

Green Stormwater Infrastructure in Seattle

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Working Together to Protect our Waterways

Green Stormwater Infrastructure Manual for
Capital Improvement Projects

Volume V: Operations & Maintenance



This is the fifth volume in a 5-volume series for the Green Stormwater Infrastructure Manual for Capital Improvement Projects (GSI Manual). Please consult other volumes for additional information:

VOLUME:

- I Project Initiation / Partnering Framework
- II Options Analysis
- III Design Phase
- IV Construction, On-boarding & Commissioning
- V Operations & Maintenance**

This document was prepared, updated and compiled by MIG Inc. for Seattle Public Utilities (SPU) and King County Wastewater Treatment Division (WTD) for the GSI Program (SPU Contract C12-004). Additional contributors to this document included representatives from SPU, WTD, High Point Open Space Association Staff, SDOT Urban Forestry and PRR (Section 11 – Community Engagement and Outreach). This document includes documentation relevant to GSI in the right-of-way and on utility owned or manage parcels from the Washington State Department of Ecology Guidance Document “Western Washington Low Impact Development (LID) Operations and Maintenance” 7/2013; generally, these excerpts are in italics.

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Abbreviations*

*See COS Standard Plan 002 for other General Abbreviations used for street improvement plans in City's ROW.

<u>Term</u>	<u>Abbreviation Definition</u>
ADA	Americans with Disability Act
AM	GSI Asset Manager (SPU term, previously referred to as FOM)
AMP	Asset Management Plan
BMP	Best management practices
BOD	Basis of Design
BSM	bioretention soil media
CB	catch basin
CIP	Capital Improvement Project
CMMS	Computerized Maintenance Manual System (WTD)
CO	cleanout
COS	City of Seattle
COS SWM	City of Seattle Stormwater Manual
CRZ	critical root zone
CSECP	Construction Stormwater and Erosion Control Plan
CSO	combined sewer overflow
CSS	combined sewer system (combined stormwater and sanitary sewer flows in a pipe)
DS&G	Seattle Public Utilities' Design Standards & Guidelines
ECA	environmentally critical area
Ecology	Washington State Department of Ecology
ECY	Ecology
EOR	Engineer of Record
FAQ	Frequently Asked Questions
GIS	Geographic Information System
GSI	Green Stormwater Infrastructure
IDT	Interdepartmental team
IP	Integrated Plan
IT	Information Technology
KC	King County
KPI	Key Performance Indicators
LA	Landscape Architect
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development (often interchanged with GSI)
LOB	Line of Business representative (SPU)
LOS	Level of Service
LTCP	Long-Term Control Plan

<u>Term</u>	<u>Abbreviation Definition (continued)</u>
MAXIMO	asset management tracking software (SPU)
MH	maintenance hole
MS4	Municipal Separate Storm Sewer System
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
NDS	Natural Drainage System
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OPCD	Seattle Office of Planning and Community Development
PDB	Project Delivery Branch (SPU)
PE	Professional Civil Engineer
PEG	Public Engagement Guidelines
PEP	Public Engagement Plan
PLA	professional Landscape Architect
PMP	Project Management Plan
PS	pipe sewer combined
PSS	pipe sewer sanitary
PSD	pipe storm drain
PSE	Puget Sound Energy
PS&E	plans, specifications & estimates
ROW	right-of-way
ROWIM	Street Illustrated, Seattle's Right-of-Way Improvements Manual (may also be referred to in the text as "Streets Illustrated ROWIM")
SCL	Seattle City Light
SDOT	Seattle Department of Transportation
SEPA	State Environmental Policy Act
SERP	State Environmental Review Process
SG	Stage Gate for project management
SME	Subject Matter Experts
SOP	Standard Operating Procedures
SPU	Seattle Public Utilities
SSD	subsurface drainpipe / slotted storm drain (aka underdrain pipe)
STD	standard
SWM	City of Seattle Stormwater Manual
SWPPP	Stormwater Pollution Prevention Plan
S#.X.#.x	ECY Special conditions for city and county NPDES Phase I & II permittees (e.g. S5.C.9.a)
TESC	Temporary Erosion and Sediment Control
UFSP	Urban Forest Stewardship Plan
UIC	Underground Injection Control (Ecology permit term)
UMH	underdrain maintenance hole
WQ	Water Quality
WTD	King County, Department of Natural Resources, Wastewater Treatment Division

Definitions

These definitions are focused on implementing green stormwater infrastructure (GSI) in the City of Seattle's (COS) right-of-way (ROW) or on utility owned or managed parcels as part of capital improvement projects (as opposed to implementation on private owned parcels). These definitions are not intended to be exhaustive as used or on the subject however some key terms are included for easy access. See Seattle's Streets Illustrated Right-of-Way Improvement Manual (ROWIM) www.streetsillustrated.seattle.gov for an expanded glossary of terms in the public realm.

Asset Management (AM):

Generally, the broader use of the term is for cradle to grave adaptive management. The term includes everything at the operation level, maintenance, resource planning, reporting and financing to achieve the best results.

Biofiltration Swale:

An open, gently sloped, vegetated earthen channel designed to treat stormwater by evenly distributing stormwater flows laterally (as opposed to vertically with infiltration) across the entire width of a densely vegetated channel that has a minimum length of 100 feet (or greater depending upon project design). Stormwater runoff flows into the facility at the head of the swale. The bottom width (2 ft to 10 ft) of the channel is to be constant along the entire length. Longitudinal slope ranges from 1.5% to 2.5%. Basic biofiltration swales provide “basic” water quality treatment in accordance with City of Seattle (COS) 2017 Stormwater Manual (SWM), Volume 3, Section 5.8.3.

