Stormwater Design Handbook
for Developers and Large Projects

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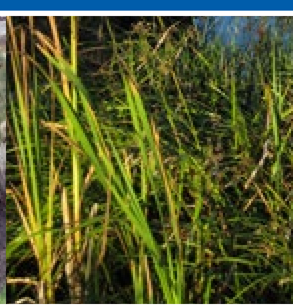


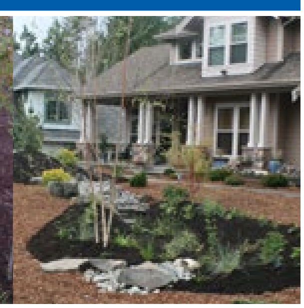

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STORMWATER DESIGN HANDBOOK

for Developers and Large Projects

List of Acronyms

BMP	Best Management Practice
CN	Curve Number
DEQ	Department of Environmental Quality
EPSC	Erosion Prevention and Sediment Control
GSI	Green Stormwater Infrastructure
MEF	Maximum Extent Feasible
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
PWDS	Public Works Design Standards
SAR	Salem Administrative Rules
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service
sf	square feet
SRC	Salem Revised Code
SWMM	Storm Water Management Model
TIA	Total Impervious Area

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1. Introduction

This handbook is a guide for developers for incorporating green stormwater infrastructure (GSI) into large project site design. The use of GSI on large projects is a requirement in the City of Salem (the City) that will better protect water resources in and around the City.

Large Project Definition

Projects with **10,000 square feet** or more of combined new and replaced impervious surface.

or

Projects with **10,000 square feet** or more of ground disturbing activities.

GSI mimics natural hydrology and reduces stormwater runoff volumes through interception, infiltration, evapotranspiration, and/or stormwater reuse. GSI provides better protection of water quality and stream habitat when compared to traditional stormwater management techniques, and reduces the risk of flooding and stream erosion.

The City's Public Works Design Standards (PWDS) for stormwater systems, as contained in Salem Administrative Rule (SAR) 109-004, require large projects to meet minimum requirements for water quality treatment and flow control, and to implement GSI to the maximum extent feasible (MEF).

This handbook highlights the GSI design process for large projects and provides detailed examples to clarify requirements, design options, and calculation methods presented in the PWDS. It is intended to supplement (and not replace) the PWDS.

This design handbook provides information on GSI requirements and methods relating to: site assessment and planning; stormwater facility selection; engineering for facility sizing and design; construction; and operations and maintenance.

GSI Stormwater Facilities:

- Can reduce stormwater utility fees.
- Can be integrated into site development landscape requirements.
- Are the best performing facilities for mimicking natural hydrology

C. Stoughton, EMSWCD

2. Site Planning and Assessment

Efficient and cost-effective use of GSI requires a thorough understanding of a site's existing conditions. Site planning and assessment should evaluate:

- Natural site characteristics
- Infrastructure characteristics
- Infiltration of soils at potential GSI facility locations
- Minimum stormwater management requirements for flow control and water quality treatment
- Options for reducing impervious surface area

GSI is more dependent on natural site conditions than traditional stormwater management facilities. It relies on the infiltration capacity of native soils to reduce runoff volumes. The preservation of existing vegetation is important for evapotranspiration, interception, and dispersion.

Natural site characteristics, as well as characteristics of the built environment such as utilities, structures, and stormwater facilities, should be considered when locating GSI facilities.

The PWDS for stormwater systems identify key natural site characteristics and key infrastructure characteristics that are particularly relevant to GSI planning. Please refer to the table on the following page.

Natural Characteristics	Site Planning for GSI
Topography	Steep slopes limit infiltration and dispersion options. ▶ Identify slopes that are steeper than 5%, as the gradient will limit GSI options. ▶ Identify and map landslide or other erosion prone areas, and review available landslide hazard maps. ▶ Identify drainage pathways pre and post development.
Soils	Soil infiltration capacity can limit the use of some GSI facilities. ▶ Identify areas with tested infiltration rates >0.5 in/hr. If possible, reserve these areas for siting GSI. Directions for conducting an infiltration test are included in this handbook, following this table. ▶ Identify areas with contaminated soils, which will not be suitable for infiltration GSI. For this situation, filtration GSI will be required.
Existing Vegetation/Trees	Vegetation intercepts rainfall and reduces the volume of runoff through uptake, transpiration, and by breaking up soils with roots. ▶ Protect vegetation on the site to disperse runoff and promote infiltration. ▶ Protect mature trees for the impervious surface reduction credit. ▶ Consider impacts of increased saturation when locating facilities near existing trees.
High Groundwater	High groundwater (less than 3 feet below surface) can prevent infiltration facilities from functioning properly. ▶ Identify areas of high groundwater on the site plans. Filtration GSI can be an alternative for these areas.
Streams/Wetlands	Construction near streams and wetlands may require additional considerations and permits. ▶ Map streams and wetlands on the site. ▶ Filter strips may be located in low slope riparian buffers.

