Generally, the building structure must be adequate to hold an additional 15 to 30 pounds per square-foot (psf) saturated weight, including the vegetation and growing medium that will be used (in addition to snow load requirements). Generally, an existing rock ballast roof may be structurally sufficient to hold a 10-20 psf ecoroof (if the ballast is removed).

Design Requirements

Sizing: Ecoroofs replace impervious area at a 1:1 ratio. They are not allowed to receive water from other impervious areas.

Slope: Maximum roof slope is 25 percent, unless the applicant provides documentation of runoff control on steeper slopes.

Access: The design must consider safe access for maintenance of the ecoroof and other maintenance needs that require roof access.

Waterproofing: A good-quality waterproofing material, such as modified asphalt, synthetic rubber, or reinforced thermal plastics, must be used on the roof surface. To maximize the life of the ecoroof, no portion of the waterproof membrane may be exposed to sunlight.

Root barrier: A root barrier is sometimes required in addition to waterproofing material, depending on the type used. Root barriers impregnated with pesticides, metals, or other chemicals that may leach into stormwater are not allowed, unless the applicant can provide documentation that leaching does not occur. If a root barrier is used, it must extend under any gravel ballast and the growing medium and up the side of any vertical elements. Some waterproofing materials also act as a root barrier.

Drainage and overflow: A method of drainage must be provided. The drainage layer may include geotextile fabric, gravel, or be the growing medium itself particularly on steeper, fast-draining ecoroofs. Ecoroofs are not a full stormwater disposal system and need to have a conventional drainage system to manage excess runoff from the roof during periods of sustained or heavy rainfall. The applicant must provide roof drains that connect to an approvable discharge location.

Growing medium: A minimum of 4 inches of growing medium is required for the vegetated portions of the ecoroof, composed of approximately 70 percent porous material and 30 percent organic material (i.e., aged compost) or other mix approved by City.

Vegetation and coverage: Drought-tolerant plants from the ecoroof plants listed on the **Gresham List of Stormwater Plants** must achieve 90 percent coverage within 2 years. At least 50 percent of the ecoroof must be composed of evergreen species. Ecoroof vegetation should be:

- Drought-tolerant, requiring no or little irrigation after establishment;
- Self-sustaining, without the need for fertilizers, pesticides, or herbicides;
- Able to withstand heat and cold;
- Very low-maintenance, needing little or no mowing or trimming;
- Perennial or self-sowing;
- Fire-resistant.

A mix of sedum/succulent plant communities is recommended because these plants possess many of these attributes. Although herbs, forbs, grasses and other low groundcovers can provide stormwater and aesthetic benefits, plants that require irrigation beyond what is allowed in this section for survival are not permitted.

Mulch: A method to retain moisture and protect exposed soil from erosion is recommended, such as gravel mulch.

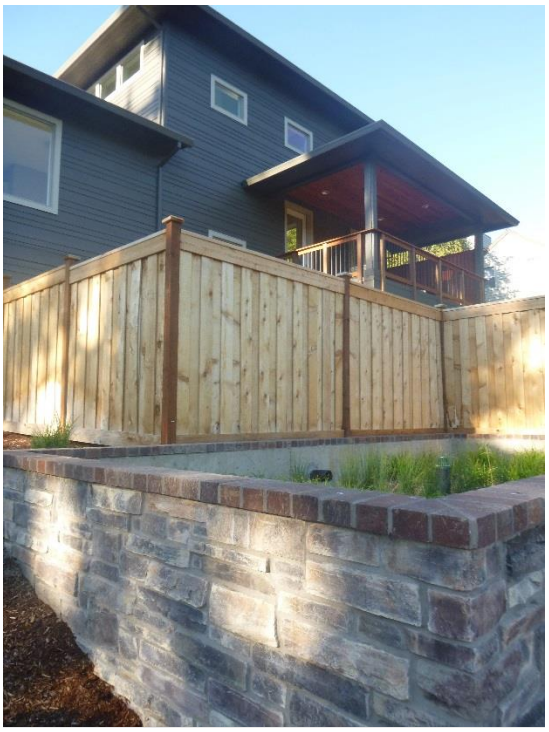
Non-vegetated components: Non-vegetated components may comprise up to 10 percent of the ecoroof while still counting toward the total ecoroof area, though the non-vegetated area should be kept to a minimum. If additional non-vegetated area is necessary to meet fire code requirements, the 10 percent maximum may be exceeded only by that required area. Rooftop features that cannot be considered non-vegetated components of an ecoroof include: mechanical equipment and solar panels (unless vegetation is extended beneath elevated units), elevator overruns, penthouses, and skylights. Runoff from portions of the structure that penetrate the ecoroof (e.g. elevator overruns and penthouses) must meet the provisions of this manual. Examples of non-vegetated components that can be counted within the 10 percent include:

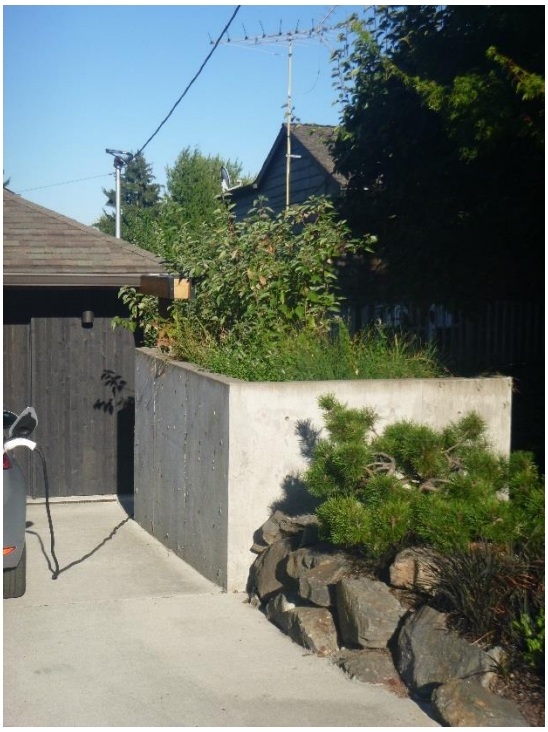
- Decking or porous materials such as gravel or pavers that are placed over sand or alternate substrate for the purpose of providing access to the ecoroof and other rooftop components;
- Ballast along parapets or mechanical units;
- Alternate non-vegetated components may be allowed subject to City review.

3.2 Vegetated Facilities

Vegetated facilities should be prioritized over “Other Facilities” (described in **section 3.4**) since surface facilities utilizing soil and plants to manage stormwater are able to filter pollutants, while also reducing volume through evapotranspiration, as well as infiltration for unlined facilities.

3.2.1 Stormwater Planters





Facility Description

Planters are structural landscaped reservoirs used to collect, filter, and infiltrate stormwater, allowing pollutants to settle and filter out as the water percolates through the vegetation, growing medium, and gravel. Depending on site conditions, planters can be designed to completely or partially infiltrate the stormwater they receive. They can also be designed as lined facilities where stormwater is temporarily stored. In lined planters, stormwater filters through the soil and excess water drains to an approved discharge location.

Private stormwater planters can be used to help fulfill a site's required landscaping area requirement and should be integrated into the overall site design. Numerous design variations of shape, wall treatment, and planting scheme can be used to fit the character of a site. Because lined planters can be constructed immediately next to buildings, they are ideal for sites with setback requirements, poorly draining soils, steep slopes, or other constraints.

Applicability

Stormwater planters are used to manage stormwater flowing from all types of impervious surfaces, on private property and within the public right-of-way. Infiltration planters are more effective than filtration/lined planters at retaining large volumes of stormwater on-site, so planters shall be designed to infiltrate unless site conditions require the facility to be lined. If native soils infiltrate at less than 0.5 inches per hour (Type C and D soils), the facility may need to have an underdrain installed and be a partial infiltration facility. Infiltration facilities should be located 10 feet from building foundations, not immediately upslope of building structures, and on slopes less than 20%. Locating a stormwater planter within 10 feet of a building, within 5 feet of a property line, or on slopes requires waterproofing/lining and an underdrain to create a filtration planter.

Design Requirements

Soil suitability: Existing infiltration rates will determine if the facility can be designed to achieve infiltration, partial infiltration, or allow the stormwater to be conveyed through the facility. The Simple Sizing Form assumes infiltration rates based on soil type and requires an overflow to be installed for Type C and D soils.

Larger sites (>10,000 sf) or those using the Engineered Method need to test infiltration rates following the procedure in **Appendix E**. Based on the infiltration results, the design professional shall include an overflow to an approved discharge location if the facility is not able to store the volume from the 10-year storm event AND fully draw down within 48 hours.

Sizing: Sizing varies by design approach. The Simple Sizing Form can be used to determine the size of facilities based on soil type.

Geometry/Slopes: See the typical details in **Appendix H** for infiltration and filtration stormwater planters.

- There is no shape requirement for stormwater planters, although they are typically designed as square or rectangular with vertical side walls.
- The minimum width for any stormwater planter shall be 24 inches.
- The minimum ponding depth for stormwater planters shall be 9 inches. The maximum ponding depth shall be 18 inches.
- The minimum depth of amended soil mix for stormwater planters shall be 18 inches. See **Appendix F** for the required soil amendment specification to be included with the permit plans.

Setbacks: Infiltration planters are typically set back 5 feet from property lines and 10 feet from building foundations. No setbacks are required for lined planters where the height above finished grade is 30 inches or less. Lined planters can be used next to foundation walls, adjacent to property lines, or on slopes when they include a waterproof lining.

Waterproofing/Lining: Lined facilities that require an impervious bottom must be a single-pour concrete box, or approved equivalent. Trees are not allowed in lined facilities.

Piping:
Inlets: Piping per Oregon Plumbing Specialty Code requirements shall be used to direct stormwater from impervious surfaces to private stormwater planters. Stormwater planters within the public street right-of-way or within or adjacent to parking lot areas may flow directly into planters via curb openings.

Outlets: An overflow drain shall be constructed to allow at least 9 but not more than 18 inches of water to pond in the planter prior to overflow. On private property, this overflow drain and piping must meet Oregon Plumbing Specialty Code requirements and shall direct excess stormwater to an approved disposal point.

Within the public street right-of-way, the overflow drain and piping must meet City of Gresham *Public Works Standards* and shall direct excess stormwater to an approved discharge point, typically using a beehive overflow structure. For green streets with multiple stormwater planters, a beehive overflow connected to a piped stormwater conveyance system must be installed every 500 feet or at the end of each block, whichever is less. Beehive outlets from one stormwater planter shall not be connected to a beehive serving as an inlet to another stormwater planter.

Underdrains: For filtration/lined facilities, a perforated pipe (24-inch maximum length) shall be constructed near the outlet of the filtration stormwater planter to drain water that has filtered through the topsoil and prevent long-term ponding.

Underdrain pipes for public facilities shall have a maximum length of 36-inches, with drain rock only surrounding the area where the underdrain is located. The downstream end of an underdrain system shall end at a beehive structure following *Public Works Standards*.

Drainage Layer: 9" depth of ¾" – 1 ½" washed drain rock must be used around the underdrain pipe for private filtration/lined facilities. 12" of drain rock required for public filtration/lined facilities. Not allowed for Type A and B soils, optional for Type C soils, and required for Type D soils. When used, drain rock and growing medium must be separated by a 2- to 3-inch layer of ¼" - #10 rock. Trees cannot be planted above a drainage layer.

Soil/Mulch: A minimum of 18 inches of planting media shall be added to all stormwater planters. Per the soil specifications in **Appendix F**, this can be accomplished by importing a 3-way soil blend or by amending native topsoil with a mix of one part imported organic compost and one-part gravelly sand, such that there are equal parts compost, sand, and native soil. The specification included in **Appendix F** shall be used for this purpose and included on the permit plans. A 2 to 3-inch layer of shredded bark mulch (not bark dust or bark chips) shall be used over the amended soil and between the plantings to completely cover the soil and prevent erosion or weed intrusion.

Vegetation: The entire facility area must be planted with vegetation. The facility area is equivalent to the bottom area of the stormwater planter. Stormwater planters should be designed so they do not require mowing. Plants shall be selected from the **Gresham List of Stormwater Plants** following the requirements in **Appendix G**. Minimum container size is #1 container.

3.2.2 Rain Gardens and Swales

Facility Description

Swales and rain gardens are designed similarly, with the exception being that swales have a gradual slope and convey water, while rain gardens typically hold water temporarily before it infiltrates. Swales are typically long, narrow, gently sloping landscaped depressions that collect and convey stormwater runoff. Both facilities are planted with dense vegetation that treats stormwater from rooftops, parking

lots, and streets. As the stormwater flows along the length of the swale, the vegetation and check dams slow the stormwater down, filter it, and allow it to infiltrate into the ground. Where soils do not drain well, a rain garden or swale can overflow to an approved discharge location such as a drywell or soakage trench.

Swales are similar to rain gardens, with the exception of being applicable on larger sites (>5000 sf impervious), and the fact they are more linear in nature and convey water versus just receiving it to filter and/or infiltrate. The best settings for a vegetated swale are along a road, parking lot, or large building.

Applicability
Rain gardens and swales are used to manage stormwater flowing from all types of impervious surfaces, on private property and within the public right-of-way. Infiltration facilities are more effective than filtration/lined facilities at retaining stormwater on-site, so rain gardens and swales shall be designed to infiltrate unless site conditions require it to be lined. If native soils infiltrate at less than 0.5 inches per hour, the facility may need to have an underdrain installed and be a partial infiltration facility. Infiltration facilities need to be located at least 10 feet from building foundations, not immediately upslope of building structures, and on slopes less than 20%. Locating a facility within 10 feet of a building or on slopes requires installation of an impermeable liner and underdrain to create a filtration facility.

Design Requirements

Soil suitability: Existing infiltration rates will determine if the facility can be designed to achieve infiltration, partial infiltration, or allow the stormwater to be conveyed through the facility. The Simple Sizing Form assumes infiltration rates based on soil type and requires an overflow to be installed for Type C and D soils.

Larger sites (>10,000 sf) or those using the Engineered Method need to test infiltration rates following the procedure in **Appendix E**. Based on the infiltration results, the design professional shall include an overflow to an approved discharge location if the facility is not able to store the volume from the 10-year storm event AND fully draw down within 48 hours.

Sizing: Sizing varies by design approach. The Simple Sizing Form can be used to determine the size of facilities based on soil type for the Simple Method.

Dimensions and slopes: The minimum width for rain gardens and swales is 10 feet. A 2-foot-wide flat bottom width is required where feasible. The minimum depth is 9-inches as measured from the top of the growing medium to the overflow inlet elevation. Maximum side slopes are 3 horizontal to 1 vertical; 4 horizontal to 1 vertical is required immediately adjacent to pedestrian areas. Maximum longitudinal slope is 6 percent. Freeboard for rain gardens/swales must be noted on the plans.

Waterproofing/Geosynthetic Liner: Full or partial liners may be required when facilities are proposed within building/property line setbacks, on steep slopes, in areas with high groundwater, in locations with hazardous materials, and in wellhead protection areas. Waterproofing can consist of a monolithic pour, the same as a stormwater planter, or a 30-mil EPDM, HDPE, or approved equal liner.

Check dams: Only required for swales or facilities that are not flat. Generally 4 to 10 inches high, depending on the depth of the facility. Width will vary depending on material.

Piping: Private pipe must follow Oregon Plumbing Specialty Code and be cast iron, ABS SCH40, or PVC SCH40. Three-inch pipe is required for facilities draining up to 1,500 square feet of impervious area; otherwise, a 4-inch pipe minimum is required. Public installations must use 6-inch or 8-inch ASTM 3034 SDR 35 PVC pipe and perforated pipe.

Underdrains: For filtration/lined facilities, a perforated pipe (24-inch maximum length) shall be constructed near the outlet of the filtration stormwater planter to drain water that has filtered through the topsoil and prevent long-term ponding.

Drainage Layer: 9 to 12" depth of ¾" – 1 ½" washed drain rock must be used around the underdrain pipe of filtration/lined facilities. A drainage layer may be placed under facilities in Type C soils for storage without the use of an underdrain. Drainage layers are not allowed for facilities in Type A and B soils, optional for Type C soils, and required for Type D soils. When used, drain rock and growing medium must be separated by a 2- to 3-inch layer of ¼" - #10 rock. Trees are not allowed in facilities where a drainage layer is installed.

