CITY OF GRESHAM

Stormwater Management Manual

An Implementation Guide for Development Projects

July 2026

Gresham Stormwater Management Manual
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Stormwater Management Manual

An Implementation Guide for Development Projects

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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.

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

CITY OF GRESHAM

Department of Environmental Services
Watershed Division

1.0 Requirements

The goal of this Stormwater Management Manual (SWMM) 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 the Oregon Department of Environmental Quality (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.

The requirements in this SWMM are designed to meet requirements set by DEQ, which require:

1) Prioritizing the use of green development practices;
2) Retaining/infiltrating stormwater onsite whenever feasible;
3) When retaining all water onsite is not feasible, treat the water quality design storm and provide flow control to prevent hydromodification of streams and minimize offsite discharge of pollutants.

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.

The SWMM provides stormwater management requirements for both public and private projects, including what must be done to meet requirements on private lots, within the public right-of-way for public projects, as well as privately financed public improvements. The manual seeks to be comprehensive without being duplicative of additional requirements for public improvements that are in the *Public Works Standards* (PWS) and private requirements that are in the Oregon Plumbing Specialty Code (OPSC). The SWMM tries to call out when the PWS and/or OPSC should be consulted for additional requirements. In an attempt to keep the SWMM and PWS from being duplicative, any current requirements in the SWMM related to public projects may be moved to the PWS in the future.

There may be additional requirements for some development projects that are not specified in this SWMM. While the manual aims to be comprehensive, there may be additional requirements not noted that apply to specific areas of the city (e.g. areas north of the Union Pacific Railroad require Urban Flood Safety & Water Quality District review).

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.

Unless a site is topographically constrained from runoff connecting to a surface waterway, ~~C~~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 1,000 square feet or more of impervious surface are required to comply with stormwater management requirements for the added or replaced 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 quality (**section 1.2.4**), quantity/volume (**section 1.2.5**), and conveyance (**section 1.2.6**).

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

Unless a pre-planned downstream facility has been approved by the City, stormwater generated from impervious area on a property shall 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.

Stormwater must be managed in a way that does not alter existing natural drainage or would cause damage or flooding to other properties. A conveyance system meeting the requirements in **section 1.2.6** must be provided to ensure any property not able to fully infiltrate the 100-year storm event does not cause issues to adjacent properties.

1.2.1 Sites Exempt from Stormwater Requirements

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:

- 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, for the same use, and discharging to the same disposal point. **Expansions to the original impervious area of the structure trigger stormwater management requirements for the new impervious area.**
- Remodeling projects or constructing vertical additions within the existing building footprint, 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. These 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.
- New street constructed of 800 lineal feet or less, when funded by the City, where the requisite stormwater treatment will be required with development of the adjacent frontage.

1.2.2 Sites Where Infiltration is Prohibited

In order to comply with requirements from DEQ, stormwater facilities should be designed to infiltrate stormwater to the maximum extent feasible. There are situations where no amount of stormwater should be infiltrated on a site. When one or more of the following conditions are present, a filtration (lined facility) shall be used on the applicable portion of the site:

1. Sites on slopes greater than 20%, on sites with slope stability concerns as identified by a geotechnical engineer or sites within the Hillside & Geologic Risk Overlay;
2. Sites where the seasonally high groundwater level is within 3 feet of the proposed bottom elevation of stormwater infiltration facilities;
3. Sites with documented contaminated soils;
4. Areas which require source controls and are categorized as high-risk sites (e.g. hazardous material loading/unloading area at a Groundwater Protection regulated businesses);
5. Areas within setbacks listed in **Table 3-2**.

~~A geotechnical report is required for the first 2 conditions.~~

1.2.3 Stormwater Management Options

Except for sites listed in **sections 1.2.1** and **1.2.2**, all stormwater facilities should allow infiltration to the maximum extent practicable. In the designated drywell area, all stormwater should be retained on-site. Projects located in areas outside of the designated drywell area shall install an overflow conveyance system to ensure that water will be safely routed away from the site. 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 1.2.3.1** for single lot developments or **section 1.2.3.2** for residential land divisions. All development projects that will create new public streets or infrastructure must follow **section 1.2.3.3**.

1.2.3.1 Single Lot Developments

Commercial, industrial, and residential lots that are not part of a land division shall manage stormwater on the same parcel treating the water quality event (**section 1.2.4**) and meet the flow control requirements in **section 1.2.5**. In areas where the City has planned or constructed a downstream centralized facility, development projects may be able to contribute funds in-lieu of meeting on-site stormwater management requirements.

~~Green practices that infiltrate and/or are v~~Vegetated facilities 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 1.2.3.3**). For areas within the City's designated UIC area green practices that infiltrate shall be used to the maximum extent practicable.

1.2.3.2 Residential Land Divisions

The preferred option for stormwater management on residential land divisions is to create a centralized facility (described in **section 3.2.6**). Residential land divisions ~~that would result in a pond smaller than 5,000 square feet may propose~~of seven acres or less may use a detention pipe (**section 3.4.2**) to meet flow control requirements, but green practices shall be used to the maximum extent practicable for stormwater quality treatment.

Green streets shall be used to the maximum extent practicable for any public streets or improvements within development per **section 1.2.3.3**. When green streets are planned as part of a residential land division, the soil and plants shall not be added until at least 90% of the development has been completed and permanently stabilized. Any material placed prior to that point (e.g. structural soil around stormwater tree wells) must be protected during construction, and the City must inspect and approve the completion of facilities following the home construction phase to determine whether sediment removal, growing media replacement, fracturing and loosening of underlying subgrade, or other improvements are required prior to finalizing the facilities.

Unless approved by the City, centralized facilities shall be located in a separate tract. This tract shall have an easement or dedication to the City for public stormwater management and maintenance per **section 6.1**. No encumbrances, obligations, or uses may be placed on, or proposed for, this tract that might limit, conflict with, or otherwise impede the City's ability to maintain, operate, modify, or reconfigure the facility.

For developments where lot sizes are adequate to allow for on-site management of stormwater, or in places where infiltration rates are suitable, water quality and/or flow control can be met on the individual lot level (following **1.2.3.1**), with approval from the City.

1.2.3.3 Streets and Public Infrastructure

All development projects that will create new public streets or infrastructure shall prioritize green infrastructure (i.e. swales or stormwater tree wells) to the maximum extent practicable (MEP). MEP is assumed to be achieved when stormwater tree wells are sized at 3.5% (for the area of the tree well containing soil), swales sized at 6% (area to be counted is the area that would be filled if water were at gutter elevation), or stormwater planters sized at 5% of the contributing impervious area. Each proposed facility must be sited to ensure they receive the drainage they are sized to receive. When streets are treated within a residential land division described in **section 1.2.3.2**, any area treated at the MEP level can be assumed to be 50% pervious when sizing downstream centralized facilities. If 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. swales sized at 3% can assume 25% of treated street surface is pervious, instead of 50%).

1.2.4 Stormwater Quality Treatment

The pollutant reduction requirement for stormwater treatment is 80 percent of the average annual rainfall. 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. Treating the water quality storm event means that a facility contains the stormwater quality design storm without overflow, and must infiltrate or filter and release the volume from the event within 48 hours.

1.2.5 Flow Control

For facilities located outside of the designated drywell area, or that cannot retain/infiltrate the 100-year storm event on-site, detention and flow control are required along with piped conveyance to an approved point of connection in the public storm system (**section 4.0**). Infiltration facilities such as drywells or soakage trenches shall not be used to meet flow control standards for sites located in type C and D soils. While some infiltration may occur in these areas, it cannot be relied upon for primary disposal of runoff. Sites with underlying hydrologic soil group types A and B where there is not an off-site conveyance system (e.g. designated drywell area) are required to size facilities to infiltrate the 100-year storm event.

Detention facilities must be sized to safely convey the 100-year storm event through the primary flow control structure without engaging the emergency overflow route. Post-development peak flows shall match or be lower than the pre-development targets in **Table 1-1**.

Table 1-1: Flow control targets.

Post-Development Peak Flow Rate	Pre-Development Peak Flow Rate Target
2-year, 24-hour	50% of 2-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. Redevelopment sites that have pre-development impervious surface equal to or greater than the proposed post-development condition do not need to provide flow control, but are required to address stormwater quality treatment per **section 1.2.4** and conveyance per **section 1.2.6.**

All facilities need to fully draw down/infiltrate within 48 hours and ensure there is an emergency overflow route to ensure any excess flow avoids damage to the parcel being developed and adjacent properties.

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.

1.2.6 Conveyance

A conveyance system must be designed to route stormwater into and away from any stormwater facility that cannot infiltrate the 100-year storm event. An emergency overflow 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 overflow routes do not need to meet the conveyance requirements in **Section 4.0**, unless a piped system is required to ensure water is routed away from adjacent private property. **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 might result in contributing pollutants to the stormwater system, as defined in GRC 3.23.025, are subject to business inspection per GRC 3.99.020.

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**)
- Covered Vehicle Parking (**Section 5.11**)

1.4 Decommissioning Stormwater Facilities

1.4.1 Private Facilities (Non-UICs)

Development Permits: If a project proposes to redevelop a property that has an existing stormwater facility and the project scope involves removing the facility, then the project must replace the functionality of the removed facility in addition to meeting SWMM requirements related to the project scope.

Enforcement: If a responsible party removes or modifies a stormwater facility without contacting or consulting with the City ahead of time, the City may issue a civil penalty. In the case of unauthorized removal, the responsible party will be required to apply for a permit and install a new stormwater facility that meets the SWMM requirements. In the case of modification, the responsible party will be required to provide documentation of the modifications and demonstrate that the facility still meets SWMM requirements.

1.4.2 Public Facilities (Non-UICs)

Decommissioning or modifying a public stormwater facility must first be approved by the Watershed Division. Review will be based on system need and regulatory compliance. Replacement in-kind or payment of a fee in-lieu may be required.

1.4.3 UICs

Privately-owned UICs: The decommissioning of a private UIC system requires submittal of a completed pre-closure notification application to DEQ prior to closure. A City building or plumbing permit does not authorize the decommissioning of a UIC on private property. DEQ requirements for UIC decommissioning are described on the DEQ website.

City-Owned UICs: For any City-owned UICs, the Watershed Division manages the pre-closure application submittal process. The City will complete the decommissioning process in accordance with the City's UIC Management Plan.

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 the site will be treated by stormwater facilities. Verify that areas to be treated by stormwater facilities can physically drain to those facilities, and that the facilities have been adequately sized to treat actual contributing area.
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 and 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 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 2-11).

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 add or alter 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 infiltrate 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 the

impervious area draining from water quality treated areas for hydrologic calculations to size detention facilities.

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 that the facility is adequately designed to manage the volume of the water quality and/or detention event required in **section 1.0**. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all single storm hydrograph methods.

Whatever method is selected to route stormwater through a facility designed to meet the water quality treatment required described in **section 1.2.3** and/or the flow control requirements in **section 1.2.5** must account for inflow from the appropriate rainfall event, storage within the soil, rock/structural soil, and ponding depth, and outflow due to infiltration and any proposed orifices that meet the flow control targets in **Table 1-1**. The design depth of the proposed facility shall meet the facility design criteria outlined in **section 3.0** (e.g. 6-inch ponding depth in stormwater tree well) without overflow. For open graded rock or structural soil, the designer shall use 40% void space, and for the 3-way blended stormwater topsoil described in **Appendix F**, the assumed void space shall be 10%. If a vegetated facility is being designed for filtration, an assumed flow rate of 2-inches per hour may be used for the 3-way stormwater facility soil blend.

Volume-based stormwater facilities shall be designed to drain down enough between storm events to allow the subsequent storm to be properly managed. When full, the drawdown time to the reference point must not exceed 48 hours for the following facilities (with the reference point for measuring drawdown listed in parentheses after each facility):

- Vegetated facilities, except ponds (the top of the growing media);
- Dry detention ponds (the bottom of the pond at the lowest outlet rim elevation);
- Wet ponds and subsurface gravel ~~extended wet~~ ponds (the top of the permanent pool);
- Soakage trenches and permeable pavement (the bottom of the aggregate, where it meets the native soil);
- Drywells (the bottom of the drywell);
- Detention pipes (the top of the dead storage).

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

Appendix D has additional details about the Engineered Method, and the overview of details and assumptions that should be made using this method are outlined in **sections 2.3.2.1** through **2.3.2.4**.

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 proposed 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 for areas being treated by on-site facilities when designing flow control facilities.

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. For post-developed conditions, minimum of 5 minutes and a maximum of 10 minutes. 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 calculated and documented 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**	**10**	**25**	**50**	**100**
24-Hour Rainfall Depth (inches)	1.2	2.8	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		X
2.4.6	Facility Planting Plan	For vegetated facilities	For vegetated facilities
2.4.7	Operation and Maintenance Plan		For facilities not detailed in **section 3.0**
4.3	Downstream Conditions Assessment		X

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 minimum 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 detached dwelling sites)
7. Sediment Containment and Removal (not applicable for detached dwelling sites)
8. Soil Stockpile Management (may not apply for detached dwelling 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 areas 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, the emergency overflow route through or from the site for the 100-year storm, 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 (DE) process must submit a Stormwater Report to DE for review and approval.

The Stormwater Report shall be prepared by and bear the seal and signature of a Professional Engineer registered in the State of Oregon. Along with the Site Plan components in **section 2.4.3**, a sheet (or multiple, if needed) shall be included in the plan set based upon the Stormwater Report Template provided in the *City of Gresham CAD Manual*. A submittal following the template will address all of the following, and will require attaching documents listed in the appendices.

1. General project information, including:
   - ☐ the project name and location;
   - ☐ submittal date;
   - ☐ applicant's name, address, and telephone number;
   - ☐ design engineer's name, address, telephone number, stamp, and signature.

2. Project description, including size and location of the project site, proposed site improvements, square feet of new and replaced impervious area (stormwater management requirement threshold listed in **section 1.2**), and a summary of the proposed stormwater management approach and how it prioritizes the use of green development practices as described in **section 1.2.4**.

3. Applicable stormwater requirements. If the project is subject to federal stormwater requirements such as SLOPES V, list those requirements in addition to the City of Gresham's water quality and flow control requirements and design storms. If multiple standards apply,

project shall use the most stringent of all applicable standards. Include the City of Gresham design storm rainfall depths listed in **section 2.3.2.4**, the water quality storm, and the flow rate targets.

4. Describe Existing Conditions, including but not limited to project site slope and land cover, points of discharge for existing drainage from the project site, any off-site drainage onto the property; location of any channels, wetlands, creeks, and sensitive areas on or adjacent to the project site; soil conditions, including NRCS Hydrologic Soil Group and infiltration test results; depth to groundwater. Include NRCS soils map and geotechnical report in appendices.

5. Pre-developed runoff analysis. Discuss existing drainage basin areas and associated curve numbers and times of concentration. Include any offsite basins that drain to the site. Provide an exhibit showing the existing drainage basins, contours, labels for drainage features, significant development such as roadways and structures, and flow paths. Provide Time of Concentration and flow rate calculations in an appendix.

Table 2-6. Example Table of Pre-Developed Basin Areas

Drainage Basin	Total Area (sf or ac)	Pervious Area (sf or ac)	Impervious Area (sf or ac)	Pervious land cover type	Hydrologic Soil Group	Pervious Curve Number (CN)	Time of Concen-tration (min.)
Basin A							
Basin B							
Total				-	-	-	-

6. Developed runoff analysis. Discuss proposed drainage basin areas and associated curve numbers and times of concentration. Include any offsite basins that drain to the site. Provide an exhibit showing the proposed drainage basins, contours, flow paths, and any points of discharge from the site. Provide post-development flow rate calculations in an appendix.

   If street-level treatment is being provided to the MEP as described in **sections 1.2.4.2** and **1.2.4.3**, calculate the impervious area reduction for each treated basin and show the adjusted impervious areas in table 2-7.

Table 2-7. Example Table of Developed Basin Areas

Drainage Basin	Total Area (sf or ac)	Pervious Area (sf or ac)	Impervious Area (Adjusted) (sf or ac)	Pervious land cover type	Hydrologic Soil Group	Pervious Curve Number (CN)	Time of Concen-tration (min.)
Basin A							
Basin B							
Total				-	-	-	-

7. Stormwater Quality Treatment
   - Describe how the facility will address the stormwater quality treatment requirement outlined in **section 1.2.3**. Identify the basin area draining to each facility, and provide sizing calculations following the guidance in **sections 2.3.2** and **3.0**. For dry ponds, ensure that the

bottom area meets the swale sizing criteria to meet the stormwater quality treatment requirement. For wet ponds, show that the permanent pool is equivalent to the water quality storm volume. For subsurface gravel ponds, the lowest outlet must be designed at or above the maximum water elevation for the water quality storm event passing through the facility.

- Provide sizing calculations for any sedimentation manholes per **section 3.2.6**

8. Flow Control: Describe the methods and software used, and provide hydrologic analysis inputs and results in an appendix. Provide a comparison table of the flow rates for pre-and post-construction for each flow control facility. Table must show that the project meets the flow control requirements set forth in **section 1.2.5**.

Table 2-8. Example Flow Rate Comparison Table

Flow Controlled Peak Discharge Rates for Basin A		
Design Storm	**Pre-Developed Peak Discharge Rate**	**Post-Developed Peak Discharge Rate with Flow Control**
2-year		*
10-year		
25-year		

*Ensure that post-developed peak flow for 2-year event is less than or equal to half the pre-developed 2-year peak flow

- For ponds, provide a cross-section drawing that shows the 100-year maximum water surface elevation, water quality elevation, and freeboard elevation; discuss the location and design of the emergency overflow path for the 100-year storm. For examples, see details ST-230 and ST-250.
- For flow control manholes, list the orifice elevations and diameters.

9. Conveyance: Demonstrate that proposed public stormwater conveyance systems have the capacity to meet the requirements of section 4, including the expected future build-out of any offsite areas that drain to the proposed system. Conveyance systems shall be designed to convey the flows stated in the *Public Works Standards* section 4.07. Describe the analysis methods used and provide associated calculations in an appendix.
   - Provide inlet calculations to demonstrate that the stormwater flow at the curb line meets the requirements in *Public Works Standards* section 4.07
   - Describe proposed methods for outfall protection, following *Public Works Standards* section 4.05.05 for outfall energy dissipation design.
   - Evaluate tailwater conditions at outfall

10. Downstream Conditions Assessment: Discuss any downstream capacity deficiencies or impacts of the project that were identified in the downstream analysis. Provide the downstream analysis as an appendix following guidelines in **section 4.3**.

11. Appendices:
    - NRCS soil report, infiltration test and geotechnical report
    - Time of concentration calculations

- Hydraulic calculations
- Geotechnical review of Stormwater Report providing a determination on
    a. any infiltration feasibility criteria listed in **section 1.2.2**;
    ~~b. any facility designed to infiltrate the 100-year event is being proposed outside the designated drywell area;~~
    ~~c.~~b. any stormwater facility being proposed within the setbacks in **section 3.0.2** or other specific facility design criteria in **section 3.0**;
    ~~d.~~c. any outfall or discharge point.

2.4.5 Infiltration Testing

Infiltration testing is required for any project proposing ~~100% on-site infiltration/retention that is located outside the designated drywell area and/or for any site proposing~~ to utilize infiltration to meet stormwater management requirements.

~~An infiltration test is required as part of the geotechnical report used to determine whether on-site infiltration is prohibited 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~~ should be performed ~~at~~ during 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.

A post-installation infiltration performance test is required for any facility designed to infiltrate the 100-year storm event. The drywell capacity testing procedures is in **Appendix E**.

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**. Plants that can be planted in stormwater facilities are listed in the **Gresham List of Stormwater Plants**.

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, or Swale		0.06	0.08	0.20	0.40	
Planter or Tree Well		0.05	0.07	0.15	0.28	
~~Tree Well~~		~~0.04635~~	~~0.0755~~	~~0.153~~	~~0.271~~	
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 single detached dwelling unit roofs 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.

3.0 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. ~~The City reserves the authority to modify, refine, or rescind approved stormwater facility types or associated design criteria based on updated regulatory guidance, observed performance, maintenance experience, or evolving best management practices.~~

3.0.1 Applicability

Table 3-1. Stormwater facility summary. Select facilities that infiltrate, unless prohibited under **section 1.2.2**. Sites that cannot infiltrate shall prioritize a green facility for stormwater quality treatment. Other facilities may be approved for sites that do not infiltrate and/or have other site constraints.

	Requirement		Impervious Surface to be Treated					
Stormwater Facility	**Infiltrate**	**Green**	**Rooftop**	**Driveway**	**Sidewalk/ Patio**	**Artificial ~~Turf~~[4] Turf**	**Parking Lot**	**Street**
Porous Pavement	●	●		●	●		●	●[5]
Ecoroof	●[1]	●	●					
Rain Garden/Swale	●	●	●	●	●	●	●	●[6]
Stormwater Tree Well	●	●	●	●	●	●	●	●[6]
Stormwater Planter	●	●	●	●	●	●	●	●
Vegetated Filter Strip	●	●		●	●		●	●
Downspout Extension[2]	●	●	●					
Drywell[3]	●		●	●	●	●	●	●
Soakage Trench[3]	●		●	●	●	●		
Infiltration Vault[3]	●		●	●	●	●	●	
Centralized Facility (Dry Detention Pond, Wet Pond, subsurface gravel pond)		●	●	●	●	●	●	●
Detention Vault/Pipe			●	●	●	●	●	●
Proprietary Devices			●	●	●	●	●	●

[1] While ecoroofs don't technically infiltrate and require overflow to a conveyance system, they are assumed to be an impervious area reduction method and are given full infiltration credit.

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

[3] Stormwater generated from anything other than single detached dwelling unit 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.

[4] Artificial turf fields containing crumb rubber, or other materials of concern, are required to provide water quality treatment for any drainage collected through perforated pipes. Detention and flow control must also be considered for any artificial turf field installed where pre-development hydrology is altered (e.g. asphalt treated base installed, which limits/prevents infiltration).

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

[6] Streets with 10-foot landscape strips shall prioritize swales. Streets with 4 to 6-foot landscape strips shall prioritize planters or stormwater tree wells.

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

3.0.2 Setbacks

Stormwater facilities shall follow the setback distances in **Table 3-2**, unless a geotechnical engineering report is provided and approved by the City. Note that sites noted in **section 1.2.2** may not propose infiltration facilities.

If a stormwater facility is proposed in an area of mapped hydric soils, the applicant must provide a wetland determination, to be reviewed by Gresham staff or representatives, documenting the absence of pre-existing wetlands within the footprint of the proposed facility, in order to ensure the facility will not be considered a jurisdictional wetland, such that routine maintenance can be conducted without permits.

Table 3-2. Stormwater Facility Setbacks. Facilities may be located within these setbacks only with a geotechnical engineering report that is 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, property line, or slope*	0
All infiltration facilities	Property Line**	5
All infiltration facilities	Any foundation	10
All infiltration facilities (including subsurface infiltration facilities***) and ponds	Slopes 20% or greater (or Hillside & Geologic Risk Overlay)	100
All infiltration facilities (including subsurface infiltration facilities) and ponds	Slope greater than 10' high & steeper than 2h:1v	200
Drywell***	Drinking water well	500 (or 2-year time travel)

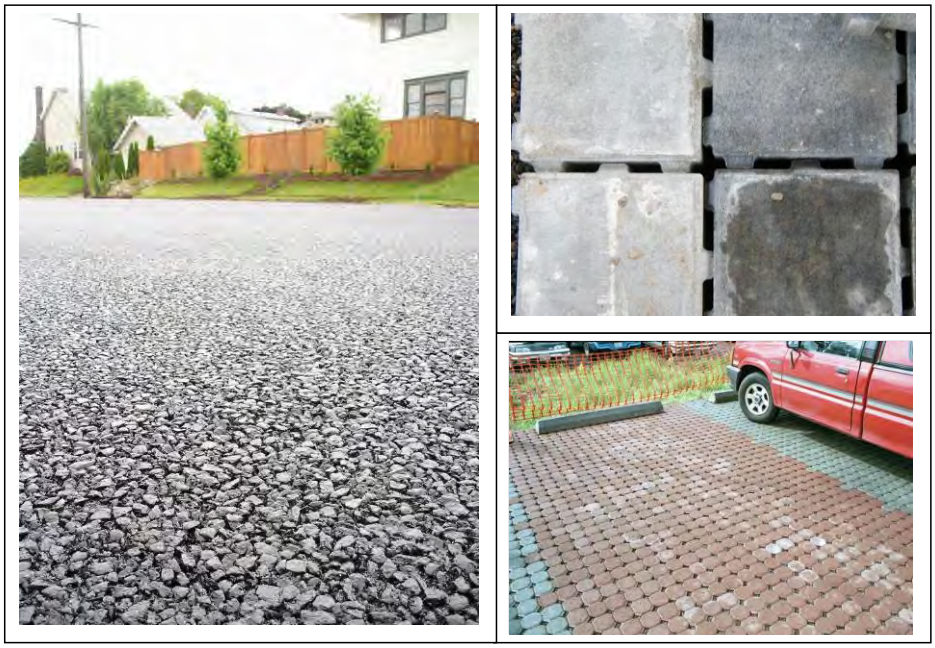
* Even when designed to not infiltrate, ponds must meet the setbacks noted below to reduce slope failure.
** No setback required for portion of property line adjacent to public right-of-way
*** Setbacks for subsurface infiltration facilities are measured from the center of a drywell or from the outside 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."



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

Setbacks: No setback is required from property lines or buildings. The designer may opt to install a partial liner when porous pavement is located within 5 feet of structures or infrastructure.

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.

Friction/Wearing Course: The depth of the top lift varies depending on the material and surface being paved. Drawing ST-100 lists depths that the surface wearing/friction course for porous concrete, porous asphalt or pavers must be.

Porous pavements installed in parking lots, or places where a large amount of "dry turning" is expected, should prioritize paver systems over porous concrete or asphalt. Porous asphalt is most commonly used for streets, driveways, and parking lots. Details about the porous warm mix asphalt that should be used as the wearing course and the subgrade rock it should be placed on, preferably an Asphalt Treated Permeable Base, are detailed below.

Porous Hot or Warm Mix Asphalt (PHMA/PWMA): When porous asphalt is used, a warm-mix asphalt cement shall be PG 70-22ER polymer modified or higher grade. Hot-mix asphalt containing the same polymer may be used if warm-mix is unavailable at the plant, but warm-mix shall be used, if available. Typical temperature ranges are 250-275°F for warm mix asphalt and 275-300°F for hot mix asphalt containing PG 70-22ER binders.

Binder content shall be between 6.0% and 7.0% by total weight of the mix, and will be the highest percentage that passes both the drain down and void requirements tests at N_{design} = 75 gyrations. The binder content tolerance shall be ±0.3% during production and placement of the asphalt. The contractor shall adjust the aggregate to meet the maximum drain down test requirements within the ranges provided below.

1. Drain down* shall be 0.3 %, maximum, according to ASTM D6390
2. Void ratio shall be 16% to 25% per ASTM D3203 at N_{design} = 75 gyrations.
   *Drain down refers to the downward movement of binder through the open graded aggregate used in the asphalt mixture.

The Contractor may use some recycled asphalt pavement (RAP) in the blend, but it must be 20 percent or less RAP by total weight.

Aggregates for PHMA/PWMA shall meet the following requirements for grading:

Sieve Size	Percent Passing*
¾" square	100
½" square	90 - 100

3/8" square	55 - 90
U.S. No. 4	10 - 40
U.S. No. 8	0 - 20
U.S No. 40	0 - 13
U.S. No. 200	0 - 5

* All percentages are by weight.

The aggregate for PHMA/PWMA shall consist of crushed stone with a percent fracture greater than 90% on two faces on the No. 4 sieve and above.

Choker/Bedding Course: A 3-inch deep layer of small uniformly sized aggregate layer shall be placed on top of the base rock before placement of the porous wearing/friction course. For porous concrete and asphalt, the choker course shall be ¾" to ½" aggregate. For paver systems, the bedding course shall be ¾ to ¼" aggregate. A choker course is not needed if an Asphalt Treated Permeable Base is used.

Base Rock: Open graded aggregate, typically washed, crushed 2 to 3/4-inch or No. 57 rock, shall be placed under the choker/bedding course. The base rock depth needed to store the 25-year event without overflow can be calculated using the Engineered Method (see **section 2.3.2** and **Appendix D**). The needed base rock depth may vary from as little as 4-inch up to 24-inch, with the typical base rock depth being 12 inches. Depending upon the storage volume needed in the base rock section, some, or all, of the base rock can be comprised of Asphalt Treated Permeable Base.

Asphalt Treated Permeable Base: Asphalt treated permeable base (ATPB) consists of a compacted course of open graded aggregate which has been weatherproofed and stabilized by treatment with an asphalt binder. ATPB is a plant mixed blend of washed aggregate combined with 3 to 4% asphalt cement binder that is placed in lifts of 4 to 5-inch depth that are compacted prior to laying additional lifts or the surface/wearing course.

Aggregates for ATPB shall meet one of the following requirements for grading:

Sieve Size	**Percent Passing ***	
	Grading 3/4 (1)	Grading 1-1/2 (2)
1-1/2"		100
1"		90 - 100
¾" square	100	80 - 95
½" square	90 – 100	35 - 65
3/8" square	40 - 80	25 - 45
U.S. No. 4	0 - 30	0 - 30
U.S. No. 8	0 - 20	0 - 20
U.S No. 16	0 - 10	0 - 10
U.S. #200	0 - 4	0 - 4

* All percentages are by weight.
(1) – Minimum asphalt binder content = 3.5%
(2) – Minimum asphalt binder content = 3.0%

The aggregate shall consist of a combination of crushed and natural aggregates with a percent fracture greater than 75% on one face on the No. 4 sieve and above, in accordance with the field operating procedures for AASHTO T 335.

The grade of paving asphalt binder shall be PG58V-22, or higher, unless otherwise specified.

The manufacture of ATPB should include warm mix asphalt, which includes organic additives, chemical additives, and foaming that allow for lower mixing and placement temperatures without impacting the final ATPB pavement properties.

ATPB shall be spread with a spreading machine equipped with a stationary, vibratory, or oscillating screed or cut-off device. The internal temperature of the ATPB mixture at the time final rolling and targeted consolidation is achieved shall be a minimum of 185°F. Rollers shall only be operated in the static mode when the internal temperature of the ATPB is less than 175°F.

A light tack coat (approximately 0.02 gallons/square yard residual asphalt) shall be applied between lifts of ATPB. A heavy application of tack coat shall be applied to all joints.

Rolling and Compaction of ATPB and Porous Asphalt: The wearing course and ATPB shall be consolidated to a firm and unyielding state. The Contractor will develop a roller pattern that will initially consolidate the pavement structure and then use static rolling only thereafter to prevent over compaction. Compaction density shall be 80% or greater (ideally 82% to 85% of maximum theoretical (Rice) density) and target 15% to 18% final air voids.

Pneumatic tire rollers shall not be used.

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 base rock layer and backing up into the wearing/friction course, an underdrain system shall be employed to direct excess water to an approved disposal point. Porous pavements installed on type A or B soils should not need an underdrain system. 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.

Soil: 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: 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 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 a piped conveyance system. The best settings for a vegetated swale are in the landscape strip along a road, in the landscape areas within parking lots, or along a 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 greater than 20% 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.

Facilities without an overflow are only allowed within the designated UIC area and only if ~~Larger sites (those adding more than 5,000 sf of impervious surface) or those using the Engineered Method need to test~~ infiltration rates, determined by following the procedure in **Appendix E**~~.~~, are shown to be~~.~~ ~~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 100-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. Facilities that will be sized using the Engineered Method shall be designed per the following:

- Inflow to the facility shall consist of the post-development ~~water quality~~ design storm per **section 2.0** The design storm is the ~~(~~water quality event, if a downstream facility is being proposed for flow control, or a larger event if the facility is being designed to meet flow control requirements as well~~).~~
- The outflow equals the infiltration rate times the wetted bottom surface area of the facility during the ~~water quality event~~design storm. If an underdrain is included, use 2 inches per hour as the infiltration rate of the stormwater facility topsoil. If there is no underdrain, use the smaller of the native soil infiltration rate or 2 inches per hour.
- The ~~water quality~~ storage volume ~~consists of the volume~~is the ponding depth above the stormwater facility topsoil to the primary outlet (e.g., gutter, beehive, or other outlet). The ~~water quality~~ storage volume shall contain the design storm hydrograph inflow less outflow. The overflow inlet from the ~~water quality~~stormwater facility to the stormwater conveyance system (or to the flow control structure if the swale/rain garden is within a dry detention pond) shall be set above the ~~water quality~~ elevation used in facility modeling.
- All stormwater treated by the facility must drain from the surface within 48 hours after a storm event ends.

Dimensions and slopes: The minimum width for rain gardens and swales is 10 feet. Public street projects with a landscape strip that is 10 feet or greater shall prioritize swales for treating street runoff. A minimum 2-foot-wide flat bottom width is required with maximum side slopes of 3 horizontal to 1 vertical. The minimum depth is 6-inches (typical depth is 12-inches) as measured from the top of the growing medium to the overflow inlet elevation. Maximum longitudinal slope is ~~4~~ 3 percent without adding check dams. Freeboard for rain gardens/swales must be noted on the plans. Public swales shall follow the dimensions shown in the swale plan view (GS-114) and swale section view (GS-115) details in the *Public Works Standards*.

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: 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. For swales located within the public right-of-way/landscape strip, no check dams are required for slopes <~~4~~3%. For slopes ~~between~~ greater than ~~4~~3% ~~and~~ to 8% slope, check dams shall be placed ~~every~~ at a maximum spacing of ~~7.5 to 15~~15 feet (evenly spaced through length of swale). For slopes ~~between~~ greater than 8% ~~and~~ to 15% slope, check dams shall be placed ~~every 5 to 10~~at a maximum spacing of 10' feet (evenly spaced through length of swale). See GS-105 in the *Public Works Standards* for more detail on check dam spacing.

Inlets: Facilities located adjacent to ground level impervious surface (e.g. driveways, streets, parking lots) shall use a curb inlet with sufficient drop to ensure that stormwater enters the facility. Public street-side swales are required use the GS-104~~B~~ inlet from the *Public Works Standards*; this inlet is highly recommended for private parking lots and streets. Inlets should not typically be placed closer together than 30 feet apart.

When pipe is required to deliver stormwater to a private rain garden or swale, the 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 minimum diameter pipe is required.

When pipe is used to deliver private stormwater to a public rain garden or swale, the pipe shall be mitered to match the planned soil surface, protruding a minimum of 2 inches beyond final soil surface elevation, and have adequate energy dissipation to prevent soil erosion. Jute or other fabric is required if water will enter facility prior to landscaping. An 8-inch deep section of 2- to 4-inch river rock that extends downslope for at least 12 inches is recommended to prevent erosion and keep vegetation from encroaching into the pipe.

When a perforated pipe is required as part of the overflow/outlet of a public facility, the pipe shall be a minimum of 6-inch ASTM 3034 SDR 35 PVC.

A splash pad shall be used for energy dissipation at any curb inlet, or piped discharge point to a rain garden or swale. See GS-104 in the *Public Works Standards* for more detail on splash pads.~~Public swales shall use an inlet with a concrete splash pad with a lip (see GS-104B)~~.

Outlets: An overflow drain shall be constructed to allow at least 9 but not more than 18 inches of water to pond in the swale or rain garden 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 streets with multiple swales with inlets and outlets overflowing to the gutter: 1) gutter flow must not exceed the width from face of curb required in *Public Works Standards*, and 2) a beehive, or other approved overflow, connected to a piped stormwater conveyance system must be installed every 400 feet or at the end of each block, whichever is less.

Underdrains: For lined facilities designed for filtration, a perforated pipe (~~36~~60-inch maximum length) shall be constructed extending out from the outlet of the facility 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 stormwater facility topsoil shall be added to all rain gardens and swales. 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 generally be designed so they do not require mowing, however, for swales designed to have trees as the primary vegetation (which requires trees planted every 25-feet or other spacing as recommended by city) may use turf grass between trees. Plants shall be selected from the **Gresham List of Stormwater Plants** following the requirements in **Appendix G**. Minimum container size is #1 container.

Post installation testing: Rain gardens and swales installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

3.2.2 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, as the goal is to allow tree roots to grow deep and wide.

Applicability
Stormwater tree wells are primarily used to manage stormwater from the public right-of-way (ROW). They are the preferred vegetated facility that should be used within the ROW. 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 for the Simple Method. Facilities that will be sized using the Engineered Method shall be designed per the following:

- Inflow to the facility shall consist of the post-development ~~water quality~~ design storm per **section 2.0** ~~(~~The design storm is the water quality event, if a downstream facility is being proposed for flow control, or a larger event if the facility is being designed to meet ~~retention~~flow control requirements as well~~).~~ ~~-~~

- The outflow equals the infiltration rate times the wetted bottom surface area of the facility during the ~~water quality event~~design storm. ~~If an underdrain is included, use 2 inches per hour as the filtration rate of the stormwater facility topsoil. If there is no underdrain, use the smaller of the native soil infiltration rate or 2 inches per hour.~~
- The ~~water quality~~ storage volume ~~consists of the volume~~ is the ponding depth above the stormwater facility topsoil to the ~~primary~~ gutter (unless another outlet type is approved). The ~~water quality~~ storage volume shall contain the design storm hydrograph inflow less outflow. The overflow inlet from the ~~water quality~~ stormwater facility to the stormwater conveyance system shall be set above the ~~water quality~~ elevation used in facility modeling.
- All stormwater treated by the facility must drain from the surface within 48 hours after a storm event ends.

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 or rectangle 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 the excavation below the gutter level shall be 20 inches to allow for a minimum of 6 inch ponding depth, 2 inches of mulch, and the root ball to be placed on a pedestal of native soil (and then surrounded by stormwater facility topsoil).
- A minimum depth of 24 inches of structural soil shall be installed under the sidewalk for the width of the stormwater tree well. See note in "structural soil" section below and more in **Appendix A.8** for projects where sidewalks will not be poured within a week of structural soil placement.

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~~A~~ in the City of Gresham *Public Works Standards*. For installations where the tree well is going to be covered with a grate, a catch basin shall be used to trap sediment prior to discharge into the facility.

Outlets: Facilities not able to store the volume from the 100-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).

As stormwater tree wells are typically located within the public street right-of-way, the overflow must meet Gresham *Public Works Standards* and shall direct excess stormwater to an approved discharge point. The most typical overflow for on-grade facilities is down the gutterline, which is designed using the modified curb and gutter detail GS-103. For streets with multiple stormwater tree wells with inlets and outlets overflowing to the gutter: 1) gutter flow must not exceed the width from face of curb required in *Public Works Standards*, and 2) an inlet to the piped stormwater conveyance system must be installed immediately downstream of a tree well, so that an inlet is spaced every 400 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: Stormwater tree wells use a combination of structural soil under the sidewalk, as well as stormwater facility topsoil in the tree well surrounding the tree root ball. Drawing GS-111 shows how the layers relate to the tree, curb, and sidewalk elevations. The specifications included in **Appendix F** detail the soil, mulch, and structural soil and shall be included on the permit plans.

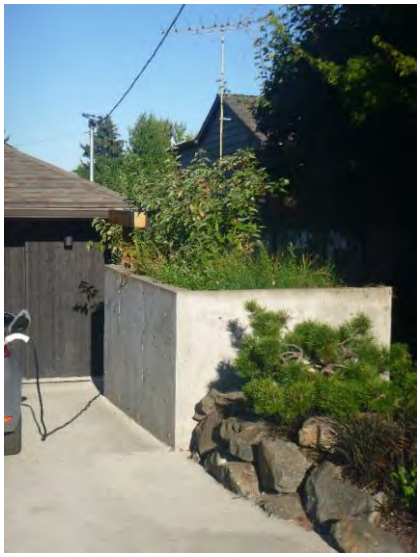
Structural Soil: A minimum of 24-inch depth structural soil meeting the requirements specified in **Appendix F** is required under the sidewalk adjacent to the stormwater tree well. The structural soil shall be at least the same length as the tree well, with additional length or depth being allowed for 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.

Structural soil that is placed under the sidewalk zone more than a week prior to sidewalk construction must follow the soil and facility protection during construction requirements in **Appendix F.8**.

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.

Post installation testing: Stormwater tree wells installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

3.2.3 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.

Planters are still a great option for private development, but the City has de-prioritized the use of stormwater planters for treating public right-of-way. Development projects required to treat public streets should use swales or stormwater tree wells following the prioritization in **Table 3-1**.

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~~Facilities without an overflow are only allowed within the designated UIC area and only if infiltration rates, determined by following the procedure in **Appendix E**~~.~~, are shown to be ~~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 100-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. Facilities that will be sized using the Engineered Method shall be designed per the following:

- Inflow to the facility shall consist of the post-development ~~water quality~~ design storm per **section 2.0** ~~(~~The design storm is the water quality event, if a downstream facility is being proposed for flow control, or a larger event if the facility is being designed to meet ~~retention~~flow control requirements as well~~)~~.
- The outflow equals the infiltration rate times the wetted bottom surface area of the facility during the ~~water quality event~~design storm. If an underdrain is included, use 2 inches per hour as the infiltration rate of the stormwater facility topsoil. If there is no underdrain, use the smaller of the native soil infiltration rate or 2 inches per hour.
- The ~~water quality~~ storage volume ~~consists of the volume~~is the ponding depth above the stormwater facility topsoil to the primary outlet (e.g. gutter, beehive, or other outlet). The ~~water quality~~ storage volume shall contain the design storm hydrograph inflow less outflow. The overflow inlet from the ~~water quality~~stormwater facility to the stormwater conveyance system shall be set above the ~~water quality~~ elevation used in facility modeling.
- All stormwater treated by the facility must drain from the surface within 48 hours after a storm event ends.

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 (typical is 12 inches). The maximum ponding depth shall be 18 inches.
- The minimum depth of stormwater facility blended soil 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.

Check dams: Required for facilities that are not flat. Generally 4 to 10 inches high, depending on the depth of the facility. Width will vary depending on material. For planters located within the public right-of-way/landscape strip, no check dams are required for slopes <4%. For slopes between 4 and 8% slope, check dams shall be placed every 7.5 to 15 feet (evenly spaced through length of swale). For slopes between 8 and 15% slope, check dams shall be placed every 5 to 10 feet (evenly spaced through length of swale).

Inlets: Facilities located adjacent to ground level impervious surface (e.g. driveways, streets, parking lots) shall use a curb inlet with sufficient drop to ensure that stormwater enters the facility. Public street-side planters are required use the GS-104A inlet from the *Public Works Standards*; this inlet is highly recommended for private parking lots and streets.

When pipe is required to deliver stormwater to a private stormwater planter, the 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 minimum diameter pipe is required.

When pipe is used to deliver stormwater to a public stormwater planter, or when a perforated pipe is required as part of the overflow/outlet, the pipe shall be a minimum of 6-inchASTM 3034 SDR 35 PVC.

A splash pad shall be used for energy dissipation at any curb inlet, or piped discharge point to a stormwater planter.

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 streets with multiple stormwater planters with inlets and outlets overflowing to the gutter: 1) gutter flow must not exceed the width from face of curb required in *Public Works Standards*, and 2) a beehive overflow connected to a piped stormwater conveyance system must be installed every 400 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 lined facilities designed for filtration, a perforated pipe (36-inch maximum length) shall be constructed extending out from the outlet of the facility to drain water that has filtered through the topsoil and prevent long-term ponding. Drain rock shall only be placed surrounding the underdrain.

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 stormwater facility topsoil shall be added to all stormwater planters, although stormwater planters within the public right-of-way may have variable depths, depending upon slope and existing soils, so these facilities shall refer to GS-107 for required soil depths. Per the soil specifications in **Appendix F**, the stormwater facility topsoil requirement can be met 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 blended soil and between the plantings to completely cover the soil and prevent erosion or weed intrusion.

When trees will be placed in stormwater planters, the root ball of the tree must be placed on structural soil that follows the requirements in **Appendix F**. The depth of structural soil needed shall ensure that a minimum of 1 to 2 inches of the root ball will extend above the planned topsoil surface elevation. The structural soil "pad" shall be 6-feet in length by the width of the planter. The area above the structural soil and surrounding the tree shall be filled with stormwater facility blended soil.

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.

Street trees placed in stormwater planters within the right-of-way shall follow GS-112. Tree root balls much be placed on structural soil following the requirements above in soil/mulch.

Post installation testing: Stormwater planters installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

3.2.4 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 3 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.

Soil: The stormwater facility topsoil must be 12 inches deep for filter strips. Per the soil specifications in **Appendix F**, the stormwater facility topsoil requirement can be met 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.

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

3.2.5 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.

3.2.6 Ponds/Centralized Facilities

Facility Description

There are ~~two~~ three facility types which can be installed to meet the centralized facility requirements for water quality and/or detention – dry detention ponds with a swale or raingarden bottom, ~~or~~ wet ponds, or subsurface gravel ponds. Pond basins are designed to store water above the surface of the growing medium. The *Public Works Standards* has conceptual drawings showing various components of ponds described further in this section.

- 415 – Dry Pond Plan View
- 416 – Dry Pond Profile View
- 417 – Wet Pond Plan View
- 418 – Wet Pond Profile View
- 419 – Subsurface Gravel Pond Plan View
- 420 – Subsurface Gravel Pond Profile View

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. 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. Wet ponds designed to meet water quality and detention requirements require plantings around the perimeter of the pond ~~(within a vegetated shelf)~~ following the requirements in **Appendix G**.

Dry detention ponds ~~-~~drain between storm events and do not have a permanent pool of water. They fill during storm events and slowly release the water over a number of hours. A dry pond shall be selected versus a wet pond or subsurface gravel pond when soil infiltration rates are greater than 0.5 inches per hour and when groundwater flows do not maintain a permanent pool. In order to receive credit for both detention/flow control and stormwater quality treatment, the bottom of a dry pond must be sized following the swale/rain garden design criteria. The swale ~~or rain garden~~ area in the bottom of a dry pond must be able to contain and/or infiltrate the water quality storm without engaging the overflow structure. An~~-~~ underdrain may be incorporated into the design to ensure that the water quality event can infiltrate through the soil media and drawdown within 48 hours.

Subsurface gravel ponds are a hybrid between a wet pond and dry pond, where the permanent pool is located beneath the soil surface, but the bottom of the pond gets planted like a dry pond. Water quality is provided by vegetation and soil in the pond bottom, as well as from water flowing through the subsurface gravel layer, where anaerobic conditions allow for filtration of pollutants and denitrification.

Applicability
Centralized facilities may be constructed on large commercial and industrial developments, or on residential land divisions. Centralized facilities are appropriate for larger drainage areas (greater than 7~~5~~ acres).

Ponds following the design requirements in **section 3.2.6** are most appropriate for sites with slow draining soils (less than 2"/hour tested). It is recommended that ~~S~~sites with well-draining soils (at or over 2"/hour tested) should install a rain garden that infiltrates (see **section 3.2.1**). It is also recommended that ~~S~~sites with infiltration rates between 0.5 and 2"/hour should design a dry pond, and sites less than 0.5"/hour should design a wet pond or subsurface gravel pond. ~~While infiltration from ponds is considered incidental, for the purposes of siting these facilities inside the natural resources overlay, it is assumed that they infiltrate, so could be proposed in that area with proper mitigation for impacts.~~ Since ponds are not designed for full infiltration, all ponds require flow control and a conveyance system.

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 granted to the City. Except for Commercial or Industrial uses, any pond designed to serve more than one lot must be a public facility and designed and built as such. Land deeded to the City, or easements granted to the City, shall include the entirety of the public facility and the surrounding area up to boundaries of rights-of-way and/or individual private lots unless otherwise agreed to by the City. In order to ensure the maintainability of the facility, tracts or lots under common ownership cannot be formed between the pond and rights-of-way and/or private lots unless otherwise agreed to by the City.

Ponds must be constructed in uplands and are not allowed to be placed instream or within an existing wetland. ~~So long as they are outside the floodplain, ponds may be proposed within natural resource overlay area, so long as they do not impact the high value resource area.~~ Follow the requirements in **section 3.02** for any facility being planned in areas with hydric soils.

If the facility is located within a natural resource overlay area, a Geotechnical Engineer's evaluation of the proposed facility must be submitted and approved by the City.

Setbacks: The pond, as defined by the footprint of the freeboard elevation (one foot above the emergency overflow structure or spillway set at the ~~100~~25-year event elevation), must be at least 5 feet from the nearest property line. Where berms are used to constrain the pond the nearest property line must be 5 feet from the outside toe of the berm.

~~Minimum distance from the edge of the maximum water surface to the top of a slope greater than 20 percent is 100 feet, or 200 feet from a slope greater than 10 feet high and steeper than 2H:1V, unless a geotechnical report indicating that water adjacent to the slope will not cause slope failure or negatively impact other properties. The Geotech evaluation of the proposed facility must submitted to and approved by the City.~~

Sizing: Ponds shall be sized to fully store the volume of the ~~post-development 100~~25-year ~~storm~~ event. ~~with~~minimum ~~1 foot of freeboard above the~~An emergency spillway~~, using the depths and side slopes specified in this section~~ shall be set at or above the 25-year even elevation. The pond berm and freeboard must be at least 1 foot above the emergency spillway elevation.