Infrastructure Characteristics	Site Planning for GSI
Stormwater System Connections	Determining where stormwater enters and leaves the site during planning will optimize solutions. ▶ Identify any off-site runoff contribution and plan to manage this stormwater or provide bypass conveyance downstream. ▶ Identify an approved point of discharge. ▶ Verify that downstream conveyance capacity is adequate.
Setbacks	Setbacks help to protect property both on-site and off-site. ▶ Identify the areas for GSI facilities that can collect runoff directly from impervious surfaces or that will allow for simple collection system design. ▶ Infiltration GSI must be located at least 10 feet from structures and 5 feet from property lines where the adjacent property is down slope.
Utilities	Determining existing utility locations during planning helps to avoid conflicts. ▶ Call 811 to locate existing underground utilities. ▶ Consider retrofitting existing stormwater facilities to incorporate GSI.

Infiltration Testing

Infiltration testing is required for all projects. Determining the soil infiltration rate is critical for correct sizing of stormwater facilities. For large projects, infiltration rates must be determined using one of three infiltration testing methods:

- Encased Falling Head Test
- Double Ring Infiltrometer
- Open Pit Falling Head Procedure

Infiltration testing methods and reporting requirements are described in the Professional Method Infiltration Testing section of Division 004 Appendix C of the PWDS. General requirements for all methods include:

- Tests must be conducted or observed by a qualified Professional Engineer, Registered Geologist, or Certified Engineering Geologist licensed in the state of Oregon.
- Tests shall be performed at the location and depth of each proposed facility.
- At least one infiltration test is required for any potential location where a public or private GSI stormwater facility will be sited, and additional tests are required every 100 feet for large and/or linear facilities.
- Although not required, it is best to test infiltration rates between March and May because soils are usually saturated and the depth to seasonal high groundwater can be more easily identified.

Determine Minimum Stormwater Management Requirements

Minimum stormwater management requirements for large projects are identified in Chapter 71 of the *Salem Revised Code* (SRC) and are summarized below.

Flow Control Requirements

- Stormwater detention facilities must be designed such that the post-development peak runoff rate is equal to or less than the pre-development peak runoff rate for half of the 2-year, 24-hour storm and the 10-year, 24-hour storm.
- The detention volume for a volume-based stormwater flow control facility (such as a dry detention basin) shall be sufficient to detain a 100-year design storm event without overflow.

Flow control requirements listed above may differ by point of discharge. For example, if a site discharges directly to the Willamette River, it is exempt from flow control requirements. There may be additional requirements if the site is located in a mapped floodplain; see SRC Chapter 601 (Floodplain Overlay Zone) for more information. If downstream capacity issues are identified, then discharges to a public stormwater system may have additional flood reduction requirements. Additional information on downstream analysis is provided in Section 4 of this handbook.

The Effect of Infiltration on GSI Facilities

The infiltration rate will affect the required size of the GSI facility. Generally:

- Low infiltration results in relatively large facilities
- High infiltration results in relatively small facilities

Runoff must be stored during rain events when the infiltration rate is less than the rate of runoff. Storage is provided in the underlying rock reservoir and by temporary ponding of the facility.

GSI facilities can be designed as infiltration, partial infiltration, or filtration. The City requires infiltration facilities whenever possible. If infiltration is particularly low or prohibited, partial infiltration or filtration facilities are allowable but must meet flow control requirements through storage or additional flow control facilities. The following outlines requirements for the use of infiltration, partial infiltration, or filtration facilities. Requirements are described in the PWDS.

- If infiltration is ***greater than or equal to 0.5 inches per hour,*** you must use infiltration facilities.
- If infiltration is ***less than 0.5 inches per hour,*** partial infiltration facilities are allowed.
- When infiltration is prohibited by contamination or high groundwater filtration facilities are allowed.