Soil/Mulch: A minimum of 18 inches of planting media shall be added to all stormwater planters. Per the soil specifications in **Appendix F**, this can be accomplished by importing a 3-way soil blend or by amending native topsoil with a mix of one part imported organic compost and one part gravelly sand, such that there are equal parts compost, sand, and native soil. The specification included in **Appendix F** shall be used for this purpose and included on the permit plans. A 2 to 3-inch layer of shredded bark mulch (not bark dust or bark chips) shall be used over the amended soil and between the plantings to completely cover the soil and prevent erosion or weed intrusion.

Vegetation: The entire facility area must be planted with vegetation. The facility area is equivalent to the total area of the rain garden/swale, including bottom and side slopes, as developed in the sizing calculations. Rain gardens/swales should be designed so they do not require mowing. Plants shall be selected from the **Gresham List of Stormwater Plants** following the requirements in **Appendix G**. Minimum container size is #1 container.

3.2.3 Vegetated Filter Strip

Facility Description
Vegetated filter strips are gently sloped areas that are designed to receive sheet flows. They are typically linear facilities that run parallel to the impervious surface and are commonly used to receive the runoff from walkways and driveways. Filter strips are covered with vegetation, including grasses and groundcovers, which filter and reduce the velocity of the stormwater. As the stormwater travels downhill, it infiltrates into the soils below.

Driveway center filter strips are used between the drive aisles of residential driveways. They are typically 3 feet wide and placed between two 3-foot-wide paved sections. (The minimum width of a residential driveway is 9 feet, of which the inner 3-foot section could be pervious and used for infiltration as long as all other code requirements are met.) The strip is used exclusively to treat and infiltrate the stormwater from the impervious area of the drive aisles. The drive aisles must be sloped toward the driveway center filter strip. The driveway center filter strip must be maintained to the required design requirements (including 100 percent landscaping coverage) stated below.

Applicability
The most common uses of vegetated filter strips are as the driveway center strip described above, or the landscape strip between the curb and sidewalk treating sidewalk runoff. Roads or parking areas with large areas downslope from them can also be suitable areas for treatment by a vegetated filter strip.

Design Requirements

Soil Suitability: Filter strips are appropriate for all soil types.

Sizing: The landscape area utilized for disposal of stormwater must be at least 20 percent of the impervious area treated, for a maximum of 500 square feet of impervious area to be managed by the filter strip.

Dimensions and slopes: Filter strips must slope between 0.5 and 6 percent. Slope of pavement area draining to the strip must be less than 6 percent. Filter strips must have a minimum length of 5 feet, measured in the direction of the flow.

Level spreaders: A grade board or sand/gravel trench may be required to disperse the runoff evenly across the filter strip. The top of the level spreader must be horizontal and at an appropriate height to provide sheet flow directly to the soil without scour. Level spreaders must not hold a permanent volume of runoff. Grade boards can be made of any material that will withstand weather and solar degradation. Trenches used as level spreaders can be filled with washed crushed rock, pea gravel, or sand.

Check dams: If necessary, check dams must be constructed of durable, nontoxic materials such as rock or brick or graded into the native soils. Check dams must be 3 to 5 inches high and run the length of the filter.

Growing medium: Imported soil must be a sandy loam mixed with compost or a sand/soil/compost blend. It must be roughly one-third compost by volume, free-draining, and support plant growing. The compost must be derived from plant material; animal waste is not allowed. The growing medium must be 12 inches deep for filter strips.

Vegetation: The entire filter strip must have 100 percent coverage by grasses, ground covers, or any combination thereof.

3.2.4 Downspout Extension

Facility Description

Directing downspouts to splash blocks is a method of stormwater management suitable for retrofitting existing properties constructed prior to stormwater requirements (not new construction). Downspout disconnection allows roof runoff to flow into vegetated or mulched landscape areas for properties with good onsite infiltration.. Roof runoff is directed to existing landscaping where it can spread out and safely soak into the soils and remain on the property. Site conditions will determine if this is a suitable method for managing stormwater onsite. Property line and building setbacks as well as surface grade and available landscaped areas for infiltration must be considered. Proposed downspout locations and roof/gutter alignments will impact the feasibility of this option. As such, a preliminary site visit by City staff is recommended to determine if downspout extensions are a viable option.

Applicability
Downspout extensions are suitable for retrofitting existing properties (primarily single family residential)that have well-draining soils (≥2 inches/hour) and have an overall slope of 10 percent or less.

Design Requirements

Setbacks: Downspouts typically discharge 3 feet from slab on grade and structures with crawl spaces and 5 feet from all foundations with basements. Splash blocks are not considered part of the downspout extension and are included for erosion control and flow dispersal only. The point of discharge must be set back 5 feet from property lines and 10 feet from all neighboring structures or buildings and retaining walls over 36 inches in height.

Sizing and grade: The landscape area utilized for disposal of stormwater must be at least 10 percent of the roof area that drains to each downspout. A maximum of 500 square feet of roof area is allowed to drain to each downspout. The grade of the landscape area must gently slope away from the foundation and neighboring properties and allow stormwater to spread out over the required 10 percent infiltration area. Setback requirements must be retained over the entire infiltration area.

Materials: Durable, gutter-grade materials such as aluminum, steel, copper, vinyl, and plastic downspouts can be utilized for extensions. Downspouts need to be secured to the structure and connections securely fastened together with appropriate materials (i.e., sheet metal or similar screws). Flexible downspout extensions are not approvable materials. Rain chains must be securely fastened to the structure and the ground in a vertical alignment and must meet setback standards in order to be approved. Splash blocks, rock, or flagstone must be utilized for erosion control and flow dispersal at the location of discharge. Downspouts can be directed to drain onto grass without additional erosion control measures.

Other Considerations: Downspouts must not be directed to drain onto or over impervious areas, including walkways, driveways, and patios or onto neighboring properties, including public sidewalks and streets. Downspouts and gutters may be regraded, piped, or redirected in order to convey water to a safe infiltration area. Downspouts need to drain directly to landscape areas intended for infiltration. Landscaped areas above buried oil tanks or adjacent to retaining walls over 36 inches high cannot be utilized as infiltration areas.

3.2.5 Ponds/Centralized Facilities

Facility Description
There are two facility types which can be installed to meet the centralized facility requirements for water quality and/or detention – dry detention ponds with a swale bottom, or wet ponds. Pond basins are designed to store water above the surface of the growing medium.

Wet ponds are constructed with a permanent pool of water (commonly referred to as pool storage or dead storage). Stormwater enters the pond at one end and displaces water from the permanent pool. Pollutants are removed from stormwater through gravitational settling and biological processes. Wet ponds are often sized to meet both water quality as well as detention requirements. In order to meet detention requirements as well, the wet pond must be designed with additional storage beyond the

permanent pool. Wet ponds that have additional detention storage beyond the permanent pool are often called extended wet detention ponds.

Dry detention ponds are typically used to meet detention requirements, since they fill during storm events and slowly release the water over a number of hours. Water quality requirements can be met by using another BMP as pre-treatment or by designing the bottom flow path of the pond as a swale (following the swale sizing and design criteria).

Applicability
Centralized facilities may be constructed on large commercial and industrial developments, or in subdivisions where lot-level stormwater management is not adequate to retain/detain the 25-year, 24-hour storm event. Centralized facilities are appropriate for larger drainage areas (greater than 5 acres).

Ponds following the design requirements in Section 3.2.5 are most appropriate for sites with slow draining soils (less than 2"/hour tested) or for facilities that must be lined due to contamination or other feasibility factor listed in **Section 1.2.1**. Sites with well-draining soils (at or over 2"/hour tested) should install a rain garden that infiltrates (see **Section 3.2.2**).

Design Requirements

Location and Ownership: All centralized facilities/ponds to be maintained by the City must be located in a separate tract, including maintenance access to the public street system, that is either deeded to the City or has a public stormwater easement dedicated to the City. Any pond designed to serve more than one tax lot must be a public facility and designed and built as such.

Instream ponds are not allowed.

Setbacks:

- 5' from the toe of the pond berm embankment to the nearest property line (or one-half of the berm height, minimum distance of 5 feet), unless an easement with adjacent property owner is provided.
- Minimum distance from the edge of the pond water surface to septic tank, distribution box, or septic tank drain field: 100 feet.
- Surrounding slopes must not exceed 10 percent, unless a geotechnical report is submitted and approved by the City.
- Minimum distance from the edge of the pond water surface to the top of a slope greater than 15 percent: 200 feet, unless a geotechnical report is submitted and approved by the City.
- Minimum distance from the edge of the pond water surface to a well: 100 feet.

Sizing:

- Ponds shall be sized to fully store the volume of the post-development 25-year storm with 1 foot of freeboard to top of berm, using the depths and side slopes specified in this section.
- Wet and extended wet detention permanent pool sizing: The permanent pool (or dead) storage volume is equivalent to the runoff volume generated by a storm of 1.2 inch over 24 hours (NRCS Type 1A rainfall distribution). Permanent pool depth should be a maximum of 2.5 feet and not exceed 8 feet during 25-year event.

Flow control for extended wet detention and dry detention ponds: To restrict flow rates exiting the pond to those required by **Section 1.2.5**, a control structure must be used. For extended wet detention ponds, this control structure must be located above the permanent pool elevation. The outlet orifice must be designed to minimize clogging (see details under Orifices).

Control structure design: Weir and orifice structures must be enclosed in a manhole, or vault and must be accessible for maintenance.

The methods and equations for the design of flow-restricting control structures, for use with extended wet detention ponds, and dry detention ponds are below.

Orifices: Orifices shall be designed to prevent clogging. Orifices that are a minimum of 1 inch for private and 2 inches for public projects are preferred.

Multiple orifices may be necessary to meet the flow control requirements in **section 1.2.5**. Extremely low flow rates may result in the need for small orifices (i.e. < 1 inch) that are prone to clogging. When necessary, smaller orifice sizes may be considered by the City. Large projects may also result in high flow rates that necessitate excessively large orifice sizes that are impractical to construct. In such cases, several orifices may be located at the same elevation to reduce the size of each individual orifice.

Orifices must be protected within a vault or manhole structure with a trash rack or other structure designed to prevent floating debris from entering the structure.

Orifices may be constructed on a “tee” riser section.

Orifice diameter must be greater than or equal to the thickness of the orifice plate.

Orifices less than 3 inches must not be made of concrete. A thin material (e.g., stainless steel, HDPE, or PVC) must be used to make the orifice plate; the plate must be attached to the concrete or structure.

Orifice Sizing Equation:

$$Q = \mathrm{C}\,\mathrm{A}\sqrt{2gh}$$

where:
Q = Orifice discharge rate, cfs
C = Coefficient of discharge, feet (suggested value = 0.60 for plate orifices)
A = Area of orifice, square feet
g = 32.2 ft/sec2
h = hydraulic head, feet

The diameter of plate orifices is typically calculated from the given flow. The orifice equation is often useful when expressed as an equivalent orifice diameter in inches.

$$d = \sqrt{\frac{36.88\,Q}{\sqrt{h}}}$$

where:
d = orifice diameter, inches
Q = flow, cfs
h = hydraulic head, feet

Rectangular Notched Sharp Crested Weir:

$$Q = C\,(L - 0.2H) * H^{1.5}$$

where:
Q= Weir discharge, cfs
C = 3.27 + 0.40*H/P, feet
H = Height from weir bottom to crest, feet
P = Height of weir bottom above downstream water surface, feet
L = Length of weir, feet*
* For weirs notched out of circular risers, length is the portion of the riser circumference not to exceed 50 percent of the circumference.

V-Notched Sharp Crested Weir:

$$Q = C_d \left(\tan\frac{\theta}{2}\right) H^{5/2}$$

where:
Q = Weir discharge, cfs
C_d = Contraction coefficient, feet (suggested value = 2.5 for 90-degree weir)
Θ = Internal angle of notch, degrees
H = Height from weir bottom to crest, feet

Dimensions and slopes: Slopes and depth should be kept as mild as possible to avoid safety risks and allow access for maintenance. Slopes within the pond should not exceed 3 horizontal to 1 vertical.

The distance between all inlets and the outlet should be maximized to facilitate sedimentation. The preferred length-to-width ratio is 3:1. Maximizing the length-to-width ratio is critical to prevent "short-circuiting," where water passes directly through the facility without being detained for any length of time. If area constraints make this ratio unworkable, baffles, islands, or peninsulas may be installed, with City approval, to increase the flow path and prevent short circuiting.

The depth of the pond for the 25-year event should not exceed 8 feet. The pond bottom shall be level with minimal slope to allow water to move from inlet to outlet.

Minimum freeboard must be 1 foot above the highest potential water surface elevation (1 foot above the emergency overflow structure or spillway elevation).

Dry and wet ponds must be divided into a minimum of two cells. The first cell (forebay) in a dry detention pond is ideally 10 percent of the design surface area. The forebay in a wet pond ideally provides 0.5 foot of dead storage for sediment accumulation.

Pretreatment: A sedimentation manhole shall be installed upstream of the facility.

Outlet/overflow: For public ponds, if a ditch inlet structure is used as an outlet or overflow, installations shall be in accordance with Public Works Standards detail 403A, and a secondary inlet shall also tie into the flow control/outlet structure but higher than the primary inlet and below the maximum pond elevation to minimize risk of failure if the lower structure becomes thatched by debris. Ditch inlet style structures must be channeled and not have any sump when used as a pond outlet, and the trash racks must be hinged at the top to allow l for opening and cleaning.

All ponds must have an emergency overflow spillway or structure designed to convey the 100-year, 24-hour design storm for post-development site conditions, assuming the pond is full to the overflow spillway or structure crest. The overflow must be designed to convey these extreme event peak flows around the berm structure for discharge into the downstream conveyance system. The overflow must be designed and sited to protect the structural integrity of the berm. This will ensure that catastrophic failure of the berm is avoided, property damage is avoided, and water quality of downstream receiving water bodies is protected.

The subgrade of the spillway must be set at or above the 100-year overflow elevation of the control structure. The spillway must be located to direct overflows safely toward the downstream conveyance system and must be located in existing soil wherever feasible. The emergency overflow spillway must be armored with riprap or other flow-resistant material that will protect the embankment and minimize erosion. Riprap must extend to the toe of each face of the berm embankment. The emergency overflow spillway weir section must be designed for the maximum design storm event for post-development conditions.

Low flow drain for wet ponds: Unless it can be demonstrated that it is infeasible, a gravity drain shall be installed for maintenance. A shear gate shall be installed at the inlet end of a pipe located as close to the pond bottom as possible. Operational access to the valve shall be located at finished ground surface and protected from damage and unauthorized operation. Valve may be located within a valve box that is less than 5’ deep, otherwise an access manhole or vault is required. All metal parts shall be corrosion-resistant and not made of galvanized material.

Berm embankment/soil stabilization: Pond berm embankments must be designed by a civil engineer or professional geotechnical engineer licensed in the State of Oregon.

Pond berm embankments must be constructed on native consolidated soil (or compacted and stable fill soil) that is free of loose surface soil materials, roots, and other organic debris. Topsoil is required over the consolidated soil to support required plantings.

Pond berm embankments must be constructed by excavating a key equal to 50 percent of the berm embankment cross-sectional height and width, measured through the center of the berm. The berm must be keyed into the native soil by excavating a trench below the berm. This keys the berm into the native soil and prevents it from sliding.

The berm embankment must be constructed of compacted soil (95 percent maximum dry density, Modified Proctor Method per ASTM D1557) placed in 6- to 8- inch lifts with hand-held equipment, or 10- to 12-inch lifts with heavy equipment.

Anti-seepage collars must be placed on outflow pipes in berm embankments that impound water greater than the designed depth of the pond. During construction, exposed earth on the pond side slopes must be seeded with appropriate seed mixture. Establishment of protective vegetative cover must be ensured with appropriate surface-protection best management practices (BMPs) and reseeded as necessary. See the City's Erosion Prevention and Sediment Control Manual.

Pond embankments should be constructed with a maximum slope of 3H: 1V.

The use of retaining walls in ponds requires preapproval from the City. If approved, retaining walls or slopes steeper than 3H:1V should not exceed one-third of the circumference of the pond. Detailed structural design calculations must be submitted with every retaining wall proposal.

Pond berm embankments 6 feet or less in height (including freeboard), measured through the center of the berm, should have a minimum top width of 6 feet, or as recommended by a geotechnical engineer. Where maintenance access is provided along the top of berm, the minimum width of the top of berm must be 15 feet.