If there is groundwater or additional flow upstream of the development that will be routed to the facility, the facility sizing and flow control shall account for all of the contributing flow to the facility. Facility sizing for any drainage area outside the proposed development shall assume full build-out.

Wet ponds designed for water quality: 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). Maximum depth of the permanent pool shall be 30 inches. The pond volume required for flow control is in addition to the permanent pool/dead storage.

Dry detention ponds designed for water quality: The bottom of the pond must be designed following the rain garden/swale requirements in **section 3.2.1**. Water quality is accomplished when the facility contains and infiltrates the water quality event without engaging the outlet structure. Facilities that cannot infiltrate the design storm within 48 hours should be designed as partial infiltration facilities and use an underdrain to ensure the water quality event is fully filtered through the stormwater soil prior to release. The underdrain shall follow the design criteria in the "underdrain for dry ponds with swale/raingarden" section.

Subsurface gravel ponds designed for water quality: The entire water quality storm (1.2 inch over 24 hours, NRCS Type 1A rainfall distribution) shall be routed through the pond's gravel layer. The water may back up into the pond, but the elevation of the piped outlet shall not be set below the maximum ponded elevation of the water quality storm. See public works details 419 and 420 and for more information.

Dimensions and slopes: ~~Slopes and depth~~Side slopes should be kept as mild as possible to avoid safety risks and allow access for maintenance. Slopes within the City's tract or easement shall be a maximum of 3H:1V (horizonal to vertical). However, the slopes from the bottom of a wet pond ~~-~~to an elevation 1-foot above the top of the permanent pool will be 4H:1V, or less steep, if the permanent pool depth is greater than 18-inches.

The distance between all inlets and the outlet shall be maximized to facilitate sedimentation within the facility. The length-to-width ratio shall be a minimum of 3:1, unless an exception is granted. 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 volume of material used to form any internal berms, islands, or other structures must be accounted for in sizing the volume of the facility.

The pond bottom shall be generally level, but particularly in the case of dry ponds, shall be uniformly graded toward the outlet structure to ensure positive drainage.

~~Dry and wet p~~Ponds shall be divided into a minimum of two cells. The first cell (sometimes referred to as a forebay) ~~is~~ shall be ~~approximately 10~~ approximately 25 percent of the design surface area and should be designed in a way that all inlets enter the first cell whenever practicable. The ~~forebay~~ first cell should be a minimum of 18-inches deep to trap sediment entering the facility. ~~A forebay shall be provided at each inlet, unless the inlet provides less than 20% of the total design flow to the pond.~~ The ~~forebay~~ first cell shall ~~have an internal berm that separates it~~be separated from the main pool under normal conditions by an internal berm; see the "internal berm" section for design criteria that will disperse stormwater throughout the facility without causing erosion to the berm.

~~Wet ponds with side slopes steeper than 4H:1V shall incorporate a vegetated shelf around the perimeter of the facility that begins just below the depth of the permanent pool. The vegetated shelf shall be a minimum of 10 feet wide for ponds draining up to 30 acres, and a minimum of 20 feet wide for ponds draining greater than 30 acres. The gradient of the vegetated shelf shall be 15:1 (horizontal to vertical), unless an exception is granted.~~

External pond berm embankments: ~~Pond berm embankments must be designed by a civil engineer or professional geotechnical engineer licensed in the State of Oregon. Embankments include all slopes surrounding a pond, not just those below the functional portion of the facility where water will be stored temporarily.~~

Pond berm embankments shall 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, free of loose surface soil materials, roots, and other organic debris,

by excavating a trench below the berm. This keys the berm into the native soil and prevents it from sliding. Topsoil is required over the consolidated soil to support required plantings.

~~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 shall 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.~~

~~External pond berm embankments~~ Embankments shall 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 shall 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 berm embankments 6 feet or less in height (including freeboard), measured through the center of the berm, shall have a minimum top width of 6 feet. Where maintenance access is provided along the top of berm, the minimum width of the top of berm shall be 15 feet.

Internal berms: Berms created ~~for forebays~~to separate pond cells shall have a native soil base that is covered with a geotextile fabric and then the upper portion of the berm is created using 1 to 4-inch angular ballast rock.

Berms separating pond cells shall be placed on native soil, except for subsurface~~merged~~ gravel ponds, where hydrologic connectivity of the subsurface ~~-~~gravel is integral to the functioning of the system. Berms separating cells in subsurface gravel ponds may be placed directly upon the choker course creating the rock gallery. The berm shall consist of a clay soil core that is wrapped in a geotextile, with the upper portion covered in 1 to 4-inch angular ballast rock. When the internal berm is not be placed on the rock gallery, piped connections allowing surface flows to enter the subsurface gravel and flow into the gravel beneath the second cell shall be installed. See drawing 420 in the Public Works Standards.

As an alternative, internal berms placed on native soil may be a 6-inch-wide concrete stem walls with footings.

Retaining walls: Retaining walls are not allowed below the freeboard level of a pond. Walls must be a minimum distance of 5-feet horizontally beyond the freeboard elevation, and, for publicly maintained walls, must be set back from the nearest property line at least the distance equal to the horizontal length of any wall restraints plus the height of the tallest part of the wall. See drawing ~~419~~ 421 in the *Public Works Standards*.

- Any wall adjacent to a public pond that would require access to the public pond parcel for maintenance or replacement shall be included within the public tract;
- Walls shall not exceed ~~one-third~~75% of the perimeter of the pond;
- Any wall shall not inhibit maintenance access into the facility, particularly the forebays;
- The designer shall ensure that any area on the upper side of a wall is accessible for maintenance;
- Walls shall incorporate geotextile and drain rock behind wall;
- Perforations through walls ~~for private storm lines shall be limited and must be approved by city~~are not allowed;
- Detailed structural design calculations must be submitted with every retaining wall proposal, and the wall must be stamped by a structural engineer.

Pretreatment: A sedimentation manhole shall be installed upstream of the facility per~~. Sedimentation manholes shall follow~~ Public Works Standard drawing 413. ~~The volume of the sump needed shall be sized based on a 2-year event assuming 20 cubic feet per 1.0 cfs of flow into the sedimentation manhole. An upstream flow splitter may be installed that bypasses any flows exceeding the 2-year event and routes them to the pond forebay. If a flow splitter is not used, the sedimentation manhole shall be designed based on the 25-year flow it receives. The maximum depth from the manhole rim to the sump bottom shall be 16 ft. The following flow rates for different sump volumes are provided for ease of calculation:~~

~~**Table 3-3.** Design Flow Rates for Sedimentation Manholes~~

~~Diameter~~	~~4-foot sump depth~~	~~5-foot sump depth~~	~~6-foot sump depth~~	~~7-foot sump depth~~
~~60-inch~~	~~3.93 cfs~~	~~4.91 cfs~~	~~5.89 cfs~~	~~6.87 cfs~~
~~72-inch~~	~~5.65 cfs~~	~~7.07 cfs~~	~~8.48 cfs~~	~~9.90 cfs~~
~~84-inch~~	~~7.70 cfs~~	~~9.62 cfs~~	~~11.55 cfs~~	~~13.47 cfs~~

~~If a sedimentation manhole would require more sump volume than a 7-foot sump depth in an 84-inch diameter structure would provide, then an accessible concrete forebay or other alternative structure may be approved by the Watershed Manager.~~

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 per PWS detail 405A. ~~Refer to PWS Drawings 415-418 for more For~~information. ~~extended wet detention ponds~~surface, ~~the~~is ~~lowest orifice in the control structure must be located above at 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. See "Access" info below for detail.

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 shall be a minimum of 1 inch diameter~~, unless an exception is granted~~. If the required detention design parameters would result in an orifice sized to less than 1 inch, a 1-inch orifice shall be used.

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.~~ 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, or a weir notch may be used.

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 shall 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.

$$d = \sqrt{((36.88\ Q)/\sqrt{h})}$$

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

Rectangular Notched Sharp Crested Weir:

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

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:

$$Q = C\_d\ (\tan\ \ 〚\theta/2〛\ )\ H\^{}(5/2)$$

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

Inlet(s): Any piped inlet shall have adequate energy dissipation to minimize erosion at the outfall. The outfall protection guidance in the *Public Works Standards* section 4.05.05 is considered to be adequately protective.

Outlet/overflow: For public ponds, ditch inlet structures shall be used as an outlet or overflow in accordance with Public Works Standards detail 403A. Outlet structure shall consist of a lower primary outlet and a secondary inlet that ties into the flow control/outlet structure higher than the primary inlet, but 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 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. The emergency overflow elevation must be set at or above the ~~100~~25-year elevation, while also being at least one foot below the top of the pond berm. The overflow must be designed to convey these extreme event peak flows safely over or around the berm structure for discharge into the downstream conveyance system. The emergency overflow spillway must be designed using the following formula:

$$L = \frac{Q_{100}}{3.21H^{1.5}} - 2.4H$$

where:
L = Length of the bottom of the weir (ft);
Q_{100} = 100-year post-development flow rate (ft3/s); and
H = Height of emergency overflow water surface (ft)

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 past the toe of the outside face of the pond embankment where the overflow is being directed. No vehicular access can be planned on the emergency overflow spillway, unless it is designed in accordance with the access road standard in the *Public Works Standards*; in cases where structures are placed in the emergency spillway, concrete may be used. If the emergency spillway is designed to overflow to a roadway, the sidewalk shall be designed to ensure flow is not impeded.

If an emergency overflow cannot be routed over a berm or to an adjacent roadway without impacting adjacent private property, an additional outlet from the pond connecting to the downstream storm system or other alternative may be approved by the city.

Low flow drain for wet ponds and subsurface gravel ponds: A gravity drain shall be installed to drain wet ponds for maintenance. The low flow drain pipe shall be a 6-inch perforated pipe within a 24-inch wide by 18-inch deep drain rock trench that is 10-feet in length, or up to one-third the pond length in larger facilities, along the pond bottom. A 3-inch choker course of smaller rock shall be used to provide separation between the stormwater facility topsoil and the drain rock surrounding the perf pipe. A shear gate shall be installed where this pipe enters the outlet structure. Operational access to the valve shall be located at finished ground surface and protected from damage and unauthorized operation. Valve shall be located within planned outlet structures; when that is infeasible, it 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.

Underdrain for dry ponds with swale: Dry ponds being designed to provide water quality may need to install an underdrain system to allow filtration of the water quality event through the soil within 48 hours. If the water quality event cannot be retained within the pond without overflow and infiltrate within 48 hours, then a drain rock trench and perforated pipe following the requirements under "low flow drain for wet ponds" shall be installed.

Soil: Because pond grading generally requires the topsoil to be removed to form the basin shape of the pond, stormwater facility topsoil following the requirements in **Appendix F** shall be used within the top 12 inches of the facility, or the soil must be amended to support plant growth. Amended soil is not required in portions of wet ponds that will be submerged under permanent pool. Subgrade soil for dry ponds or facilities intended to achieve some infiltration should be fractured and loosened prior to placement or preparation of the 12 inches of growing medium. ~~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 (see Gresham Erosion Prevention and Sediment Control Manual best practice EPSC-18) shall not place stormwater facility topsoil (nor rock for subsurface gravel ponds) until after the facility is done being used for erosion control. Sediment removal, growing media replacement and/or vegetation replacement shall be required prior to city acceptance of any facility finished prior to the construction phase being complete if construction sediment is present.

Vegetation: Plantings shall be added to the bottom of ~~the~~ dry ponds and subsurface gravel ponds (zone A ~~for dry ponds surface and zone S for wet ponds~~ shown in **Figure G-1** in **Appendix G**). For all ponds, zone A is assumed to extend one vertical foot above the pond bottom, or for ponds with a permanent pool, one vertical foot above ~~beyond~~ the permanent pool ~~elevation on wet ponds. , side slopes (zone A), plus the 10-foot buffer around the pond (zone B). Wet ponds that will have a permanent pool deeper than 24 inches shall focus plantings in the vegetated shelf.~~ Wet ponds with a permanent pool deeper than 18 inches do not need to plant zone S, but ~~not incorporating a vegetated shelf~~ shall add 1-gallon plants 15" on-center to the first ~~4~~8 feet of zone A~~S~~ above the permanent pool elevation.

Commented [TL1]: @Karen Bromley - if we do think moving from zone A and B (and S) to "wet" and "dry", we will need to go through and edit that here, and probably in all of the other Vegetation sections for facilities.

Commented [KB2R1]: For the sake of simplicity, it would be better for me to adapt the plant list to specify Zones A/B/S rather than changing the Zone language throughout the manual.

The drier transitional portions of slopes (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.

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

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 planted along the north side of a facility to minimize shading of the lower growing emergent vegetation.~~

~~The drier transitional portions of slopes (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.~~

As ponds/centralized facilities require frequent and regular maintenance in perpetuity, no encumbrances or obligations may be placed on facility vegetation that might limit, conflict with, or otherwise impede the City's ability to routinely maintain, operate, modify, or reconfigure the facility, or any of its components, as deemed necessary by the City to respond to changing water quality regulations, standards, or best management practices. As such, required plantings within the functional area of the pond, berm, or tract that will be managed as part of the facility cannot be counted towards any mitigation requirements, such as tree planting required due to impacts to areas protected through the Natural Resource Overlay.

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, or when~~ where the parcel containing the pond has any slopes steeper than 3H: 1V, or where any walls/bulkheads are greater than 24 inches high. A 3-foot chain link fence with coated wire (typically green or black) shall be placed around the ~~extent of any property containing a pond that meets any of those criteria~~portion of the pond where those conditions exist. ~~An alternative fencing option (e.g. split rail cedar fence) may be proposed, if approved by the City.~~ For facilities adjoining private properties adjacent to commercial, industrial, multi-family, or school uses, ~~where access is discouraged,~~ a 6-foot chain link fence shall be used around that portion of the pond parcel perimeter. Facilities with a wall greater than ~~24~~ 48 inches require a 6-foot fence to be placed at the top of the wall, and the fence must extend 5-feet past the wall end, or until another fence is reached or the slope is less than 2:1.

~~Fencing for privately owned facilities is at the discretion of the owner. The owner may use the criteria for City-maintained facilities.~~

Access: Access shall be provided to 1) any structures and 2) any area of the facility that will require equipment for maintenance.

Access to structures: Public facilities shall have vehicle access to manholes (e.g. sedimentation, flow control), vaults, and other structures with sumped areas designed for sedimentation located at ground level that meet City of Gresham *Public Works Standards* section 3.05.01, as well as the design criteria listed below.

- Maximum grade shall be 15% for asphalt paving and 12% for gravel or modular grid paving;
- Outside turning radius shall be 40 feet, minimum;
- 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. Fence gates shall be located only on straight sections of road;
- Access roads shall be 15 feet in width on curves and 12 feet on straight sections;
- Access shall extend all the way to the structure, or as close as possible when infeasible (maximum distance of 6 feet for straight-in and 12 feet for side access for vacuum truck access);
- A paved apron shall be provided where access roads connect to paved public roadways. The apron shall be consistent with driveway details in the *Public Works Standards*.

Access into facilities: Access to forebays, or other areas designed for sedimentation, shall be provided by leaving an area of non-woody vegetation with access perpendicular to a side slope that is ~~more gradual~~ not steeper than 3H:1V.~~Facilities where a sedimentation manhole cannot be appropriately sized as pretreatment are required to install an access road all the way into the facility forebay. All other f~~F~~acilities must delineate a clear route on the plans for how equipment needed for sediment excavation would access the facility forebay(s). If a gate and road for access to structures is being provided, the plans must show that there is adequate turning radius onto a suitable slope into facility to enter and exit the portion of the facility where sediment is expected to accumulate (i.e. forebay). A separate gate and access road from the one designed to access structures shall be required if the facility forebay cannot be accessed without impacting pond bottom vegetation outside the forebay ~~(i.e. only side slope vegetation should be impacted during equipment access)~~.

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 detached dwelling unit ~~-~~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 (duplexes, multiple single dwelling units on the same lot, attached dwelling units, commercial, industrial, etc.) 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 feet 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

For the purpose of meeting the requirements of volume reduction in this Stormwater Management Manual, drywells are only allowed in the City's designated UIC area. ~~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 detached dwelling unit roofs or footing drains.

Design Requirements

Pre-Treatment: A silt trap is required for UICs receiving runoff from residential roofs and footing drains, unless a mini drywell is being installed. The silt basin should be installed between the dwelling and the UIC. In soils draining less than 2 inches per hour, an overflow shall be installed at least 4 inches 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 be from the silt trap or from the UIC.

With DEQ concurrence, a silt trap 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~~A Geotechnical Engineer must supply supporting

documentation before drywells will be allowed to be placed in fill material or before drywells will be allowed o~~i~~n ~~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 and meet Oregon Building Code requirements.

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 3-4. Drywell Sizing Chart

	Maximum Catchment Area Managed by a Single Drywell (sq ft)		
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.

Post installation testing: UICs installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

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 detached dwelling unit roofs or footing drains

Design Requirements

Pre-Treatment: A silt trap is required for UICs receiving runoff from residential roofs and footing drains. The silt trap should be installed between the dwelling and the UIC. In soils draining less than 2"/hour, an overflow shall be installed at least 4 inches 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 be from the silt trap or from the UIC.

With DEQ concurrence, a silt trap 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. A Geotechnical Engineer must supply s~~S~~upporting ~~geotechnical analysis is required for~~documentation before soakage trenches will be allowed to be placed in fill material or allowed on 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.

Post installation testing: UICs installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

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 detached dwelling unit roofs or footing drains.

Design Requirements

Pre-Treatment: A silt trap is required for UICs receiving runoff from residential roofs and footing drains. The silt trap should be installed between the dwelling and the UIC. In soils draining less than 2"/hour, an overflow shall be installed at least 4 inches 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 be from the silt trap or from the UIC.

With DEQ concurrence, a silt trap 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. A Geotechnical Engineer must supply supporting documentation before soakage trenches will be allowed to be placed in fill material or allowed on ~~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.

Post installation testing: UICs installed outside the designated UIC area that are designed to infiltrate the 100-year storm event must conduct post-installation infiltration testing following the method in **Appendix E**.

3.4 Other Facilities

3.4.1 Proprietary Devices

Proprietary treatment devices may be approved to meet stormwater quality treatment requirements only by exception.

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 use of a vegetated stormwater facility cannot fit due to mandatory land use or grade 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, constructed, and maintained 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 and Detention ~~/~~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. **Table 3-1** should be used to select a facility to provide stormwater quality treatment.

Applicability
Detention pipes and detention vaults provide detention, but do not meet the infiltration requirement listed in **Table 3-1**. They can however be used as a downstream detention facility to provide flow control, particularly for smaller developments ~~where complete on-site infiltration cannot be achieved and a pond/centralized facility would end up being smaller than 5,000 square feet~~of seven acres or less.

~~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.

Pipes and vaults designed to detain runoff from a single private property shall be privately owned and maintained and not be located within the public right-of-way. All privately owned and maintained facilities must be located to allow easy maintenance and access.

Publicly owned detention pipes are permitted within the public right-of-way and must be designed according to *Public Works Standards*. Detention pipes/vaults treating multiple properties shall be publicly owned and maintained. When publicly owned detention pipes cannot fit within the public right-of-way, they shall be placed in a separate open space tract with a public easement dedicated to the City of Gresham.

Sizing: The maximum diameter for public detention pipes is 96 inches outside of rights-of-way and 60 inches within rights-of-way. Detention pipes may be reduced to a minimum of 36 inches in diameter at connections to manholes, per PWS detail 406. 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 0.5 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~~6**.

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 1,000 square feet of impervious surface which cannot infiltrate the 100-year event 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.
- 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.
- 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.
- Any centralized facility being designed to treat runoff from development which will be combined with upstream drainage need to ensure that the facility is designed to manage flow from the entire contributing area.
- 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 Conditions Assessment

Applicants following the Engineered Method or making public improvements that will be reviewed by Development Engineering are required to assess downstream conditions as part of the Stormwater Report described in **section 2.4.4**. The downstream conditions assessment requires consulting the mapped layer of "downstream conditions" to identify if any known issues are located downstream of the proposed development. This map layer is available on GreshamMap under the "Environmental" layers; the City will review annually and update as needed.

If any pipes or outfalls within a quarter mile downstream of the discharge point from the proposed development are highlighted on the map, the applicant is responsible to do one of the following:

1. confirm that the issue is already going to be addressed through a planned City capital project,

2. provide additional on-site detention to ensure that any additional flow will not exacerbate the existing issue,
3. replace, repair, upsize, construct, or reconstruct the undersized portion of downstream conveyance system in order to provide the capacity necessary to develop the property, or
4. contribute some proportional amount to a future city-led effort to address the mapped issue.

Consult the city to determine the best approach for any mapped downstream issue. Note that some projects may be SDC-eligible if the developer addresses a downstream capacity issue under option 3.

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 SBUHor the SWMM methods.

- Generally, the Santa Barbara Urban Hydrograph (SBUH) method for computing peak discharge is preferred by the City. Other methods may be proposed and 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)	25
	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. Pipe systems must convey the appropriate **Table 4-1** storm when tailwater conditions exceed normal depth.
- 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 the 100-year event cannot be infiltrated on-site, 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 overflow from the green facilities (swales, stormwater tree wells, stormwater planters) into a piped system every 400 feet or at the end of each block, whichever is less. While this maximum spacing between inlets to the piped conveyance system is generally adequate, the designer shall ensure that the hydraulic design complies with *Public Works Standards* section 4.07.01.

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. Pipe size shall be based on the proposed slope and drainage area, following guidance in 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[1] or drainageway.

[1] 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 the State" or "Water of the United States" criteria. A Jurisdictional Determination by U.S. Army Corps of Engineers and EPA may be required.

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 Oregon Department of State Lands (ODSL) and/or U.S. Army Corps of Engineers (USACE) criteria for a jurisdictional feature. **Section 4.7** provides City requirements that should be considered in addition to regional, 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*	1.5	1
8	12	Riprap B*	2.5	2
12	20	Slope mattress, etc.	Varies	2
20		Engineer designed per ODOT Hydraulics Manual		

**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. Before designing and constructing an outfall consider alternatives such as tying into existing municipal stormwater lines to avoid multiple stormwater discharge points and green development practices to minimize discharge impacts. 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 to open channels managed by the Urban Flood Safety and Water Quality District (UFSWQD) may require approval from that agency. Contact UFSWQD for details (www.urbanfloodsafetyor.gov

- Energy dissipaters at the end of an outfall shall be located above the Ordinary High Water Mark on fish bearing streams.
- 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[2] 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 made 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 per OAR 635-412-0035.
- 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*.

[2] 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 the State" or "Water of the United States" criteria. A Jurisdictional Determination by U.S. 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 might result in contributing pollutants to the stormwater system, as defined in GRC 3.23.025, are subject to business inspections per GRC 3.99.020.

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).

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 stormwater BMP facilities are not exempt from 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)
- Covered Vehicle Parking (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. Define allowed conditions for wastewater discharge approvals into the public sanitary sewer system.
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, waterways, groundwater, or underground injection control structures (UICs).
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

Oil/water separators shall be designed, installed and maintained in accordance with the Oregon Plumbing Specialty Code, with input and review by Gresham Wastewater staff. 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 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.

5.2.5 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 Industrial Pretreatment Program (IPP) 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**.

Canopies generally need to allow for a minimum of 13 feet 6 inch clearance to the lowest projecting element where vehicles will drive through and follow other design criteria outlined in Oregon Structural Specialty Code. Any proposed fueling area that would require more than 20 feet of clearance may apply for a variance for the roofing requirement.

In cases where a cover is deemed impractical, the concrete fueling pad may be allowed to drain to the storm system, but must be equipped with a flow-stop valve or electronically actuated valve that will convey a spill from half the volume of all bulk fuel tanks plus the volume of stormwater from the fueling pad that would be generated by the water quality event (1.2” in 24-hours) in the event of an emergency.

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.

Connecting to sanitary sewer: An oil/water separator shall be installed to collect and detain incidental and residual water 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 spill control vault shall be 1,000 gallons. A shut-off valve is required downstream of the oil/water separator and must be kept closed at all times. Accumulated wastewater must meet the City's sewer discharge limits through analytical sampling prior to being approved for discharge. Sample data must be maintained onsite and available for inspection by City staff.

Dead-end sump: Storage capacity 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. As state code requires fuel station canopies to have a minimum of 13'6" clearance, the proposed alternative method of source control proposed under **section 5.2.5** must demonstrate that equipment will exceed a height of 20'.
- 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:,
    - Any uncontaminated water may be discharged to an approved stormwater facility(ies) that is 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 stormwater facilities (if clean) or if contaminated, pumped by a licensed hauler or sent to the sanitary sewer (see below). Except when uncontaminated stormwater is being discharged, the valve shall always be kept closed so any spills within the activity area can be effectively contained.
    - Any contaminated water must either be pumped by a licensed hauler, or if approved, discharged to sanitary. Any proposed discharge to the sanitary sewer requires a non-routine batch discharge authorization from the City before discharging. This approval will determine appropriate disposal methods, identify pretreatment requirements (if applicable), and approval of the discharge. Testing shall be required to establish the specific characteristics of the substance to be discharge. Contact the City's Industrial Pretreatment Program for non-routine batch discharge information.

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 sanitary sewer 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 shall be required to ensure the wastewater meets local discharge limits. Contact the City's Industrial Pretreatment Program for information concerning discharges to the City's 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, gravity grease interceptor, or hydromechanical grease interceptor may be required as pretreatment 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 outdoors

High-Risk Materials	Low-Risk Materials	Exempt Materials
• Universal Waste (batteries, pesticides, mercury-containing items) and other recyclable materials with potential effluent • Products or materials with corrosive properties or ingredients (e.g., lead-acid batteries) • Food items • Chalk/gypsum products • Feedstock/grain • Fertilizers • Pesticides • Oily or otherwise contaminated vehicle/equipment parts • Lime/lye/soda ash • Animal/human wastes	• Recyclable materials without potential effluent • Waste tires • Used tires intended for reuse • Non-oily scrap or salvage • Treated lumber • Metal • Sawdust/bark chips • Sand/dirt/soil that meet DEQ clean-fill criteria • Unwashed gravel/rock • Compost • Asphalt debris, used concrete, or stockpiles • Non-leaking vehicles in stages of disassembly	• Washed gravel/rock • Finished untreated lumber • Wood pallets that are free of residual product • Rubber and plastic products (e.g., hoses, gaskets, pipe) • New tires • Clean concrete products (e.g., blocks, pipe) • Glass (new, clean, or free of residual products) • Materials in fully sealed watertight containers that have no residual materials on the exterior of the container

High-Risk Materials	Low-Risk Materials	Exempt Materials
• Soils that do not meet DEQ clean-fill criteria and other contaminated media		

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 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

Cover

Loading docks shall have a permanent canopy, roof, or awning extending 3 feet or more from the face of the building or dock face. Detailed cover information is located in **section 5.2.2**.

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. Sites unloading chemicals regulated under the Groundwater Protection Program shall use concrete for the first 3 feet from the face of the building or dock face.

Isolation

Loading Docks. The first 3 feet of the loading dock, 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. A cover shall be placed over the hydraulically isolated areas to prevent stormwater from entering the area, allowing this area to drain to sanitary with proper pretreatment. Sites unloading chemicals regulated under the Groundwater Protection Program shall install a shut off valve prior to discharge into the sanitary system that is kept closed. 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 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 the Industrial Pretreatment Program for further information on discharging water to the sanitary sewer system.

5.11 Covered Vehicle Parking

The requirements in this section apply to all development with covered parking structures, including below-grade parking structures and multi-story above-grade parking structures. Existing parking structures are not required to retrofit unless the structure is being redeveloped.

Requirements

Drainage for all covered structures. The site must be designed so stormwater run-on does not enter the covered areas. This can be accomplished through grading, berms, or area drains. Drainage systems to collect and transport stormwater are not required for the interior areas of the structure. If the applicant elects to install an interior drainage system to collect and transport stormwater, the drainage must be directed to sanitary. Rainfall must be directed from the cover to the onsite storm system.

Drainage for below-grade parking structures. Trench drains must be installed at the entrance to the parking structure and discharge to the storm sewer system in accordance with the following site configurations:

- For a sloped ramp longer than 10 feet long, the trench drain must be located within the first 10 feet of the covered entrance.
- For a sloped ramp less than or equal to 10 feet long, the trench drain must be located within 2 feet of the covered entrance.

Drainage for multi-story above-grade parking structures. Stormwater from the uncovered top floor of the parking structure or roof of the structure must be directed to the onsite storm system.

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.

Stormwater facilities require frequent and regular maintenance in perpetuity, so no encumbrances, obligations, or uses may be placed on, or proposed for, the portion of the tract containing the stormwater facility that might limit, conflict with, or otherwise impede the owner's ability to routinely maintain, operate, modify, or reconfigure a stormwater facility, or any of its components, as deemed necessary by the City to respond to changing water quality regulations, standards, or best management practices.

For publicly owned facilities, this prohibition includes, but is not limited to:

- Any use that would impair the facility's primary function of treating, conveying, or managing stormwater.
- Any use that would restrict the City's access to any portion of the facility for maintenance, inspection, or emergency response purposes.
- Any use that would require the City to obtain additional permits, approvals, or waivers to maintain or modify the facility.

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. City inspectors will inspect the structures and vegetation in all facilities at the end of the warranty period. During the warranty/establishment period, the party responsible for maintenance is required to, at a minimum:

- Inspect the facilities monthly;
- Remove any garbage, sediment, or weeds within one week of monthly inspection;
- Replace any dead or missing plants within one month*;
- Water plants and trees, as needed.

*monthly plant replacement not required July through September, but plants should be replaced before October 15.

Failure to demonstrate that all of the above activities and timelines were adhered to during the establishment period may result in an extension of the 2-year warranty/guarantee period.

Following the 2-year warranty period, centralized facilities/ponds shall be maintained by the City. Stormwater facilities located within the public right-of-way (e.g. stormwater planters, swales, stormwater tree wells) shall be maintained by the adjacent private property owner following the 2-year 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. Plantings shall be maintained in a way that is consistent with the facility design requirements in section 3, unless the city provides an alternative landscape approach.

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 list in Appendix G.
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 hours.

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. Prune plants, as needed. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Prune plants, as needed. 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. Prune plants, as needed. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Prune plants, as needed. Remove sediment and plant debris. Replant exposed soil and replace dead
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. Prune plants, as needed. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Prune plants, as needed. Remove sediment and plant debris. Replant exposed soil and replace dead
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. Prune plants, as needed. Remove sediment and plant debris.
Winter	Clear gutters and downspouts.
Spring	Prune plants, as needed. Remove sediment and plant debris. Replant exposed soil and replace dead
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.

Contech Filter

Note: As Contech filters are a proprietary system, any additional O&M requirements for those systems apply

Structural components, including surface materials, must evenly filter stormwater.	
MAINTENANCE INDICATOR	**CORRECTIVE ACTION**
Clogged inlet	Clean gutters and inlet/catch basins at least twice a year. Remove sediment, debris, and blockages
Cracked pipes, catch basins or manholes	Repair or seal cracks. Replace when repair is insufficient.
Clogged outlet	Clean sediment and debris from outlet structure to ensure proper conveyance from system
Sedimentation on or around filter	Sediment on or around filter typically indicates that the manhole, vault or structure where filters are housed needs to be cleaned and the filters replaced. Contact a Contect-certified maintenance service to conduct work.

Annual Maintenance Schedule

Summer	Have filters inspected by Contech-certified contractor and have filters replaced as recommended. Make structural repairs.
Fall	Inspect and clean inlets
Winter	
Spring	Inspect and clean inlets
All seasons	Monitor function. Clean and/or repair as needed

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.

Detention Pipes and Vaults

Structural components, including surface materials, must evenly infiltrate stormwater.	
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.
Clogged outlet	Clean sediment and debris from outlet and/or flow control structure to ensure proper conveyance from system
Sedimentation in pipe/vault	Remove sediment and debris from bottom of pipe if/when the depth of sediment is more than 10% of the total depth of the pipe or vault.

Annual Maintenance Schedule

Summer	Make structural repairs. Check sediment accumulation and schedule removal if more than 10% of depth filled with sediment
Fall	Inspect and clean inlets and flow control structure
Winter	
Spring	Inspect and clean inlets and flow control structure
All seasons	Monitor function. Clean and/or repair as needed

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.

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: _____

Appendix A: Definitions

The following definitions apply to terms used in this manual and are intended to supplement definitions in the *Gresham Community Development Code* and *Gresham Revised Code*.

Applicant: Any person, company, or agency that applies for a permit through the City of Gresham. Includes all parties represented by the applicant.

Approved Discharge Point: Any system or route of conveyance approved by the City to receive stormwater runoff or other discharges. Receiving systems include, but are not limited to, groundwater; onsite, offsite, or public stormwater, sanitary, or combined sewers; and waters of the state.

Best Management Practices (BMPs): Operational, maintenance and other practices that prevent or reduce environmental, health or safety impacts. BMPs include structural controls, modification of facility processes, and operating and housekeeping pollution control practices.

Caliper: The diameter of nursery stock trees, generally measured at 12" above the root flare.

Capacity: The flow volume or rate that a specific facility (e.g., basin, pipe, pond, vault, swale, ditch, or drywell.) is designed to safely contain, receive, convey, reduce pollutants from, or infiltrate to meet a specific performance standard.

Catch Basin: An inlet to the storm system that is typically flush with the ground surface, designed to collect and convey stormwater runoff to an onsite stormwater system or offsite discharge point. A catch basin typically has a grate covering the surface, a lateral pipe to convey water into the storm system, and when properly designed/constructed, a sumped bottom to capture sediment.

Centralized Stormwater Management Facility: Stormwater management facilities designed to detain stormwater from large areas. Centralized Facilities provide stormwater detention for large storm events that exceed the capacity of On-Site Green Development Practices. They work in conjunction with Green Development Practices and Green Streets to manage stormwater in a comprehensive way to best mimic pre-development hydrology

Channel: The portion of a drainageway that demonstrates evidence of the conveyance of water. It is the depression between the banks worn by the regular and usual flow of water. The channel need not contain water year-round.

Check Dam: A low structure or weir placed across an open channel to control water depth or velocity, or to control channel erosion.

Connection: The connection of drainage disposal lines from all development on a property to the public sewer and drainage system.

Culvert: A hydraulically short conduit, open on both ends, generally used to convey stormwater runoff through a roadway or an embankment and typically constructed without manholes, inlets or catch basins.

Department of Environmental Quality (DEQ): Oregon Department of Environmental Quality.

Design Storm: Design storms are a combination of the design storm return period (which refers to the frequency) and the storm duration (which defines the rainfall depth or intensity). A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) are used to estimate runoff for a hypothetical storm for the purposes of analyzing existing drainage, designing new drainage facilities, or assessing other impacts of a proposed project on the flow of surface water.

Design Water Surface Elevation (Overflow Elevation): The elevation at the upper limit of the maximum depth and the lower limit of the freeboard, which corresponds to the overflow elevation. It can be considered the initial outlet elevation or overtopping elevation of the facility where an outlet is not included. Each cell of the facility may have a different design water surface elevation. The design water surface elevation can be relative to the final discharge point, a known actual elevation onsite, or can be set to zero.

Detention Facility: A facility designed to receive and hold stormwater and release it at a slower rate, usually over a number of hours. The facility may provide minimal or no volume reduction.

Detention Tank, Vault, or Oversized Pipe: A structural subsurface facility used to provide flow control for a particular drainage basin.

Development: Any human-induced change to improved or unimproved real estate, whether public or private, including but not limited to construction, installation, or expansion of a building or other structure; land division; street construction; drilling; and site alteration such as dredging, grading, paving, parking or storage facilities, excavation, filling, or clearing. Development encompasses both new development and redevelopment.

Development Footprint: The new or redeveloped area covered by buildings or other roof structures and other impervious surface areas that 1) does not allow stormwater to percolate into the ground, such as roads, parking lots, and sidewalks, or 2) is covered by pervious paving materials and systems.

Diameter at Breast Height (DBH): The diameter of a rooted tree measured 4.5 feet up from the ground surface, on the uphill side of the tree if on a slope.

Discharge Point (Disposal): The connection point or destination for a discharge leaving a site.

Discharge Rate: The rate of flow expressed in cubic feet per second (cfs).

Disturbance: An action that causes an alteration to soil or vegetation. The action may create temporary or permanent disturbance. Examples include development, exterior alterations, exterior improvements, demolition and removal of structures and paved areas, cutting, clearing, damaging, or removing native vegetation.

Disturbance Area: The area where all temporary and permanent disturbance occurs. For new development the disturbance area must be contiguous. Native vegetation planted for resource enhancement, mitigation, remediation, and agricultural and pasture lands is not included. The disturbance area may contain two subareas, the permanent disturbance area and the temporary disturbance area:

- Permanent Disturbance Area. The permanent disturbance area includes all areas occupied by existing or proposed structures or exterior improvements. The permanent disturbance area also includes areas where vegetation must be managed to accommodate overhead utilities, existing or proposed non-native planting areas, and roadside areas subject to regular vegetation management to maintain safe visual or vehicle clearance.
- Temporary Disturbance Area. The temporary disturbance area is the portion of the site to be disturbed for the proposed development but that will not be permanently occupied by structures or exterior improvements. It includes staging and storage areas used during construction and all areas graded to facilitate proposed development on the site, but that will not be covered by permanent development. It also includes areas disturbed during construction to place underground utilities, where the land above the utility will not otherwise be occupied by structures or exterior improvements.

Drainage Basin: A defined area that contributes to flows to an approved discharge point.

Drainage: Waters generated at or conveyed through a particular site. Drainage is predominantly surface runoff generated from rainfall. Groundwater naturally occurring at the surface (such as seeps or springs) or pumped to the surface shall be considered drainage.

Drainageway: A constructed or natural channel or depression which at any time collects and conveys water. A drainageway and its reserve area function together to manage flow rate, volume and water quality.

Driveway: The area that provides vehicular access to a site. A driveway begins at the property line and extends into the site. In parking areas, the driveway does not include vehicular parking, maneuvering, or circulation areas.

Drywell: A subsurface structure (e.g. cylinder or vault) with perforated sides and/or bottom, used to infiltrate stormwater into the ground. A drywell is a UIC by DEQ definition.

Ecoroof: A lightweight low-maintenance vegetated roof system consisting of waterproofing material, growing medium, and vegetation; used in place of or over the top of a conventional roof. Ecoroofs, also called green roofs, provide stormwater management by capturing, filtering, and evaporating rainfall.

Flow: The rate or volume of water moving within a natural or man-made system. Flow is often measured as a ratio, such as cubic feet per second (cfs).

Flow Control: The practice of limiting the release of peak flow rates and volumes from a site. Flow control is intended to protect downstream properties, infrastructure, and natural resources from the increased stormwater runoff peak flow rates and volumes resulting from development.

Flow Control Structure: A device used to delay or divert a calculated amount of stormwater to or from a stormwater management facility.

Freeboard: The vertical distance between the design water surface elevation (overflow elevation) and the elevation at which overtopping of the structure or facility that contains the water would occur.

Geotextile: A woven or non-woven water-permeable material, generally made of synthetic products such as polypropylene, used in stormwater management and erosion and sediment control applications to trap sediment or to prevent fine soil particles from clogging the aggregates.

Green Development Practices: Stormwater management techniques that utilize the processes of retention, infiltration, and evapotranspiration to treat runoff and reduce the volume of stormwater.

Green Infrastructure (Green Stormwater Infrastructure, GSI): A comprehensive approach to water quality protection defined by a range of natural and built systems and practices that use or mimic natural hydrologic processes to infiltrate, evapotranspire, or reuse stormwater runoff on the site where it is generated.

Green Street: A vegetated stormwater management facility located within the planting strip or other portion of public rights-of-way.

Groundwater: Subsurface water that occurs in soils and geological formations that are fully saturated. Groundwater fluctuates seasonally and includes perched groundwater.

Growing Medium: Growing medium supports plants and microorganisms that improve the function of vegetated stormwater facilities. Growing medium may include stormwater facility blended soil, blended topsoil, or native soils. See the individual facility design criteria and details for requirements in private and public stormwater facilities.

Hydromodification: Modifications to the natural system of water flow in a human-altered landscape, including changes to water conveyance, surface water runoff, sediment transport, and water quality. This process can cause stream erosion and downcutting, habitat and water quality degradation, and risks to infrastructure.

Illicit Discharge: Any discharge to the stormwater system that is not composed entirely of stormwater. See non-stormwater discharge.

Impervious Surface: Any surface that has a runoff coefficient greater than 0.8. Types of impervious surface include rooftops, traditional asphalt and concrete parking lots, driveways, roads, sidewalks, and pedestrian plazas. Slatted decks and gravel surfaces are considered pervious unless they cover impervious surfaces or gravels are compacted to a degree that causes their runoff coefficient to exceed 0.8.

Infiltration: The percolation of water into the ground. Infiltration is often expressed as a rate (inches per hour), which is determined through an infiltration test.

Inlet: A structure designed to collect stormwater runoff and direct it to the conveyance system

Low Impact Development (LID): A stormwater management approach that seeks to mitigate the impacts of increased runoff and stormwater pollution using a set of planning, design and construction approaches and stormwater management practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater, and can occur at a wide range of landscape scales (i.e., regional, community and site scales).

Manufactured Stormwater Treatment Technology: A proprietary stormwater management facility structural facility or device.

Maximum Depth (Storage Depth): The greatest vertical distance between the design water surface elevation (overflow elevation) and the top of the growing medium of a surface facility or the base of a subsurface facility, which creates a reservoir capable of providing safe storage capacity of stormwater.

Municipal Separate Storm Sewer System (MS4): A conveyance or systems of conveyances such as municipal streets, catch basins, curbs, gutter, ditches, manmade channels or storm drains owned by the City of Gresham designed or used for collection or conveyance of stormwater.

Non-Stormwater Discharge: Water not entirely composed of rainwater. Some non-stormwater discharges are not considered to be illicit discharges and are allowed to enter the stormwater system, including irrigation water, water line flushing, uncontaminated groundwater from footing drains, and others expressly listed in code or the City's NPDES MS4 permit.

On-Site Stormwater Management: The management of stormwater as close to the impervious source as possible. For public streets, on-site stormwater management is defined as management within the public right-of-way. For commercial and industrial buildings, on-site stormwater management is defined as management within the individual tax lot. For single-family and multi-family development, on-site stormwater management is defined as management within the collective boundary of all of the individual tax lots.

Open Channel: A fluid passageway that allows part of the fluid to be exposed to the atmosphere.

Operations and Maintenance (O&M): The continuing activities required to keep stormwater management facilities and their components functioning in accordance with design objectives.

Outfall: A location where collected water is discharged. Outfalls can include discharge from stormwater management facilities, drainage pipe systems, and constructed open channels.

Overflow: Excess volume of stormwater or wastewater that exceeds the storage or conveyance capacity of a facility or system component and causes a release of flow to another facility, system component or the environment.

Partial Infiltration: When the total infiltration design storm (or another specified design storm as required) is unable to be completely percolated into the ground.

Parking Area: The area of a site devoted to the temporary or permanent storage, maneuvering, or circulation of motor vehicles. Parking areas do not include driveways or areas devoted exclusively to non-passenger loading.

Permit: An official document issued by the Director authorizing performance of a specified activity.

Pervious: Any surface determined to have a runoff coefficient less than 0.8; a surface modified in a way to encourage infiltration of water

Pervious Pavement (aka Porous Pavement or Permeable Pavement): Alternative pavement systems that allow water to percolate into subsurface drainage systems or the ground. Examples include permeable pavers, pervious asphalt, and pervious concrete systems.

Planter: A structural facility filled with stormwater facility topsoil and gravel and planted with vegetation. The stormwater planter receives runoff from impervious surfaces, which is filtered and retained for a period of time. Planters may be further classified by their ability to infiltrate. An infiltration planter has an open bottom, allowing water to infiltrate into the ground. A flow-through planter has an overflow that must be directed to an acceptable discharge point. Flow-through planters may have an impervious or sealed bottom, either through a waterproof liner or a poured concrete base. Site conditions will determine appropriate facility selection.

Pollutant: An elemental or physical material that can be mobilized or dissolved by water or air and could create a negative impact to human health or the environment.

Pollution Reduction (Water Quality): The Pollution Reduction storm event is representative of 90% of the average annual rainfall and is used to size facilities for the pollution reduction stormwater management requirement. Also known as the water quality storm.

Pollutants of Concern: Constituents identified by DEQ as having the potential to have a negative impact on the receiving system, including surface waters, groundwater, the wastewater collection system, or the wastewater treatment plant. Pollutants of concern can include suspended solids, metals, nutrients, bacteria and viruses, organics, volatiles, semi-volatiles, floatable debris, and increased temperatures.

Practicable: Available and capable of being done, as determined by the Stormwater Manager, after taking into consideration cost, resources, existing technology, and logistics in light of overall project purpose.

Public Facility: A street, right-of-way, sewer, drainage, stormwater management, or other facility that is either currently owned by the City or will be conveyed to the City for maintenance responsibility after construction. A new stormwater management facility that receives direct stormwater runoff from a public right-of-way becomes a public (City-maintained) facility unless the right-of-way is not part of the City's road maintenance system.

Public Improvement: An improvement of, on, over, or under property owned or controlled by the City, or property to be controlled by the City upon plat and easement recording for approved land divisions, by construction, reconstruction, remodeling, repair or replacement, when no property is intended to be assessed any portion of the improvement cost.

Public Works Project: Any project performed or conducted by local, state, or federal governments that result in the construction of a Local Improvement or a Public Improvement.

Public Works Standards: The Gresham Public Works Standard Details, Construction Specifications, and Design Standards

Rain Garden: A shallow depression filled with stormwater facility topsoil and planted with vegetation. Rain gardens receive runoff from impervious surfaces, which is filtered and retained for a period of time.

Infiltration rain gardens have are unlined, allowing water to infiltrate into the ground. Filtration rain gardens have a perforated underdrain and overflow that is directed to an acceptable discharge point.

Rainwater Harvesting: The collection and use of rainwater or stormwater runoff for water use purposes such as irrigation and toilet flushing. A facility that harvests rainwater is considered a stormwater facility only if the facility has water quality or flow control benefit.

Rational Method: The method used to estimate the peak rate of runoff from a drainage basin, using the formula: Q=CiA. Q is the peak discharge, cubic feet per second; C is the runoff coefficient; i is the rainfall intensity, inches per hour; and A is the drainage area, acres

Redevelopment: Any development that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces.

Repair: Work performed to patch, replace components, replace or rehabilitate entire facilities that serve the City's sewer and drainage system.

Reservoir: The temporarily stored volume of runoff prior to overflow. For vegetated surface facilities it is defined as the volume between the top of the growing medium, the design water surface elevation (overflow elevation), and the edges of the facility (whether sloped or vertical). In a sedimentation chamber, it is defined as the volume of runoff stored prior to discharge to the receiving system.

Retention Facility: A facility designed to receive and hold stormwater runoff so that some volume of stormwater that enters the facility is not released offsite. Retention facilities permanently retain a portion of the water onsite, where it infiltrates, evaporates, or is absorbed by surrounding vegetation.

Retrofit: Installation of a new facility or system components to manage stormwater or wastewater flows.

Roadway: Any paved surface used to carry vehicular traffic (cars/trucks, forklifts, farm machinery, or any other large machinery).

Runoff Coefficient: A unitless number between zero and one that relates the average rate of rainfall over a homogenous area to the maximum rate of runoff

Safety Factor: A sizing multiplier that evaluates the risks and values of specific conditions, including the failure mode of the construction material, unexpected construction deficiencies, and potential cost of system failure. The safety factor is applied to the maximum performance limit to calculate a risk-based design value used for sizing facilities. A safety factor must be used to provide reasonable assurance of acceptable long-term system performance.

Sand Filter: A structural pollution reduction or flow control facility using a layer of sand and optional vegetation to manage stormwater runoff.

Santa Barbara Urban Hydrograph (SBUH): A hydrologic method used to calculate runoff hydrographs.

Seasonally High Groundwater Level: The highest level that the permanent groundwater table or perched groundwater may reach on a seasonal basis (typically highest March through May)

Site: Any lot or parcel of land or contiguous combination where development occurs. For utility lines, trenches or other similar work, the site includes only the disturbance area directly related to the linear work activity.

Soakage Trench: A subsurface infiltration stormwater management facility that includes a perforated pipe laid in drain rock. A soakage trench is a UIC by DEQ definition.

Stormwater: Surface runoff and drainage associated with rainstorm events and snow melt.

Stormwater Facility Landscaping (Landscaping): The vegetation (plantings), mulch, rocks, and other surface elements associated with stormwater management facility design.

Stormwater Facility Topsoil: The planting media added to the top 18 inches or more of a stormwater facility to filter pollutants and provide a growing medium for plantings. This layer of soil is typically comprised of three equal parts gravelly sand, compost and loamy topsoil.

Stormwater Management: Techniques used to improve water quality (reduce pollutants from stormwater) and decrease stormwater runoff through processes that detain, retain, or provide a discharge point for stormwater runoff that best preserves or mimics the natural hydrologic cycle.