Water Quality Treatment Requirements

- Stormwater treatment facilities must be designed to treat 80% of the average annual rainfall using the water quality design storm event of 1.38 inches in 24 hours.

Determine Options for Reducing Total Impervious Area (TIA)

Integrating GSI during site planning is an iterative process of identifying opportunities, determining feasibility, and weighing cost versus benefit.

There are several GSI techniques that will help to reduce the size of the required stormwater management facilities by reducing the total impervious area (TIA) and runoff curve number (CN) used in the stormwater facility sizing calculations. The table below identifies these techniques. Additional detail on their application is available in the PWDS.

Combined facilities can be designed to provide both flow control and water quality treatment.

Total Impervious Area Reduction	Notes
Preserve Existing Trees [1]	Designer can reduce the TIA by 50 square feet (sf) for each existing tree preserved within 10 feet of an impervious area.
Plant New Trees [1]	Designer can reduce TIA by 20 sf for each new tree planted within 10 feet of an impervious area.
Pervious Pavement Area	Pervious pavement is not considered an impervious surface and is not included in calculating TIA.
Green Roof Area	The green roof provides 100% of the required water quality treatment of the covered roof area. For flow control purposes 50% of the covered roof area may be subtracted from the TIA.
Rainwater Harvesting Area	The designer must complete a water use budget for the harvested water, which will inform the TIA reduction. Any unused water must be directed to appropriate treatment facilities.

[1] Maximum allowable reduction is 10%

Runoff Curve Number Reduction	Notes
Amended Soils	Amending soils will increase the permeability of the area, reducing runoff. This affects the curve number used in the stormwater calculations, reducing the size of flow control facilities.
Vegetative Cover Improvement	Dense plant cover reduces runoff by interception, uptake, evapotranspiration, and by breaking up tight soils. If possible, increasing the density of vegetative cover of existing pervious areas allows the designer to reduce the curve number.

3. Stormwater Facility Selection

One of the main objectives of the City stormwater requirements is to reduce impacts to streams by more closely mimicking natural hydrology on developed sites. The most effective approach to mimic natural hydrology is to use facilities distributed throughout the site that provide both stormwater flow control and treatment in one vegetated facility that infiltrates runoff.

Site constraints can make the use of distributed stormwater facilities challenging. For certain situations, separate water quality and flow control facilities may be required. For example, combined facilities may not be feasible when infiltration is prohibited or extremely limited.

To give designers flexibility, the City has approved various GSI and non-GSI stormwater management facilities that fall into four categories:

- Combined Stormwater Flow Control and Treatment Facilities
- Stormwater Treatment Facilities
- Flow Control Facilities
- Retention Facilities

The table on the following page lists the approved facilities within each of these categories.

GSI facilities can provide a high aesthetic value when well-integrated into the overall site layout. The City has developed fact sheets providing easily accessible information about the design, construction and maintenance of GSI facilities.

Fact Sheets

Fact sheets for each facility type are provided in Appendix A of this handbook and City of Salem website. For more information on design and construction, see the PWDS.

When selecting an appropriate stormwater facility, consider the following:

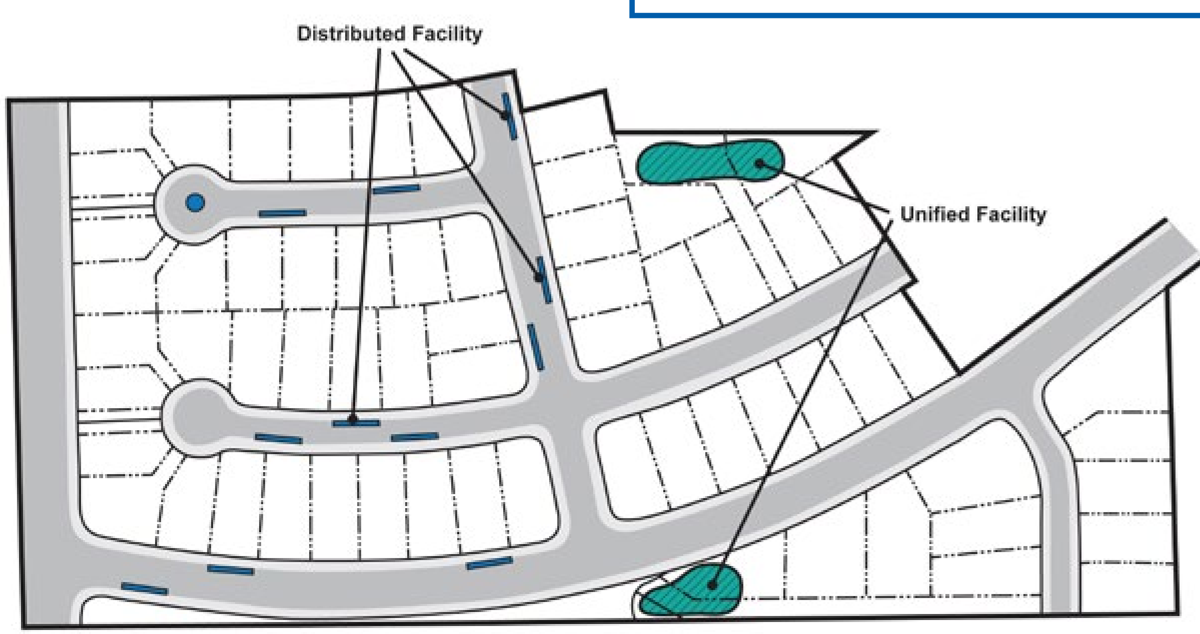
- Review stormwater needs early in the site design process to allow for integration of distributed infiltration GSI facilities, when possible.
- City stormwater code requires water quality treatment.

Distributed Combined or Filtration Facilities

Infiltration is most effective when distributed over a large area. These facilities are also most effective for water quality as they are less frequently inundated with high flows.

Unified Detention Facilities

Flow control facilities that rely exclusively on detention (such as ponds, vaults, and oversized pipes) reduce peak flow rates but do not reduce runoff volumes. These facilities have additional requirements to detain the 100-year storm event and are most efficient as unified facilities serving larger areas (greater than one acre).



Stormwater Facilities	
Combined Stormwater Flow Control and Treatment Facilities (GSI)	
Planters, Rain Gardens, and Combination Swales	These facilities can be designed to fully or partially infiltrate the design storm and work well when distributed throughout a large site.
Flow Dispersion	Flow dispersion utilizes the natural capacity of vegetated surfaces. The maximum area allowed is limited and varies by flow dispersion method
Pervious Pavement	Pervious pavement is designed to fully infiltrate the design storm without producing any runoff.
Green Roofs	Green roofs provide 100% water quality treatment and 50% management of water quantity for flow control.
Constructed Wetland Treatment Systems	These are unique facilities that require a 10-acre contributing basin
Stormwater Treatment Facilities (GSI and Non-GSI)	
Planters and Rain Gardens	When site conditions prohibit infiltration, these facilities can be designed as filtration facilities, which provide water quality treatment.
Vegetated Swales	These swales treat water as it is conveyed to an approved discharge point. Unlike combination swales they do not rely on infiltration. Often high flows must bypass the swale to achieve treatment requirements.
Vegetated Filter Strips	Vegetated filter strips are a good option adjacent to linear pavement like sidewalks.
Manufactured Treatment Technology	Review the list of accepted technologies in the PWDS. These are not considered GSI facilities.
Flow Control Facilities (Non-GSI)	
Parking Lot Detention Basin	These unified flow control facilities are required to detain the 100-year storm event and are not considered GSI facilities. Water Quality treatment must be provided after the flows leave the parking lot and before the flows enter the public stormwater system.
Structural Flow Control Facilities	Tanks, vaults, and oversized pipes are required to detain the 100-year storm event and are not considered GSI facilities. Additional Water Quality treatment is required.
Retention Facilities - Private Projects Only (GSI)	
Soakage Trench	Depending on the configuration, these facilities may be considered an Underground Injection Control (UIC) facility subject to DEQ regulation.
Manufactured Chamber Technologies	These are similar to soakage trenches but can provide additional storage. These may also be considered UICs.
Drywells	These facilities are considered UICs and are regulated by DEQ.

4. Engineered Method for Facility Sizing and Design

Stormwater facilities for large projects are to be designed using the Engineered Method outlined in Section 4.2(n) of the PWDS. The sections below provide additional detail on the use of the Engineered Method.

Delineate Sub-Basins

As the first step in the stormwater facility design process, the designer should delineate sub-basins. The delineation is based on the proposed site grading and stormwater drainage network.