Growing medium: Because pond grading generally requires the topsoil to be removed to form the basin shape of the pond, the resulting top layers of soil must be amended, or topsoil must be brought back in to ready the soil for planting.

Topsoil must be used within the top 12 inches of the facility, or the soil must be amended to support plant growth. Rock shall not be placed under the growing media to allow roots from vegetation to extend from the imported or amended topsoil into underlying existing subsoil.

Ponds/centralized facilities that are used during the construction phase as a temporary sedimentation basin should delay placing soil/growing medium or install permanent vegetation after the facility is done being used for erosion control. Sediment removal, growing media replacement and/or vegetation replacement may be required prior to city acceptance of any facility finished prior to the construction phase being complete.

Vegetation: Plantings must be added to the bottom of the pond (zone A for dry ponds and zone S for wet ponds), side slopes (zone A), plus the 10-foot buffer around the pond (zone B). See **Figure G-1** in **Appendix G** for zone references. Plants shall be selected from the **Gresham List of Stormwater Plants** following the requirements in **Appendix G**. **Table G-1** in **Appendix G** has plant spacing and size requirements for each zone of dry and wet ponds.

If trees or large shrubs are planted, they should generally be placed along the north side of a facility to minimize shading of the lower growing emergent vegetation.

Side slopes of facilities (zone B) shall be planted with a seed mix of wildflowers, native grasses, and groundcovers (not turf or lawn mix). Follow the seed coverage rate specified on the label. City-maintained facilities must not require mowing more frequently than 1-2 times annually.

Irrigation: Permanent irrigation systems are allowed for public stormwater facilities when approved by the City. Irrigation systems will be required to install a stand-alone water meter and backflow device. Meters, backflow device, and in-ground irrigation plumbing will be installed according to irrigation system specifications in the City of Gresham *Public Works Standards*.

Fencing: Fences are required for all City-maintained ponds with a permanent pool greater than 18 inches deep, interior side slopes steeper than 3H: 1V, or any walls/bulkheads greater than 24 inches high. The design must address screening requirements for fencing. Fencing for privately owned facilities is at the discretion of the owner. The owner may use the criteria for City-maintained facilities.

For both private and City-maintained facilities where fencing is used, fences should be complementary to the site design. Facilities designed as a public amenity might consider a split rail cedar fence, or a 3- or 4-foot chain link fence with coated wire (typically green or black). In situations where fences are needed to prevent climbing, a 6-foot chain link fence should be used. Fences for public facilities should be located at the extent of the property for which the City has maintenance responsibilities.

Access: Access shall be provided to any structure or area of the facility that will require equipment for maintenance. Public facilities shall have access to manholes, vaults, and other structure located at ground level that meet City of Gresham *Public Works Standards* section 4.05.01. Gravel access roads to any manhole, vault, or structures with sumped areas for sedimentation shall extend all the way to that structure, or as close as possible when infeasible. Access to forebays designed for sedimentation shall be provided by leaving an area of non-woody vegetation with side slopes less than 3:1. When fencing is installed, the fence must include at least one vehicle access gate. For public facilities, the vehicle access gates must be 12 feet wide, consisting of two swinging sections each six feet wide, be lockable, and be oriented for ease of access.

3.2.6 Stormwater Tree Wells

Facility Description
Stormwater tree wells are structural reservoirs used to collect, filter, and infiltrate stormwater, allowing pollutants to settle and filter out as the water percolates through growing medium. These facilities are similar to a stormwater planter, except the primary vegetation is a street tree. In order to increase facility capacity and create better growing conditions for the tree, these facilities also include structural soil under the adjacent sidewalk. Depending on site conditions, tree wells can be designed to completely or partially infiltrate the stormwater they receive. These facilities are typically not lined, unless an underdrain can be provided at a depth that prevents the roots from being inundated for extended periods of time.

Applicability
Stormwater tree wells are primarily used to manage stormwater from the public right-of-way. Since these are typically infiltration facilities, they should be located 10 feet from building foundations, not immediately upslope of building structures, and on slopes less than 20%.

Design Requirements

Soil suitability: The soil type or infiltration rates determine if the facility can be designed to achieve full or partial infiltration. Sites with Type C and D soils, or tested infiltration rates less than 0.5 inches per hour, may want to install an underdrain within the structural soil layer to provide an outlet for treated stormwater.

Sizing: Sizing varies by design approach. The Simple Sizing Form can be used to determine the size of facilities based on soil type.

Geometry: The typical detail for the Stormwater Tree Well is in *Public Works Standards* (GS-111).

- There is no shape requirement for stormwater tree wells, although they are typically designed as square with vertical side walls.

- The minimum width and length for any stormwater planter shall be 4 feet.
- The minimum ponding depth shall be 6 inches. The maximum ponding depth shall be 18 inches.
- The minimum depth of amended soil mix for stormwater tree wells shall be 36 inches. A minimum depth of 24 inches of structural soil shall be installed under the sidewalk for the width of the facility. See **Appendix F** for the required soil specifications to be included with the permit plans.

Setbacks: Stormwater tree wells are typically set back 10 feet from adjacent building foundations.

Piping:
Inlets: Stormwater trees wells typically receive flow from curb inlet detail GS-104 in the City of Gresham *Public Works Standards*.

Outlets: Facilities not able to store the volume from the 10-year storm event AND fully draw down within 48 hours shall ensure there is an overflow to an approved discharge location (this may be gutter flow to a standard catch basin). The facility shall be constructed to allow at least 6, but not more than 18, inches of water to pond in the facility prior to overflow.

As stormwater tree wells are typically located within the public street right-of-way, the overflow must meet City of Gresham *Public Works Standards* and shall direct excess stormwater to an approved discharge point. The most typical overflow is down the gutterline, which is designed using the modified curb and gutter detail GS-103. For green streets with multiple stormwater tree wells, an inlet to the piped stormwater conveyance system must be installed every 500 feet or at the end of each block, whichever is less.

Underdrains: For partial infiltration facilities in Type C and D soils, a perforated pipe (36-inch maximum length) may be proposed within the structural soil under the sidewalk to drain water that has filtered through the topsoil and prevent long-term ponding. Any proposed underdrain system shall be accessible for maintenance, follow *Public Works Standards*, and be approved by the Manager.

Soil/Mulch: A minimum of 36 inches of planting media shall be added to the stormwater tree well. Per the soil specifications in **Appendix F**, this can be accomplished by importing a 3-way soil blend or by amending native topsoil with a mix of one part imported organic compost and one-part gravelly sand, such that there are equal parts compost, sand, and native soil. The specification included in **Appendix F** shall be used for this purpose and included on the permit plans. A 2 to 3-inch layer of shredded bark mulch or pea gravel shall be used over the amended soil to completely cover the soil and prevent erosion or weed intrusion.

Structural Soil: A minimum of 24 inches of structural soil meeting the requirements specified in **Appendix F** is required under the sidewalk adjacent to the stormwater tree well. The structural soil shall be at least the same length as the tree well, with additional length or depth being allowed for engineering these facilities to manage runoff from the contributing drainage area. The goal for including structural soil is to allow pathways for roots to move under sidewalks without causing damage, while also providing additional temporary stormwater storage.

Vegetation: Stormwater Tree Wells are designed to support a single street tree. Trees on the **Gresham List of Stormwater Plants** are pre-approved, but other trees may also be proposed and approved by the Manager.

3.3 Subsurface Infiltration Facilities

Drywells, soakage trenches, and infiltration vaults/chambers are considered to be Underground Injection Control (UIC) devices, which are regulated by DEQ. Owners or operators of new and existing public or private UICs are required to register and provide site inventory data to DEQ. UICs collecting runoff only from single-family residential roofs and footing drains are excluded from UIC registration and only require a silt basin as pre-treatment.

All other public and private UICs receiving runoff from larger roofs or surface areas (driveways, parking lots, streets, etc) need to be registered with DEQ and meet rule authorization standards as described on the DEQ website. Meeting rule authorization standards typically means 1) having at least 5 feet vertical separation from seasonal high groundwater, 2) being located more than 500' away from or outside the 2-year time of travel of a well, and 3) having adequate water quality treatment prior to discharge.

3.3.1 Drywells

Facility Description

The typical drywell is a precast concrete ring (28" or 48" in diameter) in 5-foot-tall sections perforated to allow for infiltration. These facilities are vertical in nature and typically range from 5 to 25 feet in depth. There are also manufactured plastic "mini-drywells" which can be used for residential applications where <500 sf of roof area drains to each mini-drywell.

Applicability

Drywells are typically installed in well-draining soils, although they can be installed with an overflow in areas infiltrating less than 2 inches per hour. Drainage from private properties is not allowed to flow into public drywells located within the right-of-way. All public and private drywells need to meet DEQ's rule authorization standards, which requires a minimum of 5 feet of vertical separation between the bottom of the drywell and seasonal high groundwater, as well as pre-treatment. Drywells are UICs and require DEQ registration, unless they are used exclusively for single-family residential roofs or footing drains.

Design Requirements

Pre-Treatment: A trapped silt basin is required for UICs receiving runoff from residential roofs and footing drains. The silt basin should be installed between the dwelling and the UIC. In soils draining less than 2"/hour, an overflow shall be installed at least 4" higher than the pipe leading to the UIC and flow to an approved discharge point. Depending on the depth of the UIC and the site slope, the overflow can either tee from the inlet pipe prior to the silt basin, or from the inlet to the UIC.

With DEQ concurrence, a trapped silt basin is considered adequate pre-treatment for most roof runoff and pedestrian-only plaza areas. Commercial or industrial sites with mechanical structures or emissions that might result in elevated levels of pollutants of concern in their roof runoff should consult the City and DEQ to determine if additional pre-treatment may be required.

Pre-treatment of ground-level impervious surfaces that are not pedestrian-only plazas requires installation of one of the vegetated facilities listed in **section 3.2**; a proprietary device may be proposed if infeasibility has been demonstrated per **section 1.2.2**. For public drywells within the right-of-way where space would not allow for installation of a vegetated facility, the stormwater manager may deem a sedimentation manhole to provide adequate pre-treatment.

Soil suitability: Drywells typically function best in soils that infiltrate at least 2 inches per hour. Drywells may be installed in areas with lower infiltration rates, but must have an overflow to an approved discharge point. Installation of drywells in fill material is not permitted. All drywells must be installed in native soils. Supporting geotechnical evidence is required for all slopes of 20 percent or greater or when requested. An infiltration test or bore-log feasibility test must be performed for any site trying to demonstrate full on-site retention.

Setbacks: Drywells should be located 10 feet on-center from all foundations and 5 feet from property lines. The top of the perforated drywell sections must be located downgrade from foundations and at a lower elevation than local basements.

Sizing: For development using the Simple Method, Figure 3-1 may be used to size the drywell(s) based on the amount of impervious area that each drywell is designed to manage. Gray boxes indicate acceptable sizes in soils with infiltration rates >2" per hour. Soils with infiltration rates <2" per hour may use these sizes to meet water quality, but must install an overflow and then address remaining flow control requirements in a centralized facility.

Table 3-3. Drywell Sizing Chart

	Maximum Catchment Area Managed by a Single Drywell		
Drywell Depth (ft)	**24" Plastic Mini-drywell**	**28" Diameter Concrete**	**48" Diameter Concrete**
2'	500 sf	NA	NA
5'	NA	1,000 sf	2,500 sf
10'	NA	2,500 sf	4,500 sf
15'	NA	3,500 sf	5,000 sf

Drainage Layer: A layer of open graded washed ¾- to 2½-inch round or crushed rock must be installed on all sides of the drywell (12" minimum for private and 16" minimum for public). Plastic "mini-drywells" must also have a one-foot gravel lens below.

3.3.2 Soakage Trench

Facility Description

A soakage or infiltration trench is a shallow trench in permeable soil that is backfilled with washed drain rock. A perforated pipe delivers stormwater from the surface area being drained to the rock trench where water will be stored before infiltration. Once installed, the trench will be covered with at least a foot of stone, sand, or soil that can then support grass or other plantings. Private soakage trenches can be used to provide stormwater discharge by collecting and recharging stormwater runoff into the ground.

Applicability

Soakage trenches are typically installed in well-draining soils, although they can be installed with an overflow in areas infiltrating less than 2 inches per hour. Soakage trenches need to meet DEQ's rule authorization standards, which requires a minimum of 5 feet of vertical separation between the bottom of the trench and seasonal high groundwater. Soakage trenches are not allowed in the right-of-way. Soakage trenches are UICs and require DEQ registration, unless they are used exclusively for single-family residential roofs or footing drains

Design Requirements

Pre-Treatment: A trapped silt basin is required for UICs receiving runoff from residential roofs and footing drains. The silt basin should be installed between the dwelling and the UIC. In soils draining less than 2"/hour, an overflow shall be installed at least 4" higher than the pipe leading to the UIC and flow to an approved discharge point. Depending on the depth of the UIC and the site slope, the overflow can either tee from the inlet pipe prior to the silt basin, or from the inlet to the UIC.

With DEQ concurrence, a trapped silt basin is considered adequate pre-treatment for most roof runoff and pedestrian-only plaza areas. Commercial or industrial sites with mechanical structures or emissions that might result in elevated levels of pollutants of concern in their roof runoff should consult the City and DEQ to determine if additional pre-treatment may be required.

Pre-treatment of ground-level impervious surfaces that are not pedestrian-only plazas requires installation of one of the vegetated facilities listed in **section 3.2;** a proprietary device may be proposed if infeasibility has been demonstrated per **section 1.2.2**.

Soil suitability: Soakage trenches typically function best in soils that infiltrate at least 2 inches per hour. Soakage trenches may be installed in areas with lower infiltration rates but must have an overflow to an approved discharge point. Supporting geotechnical analysis is required for slopes of 20% or greater, or when requested. An infiltration test or bore-log feasibility test must be performed for any site trying to demonstrate full on-site retention.

All trenches must be constructed in native soil and must not be subject to vehicular traffic or construction work that will compact the soil, thus reducing permeability.

Setbacks: Soakage trenches must be located 5 feet from property lines and 10 feet from building foundations, unless approved by City. One hundred-foot setbacks are typical for slopes 20 percent or greater. Trenches may not be constructed under current or future impervious surfaces.

Sizing: Sizing requirements vary by soil infiltration rate. The maximum impervious area to be served by a soakage trench is 10,000 square feet.

The excavated trench width shall be 30" wide and 30" deep. The drainage rock will be 18", with 12" of soil over the top of the completed soakage trench.

The trench length shall be 30' for every 1000 sq ft of impervious surface draining to it. Soakage trenches installed in soils draining <2"/hour shall also add an overflow.

Drainage Layer: A minimum of 18 inches of open graded washed ¾- to 2½-inch round or crushed rock separated from soil by one layer of geotextile fabric.

Geotextile fabric: Use appropriate filter fabric between the native soil and the drain rock, including the perforated pipe to prevent clogging.

Piping: The solid conveyance piping from a building or other source must be installed at a ¼-inch per linear foot slope prior to connection with perforated pipe.

A minimum 12-inch cover is required from the top of all piping to the finished grade. All piping within 10 feet of a building must be 3-inch sch. 40 ABS, sch. 40 PVC, or cast iron for rain drain piping serving 1,500 square feet or less of impervious area. For an area greater than 1,500 square feet, 4-inch pipe must be used.

The pipe within the trench must be either PVC D2729 or HDPE leach field pipe. Perforated pipe must be laid on top of gravel bed and covered with geotextile fabric.

3.3.3 Infiltration Vault

Facility Description

Infiltration vaults are typically a horizontal perforated pipe, or proprietary open-bottomed corrugated plastic stormwater chamber which provides a temporary subsurface storage area for stormwater before it infiltrates. Most of these devices are made of high-density polypropylene or polyethylene (HPDE) installed in a rock trench that is a hybrid between a drywell and a soakage trench.

Applicability

Infiltration vaults are typically installed in well-draining soils, although they can be installed with an overflow in areas infiltrating less than 2 inches per hour. Infiltration vaults need to meet DEQ's rule authorization standards, which requires a minimum of 5 feet of vertical separation between the bottom of the trench and seasonal high groundwater. Infiltration vaults are not allowed in the right-of-

way. Infiltration vaults are UICs and require DEQ registration, unless they are used exclusively for single-family residential roofs or footing drains.