Stormwater Management Facility: A facility or other technique used to reduce the volume, flow rate or pollutant content of stormwater runoff. Stormwater facilities may reuse, collect, convey, detain, retain, or provide a discharge point for stormwater runoff.

Stormwater Retrofit: Installation of a new stormwater facility to treat stormwater from existing impervious area, including, but not limited to, roofs, patios, walkways, and driving or parking surfaces.

Stormwater Treatment: The process of removing sediment and/or pollutants from stormwater runoff by using one or more methods (e.g. detention, retention/infiltration, filtration, separation)

Sump: Any volume of a facility below the point of outlet in which water or solids can accumulate.

Surcharge: 1) A flow condition when the downstream hydraulic capacity is less than the upstream inflow causing water to back up and rise above the inside crown of a pipe or facility. 2) The greatest measured distance from the water surface to the pipe crown.

Surface Infiltration Facility: A vegetated facility designed to receive and infiltrate stormwater runoff at the ground surface to meet stormwater infiltration/discharge requirements.

Tenant Improvements: Structural upgrades made to the interior or exterior of buildings.

Temporary Structure: A structure that is a separate and distinct entity from all other structures for a continuous period of three years or less. A temporary structure must be created and removed in its entirety, including impervious area associated with the structure, within three years. Paved areas such as parking lots that are developed alongside structures are not considered temporary for the purpose of this manual.

Time of Concentration (T_c or TOC): The amount of time it takes stormwater runoff to travel from the most distant point (measured by travel time) on a particular site or drainage basin to a particular point of interest.

Total Suspended Solids (TSS): Total suspended matter that either floats on the surface or is suspended in water or wastewater and that is removable by laboratory filtering in accordance with 40 CFR Table B.

Underground Injection Control (UIC): Defined by DEQ as any system, structure, or activity that is intended to discharge fluids below the ground surface such as drywells, soakage trenches, and infiltration vaults.

Vegetated Facilities: Stormwater management facilities that rely on plantings as an integral component of their functionality.

Vegetated Filter: A gently sloping, densely vegetated area used to filter, slow, and infiltrate sheetflow stormwater.

Vegetated Infiltration Basin (Rain Garden): A vegetated facility that temporarily holds and infiltrates stormwater into the ground.

Vegetated Swale (Bioswale): A long, narrow, vegetated channel used to collect, convey and reduce pollutants from stormwater runoff. Check dams are used to slow runoff, settle sediment, and improve infiltration and pollution reduction.

Water Body: Coastal waters, rivers, sloughs, continuous and intermittent streams and seeps, ponds, lakes, aquifers, and wetlands.

Water Quality Limited: Waters identified by DEQ that do not meet water quality standards. Total Maximum Daily Load (TMDL) must be developed for these waters to satisfy Clean Water Act (CWA) requirements. The most recent EPA-approved Section 303(d) list for Oregon can be found at www.deq.state.or.us/wq/assessment/assessment.htm.

Water Table: The upper surface of an unconfined water body, the surface of which is at atmospheric pressure and fluctuates seasonally. The water table is defined by the levels at which water stands in wells that penetrate the water body (City Water Pollution Control Facility Permit).

Wellhead Protection Area: A drinking water source area where additional groundwater protections are in place to secure the City's drinking water supplies and protect public health. The City regulates the storage, use, and transportation of chemicals in these sensitive areas, and more stringent stormwater management standards may apply.

Wet Pond: A vegetated basin with a permanent pool of water, used to provide pollution reduction for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out and extended wet detention ponds have additional storage capacity for flow control.

Wetland: An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of

vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas, except those constructed as pollution reduction or flow control facilities.

Stormwater Management Guidance for Single Detached Dwelling or Duplexes

The City of Gresham has requirements designed to protect our local streams and groundwater from impacts that can be caused during and after construction activities. This document is designed to provide a concise overview of the requirements for single detached dwellings or duplexes on a single lot of record.

Why manage stormwater?

Stormwater and stream samples across the state demonstrate that there is too much pollution and erosive velocity in streams. This is largely caused by runoff from impervious areas – surfaces that prohibit water from infiltrating into the soil, such as streets, sidewalks, roofs, driveways, patios, etc.

To protect Oregon's resources for future generations, our goal is to put as much stormwater back into the ground using infiltration whenever possible. The use of plants in stormwater planters and ecoroofs helps evapotranspirate water and provides habitat and the use of porous pavement and other BMPs helps soak water back into the soil.

Before you finalize your plans

As part of your site and project plans incorporate the following to maximize your credits:

- Minimize impervious area (IA). Limit driveway size and other IA. This reduces SDCs and future stormwater rates.
- Use impervious area reduction methods. Porous pavements and ecoroofs are not considered as impervious area, so including them in your design will reduce your SDC and future monthly stormwater rate.
- Integrate stormwater management. If you still have impervious surface requiring treatment after taking the above steps, determine where that treatment will occur, since it will likely affect your plumbing and grading plans.

What is required?

1. **Erosion Prevention and Sediment Control (EPSC).** Erosion control permits are required for grading or building projects **disturbing 500 square feet** or more. Any activity that disturbs soil within the city requires erosion control. The city can enforce on any activity where dirt could potentially leave a site.

2. **Stormwater Management.** Stormwater management is required for any project **adding or replacing 1000 square feet** or more of impervious area**.**

Erosion Control Requirements

Erosion control is best accomplished by limiting disturbance to areas being activity constructed. Erosion can be prevented by keeping soil covered with vegetation, mulch, straw, rock or even plastic sheeting. Any inlets to the storm system on site need to be blocked, or have a catch basin insert installed.

The most commonly required erosion control practices are listed below**. Complete details on erosion control requirements can be found in the City's Erosion Prevention and Sediment Control (EPSC) Manual.**

Erosion Control Best Practices

Prevent erosion by retaining existing vegetation or adding mulch, straw, rock or plastic to areas with disturbed soils. **Perimeter control, inlet protection, and a construction entrance should all be added prior to any ground clearing or site disturbance.** An initial erosion control inspection (010) must be approved prior to approval of any construction activities.

1. Perimeter Control

The most commonly used perimeter control methods are silt fences (left photo) and straw wattles (right photo). Either method requires trenching and then using stakes to secure it.

2. Inlet Protection

Inlet protection filters must be installed on your site and downstream from active construction in the street. **Biobags are not allowed.**

3. Construction Entrance

Any construction site where vehicles or equipment will be driving on exposed soil need to install a rock entrance. The goal is to create an area for vehicles to enter and exit the site without tracking dirt into the street. Single detached dwelling lots can install ¾" rock in the same area where the driveway will eventually be located. The minimum depth of rock shall be 8", with a minimum length and width of 20' by 20'.

4. Material and Concrete Waste Management

Provide onsite locations for garbage management, concrete/paint washout. Store hazardous materials safely.

5. Sweep the street daily, or as dirt tracks

You are expected to keep the street in front of your job site clean on a daily basis.

Stormwater Management Methods

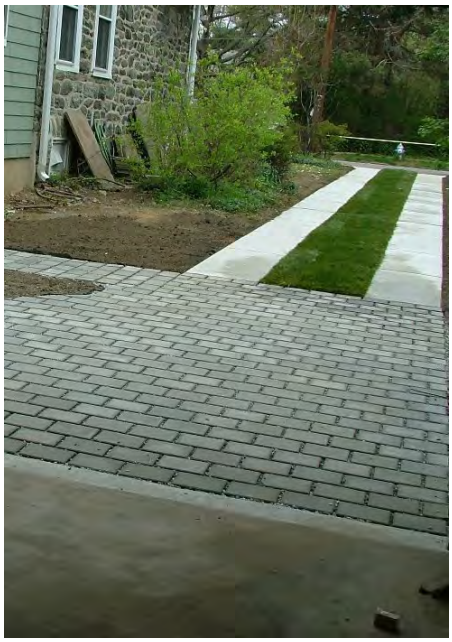
Stormwater management can be met by of the following methods:

Method	Can be used to treat	Overview
Porous pavement	Driveway, patio, walkway	Pavers or porous concrete allow water landing on paved surfaces to infiltrate
Ecoroof	Roof	Roof constructed with layer of soil and plants that intercepts and filters rain
Stormwater Planter	Roof, driveway, patio, walkway	Concrete structure containing plants and soil to filter and/or infiltrate water piped to it
Rain Garden	Roof, driveway, patio, walkway	Shallow basin containing plants and soil to infiltrate or filter water piped to it
Soakage trench or Infiltration Vault	Roof, driveway, patio, walkway	Underground trench filled with rock designed to infiltrate water piped to it
Drywell	Roof, driveway, patio, walkway	Underground chamber that stores water and slowly releases it to surrounding rock and soil

More than one method can be used to treat different areas of a single project site. Details about each of these methods, as well as the sizing requirements you will need to submit to demonstrate you have planned adequate stormwater management to meet the requirements, are below.

1. Porous/Pervious Pavement (concrete, asphalt, blocks)

Use of this technique will be given a 1:1 credit, meaning areas where porous pavements are used will not be counted towards your SDC fees or future rates. Additional flow may **NOT** be directed onto this surface to count as treatment



Location

Can be used on any external paved surface – driveways, walkways, patios. Porous pavements shall not be used in areas within the 100-year floodplain, or at slopes that exceed 5%.

Construction

There are many types of porous pavements, which range from porous concrete to concrete pavers with gaps or holes designed to allow water to pass through. Any proposed porous pavement must meet state and city building codes. Porous asphalt is typically not preferred, but will be reviewed by Stormwater staff if proposed by developer.

Underdrain: Areas which infiltrate at less than 0.5"/hour, or with a slope greater than 2%, may need an underdrain.

Safety overflow: A safety overflow is required to prevent ponding in the event the surface is clogged. The overflow may consist of an inlet drain, catch basin, curb opening, or other method to convey water to an approved disposal point.

Maintenance

The long term effectiveness of porous pavement system requires that the surface layer is kept clear of debris and sediment, which can cause clogging. Regular sweeping is general sufficient to keep water infiltrating through the porous surface.

2. Ecoroof

This technique will be given a 1:1 credit for impervious area reduction and will not count towards SDCs or future rates. No additional flow may be directed onto this surface to count as treatment. Ecoroofs have buyer selling qualities of a long-life span documented to be 30-50 years, insulation that reduces heating and air needs, and are beautiful amenities if planned with a sitting area, etc.

Location

Ecoroofs are installed in place of a standard roof on top of a house, garage or addition. Roofs being proposed for an ecoroof installation function best with lower slopes (maximum of 25% slope).

Construction

The roof must be designed to structurally support the added weight of an ecoroof. Generally, the roof must be able to support an additional 15 to 30 pounds per square foot of saturated weight,

which includes the vegetation and growing medium. There are companies that sell and/or install ecoroof materials which will meet the requirements for waterproofing, growing medium and vegetation.

Waterproofing and Root Barrier: The roof surface needs to be coated with a high-quality waterproofing material, such as modified asphalt, synthetic rubber or reinforced thermal plastic.

Growing Medium: A minimum of 4" of growing medium is required. The preferred blend for growing medium is 70% porous material, 20% organic material (e.g. compost), and 10% digested fiber.

Vegetation: Drought tolerant plants that are evergreen and require little or no irrigation after establishment work best. A mixture of sedum and succulent plants is the best way to achieve the desired plant community.

Maintenance
Plants may need to be watered during the first 2 years after installation, until they become established. Irrigation should be minimized and not exceed 0.5" of water every 10 days. Pesticides/herbicides should not be used, and if fertilizer use should be limited and only be from an organic source (fertilizer may cause nutrient export from the ecoroof into stormwater).

3. Stormwater Planter

Stormwater planters are structural reservoirs filled with soil and plants, designed to collect, filter and infiltrate stormwater (depending on location).

Location
Planters should be designed to infiltrate unless site is located 1) on fill, 2) steep slopes, or 3) in areas DEQ considers contaminated. Infiltration planters must be located 5 feet from property lines and 10 feet from building foundations. Lined/filtration planters can be located next to foundation walls, property lines, on slopes, fill or in contaminated soils.

Construction
Infiltration planters will have concrete walls, but open on bottom. Lined/filtration planters must be monolithically poured concrete without joints (all walls and bottom poured at same time), otherwise a 30-mil PVC liner must be installed inside. Pipe (cast iron, ABS or PVC) shall be installed as overflow, and a perforated underdrain pipe needs to be installed for lined/filtration planters. Lined and unlined facilities must have a minimum of 18" of 3-way soil planted with 1-gallon plants at 1-foot spacing. A layer of drain rock can be used in infiltration planters and must be used in lined/filtration planters (per detail ST-151).

Maintenance
Sediment, debris, and weeds should be removed every 6 months, or as needed. Vegetation may need to be watered during the first 2 years after installation, until it becomes established.

4. Rain Garden

Rain gardens are shallow depressions filled with soil and plants, designed to collect, filter and infiltrate stormwater (depending on location). **The City prefers planters over rain gardens.**

Location

Rain gardens should be designed to infiltrate unless site is located 1) on fill, 2) steep slopes, or 3) in areas DEQ considers contaminated. Infiltration rain gardens must be located 5 feet from property lines and 10 feet from building foundations. If a lined/filtration facility would be required, install a planter.

Construction

Infiltration rain gardens have gently sloped sides with a flat basin on the bottom. Lined/filtration rain gardens must have a 30-mil PVC liner under the soil and a layer of drain rock. Pipe (cast iron, ABS or PVC) shall be installed as overflow, and a perforated underdrain pipe needs to be installed for lined/filtration rain gardens. Lined and unlined facilities must have a minimum of 18" of 3-way soil planted with 1-gallon plants at 1-foot spacing. A layer of drain rock can be used in infiltration rain gardens and must be used in lined/filtration planters (per detail ST-141).

Maintenance

Sediment, debris, and weeds should be removed every 6 months, or as needed. Vegetation may need to be watered during the first 2 years after installation, until it becomes established.

5. Soakage Trench or Infiltration Vault

A soakage trench is a shallow trench filled with drain rock. A perforated pipe distributes stormwater to the trench, where it is stored before infiltrating into underlying soil. An infiltration vault is a trench containing drain rock that also has a larger horizontal perforated pipe within it to store water that will eventually infiltrate. Soakage trenches and infiltration vaults are classified as UICs by DEQ, and if anything except runoff from single detached dwelling roofs drains to them, they must have pre-treatment and be registered with DEQ.

Location

Soakage trenches must be located 5 feet from property lines and 10 feet from building foundations. Soakage trenches should not be installed on slopes 20% or greater. There must be a 5-foot separation distance between bottom of trench to groundwater.

Construction

The trench should be a minimum of 30" deep and 30" wide, with the length being 20' (or 30' in soils draining <2"/hour) for every 1,000 sq ft of impervious area draining to the soakage trench. The trench should be lined with permeable filter fabric prior to adding the drain rock, and then the filter fabric should be folded over the top of the trench after the perforated pipe has been installed. At least a foot of soil or drain rock should be placed over the top of the soakage trench, depending on whether lawn or a "dry riverbed" landscape is desired.

Maintenance
A sediment trap must be located upstream of the soakage trench to ensure that leaves and sediment don't clog it. The sediment trap should be inspected and cleaned once per year, or as needed.

6. Drywell

A drywell is an underground perforated plastic or concrete chamber surrounded by drain rock. Stormwater is temporarily stored in the drywell before it soaks into the surrounding soil. Drywells are classified as UICs by DEQ, and if anything except single detached dwelling roof runoff drains to them, they must have pre-treatment and then be registered with DEQ.

Location
Drywells must have a 5-foot separation distance between bottom of trench to groundwater. The center of the drywell must be located 5 feet from property lines and 10 feet from building foundations. The top of the drywell shall be located downslope from all foundations and should not be installed on slopes 20% or greater.

Construction
The drywell size should be selected based on the table on detail ST-170. The depth of the hole to be excavated needs to be at least 2' deeper than the depth listed in the table to account for 2' minimum fill on top of drywell, and the width of the hole should be at least 2' wider than listed to provide space for drain rock to be added around the drywell.

Maintenance
A sediment trap must be located upstream of the drywell to ensure that leaves and sediment don't clog it. The sediment trap should be inspected and cleaned once per year, or as needed.

Attachments

1. EPSC Plan for Single Detached Dwelling/Duplex sites
2. Stormwater Facility Simple Sizing Form
3. Typical Stormwater Details
    a. Porous pavement (ST-100)
    b. Ecoroof (ST-110)
    c. Rain Garden (infiltration option ST-140; filtration option ST-141)
    d. Stormwater Planter (infiltration option ST-150; filtration option ST-151)
    e. Drywell (ST-170)
    f. Mini Drywell (ST-171)
    g. Soakage Trench (ST-180)
    h. Infiltration Vault (ST-190)

EPSC Plan for Single Detached Dwelling/Duplex– City of Gresham

The following commitments constitute my Erosion Prevention and Sediment Control (EPSC) Plan as required under the City's EPSC Manual. In developing this plan, I certify that I have evaluated site contours and drainage patterns, identified potential erosion and sediment problems, evaluated EPSC measures, and will implement EPSC measures prior to performing any earthwork or site grading. I will follow this plan and make ongoing revisions as needed to ensure sediment stays on site and other construction-related pollutants and debris are kept out of stormwater and other waters.

I further certify that all EPSC measures will be installed in accordance with City requirements including the City's Stormwater Management Manual and EPSC Manual. I understand that the City will inspect my site for implementation of this EPSC Plan before and during construction, and that a stop-work order may be issued if I fail to properly implement EPSC measures.

	Responsibilities	**Initial**
1.	I understand I am responsible, as the permit holder, to keep sediment onsite.	
2.	I will provide a linear barrier (such as a sediment fence) and perimeter control where needed to keep sediment onsite.	
3.	I will ensure that construction debris, paint, concrete, and other pollutants are kept out of stormwater, streams, storm drains, and any stormwater treatment systems such as street raingardens.	
4.	I will provide storm drain inlet protection.	
5.	I will provide construction entrance/exit tracking controls.	
6.	I will provide concrete management.	
7.	I will provide slope breaks for steep slopes.	
8.	I will provide stockpile management for both soil stockpiles and non-soil stockpiles.	
9.	I will provide temporary ground cover (such as straw mulch) during October 1 – May 31, or until wet weather subsides, and permanent seeding and planting.	
10.	I will provide daily inspection and maintenance when work is ongoing, as needed during wet weather, and even if work is not ongoing to ensure this plan is met.	
11.	I will remove temporary erosion controls once construction is completed and the site is stabilized.	
12.	I understand the City may require modifications or additional EPSC measures to be installed onsite.	

Name: _____ Phone Number: _____

Full Construction Property Address: _____

Person Responsible for Implementing and Inspecting EPSC Measures: _____

Phone Number: _____

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: _____

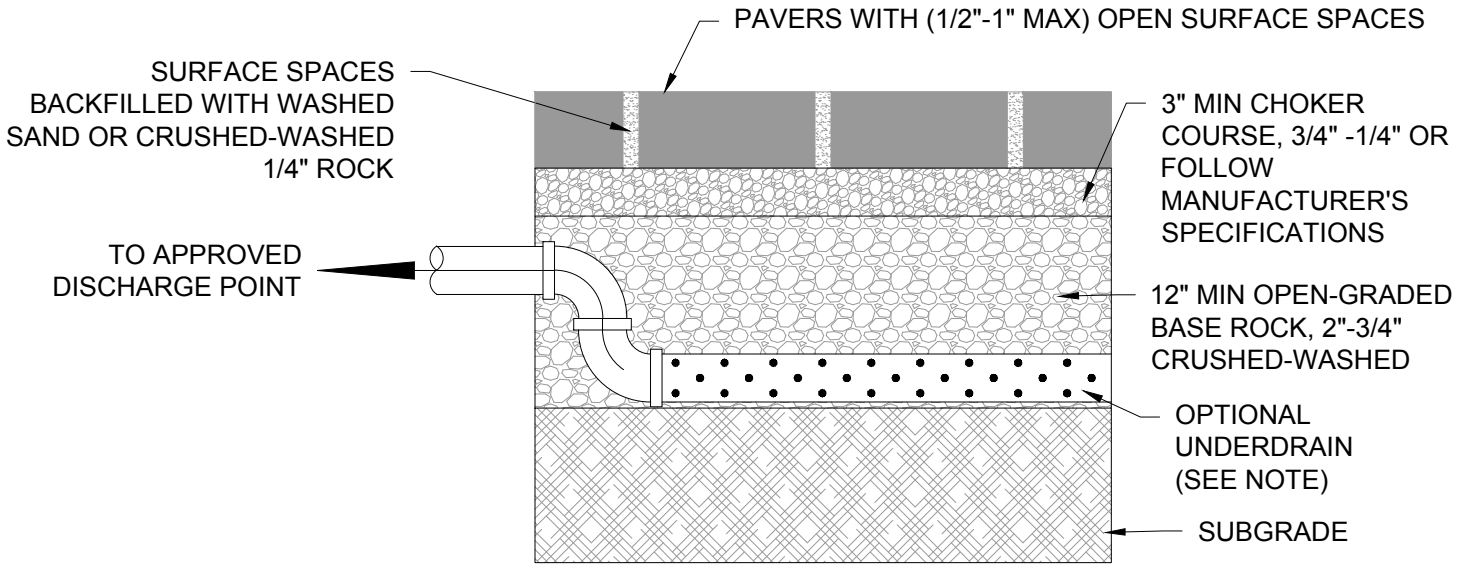
Impervious Area from Development (sf): _____ Soil Type: A B C D
(circle one)

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		0.035	0.055	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 single detached dwelling unit roofs 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.

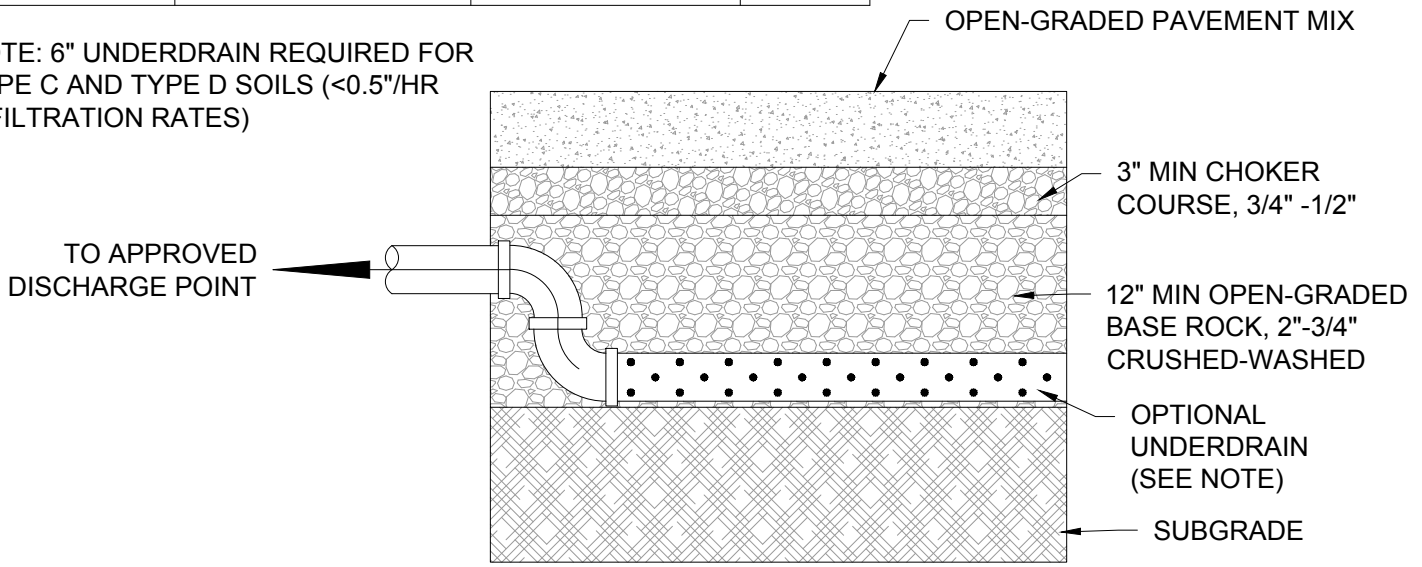


PERMEABLE CONCRETE BLOCK OR "PAVER" SYSTEMS

DESIGN REQUIREMENTS FOR TOP LIFT DEPTH

	RESIDENTIAL DRIVEWAY OR PEDESTRIAN ONLY	PRIVATE STREET, PARKING LOT, OR FIRE LANE	PUBLIC STREET
CONCRETE	4"	4"	7"
ASPHALT	2 1/2"	3"	6"
PAVERS	2 3/8"	3 1/8"	3 1/8"
ENGINEERING REQ'D	NO	YES	YES
COMPACTION REQ'D	NO	YES	95%

NOTE: 6" UNDERDRAIN REQUIRED FOR TYPE C AND TYPE D SOILS (<0.5"/HR INFILTRATION RATES)



PERVIOUS (OPEN GRADED) CONCRETE AND ASPHALT SYSTEMS

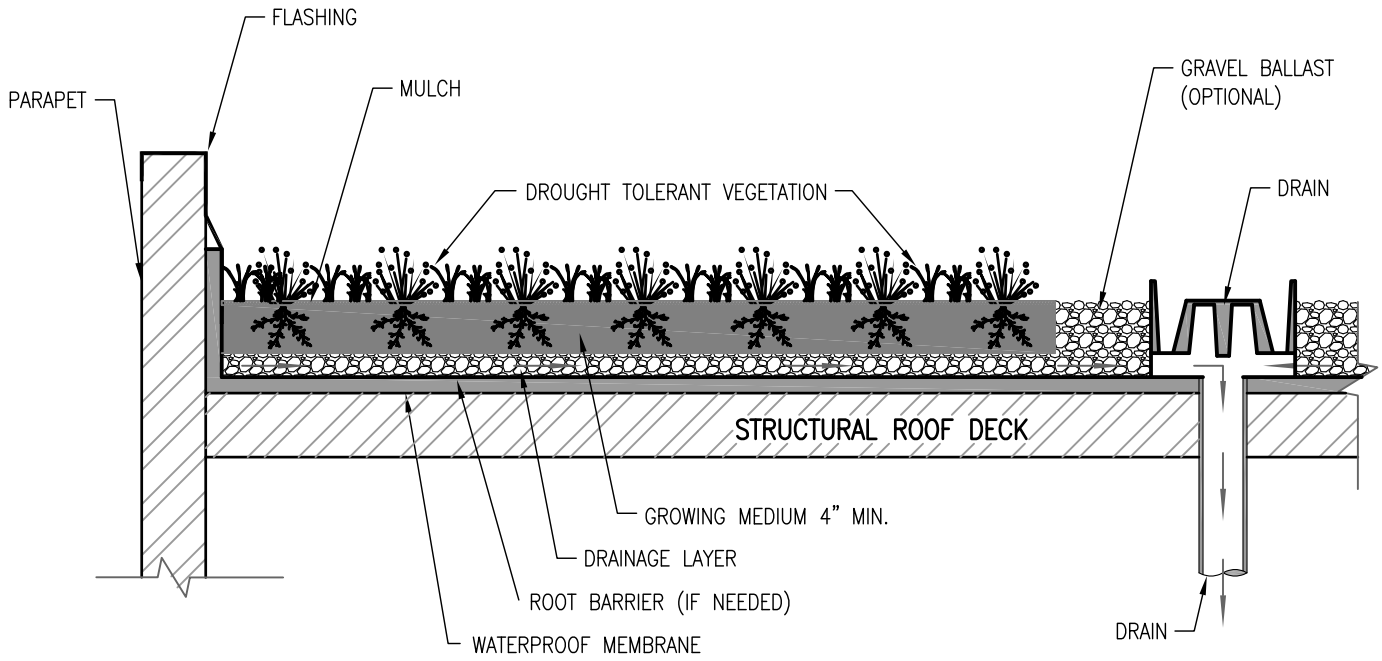
– DRAWING NOT TO SCALE –

CITY OF GRESHAM

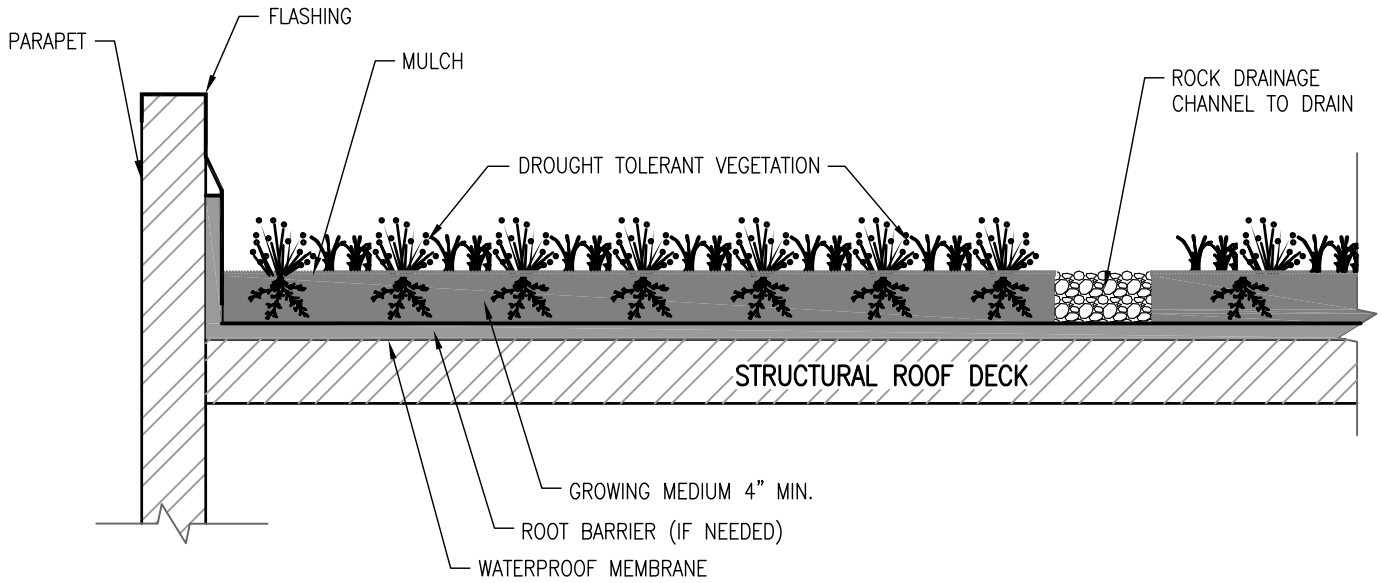
POROUS PAVEMENT

PUBLISHED: DRAFT

DRAWN	RMS
REV. DATE	APR 2024
APPR.	
DETAIL NO.	ST-100

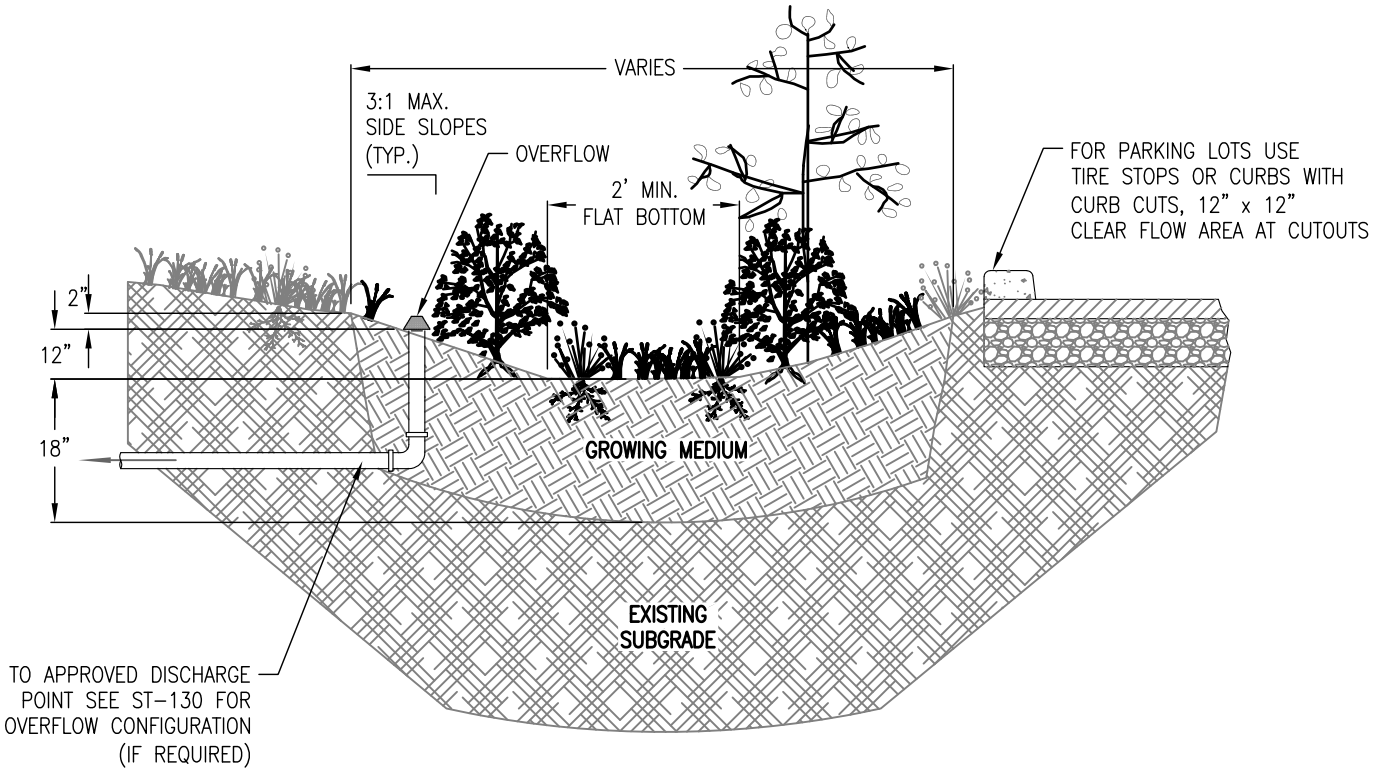


ECOROOF WITH DRAINAGE LAYER



ECOROOF WITH DRAINAGE CHANNELS

CITY OF GRESHAM	ECOROOF	DRAWN DRO DATE APR 2018 APPR. DWG. NO. ST-110



1. Provide protection from all vehicle traffic and equipment staging in proposed infiltration areas prior to, during, and after construction.

2. Dimensions:
   Width and length vary. Dimensions to be specified on plans based on sizing form.
   Depth (from top of growing medium to overflow elevation): 12".
   Flat bottom width: 2' minimum.
   Side slopes: 3:1 maximum.

3. Setbacks:
   Facility should be 10' away from foundations and 5' away from property lines.

4. Overflow:
   Facility must connect to approved discharge point per detail ST-130.
   Overflow elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.

5. Piping must be cast iron, ABS or PVC. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" minimum pipe. Oregon Plumbing Specialty Code also applies.

6. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.

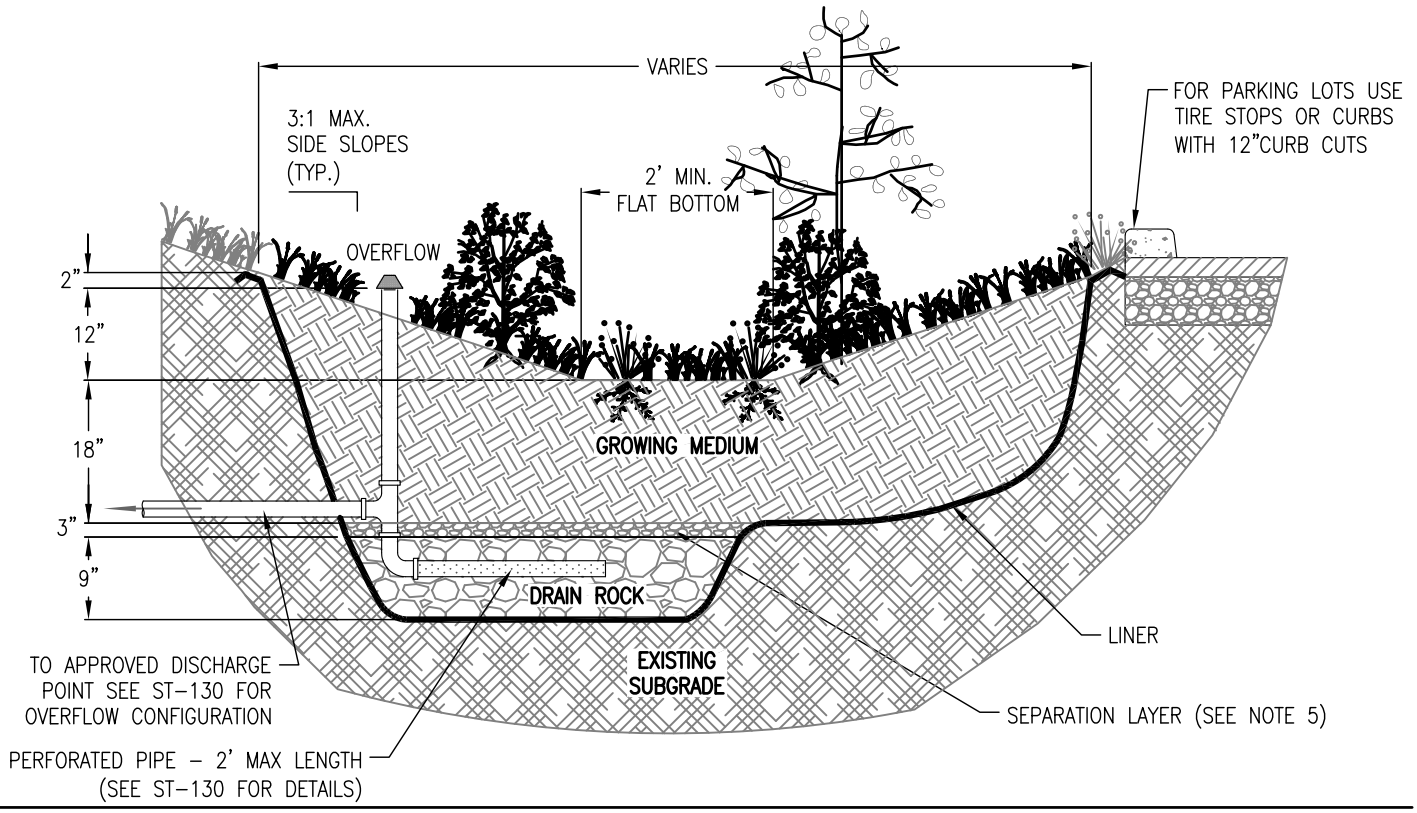
7. Vegetation: Follow landscape plans otherwise refer to plant list in Appendix G. Minimum container size is #1. # of plantings per 100sf of facility area:
   Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
   Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
   The delineation between Zone A and B must be either at the outlet elevation or the check dam elevation, whichever is lowest.
   If facility area is over 200sf consider adding a tree.

8. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

9. Rain garden can be elongated to create a swale for larger developments. Slope should be 6% or less.

– DRAWING NOT TO SCALE –
ORIGINAL DRAWING AND SPECIFICATIONS FROM PORTLAND BUREAU OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM	INFILTRATION RAIN GARDEN/SWALE	DRAWN DRO
		DATE OCT 2019
		APPR.
		DWG. NO. ST-140



1. Dimensions:
   Width and length vary. Dimensions to be specified on plans based on sizing form.
   Depth (from top of growing medium to overflow elevation): 12".
   Flat bottom width: 2' recommended.
   Side slopes of swale: 3:1 maximum.

2. Setbacks: None required for lined facilities. Partial infiltration facilities should be 10' from foundations and 5' from property lines..

3. Overflow:
   Facility must connect to approved discharge point per detail ST-130.
   Overflow elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.
   Overflow must have a 6"-12" upturn prior to discharge.

4. Piping must be cast iron, ABS or PVC. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" minimum pipe. Oregon Plumbing Specialty Code also applies.

5. Drain Layer:
   Not allowed for type A and B soils (unless lined facility). Optional for type C soils, and required for type D soils.
   ¾"-1 ½" washed round rock. Depth: 9".
   Separation between drain rock and growing medium:
   ¼" – #10 rock, 2 to 3 inches deep.

6. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.

7. Vegetation: Follow landscape plans otherwise refer to plant list in Appendix G. Minimum container size is #1. # of plantings per 100sf of facility area:
   Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
   Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
   The delineation between Zone A and B must be either at the outlet elevation or the check dam elevation, whichever is lowest.
   If facility area is over 200sf consider adding a tree.

8. Waterproof Liner: 30 mil EPDM, HDPE or approved equivalent required for lined/filtration facilities per SWMM section 1.2.2.

9. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

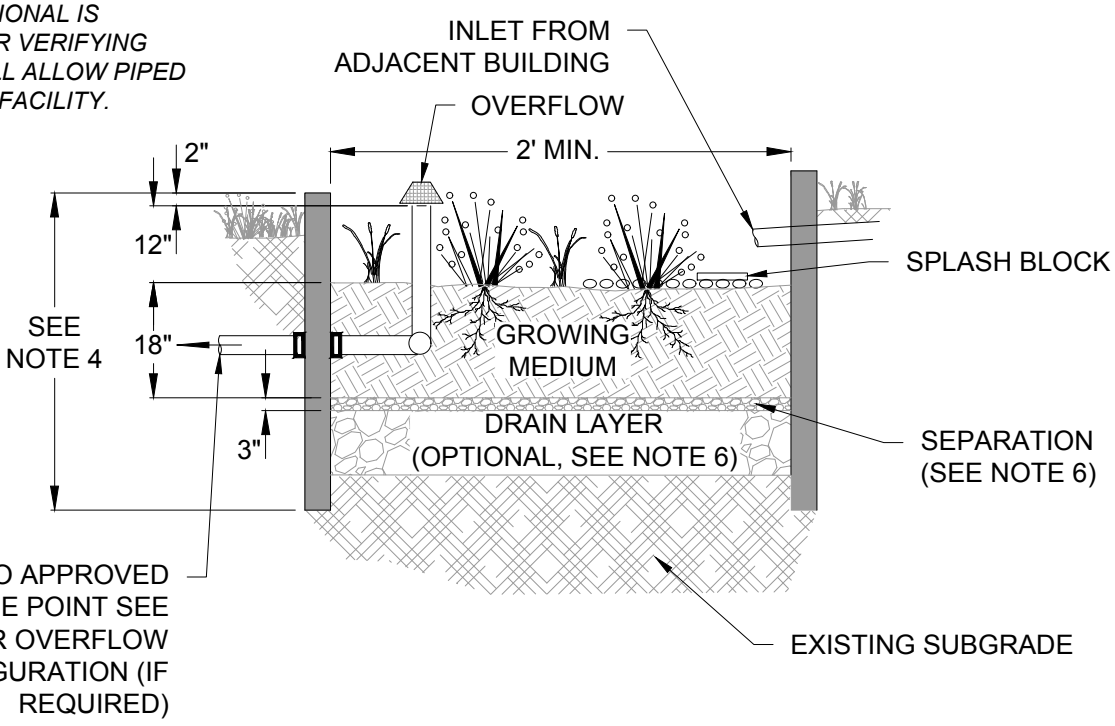
10. Rain garden can be elongated to create a swale for larger developments. Slope should be 6% or less.

– DRAWING NOT TO SCALE –
ORIGINAL DRAWING AND SPECIFICATIONS FROM PORTLAND BUREAU OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM	PARTIAL INFILTRATION - LINED/FILTRATION RAIN GARDEN/SWALE	DRAWN DRO
		DATE OCT 2019
		APPR.
		DWG. NO. ST-141

FREESTANDING

DESIGN PROFESSIONAL IS RESPONSIBLE FOR VERIFYING THAT GRADES WILL ALLOW PIPED CONVEYANCE TO FACILITY.



1. PROVIDE PROTECTION FROM ALL VEHICLE TRAFFIC AND EQUIPMENT STAGING IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING, AND AFTER CONSTRUCTION.

2. DIMENSIONS:
   WIDTH OF PLANTER: 24" MINIMUM.
   DEPTH OF PLANTER (FROM TOP OF GROWING MEDIUM TO OVERFLOW ELEVATION): 12".
   LONGITUDINAL SLOPE OF PLANTER: 0.5% OR LESS.

3. SETBACKS:
   INFILTRATION PLANTERS SHOULD BE LOCATED 5-FEET FROM PROPERTY LINE AND 10-FEET FROM BUILDING FOUNDATIONS.

4. PLANTER WALLS:
   MATERIAL MUST BE CONCRETE, UNLESS OTHERWISE APPROVED. WALLS MUST BE INCLUDED ON FOUNDATION PLANS.
   HEIGHT: 44" MINIMUM WITH DRAIN ROCK, 32" MINIMUM WITHOUT DRAIN ROCK.

5. PIPING MUST BE CAST IRON, ABS OR PVC. 3" PIPE REQUIRED FOR FACILITIES DRAINING UP TO 1500 S.F., OTHERWISE 4" MINIMUM PIPE. OREGON PLUMBING SPECIALTY CODE ALSO APPLIES.

6. DRAIN LAYER:
   NOT ALLOWED FOR TYPE A AND B SOILS, OPTIONAL FOR TYPE C SOILS, AND REQUIRED FOR TYPE D SOILS.
   3/4" - 1 ½" WASHED.
   DEPTH: 9".
   SEPARATION BETWEEN DRAIN ROCK AND GROWING MEDIUM: ¼" - #10 ROCK, 2 TO 3 INCHES DEEP.

7. OVERFLOW:
   PLANTERS MUST CONNECT TO APPROVED DISCHARGE POINT PER DETAIL ST-130.
   OVERFLOW ELEVATION MUST ALLOW FOR 2"OF FREEBOARD, MINIMUM.
   PROTECT FROM DEBRIS AND SEDIMENT WITH STRAINER OR GRATE.

8. GROWING MEDIUM:
   18" MINIMUM DEPTH. USE SAND/LOAM/COMPOST 3-WAY MIX, OR APPROVED MIX THAT WILL SUPPORT HEALTHY PLANTS.

9. VEGETATION: REFER TO PLANT LIST IN APPENDIX G. MINIMUM CONTAINER SIZE IS #1. # OF PLANTINGS PER 100SF OF FACILITY AREA:
   80 HERBACEOUS PLANTS OR;
   72 HERBACEOUS PLANTS AND 4 SMALL SHRUBS.

10. SPLASH BLOCK: INSTALL 4-6" WASHED RIVER ROCK OR SPLASH PAD FOR EROSION CONTROL AT INLETS AND DOWNSPOUT.

11. PERFORATED PIPE TO BE ADDED FOR FACILITIES IN POORLY INFILTRATING SOILS (TYPE D) PER ST-130.

12. LINED/FILTRATION PLANTER TO BE USED ON STEEP SLOPES OR WITHIN 10' OF BUILDINGS OR 5' OF PROPERTY LINES.

13. THIS DRAWING IS INTENDED FOR PRIVATE FACILITIES TREATING ROOF RUNOFF. FOR PLANTERS TREATING PRIVATE ROADWAYS, SEE THE GREEN STREETS DETAILS IN GRESHAM PUBLIC WORKS STANDARDS. FOR PRIVATE FACILITIES THE BEEHIVE OVERFLOW (GS-108) MAY BE REPLACED BY OTHER STRUCTURES THAT MEET OREGON PLUMBING SPECIALTY CODE.

– DRAWING NOT TO SCALE –
ORIGINAL DRAWING AND SPECIFICATIONS FROM PORTLAND BUREAU OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM

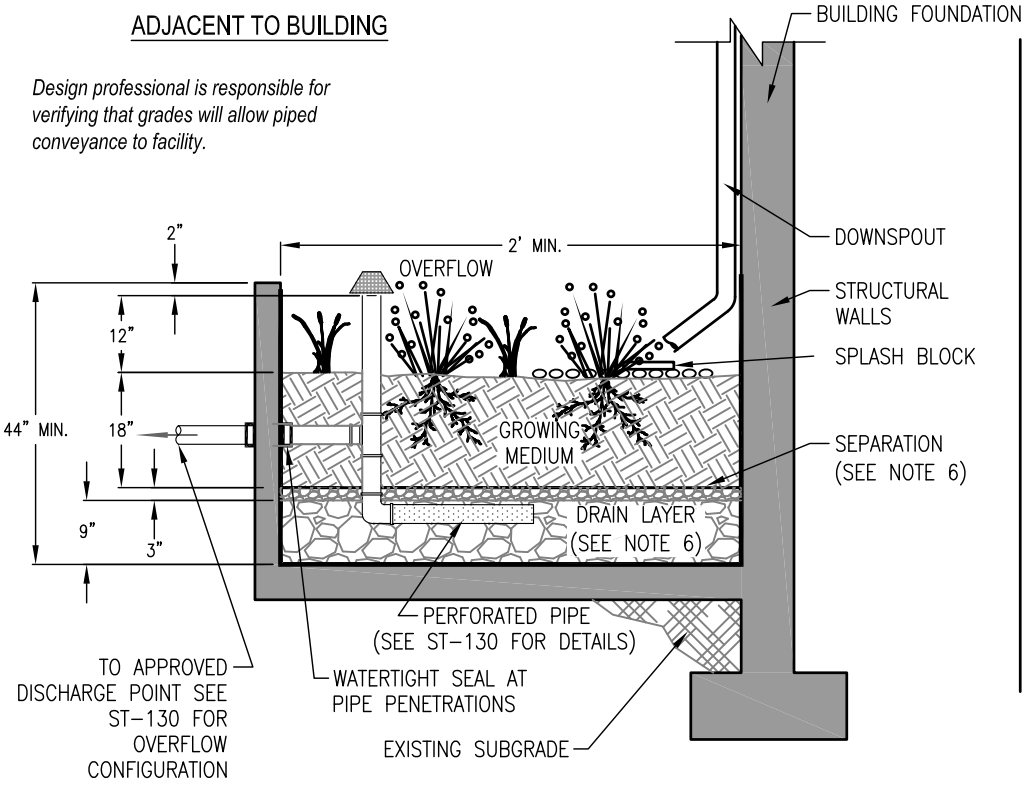
INFILTRATION PLANTER

PUBLISHED: JAN 2023

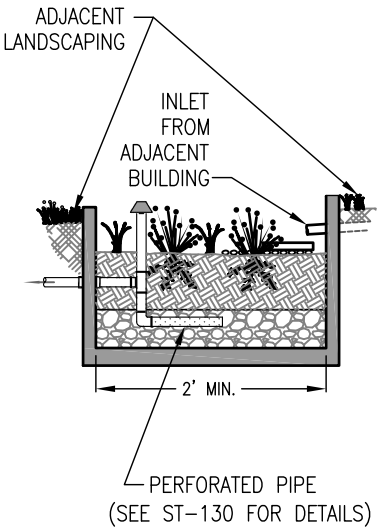
DRAWN	DRO
REV. DATE	JULY 2024
APPR.	
DETAIL NO.	ST-150

ADJACENT TO BUILDING

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



FREESTANDING PLANTER



1. Dimensions:
   Width of planter: 24" minimum.
   Depth of planter (from top of growing medium to overflow elevation): 12".
   Longitudinal slope of planter: 0.5% or less.