Curve numbers (CN) are estimated for each pervious cover type within a sub-basin and used to calculate a pervious weighted CN as an input parameter for sizing facilities. CNs were developed to predict runoff from an area based on soil type and cover and can be calculated using the equation:

$$CN = \frac{(A1 \times CN1 + A2 \times CN2 + A3 \times CN3)}{\text{Total Pervious Area}}$$

CNs for predevelopment, amended, and unamended soils are provided in the PWDS 4.2. Amending soils substantially reduces runoff and this is reflected by using the appropriate CN.

Land Cover Category	Curve Numbers for Hydrologic Soil Group A	B	C	D
Impervious Surface	**98**	**98**	**98**	**98**
Pervious Land Cover				
Pre-developed	35	58	72	79
Unamended Soils	72	82	87	89
Amended Soils	39	61	74	80

Calculate Total Managed Impervious Surface

Total managed impervious surface is calculated to determine the total impervious area contribution subject to flow control and water quality treatment requirements. It is an important input to the hydrologic model or sizing tool used to design the facility.

Total *Managed* Impervious Surface Area

Measure Total Impervious Area for the site and subtract the total impervious area reduction:

TIA - TIA Reductions = Total Managed Impervious Surface

Hydrologic Analysis

Designers may use the Santa Barbara Urban Hydrograph (SBUH) method or Unites States Natural Resources Conservation Service (NRCS) Technical Release No. 55 (TR-55) method for the design and analysis of detention and infiltration facilities. Designers may also elect to use continuous simulation hydrology modeling methods, using local historic rainfall records. The table below shows the 24-hour rainfall depths to be used for hydrologic analyses.

24-hour Rainfall Depths for Salem

Design Storm Event	Precipitation (inches/24 hours)
WQ Event	1.38
2-year	2.20
10-year	3.20
100-year	4.40

In addition to the approved hydrologic calculation methods, the City has also approved several facility sizing tools to support facility design. These sizing tools include:

- Salem Detention Pond Sizing Tool
- Salem Infiltration Facility Sizing Tools
- Salem Filtration Sizing Tool
- Salem Partial Infiltration Sizing Tool

Appropriate analysis and design of GSI strategies relies on accurate estimates of precipitation. For the purposes of regulatory compliance, the City has defined the 24-hour rainfall depth for each design storm event. These values must be used with an approved hydrograph method based on a Type 1A rainfall distribution.

The Rational Method

The City no longer allows the use of the Rational Method for sizing stormwater facilities.

The Rational Method was developed to predict peak runoff rates and does not reflect total runoff volume. The Rational Method is still appropriate for designing conveyance systems such as collector drain inlets, catch basins, etc.

Impervious Area Reduction Methods	
Rainwater Harvesting Area (sf)	100% area subtracted from TIA
Pervious Pavement Area (sf)	100% area subtracted from TIA
Preserve Existing Trees	50 sf / tree *
Plant New Trees	20 sf / tree *
Green Roof Area (sf)	50% green roof subtracted from TIA for flow control
Green Roof Area (sf)	100% area subtracted from TIA for Water Quality
Total Managed Impervious Surface	**TIA – (SUM IA Reduction)**

* Trees have a maximum 10% total reduction

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Hydromodification...

Refers to the degradation of stream channels and habitat resulting from hydrologic alterations to a water body. Hydromodification analyses consider flow rates that are usually less than a 10-year storm.

Flood Control...

Refers to control of flow rates associated with larger, more infrequent storm events that cause flooding. Often this is greater than a 10-year storm.

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Downstream Capacity Analysis

If the receiving public stormwater system has known or suspected flooding or capacity issues, the City may require the developer to perform a downstream capacity analysis of the existing public stormwater system (SAR Chapter 109-004.2(k) and SRC 71). Downstream capacity issues are identified through operational knowledge, flood complaint calls, or the Stormwater Master Plan. The need for downstream capacity analysis will be determined by the City during site plan review process.

Downstream capacity analysis shall:

- Be based on peak flows at the point of discharge, as listed in the table below.
- Evaluate the system's conveyance capacity from the point of discharge to ¼ mile downstream or to a distance where the project site contributes less than 15 percent of the upstream drainage basin area, whichever is greater.
- Use the Manning's Formula for evaluating the capacity of pipes, ditches, and waterways. Backwater effect shall be included in determining capacity for waterways with drainage areas greater than 250 acres, using HEC-RAS or equivalent computer modeling software.