Design Requirements

Pre-Treatment: A trapped silt basin is required for UICs receiving runoff from residential roofs and footing drains. The silt basin should be installed between the dwelling and the UIC. In soils draining less than 2"/hour, an overflow shall be installed at least 4" higher than the pipe leading to the UIC and flow to an approved discharge point. Depending on the depth of the UIC and the site slope, the overflow can either tee from the inlet pipe prior to the silt basin, or from the inlet to the UIC.

With DEQ concurrence, a trapped silt basin is considered adequate pre-treatment for most roof runoff and pedestrian-only plaza areas. Commercial or industrial sites with mechanical structures or emissions that might result in elevated levels of pollutants of concern in their roof runoff should consult the City and DEQ to determine if additional pre-treatment may be required.

Pre-treatment of ground-level impervious surfaces that are not pedestrian-only plazas requires installation of one of the vegetated facilities listed in **section 3.2;** a proprietary device may be proposed if infeasibility has been demonstrated per **section 1.2.2**.

Soil suitability: Infiltration vaults typically function best in soils that infiltrate at least 2 inches per hour. Infiltration vaults may be installed in areas with lower infiltration rates but must have an overflow to an approved discharge point. Supporting geotechnical analysis is required for slopes of 20% or greater, or when requested. An infiltration test or bore-log feasibility test must be performed for any site trying to demonstrate full on-site retention.

Sizing: Any manufactured chamber proposed must be installed according to the manufacturer's specifications based on the measured infiltration rate for the site. The City has also developed a sizing calculator for infiltration vaults consisting of horizontal pipes in a rock trench.

Setbacks: Infiltration vaults are typically 10 feet on center from all foundations and 5 feet from property lines. The bottom of the drain rock must be a minimum of 5 feet from permanent groundwater.

Drainage Layer: A minimum of six inches of open graded washed drain rock is required below the vault/chamber, as well as on all sides and over top of chamber. A minimum of a foot of topsoil must be placed over the top of the rock.

Geotextile fabric: Use appropriate filter fabric between the drainage rock and native soils to prevent clogging.

3.4 Other Facilities

3.4.1 Proprietary Devices

Proprietary treatment devices may be proposed to meet pollution reduction requirements only if green infrastructure facilities have been demonstrated to be infeasible per **section 1.2.2**.

Facility Description

The only proprietary water quality facility currently approved for public projects within the City of Gresham is the Contech Stormfilter (see approved list for specific size and model details). The City of Portland maintains a list of approved manufactured stormwater treatment technologies which Gresham will consider in meeting pollution reduction requirements for private facilities, only if the developer demonstrates that on-site infiltration not feasible, and that use of a vegetated stormwater facility cannot fit due to mandatory land use constraints.

Note that the Stormfilter, and many of other proprietary devices, are only designed to treat water quality – so detention and flow control will need to be addressed using a separate facility.

If use is approved, the proprietary facility must be designed and constructed in accordance with the manufacturer's specifications.

Each site plan must undergo manufacturer review before the City can approve the design for site installation. A letter that certifies that the project has been designed to manufacturer's specifications must be submitted to City prior to the appropriate design milestone. For public improvements, including Public Works Permits, the letter must be submitted to City prior to 60% plan review. For installation on private property, the letter must be submitted prior to building permit plan approval.

Submittal Requirements: The following must be submitted with each project proposing use of a proprietary facility:

- Flow-rate calculations to demonstrate that the proprietary facility will perform within the approved sizing standards.
- Identification of high flow bypass.
- Facility dimensions and setbacks from property lines and structures.
- Profile view of facility, including typical cross-sections with dimensions.
- All stormwater piping associated with the facility, including pipe materials, sizes, and slopes.
- High-flow or overflow bypass.
- Any necessary documentation to demonstrate compliance with the specific Conditions of Approval for that device.

3.4.2 Detention Pipes/Vaults

Facility Description
Structural detention facilities such as tanks, vaults, and oversized pipes provide detention of stormwater, slowly releasing it at a rate determined by an orifice at the outlet. These structures must be designed not only for their function as runoff flow control facilities, but also to withstand an environment of periodic inundation, potentially corrosive chemical or electrochemical soil conditions, and heavy ground and surface loadings.

Tanks and vaults require a sedimentation manhole to capture sediment upstream of the tank or vault. The sedimentation manhole does not provide adequate water quality treatment, so a stormwater quality treatment facility is required to meet pollution reduction requirements. The vegetated facilities listed in **section 3.2** are considered to be adequate pre-treatment by the City, but a proprietary device may be proposed if infeasibility has been demonstrated per **section 1.2.2**.

Applicability
Detention pipes and vaults provide detention, but no volume reduction – so the City prioritizes other detention methods over these structures. They can however be used as a downstream detention facility to provide flow control, particularly for smaller developments (<5 acres) where complete on-site infiltration cannot be achieved and a surface facility (e.g. pond/centralized facility) would not be large enough to provide benefits beyond stormwater management (e.g. habitat).

Since the City has minimum orifice size requirements (2 inches for public facilities, 1 inch for private facilities), a V-notch weir may need to be utilized if these facilities are proposed for smaller projects.

Design Requirements

Access: All areas of a tank or vault must be within 50 feet of a minimum 24-inch diameter access entry cover. All access openings must have round, solid locking lids.

Publicly owned detention pipes are permitted within the public right-of-way and must be designed according to *Public Works Standards*. Pipes and vaults designed to detain runoff from private properties may not be located within the public right-of-way, but must instead be located in a separate open space tract. Detention pipes/vaults treating multiple properties shall be publicly owned and maintained, so the open space tract must have a public easement dedicated to the City of Gresham. All privately owned and maintained facilities must be located to allow easy maintenance and access.

Sizing: Detention pipes located in the public right-of-way must not be larger than 36 inches. The maximum diameter for public detention pipes located outside of the right-of-way is 96 inches. Access for inspection and maintenance shall be provided for all detention pipes.

If the collection system piping is designed also to provide storage, the resulting maximum water surface elevation must maintain a minimum 1-foot of freeboard in any catch basin below the catch basin grate. Pipe capacity must be verified using an accepted methodology approved by the City. The minimum internal height of a vault or tank must be 3 feet, and the minimum width must be 3 feet. The maximum depth of the vault or tank invert is 20 feet.

Where the tank or vault is designed to provide sediment containment, a minimum of ½ foot of dead storage must be provided, and the tank or vault must be laid flat.

Materials and Structural Stability: For public facilities, pipe materials and joints must conform to the *Public Works Standards*. For private facilities, the pipe material must conform to the Oregon Plumbing Specialty Code.

All tanks, vaults, and pipes must meet structural requirements for overburden support and traffic loadings, if appropriate. H-20 live loads must be accommodated for tanks and vaults under roadways and parking areas. End caps must be designed for structural stability at maximum hydrostatic loading conditions.

Detention vaults must be constructed of structural reinforced concrete (3000 psi, ASTM 405). All construction joints must be provided with water stops.

In soils where groundwater may induce flotation and buoyancy, measures must be taken to counteract these forces. Ballasting with concrete or earth backfill, providing concrete anchors, or other counteractive measures must be required. Calculations must be required to demonstrate stability. Tanks and vaults must be placed on stable, consolidated native soil with suitable bedding. Tanks and vaults must not be allowed in fill slopes, unless a geotechnical analysis is performed for stability and construction practices.

Flow Control Structures for Detention Systems: To restrict flow rates, a flow control structure must be used. The outlet control structure and orifice sizing shall follow the requirements listed under **Section 3.2.5**.

4.0 Conveyance

Storm drainage design for any development must include provisions to adequately control runoff from all public and private streets, and the roof, footing, and area drains of residential, multi-family, commercial, or industrial buildings.

4.1 Requirements

Any public or private development adding or replacing more than 100 square feet of impervious surface which cannot be fully infiltrated on-site must follow the requirements in this section for developing a collection system to convey water from the site to an approved point of discharge. Conveyance of runoff from uphill development must also be considered when developing a conveyance system.

The design must ensure future extension of the drainage system to the entire drainage basin in conformance with the adopted Storm Drainage Master Plans, as well as the following:

- Surface or subsurface drainage, caused or affected by the changing of the natural grade of the existing ground or removal of natural ground cover or placement of impervious surfaces, shall not be allowed to flow over adjacent public or private property in a volume or location materially different from that which existed before development occurred, but shall be collected and conveyed in an approved manner to an approved point of disposal.
- When field tile drains exist, the lines shall be capped, plugged or removed prior to development.
- Surface water entering the subject property shall be received at the naturally occurring locations, and surface water exiting the subject property shall be discharged at the natural locations with adequate energy dissipaters within the subject property to minimize downstream damage and with no diversion at any of these points.
- Developments shall not materially increase or concentrate runoff onto adjacent properties, except when the runoff is contained in an existing drainageway that is adequately protected to prevent erosion.
- Developments shall accommodate existing off-site drainage entering a development site so as to not impact upstream property owners.
- Modifications to the existing on-site storm drainage facilities shall not restrict flows thereby creating backwater onto off-site property to levels greater than the existing situation, unless approved by the impacted off-site property owners and the City.
- When adjacent private property must be crossed in order to reach an approved point of disposal, it shall be the developer's responsibility to acquire a recorded drainage easement (Easement requirements specified in the *Public Works Standards*).
- Temporary drainage ditch facilities, when approved, must be engineered to contain stormwater without causing erosion or other adverse effects to adjacent private property.
- All storm drain system designs shall make adequate provisions for collecting all stormwater runoff. The system shall accommodate all runoff from upstream tributary areas whether or not such areas are within the proposed development. The amount of runoff to be accommodated shall be based upon ultimate development of all upstream tributary areas.
- The applicant is required to provide an acceptable point for stormwater discharge from the developed site.
    - The approved point of disposal for all stormwater may be a storm drain, existing open channel, creek or other waterway, pond/centralized facility, or other point approved by the

City. Acceptance of proposed systems will depend upon the prevailing site conditions, capacity of existing downstream facilities, and feasibility of the design.
    - Runoff from developed portions of the site drainage basin should be discharged at the existing natural or manmade drainage outlet or outlets.
    - Runoff must be discharged in a manner that will not cause adverse impacts to downstream properties or previously constructed stormwater systems.
    - If the point of discharge is an open drainageway, then adequate velocity dissipation and/or additional channel protection shall be required to prevent erosion and/or alteration to the existing downstream drainageway.
    - If the point of discharge is a creek or other waterway, protection of stream channels shall be accomplished using bioengineering methods, minimizing the use of rock which can limit or inhibit the establishment of riparian vegetation. Permits from state and/or federal agencies may be required. See Section 4.7.
- Development shall extend the public stormwater conveyance system to provide a point of connection for all adjacent uphill parcels. The storm connection point shall be determined based on natural drainage patterns and input from the City related to future development plans.
- Stormwater conveyance systems are required to accept and convey upstream off-site stormwater runoff through the site.
- The applicant is also responsible for collecting and safely conveying the flows from springs and groundwater that surface during construction and within the warranty period of the stormwater system.
- Conveyance systems shall be designed and constructed such that the cumulative incremental effects of such work considered alone or together with existing or similar projects in the vicinity will not result in damage to existing waterways and surface waters by erosion, siltation or sedimentation, significant adverse effects to water quality, increased downstream water velocity, significant harmful deterioration of groundwater drainage. Projects affecting regulated floodplains and critical habitat need to complete a Habitat Assessment to demonstrate no deterioration of fish habitat or floodplain capacity.
- Conveyance systems shall be designed and constructed to carry the design storm flowing full with no surcharge or pressure flow. Flow conditions in existing pipe systems shall be evaluated on a case by case basis for adequacy in accordance with **section 4.4.1**.
- The City's construction and design specifications for conveyance systems, including acceptable materials, workmanship, fittings and installation, is described in the *Public Works Standards*.
- Conveyance systems shall be designed and constructed in compliance with requirements of all applicable Federal, State, and Local agencies, including Gresham's Floodplain Overlay code.
- Any proposed modification to the approved conveyance system plans shall be submitted to the City for review and approval prior to construction.

4.2 Conveyance Systems

There are generally two stormwater drainage conveyance systems preceding stormwater discharge to natural waterways: the on-site conveyance system and the sub-basin conveyance system. The on-site conveyance system is designed to convey stormwater runoff from the developed areas on the site to the stormwater BMP facilities. The BMP facilities are then connected to the sub-basin conveyance system which conveys upstream stormwater runoff around or through the developed site and conveys the stormwater to the natural point of discharge downstream.

4.2.1 On-site Conveyance System

The following on-site conveyance system requirements shall be incorporated into the design of the stormwater management plan:

- The site shall be planned and designed so as to generally conform to the existing natural drainage patterns and paths within the drainage basin. These natural drainage patterns and paths may be modified as necessary to contain and safely convey the peak flows generated by the development.
- It shall be the responsibility of the applicant to provide a conveyance drainage system for all stormwater runoff and/or for surface water entering the property from off-site. Surface water, springs, and groundwater shall be incorporated into the overall design of the stormwater management plan.

4.2.2 Sub-Basin Conveyance System

Developments are required to convey upstream drainage through or around the development in a sub-basin conveyance system.

- In establishing the layout of stormwater networks, it is essential to ensure that upstream flows will not be directed and/or discharged onto private property during rainfall events up to the conveyance system design capacity.
- Upstream drainage basin analysis shall assume ultimate build out at maximum zoning density in determining the size of the conveyance system required through the site.
- Generally, land use zoning adopted by the City will be used to size the capacity of the sub-basin conveyance system. For areas within the upstream basin that currently have a rural zoning designation but have the potential to be incorporated into the Urban Growth Boundary or Reserve, the City will assign the appropriate zoning designation and/or allowable maximum density to use in the upstream basin analysis for ultimate development potential and conveyance system sizing based on the best available information.

4.3 Downstream Analysis Report

Applicants may be required to provide a downstream analysis report. When required, an analysis shall be performed to determine the potential impacts from the project on the downstream system. The analysis must proceed far enough along the drainage course to determine that nothing downstream of the end point will be adversely affected by the project's runoff. The downstream analysis shall demonstrate adequate conveyance capacity to the distance where the project site contributes less than 15% of the upstream drainage basin area or 1,500 feet downstream of the stormwater point of discharge, whichever is greater.

The downstream analysis will show what impacts, if any, a project will have on the hydraulic conveyance system(s) downstream of the project site. The analysis is to be divided sequentially into 3 parts:

1. review of resources,
2. inspection of the affected area, and
3. analysis of downstream effects.

4.3.1 Review of Resources

During the review of resources, the Engineer of Record must review any existing data concerning drainage of the project area. This data will commonly include area maps, City's adopted floodplain and flood prone maps, Gresham's Local Wetland Inventory and database of Title 3 wetlands, groundwater

maps, stream surveys, engineering reports concerning the entire drainage basin, inventories of known drainage problems, and previously completed downstream analyses. The City may be able to provide most of this information. Other sources of information include: U.S. Geological Survey, Oregon Department of Environmental Quality, Oregon Department of State Lands, Oregon Department of Fish and Wildlife, and other local agencies.

4.3.2 Inspection of Affected Area

During the inspection of the affected area, the Engineer of Record must physically inspect the drainage system at the project site and downstream of the site. If downstream inspection of the system to the downstream distance specified in this section is not feasible due to access or other reason, the City may approve an alternative. During the inspection, the Engineer of Record should investigate any problems or areas of concern that were noted during the review of resources. The Engineer of Record should also identify any existing or potential capacity problems in the drainage system, any existing or potential areas where flooding may occur, any existing or potential areas of channel destruction (including erosion and sedimentation), and existing or potential areas of significant destruction of aquatic habitat.

4.3.3 Analysis of Downstream Effects

During the analysis of downstream effects, the information that has been gathered must be analyzed to determine if construction of the project will create any drainage problems downstream or will make any existing problems worse. Often, if the other minimum requirements are met, the project will not negatively impact the downstream drainage system. There are however some situations that, although minimum requirements have been met, will still have negative impacts. Whenever a situation is encountered where it has been determined that there will be negative impacts resulting from the project, mitigation measures must be included in the project to correct for the impacts.