2. Setbacks:
   Planters must be less than 30" in height above finish grade if within 5-feet of property line.

3. Planter Walls:
   Material must be monolithically poured concrete. Walls must be included on foundation plans.

4. Waterproofing:
   Monolithically poured planter, without joints is required. Check state structural requirements for foundations.

5. Piping must be cast iron, ABS or PVC. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" minimum pipe. Oregon Plumbing Specialty Code also applies.

6. Drain Layer:
   3/4" – 1 ½" washed round rock.
   Depth: 9".
   Separation between drain rock and growing medium:
   ¼" – #10 rock, 2 to 3 inches deep.

7. Overflow:
   Planters must connect to approved discharge point per detail ST-130.
   Overflow elevation must allow for 2" of freeboard, minimum.
   Protect from debris and sediment with strainer or grate.

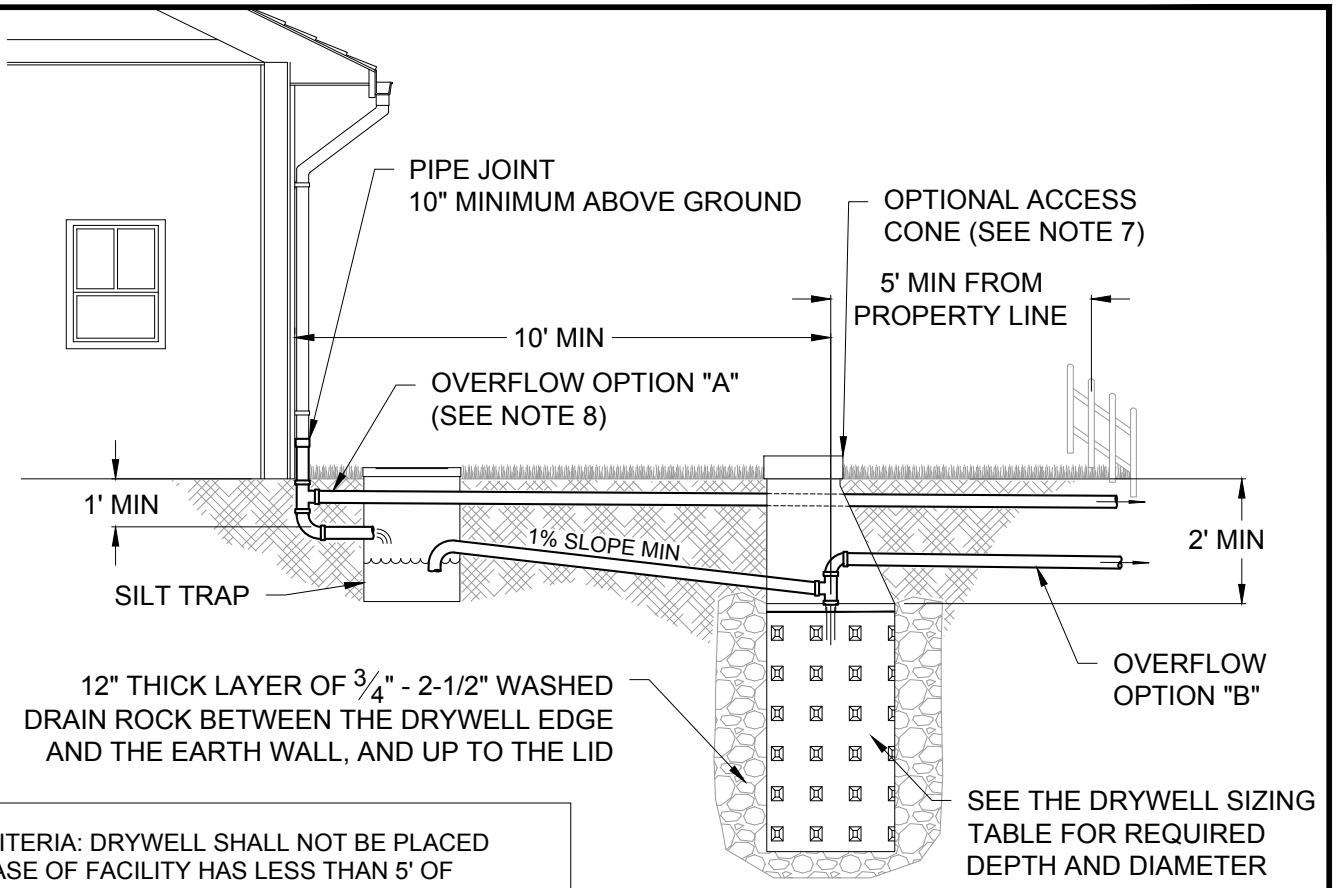
8. Growing Medium:
   18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.

9. Vegetation: Refer to plant list in Appendix G. Minimum container size is #1.
   # of plantings per 100sf of facility area:
   80 herbaceous plants OR;
   72 herbaceous plants and 4 small shrubs.

10. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.

– DRAWING NOT TO SCALE –
ORIGINAL DRAWING AND SPECIFICATIONS FROM PORTLAND BUREAU OF ENVIRONMENTAL SERVICES

CITY OF GRESHAM	FILTRATION PLANTER	DRAWN DRO DATE OCT 2019 APPR. DWG. NO. ST-151



1. SITING CRITERIA: DRYWELL SHALL NOT BE PLACED WHERE BASE OF FACILITY HAS LESS THAN 5' OF SEPARATION TO THE SEASONAL HIGH WATER TABLE.

2. SIZING: USE DRYWELL SIZING TABLE TO SIZE THE DRYWELL(S) BASED ON IMPERVIOUS AREA.

3. THE TOP OF THE PERFORATED DRYWELL SECTIONS MUST BE BELOW THE FOUNDATION OR BASEMENT LEVEL OF THE PROPERTY AND THOSE OF NEIGHBORING PROPERTIES.

4. SETBACKS: MEASURED FROM THE CENTER OF DRYWELL, MUST BE 10' FROM FOUNDATIONS AND 5' FROM PROPERTY LINES, EXCEPT NEXT TO THE RIGHT-OF-WAY WHERE NO SETBACK IS REQUIRED BETWEEN THE EDGE OF THE DRYWELL DRAIN ROCK AND THE PROPERTY LINE.

5. PIPING MUST BE CAST IRON, ABS OR PVC. 3" PIPE REQUIRED FOR FACILITIES DRAINING UP TO 1500 SF, OTHERWISE 4" MINIMUM PIPE. OREGON PLUMBING SPECIALTY CODE ALSO APPLIES.

6. SILT TRAP: SHALL BE INCLUDED AS PRE-TREATMENT FOR RESIDENTIAL ROOFS. SILT TRAP MUST HAVE SOLID COVER AND MEET OREGON SPECIALTY PLUMBING CODE. NON-RESIDENTIAL SETTINGS REQUIRE A LYNCH-STYLE CATCH BASIN OR SEDIMENTATION MANHOLE AS PRE-TREATMENT.

7. ADD MAINTENANCE ACCESS MANHOLE AND CONE FOR DRYWELL INSTALLED IN NON-RESIDENTIAL SETTINGS. ACCESS IS OPTIONAL IN RESIDENTIAL SETTINGS BUT HIGHLY RECOMMENDED.

8. OVERFLOW: NOT REQUIRED FOR SITES WITH INFILTRATION RATES ≥2"/HOUR. FOR AREAS WITH INFILTRATION RATES <2"/HOUR, INSTALL OVERFLOW PIPE TO APPROVED DISCHARGE POINT. FOR FLATTER SITES, OPTION "A" MAY BE USED, WHERE OVERFLOW IS SET 2"-6" HIGHER THAN INLET TO SILT TRAP. FOR SLOPED SITES, USE OVERFLOW OPTION "B" FROM TOP OF DRYWELL. OPTION "B" OVERFLOW PIPE SHOULD BE 4"-6" HIGHER THAN PIPE TO DRYWELL.

9. DRYWELLS RECEIVING FLOW FROM ANYTHING OTHER THAN SINGLE-DETACHED DWELLING UNIT ROOFS MUST BE REGISTERED WITH DEQ AS AN UNDERGROUND INJECTION CONTROL (UIC).

DRYWELL DEPTH	MAXIMUM CATCHMENT AREA MANAGED BY A SINGLE DRYWELL (SF)	
	28" DIAMETER	48" DIAMETER
5 FT	1000	2500
10 FT	2500	4500
15 FT	3500	5000

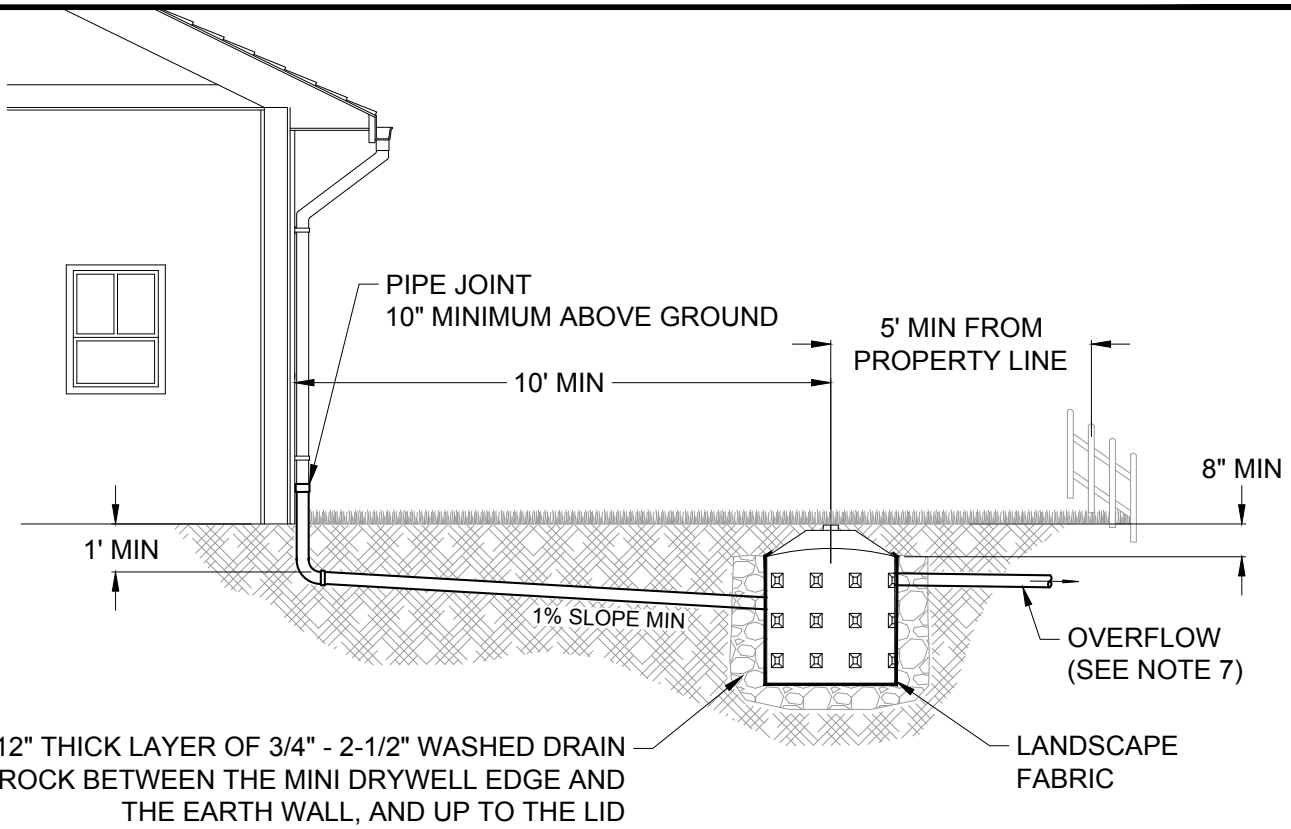
– DRAWING NOT TO SCALE –

CITY OF GRESHAM

DRYWELL

PUBLISHED: APRIL 2025

DRAWN	AAD
REV. DATE	APRIL 2025
APPR.	
DETAIL NO.	ST-170



1. SITING CRITERIA: MINI DRYWELL SHALL NOT BE PLACED WHERE BASE OF FACILITY HAS LESS THAN 5' OF SEPARATION TO THE SEASONAL HIGH WATER TABLE.

2. SIZING: ONLY 500 SF OF SINGLE FAMILY RESIDENTIAL ROOF AREA MAY BE CONNECTED TO EACH MINI DRYWELL.

3. THE TOP OF THE PERFORATED DRYWELL SECTIONS MUST BE BELOW THE FOUNDATION OR BASEMENT LEVEL OF THE PROPERTY AND THOSE OF NEIGHBORING PROPERTIES.

4. WRAP MINI DRYWELL WITH LANDSCAPE FABRIC PRIOR TO BACKFILLING WITH DRAIN ROCK.

5. SETBACKS: MEASURED FROM THE CENTER OF DRYWELL, MUST BE 10' FROM FOUNDATIONS, 20' FROM SESSPOOLS AND 5' FROM PROPERTY LINES, EXCEPT NEXT TO THE RIGHT-OF-WAY WHERE NO SETBACK IS REQUIRED BETWEEN THE EDGE OF THE DRYWELL DRAIN ROCK AND THE PROPERTY LINE.

6. PIPING MUST BE 3"CAST IRON, ABS OR PVC. OREGON PLUMBING SPECIALTY CODE ALSO APPLIES.

7. OVERFLOW: NOT REQUIRED FOR SITES WITH INFILTRATION RATES ≥2"/HOUR. FOR AREAS WITH INFILTRATION RATES <2"/HOUR, INSTALL OVERFLOW PIPE TO APPROVED DISCHARGE POINT. OVERFLOW PIPE SHOULD BE 4"-6" HIGHER THAN PIPE TO MINI DRYWELL.

8. MINI DRYWELLS FOR SINGLE-DETACH DWELLING UNIT ROOFS DO NOT NEED TO BE REGISTERED WITH DEQ AS AN UNDERGROUND INJECTION CONTROL (UIC).

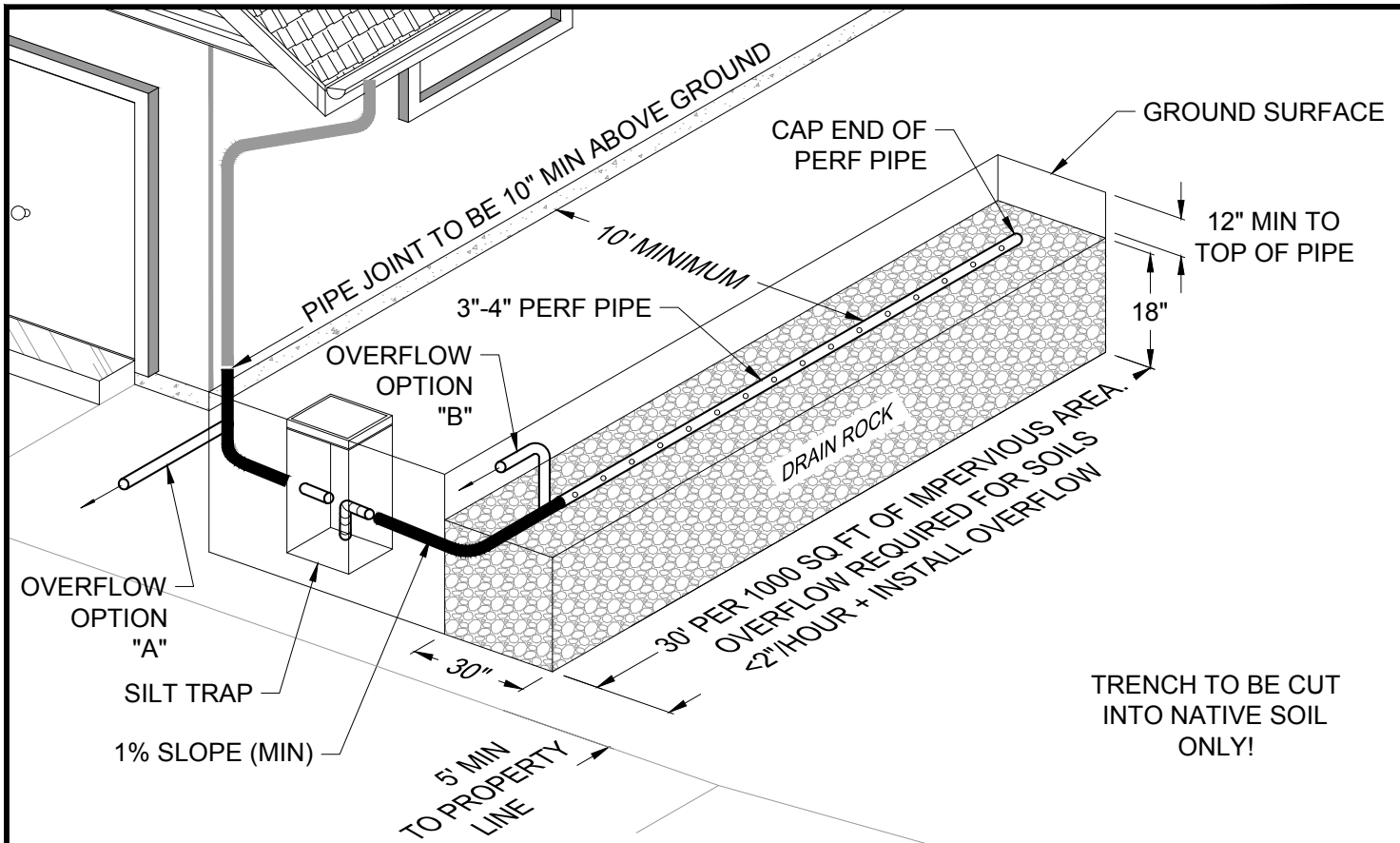
– DRAWING NOT TO SCALE –

CITY OF GRESHAM

MINI DRYWELL

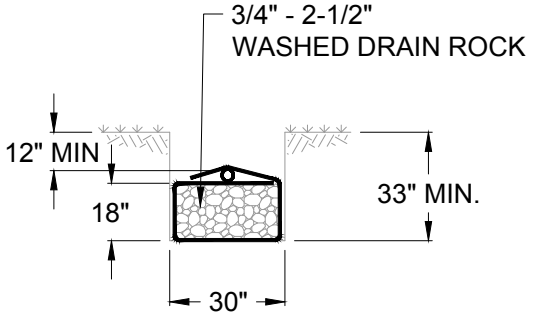
PUBLISHED: APRIL 2025

DRAWN	AAD
REV. DATE	APRIL 2025
APPR.	
DETAIL NO.	ST-171



1. PROVIDE PROTECTION FROM ALL VEHICLE TRAFFIC AND EQUIPMENT STAGING IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING AND AFTER CONSTRUCTION.
2. SITING CRITERIA: SOAKAGE TRENCH SHALL NOT BE PLACED WHERE BASE OF FACILITY HAS LESS THAN 5' OF SEPARATION TO THE SEASONAL HIGH WATER TABLE.
3. SIZING: 30" WIDE X 18" TALL X 30' LONG PER 1000 SQUARE FEET OF IMPERVIOUS SURFACE.
4. SETBACKS: SOAKAGE TRENCH MUST BE 10' FROM FOUNDATIONS, 5' FROM PROPERTY LINES, AND 20' FROM CESSPOOLS.
5. PIPING MUST BE CAST IRON, ABS OR PVC. 3" PIPE REQUIRED FOR FACILITIES DRAINING UP TO 1500 SF, OTHERWISE 4" MINIMUM PIPE. OREGON PLUMBING SPECIALTY CODE ALSO APPLIES.
6. SILT TRAP: SHALL BE INCLUDED AS PRE-TREATMENT FOR RESIDENTIAL ROOFS. SILT TRAP MUST HAVE SOLID COVER AND MEET OREGON SPECIALTY PLUMBING CODE. NON-RESIDENTIAL SETTINGS REQUIRE A LYNCH-STYLE CATCH BASIN OR SEDIMENTATION MANHOLE AS PRE-TREATMENT.
7. OVERFLOW: NOT REQUIRED FOR SITES WITH INFILTRATION RATES >2"/HOUR. FOR AREAS WITH INFILTRATION RATES <2"/HOUR, INSTALL OVERFLOW PIPE TO APPROVED DISCHARGE POINT. FOR FLATTER SITES, OPTION "A" MAY BE USED, WHERE OVERFLOW IS SET 2"-6" HIGHER THAN INLET THE SILT TRAP. FOR SLOPED SITES, USE OPTION "B" WITH TEE THAT IS 4"-6" HIGHER THAN PIPE IN TRENCH.
8. SOAKAGE TRENCHES RECEIVING FLOW FROM ANYTHING OTHER THAN SINGLE-DETACHED DWELLING UNIT ROOF RUNOFF MUST BE REGISTERED WITH DEQ AS A (UIC).

SOAKAGE TRENCH CONSTRUCTION



FILTER FABRIC TO BE PLACED ON SIDES AND ENDS OF TRENCH. ADD DRAIN ROCK AND FOLD ONE SIDE OF FABRIC OVER ROCK. PLACE PERFORATED PIPE IN CENTER AND THEN INSTALL GREEN TRACER WIRE ON PIPE. COVER ALL WITH REMAINING SIDE OF FABRIC PRIOR TO BACKFILL.

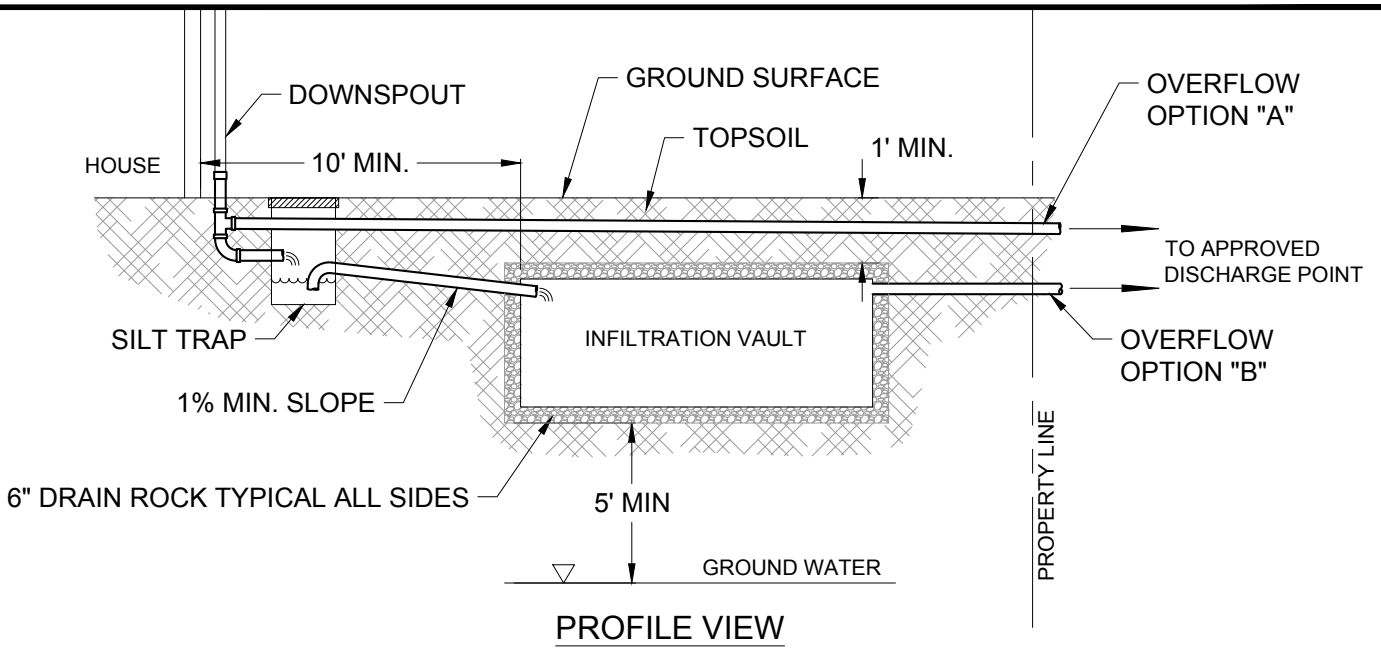
– DRAWING NOT TO SCALE –

CITY OF GRESHAM

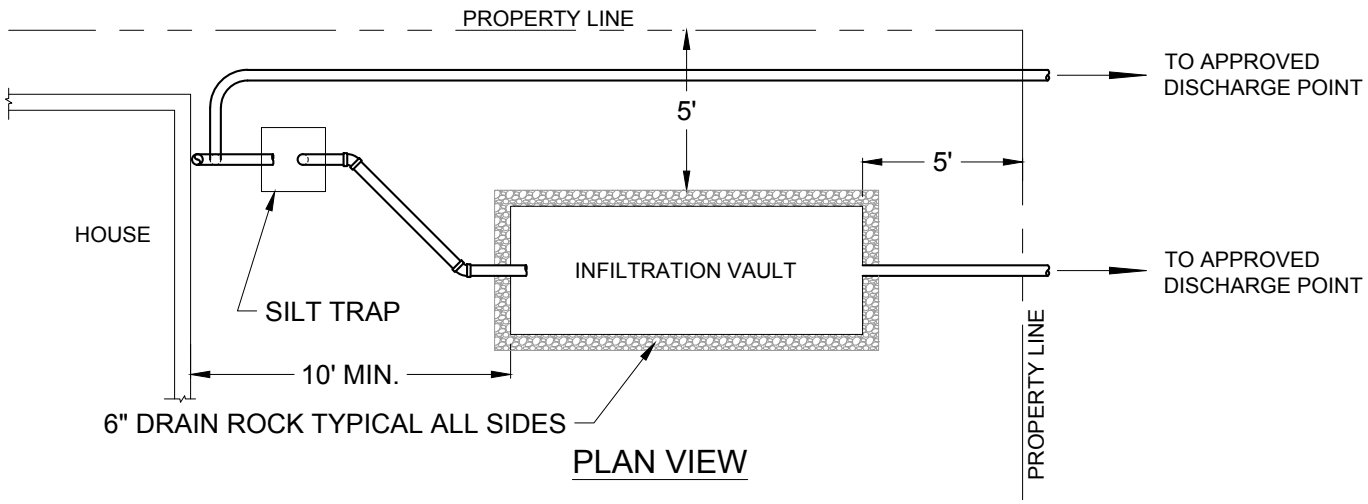
SOAKAGE TRENCH

PUBLISHED: APRIL 2025

DRAWN	AAD
REV. DATE	APRIL 2025
APPR.	
DETAIL NO.	ST-180



PROFILE VIEW



PLAN VIEW

1. SILT TRAP: SHALL BE INCLUDED AS PRE-TREATMENT FOR RESIDENTIAL ROOFS. SILT TRAP MUST HAVE SOLID COVER AND MEET OREGON SPECIALTY PLUMBING CODE. NON-RESIDENTIAL SETTINGS REQUIRE A LYNCH-STYLE CATCH BASIN OR SEDIMENTATION MANHOLE AS PRE-TREATMENT.

2. INFILTRATION VAULTS RECEIVING FLOW FROM ANYTHING OTHER THAN SINGLE-DETACHED DWELLING UNIT ROOFS MUST BE REGISTERED WITH DEQ AS AN UNDERGROUND INJECTION CONTROL DEVICE.

3. OVERFLOW: NOT REQUIRED FOR SITES WITH SOIL INFILTRATION RATES ≥2"/HOUR. FOR AREAS WITH INFILTRATION RATES <2"/HOUR, INSTALL OVERFLOW PIPE TO APPROVED DISCHARGE POINT. FOR FLATTER SITES, USE OVERFLOW OPTION "A", WHERE OVERFLOW IS SET 2"-6" HIGHER THAN INLET TO SILT TRAP. FOR SLOPED SITES, USE OPTION "B".

4. SETBACKS: 5' FROM PROPERTY LINES AND 10' FROM FOUNDATIONS.

5. IF USING PROPRIETARY VAULT, FOLLOW SIZING AND INSTALLATION GUIDELINES FROM VAULT MANUFACTURER.

– DRAWING NOT TO SCALE –

CITY OF GRESHAM

INFILTRATION VAULT

PUBLISHED: APRIL 2025

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REV. DATE	APRIL 2025
APPR.	
DETAIL NO.	ST-190

Erosion Prevention and Sediment Control Manual

Land disturbance increases the potential for soil erosion, which can enter the City's stormwater system and harm local water bodies. The City of Gresham requires erosion prevention and sediment control on all land-disturbing activities.

This manual outlines the requirements for Erosion Prevention and Sediment Control (EPSC) and other activities to prevent stormwater pollution due to construction activities.

The authority for this Manual is derived from the Gresham Community Development Code (GCDC) and the Gresham Revised Code (GRC).

C.1 Applicability

- The City of Gresham requires erosion prevention and sediment control on all land-disturbing activities, regardless of whether that property is involved in a construction or development activity.
- 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. 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.

C.2 Prohibitions

The discharge of sediment laden water from a construction site is a violation of the Gresham Revised Code Article 3.23.025, and is subject to the enforcement actions listed in section C.8.

C.3 Requirements

No work shall be conducted prior to EPSC Plan approval.

The owner, agent, contractor, or employee shall:

- Develop and submit an EPSC Plan at the same time as the building permit application
- Properly install, operate and maintain best management practices (BMPs) to protect the environment during the useful life of the project.

Approval of an EPSC Plan does not relieve the applicant's responsibility to ensure that erosion prevention and sediment control measures are constructed and maintained to contain sediment on the construction site.

Land disturbing activities not required to obtain an EPSC permit are required to utilize EPSC measures if sediment is leaving or has the potential to leave site.

C.4 Minimum Site Requirements

The owner or agent shall indicate how the following requirements are addressed in the development of the EPSC Plan submitted to the City for review.

Requirement #1: Preserve Vegetation/Mark Clearing Limits

- Phase work to avoid disturbing more land than needed
- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. Trees within environmental protection areas (HCA/ESRA) are to be protected. Temporary fencing shall be placed around the dripline of all trees and vegetation to be protected.
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree possible.

Requirement #2: Construction Entrance Protection

- Limit construction vehicle access and exit to one route, if possible.
- Stabilized surfaces shall be of sufficient length/width to provide vehicle access/parking, based on lot size/configuration.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary. Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.
- Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into stormwater system or watercourse.

Requirement #3: Perimeter Control

- Maximize erosion protection and minimize sediment transport from disturbed ground surfaces.
- The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics.

Requirement #4: Storm Drain Inlet Protection

- Protect all storm drain inlets so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage.
- Keep all approach roads clean. Do not allow sediment or street wash water to enter storm drains.
- Inlets should be inspected weekly at a minimum and daily during storm events.

Requirement #5: Soil and Slope Protection

- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion.
    - During the wet season (October 1 - April 30): within 2 days
    - During the dry season (May 1 - Sept. 30): within 7 days
- Control stormwater volume and velocity within the site to minimize soil erosion.

- Stabilize soils at the end of the shift before a holiday or weekend if needed based on weather forecast.
- Establish temporary vegetation during construction and permanent vegetation when completed.

Requirement #6: Control Runoff (may not apply for detached dwelling units and middle housing)
- Divert stormwater or ground water away from slopes and disturbed areas with diversion/interceptor dikes, pipes, and/or swales.
- Place check dams at regular intervals within constructed channels that are cut down a slope.
- Dissipate energy of any diverted water.

Requirement #7: Sediment Containment and Removal (may not apply for detached dwelling units and middle housing)
- Direct stormwater runoff from disturbed areas through vegetation, a sediment pond or other appropriate sediment removal BMP, before the runoff leaves site.
- Withdraw ponded stormwater from the surface to avoid discharging sediment, or use filtration during dewatering to avoid discharging sediment.

Requirement #8: Soil Stockpile Management (may not apply for detached dwelling units and middle housing)
- Locate temporary stockpiles at least 50 feet away from inlets, drainage courses, or water bodies.
- Stockpiles shall be seeded, mulched, or covered with plastic sheeting within the following time periods:
    - During the wet season (October 1 - April 30): within 2 days
    - During the dry season (May 1 - Sept. 30): within 7 days
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.

Requirement #9: Construction Site Pollution Prevention
- Do not dump excess concrete into storm drains, open ditches, streets, or streams; if it is rinsed out on-site, keep it in a designated concrete washout area.
- Store all chemicals, fuels, and materials in a designated area at least 50 feet from stormwater inlets, and provide secondary containment for hazardous materials
- Ensure portable toilets are placed off pavement if possible, and are secured to keep upright in areas of high wind.

C.5 Best Management Practices to Meet Minimum Requirements

Table C-1 contains a list of approved Best Management Practice (BMP) measures. One or more of the listed BMPs, or their equivalent if approved by EPSC Program Manager, shall be used to meet the minimum requirements outlined in the previous section. Each BMP shall be implemented consistent with the information in the BMP Fact Sheets (**Section C.10**) and the Standard Detail (**Section C.11**) portions of this manual.

Table C-1. Minimum BMPs for All Construction Projects

BMP Code	BMP Name	BMP Fact Sheet Page	Standard Detail
Requirement 1: Preserve Vegetation/Mark Clearing Limits			
EPSC-1	Scheduling	C-9	-
EPSC-2	Preservation of Existing Vegetation/Buffer Strips	C-10	EPSC-2
Requirement 2: Construction Entrance Protection			
EPSC-3	Construction Entrance/Exit Tracking Controls	C-11	EPSC-3
Requirement 3: Perimeter Control			
EPSC-4	Sediment Fence	C-12	EPSC-4
EPSC-5	Fiber Rolls/Wattles	C-13	EPSC-5
EPSC-6	Compost Berm/Sock	C-14	EPSC-6
EPSC-7	Undercut Lots/Sidewalk Subgrades	C-15	EPSC-7
Requirement 4: Storm Drain Inlet Protection			
EPSC-8	Storm Drain Inlet Protection	C-16	EPSC-8A EPSC-8B
Requirement 5: Soil and Slope Protection			
EPSC-9	Surface Roughening	C-17	EPSC-9
EPSC-10	Hydroseeding, Mulching and Tackifiers	C-18	EPSC-10
EPSC-11	Erosion Blankets and Mats	C-19	EPSC-11
EPSC-12	Seeding and Planting (Temporary and Permanent)	C-20	-
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Requirement 6: Control Runoff (may not apply for detached dwelling sites)			
EPSC-14	Slope Drain	C-22	EPSC-14
EPSC-15	Energy Dissipation/Outlet Protection	C-23	EPSC-15
EPSC-16	Diversion Dikes/Swales	C-24	EPSC-16
EPSC-17	Check Dams	C-25	EPSC-17A EPSC-17B EPSC-17C
Requirement 7: Sediment Containment and Removal (may not apply for detached dwelling sites)			
EPSC-18	Temporary Sediment Basin	C-26	EPSC-18
EPSC-19	Dewatering and Ponded Water Management	C-27	-
Requirement 8: Soil Stockpile Management (may not apply for detached dwelling sites)			
EPSC-20	Soil Stockpile Management	C-28	EPSC-20
Requirement 9: Construction Site Pollution Prevention			
EPSC-21	Concrete Management	C-29	EPSC-21
EPSC-22	Materials Management	C-30	-
EPSC-23	Sanitary Waste Management	C-31	-

C.6 Maintenance and Removal of BMPs

- The permittee shall maintain the Erosion Control BMP measures and apply the techniques contained in the approved EPSC Plan during: the construction phase, post construction phase, establishment of permanent vegetation, or any other permitted activity.
- When sediment is captured by BMPs so that it fills 1/3 height, 50% of the capacity, or is deposited in locations where it can enter the storm and surface water system, the sediment shall be immediately removed.
- No sediment shall be washed or flushed into any part of the storm and surface water system until all mechanical means to remove the sediment have been exhausted and preventative sediment measures, e.g., inlet protection, is in place.
- If the BMP measures and techniques approved in an EPSC Plan are not effective or sufficient as determined by the permittee or City, the permittee shall submit a revised plan within three working days of notification by the City. Upon approval of the revised plan by the City the permittee shall immediately implement the additional measures and techniques included in the revised plan. In cases where erosion is likely to occur, the City may require the applicant to install interim control measures prior to submittal of the revised EPSC Plan.
- Temporary BMPs, such as sediment fences, shall be removed after permanent vegetation is established but not before all construction activities on the site are completed.

C.7 Inspection

C.7.1 Pre-Construction Conference

Prior to the initial EPSC inspection, the City, Permittee, Owner, or Contractor may request, a pre-construction meeting to review and discuss the EPSC plan for the site.

A pre-construction conference shall be required when the risk of erosion is high due to one or more of the following factors:

- Wet weather construction.
- Steep slopes with severe erosion potential.
- Construction adjacent to a sensitive area or vegetated corridor.
- Mass grading on a large site.

C.7.2 City Initial EPSC Inspection

On all projects, erosion prevention and sediment control base measures shall be installed by the permittee and then inspected and approved by the City inspector prior to the start of any permitted activity (e.g. clearing and grading). For detached dwelling construction sites, erosion prevention and sediment control measures for each property shall be installed by the permittee and then inspected and approved by the City inspector prior to the building foundation installation. Foundation approvals shall not be given until erosion prevention and sediment control measures are approved.

C.7.3 Permittee Inspections

The permittee shall inspect the EPSC measures and provide maintenance as required to maintain the functionality of the BMP measures. Minimum inspection frequency requirements are:

- Daily when stormwater runoff, including runoff from snow melt, is occurring

- Once per week on active sites when runoff not occurring
- Once every two weeks on inactive sites

C.7.4 Interim Inspections

Routine erosion control inspections conducted by the City will be performed at the discretion of the City throughout the building permit process.

C.7.5 Final Inspection

A final erosion control inspection shall be required on all sites prior to issuance of a Certificate of Occupancy. Final Inspection requirements are:

- Removal of EPSC measures, unless needed to prevent movement of sediment or pollutants off-site
- All bare soil protected with permanent vegetation or 2" layer of landscaping bark mulch

DEQ may have additional requirements in order to terminate a NPDES 1200-C Permit.

C.8 Compliance and Enforcement Action

Violations of the erosion prevention and sediment control requirements will be enforced per Gresham Revised Code and/or ODEQ regulations. Enforcement actions for sites not making corrective actions within the period provided by the City inspector include, but are not limited to:

- Charging re-inspection fee,
- Issuance of a Stop Work Order,
- Civil Penalties based per violation per day, and/or
- Abatement to correct EPSC measures.

The City may take enforcement action for any of the following criteria:

- Failure to repair or install BMPs according to the City Inspectors directive (written or verbal) within the specified timeframe.
- If one pound or more of sediment (wet weight) yield per acre is discharged from a construction site in a single day, the City may require additional BMPs or levels of BMP implementation at the site.
- Visible turbid runoff into stream due to construction activity.
- Failure to respond, contain, or cleanup any other spills or discharges that are capable of polluting stormwater. Exceedance of the average daily amount of soil loss predicted by the Revised Universal Soil Loss Equation (RUSLE).

C.9 EPSC Plan Development

The City reviews and approves several different types of development activities, such as Detached Dwelling and Middle Housing, Commercial, Industrial, Land Partitions, and Subdivisions. Depending on the type of development and the area of disturbance, the City will review, approve and issue an Erosion Control Permit. Below are the requirements for EPSC Plans submitted to the City.

C.9.1 Single-Family/Duplex EPSC Plan

Detached home sites which disturb less than 1 acre shall prepare an EPSC plan for all sites where an Erosion Control Permit is required.

For detached dwelling permit applications, the applicant will apply for the erosion control permit along with the building permit application.

The following checklist constitutes the Detached Dwelling EPSC site plan:

- ☐ Site plan that includes:
  - ☐ Contours and/or drainage patterns found on the site—identify any slope greater than 5%.
  - ☐ Location of erosion prevention and sediment control measures to be used on site*. Including but not limited to:
    - ☐ Gravel construction entrance
    - ☐ Perimeter control downslope side of the site along contours
    - ☐ Storm drain/catch basin inlet protection
    - ☐ Soil/stockpile management
    - ☐ Concrete, materials and sanitary waste management
- ☐ Completed EPSC Checklist, including name and phone number of the person(s) responsible for erosion prevention and sediment control on site.

**Between October 1 and May 31 notes describing additional wet weather BMPs to be utilized for soil and slope protection.*

C.9.2 Non-Residential EPSC Plan Process

Non-residential sites of less than 1 acre of disturbance shall follow the same Erosion and Sediment Control Plan templates as used for NPDES 1200-C permits.

The following is an outline of the process for submitting an EPSC plan to the City for review and approval.

The EPSC Plan submittal must include:

- ☐ Cover sheet with a site location map.
- ☐ Proposed public and private stormwater system plan or composite utility plan.
- ☐ Final site stabilization or planting plan.
- ☐ Completed EPSC Site Plan (see below)

The EPSC Site Plan must include the following items:

- ☐ Name and number of the designated person responsible for erosion control
- ☐ Contour lines with elevations included on the plan extending 200 feet beyond the property line
- ☐ Adjacent natural resources, such as, streams, creeks, wetlands, ponds, drainage channels, lakes, and other sensitive areas
- ☐ Identification of slopes, drainage patterns, and concentrated flows
- ☐ Location of cuts and fills
- ☐ Locations, specifications, details and/or standard notes for all required BMPs:

  Requirement 1: Preserve Vegetation/Mark Clearing Limits
  - ☐ Scheduling/Phasing of work
  - ☐ Preservation of Existing Vegetation/Mark Clearing Limits

  Requirement 2: Construction Entrance/Exit Tracking Controls
  - ☐ Construction Entrance/Exit Tracking Controls

  Requirement 3: Perimeter Control
  - ☐ Sediment Fence
  - ☐ Fiber Rolls/Wattles

- ☐ Compost Berm/Sock
- ☐ Undercut Lots/Sidewalk Subgrades

Requirement 4: Storm Drain Inlet Protection

- ☐ Catch Basin Inlet Protection
- ☐ Ditch/Field Inlet Protection

Requirement 5: Soil and Slope Protection

- ☐ Surface Roughening
- ☐ Hydroseeding, Mulching and Tackifiers
- ☐ Erosion Blankets and Mats
- ☐ Seeding and Planting (Temporary and Permanent)
- ☐ Wind Erosion/Dust Control

Requirement 6: Control Runoff

- ☐ Slope Drain
- ☐ Energy Dissipation/Outlet Protection
- ☐ Diversion Dikes/Swales
- ☐ Check Dams

Requirement 7: Sediment Containment and Removal

- ☐ Temporary Sediment Basin
- ☐ Dewatering and Ponded Water Management

Requirement 8: Soil Stockpile Management

- ☐ Soil Stockpile Management

Requirement 9: Construction Site Pollution Prevention

- ☐ Concrete Management
- ☐ Materials Management
- ☐ Sanitary Waste Management

☐ BMP maintenance & inspection schedule

☐ Construction schedule

C.10 BMP Fact Sheets

The following fact sheets provide a basic overview of each of the BMPs listed in Table C-1 to meet the minimum EPSC requirements. For technical drawings and/or notes about each BMP, see the EPSC Standard details.

C.11 EPSC Standard Details

Standard details, including drawing and standard notes for each of the BMPs in Table C-1 are included in Table C-2 on page C-32.

SCHEDULING – EPSC-1

Objective:
Scheduling involves sequencing construction activities and the installation of erosion prevention and sediment control measures to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff and vehicle tracking.

Installation:
- Optimum grading period is when the chance for precipitation is minimized. If precipitation is likely during grading, minimize the length of time that soils are exposed, and the total area of exposure.
- Perform the following actions when precipitation is forecast:
    - Minimize the length of time that the soils are left exposed.
    - Reduce the total area of exposed soil.
    - Protect critical areas such as drainage channels, streams, and natural water courses.
    - Stabilize exposed areas quickly.
    - Ensure inlets are protected and protection measures maintained.
- The schedule shall include detail on the implementation of temporary soil stabilization measures, temporary sediment controls, tracking controls, wind erosion controls, non-stormwater pollution controls (including waste management and materials pollution controls).
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment control on all disturbed areas prior to the onset of rain.
- Keep the site stabilized year-round, and retain and maintain sediment trapping devices in operational condition. Erosion may be caused during dry seasons by unseasonable rainfall, wind, and vehicle tracking.
- Sequence trenching activities so that most open portions are closed before new trenching begins.
- Materials used for erosion and sediment control should be on site at all times.

Maintenance:
- Minimize construction during rainy weather.
- Schedule projects to disturb only small portions of the site at any one time.
- Complete grading as soon as possible and immediately stabilize the disturbed portion before grading the next portion.
- Practice staged seeding in order to re-vegetate cut and fill slopes as the work progresses.

PRESERVATION OF EXISTING VEGETATION/BUFFER STRIPS – EPSC-2

Objective:
Maintaining existing vegetation or placing vegetative buffer strips can reduce runoff and erosion, filter out sediments and other pollutants, and provide protection for sensitive areas. Preserving existing trees on site can help provide habitat, shade and other stormwater benefits – but ensuring tree survival requires avoiding damage to the roots, trunk and canopy during construction.

Installation:
- When perimeter vegetation is to be preserved, install orange safety fence immediately after construction limits have been determined. Orange poly fence with 2" x 2" max openings requires posts spaced no more than 4'.
- For trees being preserved, immediately install tree protection fencing per detail EPSC-2. Chain link fencing, a minimum of 4' in height, is preferred.
- Preserve as much of the natural landscape as possible.
- Preserve natural vegetation on unstable, steep slopes.
- Current regulatory buffer zone widths must be met around sensitive habitat areas.
- Protect trees and vegetation from:
    - Construction equipment both above and below ground level, including breakage, scarring, cutting roots or compaction of root zone.
    - Root exposure.
    - Damage caused by excavations for utility lines.

Maintenance:
- Inspect fencing often to ensure that preserved areas remain clearly marked and fencing is properly located.
- Check for damage to surrounding vegetation.
- Remove the fences and barriers last, after final cleanup and landscaping is completed.

CONSTRUCTION ENTRANCE/EXIT TRACKING CONTROLS – EPSC-3

Objective:
Stabilized construction entrance and exit help to prevent the tracking of soil onto public or private roadways that could flow into stormwater conveyance systems or surface waters.

Installation:
- Stabilize entrance/exit prior to any site work.
- Minimum length should be 20 feet on detached dwelling and middle housing sites and 50 feet for all other sites
- Width shall not be less than width of all points of ingress and egress, with minimum width of 20 feet
- Depth shall be 8 inches
- The aggregate size for construction of the pad shall be 3/4 inch rock for detached dwelling and middle housing construction and 3-6 inch rock for other development.
- Use only washed rock to minimize sediment runoff.
- All sediment tracked onto public rights-of-way shall be removed as soon as possible by hand sweeping, mechanized sweeper, or vacuum. Washing of sediment from the public right-of-way shall be prohibited.

Maintenance:
- Immediately sweep up and remove rock or sediment carried from the site. Stabilize onsite sediment generation areas to prevent tracking onto pavement.
- Do not flush rock or sediment from the site into the stormwater system.
- Add or replace rock as needed to maintain specified dimensions.

SEDIMENT FENCE – EPSC-4

Objective:
A sediment fence is a perimeter control consisting of filtering geotextile fabric secured between and attached to support posts. A sediment fence is a temporary measure used to intercept and filter sediment-laden runoff.