Detailed information on reporting requirements for the downstream analysis can be found in Appendix 4-A of the PWDS.

If downstream capacity issues are identified, the developer is responsible for:

- Improving capacity,
- Providing additional on-site detention, or
- Mitigating downstream impacts.

The PWDS provides information on peak flow discharge design and recurrence intervals for a variety of system elements including local, arterial, collector streets, local storm drains, and collector storm sewers.

ESA Vigil-Agrimis

5. GSI to the Maximum Extent Feasible

For large projects, GSI must be applied to the Maximum Extent Feasible (MEF), as described in the PWDS. The MEF requirements are:

- The total area of the site covered by GSI facilities is at least 10 percent of the combined amount of new plus replaced impervious surfaces on the entire site; or
- GSI is used to fully mitigate the impacts of stormwater runoff from at least 80 percent of the total new plus replaced impervious surfaces.

A more detailed description of this requirement can be found in Appendix 4E of the PWDS.

Use of GSI to manage stormwater may not be feasible due to physical site limitations, engineering design considerations, financial costs, or environmental impacts. Even when GSI cannot be used to manage stormwater runoff to the MEF, the requirements for water quality protection and flow control must still be met. Submittal requirements for demonstrating limitations can be found in the PWDS. The following sub-sections summarize typical constraints that can be used to justify not implementing GSI to the MEF.

Site Constraints Limiting GSI

To demonstrate GSI cannot be used due to non-financial factors, one or more of the following considerations must be documented:

- Surface slopes cannot be graded to meet GSI design criteria.
- Minimum facility dimensions cannot be met due to mandatory setbacks.
- Downspout configuration cannot be reasonably modified to convey roof runoff to a facility.
- Minimum vertical or horizontal clearance from utilities cannot be achieved.
- Sensitive areas preclude the use of GSI.
- GSI unreasonably restricts pedestrian, bicycle, or vehicular access.
- GSI is limited by historical preservation (SRC Chapter 230).
- In conjunction with one or more other limiting factors, GSI cannot be reasonably incorporated into the landscaping requirements.

Financial Factors Limiting GSI

To demonstrate GSI cannot be used due to financial factors, one or both of the following considerations must be documented:

- Using GSI represents an unreasonably disproportionate increase in total project costs in comparison to meeting requirements using other stormwater facilities. Life-cycle costs shall be used when comparing costs of stormwater facilities.
- Implementing GSI will unreasonably and adversely impact planned business practices or other intended use of the property in comparison to meeting requirements using other stormwater facilities described in the PWDS. Factors to be considered include building footprint requirements, parking needs, and traffic circulation considerations.

Life-Cycle Costs

Include quantification of:

- Capital construction costs, when compared with non-GSI facilities, and
- Net present value of 25 years of O&M.

Incorporating GSI

Several other elements of site assessment, design and construction can improve the success of the project and overall site aesthetic, even if not required by SRC Chapter 71. Some of these other considerations include:

- Incorporating stormwater facilities into landscaping features.
- Minimizing soil compaction and preserving existing soil permeability.
- Using pervious pavement where practicable to minimize surface runoff.
- Constructing stormwater facilities that are non-operator dependent, reliable, and have minimal operation and maintenance.

6. Construction Guide

Constructing a stormwater facility includes activities from site preparation through planting. The PWDS identify the requirements applicable to each stormwater facility type. Additional considerations applicable to most or all stormwater facilities are outlined below.

Erosion Prevention and Sediment Control for Sites with GSI

Erosion Prevention and Sediment Control (EPSC) permits are required for earth disturbing activities, based on thresholds established in SRC Chapter 75 (Erosion Prevention and Sediment Control):

- For a project greater than one acre in size, the EPSC permit is obtained from the Oregon Department of Environmental Quality (DEQ) as a 1200-C permit.
- For a project less than one acre, the EPSC permit is obtained from the City.

The EPSC permit requires developers to prepare an EPSC Plan. This plan has several elements intended to reduce or prevent sediment from leaving a site during construction, including:

- Site Assessment
- BMPs/Design Elements
- Wet Weather Requirements
- Plan Review Checklist
- Natural Resource Agency Permit Coordination
- Hydrology and Hydraulic Design Calculations

Detailed descriptions of design, analysis, and implementation of EPSC BMPs are provided in Chapter 109-007 of the *Salem Administrative Rules*. These standards must be met on all construction sites.