If the downstream conveyance system capacity is undersized, the following design requirements shall be considered:

- Downstream system capacity analysis is the responsibility of the applicant. Based on the information submitted, the City will determine the adequacy of the downstream conveyance system. This determination will be based on the analysis submitted but may also be based upon existing information indicating current or past drainage problems downstream from the project.
- If additional stormwater flow control measures are required by the City, the applicant may have the option to correct and/or improve downstream drainage conditions so that the proposed stormwater release rates do not have to be further restricted.
- The applicant is responsible to replace, repair, upsize, construct, or reconstruct the downstream conveyance system in order to provide the capacity necessary to develop the property. The downstream conveyance system may include any open or closed public or private stormwater conveyance system.
- The applicant is required to identify all offsite downstream conveyance restrictions.
- Any offsite improvements will be the requirement and responsibility of the applicant to obtain private and public easements, design approval, and authorization from all owners of any private property and/or agency having the authority to regulate the activity. All agreements, easements, authorization and approvals shall be acquired prior to stormwater management plan approval.
- Where no conveyance system exists at the adjacent down gradient property line and the discharge was previously un-concentrated or significantly lower concentrated flow, measures shall be taken to prevent adverse downstream impacts.

- Drainage easements from downstream property owners may be needed and shall be obtained in addition to the construction of an adequate conveyance system prior to the City approving the Preliminary Statement of Feasibility and/or the stormwater management plan.

4.4 Conveyance System Sizing

Unless an alternative method is approved by the City in writing, calculation of storm runoff used for conveyance capacity design shall be based on SBUH, SCS TR-55 or the SWMM methods.

- Generally, the Santa Barbara Urban Hydrograph (SBUH) method for computing peak discharge is preferred by the City. Other acceptable methods include National Resource and Conservation Service (formerly Soil Conservation Service (SCS)) Technical Release 55 (TR-55), US Environmental Protection Agency Stormwater Management Model (EPA SWMM-Runoff), or other acceptable methods as approved by the City. For drainage basins 10 acres or less, the Rational Method is acceptable.
- Manning's equation shall generally be acceptable for determining pipe or open channel capacity.
- The rainfall distribution to be used within the City is the design storm of 24-hour duration based on the standard National Resources Conservation Service's (NRCS) Type 1A rainfall distribution using the 24-hour precipitation isopluvials in the National Oceanic and Atmospheric Administration Atlas 2, Volume 10, *Precipitation-Frequency Atlas of the Western United States*.
- Curve numbers shall be derived from the NRCS runoff curve numbers contained in TR-55 *Urban Hydrology for Small Watersheds*.
- Soil types shall be derived from the NRCS Soil Survey for Multnomah County.
- A maximum overland distance for sheet flow used in calculations shall be 300 feet.

Table 4-1. Conveyance design storm sizing criteria

Structure or facility		Design storm recurrence interval (years)
Storm sewers, ditches, and outfall pipes	Draining less than 250 acres (includes residential streets, curbs, gutters, inlets, catch basins, connector drains)	10
	Draining greater than 250 acres (includes culverts, trunk lines and drainage systems associated with arterial streets)	50
Creek or stream channels	Without designated floodplain	50
	With designated floodplain	100

4.4.1 Hydraulic Design

The following provides a list of hydraulic design criteria.

- For new development utilizing an existing, undersized storm conveyance system, there shall be a 1-foot minimum freeboard between the hydraulic grade line and the top of the structure or finish grade above pipe for the conveyance design storm post-development peak rate of runoff.
- Design surcharge (hydraulic grade line) in pipe systems for the conveyance design storm event shall not cause flooding in portions of a habitable structure, including below floor crawl spaces, or otherwise create a hazard or danger to the health and safety of the public.

- Stormwater runoff along a street during the peak conveyance design storm event shall not run deeper than 3 inches against the curb or extend more than 3 feet into the roadway, measured from face of curb.
- The overland stormwater runoff component to accommodate the 100-year event shall not be allowed to flow through, backwater or inundate an existing building or adjacent property.
- Upstream impacts: When approved by the City, the off-site upstream property owner(s) shall agree to and sign a permanent stormwater – surface water drainage easement legally describing the location of the backwater storage and authorizing the use of their property for stormwater drainage and detention purposes. The easement shall be in a form approved by the City or shown on a recorded plat.
- Downstream impacts: Downstream restrictions that create backwater during the 25-year design storm in the current or post-development condition may be required to be addressed by the applicant, at the discretion of the City.
- Removal of downstream restrictions shall not be allowed without City approval if the removal will cause, contribute, or exacerbate damage from flooding to existing property, buildings or dwellings.

4.4.2 Land Use Assumptions for Flow Determination

Land use assumptions for analyzing and designing the capacity of the conveyance system for the design storm flows shown in Table 4-1 shall be based on full build-out of the upstream drainage basin based upon City of Gresham zoning and/or realistic estimates of development densities in areas included in recent additions to the Urban Growth Boundary or Urban Growth Reserve.

For large or complex drainage areas containing a variety of different land uses or topography, select several homogenous areas and determine the slope for each and average the slope of them together to determine a representative area slope. The City accepts this simplifying assumption because it is impossible to explicitly define all of the potential slopes that could occur across anything but a very simple homogeneous area.

4.5 Pipe System Design

Piped conveyance systems are used to transport stormwater runoff from both:

1. impervious surfaces (roof, driveway, street, etc.) to an on-site stormwater facility, and
2. from on-site stormwater facilities to an approved off-site discharge point (gutter, centralized stormwater facility, outfall, ditch, drainageway, surface water, etc.).

When full on-site infiltration/retention is not feasible, a piped system is required to convey excess water from the edge of any property not adjacent to a natural drainageway. Open channel conveyance may be proposed for parcels where it is practical and fits within the planned future street section. Public green streets typically require installation of an inlet leading to a piped system every 500 feet or at the end of each block, whichever is less.

4.5.1 Public Storm Pipe System Requirements

Public storm pipe systems shall be in accordance with the *Public Works Standards*.

4.5.2 Private Storm Pipe Systems

Piped systems serving a single property are considered private, until they become public at the edge of the right-of-way. Privately maintained storm systems outside the public right-of-way shall be permitted by the City following Oregon Plumbing Specialty Code (OPSC). The provisions of the City ordinances requiring permits, fees, and other requirements shall be completed prior to the start of work on any portion of the storm systems.

A. Planning Considerations
   1. Each parcel requiring a connection to the public storm system shall be served by a storm sewer pipe, sized in accordance with Chapter 11 of the OPSC.
   2. Private connections extending into the public right-of-way shall connect at an approved point of discharge with the public storm system in accordance with the *Public Works Standards*.
   3. When subdivision lots drain away from the right-of-way, it may be necessary to provide a backyard storm drain system. When necessary, a public main line collecting drainage from multiple properties may be approved by the City. In this case, all laterals and appurtenances will be considered private and will be the responsibility of the homeowner. Any public main shall be publicly owned, in a public easement, and must follow requirements outlined in the *Public Works Standards*.

B. Design Considerations for Private Storm Sewer Pipe Systems
   1. Private storm sewer connections (laterals) shall provide gravity service to the entire roof area drain and foundation drains of buildings on a parcel.
   2. Private storm pipes that continue into the right-of-way become public at the edge of the right-of-way, and must then meet *Public Works Standards* between the connection point and the public mainline.
   3. A minimum grade of 2% is required for private storm pipes, unless a lesser grade is approved by the OPSC.
   4. All private storm lines shall be marked with detectable tracer wire or magnetic tape per OPSC.
   5. All portions of the lot shall be adequately drained so runoff does not cross onto other adjacent property prior to entering a public pipe or drainageway.

4.6 Open Channel System Design

An open channel is defined as a conveyance in which water flows with a free surface, such as a ditch or drainageway.*

4.6.1 Applicability

This section shall apply to open channels constructed to convey stormwater runoff. This section does not apply to work within regulated waterways, i.e., existing surface water features that meet Department of State Lands and/or U.S. Army Corps of Engineers criteria for a jurisdictional feature. **Section 4.7** provides City requirements that should be considered in addition to state and federal requirements for modifying jurisdictional waterways.

Development which re-grades existing roadside ditches or constructs new roadside ditches shall also meet applicable local roadway standards.

4.6.2 Channel Design

- Beginning at the point of discharge from the site, the surface conveyance facility must have the capacity to convey flows in **Table 4-1** from all contributing upstream drainage areas.
- Roadside facilities shall convey the design storm within a channel defined within the top of bank.
- Open channels shall generally have a natural curvilinear alignment with a 100-foot-minimum flow-line radius and a low-flow channel designed to convey a 2-year design storm and high-flow channel designed to convey the peak conveyance storm per **Section 4.4**.
- Banks shall be designed with a minimum 1 foot of freeboard above the design storm provided no structures are impacted by the design water surface elevation. The surface configuration at the top of bank should provide adequate accessibility for maintenance as determined by the City.
- Open channels shall be designed to prevent scouring of the channel.
- If a minimum slope of 0.1% cannot be achieved then design the channel with features that encourage infiltration, water use by vegetation or evaporation.
- Vegetation-lined channels shall be used whenever practicable as determined by the City. Rock-lined channels shall be used only where a vegetative lining will not provide adequate protection from erosion.
- Where riprap protection is specified, riprap shall be placed over a woven geo-textile fabric.
- Constructed open channels shall be sized to pass the required flows without causing erosion and shall have side slopes no steeper than 2:1 (2 horizontal to 1 vertical)
- Manning's Roughness Coefficient ("n") shall generally comply with the ODOT *Hydraulics Manual*.
- No protruding pipes, culverts or other manmade structures, which reduce or hinder the flow characteristics of the channel, will be allowed. Channel connections shall be designed to prevent scouring. All pipe connections shall match side slopes and incorporate a headwall.
- Open channel designs shall be based on the minimum level of protection shown in **Table 4--2**. Maximum design velocity shall be 6 feet per second (fps), unless approved by City.
- Areas of extreme curvature, changes in channel cross-section, or low-flow channels with design flow velocities exceeding 3 fps shall be designed and constructed with bank stabilization to consider additional potential for scouring from turbulent flows.

Table 4-2. Protection for New Channel Construction

Velocity at Design Flow (fps)				
Greater than	**Less than or equal to**	**Required protection**	**Thickness (ft)**	**Minimum height above design water surface (ft)**
0	5	Vegetation lining	Not applicable	0.5
5	8	Bioengineered lining	Not applicable	1
		Riprap A[1]	1.5	1
8	12	Riprap B[1]	2.5	2
12	20	Slope mattress, etc.	Varies	2
20		Engineer designed per ODOT Hydraulics Manual		

[1]Gradations for Riprap A and B can be found in Table 4.05.05-2 "Rock Protection Design" of the Public Works Standards.

4.7 Impacts to Jurisdictional Waterways

Any project proposing stormwater discharge to a jurisdictional waterway will need to be permitted through and meet the current standards of Oregon Department of State Lands (ODSL) and/or U.S. Army Corps of Engineers (USACE).

Unless otherwise approved by the City, the following requirements apply to impacted waterways:

- Bank slopes shall generally be no steeper than 3:1 (3 horizontal to 1 vertical). In areas where 3:1 side slopes are impracticable because of existing natural features or other limitations obstructing the channel, the bank slope shall be no steeper than 2:1.
- If the top of bank is a berm, the backslope shall generally be no steeper than 2:1 and shall be graded to prevent fish impoundment. In areas of compacted fill and/or potential instability, the City may, at its discretion, require grading to be designed by a geotechnical engineer.
- Regulated waterways shall be designed and constructed with temporary and permanent bank stabilization measures in all impacted locations.
- Natural bank stabilization measures (i.e., slope pull-back, willow mats, rock barbs, or revegetation with localized native plant species) shall be used.
- Post-construction bank stabilization shall minimize the potential for erosion or sedimentation.

4.8 Outfalls

The outlets of pipes and open channels are points of critical erosion potential. Stormwater that is transported through man-made conveyance systems at design capacity generally reaches a velocity that will cause channel erosion. To prevent scour at stormwater outlets, protect the outlet structure, and minimize the potential for downstream erosion, a flow transition structure is needed to absorb the initial impact of flow and reduce the speed of the flow to a non-erosive velocity.

- Outfalls to waterways may require ODSL and USACE permits. The applicant is responsible for obtaining necessary State and Federal permits and providing proof of approval to the City before construction begins.
- Outfalls shall be constructed to prevent scouring, reduce velocity and minimize the potential for erosion and other potential damage to the waterway banks. Outfall designs shall address erosion and scouring within the waterway upstream and downstream of the outfall structure.
- Bank stabilization shall not reduce the carrying capacity of the water course. Bank stabilization designs shall consider the flow velocities of pipe outlets and the flow velocity in the waterway to which the discharge is proposed.
- See *Public Works Standards* section 4.05.05 for outfall energy dissipation design.

4.9 Culverts and Bridges

For waterways and ditches* deemed to be jurisdictional by the Oregon Department of State Lands or US Army Corps of Engineers, all bridge and culvert projects are required to ensure that the waterway crossing is constructed and maintained to be passable by juvenile and adult forms of native fish species, per Oregon Department of Fish & Wildlife (ODFW) criteria. Waivers and exemptions from these criteria are available from ODFW and will be the responsibility of the applicant to secure.

New installations or modifications of culverts and bridges within designated 100-year floodplains shall be reviewed and approved by Gresham Development Planning. If the floodplain boundary, Base Flood Elevation, or other floodplain characteristics will be altered, the project will require Federal Emergency

Management Agency (FEMA) review and approval by means of a Letter of Map Change request. A Habitat Assessment and No-Rise Analysis will need to be completed if a Letter of Map Change application is to be submitted. These will need to be reviewed and approved by Gresham Natural Resources Program and Stormwater Engineering staff prior to sign off by the City's Floodplain Manager. Sign off by the Floodplain Manager is required of the applicant in advance of submitting the application materials to FEMA.

General criteria for new culverts or bridges over jurisdictional waterways*:

- Be fish passable.
- Have a natural stream bottom.
- Pass the 100-year peak discharge from the upstream drainage area assuming full development.
- Have a minimum vertical clearance between the design water surface and the bottom of any part of the bridge of 3-feet.
- Culverts which are part of the public stormwater system shall be constructed following *Public Works Standards*.

* Note: some roadside ditches may be considered a jurisdictional waterway. A natural resource professional should be consulted to assess whether a waterway or ditch meets "Water of this State" or "Water of the US" criteria. A Jurisdictional Determination by US Army Corps of Engineers and EPA may be required.

5.0 Source Control

Commercial activities generate pollutants that may be introduced into the City's stormwater system or directly into local water bodies. Traditional stormwater Best Management Practices (BMP) as detailed in section 3, are not designed to adequately remove the pollutants generated from these business activities.

This chapter identifies those business activities and details the additional BMPs required to control those pollutants at their source. Examples of pollutants requiring source control BMPs include oil and grease, hydrocarbons, heavy metals, toxic organics, solvents, high or low pH substances, nutrients, bacteria, and suspended solids.

5.1 Applicability

All businesses within the city whose activities result in recurring sources of pollution as defined in GRC 3.23.025, shall be subject to the Stormwater Pollution Prevention for Businesses Program inspections, technical assistance and pollution prevention factsheets of policies and best practices for preventing, controlling, and cleanup of pollutants.

The source controls listed in this section apply to all business activities conducting site activities listed in **Section 5.1.1**, including new development, redevelopment (including tenant improvements), enforcement cases, and existing sites proposing new offsite discharges.

For tenant improvements, only those areas of a structure or activity area being disturbed are required to make the relevant structural changes identified in this chapter. If a business implements a new activity listed in **Section 5.1.1** in an existing area, it must meet the source control requirements of the applicable section(s).

For facilities with new offsite discharges, only those proposed areas draining offsite are subject to these regulations.

The requirements of this chapter are in addition to the traditional stormwater BMPs identified in Chapter 3.

Developments requiring source control BMPs which have existing or proposed off-site stormwater BMP facilities are not exempt from on-site source control requirements of this section.

5.1.1 Source Control Triggers

Projects with the following site activities are subject to the requirements of this section:

- Fuel Dispensing Facilities and Surrounding Traffic Areas (Section 5.3)
- Above-Ground Storage of Liquid Materials (Section 5.4)
- Solid Waste Storage Areas, Containers, and Trash Compactors (Section 5.5)
- Exterior Storage of Bulk Materials (Section 5.6)
- Material Transfer Areas/Loading Docks (Section 5.7)
- Equipment and/or Vehicle Washing Facilities (Section 5.8)
- Equipment and/or Vehicle Repair Facilities (Section 5.9)
- Stormwater and Groundwater Management for Development on Land with Suspected or Known Contamination (Section 5.10)

- Multilevel Parking Structures (Section 5.11)

Applicants are required to address all applicable site activities listed in Sections 5.2 through 5.11. For example, if a development includes both a fuel dispensing area and a vehicle washing facility, the source controls requirements in both Sections 5.3 and 5.8 will apply.