Installation:
- Install as far away from toe of slope as possible in order to maximize storage area.
- Do not place sediment fence in or across streams, channels, or ditches.
- Proper installation and use prevents sediment-laden runoff from flowing beneath, through or over the sediment fence.
- Sediment fence shall have manufactured stitched loops with 4-foot long 2-inch x 2-inch posts. Stitched loops shall be installed on the uphill side of the slope.
- Bury the lower 6 inches of fabric in a trench along the contour. Backfill trench and compact the soil on both sides of the fence.
- When joining two sections of sediment fencing together, connect the two end stakes by wrapping them together at least one and a half turns and driving the joined stakes into the ground.
- At the end point of a sediment fence, angle the fence slightly uphill for one full 6-foot panel.

Maintenance:
- Inspect frequently and immediately repair or replace split, torn, slumping, or weathered fabric.
- Remove sediment when accumulation reaches 1/3 the fence height. Incorporate sediment into the project site and stabilize or dispose of properly offsite.
- Remove sediment fence when the upslope area has been stabilized. Fill and compact post holes and anchorage trench, remove sediment accumulation, and grade fence alignment to blend with adjacent ground.

FIBER ROLLS OR WATTLES – EPSC-5

Objective:
Wattles are used primarily to intercept sheet and rill erosion on slopes. Wattles can be left in place as permanent landscape, or used as a bio-technical slope application. Wattles create a favorable environment for plant establishment by interrupting the slope length, trapping soil and moisture.

Installation:
- Wattles should be made from rice straw, wood, or coconut fiber, placed inside plastic netting.
- Dig trench approximately 1/3 the diameter of the wattle.
- Use ¾ x ¾ inch stakes every 4 feet on center
- When spaced on contour, off-set joints on each uphill installation.
- When used for slope stabilization, live willow can be used as stakes and permanent landscaping can be installed while leaving wattles in place

Maintenance:
- Make sure wattles are in contact with the soil and stakes are holding.
- Check for gaps at all joints.
- Immediately replace torn or damaged wattles.
- Clear accumulated sediment frequently so wattle is not breached.

COMPOST BERMS AND SOCKS – EPSC-6

Objective:

A compost filter berm is a trapezoidal berm applied by a blower, and a compost sock is compost material encased in mesh to form a tube or roll. Both techniques intercept sheet flow and pond runoff, allowing sediment to fall out of suspension, and often filtering sediment as well. Compost berms and socks provide an environmentally-sensitive and cost-effective alternative to sediment fence.

Installation:

- Compost barriers shall only be used at the base of slopes 2H:1V or less.
- Compost needs to be stable and mature.
- The recommended moisture content ranges from 20-50%. Compost that is too dry is harder to apply, while that which is too wet is heavier and harder to transport.
- Compost must be weed and pesticide free, with manmade materials comprising less than 1%.
- Check for undercutting or piping under compost barrier.
- Inspect for channel formation parallel to the berm, which indicates it is acting as a flow barrier.
- Remove sediment accumulation when it reaches one-third of the barrier height.
- Compost berms and socks can be seeded during application. Do not cover seed with more than 2-4 inches of compost.
- Tackifiers may be applied to berms if needed to enhance performance.

Maintenance:

- Compost barriers shall be inspected frequently and reapplied if necessary.
- Berms can be left on-site and seeded, or spread out in place as a soil enhancement

UNDERCUT LOTS/SIDEWALK SUBGRADES – EPSC-7

Objective:
Undercut lots or sidewalk subgrades provide an effective sediment filtration and retention on sites with no slope.

Installation:
- Only appropriate on flat sites. Do not use if site has visible slope to street.
- Site must have street with curbs
- Sidewalk subgrade must have a minimum 4-inch depth and 4-foot width.
- Place a 2-inch layer of aggregate sub-base.
- Weep holes in curb must be plugged.
- If sidewalk is to be poured prior to site stabilization, alternative sediment barriers must be installed.

Maintenance:
- Inspect weekly, and prior to and after rain events.
- Maintain as needed.
- Remove accumulated sediment and replace aggregate when filtering capacity is reduced by 50 percent or aggregate is clogged with sediment.
- All sediment must be removed from gravel subgrade and replaced with clean rock prior to pouring sidewalk

STORM DRAIN INLET PROTECTION – EPSC-8

Objective:
Temporary inlet protection must be provided for all active inlets for the duration of construction to keep sediment, trash, and other construction-related pollutants out of the storm drain system.

Installation:
- Provide protection for all storm drain inlets adjacent to and within 500 feet of construction site.
- Both inlet inserts and barriers must be used at any catch basin that may receive runoff from construction activity.
- Installation of insert protection must not block flow from filtering into the inlet or catch basin.
- Curb inlet protection devices are required in addition to inlet inserts where recessed curb inlets are present.

Maintenance:
- Accumulated sediment and debris must be removed from inlet insert when one-third the insert storage area is reached.
- Inspect all inlet protection devices before and after every rain event and weekly at active construction sites. During extended rain events, inspect inlet protection devices at least every 24 hours.
- Inspect the storm drain inlet for bypassed material after severe storms during the rainy season.
- Inlet protection must be removed and catch basin cleaned prior to project finalization.

SURFACE ROUGHENING – EPSC-9

Objective:
Surface roughening provides horizontal depressions or grooves that will trap seed and reduce run-off velocities. Roughening also reduces the length and steepness of slope. Roughening can be accomplished by 'track walking' slopes with tracked equipment, by using a serrated wing blade attached to the side of a bulldozer, a sheepsfoot roller, or by other agricultural equipment.

Installation:
- Tracking is generally installed on 3:1 slopes or less, but may be installed on steeper slopes with additional sediment barriers.
- Surface roughening must run up and downs the slope.
- Immediately seed and mulch area for optimum germination.
- Divert all concentrated run-off around treated area.

Maintenance:
- Check the seeded slopes for signs of erosion such as rills and gullies. Fill these areas slightly above the original grade, then reseed and mulch as soon as possible.

HYDROSEEDING, MULCHING, AND TACKIFIERS – EPSC-10

Objective:
Hydraulic applications are a mechanical method of applying a homogenous slurry of material onto bare soil in order to establish erosion-resistant vegetation on disturbed areas and critical slopes. These erosion and dust control materials can often be applied in one operation. Mulching is the process of applying bulk materials to the soil surface to reduce rainfall impact, increase infiltration and, in some cases, aid in re-vegetation. Common types of mulch include vegetable fibers, green material, hydraulic mulches from recycled paper or wood fibers, straw mulch, and compost blankets.

Installation:
- Divert concentrated run-off away from treated area.
- Seed, fertilizer, mulch, and tackifier can all be applied in a one step process.
- Exposed soils must be stabilized within the following periods:
    - During the wet season (October 1 - April 30): within 7 days
    - During the dry season (May 1 - Sept. 30): within 30 days
- Use liquid tacking agent for anchoring straw or as a dust control measure.
- Hydraulic applications should be applied in opposing directions in order to create a continuous uniform layer of protection.
- Allow for a minimum 24 hour curing time.
- If soil conditions are extremely dry, pre-water prior to application.

Maintenance:
- Repair all damaged areas by applying additional material or matting.
- Check for 80% vegetative cover prior to wet weather season.

EROSION BLANKETS AND MATS – EPSC-11

Objective:
Erosion blankets or matting provides an immediate layer of protection from water or wind erosion. Matting can stop the impact of splash erosion, reduce run-off velocity, and force water infiltration. Matting can also promote seed germination by providing a thermal layer that retains moisture.

Installation:
- Commonly used on 2:1 slopes or greater.
- Surface must be graded smooth prior to installation.
- Seed and fertilizer should be applied first.
- At the top of the slope, matting must be secured by burying in a trench
- Matting should be rolled down the slope and each roll should be overlapped according to manufacturer's instructions
- Matting must be in complete contact with the surface.
- Staples at top, bottom and along mats should be installed according to manufacturer's instructions

Maintenance:
- Check condition of existing staples.
- Check surface to matting contact and add staples as needed.
- Repair or replace damaged matting.
- Check to make certain run-off is not flowing under matting at any point.

SEEDING AND PLANTING (TEMPORARY AND PERMANENT) – EPSC-12

Objective:
Seeding and planting consists of the establishment of vegetative cover on disturbed areas to protect soil surface and reduce erosion. Vegetative cover also promotes infiltration, traps sediment, and is effective for dust control.

Installation:
- Exposed soils must be stabilized within the following periods:
    - During the wet season (October 1 - April 30): within 7 days
    - During the dry season (May 1 - Sept. 30): within 30 days
- Prepare site for seeding by fracturing and loosening the top 12 inches of soil and ensuring it is free of large clods or stones.
- Amend the soil by adding 3 inches of compost and incorporating it into the upper 8 inches. Compost must meet the requirements in SWMM **Appendix F**.
- In areas that will be seeded with turf grass, provide tackifier or light cover of mulch to protect seed, increase moisture, retention, and add a thermal layer. For permanent stabilization using turf, rolled sod may be installed over the amended soil.
- In areas that will be planting beds that are not covered by turf grass, a 2-4 inch layer of mulch following the requirements in SWMM **Appendix F** shall be used to cover the compost-amended soil.
- Divert all concentrated run-off around treated area.
- All seed shall be selected in accordance with City requirements, site conditions, and season.
- Sites located in Resource Areas or in a water quality facility that will be publicly owned or maintained require a City-approved native erosion control seed mix.
- If seeding is applied during the dry season (June 1 through September 30) or drought periods, irrigate seeds so that at least 80% ground cover is established by October 1.
- Apply seeding or sod so vegetative layer is established by start of the wet season (October 1 through May 31) or before freezing weather is anticipated.

Maintenance:
- Check for damage due to concentrated runoff.
- Repairs may require prevention measures such as matting or sod.
- Check germination rate to make certain it reaches a minimum of 80% growth prior to wet weather period.

WIND EROSION / DUST CONTROL – EPSC -13

Objective:
Wind erosion control consists of preventative measures to reduce sediment transported by wind and deposited in water resources.

Installation:
- Dust control shall be provided daily or more often (as deemed necessary based on wind conditions, time of year, and physical conditions of the site) by application of water alone or with addition of magnesium chloride or calcium chloride in accordance with manufacturer's specifications.
- Acrylic co-polymers or other biodegradable products (soil stabilizers/tackifiers) may be used for daily dust control if approved by the City.
- Water applied for dust control shall be applied evenly and without over watering, which generates runoff and may result in erosion by water.
- Oil or other petroleum-based products shall not be used for dust control.
- Dust control must be implemented in accordance with state air quality requirements.
- Keep stockpiles covered to minimize wind erosion.

Maintenance:
- Check areas protected to ensure appropriate coverage.
- Reapply water or maintain covers, as necessary to be effective.

SLOPE DRAIN – EPSC-14

Objective:
Slope drains are used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area.

Installation:
- Place slope drains on undisturbed soil or well-compacted fill at locations and elevations shown on plans.
- Slightly slope the section of pipe under the dike toward its outlet.
- Compact the soil under and around the entrance section in lifts not to exceed 6 inches.
- Ensure that fill over the drain at the top of the slope has a minimum depth of 1.5 feet and a minimum top width of 4 feet. The sides should have a 3H:1V slope.
- Ensure that all slope drain connections are watertight.
- Ensure that all fill material is well-compacted. Extend the drain beyond the toe of the slope and adequately protect the outlet from erosion.
- Make the settled, compacted dike ridge no less than 1 foot higher than the top of the pipe inlet.
- Immediately after grading, stabilize all disturbed areas as appropriate.

Maintenance:
- Inspect the slope drain and supporting diversions before, during, and after every storm event and promptly make necessary repairs.
- When the protected area has been permanently stabilized, remove the temporary measures, dispose of the materials properly, and stabilize disturbed areas appropriately.

ENERGY DISSIPATION/OUTLET PROTECTION – EPSC-15

Objective:
Outlet protection prevents scour at conveyance outlets and minimizes the potential for downstream erosion by reducing the velocity of concentrated stormwater flows. Outlet protection is required at the outlets of all ponds, pipes, ditches, and where runoff is conveyed to a drainage feature such as a stormwater facility, ditch, natural drainageway, stream, wetland, or lake. Any energy dissipation that will be installed within a Resource Area or discharging to a protected waterway must meet the requirements in SWMM **section 4.8**.

Installation:
- Riprap should be inlaid into the soil a minimum of 1 times the diameter of maximum stone size, with a layer of geotextile fabric under rock.
- Depth of riprap should be 1.5 feet times the diameter of maximum rock size used.
- Length of apron should be long enough to prevent erosive velocities both at the outlet structure and downstream as well.
- Riprap should be placed above and around the sides of the outlet pipe to prevent erosion.
- Size of rock and installation shall follow the outlet protection guidance in the ODOT Hydraulics Manual.

Maintenance:
- Check for scouring around riprap apron.
- Check for scouring downstream of structure.
- Remove accumulated sediment.
- If outlet structure is temporary, remove once permanent structure has been installed.

DIVERSION DIKES AND SWALES – EPSC-16

Objective:
Dikes and swales divert storm runoff from onsite and offsite drainage areas and direct flow to a sediment trap, pond, or other approved stabilized outlet. Dikes and swales may be installed as permanent site drainage control features, while providing conveyance of temporary development flows.

Installation:
- Estimate flows from the drainage areas to be collected and conveyed by the dike or swale.
- Intercepted runoff shall be directed to a stabilized area such as a basin, trap, or other holding area. The diversion shall be designed so that no erosion occurs from the movement of the additional water volume and flow rate.
- Use check dams to control flow rate within dikes and swales.
- Outlet protection shall be provided to minimize erosion at dike outlet.
- Construction traffic over dikes and swales shall be minimized.

Maintenance:
- Inspect after every major rainstorm for side and bottom inlet and outlet scour.
- Remove sediment and other debris when one-third of conveyance storage capacity is reached.
- Temporary dikes and swales shall be graded out at the completion of construction, when permanent vegetation has been established.

CHECK DAMS – EPSC-17

Objective:
Check dams reduce the velocity of concentrated flow in swales, dikes, or ditches. Check dams reduce erosion and act as a barrier trapping sediments and other site pollutants.

Installation:
- Check dams shall be constructed of rock, fiber rolls, or filled compost socks.
- Rock check dams must be constructed of appropriately sized rock. The rock must be large enough to stay in place given the expected design flow through the channel.
- Place check dams perpendicular to the flow of water.
- Ensure that check dams are adequately keyed into side slopes to withstand flows and prevent washouts at ends.
- Check dams must be imbedded into channel bottom so that undercutting does not occur.
- Plan for adequate methods of sediment removal behind check dams and ensure that sufficient area for equipment access is available.

Maintenance:
- Inspect check dams before, during, and after each rainfall event. Repair damage as needed.
- Remove sediment when depth reaches one-third the height of the check dam.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.
- Removed sediment shall be incorporated in the project or disposed of properly.

TEMPORARY SEDIMENT BASIN – EPSC-18

Objective:
Temporary sediment basins are used to collect and store sediment from sites cleared and/or graded during construction. Sediment basins, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Installation:
- Sediment basin must be designed by a professional engineer licensed in Oregon and design must be approved by the City.
- Must be located offline of any natural drainage system.
- No groundwater flows can limit basin effectiveness. If groundwater flows are anticipated, the basin must be sized accordingly.
- Stabilized inlet, outlet, and side slope structures capable of withstanding predicted flows before the basin receives flows.
- Outlet devices must be sized to empty the basin within 48 hours. Release rates of sediment-free runoff are required to meet the post-construction flow control thresholds required in SWMM **section 1.2.5**. In soils with low infiltration rates, the basin may only provide storage and a secondary measure may be required to filter sediment and ensure that the basin maintains adequate capacity to store site runoff before any anticipated storm.
- Basin design must consider drain valves, forebays, and other features that ensure ease of maintenance.
- Adequate access must be provided for maintenance procedures.

Maintenance:
- All basins must be maintained prior to major rainstorm to ensure they have capacity for flows.
- Consider type of maintenance vehicle required and provide sufficient access.
- Sediment must be removed when one-third of the basin's capacity is filled. Removed sediment must be disposed of properly.
- If a temporary sediment basin is to be used for post-construction stormwater management, all sediment must be removed prior to placement of stormwater soil and installation of plantings.

Conversion shall not take place prior to at least 90% of development being completed and permanently stabilized.

- If the developer can make a case that other upstream erosion control measures will prevent sediment from entering the basin, the City may approve conversion of the temporary sedimentation basin to permanent post-construction stormwater facility prior to construction being finished. If approved, the City will inspect facility when construction phase is complete and the developer will be responsible for sediment removal, growing media replacement and/or vegetation replacement.

DEWATERING AND PONDED WATER MANAGEMENT – EPSC-19

Objective:
Dewatering operations prevent or reduce the discharge of pollutants to the storm drain system or to watercourses by using sediment controls and by testing the discharges for pollution. Dewatering and ponded water management applies to areas where stormwater has collected in low spots, trenches or other depressions and needs to be removed to proceed with construction activities or for vector control.

Installation:
- Ponded stormwater shall be settled or filtered for sediment removal prior to discharge.
- Water shall be clean and free of significant sediment, surfactants, or other pollutants.
- For clean ponded stormwater, use one of the following methods for discharge disposal as appropriate for onsite drainage:
    - Reduce sediment discharge by pumping water from the top of ponded areas using a floating or raised hose.
    - Infiltrate to an appropriate stabilized surface area (landscaped or vegetated).
    - Discharge to an on-site temporary sediment basin.
    - Only with approval by the City, discharge to a nearby waterbody or the storm drain system. Discharge flow rates must meet flow control requirements in SWMM **section 1.2.5**.
    - A vacuum truck may be used to remove the water and dispose at an authorized discharge location.

Maintenance:
- Inspect pumps, hoses and all equipment before use. Monitor dewatering operations to ensure it does not cause offsite discharge or erosion.
- Inspect routinely, when applicable activities are under way.

SOIL STOCKPILE MANAGEMENT – EPSC-20

Objective:
Soil stockpile management reduces or eliminates stormwater and air pollution from temporary stockpiles of soil, which are susceptible because slopes may be steep and soil may be recently disturbed.

Installation:
- Locate temporary stockpiles at least 50 feet away from inlets, drainage courses, or water bodies.
- Limit soil stockpile height to 15 feet, unless City approves taller stockpile.
- Perimeter sediment control (e.g., berm, sediment fence, fiber rolls, or gravel bags) at the toe of slope shall be installed at soil stockpiles year round.
- Maintain cover on stockpile using mulch or plastic sheeting whenever stockpile is not in use for more than the following periods:
    - During the wet season (October 1 - April 30): within 7 days
    - During the dry season (May 1 - Sept. 30): within 30 days
- Protect storm drain inlets, drainage courses, and receiving waters from soil stockpile erosion, using drain inlet protection and perimeter sediment controls, as appropriate.
- Implement dust control practices, as appropriate, to prevent wind erosion of stockpiled soil material.

Maintenance:
- Inspect stockpiles regularly, and prior to and after storm events.
- Add mulch as needed to maintain complete cover.
- Repair rills and gullies of vegetated stockpiles.
- Check plastic anchoring system and repair or add anchors, as needed.
- Replace torn plastic sheeting and repair open seams.
- Completely remove plastic sheeting after it is no longer needed.

CONCRETE MANAGEMENT – EPSC-21

Objective:
Concrete management prevents or reduces discharge of pollutants to stormwater from concrete waste.

Installation:
- Perform washout of concrete trucks off-site or in designated concrete washout areas only.
- Do not wash out concrete trucks into storm drains, streets, open ditches or streams.
- Concrete washout areas may be prefabricated concrete washout containers, or self-installed structures.
- Locate washout areas 50 feet from sensitive areas such as storm drains, open ditches, or water bodies.
- On large sites with extensive concrete work, washouts should be placed in multiple locations for ease of use by concrete equipment operators.

Maintenance:
- During periods of concrete work, inspect washouts for overall condition and performance.
- Washout facilities must be emptied when washout is 75% full to prevent overflow.
- Hardened concrete, slurries and liquids from washout must be disposed of properly.
- Holes, depressions or other ground disturbance caused by the removal of temporary concrete washout facilities shall be backfilled, repaired, and stabilized to prevent erosion.

MATERIALS MANAGEMENT – EPSC-22

Objective:
Prevent, reduce, or eliminate the discharge of pollutants to the stromwater system or watercourses from material delivery and storage. Minimize the storage of hazardous materials on-site, store materials in a designated area, and install secondary containment.

Installation:
- All construction materials shall be delivered to and stored in designated areas or designated staging areas at the construction site.
- Material storage areas shall be placed near construction site entrances to the extent practicable, away from storm drain inlets, culverts and surface waterbodies.
- Designated storage areas shall be kept clean, well-organized, and litter-free.
- Any materials being stored that could release pollutants by wind or runoff transport shall be protected by overhead cover, secondary containment, tarpaulins, or other appropriate method prior to rainfall or periods of high wind. Where feasible, store materials indoors (e.g., container storage or garages/buildings under construction, where work is being conducted).
- Any chemicals, drums or bagged materials not stored in a covered location, shall be stored on pallets and in secondary containment.
- Secondary containment shall be provided for liquids.
- Secondary containment areas shall be covered to prevent accumulation of rainwater.
- Construction materials shall be stored in a manner to prevent or minimize contact with storm water.

Maintenance:
- Inspect material storage areas routinely for compliance with the above practices.

SANITARY WASTE MANAGEMENT – ESPC-23

Objective:
Sanitary and septic waste management controls minimize or eliminate the discharge of construction site sanitary/septic waste materials to the storm drain system or to watercourses.

Installation:
- All sanitary wastes shall be collected and managed through the use of portable toilet facilities.
- Portable toilets shall be placed on a level surface and to the extent practical, a safe distance away from paved areas and away from storm drains.
- If placed in an area of high winds, portable toilets shall be secured to the ground to prevent blowing over.
- Portable toilets shall be transported to and from the construction site by a licensed contractor.
- No sanitary wastes shall be disposed of on-site (e.g., to on-site storm drains, burial).
- Care shall be taken during pump-out to avoid spillage. If spillage occurs, it shall be cleaned up immediately.

Maintenance:
- Inspect material storage areas routinely for compliance with the above practice

EPSC Plan for Detached Dwelling – City of Gresham

The following commitments constitute my Erosion Prevention and Sediment Control (EPSC) Plan as required under the City's EPSC Manual. In developing this plan, I certify that I have evaluated site contours and drainage patterns, identified potential erosion and sediment problems, evaluated EPSC measures, and will implement EPSC measures prior to performing any earthwork or site grading. I will follow this plan and make ongoing revisions as needed to ensure sediment stays on site and other construction-related pollutants and debris are kept out of stormwater and other waters.

I further certify that all EPSC measures will be installed in accordance with City requirements including the City's Stormwater Management Manual and EPSC Manual. I understand that the City will inspect my site for implementation of this EPSC Plan before and during construction, and that a stop-work order may be issued if I fail to properly implement EPSC measures.

	Responsibilities	**Initial**
1.	I understand I am responsible, as the permit holder, to keep sediment onsite.	
2.	I will provide a linear barrier (such as a sediment fence) and perimeter control where needed to keep sediment onsite.	
3.	I will ensure that construction debris, paint, concrete, and other pollutants are kept out of stormwater, streams, storm drains, and any stormwater treatment systems such as street raingardens.	
4.	I will provide storm drain inlet protection.	
5.	I will provide construction entrance/exit tracking controls.	
6.	I will provide concrete management.	
7.	I will provide slope breaks for steep slopes.	
8.	I will provide stockpile management for both soil stockpiles and non-soil stockpiles.	
9.	I will provide temporary ground cover (such as straw mulch) during October 1 – May 31, or until wet weather subsides, and permanent seeding and planting.	
10.	I will provide daily inspection and maintenance when work is ongoing, as needed during wet weather, and even if work is not ongoing to ensure this plan is met.	
11.	I will remove temporary erosion controls once construction is completed and the site is stabilized.	
12.	I understand the City may require modifications or additional EPSC measures to be installed onsite.	

Name: _____ Phone Number: _____

Full Construction Property Address: _____

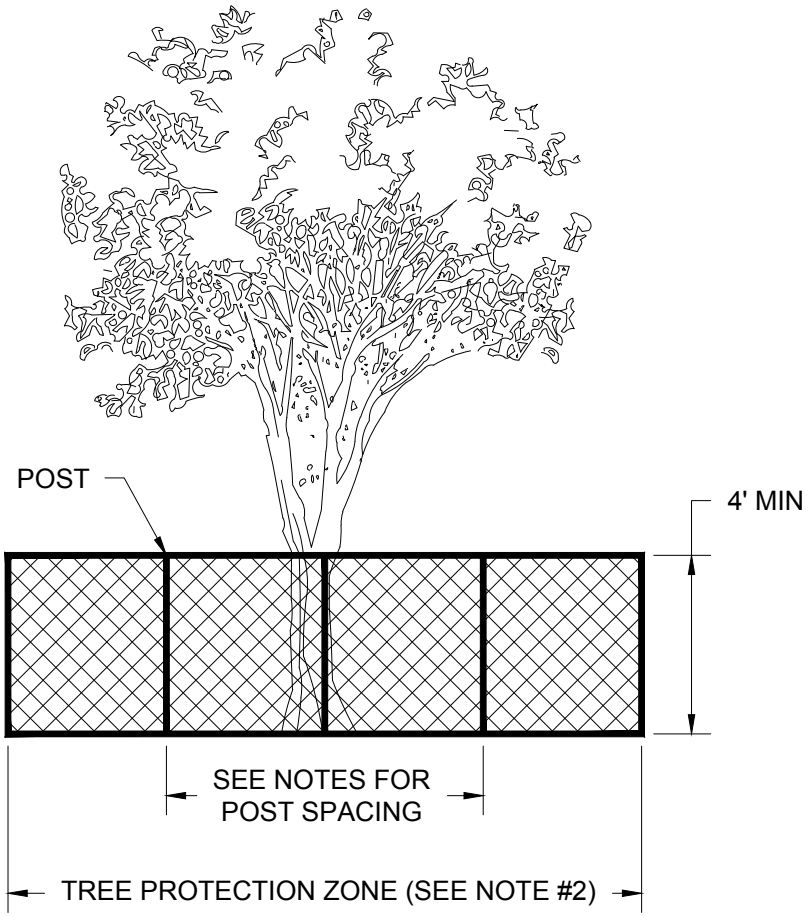
Person Responsible for Implementing and Inspecting EPSC Measures: _____

Phone Number: _____

Erosion Prevention and Sediment Control
Standard Details

Table C-2. Erosion control standard details

Standard Detail	BMP Name	BMP Fact Sheet Page	Standard Detail Page
EPSC-1	Scheduling	C-9	-
EPSC-2	Preservation of Existing Vegetation/Buffer Strips	C-10	C-35
EPSC-3	Construction Entrance/Exit Tracking Controls	C-11	C-36
EPSC-4	Sediment Fence	C-12	C-37
EPSC-5	Fiber Rolls/Wattles	C-13	C-38
EPSC-6	Compost Berm/Sock	C-14	C-39
EPSC-7	Undercut Lots/Sidewalk Subgrades	C-15	C-40
EPSC-8A EPSC-8B	Catch Basin Inlet Protection Inlet Protection	C-16	C-41 C-42
EPSC-9	Surface Roughening	C-17	C-43
EPSC-10	Hydroseeding, Mulching and Tackifiers	C-18	C-44
EPSC-11	Erosion Blankets and Mats	C-19	C-45
EPSC-12	Seeding and Planting (Temporary and Permanent)	C-20	-
EPSC-13	Wind Erosion/Dust Control	C-21	-
EPSC-14	Slope Drain	C-22	C-46
EPSC-15	Energy Dissipation/Outlet Protection	C-23	C-47
EPSC-16	Diversion Dikes/Swales	C-24	C-48
EPSC-17A EPSC-17B EPSC-17C	Rock Check Dam Wattle Check Dam Sand bag Check Dam	C-25	C-49 C-50 C-51
EPSC-18	Temporary Sediment Basin	C-26	C-52
EPSC-19	Dewatering and Ponded Water Management	C-28	-
EPSC-20	Soil Stockpile Management	C-29	C-53
EPSC-21	Concrete Management	C-30	C-54
EPSC-22	Materials Management	C-31	-
EPSC-23	Sanitary Waste Management	C-32	-



NOTES:

1. LIMITS FOR PRESERVATION OF EXISTING TREES OR VEGETATION SHALL BE MARKED PRIOR TO ALL CLEARING, GRUBBING OR SOIL DISTURBANCE ACTIVITIES.
2. MINIMUM TREE PROTECTION ZONE IS THE LARGER OF THE FOLLOWING:
   A. 15' RADIUS FROM THE EDGE OF THE TREE TRUNK
   B. DRIPLINE
   C. 1' FOR EACH INCH OF TREE DIAMETER AT BREAST HEIGHT (4.5' OFF GROUND)
3. FOR TREE PROTECTION, USE CHAIN LINK FENCE. POSTS SHALL BE A MAXIMUM OF 10' SPACING, DRIVEN 2' MINIMUM INTO GROUND. SURFACE MOUNTED POLE SUPPORTS MAY BE USED IF APPROVED BY THE CITY.
4. FOR PROTECTION OF PERIMETER VEGETATION, AN ORANGE POLY FENCE WITH MAXIMUM OPENINGS OF 2" X 2" MAY BE USED AS AN ALTERNATE. POSTS SHALL BE A MAXIMUM OF 4' SPACING WHEN POLY FENCE IS USED.
5. PROTECTIVE AREA OF TREES TO BE PRESERVED SHALL BE BEYOND CRITICAL ROOT ZONE FOR TREATMENT OF SHEET FLOW.
6. LIMIT TRENCHING NEAR OR UNDER TREES TO BE PRESERVED FOR TREATMENT OF SHEET FLOW.
7. SMOOTHLY CUT OFF ENDS OF ANY DAMAGED ROOTS AND COVER WITH SOIL.

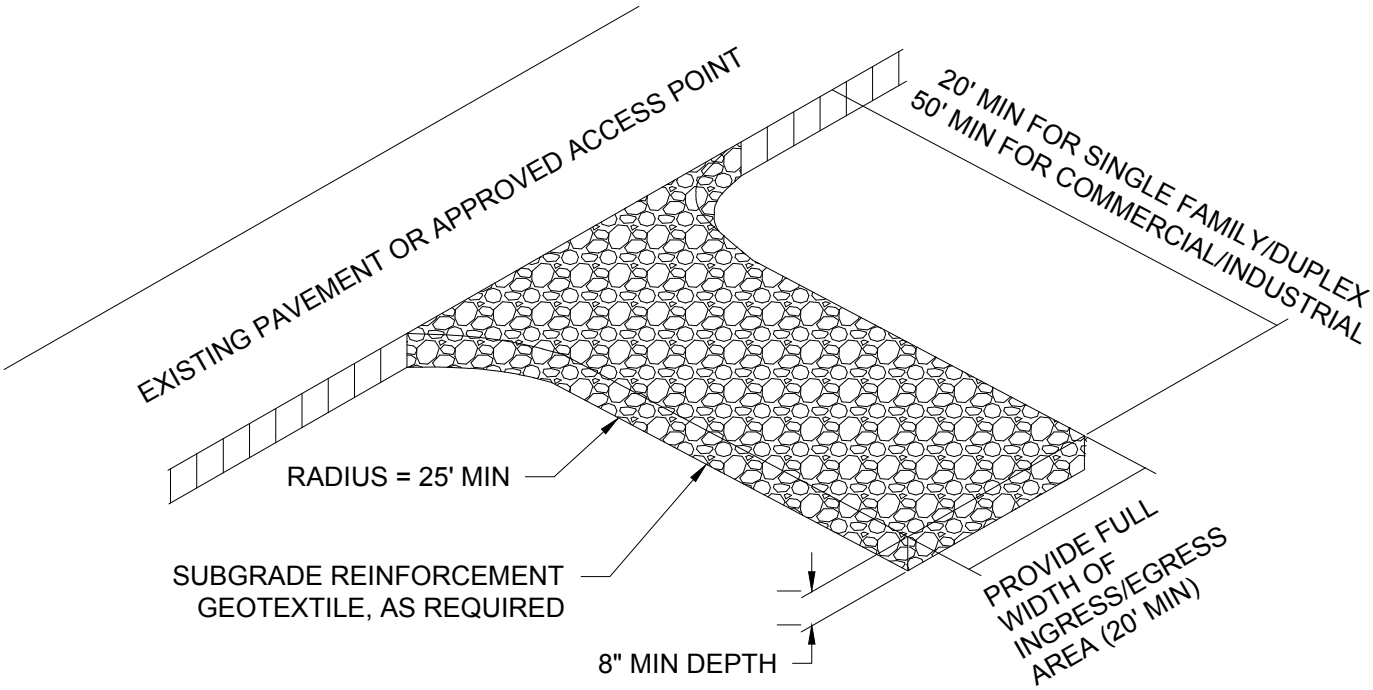
NTS

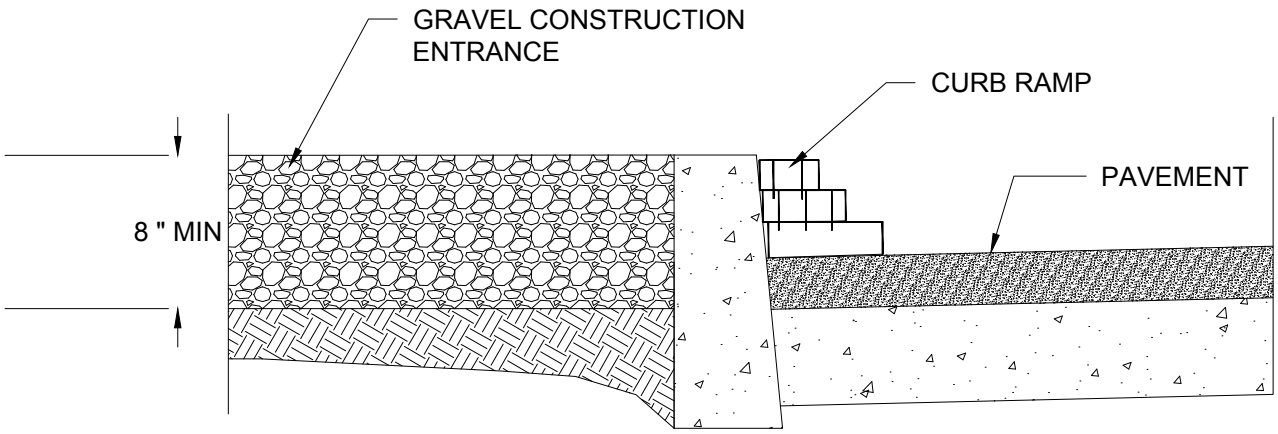
CITY OF GRESHAM

PROTECTION OF TREES AND VEGETATION

PUBLISHED: JAN 2023

DRAWN	KRB
REV. DATE	NOV 2022
APPR.	
DETAIL NO.	EPSC-2





NOTES:

1. DO NOT INSTALL ROCK ON PAVED SURFACES (USE WOOD CURB RAMPS)
2. INCLUDE A TIRE WASH FACILITY IF THE ENTRANCE DOES NOT PROVE EFFECTIVE IN RETAINING SEDIMENT ONSITE
3. SWEEP/REMOVE ANY SEDIMENT TRACKED OFFSITE
4. ADD/REPLACE ROCK AS NEEDED TO ENSURE SPECIFIED DIMENSIONS AND IF NO LONGER TRAPPING SEDIMENT

DIMENSIONS:

SINGLE FAMILY
20' LONG BY 20' MIN WIDTH
8" DEEP OF 3/4" MINUS ROCK

COMMERCIAL
50' LONG BY 20' MIN WIDTH
8" DEEP OF 3"-6" CLEAN ROCK.
GEOTEXTILE FABRIC MAY BE REQUIRED IF SUB-SOIL PUMPING OCCURS

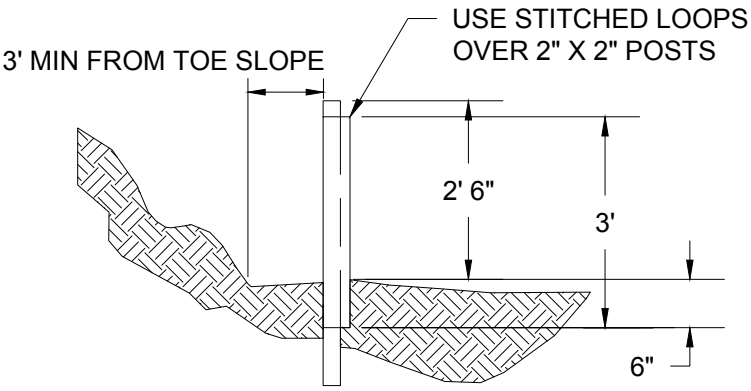
NTS

CITY OF GRESHAM

CONSTRUCTION ENTRANCE/EXIT TRACKING CONTROLS

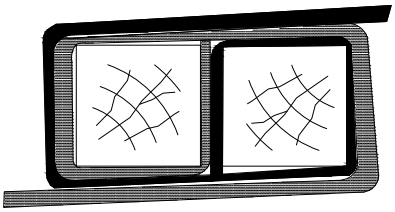
PUBLISHED: JAN 2023

DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-3



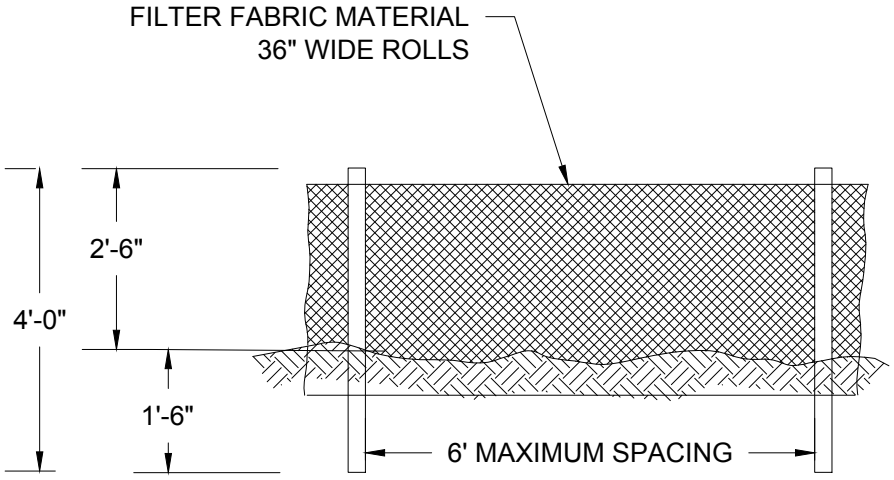
PROFILE

SILT FENCE B



SILT FENCE A

ROLL JOINTS



FRONT VIEW

SPACING REQUIREMENTS:

PERCENT SLOPE	SLOPE	MAX SPACING
<20	LESS THAN 5H:1V	100'
20 TO 30	5H:1V TO 3H:1V	50'
>30	GREATER THAN 3H:1V	25'

NOTES:

1. PLACE ALONG CONTOUR OF SLOPE OR AT PERIMETER OF SITE.
2. DO NOT PLACE IN STREAM CHANNELS OR CONCENTRATED FLOWS
3. BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE
4. 2"X2" FIR, PINE OR STEEL FENCE POSTS
5. POSTS TO BE INSTALLED ON UPHILL SIDE OF SLOPE
6. COMPACT BOTH SIDES OF FILTER FABRIC
7. ANGLE SILT FENCE AT END OF CONTOUR FOR ONE FULL 6' PANEL TO ASSURE SOIL IS TRAPPED

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CITY OF GRESHAM

SILT FENCE

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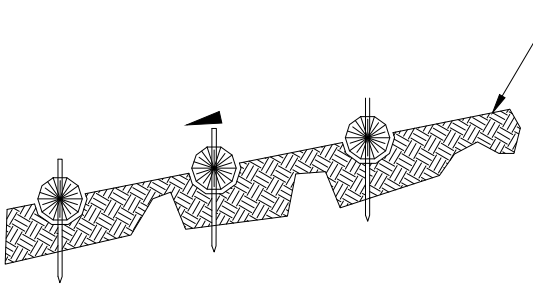
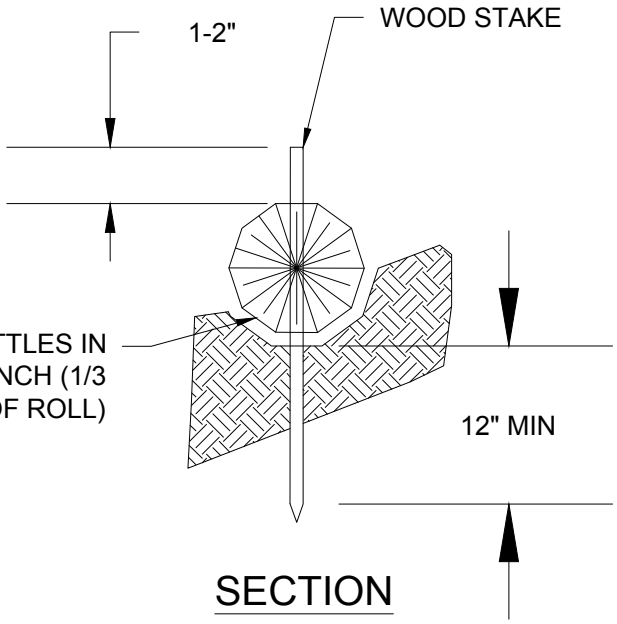
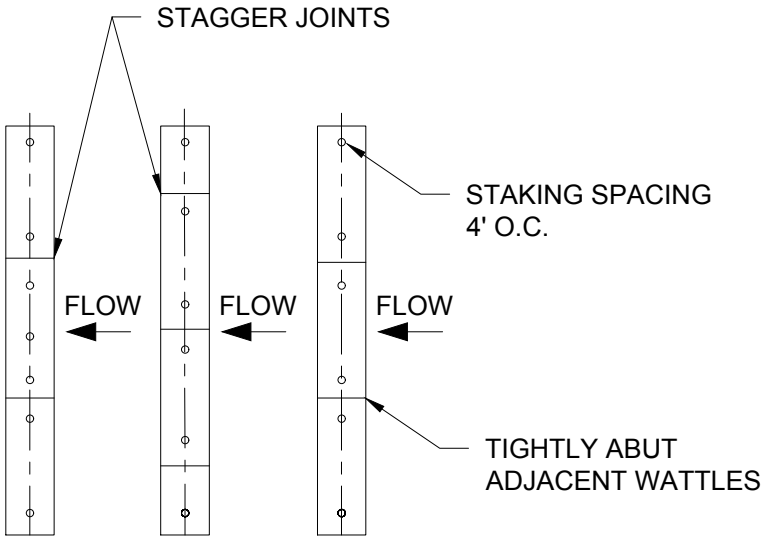
DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-4



PROFILE



SECTION



PLAN VIEW

NOTES:

1. STAKING SPECIFICATIONS:
   a. ¾ " x ¾ " WOODEN STAKES
   b. ADDITIONAL STAKES MAY BE INSTALLED ON DOWNHILL SIDE OF WATTLES, ON STEEP SLOPE OR HIGHLY EROSIVE SOILS
   c. STAKES SHOULD BE DRIVEN 12" MIN INTO GROUND
2. SEE TABLE FOR SPACING ON SLOPES

SLOPING REQUIREMENTS:

PERCENT SLOPE	SLOPE	MAX SPACING
<20	LESS THAN 5H:1V	100'
20 TO 30	5H:1V TO 3H:1V	50'
>30	GREATER THAN 3H:1V	25'

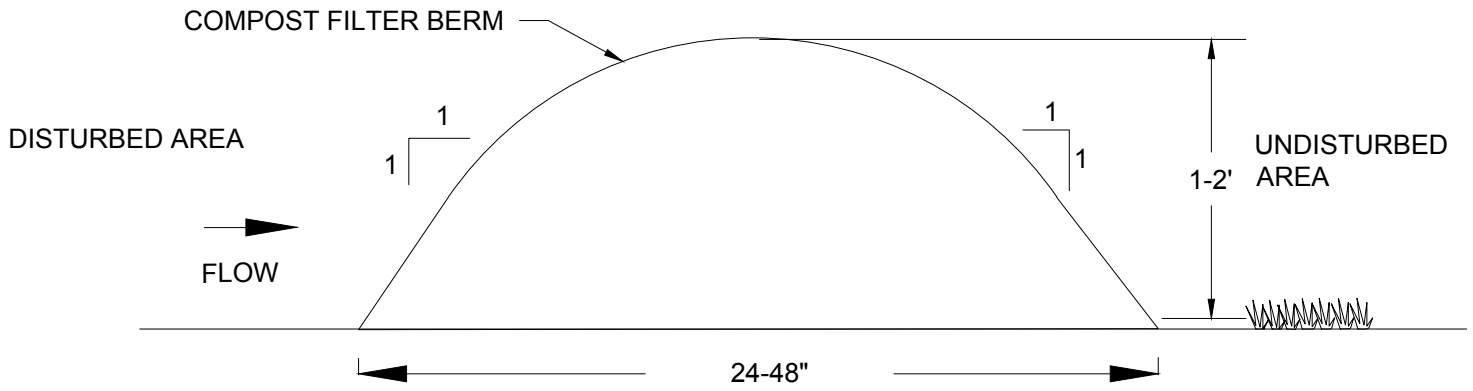
NTS

CITY OF GRESHAM

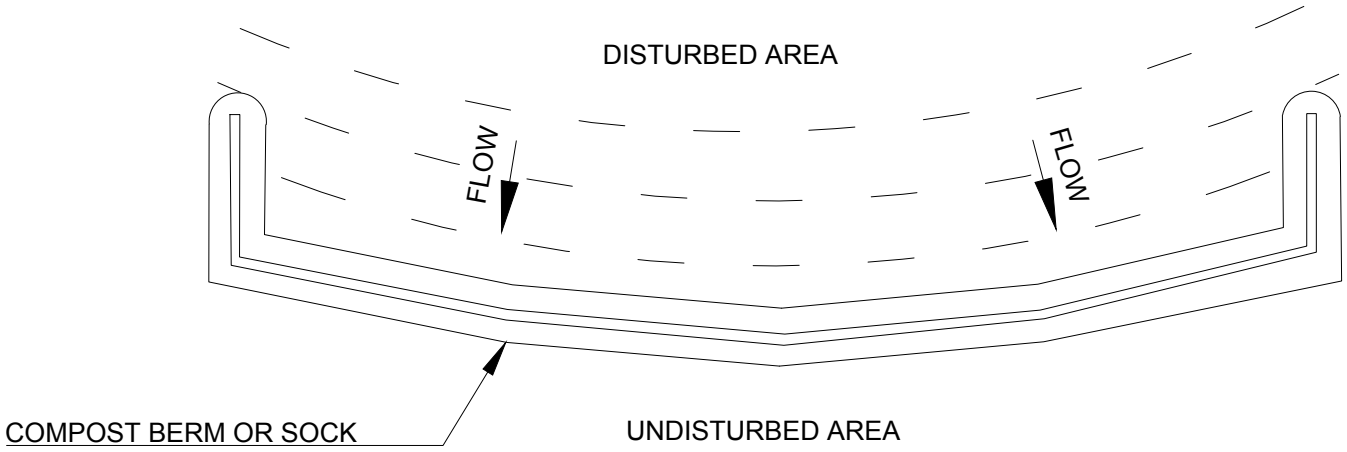
FIBER ROLLS/WATTLES

PUBLISHED: JAN 2023

DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-5



COMPOST BERM SECTION VIEW



PLAN VIEW

NOTES:

1. COMPOST NEEDS TO BE STABLE AND MATURE SEDIMENT SHALL BE REMOVED WHEN IT REACHES ⅓ OF THE EXPOSED HEIGHT OF SOCK OR BERM
2. PLACE BERMS OR SOCK ON CONTOUR AND/OR AT PERIMETER OF SITE.
3. PLACE 5' OR MORE FROM TOE OF SLOPE TO MAXIMIZE SPACE FOR SEDIMENT DEPOSITION
4. DO NOT PLACE ACROSS STREAMS, CHANNELS OR CONCENTRATED FLOW

SPACING REQUIREMENTS:

SLOPE	HEIGHT	BASE WIDTH	MAX SPACING
<5H:1V	12" MIN	24" MIN	100'
5H:1V TO 3H:1V	24" MIN	48" MIN	50'
≥3H:1V	≥24"	≥48"	25'