Wet Weather Season

October 1 through April 30 (City's MS4 Permit)

Construction of GSI Facilities

Sites using GSI should take additional precautions during the construction phase of a project. Areas that will be used for infiltration facilities should be delineated in the field using high visibility fencing, and soils should be protected from compaction by heavy equipment. Turbid runoff from disturbed areas of the site should not be directed to infiltration areas; fine sediment in construction runoff can clog course soils and significantly reduce the infiltration potential. Also, areas where native and existing vegetation will be used for dispersion should be delineated using high visibility fencing and protected from clearing and grading.

Construction of GSI facilities should be done according to the guidelines provided for each facility in the PWDS (SAR 109-004). Projects must use the City's specifications for growing medium, topsoil, storage rock, compost, etc. Additional considerations are provided below.

Siting

Lay out the design prior to digging. Check elevations of the discharge point from the impervious area, the location of the facility, and the location of the facility discharge to ensure gravity flow.

Amending Soil

Amend soil by scraping off topsoil to ≥ 8 in, importing topsoil compost mix (see Appendix 4G of the PWDS), mixing removed topsoil with compost, and replacing, tilling until no ponding occurs. Depending on facility and topography, the growing medium may need protection from erosion and rilling as plants mature.

Soil Compaction

Minimize soil compaction and preserve the existing soil permeability, especially in the location of the proposed GSI facility. If additional construction is occurring on the property, minimize grading and compaction of the GSI facility location and areas to remain natural or landscaped. If a permeable surface is to be constructed, steel plating or other methods should be installed to protect the native soils from compaction during construction.

Planting Guidelines

City planting guidelines (Appendix 4B of the PWDS) provide descriptions of plants appropriate for each GSI facility, locations within the facilities for individual plant species, plant characteristics, and planting densities. The City encourages use of native plants, since they are best suited to long-term survival in the local climate and help sustain infiltration and facility function. Planting species included on the City's Non-Native, Nuisance, and Noxious weed list is prohibited anywhere on the site (see References for more information). Additionally, the developer should consider plants that have minimal need for fertilizers, pesticides, and maintenance.

To increase survival rate, plant vegetation using best practices typical to any garden. These best practices include:

- Plant in the dormant season.
- Choose plant species according to sun exposure.
- Choose plants according to the saturation of the planting zone where the plant will be placed.
- Provide supplemental water for the first few growing seasons until the plants are established or during unusually extended periods of dry weather.

7. Operations and Maintenance

Operations and maintenance obligations are described in Administrative Rule 109-011 “Operations and Maintenance of Stormwater Facilities” and includes the Private Facilities Agreement and other necessary forms.

Regular inspections and maintenance are critical to the proper operation of a stormwater facility. City staff are responsible for inspecting stormwater facilities on both public and private property to ensure proper maintenance is being performed. Inspection will occur based on a prioritized list and not all facilities will be inspected every year.

A Private Stormwater Facility Agreement is required for any development that constructs a stormwater facility that will be privately operated and maintained (Administrative Rule 109-011). A form is completed that identifies the property owner’s name, address, and phone number; site address; financial method to ensure maintenance; and party responsible for inspection and maintenance and their contact information. The project proponent must submit the agreement during the development permit application process; a notarized copy of the agreement will be kept on file with the Salem Public Works Department and recorded with the County. A copy of this form can be found on the City’s website.

At a minimum, the agreement will:

- Provide the property address and contact information for the property owner;
- Document the number, types, and locations of facilities;
- Establish the responsibility of the owner to inspect, operate, and maintain facilities in accordance with approved standards;
- Identify the maintenance and operating standards and activities that will be implemented to ensure long-term functioning of the stormwater facilities;
- Grant the City access for the purpose of inspecting facilities and, in the event any deficiencies are not corrected in a timely manner by the owner, for the purpose of correcting deficiencies; and
- Grant the City access if the City has reasonably determined that emergency measures are necessary to remedy a threat to public health, safety, or welfare caused by facilities.

The Operations and Maintenance record keeping must include Facility Maintenance Forms that are completed when maintenance is performed. The forms identify specific maintenance activities to assure long-term functioning of the facility. Forms can be revised and/or modified by property owner to adjust for maintenance based on site-specific conditions and operations, subject to Public Works Department Approval. Copies of these forms can be found on the City’s website (Administrative Rule 109-011).