5.1.2 Goals and Objectives for Source Control

The source control requirements are based on the following goals and objectives:

1. Prevent stormwater pollution by eliminating pathways that may introduce pollutants into stormwater.
2. Protect soil, groundwater, and surface water by capturing pollutants and reducing impacts to the environment.
3. Permit the wastewater discharges and areas with the potential for relatively consistent discharges into the public sanitary sewer system (such as vehicle washing facilities), excluding non-contaminated stormwater runoff.
4. Direct areas that have the potential for pollutant releases or accidental spills, and are not expected to regularly receive flow, stormwater runoff or require water use (such as covered fuel islands or covered containment areas) to an approved method of containment, disposal or point of connection.
5. Safely contain spills on-site and prevent discharges to any storm sewers, sanitary sewers, and/or drainageways.
6. Emphasize structural BMP source controls over operational procedures. Structural BMP source controls are not operator dependent and are considered to provide more permanent and reliable prevention of pollutant discharges. Any operation-based method proposed to ensure source control needs to describe the long-term viability of the maintenance and operational program.

5.2 Common Source Control BMPs

5.2.1 Signage Requirements

Informational signage is required for some site uses and activities that have the potential to contaminate stormwater. Signage addresses good housekeeping rules and provides emergency response measures in case of an accidental spill or discharge.

Signage requirements for specific activities are noted in applicable sections. Signs must be located where they are plainly visible from all activity areas. More than one sign may be needed to accommodate larger activity areas. All signage shall conform to the requirements described in the example below.

- Signs must be water-resistant.
- Signs must provide safety precautions.
- Signs must provide immediate spill response procedures—for example: “Turn the valve located at. . .” and “Use absorbent materials.”
- Signs must have emergency contact(s) and telephone number(s)—for example: “Call 911” and “City of Gresham Operations Center 503-618-2626”
- Any applicable spill response supplies need to be clearly marked and located where the signage is posted and near a high-risk activity area. More than one spill response kit may be necessary to accommodate larger activity areas. The City expects spill response supplies,

such as absorbent material and protective clothing, to be available at all potential spill areas. Employees should be familiar with the site's operations and maintenance plan and/or proper spill cleanup procedures.

5.2.2 Cover Requirements

Covers are required for some site activities that have the potential to contaminate stormwater. When required, covers must meet the following conditions.

- Covers 10 feet high or less shall have a minimum overhang of 3 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated activity area.
- Covers higher than 10 feet shall have a minimum overhang of 5 feet on each side. The overhang shall be measured relative to the perimeter of the hydraulically isolated activity area.
- Runoff shall be directed from the cover to a stormwater BMP facility that meets all applicable code requirements.

5.2.3 Oil/Water Separator Design Requirements

An oil/water separator or a spill control manhole is required as pre-treatment for activities that occur indoors/under cover, and are piped to sanitary, such as:

- Fuel dispensing
- Wash racks/pads
- Food waste storage areas (e.g. oil/grease containers, food scrap collection containers, trash compactors)
- Vehicle/heavy equipment repair (unless dry shop or dead end sump utilized)
- Impound yards
- Where high concentrations of oil or grease are expected to discharge to the storm system.

Oil/water separators shall be designed, installed and maintained in accordance with the Oregon Plumbing Specialty Code, with input and review by Gresham Wastewater Pretreatment staff. The separator details must be shown on the building plans submitted at the time of building permit application and shall match manufacturer specifications and details, including the unit flow rate, effluent water quality, and maximum process flow rate. All separators shall be maintained per the manufacturer specifications and maintenance records shall be retained for a minimum of 5 years and made available upon request by City inspection personnel.

5.2.4 Spill Control Manhole Design Requirements

Spill control manholes are one of the options allowed for pre-treatment spill containment for fueling station areas outside the covered island. Spill control manholes are typically 4 foot diameter and 5 feet deep, with an outlet tee that extends down 18 inches below the outlet elevation. The area below the outlet must provide 60 cubic feet of dead storage volume for the capturing oil, grease and solids.

5.2.5 Request for Alternative Method of Source Control

Applicants may request an alternative method of source control by notifying in writing the City's Development Engineering division. The written request must specify the reason for the request and provide supporting technical and factual data demonstrating that the alternative BMP is as protective as the required BMP. The applicant will be notified in writing whether the request is approved or denied.

5.2.6 Other Applicable Codes or Regulations

The requirements of this chapter are separate from requirements or conditions required by state or federal regulations which could be more stringent.

Wellhead Protection Areas

Transport and handling of hazardous materials in designated well field protection areas are subject to additional requirements, as identified in the City's Columbia South Shore and Cascade Well Field Protection Manuals.

Sanitary Sewer

Applicants may be required to obtain an Industrial Waste Discharge Permit (IWDP) from the City's Pretreatment program for discharges into the public sanitary sewer system. For more information on the IWDP, visit the City's website at: GreshamOregon.gov

DEQ Permits

Some facilities, depending on their future intended use may be subject to a variety of DEQ permits for air, water and/or solid waste. Particular to stormwater, certain types of facilities are required to obtain an Industrial Stormwater Permit (1200-Z) from the Oregon Department of Environmental Quality (DEQ). For more information on facilities that require State stormwater permits, visit the DEQ website.

Private Underground Injection Control (UIC)

If discharge to a private UIC (drywells, sumps, and piped soakage trenches) is planned, the applicant must obtain a permit from DEQ prior to construction of the UIC. For more information on UIC permits, visit the DEQ website.

5.3 Fuel Dispensing Facilities and Surrounding Traffic Areas

The requirements in this section apply to all development where vehicles, equipment, or fuel tanks are refueled on the premises, whether it is a gas station, a single-pump maintenance yard, or a small-sized fuel tank. This includes activities defined as development or re-grading the surface of the fueling activity area.

A fuel dispensing facility is defined as the area where fuel is transferred from bulk storage tanks to vehicles, equipment, and/or mobile containers (including fuel islands, above- or below-ground fuel tanks, fuel pumps, and the surrounding pad).

Requirements

Cover

The fuel dispensing area shall be covered with a permanent canopy, roof, or awning so rainfall and stormwater runoff cannot come in contact with the fueling activity area. Detailed cover information is located in **section 5.2.2**.

Signage

Signage shall be provided at the fuel dispensing area and shall be plainly visible from all fueling activity areas. Detailed signage information is located in **Section 5.2.1**.

Pavement
A paved fueling pad of impervious concrete shall be placed under and around the fueling activity area and shall meet all applicable building code requirements. Sizing of the paved area shall be adequate to cover the activity area, including placement and number of the vehicles or pieces of equipment to be fueled by each dispenser.

Drainage
The impervious area beneath the cover shall be hydraulically isolated from the surrounding area through grading, berms, or drains.

Areas Under Cover
Drains from the fueling island must discharge to the sanitary sewer or to a dead-end sump. When connecting to sanitary sewer, an oil/water separator shall be installed to collect and detain the runoff from under the cover of a fuel dispensing area. Unless the City Building official requires a different volume, the minimum storage capacity of the oil/water separator and, if needed, an upstream storage sump/vault shall be 1,000 gallons. A flow-stop or shut-off valve is require downstream of the oil/water separator prior to connection with the public sanitary sewer system. If a dead-end sump is selected, the storage shall be a minimum of 2,000 gallons, or an alternative storage volume calculated by an engineer and approved by City.

Areas Outside Cover
Surrounding runoff must be directed away from the hydraulically isolated fueling pad to a stormwater discharge point that meets all stormwater management requirements of this manual and other applicable code requirements. A spill control manhole consistent with **Section 5.2.4** must be installed downstream of all applicable private stormwater quality facilities to accommodate spill containment.

Additional Requirements
- Installation, alterations, or removal of above-ground fuel tanks larger than 55 gallons, and any related equipment may be subject to additional building permit and fire department requirements.
- Underground fuel tanks are subject to additional permitting requirements by DEQ or the EPA. For more information on underground tank permitting, visit the DEQ website.

Exceptions
- The requirement to cover the fuel dispensing area can be appealed if the fuel dispensing area is generally used to service oversized equipment (e.g., cranes) that cannot maneuver under a roof or canopy.
- Propane tanks are exempt from the requirements of this section.
- Existing fueling areas are not required to install source controls identified in this section if the scope of work is limited to the following:
    1. A new canopy installation over an existing fuel dispensing area which has, as determined by the City, an adequate spill prevention plan.
    2. The replacement of a fuel pump on an existing fuel pad that is not being upgraded.

5.4 Above-Ground Storage of Liquid Materials
The requirements in this section apply to all development where there is any exterior storage of liquid chemicals including but not limited to, food products, waste oils, solvents, pesticides, process

wastewaters, or petroleum products in above-ground containers, in quantities of 50 gallons or more. This includes both permanent storage and temporary storage areas.

Requirements

Containment

Liquid materials shall be stored and contained in such a manner that if the container(s) is ruptured, the contents will not discharge, flow, or be washed into a drainageway, public storm or sanitary sewer system. A containment device and/or structure for accidental spills shall have capacity to capture a minimum of 110% of the product's largest container, or 10% of the total volume of product stored, whichever is larger.

Double-walled containers may be exempt from these spill containment requirements.
Pesticide storage requirements are regulated by EPA. Check EPA.gov/pesticides for current regulations.
The city may require additional controls in highly sensitive areas such as the wellfield protection area.

Cover

Storage containers (other than tanks) shall be completely covered so rainfall and stormwater runoff cannot come in contact with them. Detailed cover information is located in **Section 5.2.2**.

Pavement

The storage area shall be constructed with impervious materials that meet all applicable building code requirements. The impervious areas shall cover the area intended for storage.

Drainage

All impervious storage areas shall be hydraulically isolated through grading, berms, or drains.

- Covered storage areas: Significant amounts of precipitation are not expected to accumulate in covered storage areas, and drainage facilities are not required for the contained area beneath the cover. If the applicant elects to install drainage facilities, then discharges from the hydraulically isolated area shall meet the same approval requirements for Uncovered storage areas with containment.
- Uncovered storage areas with containment: When water accumulates in uncovered storage areas, approval of a batch discharge from the City is required before discharging a containment area into a public sanitary. This approval will determine appropriate disposal methods, identify pretreatment requirements (if applicable), and approval of the discharge. Testing may be required to establish the specific characteristics of the substance to be discharge. Contact the City's Source Control Program for batch discharge information.
- Discharges planned to be directed into the stormwater system must go into an approved stormwater facility(ies) that are approved during the site design process. Shut Off Valves shall be installed in the storage area so excess stormwater can be drained out of the activity area and directed either to the storm drainage facilities (if clean) or into the public sanitary sewer or authorized pretreatment facility (if contaminated). Except when stormwater is being discharged, the valve shall always be kept closed so any spills within the activity area can be effectively contained.

Signage

Signage shall be provided at the liquid storage area and be plainly visible from all surrounding activity areas. Detailed information is located in **Section 5.2.1**.

Bulk Fuel Terminals

Bulk fuel terminals, also known as tank farms, require the following:

- A separate containment area for all valves, pumps, and coupling areas, with sub-bermed areas either in front of or inside the main containment areas. These sub-bermed areas shall have rain shields and be directed to a public sanitary sewer system with a valve maintained in the closed position to control unauthorized discharges.
- An impervious floor within all containment areas is required to prevent spills from contaminating the groundwater.
- Truck loading and off-loading areas shall be covered to prevent spills from entering the public sanitary or storm system. To prevent the discharge of spills a shut-off valve is required as identified for fuel dispensing facilities.
- Shut-off valves shall be installed for the drainage of the required containment facilities for a tank yard. The valves shall be installed downstream of the primary containment area and kept closed. Valves installed for the drainage of the truck pad and sub-bermed containment areas shall be installed downstream of the BMP facilities including the spill control manhole.
- Storage of reactive, ignitable, or flammable liquids shall comply with the Uniform Fire Code as adopted by the State of Oregon. Source controls presented in this section are intended to complement, not conflict with, current fire code requirements. None of these requirements shall exclude or supersede any other requirements in this manual, other City permit requirements, or State and Federal laws pertaining to water quality. Contact the City for further information and requirements.

Batch Discharges

Any discharges to the sanitary sewer must meet the City's discharge limits as detailed in GRC Chapter 4 and be authorized by the City prior to release. In certain cases, an Industrial Waste Discharge Permit may be required. Laboratory analysis may be required to ensure the wastewater meets local discharge limits. Contact the City's Source Control program for information concerning discharges to the City's storm or sanitary sewer system.

5.5 Solid Waste Storage Areas, Containers, and Trash Compactors

A solid waste storage area is a place where solid waste containers are collectively stored. Solid wastes include both food and non-food waste. Typical solid waste collection equipment includes compactors, food scrap containers, grease bins, recycling containers, and garbage containers. Garbage, food scraps and recycling can be collected in yard containers or roll carts depending on waste generation.

Requirements

All roll carts, yard containers and trash compactors used for storage of solid waste and recycling are required to be leak-proof, and must remain watertight and free of holes throughout their period of use per Article 7.25.245(3) of the Gresham Revised Code. In addition to being stored in leak-proof containers, all development, redevelopment and tenant improvements to any portion of the site for one of the following types of waste is required to meet the cover, pavement and drainage requirements in this section.

- **Food waste generators.** Restaurants, grocery stores, bakeries, delis, hotels, and other businesses that have waste that is putrescible or likely to attract rodents or insects must meet the cover, pavement and drainage standards below.

- **Oil and grease containers.** Restaurants and other businesses that collect and store oil and grease shall create a separate space under their covered enclosure to store the oil/grease container that does not block access to garbage, food, and recycling containers.
- **Multi-family residential.** Waste storage for multi-family developments with shared trash areas must be stored in a roofed enclosure that meets the pavement and drainage requirements listed below.
- **Food carts.** "Pods" with multiple food carts shall create a shared trash area that meets the cover, pavement and drainage standards below. Stand-alone food carts shall provide a cover that prevents rainwater from coming into contact with any roll cart or oil and grease storage containers that will be stored outside of the cart. The cover for stand-alone food carts does not need to meet the standards for cover listed below, and does not need to meet the pavement or drainage requirements.

Cover

A permanent canopy, roof, or awning must be provided to cover the solid waste storage activity area. This covered storage area shall be constructed so that rainwater cannot come into contact with waste containers being stored under the cover.

The cover size must be relative to the perimeter of the hydraulically isolated activity area it is to cover and must accommodate truck access to the equipment. The cover width and opening height shall meet the following sizing guidelines, unless other dimensions are provided by the City's solid waste and sustainability division.

Table 5-1. Minimum Height and Width Requirements for front load pickup

Distance from front of container to exterior entrance or overhang (feet)	Minimum opening Height	Minimum opening Width
0-1'	9'	12'
1-3'	12'	12'
4-6'	14'	13'-6"
7'+	15'-5"	13'-6"

Interior height required to allow full lid opening:
6-yard Recycling Container: 11'-6"
4-yard Garbage Container: 10'-6"

Table 5-2. Minimum Height and Width Requirements for compacter pickup

Distance from front of container to exterior entrance or overhang(feet)	Minimum opening Height	Minimum opening Width
0-3'	12'	12'
4-6'	18'	13'-6"
7'+	22'	13'-6"

A reflective edge shall be added to the front of the cover to provide added visibility for waste haulers.

Pavement

The area beneath the cover shall be paved with concrete. The paved area must be sized adequately to cover the activity area intended for refuse storage or the trash compactor(s) and associated equipment.

Drainage
The paved area under the cover shall be hydraulically isolated, meaning no stormwater draining into or liquids draining out of the covered storage area. Hydraulic isolation may include installation of a berm or grading that prevents uncontaminated stormwater from running into the waste storage area, and ensures that any fluid under the enclosure drains to sanitary. An oil/water separator may be required as pre-treatment before discharging to sanitary, per **Section 5.2.3**.

Multi-family developments may be able to propose alternative methods to the sanitary plumbing requirement, if they demonstrate they are able to grade the paved surface on which waste containers are stored toward an approved private stormwater treatment facility that can adequately treat any pollutants that might be present.