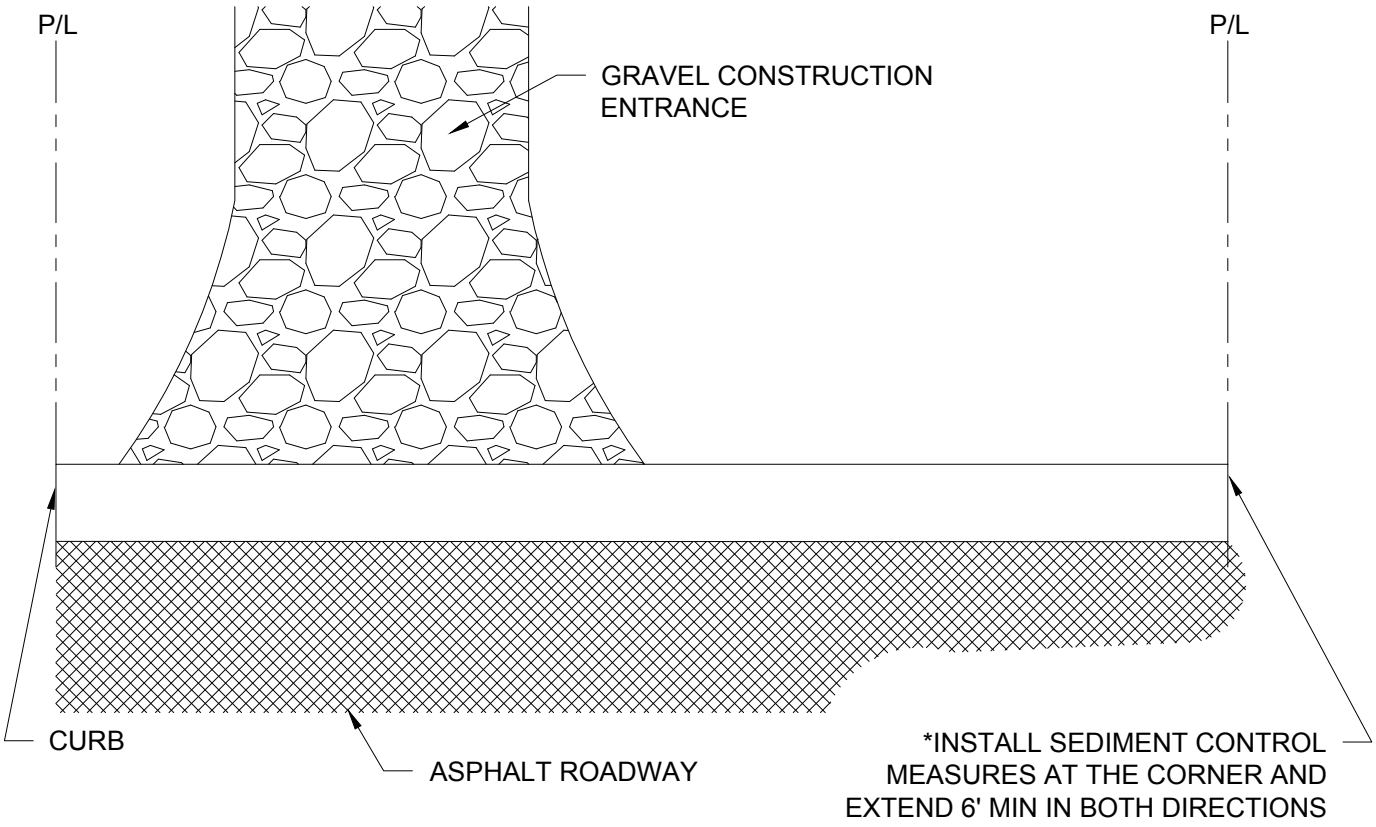
NTS

CITY OF GRESHAM

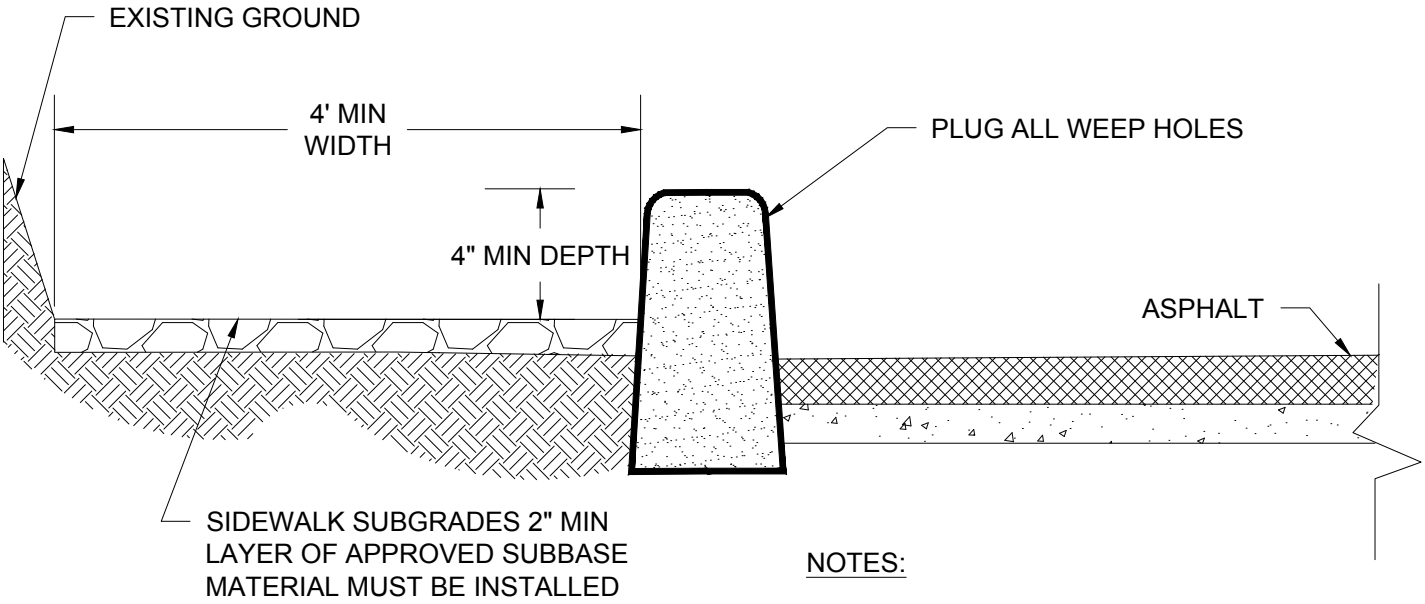
COMPOST BERM/SOCK

PUBLISHED: JAN 2023

DRAWN KRJ
REV. DATE SEPT 2014
APPR.
DETAIL NO. EPSC-6



PLAN VIEW



PROFILE

NOTES:

1. NOT APPLICABLE FOR SITES WITH SLOPE
2. CUT SOIL BACK FROM CURB 2-4" DEEP AND 4' WIDE
3. INSTALL 2" MIN AGGREGATE SUBGRADE
4. REMOVE AND REPLACE AGGREGATE IF 50% IS CLOGGED WITH SEDIMENT

NTS

CITY OF GRESHAM

UNDERCUT LOTS/SIDEWALK SUBGRADE

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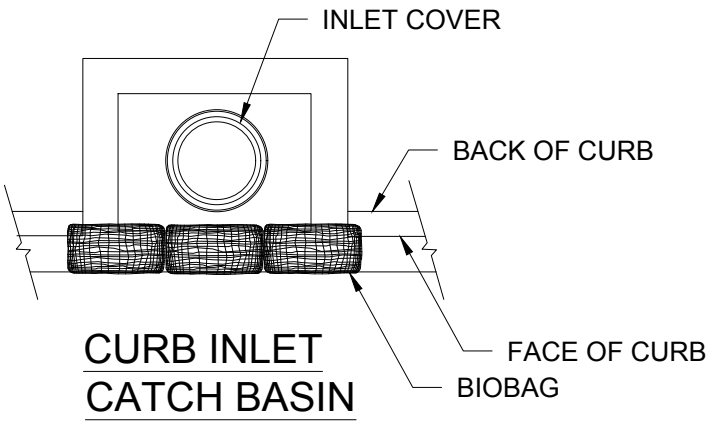
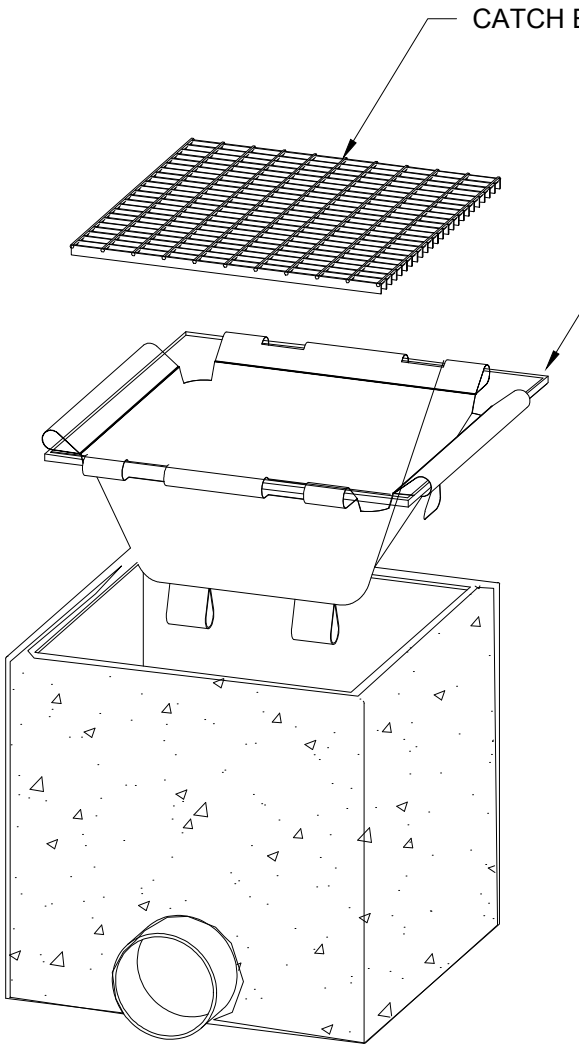
DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-7



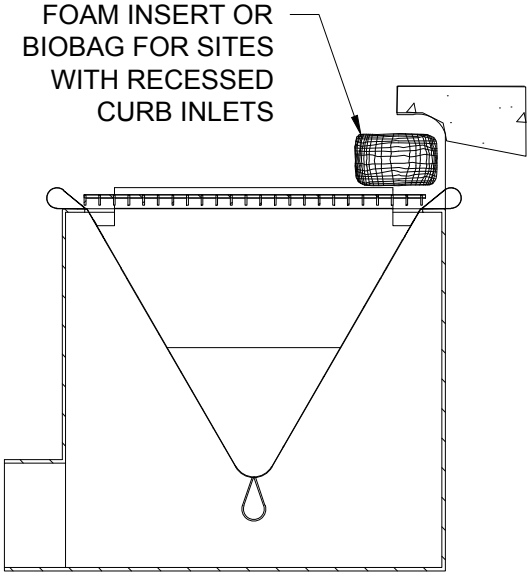
CURB INLET CATCH BASIN

NOTES:

1. TO BE INSTALLED IN ALL CATCH BASINS IMMEDIATELY DOWNSLOPE FROM SITE
2. INSTALL PER MANUFACTURER SPECIFICATIONS
3. STORM DRAINS WITH RECESSED CURB INLETS SHALL USE FOAM BLOCK OR BIOBAG TO DIRECT STORMWATER INTO INSERT BAG
4. REPLACE OR CLEAN WHEN BAG IS 1/3 FULL



SEDIMENT INSERT BAG



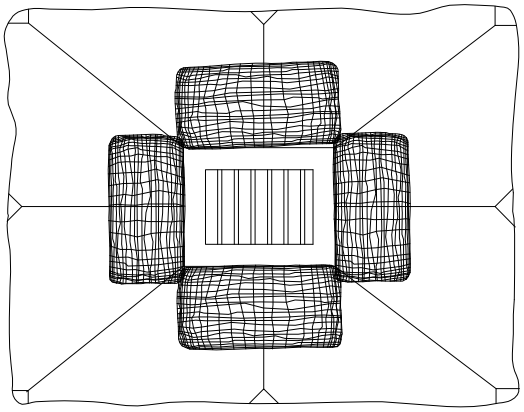
PROFILE VIEW

CITY OF GRESHAM

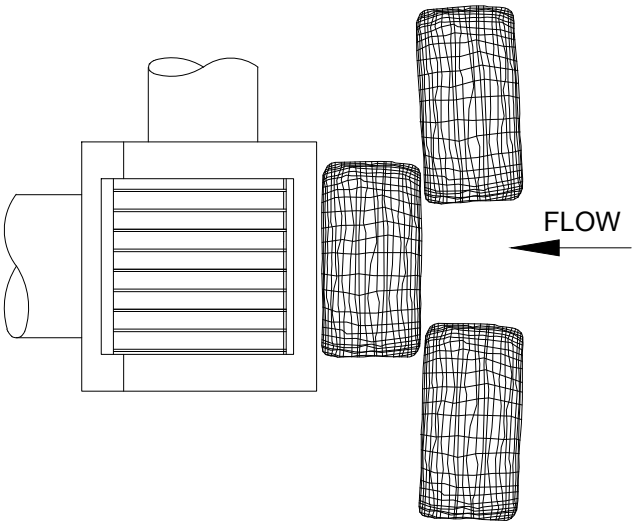
CATCH BASIN INLET PROTECTION

PUBLISHED: JAN 2023

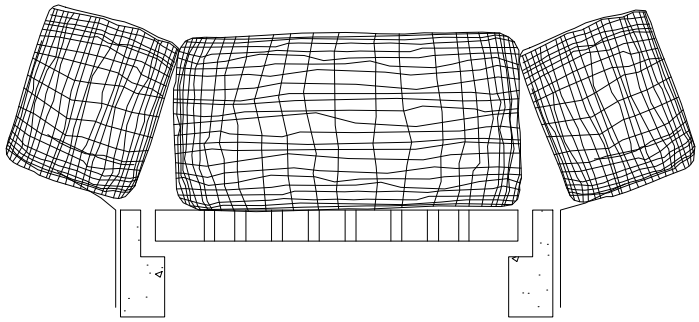
DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-8A



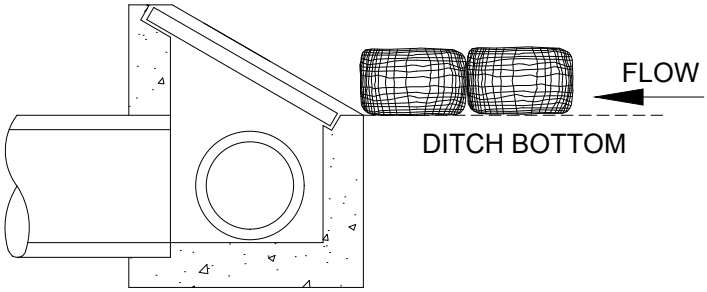
AREA DRAIN PLAN VIEW



DITCH INLET PLAN VIEW



AREA DRAIN PROFILE VIEW



DITCH INLET PROFILE

NOTES:

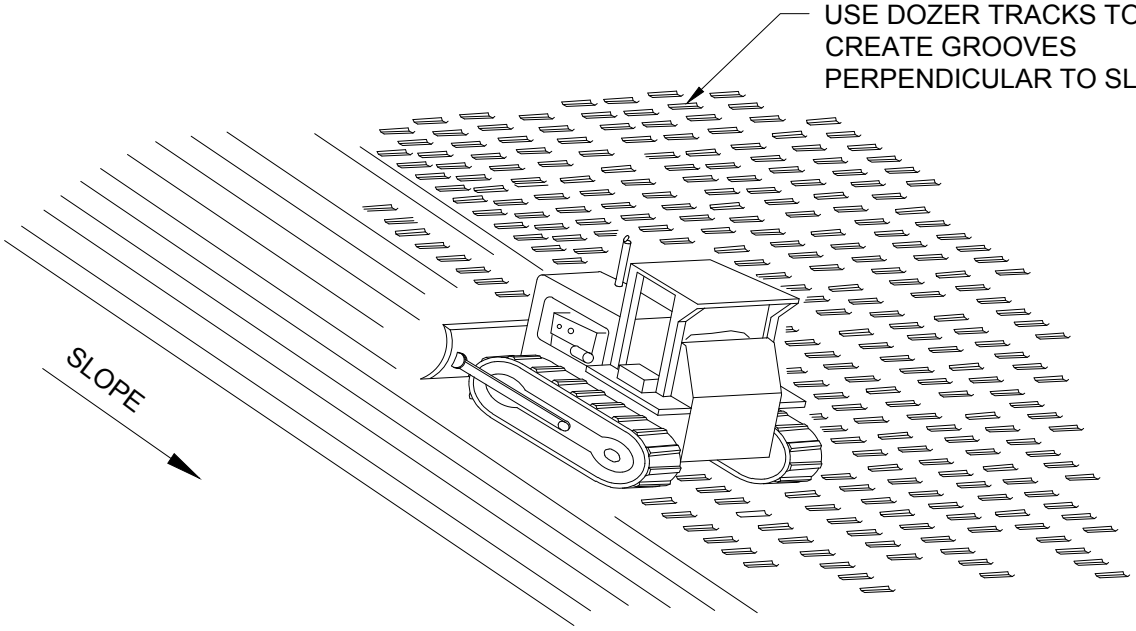
1. ONLY TO BE USED IN UNPAVED AREAS WITHOUT TRAFFIC
2. BARRIER SHALL FULLY COVER INLETS
3. BIOFILTER BAGS SHOULD BE STAKED WHERE APPLICABLE USING (2) 1"X2" WOODEN STAKES OR APPROVED EQUAL PER BAG
4. CLEAN/REPLACE BAGS WHEN CAPACITY REDUCED BY 50% OR WHEN SEDIMENT IS 1/3 HEIGHT OF BIOBAG

CITY OF GRESHAM

INLET PROTECTION

PUBLISHED: JAN 2023

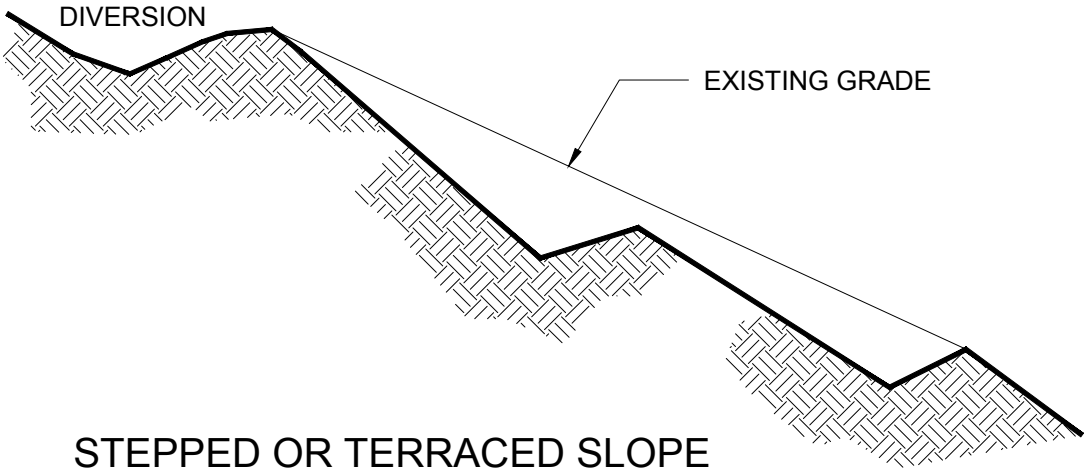
DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-8B



NOTES:

1. USE SHEEPSFOOT ROLLER OR MACHINERY
2. GROOVES SHOULD BE CLOSE TOGETHER (≤10") AND NOT LESS THAN 1" DEEP
3. SEED AND MULCH ROUGHENED AREAS AS SOON AS POSSIBLE

TRACKING



STEPPED OR TERRACED SLOPE

NOTES:

1. FOR USE ON SLOPES STEEPER THAN 3H:1V
2. VERTICAL CUT DISTANCE SHALL BE LESS THAN HORIZONTAL DISTANCE
3. VERTICAL CUT SHALL NOT EXCEED 2 FT. (0.6m) IN SOFT MATERIAL AND 3 FT. (0.9m) IN ROCKY MATERIAL
4. RIDGES/DEPRESSIONS SHOULD RUN PARALLEL TO SLOPE CONTOURS

CITY OF GRESHAM

SURFACE ROUGHENING

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CITY OF GRESHAM

HYDROSEEDING, MULCHING AND TACKIFIERS

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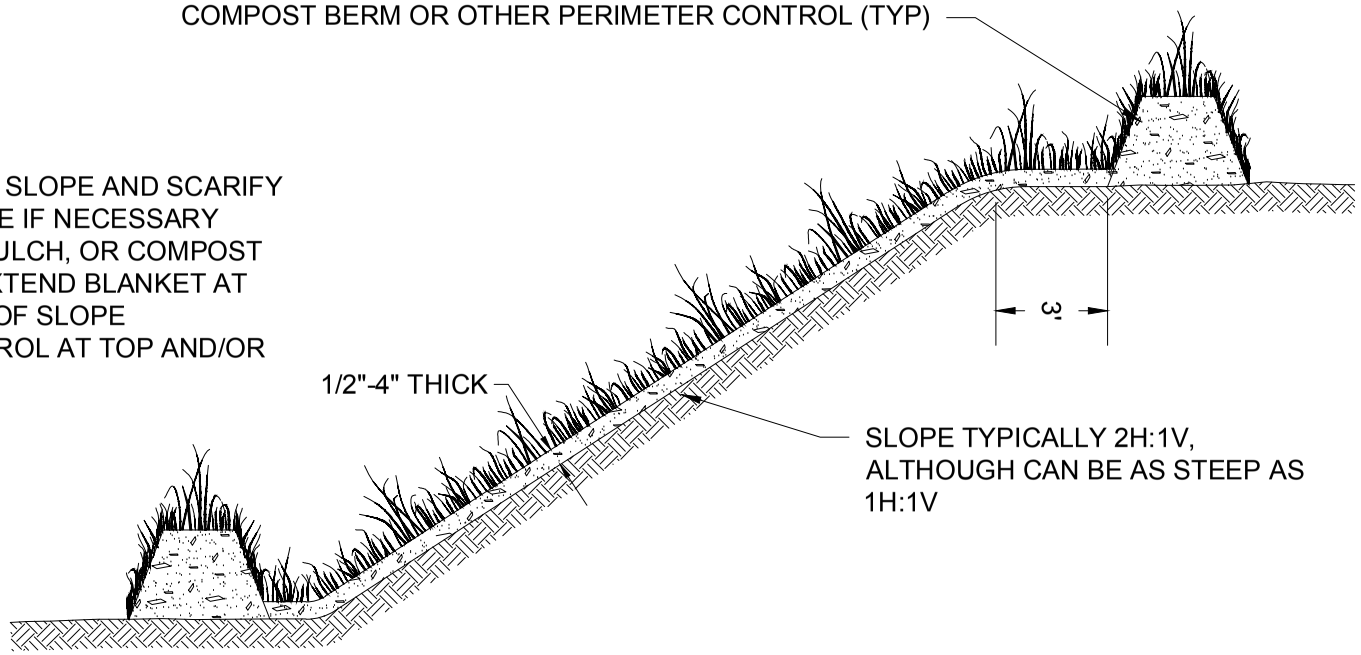
NOTES:

1. REMOVE DEBRIS FROM SLOPE AND SCARIFY
2. TRACKWALK THE SLOPE IF NECESSARY
3. APPLY HYDROSEED, MULCH, OR COMPOST AT SPECIFIED RATE; EXTEND BLANKET AT LEAST 3' BEYOND TOP OF SLOPE
4. ADD PERIMETER CONTROL AT TOP AND/OR BOTTOM OF SLOPE



MULCH MATERIAL TABLE:

MULCH MATERIAL	APPLICATION RATE	DEPTH	NOTES
STRAW	2-3 TONS/ACRE	2-3 INCHES	ONLY FOR SHORT TERM USE (<3 MONTHS); DEPTH MAY BE REDUCED BY HALF IF USED WITH SEED
WOOD FIBER CELLULOSE	1000-1500 LBS/ACRE	N/A	APPLY WITH HYDROMULCHER; REQUIRES USE OF TACKIFIER AND SEED
BONDED FIBER MATRIX (BFM)	3000-4000 LBS/ACRE	N/A	APPLY WITH HYDROMULCHER; REQUIRES USE OF TACKIFIER AND SEED
COMPOST	3-6 TONS/ACRE	2" FOR SLOPES <3:1; 3" FOR SLOPES 2:1	EXCELLENT SOIL AMENDMENT; USE 3/4" FOR SLOPS <3:1 AND 1 1/2" FOR 2:1 SLOPES
WOOD CHIPS OR GRINDINGS	5-6 TONS/ACRE	2" MIN	NOT FOR USE ON SLOPES >10% OR WITHIN 200' OF SURFACE WATER
GRAVEL OR CRUSHED ROCK	9 YARDS/1000 SQUARE FEET	3 INCHES	SUITABLE FOR SHORT SLOPES AND AREAS OF HIGH FOOT TRAFFIC

DRAWN KJR

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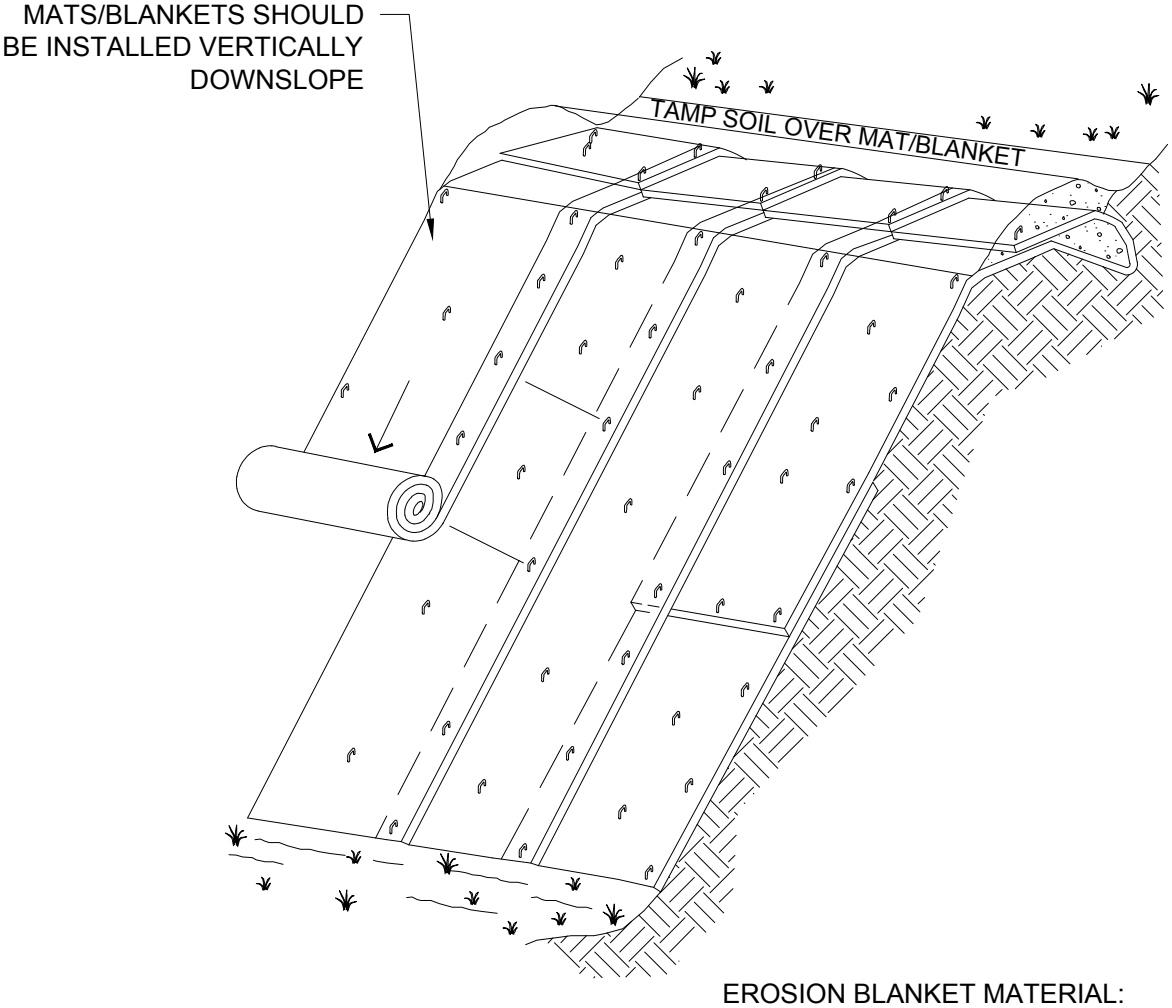
APPR.

DETAIL NO. EPSC-10



ISOMETRIC VIEW

NOTES:

1. SLOPE SURFACE SHALL BE FREE OF ROCKS, CLODS, STICKS AND GRASS; MATS/ BLANKETS SHALL HAVE GOOD SOIL CONTACT
2. APPLY PERMANENT SEEDING BEFORE PLACING BLANKETS
3. LAY BLANKETS LOOSELY AND STAKE OR STAPLE TO MAINTAIN DIRECT CONTACT WITH THE SOIL. DO NOT STRETCH
4. STAPLE ACCORDING TO MANUFACTURER SPECIFICATIONS

EROSION BLANKET MATERIAL:

MATTING TYPE	SLOPE APPLICATION	CHANNEL APPLICATIONS (VELOCITIES IN FEET PER SECOND)
STRAW	3H:1V OR LESS	N/A
JUTE	3H:1V OR LESS, OR SHORT 2H:1V	N/A
CURLED WOOD FIBER (EXCELSIOR)	2H:1V OR LESS	LOW FLOW (<8 FPS)
STRAW/COCONUT	2H:1V OR LESS	N/A
COCONUT	1H:1V OR LESS	LOW FLOW (<8 FPS)
COIR FABRIC	1H:1V OR LESS	MEDIUM FLOW (8-10 FPS)
TURF REINFORCEMENT MAT (TRM)	1H:1V	HIGH FLOW (8-20 FPS)

CITY OF GRESHAM

EROSION BLANKETS AND MATS

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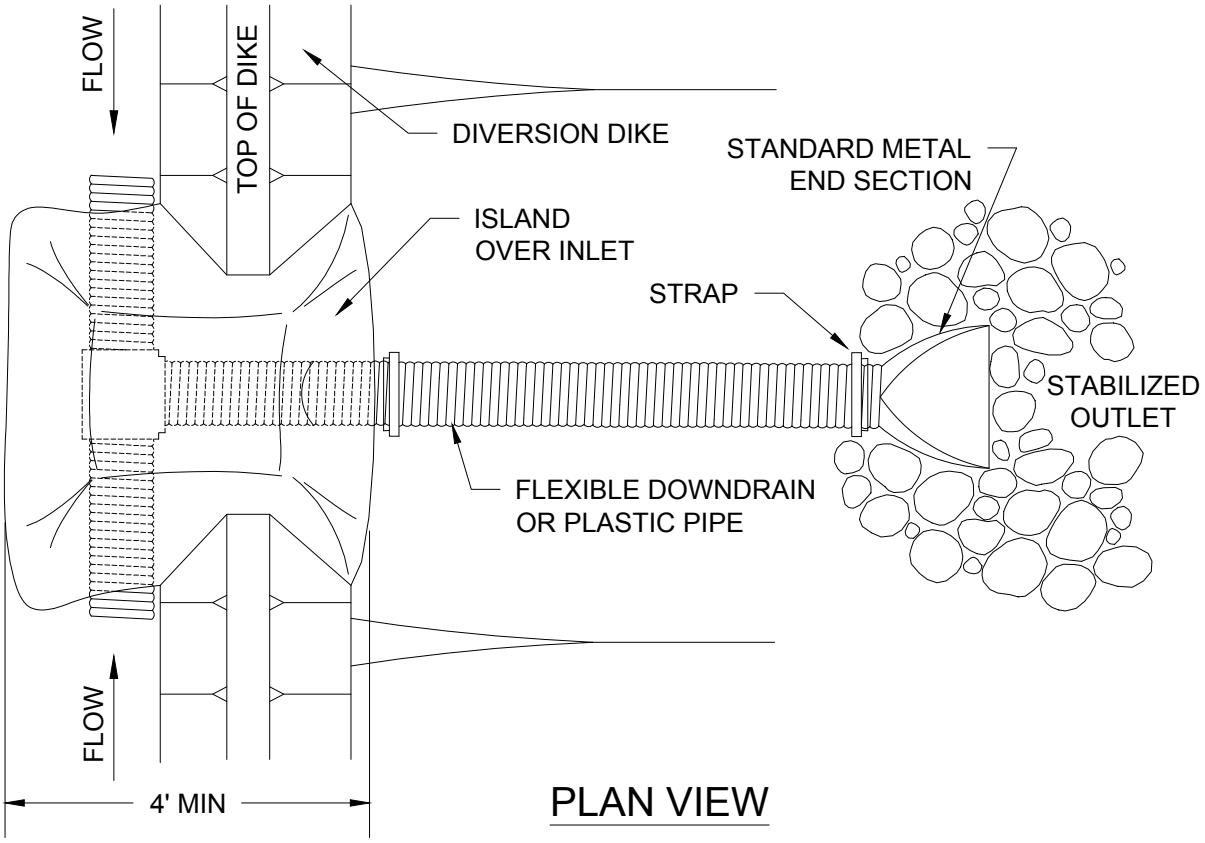
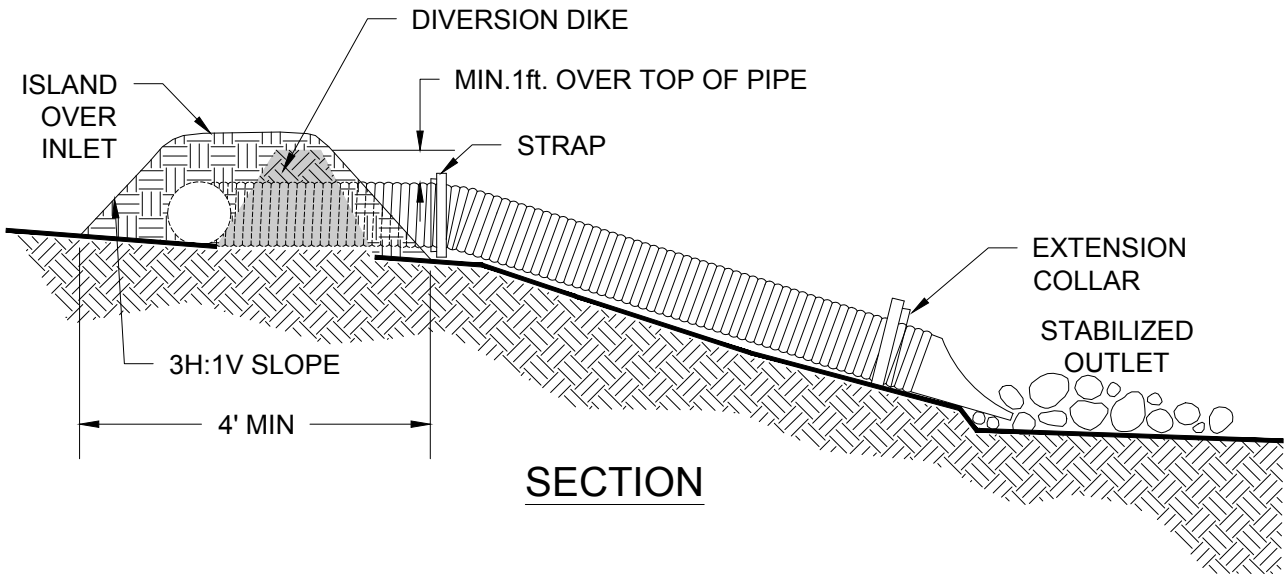
DETAIL NO. EPSC-11



PLAN VIEW



SECTION

NOTES:

1. USE CABLE ANCHOR ON DOWNDRAIN FOR CRITICAL SLOPES OR SLOPES STEEPER THAN 1V:1.5H
2. FASTEN EXPOSED SECTIONS OF PIPE WITH GROMMETS OR STAKES SPACED 10' OR LESS
3. USE CABLE ANCHOR ON DOWNDRAIN FOR CRITICAL SLOPES OR SLOPES STEEPER THAN 1V:5H
4. EXTEND DRAIN BEYOND TOE OF SLOPE AND PROTECT OUTLET FROM EROSION (SEE EPSC-15)

CITY OF GRESHAM

SLOPE DRAIN

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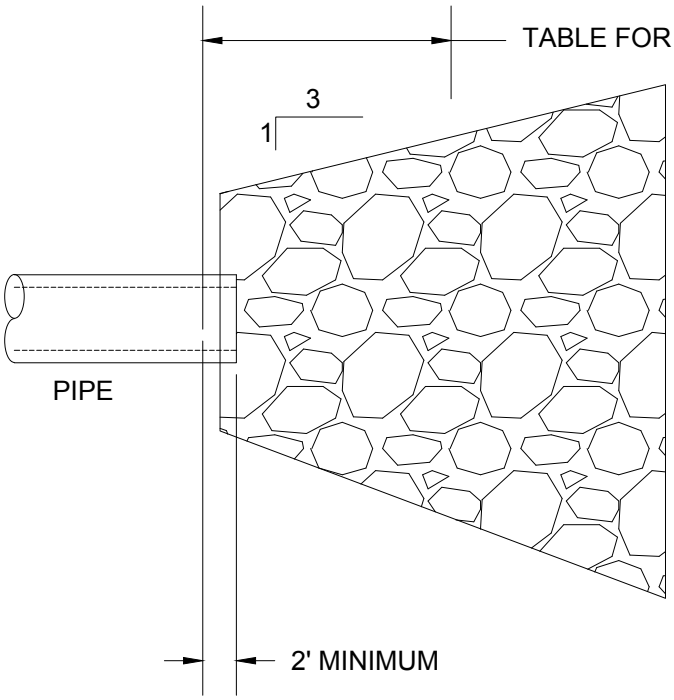
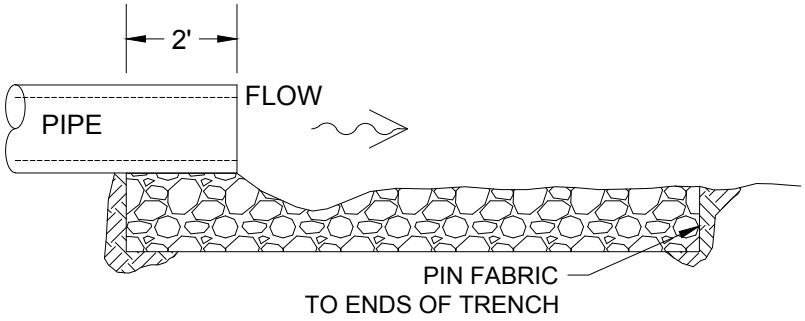
DETAIL NO.	EPSC-14



PLAN VIEW



PROFILE VIEW

NOTES:

1. CONSTRUCT APRON SO FLAT; ZERO GRADE WITH NO OVERFLOW; FILTER FABRIC MUST BE USED; DO NOT TEAR AND OVERLAP JOINTS BY 1' MIN
2. RIPRAP IS FIELD STONE OR ROUGH QUARRY STONE
3. SEE ROCK PROTECTION AT OUTFALLS TABLE IN SECTION 4.05.04 OF PUBLIC WORKS STANDARDS

CITY OF GRESHAM

ENERGY DISSIPATION/OUTLET PROTECTION

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DRAWN	KJR
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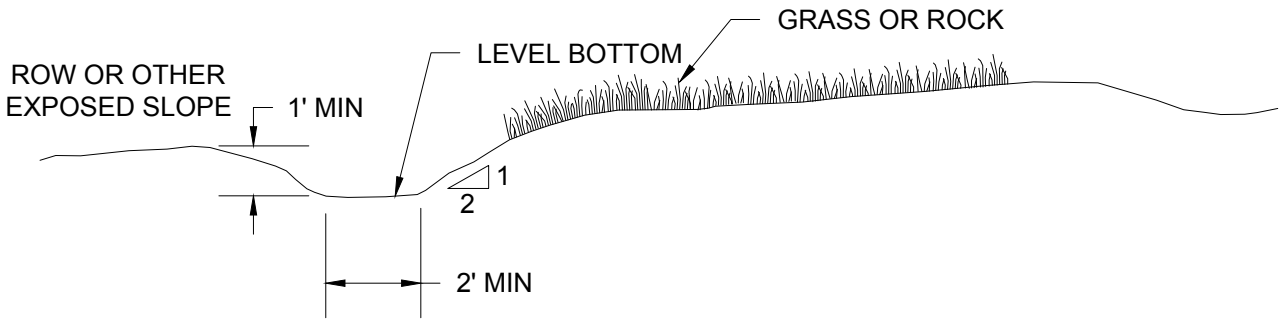
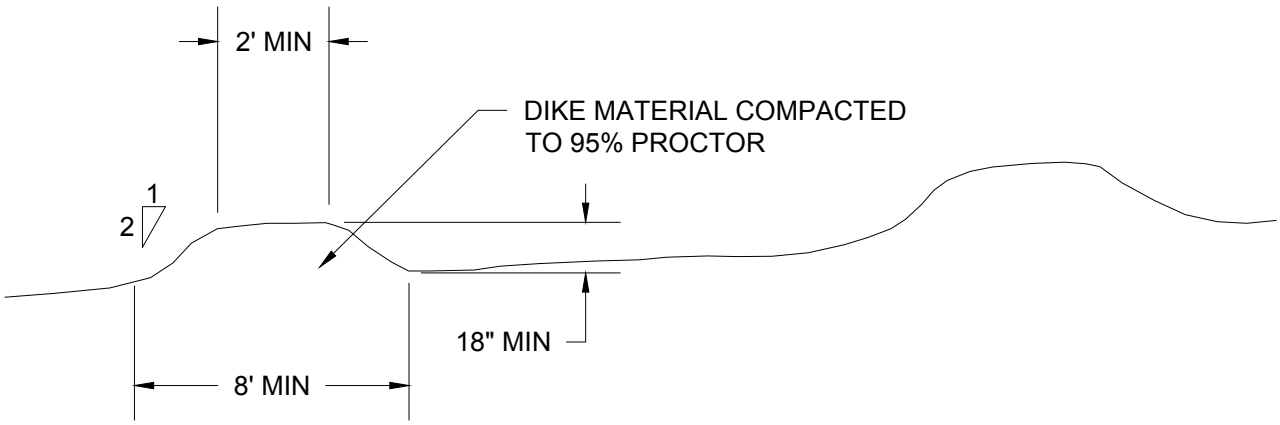
APPR.	
DETAIL NO.	EPSC-15



TOP/BOTTOM WIDTH	2 FEET MINIMUM; THE BOTTOM WIDTH SHALL BE LEVEL
HEIGHT/DEPTH	1 FOOT MINIMUM
SIDE SLOPE	2H:1V OR FLATTER
GRADE	MAXIMUM 5 PERCENT, WITH POSITIVE DRAINAGE TO A SUITABLE OUTLET SUCH AS TEMPORARY SEDIMENT BASIN (SEE EPSC-18)

DIVERSION SWALE



TEMPORARY DIVERSION DIKE

NOTES:

1. IMMEDIATELY UPON CONSTRUCTION, ESTABLISHED VEGETATION OR EROSION MATS (SEE EPSC-11) ARE REQUIRED
2. CHECK DAMS (SEE EPSC-17) MAY BE REQUIRED
3. ENERGY DISSIPATION (EPSC-15) MAY BE REQUIRED AT OUTLET

CITY OF GRESHAM

DIVERSION DIKES/SWALES

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DRAWN	KJR
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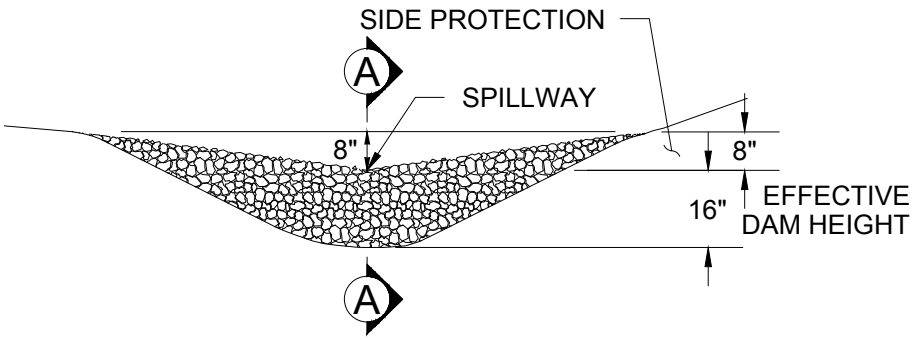
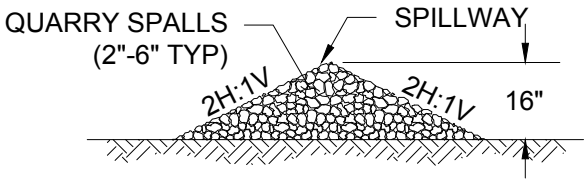
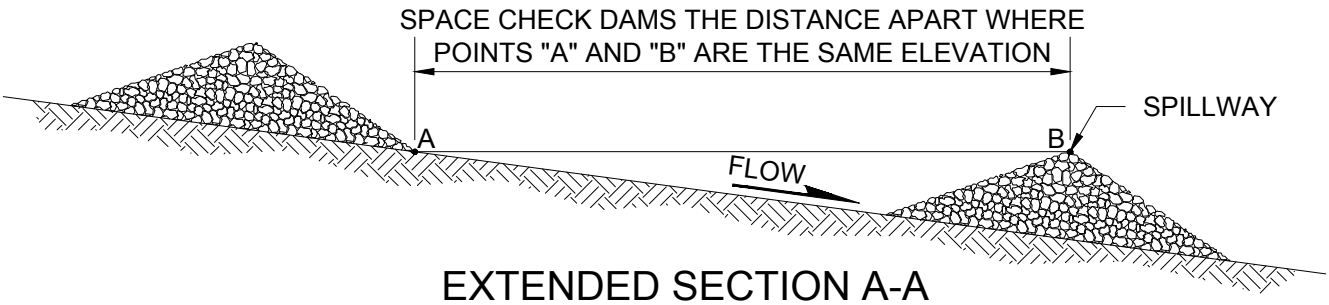
DETAIL NO.	EPSC-16



ELEVATION



SECTION A-A



EXTENDED SECTION A-A

NOTES:

1. UPPER EXTENT MUST BE AT LEAST 6" ABOVE SPILLWAY
2. NOT FOR USE IN STREAMS OR RIVERS
3. CONSTRUCT WITH ROCKS TYPICALLY 2-6"

CITY OF GRESHAM

ROCK CHECK DAM

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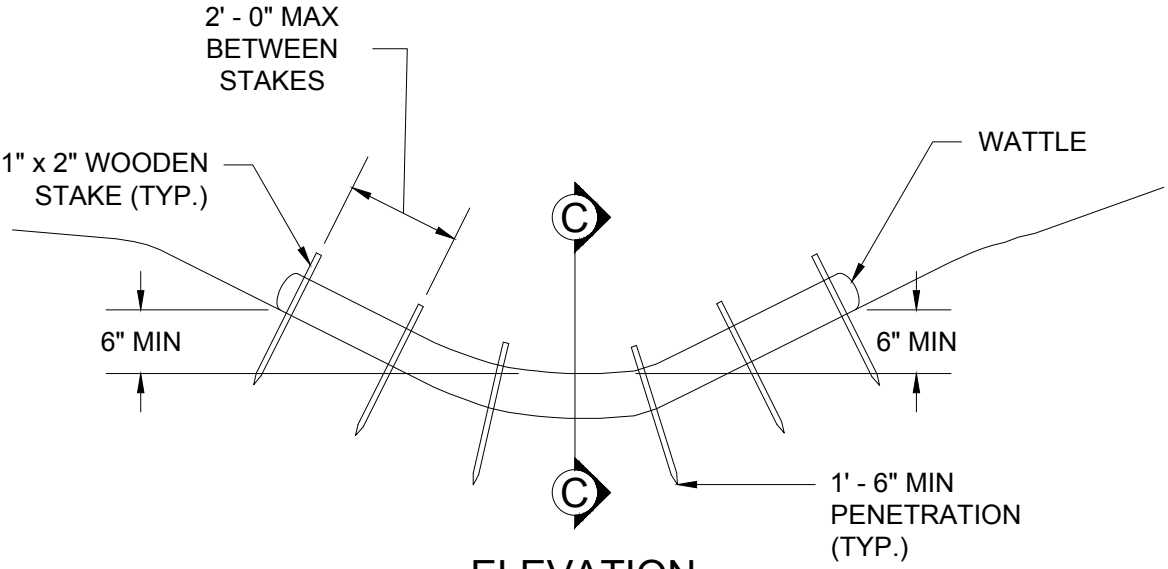
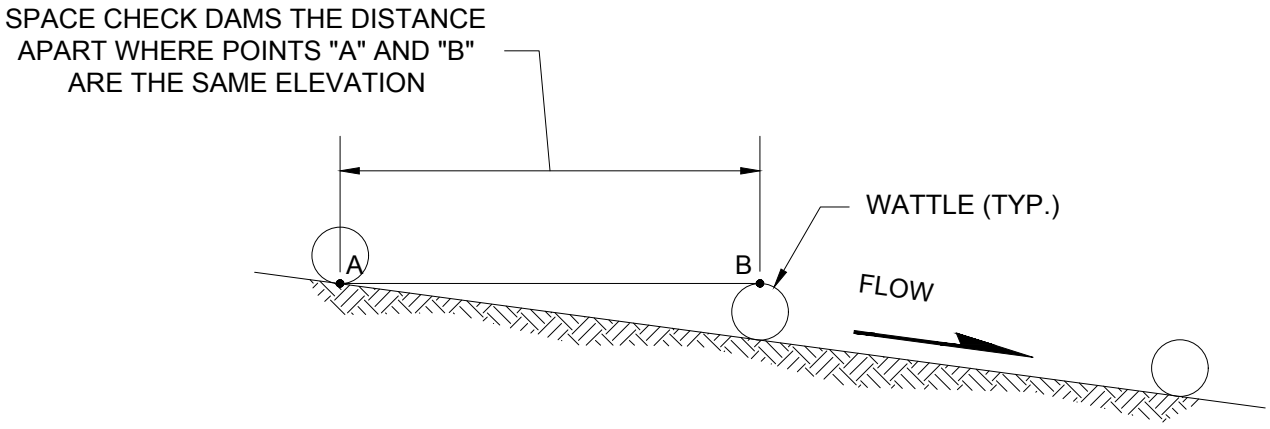
DETAIL NO.	EPSC-17A