If pesticides or herbicides are planned for use in a stormwater facility, care must be taken to minimize the risk of downstream pollution. Fertilizers negatively impact stream organisms. The following guidelines shall be adhered to when applying herbicides, pesticides, and fertilizers:

- Follow all relevant State and Federal regulations
- Read and follow application instructions
- Use the application rate indicated and do not over-apply
- Do not apply when rainfall is expected
- Avoid application when windy to minimize chemical “drift”

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8. Annotated References

Salem Administrative Rules Chapter 109-004 (Stormwater System Design Standards)

Stormwater design standards provide implementation requirements for the design of stormwater facilities. The standards provide criteria on what actions are applicable for managing runoff given the type of development and site conditions. Green infrastructure that provides infiltration and evapotranspiration functions are required to the maximum extent feasible. Standards are provided for approved stormwater facilities, including detailed appendices with planting guidelines and infiltration testing directions.

www.cityofsalem.net/Departments/PublicWorks/PW%20Administrative%20Rules/admin_rule_109-001_109-007.pdf

Salem Administrative Rules Chapter 109-007 Erosion Prevention Sediment Control Plan (EPSCP)

The EPSCP standards define how the requirements of the SRC are implemented. The standards aid in planning construction activities and implementing actions that prevent erosion and control sediment discharge by using best management practices. The design standards for preparing a EPSCP are provided.

www.cityofsalem.net/Departments/PublicWorks/PW%20Administrative%20Rules/admin_rule_109-001_109-007.pdf

The City of Salem Erosion Prevention and Sediment Control (EPSC) Plan Technical Guidance Handbook (Version 11/17/2003)

The City of Salem provides a technical guidance handbook describing required erosion control measures for all stormwater facilities.

www.cityofsalem.net/Departments/PublicWorks/Operations/EnvironmentalServices/Best%20Management%20Practices%20BMPs/Salem%27s%20Erosion%20Control%20Handbook.pdf

Salem Administrative Rules Chapter 109-011 Operations and Maintenance of Stormwater Facilities

The rules address operation and maintenance practices for all stormwater facilities. Private Stormwater Facility Agreement and Facility Maintenance forms are included.

www.cityofsalem.net/Departments/PublicWorks/PW%20Administrative%20Rules/admin_rule_109-011.pdf

Salem Revised Code Chapter 71 (Stormwater Code)

SRC Chapter 71 establishes a consistent set of stormwater regulations for development projects with requirements associated with stormwater flow control and treatment standards, requiring and prioritizing the use of green stormwater infrastructure. The Stormwater Code includes the mandated requirements contained in the NPDES municipal stormwater permit and consolidates existing local requirements, regulations, and practices related to stormwater management.

www.cityofsalem.net/Departments/PublicWorks/Pages/stormwater-code.aspx

SRC Chapter 68 (Preservation of Trees and Vegetation)

SRC Chapter 68 establishes requirements for the preservation of trees, and native vegetation within riparian corridors, throughout the City. The chapter specifically includes requirements for the preservation of heritage trees, significant trees, trees and native vegetation within riparian corridors, and trees on lots and parcels 20,000 square feet or greater. The chapter also includes requirements for tree and vegetation removal permits, tree conservation plans, adjustments to tree conservation plans, and variances.

http://salemcodecleanup.net/?page_id=3189

Non-Native, Noxious Weed and Nuisance Plant Lists

The City of Salem provides three tables describing plants that are discouraged and/or prohibited from use by Oregon State law: Non-Native Plant List, Noxious Weed List, and Nuisance Plant List.

www.cityofsalem.net/Departments/PublicWorks/Administration/WaterResources/SalemNativePlants/Pages/default.aspx

Salem's Stormwater Utility: Information Report

The intent of this document is to explain the stormwater utility fee system. The Base Fee is applied regardless of the amount of impervious surface, whereas the Impervious Surface Charge may be reduced by either a rate adjustment (based on less total impervious area) or rate credit (for non-single family residents). Reasoning for the fee program and example calculations of fees are provided.

www.cityofsalem.net/Departments/PublicWorks/Pages/sw_utility.aspx

Public and Private Facilities

Public facilities are located on public property, manage runoff from public impervious areas such as streets and sidewalks, and are maintained by the City.

Private facilities are located on private property, manage runoff from private impervious areas such as buildings and parking lots, and are maintained by the property owner.