5.6 Exterior Storage of Bulk Materials

The requirements of this section apply to developments that stockpile or store materials outdoors that may enter the City's stormwater system. The materials are separated into categories, based on risk assessments for each material: high-risk, low-risk, and exempt. **Table 5-3** provides examples of materials in each category and is not considered to be comprehensive:

Table 5-3. Risk level of bulk materials that might be stored

High-Risk Materials	Low-Risk Materials	Exempt Materials
• Universal Waste (batteries, pesticides, mercury-containing items) and other recyclable materials with potential effluent • Corrosive materials (e.g., lead-acid batteries) • Storage and processing of food items • Chalk/gypsum products • Feedstock/grain • Material by-products with potential effluent • Fertilizer/pesticides • Oily or otherwise contaminated vehicle/equipment parts • Lime/lye/soda ash • Animal/human wastes	• Recyclable materials without potential effluent • Used tires • Non-oily scrap or salvage • Treated lumber • Metal • Sawdust/bark chips • Sand/dirt/soil (including contaminated soil piles) • Material by-products without potential effluent • Unwashed gravel/rock • Compost • Asphalt • Non-leaking vehicles in stages of disassembly	• Washed gravel/rock • Finished untreated lumber • Rubber and plastic products (hoses, gaskets, pipe, etc.) • Clean concrete products (blocks, pipe, etc.) • Glass products • Inert products

Materials with any of the following characteristics are exempt from the requirements of this section:

- Have no measurable solubility or mobility in water and no hazardous, toxic, or flammable properties.
- Exist in a gaseous form at ambient temperature.

- Are contained in a manner that prevents contact with stormwater (excluding pesticides and fertilizers).

Requirements

Cover

- Low-risk materials shall be covered. Could be a temporary plastic film or sheeting if allowable by Fire code.
- High-risk materials shall be permanently covered with a canopy or roof to prevent stormwater contact and minimize the quantity of rainfall entering the storage area. Detailed cover information is located in **Section 5.2.2**.

Pavement

- Low-risk material storage areas are not required to have an impermeable surface.
- High-risk material storage areas shall be impervious beneath the structural cover. Sizing of the impervious surface area shall adequately cover the activity area intended for storage.

Drainage

- Low-risk material storage areas are typically allowed in areas served by standard stormwater BMP facilities. However, all erodible materials being stored must be protected from rainfall and stormwater runoff.
- If materials are erodible, a structural containment barrier shall be placed on at least three sides of every stockpile. The applicant shall clearly identify the method of containment on the building and/or stormwater management plans.
- For high-risk material storage areas, the paved area beneath the structural cover shall be hydraulically isolated through grading, structural containment berms or walls, or perimeter drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away.

Additional Requirements

- Storage of pesticides and fertilizers need to comply with specific regulations defined by EPA. For details refer to EPA.gov/pesticides. Signage shall be provided at the storage area if hazardous materials or other materials of concern are stored. Detailed information and examples are provided in **Section 5.2.1**.
- A shut-off valve may be required, depending on the nature of material stored, for the structurally covered storage area if the applicant elects to install drainage facilities and discharge into the sanitary or stormwater system.

5.7 Material Transfer and Loading Docks Areas

The requirements in this section apply to all developments proposing the installation of new material transfer areas, or structural alterations to existing material transfer areas (e.g., access ramp regarding, leveler installations).

The requirements apply to all material transfer areas, including loading/unloading docks, bay doors, and any other building access point(s) with the following characteristics:

- The area is designed (size, width, etc.) to accommodate a truck or trailer being backed up to or into it; and,

- The area is expected to be used specifically to receive or distribute materials to and from trucks or trailers.

The requirements may not apply to areas that are used only for mid-sized to small-sized passenger vehicles and that are restricted (by lease agreements or other regulatory requirements) to storing, transporting, or using materials that are classified as domestic use: Primary educational facilities (elementary, middle, or high schools), buildings used for temporary storage (a lease agreement may need to be provided), and churches.

Requirements

Pavement

An impervious surface area such as asphalt or concrete shall be placed underneath and around the loading and unloading activity area and shall meet all applicable building code requirements.

Isolation

Loading Docks. The first 3 feet of the paved/covered area, measured from the building or dock face, shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away.

Bay Doors and Other Interior Transfer Areas. Bay doors and other interior transfer areas shall be designed so that stormwater runoff does not enter the building. This can be accomplished by grading or drains.

Drainage

Loading Docks. Drainage from the hydraulically isolated area shall be directed to a pretreatment facility and approved point of discharge. Surrounding runoff and drainage from the access ramp shall be directed away from the hydraulically isolated area to a stormwater BMP facility that meets all applicable requirements of this manual.

Non-Gravity Option. Areas which cannot gravity discharge may be allowed to install a pressurized system. The City will review all sump pump or sewage ejector installations for compliance with the Uniform Plumbing Code and Oregon State Plumbing Specialty Code.

Pressurized system installations are considered “permanent equipment” and deemed the property owner’s liability in the event of system failure or if the property becomes vacated.

Bay Doors and Other Interior Transfer Areas. Because interior material transfer areas are not expected to accumulate precipitation, installation of floor drains is not required or recommended. It is preferable to handle these areas with a dry mop or absorbent material. If interior floor drains are installed, they shall be plumbed to an approved pretreatment facility and discharge into the public sanitary sewer.

Signage

Informational signage shall be provided at the material transfer area. Detailed information is located in **Section 5.2.1**.

Additional Requirements

- Bay doors and other interior transfer areas shall provide a 10-foot "no obstruction zone" beyond the entrance within the building. The "no obstruction" zone shall be clearly identified on the stormwater management plan at the time of the building permit application, and shall be demarked at the facility with bright or fluorescent floor paint.
- Areas that transfer chemicals or other substances detrimental to the stormwater system may be required to install a shutoff valve downstream of the transfer area.
- Valves located in material transfer areas are typically left open to facilitate drainage during normal conditions. Prior to transfer of chemicals, the valves shall be closed and reopened only after the transfer is complete. All valves shall be installed and maintained in accordance with manufacturer specifications.

5.8 Equipment and/or Vehicle Washing Facilities

The requirements in this section apply to all development within designated equipment, vehicle washing or cleaning areas. This includes smaller activity areas, such as wheel-washing stations. Residential sites are exempt.

Requirements

Cover

The washing area shall be covered with a permanent canopy or roof so precipitation cannot come in contact with the washing activity area. Detailed cover information is located in **Section 5.2.2**.

Pavement

The wash pad area shall be impervious surface such as asphalt or concrete placed under and around the washing activity area and shall meet all applicable building code requirements. Sizing of the paved area shall adequately cover the activity area, including the placement of the vehicle or piece of equipment to be cleaned.

Drainage

The paved area beneath the cover shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away. Drainage from the hydraulically isolated area shall be directed to an oil water separator connected to the public sanitary sewer. Surrounding runoff shall be directed away from the hydraulically isolated washing pad to a stormwater BMP facility that meets all applicable requirements.

Pretreatment

All vehicle and equipment washing activities shall be equipped with an approved oil/water separator system and comply with the City's sanitary sewer discharge standards listed in GRC Articles 4.40.040 and 4.45.010. Details on oil water separator design criteria are located in **Section 5.2.3**.

5.9 Equipment and/or Vehicle Repair Facilities

The requirements in this section apply to all development within designated equipment or vehicle repair including areas conducting body work.

Requirements

Cover

Repair areas shall be located indoors so precipitation cannot come in contact with the repair area. Precipitation shall be directed from the repair facility roof to a stormwater BMP facility that meets all applicable code requirements.

Floors
The floor shall be impervious material such as concrete.

Drainage

- Interior – Any proposed interior plumbing shall be designed, installed and maintained in accordance with the Oregon Plumbing Specialty Code, with input and review by Gresham Wastewater Pretreatment staff.
- Exterior - The repair area shall be hydraulically isolated through grading, berms, or drains to prevent uncontaminated stormwater from running onto the area and carrying pollutants away. Runoff shall be directed away from the hydraulically isolated repair area to a stormwater BMP facility that meets all applicable requirements.

Storage

- Interior – Chemicals used for cleaning machinery or motor vehicle and machine parts (including, but not limited to, lubricants, used fluids, solvents, cleaners, etc.) of any quantity must be stored in or on secondary containment structures.
- Exterior - Chemicals and materials must be stored in a manner consistent with the requirements set forth in **Section 5.3**, Above Ground Storage of Liquid Materials and **Section 5.4**, Exterior Storage of Bulk Materials.

Pretreatment
All vehicle and equipment repair areas with floor drains and/or shop sinks must have an approved oil/water separator system and comply with the City's sanitary sewer discharge standards listed in GRC Articles 4.40.040 and 4.45.010. Details on oil/water separator design criteria are located in **Section 5.2.3**.

5.10 Land with Suspected or Known Contamination

The requirements in this section apply to all development projects that disturb property suspected, or known to contain pollutants in the soil or groundwater. This includes development that is surrounded by properties found to have trace pollutants. These requirements will also be applied to any property that is seeking to make a new connection to a public storm system or drainageway from a property that is suspected, or known to contain pollutants in the soil or groundwater.

Local, State, and Federal regulations may require special handling and management of soils, groundwater, and surface drainage depending on the types and/or concentrations of pollutants. As a result of these regulations, sites with suspected or known contamination require a more detailed review process potentially delaying issuance of building permit approvals. Applicants are advised to contact the City early in the planning process (before plan submittal) if they are aware or suspect the site has contaminants or is adjacent to a contaminated site.

- To research contaminant information, refer to DEQ's Environmental Cleanup Site Information (ECSI) database. If records indicate there is a potential of contamination on the site, you must contact DEQ prior to pre- and post-construction activities. For technical

questions related to site contamination and clean-up, contact the Land Quality Division of DEQ.

- If contamination is discovered subsequent to stormwater management plan approval the owner shall immediately take steps to protect health, safety and the environment and contact the City and DEQ Northwest Regional Office Cleanup Duty Officer. Plan approval is suspended until an appropriate control and remediation/disposal plan for contaminated soil and/or water has been approved by DEQ and the City.

Requirements

Contaminants, media, and site conditions are unique to each parcel of land. Sites at risk for contamination shall therefore be reviewed on a case-by-case basis.

Soil Management

- Stockpiles of contaminated soils shall be covered with temporary plastic film or sheeting to prevent stormwater from contacting them.
- Stockpile perimeters shall have a containment barrier on all four sides of every stockpile to prevent stormwater run-on and material run-off. Barriers can consist of concrete curbing, silt fencing, or other berming material, depending on the activity, size, and resources available.
- Areas under stockpiles of contaminated soils are not required to be paved. However, an impervious layer shall be placed beneath the stockpile to protect uncontaminated areas from potential leachate.

Construction Dewatering

- Construction dewatering discharges from contaminated sites to the City's stormwater system are prohibited. Upon approval by the City, these waste streams may be discharged to the sanitary sewer if the discharge meets all standards detailed in GRC Articles 4.40.040 and 4.45.010.
- Laboratory analysis reports with data for all pollutants of concern will be required.
- Installation of required pretreatment technology, an approved sampling point, and/or a meter may be required by the City prior to any discharge to the sanitary sewer is permitted.
- Contact Department of Environmental Services for further information on discharging water to the sanitary sewer system.

5.11 Multilevel Parking Structures

The requirements in this section apply to all development with multilevel parking structures. Existing multilevel parking structures are not required to retrofit unless the structure is being redeveloped.

Requirements

Top Floor Drainage. Stormwater runoff from the top floor shall be directed to a stormwater BMP facility and approved point of discharge.

Lower Level Floor Drainage. Significant amounts of precipitation are not expected to accumulate in lower parking areas, and drainage facilities are not required for the lower floors. If the applicant elects to install drainage facilities, the drainage from the lower floors shall be directed to the public sanitary

sewer system. Prior to discharge all applicable pretreatment and/or oil water separator requirements shall be met.

Adjacent, Uncovered Portions of the Site. The surrounding uncovered portions of the site shall be designed so precipitation and stormwater runoff does not enter the multilevel structure. This can be accomplished through grading and/or drains.

6.0 Operation & Maintenance of Facilities

In order to function for their intended purpose over the long term, stormwater facilities must be periodically maintained.

6.1 Maintenance Responsibility

Stormwater facilities on a single private parcel (e.g. commercial, industrial, apartment complex) shall:

- Prioritize vegetated infiltration facilities to the maximum extent practicable;
- Be constructed in accordance with Building Code, the Stormwater Management Manual and, if applicable, the Public Works Standards; and
- Be privately owned and maintained. City staff may periodically inspect facility/structures and require private owner to conduct maintenance to ensure facility is still providing the water quality, conveyance, flow control, and/or retention/detention functions as designed.

Stormwater facilities treating multiple private parcels (e.g. condos, residential subdivision) shall be public. Any stormwater facility serving more than one property shall be sited on a separate tract with an easement or dedication to the City.

Gresham Revised Code section 3.24.050(4) requires private stormwater facilities to be maintained following the guidelines in this manual (see **section 6.3**). Private facilities constructed using the standard facility design criteria in **section 3.0** do not need to create an O&M plan or record an O&M form as described in **section 6.2**.

Stormwater facilities that do not have standard maintenance activities described in **section 6.3** must create an O&M Agreement following the requirements in **section 6.2**. The O&M Agreement includes an O&M Form, a Site Plan, and O&M Plan that shall be recorded with Multnomah County prior to issuance of an occupancy permit.

Publicly or privately financed projects constructed within the public right of way, or on parcels deeded for public ownership, shall be maintained by the developer for the warranty period, then publicly maintained following the 2-year warranty period. City inspectors will inspect the structures and vegetation at the end of the warranty period.

Maintenance responsibility for stormwater facilities located within public street right-of-ways or easements dedicated to the City will be shared between the City and adjacent private property owner. The City's maintenance responsibility will include periodic removal of accumulated trash, debris, and sediment, and repair or replacement of curbing, inlet drains, or rock check-dams. Weeding and trimming or replacement of shrubs, grasses, or other plantings will be the responsibility of the adjacent private property owner. In order to comply with adjacent private property owners' aesthetic values, adjacent private property owners may perform trash and sediment removal on a more frequent basis than the City is capable of achieving. Under no circumstance shall a private property owner place fill, trash, lawn trimmings, or leaves into a public or private stormwater facility.

6.2 O&M Agreement Requirements

An O&M Agreement is required for any stormwater facility located on private property that does not follow the standard facility design requirements in **section 3.0** with a typical detail from **Appendix H**. The required components of an O&M Agreement include:

- O&M Form;
- Site Plan; and
- O&M Activities for each facility type included in the permitted development.

A complete O&M Agreement containing these 3 items must be recorded with Multnomah County and then submitted to the City of Gresham prior to occupancy permit issuance.

The property owner, or responsible party, must keep a copy of the recorded O&M Agreement. The property owner is responsible for ensuring that maintenance is completed, and records are kept, even if someone other than the property owner is performing the maintenance, such as a facility manager or maintenance company.

6.2.1 O&M Form

The O&M Form to be included with the O&M Agreement for custom facilities is included at the end of this section. This form must be filled out and notarized prior to recording.

6.2.2 Site Plan

A site plan of the property must be included in Box 4 of the O&M Form or included as a separate sheet. The Site Plan must show: street frontage (label street name), home or buildings, parking lots, and driveways. Indicate with a "*" where each stormwater facility is to be located and label each one with the type. The O&M Plan (**section 6.2.3**) should provide dimensions, design drawings, and other design details for all stormwater facilities being installed.

6.2.3 O&M Plan

An O&M Plan that has details about each stormwater facility being proposed, as well as operations and maintenance activities that will be performed must be included in the O&M Agreement. Maintenance activities and frequency must be detailed and should be consistent with maintenance activities used for typical stormwater facilities described in **section 6.3** of this Stormwater Management Manual. Include engineered drawings, and design detail specifics about any stormwater facility not following one of the typical details included in **Appendix H**.

6.3 Typical Facility Maintenance Activities

Maintenance is required for ensuring the functionality of stormwater facilities. The following maintenance activities must be followed for stormwater facilities designed following the guidance in **section 3.0** of this manual. The owner of any property containing a stormwater facility shown on the development plan as a condition of approval is required to operate and maintain these facilities in accordance with the facility maintenance activities in this section.