ELEVATION



EXTENDED SECTION C-C

NOTES:

1. UPPER EXTENT MUST BE AT LEAST 6" ABOVE SPILLWAY
2. NOT FOR USE IN STREAMS OR RIVERS

CITY OF GRESHAM

WATTLE CHECK DAM

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DRAWN	KJR
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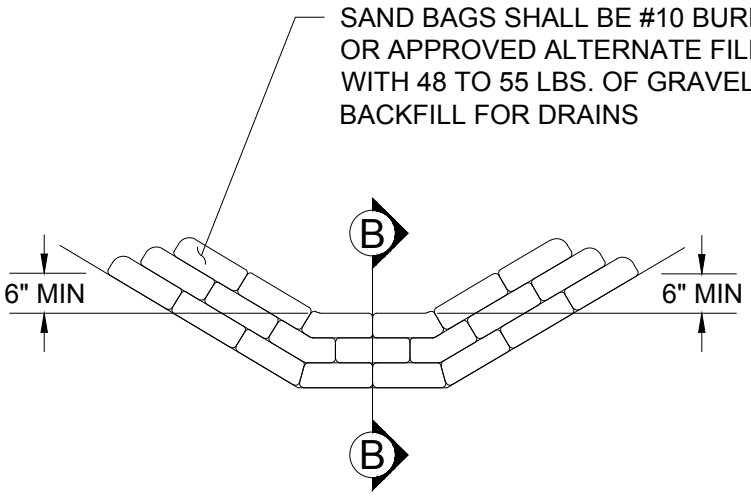
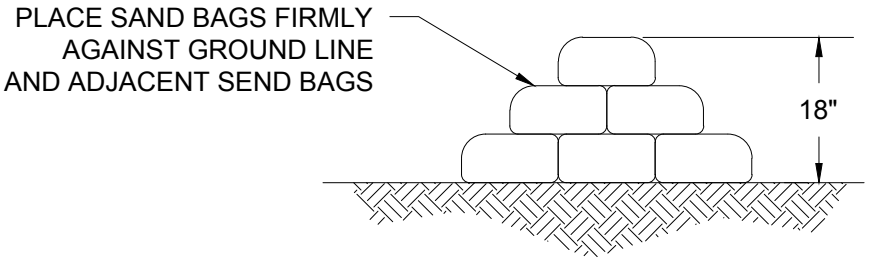
DETAIL NO.	EPSC-17B

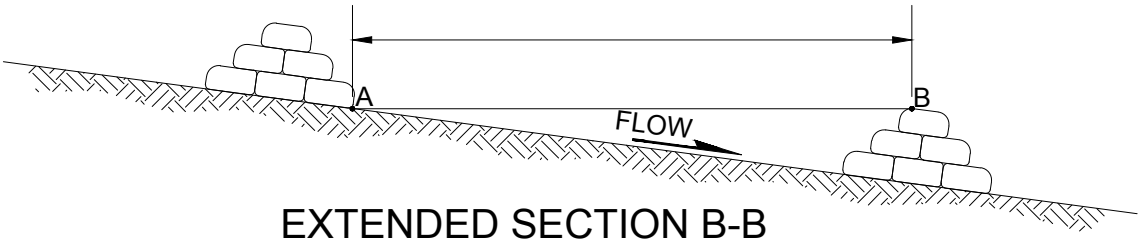


ELEVATION



SECTION B-B

SPACE CHECK DAMS THE DISTANCE APART WHERE
POINTS "A" AND "B" ARE THE SAME ELEVATION



EXTENDED SECTION B-B

NOTES:

1. UPPER EXTENT MUST BE AT LEAST 6" ABOVE SPILLWAY
2. NOT FOR USE IN STREAMS OR RIVERS

CITY OF GRESHAM

SAND BAG CHECK DAM

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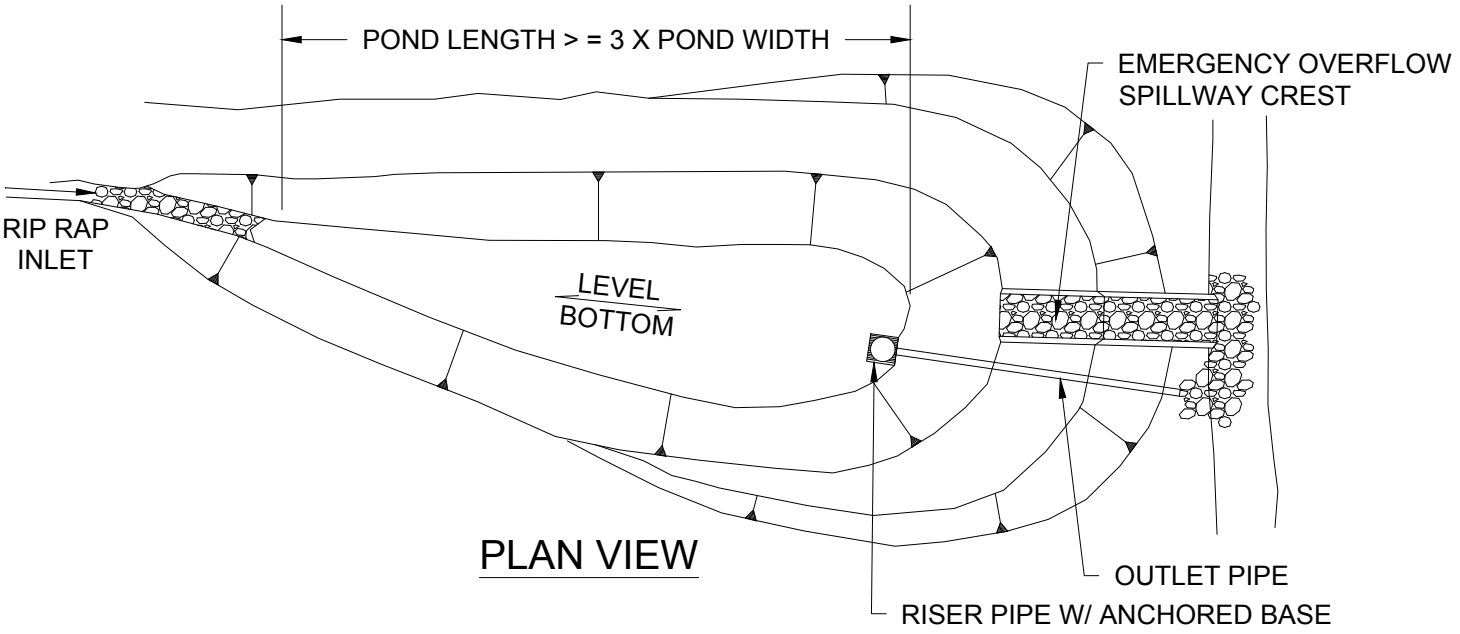
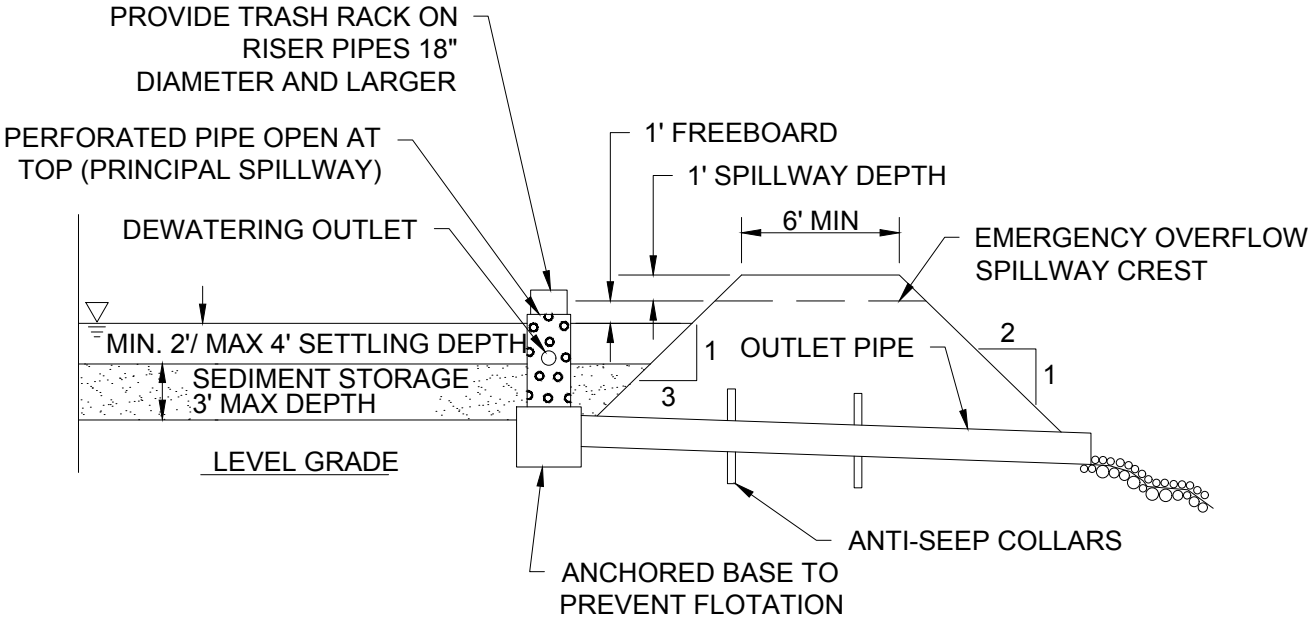
DRAWN	KJR
REV. DATE	SEPT 2014
APPR.	
DETAIL NO.	EPSC-17C



PLAN VIEW



PROFILE

NOTES:

1. 50' MINIMUM OF HIGHLY VEGETATED AREA AND OR SEDIMENT FENCE IS REQUIRED PRIOR TO DISCHARGING TO STREAM OR WETLAND
2. MUST BE DESIGNED BY LICENSED ENGINEER
3. OUTLET SHALL BE SIZED TO EMPTY WITHIN 48 HOURS
4. BASINS SHALL BE SIZED TO RETAIN MIN OF 3,600 FT³ PER ACRE OF DRAINAGE AREA

CITY OF GRESHAM

TEMPORARY SEDIMENT BASIN

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DRAWN	KJR
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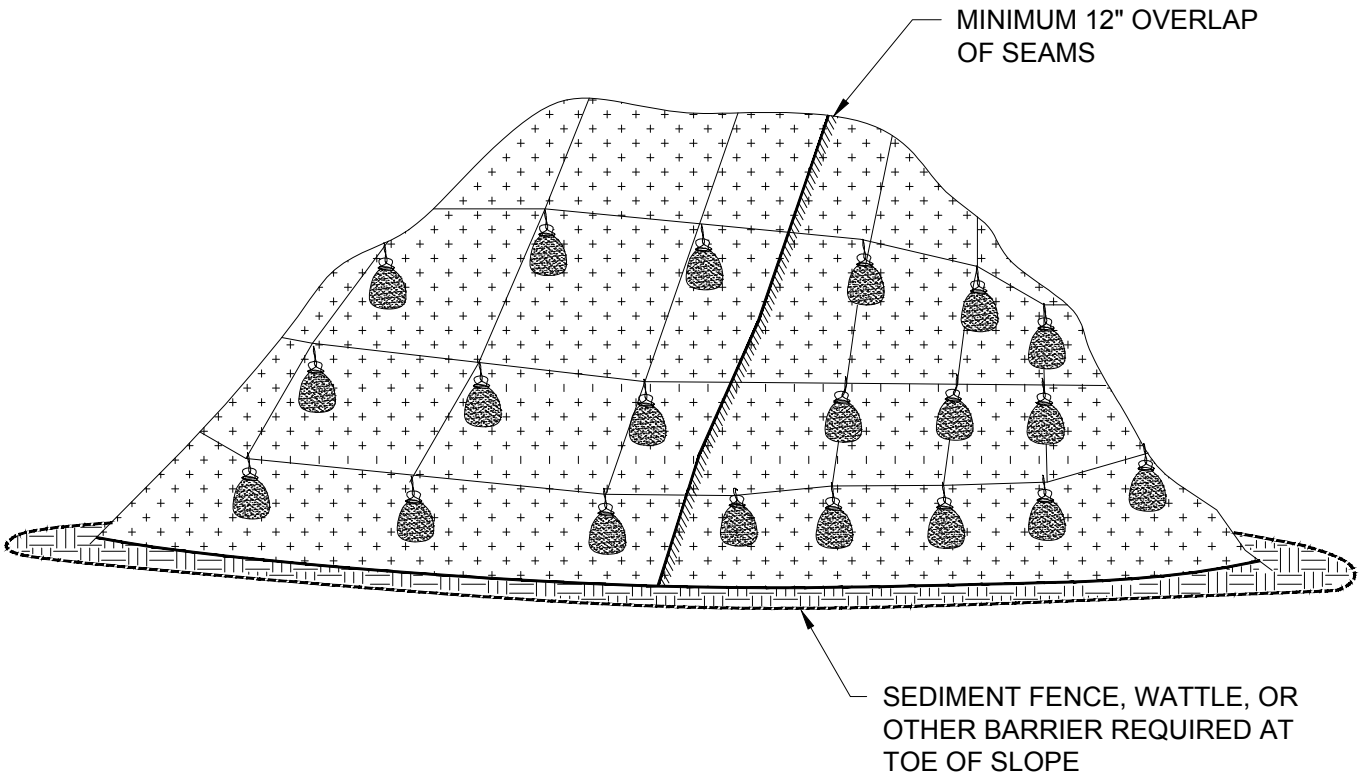
DETAIL NO.	EPSC-18



NOTES:

1. LOCATE MIN 50' FROM INLETS OR WATER BODIES
2. LIMIT STOCKPILE HEIGHT TO 15' UNLESS APPROVED BY CITY
3. STOCKPILES SHALL BE SEEDED WITH VEGETATION OR COVERED WITH PLASTIC OR MULCH PER EPSC-10
4. TEMPORARY SEEDING MUST BE APPLIED WITHIN 2 DAYS DURING WET SEASON (OCT 1-MAY 31) OR WITHIN 7 DAYS DURING DRY SEASON (JUNE 1-SEPT 3)
5. MINIMUM 12" OVERLAP OF ALL SEAMS REQUIRED
6. BARRIER REQUIRED AT TOE OF STOCK PILE
7. COVERING MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10' GRID SPACING IN ALL DIRECTIONS
8. AVOID USING PLASTIC ON STOCKPILE LOCATED ABOVE STEEP OR UNSTABLE SLOPES

CITY OF GRESHAM

SOIL STOCKPILE MANAGEMENT WITH PLASTIC SHEETING

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DRAWN	KJR
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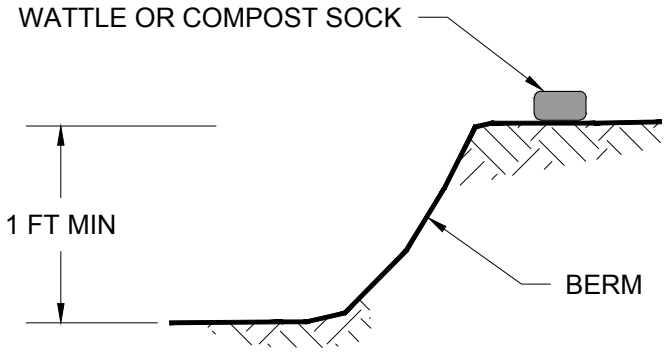
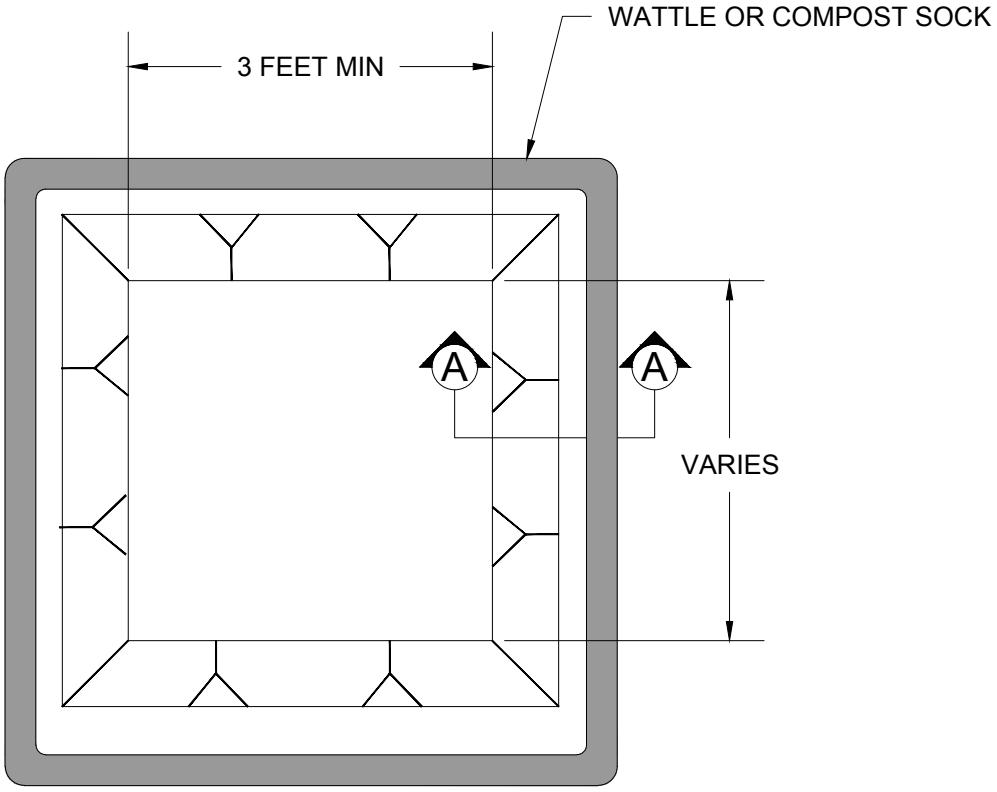
DETAIL NO.	EPSC-20



SECTION A-A



PLAN

NOTES:

1. ACTUAL LAYOUT DETERMINED IN THE FIELD
2. ALL CONCRETE TRUCKS WASHING OUT ON SITE SHALL USE CONCRETE WASHOUT
3. WASHOUT AREA SHALL BE LOCATED AWAY FROM STORM DRAINS AND WATER BODIES
4. EXCAVATED AREA SHALL BE LARGE ENOUGH TO PREVENT CONCRETE SLURRY OVERFLOW; SLURRY FROM CONCRETE CUTTING/CORING OR WORKING SHALL BE SHOVELED OR WET VACUUMED TO PREVENT FROM ENTERING STORM SYSTEM
5. WATTLE, COMPOST SOCK, SAND BAGS OR OTHER CONTAINMENT IS TO BE USED AROUND PERIMETER OF CLEANOUT

CITY OF GRESHAM

CONCRETE MANAGEMENT

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DETAIL NO.	EPSC-21

Appendix D: Stormwater Facility Sizing Methods

There are two methods for sizing stormwater facilities: 1) the Simple Method and 2) the Engineered Method.

Simple Method

The Simple Method uses pre-defined sizing factors to size stormwater facilities based on the amount of new or replaced impervious area which will be added. Background and instructions for using this method are contained in **section 2, "Stormwater Facility Sizing and Submittals."**

The sizing factors in the Simple Sizing Form were calculated using a spreadsheet based on the Santa Barbara Urban Hydrograph following the SCS Type 1A 24-hour storm event using a 10-year event (3.6"/24-hours; see **Table D-1**) where that storm event was stored without overflow from a facility when using the assumed infiltration rates for type A, B, C, and D soils listed in **Table D-2**. Note that in order to meet the requirements outlined in the SWMM, a facility meeting the Simple Method may still need an overflow if the facility cannot retain the 100-year event.

For any project where the sizing factor on the Simple Sizing Form would require facilities larger than those listed in the stormwater management options (**section 1.2.4**), an on-site stormwater 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 1.0**.

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

Engineered Method

The Engineered Method uses hydraulic and hydrologic engineering calculations to size stormwater facilities. This appendix provides requirements for the various hydrologic and hydraulic calculations necessary to determine runoff, flow, volume, storage, conveyance capacity, etc.

Impervious area utilized in calculations may be reduced per the guidelines in **Section 3.1** "Impervious Area Reduction." Hydrologic analysis requirements can be found in **Section 2.3.2** "Engineered Method." The information provided in this appendix is intended to provide guidance for making consistent hydrologic calculations that will be submitted to the City for review.

D.1. Engineered Method Requirements

To meet Design Standard requirements according to the Engineered Method, stormwater facility design flows and volumes shall be determined using the methods, assumptions and inputs specified in this appendix.

For every project, the impervious area shall include the total proposed impervious area, including all streets, driveways, redeveloped areas, and tentative building footprints based on the allowed building coverage and setbacks per the zoning code.

A. Drainage Areas

All hydrologic analyses must include the drainage area of the site being evaluated and all of the upstream contributing basin area, including those areas outside the proposed development site. Drainage calculations for flow control analysis shall include both the pre-developed and the post-developed drainage conditions within the proposed development site.

B. Acceptable Analytical Methods

Facilities may be sized by routing a hydrograph through the facility (rate-based facilities with a storage volume component) using a continuous simulation program (using a minimum of 20 years of Gresham rainfall data) or a single-storm hydrograph-based analysis method. The preferred single-storm hydrograph method for calculating stormwater runoff for stormwater treatment and flow control is the Santa Barbara Urban Hydrograph (SBUH) Method. The Soil Conservation Service Type 1-A, 24-hour rainfall distribution, shall be used in all single storm hydrograph methods.

C. Hydrograph Methods

The following conditions shall be met when evaluating the basin area characteristics using a hydrograph method.

1. Pre-development Conditions

Develop a runoff hydrograph based on the pre-development site conditions including the contributing pervious and impervious areas along with their associated runoff curve numbers. The curve numbers (CN) that should be used are available in **Table D-3.**

2. Post-development Conditions

A runoff hydrograph shall be created from an accurate characterization of the post-development site conditions. The runoff hydrograph shall include the contributing pervious and impervious areas along with their associated runoff CN values (see **Table D-3**). Sub-basins shall be delineated and routed together when appropriate. A separate analysis of just the impervious area shall also be performed. The larger of the two hydrographs shall be used for design.

D. Rational Method

The Rational Method may only be used to determine the peak flow for sizing conveyance systems with contributing drainage areas less than ten acres. Since conveyance systems are designed for post-

development conditions, **the time of concentration shall be a maximum of ten minutes and a minimum of five minutes.**

D.2. Stormwater Treatment and Flow Control Design Storm Events

As specified in Section 1 "Requirements", where stormwater treatment facilities are required, they must be designed to treat 80 percent of the average annual rainfall – this water quality event is equal to 1.2 inches in a 24-hour period.

For sites where full retention/infiltration is not feasible, the methods described in this appendix shall be used to demonstrate that the post-development runoff volumes and flow rates are controlled so that:

- The 2-year, 24-hour post-development peak flow rate is restricted to at least one-half of the 2-year, 24-hour pre-development design storm peak flow; and
- Post-development flows from the 10-, and 25-year, 24-hour design storm peak flows are equal to or less than the predevelopment 10-, and 25-year design storm at 24-hour levels.

D.3. Hydrograph Methods

A hydrograph method, such as the Santa Barbara Urban Hydrograph (SBUH) method, shall be used to determine the design flows and volumes for all stormwater facilities when using the Engineered Method. Hydrograph methods use the physical characteristics of the site and a design storm to determine the magnitude, volume, and duration of the runoff hydrograph if a software package is utilized. Documentation of the software used shall be submitted with the results, along with all assumptions and input values.

The typical input information needed for hydrograph methods are:

1. Basin area characteristics – pervious and impervious land areas
2. 24-hour type 1A rainfall distribution
3. Total 24-hour rainfall amount
4. Runoff Curve Numbers (CN) applicable to site
5. Time of Concentration

D.3.1 Basin Area Characteristics

For the highest degree of accuracy in hydrograph analysis, proper selection of homogeneous basin areas is needed. Significant differences in land use within a given basin must be addressed by dividing the basin area into sub-basins with similar land use and/or runoff characteristics. Hydrographs should be computed for each sub-basin area and superimposed to form the total runoff hydrograph for the basin.

All pervious and impervious areas within a given basin or sub-basin shall be analyzed separately. By analyzing pervious and impervious areas separately, the cumulative errors associated with averaging these areas are avoided, resulting in a more accurate runoff hydrograph.

D.3.2 Rainfall Distribution and Depth

The rainfall distribution to use within the City is the design storm for a 24-hour duration based on the standard NRCS Type 1A rainfall distribution. This distribution is contained in **Table D-5**.

Table D-1 contains the 24-hour rainfall totals that shall be used in determining the runoff hydrograph for various sized storm events.

Table D-1. 24-hour rainfall depths for Gresham, OR

Recurrence Interval (Years)	WQ	2	10	25	50	100
24-hour Rainfall (inches)	1.2	2.8	3.6	4.0	4.4	4.9

D.3.3 Runoff Curve Number (CN)

Runoff curve numbers were developed by the Natural Resources Conservation Service (NRCS) after studying the runoff characteristics of various types of land. Curve numbers (CN) were developed to consolidate diverse characteristics such as soil type, land usage, and vegetation into a single variable for computing runoff.

Runoff CNs to be used in the hydrograph methods are included in **Table D-3**. The CN values are based on the hydrologic soil groups described in **Tables D-2a** and **D-2b**. 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 for that modeled impervious surface.

The CN values in **Table D-3** are for wet antecedent moisture conditions. Wet conditions assume previous rainstorms have reduced the capacity of soil to absorb water. Given the frequency of rainstorms in the Gresham area, wet conditions are most likely, and give conservative hydrographic values.

Table D-2a. Gresham soil types from the Natural Resource Conservation Service's (NRCS) Soil Survey of Multnomah County (1983, Table 24). The NRCS soil maps can be found on-line at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Soil Survey Map ID#	Soil Group	Hydrologic Soil Group
1	Aloha silt loam	C
2	Aloha-Urban land complex	C
7	Cascade silt loam	C
10	Cornelius silt loam	C
25	Latourell loam	B
26	Latourell-Urban land complex	B
29	Multnomah silt loam	B
30	Multnomah-Urban land complex	B
34	Powell silt loam	D
36	Quafeno loam	C
37	Quatama loam	C

Soil Survey Map ID#	Soil Group	Hydrologic Soil Group
38	Quatama-Urban land complex	C
40	Rafton silt loam	C/D
45	Sauvie silt loam	C/D
46	Sauvie silty clay loam	C/D
51	Urban land-Latourell complex	B
54	Urban land- Quatama complex	C
55	Wapato silt loam	D
57	Wollent silt loam	D

Table D-2b. Hydrologic soil group descriptions from NRCS. The ~~assumed~~ infiltration rates in this table are the values used in developing the Simple Sizing Form and are listed for reference. These should ~~not~~ also be used for the Engineered Method unless an Engineer or Geotechnical Engineer specifies a lower infiltration rate~~, as those projects require infiltration testing following guidance in **Appendix E**~~.

~~NRCS~~ Hydrologic Soil Group	Assumed Infiltration Rate	Description
Group A	4”/hour	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.
Group B	2”/hour	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
Group C	0.5”/hour	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have a moderately fine texture or fine texture. These soils have a slow rate of water transmission.
Group D	0.1”/hour	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a fragipan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Source: USDA/NRCS National Engineering Handbook, Chapter 7 “Hydrologic Soil Groups” (2007)

Table D-3. Runoff Curve Number (CN) values for NRCS Hydrologic Soil Groups

Cover Description	A	B	C	D
Pervious Surfaces				
Compacted lawn.	68	79	86	89

Cover Description	A	B	C	D
Un-amended soil				
Pasture or grass/lawn with **amended soil**	39	61	74	80
Grass/Woods combination	32	58	72	79
Forest/Woods	30	55	70	77
Impervious Surfaces				
Paved roads, parking lots, roofs, driveways	98	98	98	98
Gravel roads and parking areas	76	85	89	91
Compacted Dirt	72	82	87	89
Green Practices				
Pervious Pavement	76	85	89	91
Trees	36	60	73	79
Green Roof	61	61	61	61
Infiltration and Filtration Stormwater Planter	30	48	65	73

Sources: Pervious and impervious values are from National Engineering Handbook (2004). Values for green practices come from Portland's Stormwater Management Manual

D.3.4 Time of Concentration (T_c)

Time of concentration, T_c, is the time for a theoretical drop of water to travel from the furthest point in the drainage basin to the facility being designed.

T_c is derived by calculating the overland flow time of concentration and the channelized flow time of concentration. T_c depends on several factors, including ground slope, ground roughness, and distance of flow.

Total time of concentration should be a minimum of 10 minutes for pre-developed conditions and a minimum of 5 and 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 calculated and documented by the engineer of record and may exceed 10 minutes.

Calculations for total T_c should be divided into three segments: sheet flow, shallow concentrated flow, and channel/pipe flow. The total time of concentration (T_c) is calculated as:

$$T_c = T_{osf} + T_{scf} + T_{ocf}$$

Time of concentration for overland sheet flow (T_{osf}). For the first 300 feet of overland flow, the sheet flow time of concentration can be calculated with the kinematic wave equation:

$$Sheet\ flow\ T_{osf} = \frac{0.42(nL)^{0.8}}{P^{0.5} * s^{0.4}}$$

T_{osf}	=	Flow time for overland sheet flow (minutes)
L	=	Overland Flow Length (feet)
n	=	Manning's Roughness Coefficient (See **Table D-4**)
P	=	Rainfall event (inches/24 hours)
s	=	Average Slope of Overland Area (foot/foot)

Time of concentration for shallow concentrated flow (T_{scf}). For overland flow distances greater than 300 feet, sheet flow typically becomes shallow concentrated flow. The average velocity for this flow can be determined from **Figure D-2**, where the average velocity is a function of watercourse slope and surface type.

$$Shallow\ concentrated\ flow, T_{scf} = \frac{L}{60(V)(s)^{0.5}}$$

Tscf	=	Flow time for shallow concentrated flow (minutes)
L	=	Flow Length (feet)
V	=	Velocity Factor Coefficient
s	=	Slope of Land Segment (feet/feet)

Time of concentration for open channel flow (T_{ocf}). For open channels, Manning's equation should be used to estimate average flow velocity.

$$Open\ channel\ flow, T_{ocf} = \frac{L}{60(V)(s)^{0.5}}$$

T_{ocf}	=	Flow Time for open channel flow (minutes)
L	=	Flow Length (feet)
V	=	Flow Velocity (feet/second) (See **Figure D-2**)
s	=	Slope of Land Segment (feet/feet)

Table D-4. Manning's Roughness Coefficients for Overland Sheet Flow

Surface Types:	**n**
Impervious Areas	0.014
Gravel Pavement	0.02
Developed: Landscape Areas (Except Lawns)	0.08
Undeveloped: Meadow, Pasture, or Farm	0.15
Developed: Lawns	0.24
Pre-developed: Mixed	0.30
Pre-developed: Woodland and Forest	0.40
Development Types:	**n**
Commercial Development	0.015
Industrial Development, Heavy	0.04
Industrial Development, Light	0.05
Dense Residential (over 6 units/acre)	0.08
Normal Residential (3 to 6 units/acre)	0.20
Light Residential (1 to 3 units/acre)	0.30
Parks	0.40

D.4. Santa Barbara Urban Hydrograph (SBUH) Equations

Abstract Runoff Value $$S = \left(\frac{1000}{CN}\right) - 10$$

Runoff Depth $$D(t) = \frac{(Pt - 0.2(S))^2}{(Pt + 0.8(S))}$$

Total Runoff $$R(t) = D(t) - D(t-1)$$

Instantaneous Hydrograph $$I(t) = \frac{60.5(R(t))A}{dt}$$

Design Flow Rate $$Q(t+1) = Q(t) + w(I(t) + I(t+1) - 2Q(t))$$

Where:

CN	=	Curve Number
D(t)	=	Depth of Runoff at Time (t)
Pt	=	Precipitation for the Time Increment
A	=	Basin Area in acres
Dt	=	Time Interval in Ten Minute Increments
w	=	$dt/(2T_c + dt)$
T_c	=	Time of Concentration for the Drainage Basin

Storage Determination

Inflow–Outflow=Change in Storage $[(I_1 + I_2)/2] - [(O_1 + O_2)/2] = S_1 - S_2$

Where:

I	=	Inflow at Time 1 and Time 2
O	=	Outflow at Time 1 and Time 2
S	=	Storage at Time 1 and Time 2

The time interval, Δt, must be consistent with the time interval used in developing the inflow hydrograph. The time interval used for a 24-hour storm is ten minutes. The terms I_1, I_2, O_1, and S_1 are known from the inflow hydrograph and from the storage and outflow values of the previous time step. The unknowns O_2 and S_2 can be solved iteratively from the given stage-storage and stage-discharge curves.

Figure D-1. Average velocity of shallow concentrated flow. From Figure III-2 in *Soil Conservation Service Handbook (1972).*

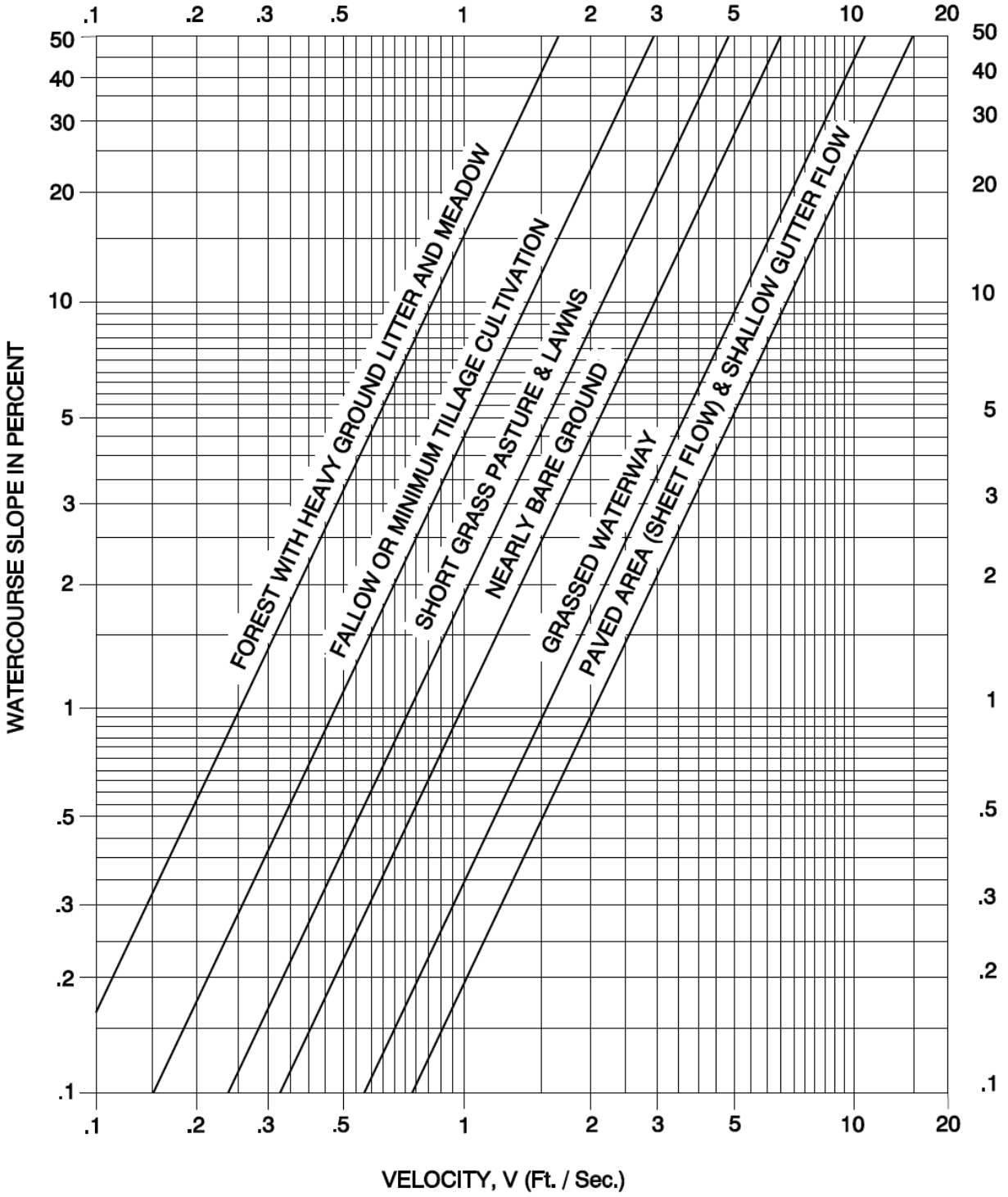


Table D-5. NRCS 24-Hour Type IA Rainfall Distribution

Time from Start of Storm (Minutes)	% Rainfall	Cumulative % Rainfall	**Time from Start of Storm (Minutes)**	% Rainfall	Cumulative % Rainfall	**Time from Start of Storm (Minutes)**	% Rainfall	Cumulative % Rainfall	**Time from Start of Storm (Minutes)**	% Rainfall	Cumulative % Rainfall
10	0.40	0.40	**370**	0.95	22.57	**730**	0.72	67.40	**1090**	0.40	86.00
20	0.40	0.80	**380**	0.95	23.52	**740**	0.72	68.12	**1100**	0.40	86.40
30	0.40	1.20	**390**	0.95	24.47	**750**	0.72	68.84	**1110**	0.40	86.80
40	0.40	1.60	**400**	0.95	25.42	**760**	0.72	69.56	**1120**	0.40	87.20
50	0.40	2.00	**410**	1.34	26.76	**770**	0.57	70.13	**1130**	0.40	87.60
60	0.40	2.40	**420**	1.34	28.10	**780**	0.57	70.70	**1140**	0.40	88.00
70	0.40	2.80	**430**	1.34	29.44	**790**	0.57	71.27	**1150**	0.40	88.40
80	0.40	3.20	**440**	1.80	31.24	**800**	0.57	71.84	**1160**	0.40	88.80
90	0.40	3.60	**450**	1.80	33.04	**810**	0.57	72.41	**1170**	0.40	89.20
100	0.40	4.00	**460**	3.40	36.44	**820**	0.57	72.98	**1180**	0.40	89.60
110	0.50	4.50	**470**	5.40	41.84	**830**	0.57	73.55	**1190**	0.40	90.00
120	0.50	5.00	**480**	2.70	44.54	**840**	0.57	74.12	**1200**	0.40	90.40
130	0.50	5.50	**490**	1.80	46.34	**850**	0.57	74.69	**1210**	0.40	90.80
140	0.50	6.00	**500**	1.34	47.68	**860**	0.57	75.26	**1220**	0.40	91.20
150	0.50	6.50	**510**	1.34	49.02	**870**	0.57	75.83	**1230**	0.40	91.60
160	0.50	7.00	**520**	1.34	50.36	**880**	0.57	76.40	**1240**	0.40	92.00
170	0.60	7.60	**530**	0.88	51.24	**890**	0.50	76.90	**1250**	0.40	92.40
180	0.60	8.20	**540**	0.88	52.12	**900**	0.50	77.40	**1260**	0.40	92.80
190	0.60	8.80	**550**	0.88	53.00	**910**	0.50	77.90	**1270**	0.40	93.20
200	0.60	9.40	**560**	0.88	53.88	**920**	0.50	78.40	**1280**	0.40	93.60
210	0.60	10.00	**570**	0.88	54.76	**930**	0.50	78.90	**1290**	0.40	94.00
220	0.60	10.60	**580**	0.88	55.64	**940**	0.50	79.40	**1300**	0.40	94.40
230	0.70	11.30	**590**	0.88	56.52	**950**	0.50	79.90	**1310**	0.40	94.80
240	0.70	12.00	**600**	0.88	57.40	**960**	0.50	80.40	**1320**	0.40	95.20
250	0.70	12.70	**610**	0.88	58.28	**970**	0.50	80.90	**1330**	0.40	95.60
260	0.70	13.40	**620**	0.88	59.16	**980**	0.50	81.40	**1340**	0.40	96.00
270	0.70	14.10	**630**	0.88	60.04	**990**	0.50	81.90	**1350**	0.40	96.40
280	0.70	14.80	**640**	0.88	60.92	**1000**	0.50	82.40	**1360**	0.40	96.80
290	0.82	15.62	**650**	0.72	61.64	**1010**	0.40	82.80	**1370**	0.40	97.20
300	0.82	16.44	**660**	0.72	62.36	**1020**	0.40	83.20	**1380**	0.40	97.60
310	0.82	17.26	**670**	0.72	63.08	**1030**	0.40	83.60	**1390**	0.40	98.00
320	0.82	18.08	**680**	0.72	36.80	**1040**	0.40	84.00	**1400**	0.40	98.40
330	0.82	18.90	**690**	0.72	64.52	**1050**	0.40	84.40	**1410**	0.40	98.80
340	0.82	19.72	**700**	0.72	65.24	**1060**	0.40	84.80	**1420**	0.40	99.20
350	0.95	20.67	**710**	0.72	65.96	**1070**	0.40	85.20	**1430**	0.40	99.60
360	0.95	21.62	**720**	0.72	66.68	**1080**	0.40	85.60	**1440**	0.40	100.0

D.5. Rational Method

The rational method may be used for analyzing conveyance from small drainage basins, ten acres or less in size, with the following restrictions:

1. May only be used for determining the peak flow for determining the required capacity of conveyance elements.

2. The time of concentration shall be a maximum of ten minutes and a minimum of five minutes.

3. For areas larger than ten acres in size, one of the hydrograph methods listed in the next section shall be used to determine the peak flow conditions.

Rational Method Equation

The rational method calculation shall be made as follows: $Q = C_y \times C \times I \times A$

Q	=	Peak flow (cubic feet/second)
C_y	=	Runoff Coefficient adjustment factor (see **Table D-7** for Runoff Coefficient Adjustment Factors)
C	=	Runoff Coefficient
I	=	Rainfall Intensity (inches/hour)
A	=	Drainage Area (acres)

Runoff Coefficient "C"

The runoff coefficient is difficult to estimate because it represents the interaction of many complex factors including surface ponding, infiltration, antecedent moisture, ground cover conditions, ground slopes, and soil type. The actual runoff coefficient for a given drainage basin can best be approximated by calculating a weighted average of all distinct surface types:

$$C_{av} = \frac{\sum C_x A_x}{A_{total}}$$

Table D-6. Runoff Coefficients (C)

Developed Surface Types	Flat 0% to 2%	Rolling 2% to 10%	Hilly Over 10%
Impervious Areas	0.9	0.9	0.9
Gravel Pavement	0.5	0.55	0.6
Landscape Areas (Except Lawns)	0.3	0.35	0.4
Lawns	0.17	0.22	0.35
Pre-developed Surface Types			
Meadow, Pasture, or Farm	0.25	0.3	0.35
Mixed	0.15	0.2	0.25
Woodland and Forest	0.1	0.15	0.2
Development Types			
Commercial Development	0.8	0.85	0.9
Industrial Development, Heavy	0.7	0.8	0.9
Dense Residential (over 6 units/acre)	0.7	0.75	0.8
Industrial Development, Light	0.6	0.7	0.8
Normal Residential (3 to 6 units/acre)	0.5	0.55	0.6
Light Residential (1 to 3 units/acre)	0.35	0.4	0.45
Parks	0.15	0.2	0.25

Runoff Coefficient Adjustment Factor

The runoff coefficients listed in **Table D-6**, above, are applicable for a storm with a recurrence interval of ten years or less. Less frequent, higher intensity storms require adjusted runoff coefficients because infiltration and other losses have a proportionally smaller effect on runoff. Runoff coefficient adjustment factors (C_y) for storms of different recurrence intervals are listed in **Table D-7**.