Ecoroofs

Note: If the installed ecoroof is a proprietary system, then the O&M requirements for that system supersede this plan.

Structural components, including the waterproof membrane, must be operated and maintained in accordance with the manufacturer's specifications and design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged drains	Remove sediment and debris if necessary
Tears or perforation of membrane	Repair any leaks or structural deficiencies; contact manufacturer for repair or replacement
Vegetation must cover at least 90% of the facility at maturity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Appendix G.
Dry grass or other plants	Prune dry grasses and remove clippings.
Weeds	Manually remove weeds before they go to seed.
Growing medium must sustain healthy plant cover and drain within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Exposed soil	Cover with plants and mulch as needed
Eroded soils and gullies	Fill, hand tamp, or lightly compact and plant to disperse flow
Crusting, dry, or shrinking medium	Rake or amend to restore infiltration or flow
Ponding or excessive moisture	Amend soils and clear drains. Check irrigation system for leaks.

Annual Maintenance Schedule

Summer	Make necessary repairs. Improve growing medium as needed. Irrigate as needed.
Fall	Replant areas of exposed soil, replace dead plants. Provide erosion control for bare soil.
Winter	Monitor infiltration/flow-through rates.
Spring	Replant areas of exposed soil and replace dead plants
All seasons	Weed as necessary. Clean drains as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides. Their use is strongly discouraged because of the potential for negative impacts to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Irrigation: During the establishment period (up to 3 years), irrigation must not exceed ½ inch of water every 10 days, regardless of water source. Post-establishment irrigation must not exceed ¼ inch of water every 14 days (May through October), regardless of water source. Consider installing an irrigation flow meter for ecoroofs greater than 5,000 square feet. Test the irrigation system for leaks annually. Make sure irrigation piping is covered by at least 2" of soil at all times.

Infiltration/Flow Control: Ecoroofs must drain within 48 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent the introduction of pollutants into stormwater.

Record the time/date, weather, and site conditions when site activities contaminate stormwater. Record the time/date and description of corrective action taken.

Vectors (Mosquitoes and Rats): Ecoroofs must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Porous Pavement

Note: If this is a proprietary system, the O&M requirements for the system supersede this plan.

Structural components, including surface materials, must evenly infiltrate stormwater.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged surface	Vacuum or dry sweep at least once a year.
Unraveling or settled pavement	Repair as per manufacturer specification. Do not apply sealants to porous pavement.
Vegetation must be managed to reduce impacts to porous pavement.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Leaf debris	Sweep leaf litter and sediment to prevent surface clogging and ponding.
Vegetation encroachment	Prevent large root systems from damaging subsurface structural components.
Weeds	Manually remove, mow, or torch weeds
Filter medium must be maintained to preserve infiltration capacity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Aggregate loss	Replace paver pore space with aggregate per original design.

Annual Maintenance Schedule

Summer	Make structural repairs.
Fall	Vacuum sweep.
Winter	Monitor infiltration rates.
Spring	Vacuum sweep.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent the introduction of pollutants into stormwater.

Record the time/date, weather, and site conditions when site activities contaminate stormwater. Record the time/date and description of corrective action taken.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Downspout Extensions

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged gutters, drains, or downspouts	Remove sediment, debris, and blockages from downspouts, gutters, and pipes to maintain at least 50% conveyance at all times. Clean at least twice a year, or more often depending on the presence of overhanging trees.
Damaged or missing pipes, gutters, and downspouts	Repair or replace broken gutters and downspouts as needed. Identify possible leaks and verity that roof flashing directs water into gutters. Look for low spots or sagging areas along the gutter line and repair as needed with new hangers.
Blocked downspout extension	Clear downspout elbows of debris. Clear any build-up of soil, bark dust, and/or vegetative growth from around downspout extension and/or splash blocks. Verify that there is sufficient slope so that water flows away from the foundation.
Vegetation	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Appendix G
Dry grass or other plants	Irrigate and mulch as needed; prune tall, dry grasses and remove
Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion, or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from the plant list in Appendix G
Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.

Annual Maintenance Schedule

Summer	Make structural repairs. Clean gutters and downspouts. Remove any build-up of weeds or organic
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts to maintain conveyance.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and cleaning activities. Keep work orders and invoices on file and make them available upon request of the City inspector.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites must implement best management practices to prevent the introduction of pollutants into stormwater. Record the time/date, weather, and site conditions when site activities contaminate stormwater. Record the time/date and description of corrective action taken.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Rain Gardens/Swales

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged gutters, drains, or downspouts	Remove sediment, debris, and blockages from downspouts, gutters, and pipes to maintain at least 50% conveyance at all times. Recommend cleaning at least twice a year, or more often depending on the presence of overhanging trees.
Damaged or missing pipes, gutters, and downspouts	Repair or replace broken gutters and downspouts as needed. Identify possible leaks and verity that roof flashing directs water into gutters. Look for low spots or sagging areas along the gutter line and repair as needed with new hangers.
Blocked downspout extension	Clear any build-up of soil, bark dust, and/or vegetative growth from around downspout extension and/or splash blocks. Verify that there is sufficient slope so that water flows away from the foundation.
Vegetation must cover at least 90% of the facility at maturity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Remove dead material; replant per original planting plan, or substitute from the plant list in Appendix G.
Dry grass or other plants	Irrigate and mulch as needed; prune tall, dry grasses and remove clippings.
Weeds	Manually remove weeds
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from the plant
Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate
Ponding	Till, amend, or rake soil as needed to ensure ponding water drains within 48

Annual Maintenance Schedule

Summer	**Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.**
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Stormwater Planters

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged inlets or outlets	Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes; maintain at least 50% conveyance at all times.
Broken inlets or outlets	Repair/replace broken downspouts, curb cuts, standpipes, and screens.
Damaged liners and walls	Extend and secure liner to planter walls above the high water mark. The facility must be water tight to protect abutting foundations from moisture damage.
Cracked or exposed drain pipes	Repair or seal cracks. Replace when repair is insufficient. Cover with 6 inches of growing medium to prevent freeze/thaw and UV damage
Vegetation must cover at least 90% of the facility at maturity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Appendix G. Irrigate and mulch as needed; prune tall, dry grasses and remove clippings.
Tall grass and vegetation	Prune to allow sight lines and foot traffic. Prune to ensure inlets and outlets freely convey stormwater into and/or out of facility.
Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion, or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from the plant list in Appendix G.
Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.
Ponding	Rake, till, or amend soil surface with City-approved soil mix to restore infiltration rate. Remove and replace sediment at entrances.

Annual Maintenance Schedule

Summer	Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine facility structures. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Stormwater Tree Well

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged inlets or outlets	Remove sediment and debris from catch basins, trench drains, curb inlets, and pipes; maintain at least 50% conveyance at all times.
Broken inlets or outlets	Repair/replace broken inlets, curb cuts, and any overflow outlet.
Damaged walls	Repair/replace broken planter walls.
Tree must be replaced if it dies	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Appendix G. Irrigate and mulch as needed; prune branches as needed and remove clippings.
Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion, or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from the plant list in Appendix G.
Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.
Ponding	Rake, till, or amend soil surface with City-approved soil mix to restore infiltration rate. Remove and replace sediment at entrances.

Annual Maintenance Schedule

Summer	Make structural repairs; clean inlets; remove any build-up of weeds or organic debris.
Fall	Remove sediment and plant debris.
Winter	Clear inlets.
Spring	Remove sediment and plant debris.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine facility structures. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Pond/Centralized Facility

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged inlets or outlets	Remove sediment, debris, and blockages from catch basins, trench drains, curb inlets, and pipes to maintain at least 50% conveyance at all times.
Broken inlets, outlets, or	Repair or replace broken downspouts, curb cuts, standpipes, and screens as needed.
Cracked or exposed drain pipes	Repair or seal cracks. Replace when repair is insufficient. Cover with 6 inches of growing medium to prevent freeze/thaw and UV damage.
Check dams missing or with	Maintain or replace rock check dams as per design specifications.
Perforated liner	Replace or repair liner as needed.
Vegetation must cover at least 90% of the facility at maturity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per original planting plan, or substitute from the plant list in Appendix G. Irrigate and mulch as needed; prune tall, dry grasses and remove clippings.
Tall grass and vegetation	Prune to allow sight lines and foot traffic. Prune to ensure inlets and outlets freely convey stormwater into and/or out of facility.
Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover and infiltrate within 48 hours.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion, or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from the plant list in Appendix G
Scouring at the inlet(s)	Ensure splash blocks or inlet gravel/rock are adequate.
Slope slippage	Stabilize 3:1 slopes/banks with plantings from the original planting plan or from the plant list in Appendix G.
Ponding	Rake, till, or amend soil surface with City-approved soil mix to restore infiltration rate. Remove sediment at entrance.

Annual Maintenance Schedule

Summer	Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides. Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Vegetated Filter Strips

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Ineffective flow spreader	Repair structure to evenly disperse flow.
Vegetation must cover at least 90% of the facility at maturity.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Dead or stressed vegetation	Replant per planting plan, or substitute from Appendix G plant list.
Dry grass or other plants	Irrigate and mulch as needed; prune tall grasses and remove clippings.
Tall grass and vegetation	Prune to allow sight lines
Weeds	Manually remove weeds.
Growing medium must sustain healthy plant cover.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Gullies, erosion, or exposed soils	Fill in and lightly compact areas of erosion with City-approved soil mix (see Appendix F) and replant according to planting plan or substitute from Appendix G Plant list.
Slope slippage	Stabilize slopes with plantings from the plant list in Appendix G.

Annual Maintenance Schedule

Summer	Make structural repairs; clean gutters and downspouts; remove any build-up of weeds or organic debris.
Fall	Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Remove sediment and plant debris. Replant exposed soil and replace dead plants.
All seasons	Weed as necessary.

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Fertilizers/Pesticides/Herbicides: Their use is strongly discouraged because of the potential for damage to downstream systems. If pesticides or herbicides are required, use the services of a licensed applicator and products approved for aquatic use.

Access: Maintain ingress/egress per design standards.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

Drywell/Soakage Trench/Infiltration Vault

Structural components must be operated and maintained in accordance with the design specifications.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged inlets, manholes, catch basins, or silt traps	Clean gutters, rain drains, catch basins, or silt traps at least twice a year. Remove sediment, debris, and blockages from catch basins, trench drains, curb inlets, and pipes to maintain at least 50% conveyance at all times.
Cracked drain pipes, catch basins or manholes	Repair or seal cracks. Replace when repair is insufficient.
Vegetation encroachment	Prevent large root systems from trees and bushes from damaging subsurface structural components.
Ponding water	Remove sediment and debris from all accessible components. Repeated ponding in the system may indicate end of facility life. Consult with City prior to decommissioning or replacement activities.

Annual Maintenance Schedule

Summer	**Make structural repairs. Clear drains, inlets and catch basins.**
Fall	Clean gutters and rain drains; remove sediment and plant debris.
Winter	Monitor infiltration rates.
Spring	Clean gutters and rain drains

Maintenance Records: All facility operators are required to keep an inspection and maintenance log. Record date, description, and contractor (if applicable) for all repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the City inspector.

Access: Maintain ingress/egress per design standards.

Infiltration/Flow Control: All facilities must drain within 48 hours. Record time/date, weather, and site conditions when ponding occurs.

Pollution Prevention: All sites must implement Best Management Practices to prevent contamination of stormwater. Call 503-618-3000 to report spills. Never wash spills into a stormwater facility. If contamination occurs, document the circumstances and the corrective action taken; include the time/date, weather, and site conditions.

Vectors (Mosquitoes and Rats): Stormwater facilities must not harbor mosquito larvae or rodents that pose a threat to public health or that undermine the facility structure. Record the time/date, weather, and site conditions when vector activity observed. Record when vector abatement started and ended.

CITY OF GRESHAM

Area below for Multnomah County Recording Use Only

AFTER RECORDING, RETURN TO:

TITLES, LIENS & COLLECTIONS
RECORDING SERVICES
CITY OF GRESHAM
1333 NW EASTMAN PKWY.
GRESHAM, OR 97030-3813

Operations & Maintenance Agreement for Stormwater Management Facilities

Permit Application #: **Project #:**

PARTIES

Property Owner (OWNER):

CITY: City of Gresham
1333 NW Eastman Parkway, Gresham, OR 97030
503.618.2525

PROPERTY INFORMATION

Site Address:
Site Legal Description:

STORMWATER FACILITIES

EXHIBITS

LEGAL REQUIREMENTS

The Stormwater Management Practices located at this site are a condition of permit approval and site development. OWNER of this property is required to operate and maintain these facilities (Facilities) in accordance with City of Gresham Stormwater Management Manual. Call (503) 618-2525 or visit www.greshamoregon.gov/watershed for information or assistance.

I. OWNER INSPECTIONS
OWNER shall inspect the Facilities often to ensure the Facilities are functioning properly. Proper function for each facility type is described in the City of Gresham Stormwater Management Manual.

II. DEFICIENCIES
All aspects in which the Facilities fail to satisfy the O&M Plan shall be noted as "Deficiencies".

III. CITY INSPECTIONS
OWNER grants to the CITY the right to inspect the Facilities. CITY will endeavor to give ten (10) days prior written notice (as courtesy to OWNER), except that no notice shall be required in case of an emergency. CITY shall determine whether Deficiencies need to be corrected. OWNER (at the address provided in this Agreement, or such other address as OWNER may designate in writing to City) will be notified in writing of the Deficiencies and shall make corrections within 30 days of the date of the notice.

IV. DEFICIENCY CORRECTIONS
All Deficiencies discovered by OWNER or CITY shall be corrected at OWNER'S expense within thirty (30) days after completion of the inspection, or in the case of Deficiencies found by the CITY, within 30 days of written notice of any Deficiency. If more than 30 days is reasonably needed, OWNER may request, in writing, and the CITY may approve, an

extension of time to correct the Deficiency so long as the correction is commenced within the 30-day period and is diligently prosecuted to completion.

V. CITY CORRECTIONS

If correction of Deficiencies is not completed within thirty (30) days (or other agreed upon time) after CITY notice, CITY shall have the right to correct the Deficiencies. The CITY (i) shall have access to the Facilities for the purpose of correcting such Deficiencies and (ii) shall bill OWNER for all costs reasonably incurred by CITY for work performed to correct such Deficiencies ("City Correction Costs") following OWNER'S failure to correct any Deficiencies in the Facilities. OWNER shall pay to CITY the City Correction Costs within thirty (30) days of the date of the invoice. If payment is not made within 30 days, the CITY shall collect the unpaid City Collection Costs pursuant to Gresham Revised Code Article 7.50 regarding enforcement of cost assessment. OWNER understands and agrees that upon non-payment, City Correction Costs shall be secured by a lien on OWNER'S property for the City Correction Cost amount plus interest and penalties.

VI. EMERGENCY MEASURES

If at any time the CITY reasonably determines that the Facilities create any imminent threat to public health, safety or welfare, the CITY may immediately and without prior notice to the OWNER enter the property and take measures reasonably designed to remedy the threat. The CITY shall provide notice to OWNER of the threat and the measures taken as soon as reasonably practicable, and charge OWNER for the cost of corrective measures.

VII. FORCE AND EFFECT

This Agreement has the same force and effect as any deed covenant running with the land and shall benefit and bind all owners of the site, present and future, and their heirs, successors and assigns.

VIII. AMENDMENTS

The terms of this Agreement may be amended only by mutual agreement of the parties. Any amendments shall be in writing, shall refer specifically to this Agreement, and shall be valid only when executed by both parties to this Agreement and recorded in the Official Records of Multnomah County.

IX. PREVAILING PARTY

In any action brought by either party to enforce the terms of this Agreement, the prevailing party shall be entitled to recover all costs, including reasonable attorney's fees as may be determined by the court having jurisdiction, including any appeal.

X. SEVERABILITY

The invalidity of any section, clause, sentence, or provision of this Agreement shall not affect the validity of any other part of this Agreement, which can be given effect without such invalid part or parts.

OWNER ACCEPTANCE

BY SIGNING BELOW, OWNER accepts and agrees to the terms and conditions contained in this Operations & Maintenance Agreement and in any document executed by filer and recorded with it.

OWNER:

_____

STATE OF _____)
)ss.
County of _____)

This instrument was acknowledged before me on _____, 201___ by _____.

_____
Notary Public for Oregon
My Commission Expires: _____