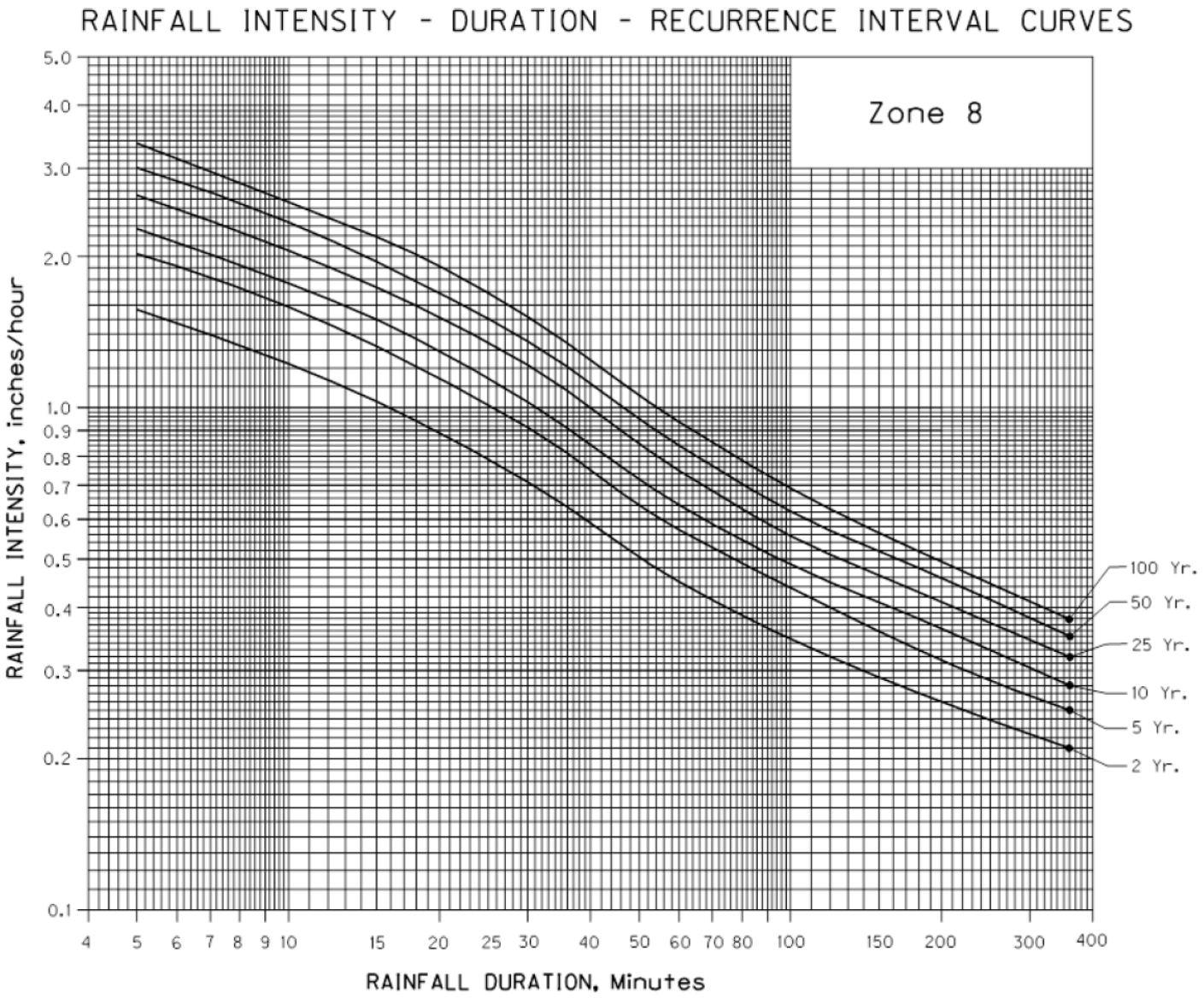
Table D-7. Runoff Coefficient Adjustment Factors

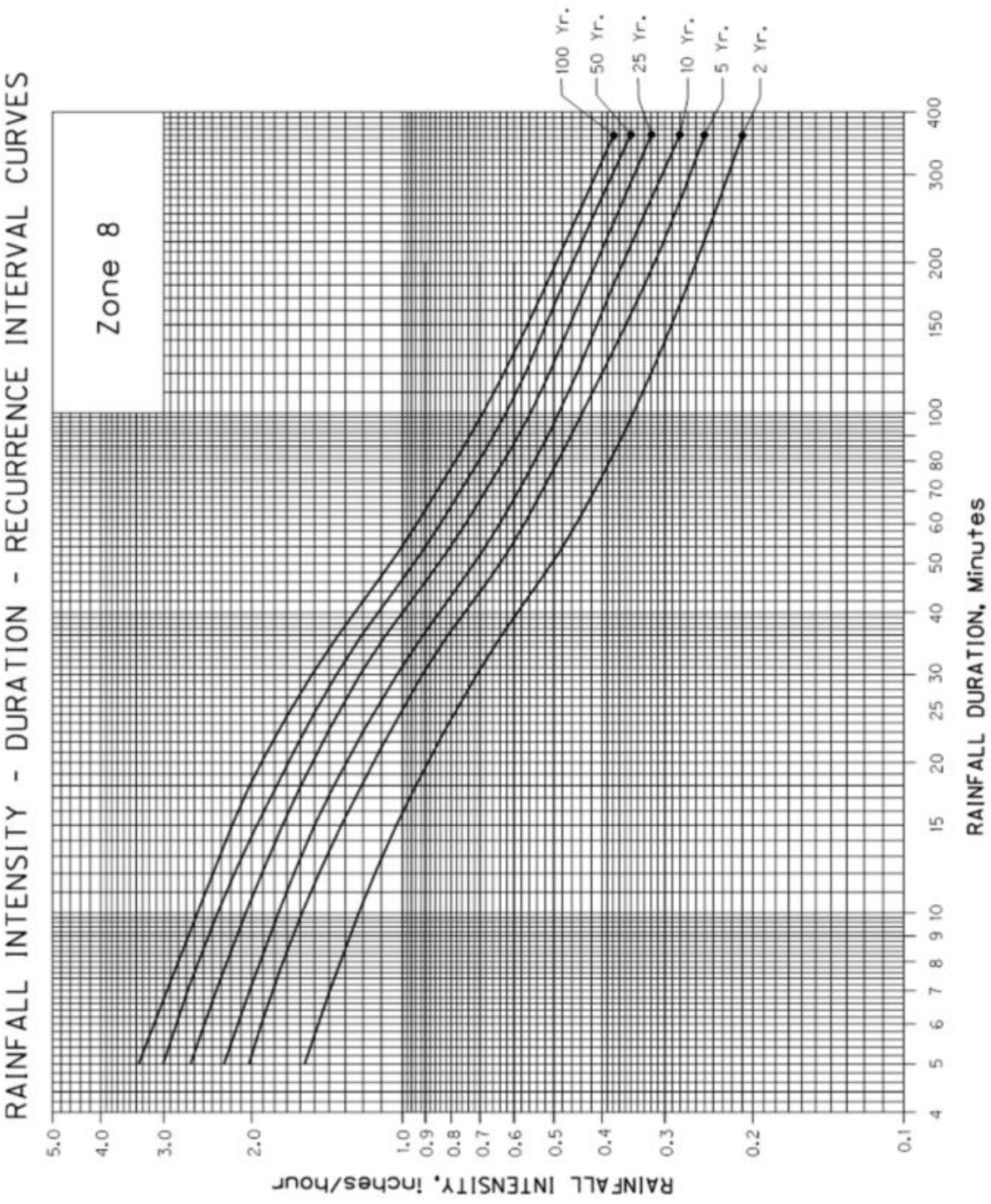
Recurrence Interval	Runoff Coefficient Adjustment Factor (C_y)
10 years or less	1.0
25 years	1.1
50 years	1.2
100 years	1.25

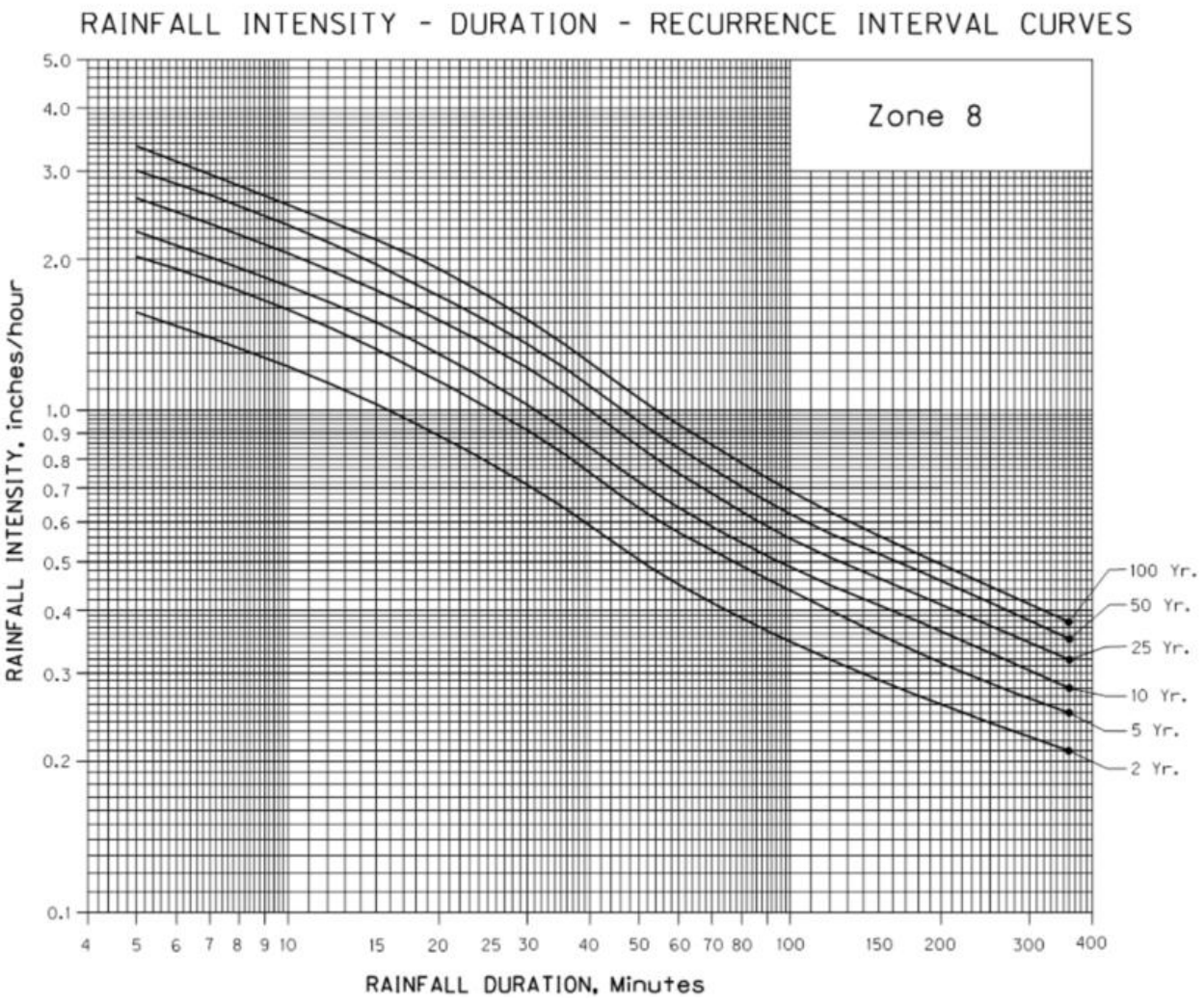
Rainfall Intensity "I"

The cumulative rainfall intensity shall be derived from the Rainfall Intensity-Duration-Frequency curve (Gresham is in Zone 8, see **Figure D-2**). The design storm interval is typically based on the longest time of concentration for the drainage area.

Figure D-2. Rainfall Intensity-Duration-Frequency curve




RAINFALL INTENSITY - DURATION - RECURRENCE INTERVAL CURVES
Zone 8
100 Yr.
50 Yr.
25 Yr.
10 Yr.
5 Yr.
2 Yr.
RAINFALL INTENSITY, inches/hour
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
RAINFALL DURATION, Minutes
4
5
6
7
8
9
10
15
20
25
30
40
50
60
70
80
100
150
200
300
400


RAINFALL INTENSITY - DURATION - RECURRENCE INTERVAL CURVES
Zone 8
RAINFALL INTENSITY, inches/hour
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
4
5
6
7
8
9
10
15
20
25
30
40
50
60
70
80
100
150
200
300
400
RAINFALL DURATION, Minutes
100 Yr.
50 Yr.
25 Yr.
10 Yr.
5 Yr.
2 Yr.

Appendix E: Infiltration Testing

To properly size and locate stormwater management facilities, it is necessary to characterize the soil infiltration conditions at the location of the proposed facility. Projects following the Simple Method utilize assumed soil infiltration rates based on soil type. Projects following the Simple Method that will be adding >10,000 sf of impervious may want to perform an infiltration test to ensure that the assumptions used in developing the sizing factors on the Simple Sizing Form are appropriate for site conditions (e.g. soil infiltration rates, in inches per hour, assumed for soil types are A = 4"/hr, B = 2"/hr, C = 0.5"/hr, D = 0.1"/hr).

All projects following the Engineered Method must evaluate existing site conditions and determine the infiltration rate prior to facility design. An infiltration test is also required for sites trying to demonstrate that on-site infiltration is infeasible per **section 1.2.2**. Post installation infiltration testing is required for any infiltration facility installed outside the designated UIC area being designed to infiltrate the 100-year storm event

E.1 Infiltration Test Requirements

- Testing must be conducted or overseen by a qualified Professional Engineer, Registered Geologist, or Certified Engineering Geologist licensed in the State of Oregon
- The depth of the test must correspond to the facility depth. If a confining layer, or soil with a greater percentage of fines, is observed during the subsurface investigation to be within 4 feet of the bottom of the planned infiltration system, the testing should be conducted within that confining layer. Based on DEQ requirements, the boring log must be continued to a depth adequate to show separation between the bottom of the infiltration facility and the seasonal high groundwater level. (The boring depth will vary, based on facility depth).
- Tests must be performed in the immediate vicinity of the proposed facility. Exceptions can be made to the test location provided the qualified professional can support that the strata are consistent from the proposed facility to the test location. The test must be conducted in the twenty-four months prior to the date the plans were submitted for review.
- Infiltration testing should not be conducted in engineered or undocumented fill.

There are three infiltration testing methods that can be used to determine design infiltration rate:

1. Open pit falling head (see **section E.4**)
2. Encased falling head (see **section E.5**)
3. Double-ring infiltrometer (see **section E.6**)

The qualified professional who will be performing the infiltration test must exercise judgment in the selection of the infiltration test method.

Where satisfactory data from adjacent areas using similar infiltration testing methods is available that demonstrates infiltration testing is not necessary, the infiltration testing requirement may be waived by the City of Gresham design reviewer. A recommendation for forgoing infiltration testing must be submitted in a report which includes supporting data and is stamped and signed by the project geotechnical engineer or project geologist.

E.2 Minimum Number of Required Tests

- At least one infiltration test is required for any potential located where a stormwater facility will be sited
- Additional tests should be considered for every 10,000 square feet of project area
- Additional tests should be considered for every 100 lineal feet of infiltration facility
- No more than five tests are required per development (at the discretion of the qualified professional assessing the site, as well as the City of Gresham).

Tests performed for a proposed land division can be used at the building permit stage as long as the results of the test are submitted with the separate applications and were conducted within twenty-four months prior to the date the plans were submitted for review.

Where multiple types of facilities are used, it is likely that multiple tests will be necessary, since an infiltration test can test only a single location. It is highly recommended to conduct an infiltration test at each stratum used. City of Gresham staff may require additional testing. If additional testing is required during plan review, the applicant must provide 24-hours of notice to City of Gresham staff and specify the time and location that the test will take place.

E.3 Factor of Safety

For all of the testing methods described in this section, a **minimum allowable factor of safety of 2** shall be applied to field obtained infiltration rates for use in stormwater system design. To obtain the infiltration rate used in design, divide the infiltration rate measured in the field by the factor of safety. The factor of safety used in design should be chosen by collaboration between the geotechnical engineer or geologist overseeing the infiltration testing and the civil engineer designing the stormwater management system. Determination of the factor of safety should include consideration of project specific conditions such as soil variability, testing methods, consequences of system failure, complexity of proposed construction, etc.

E.4 Open Pit Falling Head Procedure Instructions

The open pit falling head procedure is performed in an open excavation and therefore is a test of the combination of vertical and lateral infiltration.

1. Excavate a hole with dimensions of approximately 2 feet wide by 2 feet long into the native soil to the depth of the proposed facility bottom. The test can be conducted in a machine-excavated pit or a hand-dug pit using a shovel, post hole digger, or hand auger. If smooth augering tools or a smooth excavation bucket are used, scratch the sides and bottom of the hole with a sharp pointed instrument, and remove the loose material from the bottom of the test hole.

2. Fill the hole with clean water a minimum of 12 inches and maintain this depth of water for at least 4 hours (or overnight if clay soils are present) to pre-saturate the native material.

3. Determine how the water level will be accurately measured. The measurements should be made with reference to a fixed point. A lath placed in the test pit prior to filling or a sturdy beam across the top of the pit are convenient reference points. The tester and excavator should conduct all testing in accordance with OSHA regulations.

4. After the pre-saturation period required in step 2, refill the hole with water to 12 inches and record the draw-down time. Alternative water head heights may be used for testing provided the pre-saturation height is adjusted accordingly and the water head height used in infiltration testing is no more than 50 percent of water head height in the proposed stormwater system during the design storm event. Measure the water level to the nearest 0.01 foot (⅛ inch) at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower draining soils) or until all the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval to obtain a well-defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing.

5. Repeat the infiltration test until the change in measured infiltration rate between two successive trials is no more than 10 percent. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level must be readjusted to the 12-inch level. Enter results into the data table (See **section E.8**).

6. The average infiltration rate over the last trial should be used to calculate the design infiltration rate without a factor of safety applied. Alternatively, the infiltration rate measured over the range of water head applicable to the project stormwater system design may be used at the discretion of the professional overseeing the testing. The final rate must be reported in inches per hour.

7. Upon completion of the testing, the excavation must be backfilled.

8. For very rapidly-draining soils, it may not be possible to maintain a water head above the bottom of the test pit. If the infiltration rate meets or exceeds the flow of water into the test pit, conduct the test in the following manner:
    A. Approximate the area over which the water is infiltrating.
    B. Using a water meter, bucket, or other device, measure the rate of water discharging into the test pit.
    C. Calculate the infiltration rate by dividing the rate of discharge (cubic inches per hour) by the area over which it is infiltrating (square inches).

    Note that a maximum infiltration rate of 20 inches per hour can be used in stormwater system design.

E.5 Encased Falling Head Procedure Instructions

The encased falling head procedure is performed with a 6-inch casing that is embedded approximately 6 inches into the native soil. The goal of this field test is to evaluate the vertical infiltration rate through a 6-inch plug of soil, without allowing any lateral infiltration. The test is not appropriate in gravelly soils or in other soils where a good seal with the casing cannot be established.

1. Embed a solid 6-inch diameter casing into the native soil at the elevation of the proposed facility bottom (see **section E.8**). Ensure that the embedment provides a good seal around the pipe casing so that percolation will be limited to the 6-inch plug of the material within the casing. This method can also be used when testing within hollow stem augers, provided the driller and tester are reasonably certain that a good seal has been achieved between the soil and auger.

2. Fill the pipe with clean water a minimum of 1 foot above the soil to be tested and maintain this depth for at least 4 hours (or overnight if clay soils are present) to pre-saturate the native material. Any soil that sloughed into the hole during the soaking period should be removed. In sandy soils with little or no clay or silt, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.

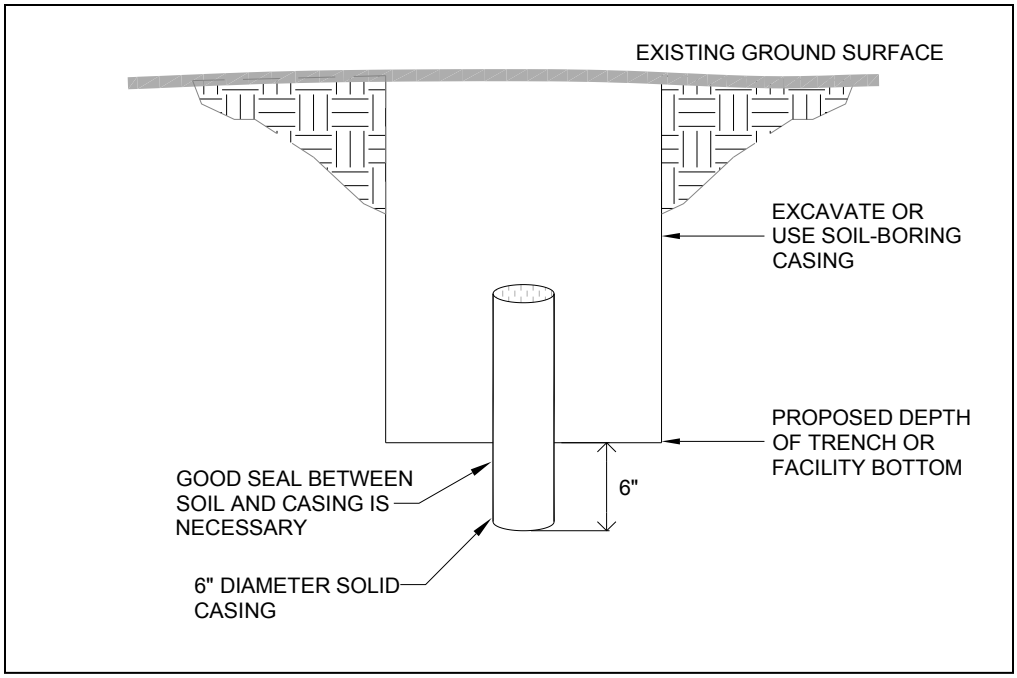
3. To conduct the first trial of the test, fill the pipe to approximately 12 inches above the soil and measure the water level to the nearest 0.01 foot (⅛ inch). Alternative water head heights may be used for testing provided the pre-saturation height is adjusted accordingly and the water head height used in infiltration testing is 50 percent or less than the water head height in the proposed stormwater system during the design storm event. The level should be measured with a tape or other device with reference to a fixed point. The top of the pipe is often a convenient reference point. Record the exact time.

4. Measure the water level to the nearest 0.01 foot (⅛ inch) at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower soils) or until all the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval in order to obtain a well-defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing. Successive trials should be run until the percent change in measured infiltration rate between two successive trials is minimal. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level is readjusted to the 12-inch level. Enter results into the data table (see **section E.8**).

5. The average infiltration rate over the last trial should be used to calculate the unfactored infiltration rate. Alternatively, the infiltration rate measured over the range of water head applicable to the project stormwater system design may be used at the discretion of the professional overseeing the testing. The final rate must be reported in inches per hour.

6. Upon completion of the testing, the casing should be pulled and the test pit backfilled.

Figure E-1. Encased Falling Head Procedure



E.6 Double Ring Infiltrometer Test

The double-ring infiltrometer test procedure should be performed in accordance with ASTM 3385-94. The test is performed within two concentric casings embedded and sealed to the native soils. The outer ring maintains a volume of water to diminish the potential of lateral infiltration through the center casing. The volume of water added to the center ring to maintain a static water level is used to calculate the infiltration rate. The double-ring infiltrometer is appropriate only in soils where an adequate seal can be established.

E.7 Infiltration Test Report Requirements

The Infiltration Test Report must be attached to the project's Site Plan and Stormwater Report. The following information must be included in the Infiltration Testing Report:

1. Statement of project understanding (proposed stormwater system).

2. Name, contact information, professional license information and qualifications of the person conducting the infiltration test.

3. Summary of subsurface conditions encountered, including soil textures and the depth that they were found.

4. Summary of pre-saturation timing.

5. Summary of infiltration testing including location and number of tests and testing method used. Discussion of how the tests were performed (i.e. pipe type or diameter or test pit dimensions).

6. Infiltration testing results in inches per hour for each interval as well as the average for the entire testing period

7. Recommended design infiltration rate.

8. Groundwater observations within exploration and an estimate of the depth to seasonal high groundwater.

9. Site plan showing location of infiltration tests.

10. Boring or test pit logs. Boring or test pit logs will be required when an applicant's proposal relies on the presence of specific subsurface strata that allows infiltration. The logs must include an associated soil classification consistent with ASTM D2488-00, Standard Practice for Classification for Description and Identification of Soils (Visual-Manual Procedure). The logs must also include any additional pertinent subsurface information, such as soil moisture conditions, depth and description of undocumented or engineered fill, soil color and mottling conditions, soil stiffness or density, and approximate depth of contact between soil types.

11. A summary of the entire Infiltration Test

E.8 Infiltration Test Data Form

An example Infiltration Test Data Form is provided below, and then a blank form that can be used with an infiltration test report submittal is included at the end of this appendix.

Location: Lot 105, Point Heights Subdivision	**Date:** 3/27/2018	**Test Hole Number:** 3
Depth to bottom of hole: 63 inches	**Dimension of hole:** 0.5 feet diameter	**Test Method:** Encased Falling Head
Tester's Name: Guy Holeman **Tester's Company:** Infiltrator Brothers **Tester's Contact Number:** (503) 123-4567		
Depth (feet):	**Soil Texture:**	
0-0.5	Black Top Soil	
0.5-1.7	Brown SM	
1.7-2.9	Brown ML	
2.9-5.25	Brown CL	
Presaturation Start Time: 9:00 am		

Presaturation End Time: 1:00 pm					
Time:	**Time interval (minutes):**	**Measurement (feet):**	**Drop in water level (feet):**	**Infiltration rate (inches per hour):**	**Remarks:**
1:00	0	3.75	-		Filled with 6”
1:20	20	3.83	0.08		
1:40	20	3.91	0.08	2.88	
2:00	20	3.98	0.07	2.52	
2:20	20	4.04	0.06	2.16	
2:40	20	4.11	0.07	2.52	
3:00	20	4.17	0.06	2.16	
3:20	20	4.225	0.055	1.98	
			Average Infiltration rate =	2.37	
			Factor of Safety =	2	(minimum of 2)
			Design Infiltration Rate =	1.18	

E.9 Drywell Capacity Testing

When capacity testing is required as a condition of acceptance or approval of a drywell, the following procedure shall be used. Note that conducting this test will require getting approval from the local water provider for use of one or two hydrants.

1. Fill drywell with water at an initial rate equivalent to the minimum required design flow rate, or 300 gallons per minute (gpm), whichever is less.
    a. Record the water surface elevation below the drywell rim after 5 minutes
    b. Maintain the initial flow rate, recording the water surface elevation every 5 minutes, until the water surface elevation stabilizes.
2. If/when the water surface elevation stabilizes, and there is additional capacity in the hydrant or access to a second hydrant, increase the flow rate by another 300 gpm. Continue recording the water elevation every 5 minutes.
3. Repeat step 2 until:
    a. The drywell has reached the design capacity, or
    b. The drywell has reached the maximum allowable capacity for a single drywell, or
    c. The drywell has reached its actual in-place capacity, or
    d. The maximum flow rate from the water source has been reached*
4. Cease discharge of water to the drywell and record the water surface elevation every minute until the drywell is empty, or the water surface elevation has remained constant for a period of 5 minutes

*Note: the minimum peak inflow for a test to be considered valid shall be 600 gpm, unless this exceeds the design capacity of the drywell.

Only clean water shall be delivered to the drywell or sedimentation manhole for capacity testing. The introduction of silts, sediments, gravels, or any other foreign material shall not be permitted.

Infiltration Test Data Form

Location:	**Date:**	**Test Hole Number:**
Depth to bottom of hole:	**Dimension of hole:**	**Test Method:**
Tester's Name: **Tester's Company:** **Tester's Contact Number:**		

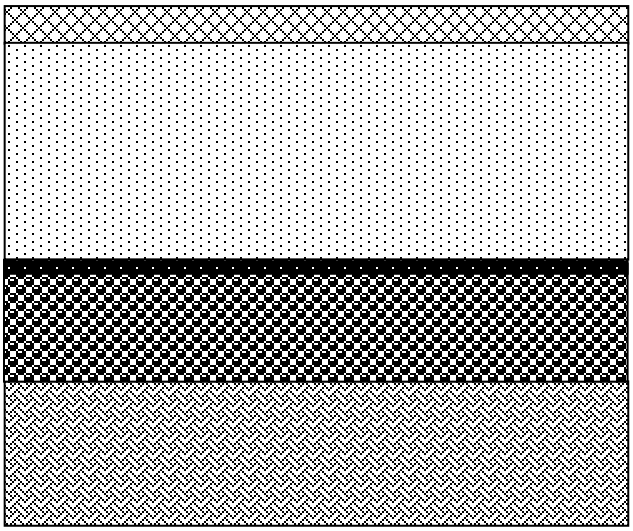
Depth (feet):	**Soil Texture:**

Presaturation Start Time:
Presaturation End Time:

Time:	**Time Interval (minutes):**	**Measurement (feet):**	**Drop in water level (feet):**	**Infiltration rate (inches per hour):**	**Remarks:**
			Average Infiltration rate =		
			Factor of Safety =		(minimum of 2)
			Design Infiltration Rate =		

Appendix F: Soil and Mulch Specifications

Public and private stormwater facilities all require a stormwater facility topsoil blend. All, except stormwater pond facilities, shall be covered by a layer of mulch. Depending upon the type of stormwater facility being constructed, there may also be a layer of drain rock required. This appendix provides specifications about soil, mulch, rock and placement of those materials into stormwater facilities.



Mulch (2-3 inches)

Blended Soil (typically 18 inches; follow facility detail specifications)

Separation Layer (when drain rock required)

Washed drain rock (when required; follow facility detail specifications)

Existing subgrade

F.1 Stormwater Facility Topsoil

The planting media or blended soil to be used in vegetated stormwater facilities shall be a 3-way blend with equal parts topsoil, sand, and compost (by volume) and meets the other criteria in this specification.

Table F-1. Recommended particle gradation for final planting media to be used in stormwater facilities

U.S. Sieve Size	Percent Passing
1 inch (25.4 mm)	100
# 4 (4.75 mm)	75-100
# 10 (2.0 mm)	40-100
# 40 (0.42 mm)	15-50
# 100 (0.15 mm)	5-25
# 200 (0.075 mm)	5-15

In addition to meeting the meeting the particle gradation, the blended soil/planting media shall also meet the following criteria:

- The pH of the blended material shall be tested. The material shall have a pH of 5.5 to 8.
- The material shall be loose and easily broken into small pieces.
- It shall be well mixed and homogenous.
- It shall be free of wood pieces, plastic, and other foreign matter.
- It shall have no visible free water.

The best way to ensure the planting media installed meets the blended soil requirements is to import a 3-way mix from a commercial facility. However, it is possible to stockpile the existing topsoil on-site and then amend with one part imported organic compost and one part gravelly sand, such that there are equal parts compost, sand, and topsoil. Existing topsoil shall be topsoil, rather than subgrade soil and meet the requirements specified in the Topsoil section below (F.1.1).

The assumed infiltration rate for the stormwater facility topsoil is 2 inches per hour.

F.1.1 Topsoil

Topsoil shall be a loamy soil, rather than a soil with a high clay content. Topsoil shall not contain contaminants or other substances that would be detrimental to the growth of plants. Soil shall be free of plant material or seeds designated by the Oregon Department of Agriculture as Type "A" or Type "B" weeds.

F.1.2 Compost

Compost material shall be derived from plant material, be provided by a member of the U.S. Composting Council Seal of Testing Assurance program, and have the following properties:

- 100% shall pass a ½-inch screen.
- pH between 6-8.
- Carbon/Nitrogen ratio less than 25:1
- Organic matter content between 30 and 70% (dry weight basis)
- Manufactured inert material (plastic, concrete, ceramics, metal, etc.) shall be less than 1.0% by weight.
- Soluble salt content less than 6.0 mmhos/cm.
- Maturity Indicator greater than 80% for Germination and Vigor.
- Stability shall be 'Stable' to 'Very Stable'
- Trace metals test result = Pass

F.1.3 Gravelly Sand

Gravelly sand shall be free of organic material, contaminants, and hazardous materials. 100% shall pass a ½-inch screen. Sand may need to be tested for metals to ensure it does not contain high levels of zinc or other RCRA-8 metals.

F.2 Drain Rock

For facilities where drain rock is required, this layer shall consist of ¾" to 1.5" washed rock (open graded aggregate). The depth varies by facility type, but is general a minimum of 9" and might be 18" deep for public facilities in the right of way.

A 2-3" deep lens of finer rock shall be used to provide separation between the underlying drain rock and the blended soil that will be placed on top. This separation or "choker" layer should consist of ¼" - #10 rock (ensure "clean" so no fine smaller than #1- sieve), rather than pea gravel.

F.3 Mulch

After placement of the soil blend and vegetation installation, all stormwater facilities, except stormwater pond facilities, shall be top dressed with medium fine fir or hemlock bark mulch (not bark

dust or bark chips). For some facilities located within the right-of-way where fire prevention may be an issue, the City may recommend use of gravel mulch (pea gravel or ¼-). Mulch shall be placed in a 2 to 3 inch layer over exposed soil between the plantings to completely cover the soil and prevent erosion or weed intrusion.

F.4 Facility Excavation and Subgrade Preparation

Native soil in a stormwater facility is removed to a typical depth of 18 inches below final soil grade (excavation depth needs to also account for ponding depth of water in facility and account for additional depth if rock is to be included below soil) and replaced with a 3-way blend of sand-compost-topsoil. Prior to placement of the blended soil, all construction waste should be removed from the underlying subgrade and the existing soil should be fractured and loosened to prevent the existing subgrade soil from becoming sealed following mechanical excavation.

F.5 Storage of Materials

Store stockpiles of organic soil mix in a manner that prevents them from becoming wet from rain, stormwater runoff, or other sources of water, or contaminated by fine soil or other undesirable materials. All stockpiles of mixed soil material shall be protected and covered.

F.6 Soil Placement

Place amended soil mix in stormwater facilities in lifts not exceeding 8 inches in loose thickness. Each lift shall be compacted with a water-filled landscape roller. After all lifts have been placed, grade soil to finish grades as specified on the plans. Do not overly compact soil mix with mechanical equipment after placement.

F.7 Infiltration Testing

Infiltration testing is not required for projects electing to install a 3-way soil blend that meets the above specifications.

Sites opting to amend existing topsoil using compost and gravelly sand must ensure that the blended soil infiltrates at a rate of at least 2 inches per hour. The following method shall be used to ensure the blended soil has an adequate amount of compost and sand added.

Wet the surface of the rain garden or stormwater planter with a sprinkler or hose until saturated. Small rain gardens and planters (<100 square-feet in surface) area can be tested full-scale, while large rain gardens and planters can utilize isolated falling head tests (minimum 2 per 100 square-feet of area). Fill the testing area to a depth of 4-inches and track the time it takes to completely draw down. Repeat test 3 times. If the water in any of the tests fails to draw down in less than an hour, add compost and gravelly sand to the mix and re-till. Repeat this procedure until favorable test results are achieved.

F.8 Protection of Soil and Facility During Construction

Soil shall be protected from all sources of contamination, including weed seeds, while at the supplier, in conveyance, and at the project site. The facility shall be protected from foot or equipment traffic that is unrelated to the construction of the facility. Temporary fencing or walkways should be installed as needed to keep workers, pedestrians, and equipment out of the facility. Stormwater facilities shall be

kept clean. Materials and equipment shall not be stored in the facility, and any sediment or materials collected in the facility during construction shall be removed prior to final acceptance.

For projects installing stormwater tree wells within the public right-of-way that will be including structural soil under a sidewalk that will be constructed after placement of the material, the structural soil shall be protected from rain, foot traffic, construction debris and other materials by covering the material with plastic, or some other durable material, that will protect it until sidewalk construction is completed.

F.9 Installation in Wet and Winter Conditions

Avoid soil placement when the ground is frozen, saturated, or when the weather is too wet. Construction during the wet winter months may lead to damage to soil by compaction and sedimentation, higher risk of erosion, and harsher conditions for new plantings.

F.10 Structural Soil

Structural soil consists of a mixture of coarse open-graded crushed rock and Stormwater Facility Blended Soil. This material provides load bearing capacity for use under sidewalks, streets and parking lots – particularly for providing root space for trees and/or storage and treatment of stormwater.

F.10.1. Materials

Structural soil shall consist of the following materials:

1. AASHTO Grading #4: Angular, open-graded, crushed rock with the following gradation:

Sieve Size	Percent Passing by Weight
2”	100
1.5”	90-100
1”	20-55
3/4”	0-15
3/8”	0-5
No. 40 sieve	<0.5

2. Stormwater Facility Blended Soil (see **section F.1**)
3. Potable water

Material should be sourced as close to the project site as practicable. The contractor must submit material specification information in sufficient detail for the City to determine if the material meets these specifications.

F.10.2. Proportions of Materials

The major components of the structural soil mixture are crushed rock and Stormwater Facility Blended Soil (hereafter referred to as Blended Soil). Since the blended soil fills in the voids of the crushed rock

material, the sum of the rock and topsoil volumes does not equal the total volume of the structural soil material.

Material	Amount for creating Structural Soil
Crushed Rock	3 parts
Stormwater Facility Blended Soil	1 part

F.10.3. Placement

Protect the blended soil from absorbing excess water and from erosion at all times. Do not store blended soil unprotected from rainfall events.

All areas to receive structural soil mixture shall be inspected by the City before starting placement. Sub-grade of areas that are designated for structural soil are to be compacted to 90% Modified Proctor Density and shall be free of extraneous materials and standing water. All defects such as incorrect grading, compaction and inadequate drainage, etc., shall be corrected prior to beginning placement of structural soil.

To install structural soil:

1. Confirm that the sub-grade is at the proper elevation and compacted as required. Sub-grade elevations shall be parallel to the finished grade. Clear the excavation of all construction debris, trash, rubble and foreign material. If over excavation is approved by City, fill any over excavation with approved fill and compact to the required sub-grade compaction.

2. Install 12” lift of crushed rock uniformly over the area.

3. Spread blended soil on top of crushed rock lift to a depth of 4” and wash into crushed rock.

4. Compact lift to achieve equivalent of 95% modified Proctor Density

5. Repeat steps 2-4 until top of compacted structural soil meets finished grade below aggregate base or as otherwise defined. Top lift must not be thicker than 12”. .

Bring structural soils to finished grades as shown in standard detail drawing or on plans. Immediately protect the structural soil material from contamination from construction dirt and water by covering with plastic or plywood.

The structural soil should have a geotextile or aggregate base “choker” layer, as specified, installed over the top of it to prevent migration of fines or concrete from sidewalk or paved surface from migrating down into the mix. Typical depth of structural soil placed under sidewalks is 24” and under paved parking lots or streets is 36”, though actual depths will be as specified in plans.

Appendix G: Stormwater Facility Planting

Public and private stormwater facilities require vegetation to be added after the blended soil has been added. Plants that can be planted in stormwater facilities are listed in the **Gresham List of Stormwater Plants**. The list provides specific information about the appropriate planting zone (see **section G.1**), whether plants are native to the Pacific Northwest, evergreen or deciduous, height at maturity, as well as whether they are appropriate for private facilities, or ones that will be publicly owned and/or maintained projects.

The list of approved plants for public facilities within the right-of-way is limited to those the City knows will survive in street-side facilities. Because these facilities get very hot and dry in the summer, the goal is to utilize plants that survive in the summer, while also being easy to prune and maintain for City staff or contracted crews.

G.1 Planting Zones

Stormwater facilities have different moisture levels, depending upon facility design. Zone A is the most common moisture zone type (e.g. bottom area of a stormwater planter or rain garden). Zone S is the least frequent moisture zone, as these really only exist in wet ponds or centralized facilities with year-round flow. Zone B plants should only be selected if the proposed facility will actually have areas that are above an area that will be inundated when stormwater fills a facility.

The plant list categorizes allowable plants by the following moisture zones:

- **Zone A:** Uniformly wet to moist, facility bottom up to high water mark or overflow structure; aerobic and anaerobic soils
- **Zone A/B:** Broad range of moisture from moist to dry; aerobic soils
- **Zone B:** Drier transitional zone, generally above the high-water mark or overflow structure; aerobic soils
- **Zone S:** Wet or saturated, standing or flowing water with nearly constant saturation, and permanent pool; anaerobic soils.

Figure G-1 provides a general overview of moisture zones in typical stormwater facility types. Site conditions such as inlets, outlets, flow path, slopes, and elevations will also affect moisture conditions.

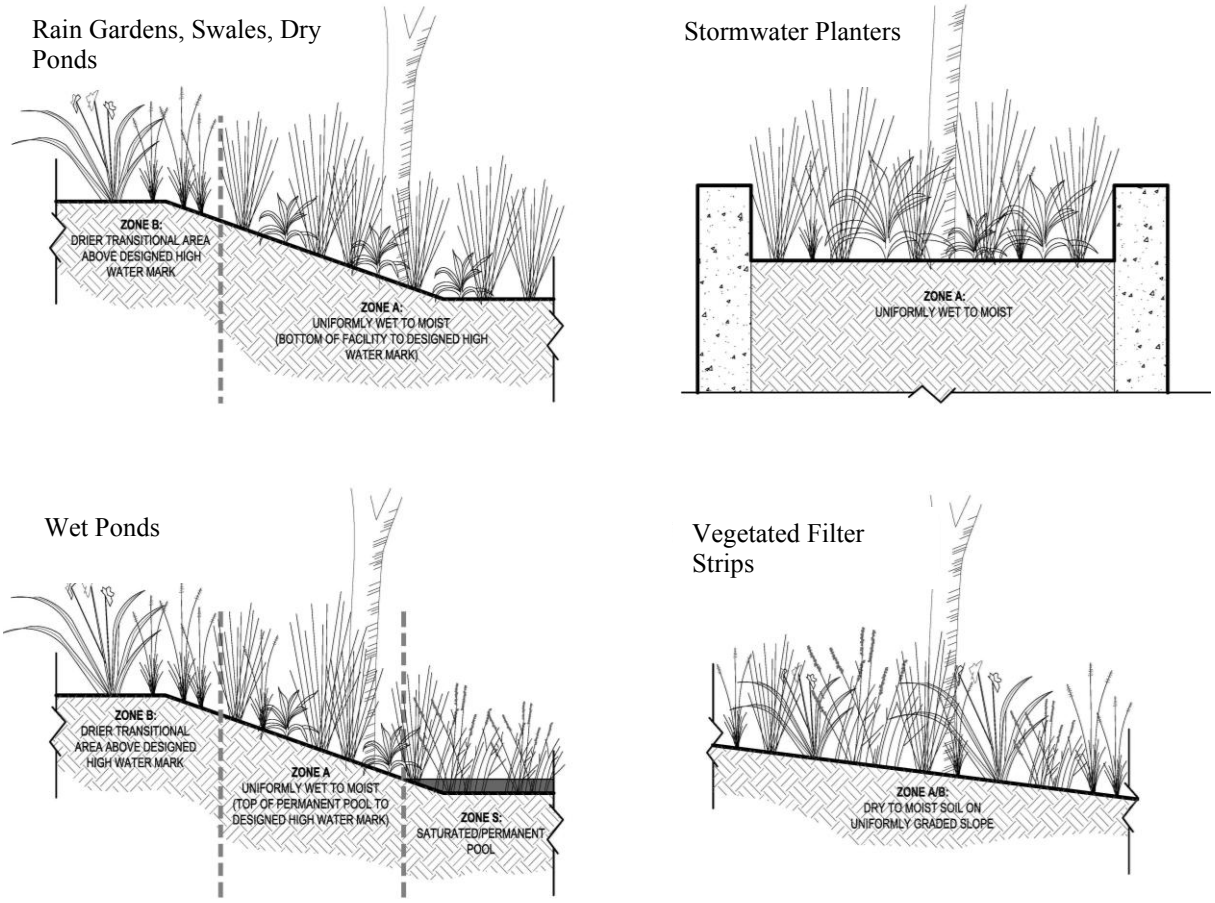


Figure G-1. Planting Zones by Facility Type (Figure from Clackamas County Water Environment Services)

G.2 Plant Selection Considerations

The plants that can be installed in stormwater facilities is contained in the **Gresham List of Stormwater Plants.** The list is extensive, but focuses on plants that do well in the different zones described in **section G.1**. The large variety of plants available, particularly for private facilities, allows for a planting plan that can be customized to fit site function and aesthetics. For a natural aesthetic, species are often arranged in irregular clusters and groupings. For a manicured aesthetic, regular patterns are often used. Regardless of plant arrangement, the following general plan criteria must be followed.

- Plantings should consider flow patterns of water flowing through a facility. Plantings which have each row off-set are less likely to develop preferential flow paths.
- Like-species should be arranged together in groups of 3 or more; and larger facilities are well-suited for larger clusters of like-species
- All zones must have a minimum of 50 percent evergreen plants
- Integrate herbaceous evergreen species throughout the entire facility for increased filtration and evapotranspiration during the rainy winter months

- Plants that are dormant in the winter (i.e. bulbs and perennials) may be used as accent plants for visual interest, but may not be counted toward minimum plant densities for water quality function
- Select plants with consideration for growing habits, and long-term pruning and maintenance requirements
- 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
- Facilities less than 3 feet wide should not use plants that are too large and will outgrow facilities or have the potential to cause root damage
- Lined facilities should not use large plant material (shrubs, trees) or plants with aggressive roots
- Parking areas should not impact required line of sight visibility
- Plants in street side facilities cannot impact required line of sight visibility
- Facilities adjacent to buildings and structures should not use plants that impact building footings, windows, retaining walls, culverts, underground pipes and utilities, or other structures
- Berms over four feet tall that impound water cannot have large trees or shrubs
- Stormwater facilities constructed within a Natural Resource Overlay must only use native vegetation.

G.3 Plant Size Requirements

Minimum size is one gallon (#1) container pots for all plants.

Table G-1. Plant spacing by facility type and zone:

Facility Type	Planting Zone	Plant size	Spacing[1] Public / Private
Stormwater Planter	A	1 gallon	12” / 15”
Rain Garden/Swale[2]	A and B	1 gallon	12” / 15”
Dry Pond and Subsurface Gravel Pond	A B	1 gallon Seed	15” / 15” Follow label for coverage
Wet Pond[3]	A B S	1 gallon Seed 1 gallon	15” / 15” Follow label for coverage 15” / 15” (unless permanent pool >18” deep)
Filter Strip	A/B	Seed	Follow label for coverage

[1]On center (O.C.) spacing

[2]Swales within the right-of-way that intend to use trees as the primary vegetation require trees to be planted every 25-feet (or other spacing if recommended by city) and may use turf grass between trees.

[3]If permanent pool depth in zone S will be deeper than 1824 inches, no planting required on pond bottom, otherwise plant spacing in zone SA shall be 15” O.C. ~~and the vegetated shelf (see the Dimensions and Slopes section in **3.2.6** for details) shall have 1-gallon sized plants 15” O.C.~~ Wet ponds ~~not incorporating a vegetated shelf~~ shall add 1-gallon plants 15” on-center to the first 48 feet of zone AS (above the permanent pool elevation).

- Public facilities within the right-of-way shall have plants be spaced 12” on center (O.C.)
- Private rain gardens and planters shall be spaced according to the notes on the typical detail (see **Appendix H**). In general, the spacing for plants in these facilities is 15” O.C. Facilities where

accent plants, shrubs or trees are included will have different spacing requirements. For example:
    - Zone A (wet): 80 herbaceous plants per 100 sf, or 72 herbaceous plants and 4 small shrubs
    - Zone B (moderate to dry): 7 large or small shrubs and 70 groundcover plants per 100 sf
- Private or public ponds/centralized facilities shall have gallon sized (#1) plants spaced 15" O.C. for zone A. Zone A extends one vertical foot up from the bottom of dry ponds and subsurface gravel ponds, and one vertical foot up from the permanent pool elevation of wet ponds.

If trees have been approved for use in stormwater facility, minimum size is 2" caliper. Note that trees shall not be added over any portion of a facility where a rock/drain layer has been installed.

The **Gresham List of Stormwater Plants** contains a list of plants approved for use in green roof/ecoroofs. The planting density expected for an ecoroof is 90% cover after the establishment period; no on-center spacing requirement is provided.

G.4 Plant Installation

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.

Weather permitting, plants shall be installed as soon as possible after placing and grading the stormwater soil in order to minimize erosion and compaction. For optimal plant survival, planting should be completed in the late summer or early fall.

G.5 Plant Maintenance and Guarantee

PRIVATELY OWNED AND MAINTAINED FACILITIES:
Plants within privately owned facilities, such as rain gardens and stormwater planters, on private property are the sole responsibility of the property owner to maintain.

FACILITIES THAT WILL BE PUBLICLY OWNED OR MAINTAINED:
Stormwater facilities that will be publicly owned or maintained have a 2-year guarantee that is outlined in the *Public Works Standards*. The intent is to have well established plants that require less care following the 2-year establishment period. Plants must survive the first two years after planting before becoming public maintenance responsibility, so watering, weeding, mulching and replanting during the first 2 years are the responsibility of the private party installing the public infrastructure.

Any contractor or developer constructing vegetated facilities which will be publicly owned or maintained is responsible for maintaining all site stormwater management features during the 2-year maintenance warranty period in accordance with PWS 209.03.04 Plant Guarantee and Maintenance. This includes maintaining, repairing, and/or replacing plants and/or trees; any structural or functional repairs; and the maintenance of the facility, which includes: hand removal of undesirable or "weedy" vegetation, mowing, pruning, mulching, and regular summer irrigation.

During the establishment period, the party responsible for maintenance is required to, at a minimum:

- Inspect the facilities monthly;
- Remove any garbage, sediment, or weeds within one week of monthly inspection;
- Replace any dead or missing plants within one month*;
- Water plants and trees, as needed.

*monthly plant replacement not required July through September, but plants should be replaced before October 15.

Failure to demonstrate that all of the above activities and timelines were adhered to during the establishment period may result in an extension of the 2-year guarantee period.

The City will provide inspection and some general maintenance (e.g. sediment and garbage removal) during the warrantee period, but because maintenance related to weeds, soil, mulch and plant pruning might affect the survival of plants, City personnel will not perform maintenance activities, or arrange for contractor-performed maintenance, during the 2-year warranty period unless the developer has entered into an agreement to compensate the City for taking on this work.

G.6 Planting Template for Stormwater Facilities Within Public ROW

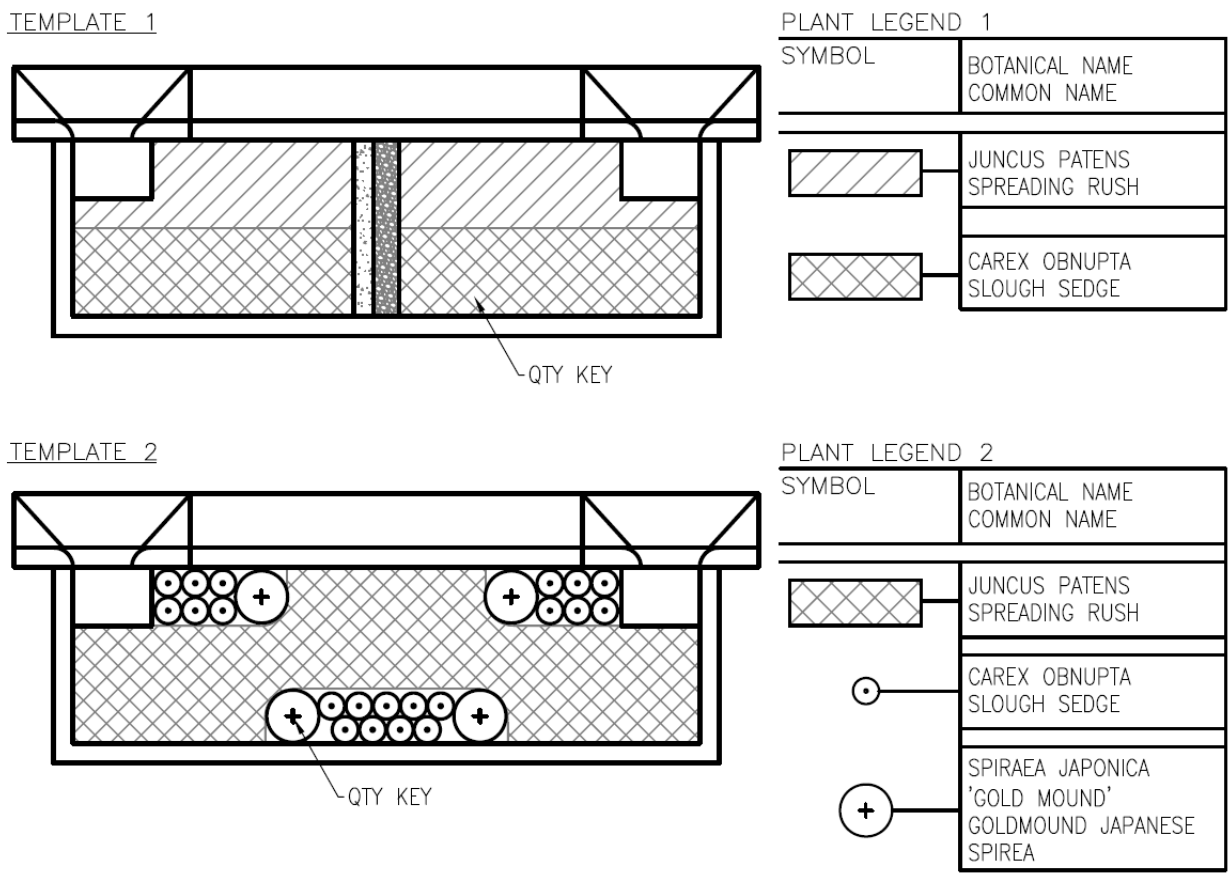


Figure G-2. Planting template options for stormwater planters located within public ROW. These templates may be modified using other plants listed as approved for use within ROW from the **Gresham List of Stormwater Plants**. The template is included as standard detail GS-113 in the Gresham *Public Works Standards*.