Bioretention:

A designed shallow earthen depression with engineered soil mix and plants adapted to the local climate and soil conditions to provide water quality treatment and either retain or detain the treated stormwater for flow attenuation. The facility is designed to mimic natural processes by filtering stormwater through the vegetation and into the imported bioretention soil mix (BSM). When designed with required BSM depth (at least 18 inches), and infiltrating into the underlying soil or in soils with lower infiltration rates, collected by an underdrain these bioretention facilities provide “enhanced” water quality treatment in accordance with COS 2017 SWM, Volume 3, Section 5.4.4 (infiltrating bioretention) and Section 5.8.2 (non-infiltrating bioretention).

In the City's ROW, stormwater enters the bioretention facility through sheet flow across landscape/pavement; through breaks in the curb along the roadway or sidewalk; and/or through a piped/culvert system daylighting into the facility.

Depending upon the rainfall event and intensity, stormwater may:

- filter through the vegetation and BSM and infiltrate into the underlying soils;
- filter through the vegetation and BSM and collect in an underdrain pipe that

- connects to the drainage/sewer system or is conveyed and infiltrates into the underlying soils via a deeper infiltration facility such as a screen well; or
- overflow out of the cell via a drain curb cut or overflow pipe and continue to flow down the road to the next bioretention cell or into the drainage sewer system.

The terms Rain garden and “Natural Drainage System” or “NDS” may also be used to describe bioretention in public outreach materials. See Rain garden and Natural Drainage System definitions.

Block:

Refers to a street length from intersection to intersection. A block includes the street and adjacent private/public parcels (residential, commercial, parks etc.). A City block can range from 300-feet to 800-feet long, varying widths, surrounded on four corners by public street right-of-way and may/may not include a public alley through the block.

Blue Book:

SPU asset management term for a project’s operation and maintenance manual for non-standard elements. Describes how to maintain and operate new assets.

Cells:

Individual depressions within a bioretention facility are called “**cells**”. For ROW applications usually, there are multiple bioretention cells in a series within a block. Because each cell is a depression, water ponds in the cell and infiltrates downward into the underlying soil as opposed to continuing to flow horizontally along the longitudinal profile like a conveyance swale or biofiltration swale. However, if the cell receives more water than it was designed for, the water ponds up and overflows out of the cell either through a drain curb cut or overflow pipe in the cell and either flows down the block to another cell or into the gutter/drainage system. See “bioretention” in this section.

Combined Sewer Overflow (CSO):

Combined sewer overflow is the result of combined sewers that are designed to collect rainwater runoff, domestic sewage and industrial wastewater in the same pipe. During periods of heavy rainfall or snowmelt however, the wastewater volume can exceed the capacity of the pipe and at that point they are designed to overflow to a sea, stream, river or water bodies. CSOs may be thought of as a type of “urban wet weather” discharge. Source: Environmental Protection Agency (EPA)

Component:

A part or element of a larger whole. Used herein to refer to various tools or elements that are part of a GSI facility.

Consent Decree:

Specific to stormwater and CSOs: Since 2000, EPA has taken enforcement actions under the Clean Water Act (CWA) to reduce violations under municipal stormwater

permits. As part of these judicial actions the EPA has required permittees to commit to implement green infrastructure. Pursuit to Section 309€ of the CWA, the State of Washington joins the United States as a Plaintiff to both SPU and WTD's Consent Decrees with EPA. Washington State Department of Ecology (Ecology) is the state regulatory agency.

Conveyance Swale:

Conveyance swale refers to shallow vegetated earthen channel to convey stormwater runoff (as opposed to a piped system). See COS Standard Plan 294 for cross section of a vegetated conveyance swale that is not for water quality treatment.

Deep Infiltration:

A term describing various methods of moving water from the surface of the land into the subsurface. In this volume Pit drains, drilled drains and screen wells are all considered deep infiltration. See Section 6 herein and GSI Manual Volume III: Design for general descriptions.

Dirt:

Can informally refer to loose soil or earth however a primary difference from soil is that dirt lacks nutrients needed to promote growth. See Soil.

Emergents:

A plant whose root system grows underwater, but whose shoot, leaves and flowers grow up and above the water. (source: Wiktionary).

Failed System:

These facilities support agency regulatory responsibilities and compliance measures. A facility is considered a “failed system” if extensive maintenance or major corrective action is required for ongoing performance.

For SPU some facilities have a direct regulatory function. (See project specific information). A system considered failed means that the system is a candidate for major corrective action or extensive maintenance requiring authorized funding.

Grasses:

A plant in the Poaceae family that is hollow (between the nodes), round stems; leaves 2-ranked; fruit a grain covered by two papery scales. (source: Steve Eggers)

Guidance:

Specific to the intent of this volume of the GSI Manual, guidance is intended to mean “Help or advice about how to do something or about how to deal with problems” (Source: Cambridge Dictionary). The joint SPU and King County Wastewater Treatment Division (WTD) GSI program is looking to establish consistent methods of O&M in the public realm as the public is not typically aware of which agency is responsible for the asset.

Hardscape:

A term that typically describes fixed surfaces on the ground plane. For GSI facilities, this may mean pavement, pavers, drain curb cuts, gutter line, sidewalk, structures, lids, walls for bioretention cells, etc.

Invasive Plant Species:

Invasive species are typically non-native plants that are highly competitive over native species, often difficult to control or eliminate, and in extreme cases may be quite destructive of native ecosystems or economically valuable plant resources. Invasive plants that are highly destructive are termed "noxious weeds." See www.kingcounty.gov/services/environment/animals-and-plants/biodiversity/threats/Invasives.aspx

Key Performance Indicators (KPI):

A term used for evaluation of bioretention assets over time as defined by the agency. See Section 3 in this volume.

Landscape:

For GSI facilities this refers to the surface area as a whole and the term may also refer generically to trees, plantings or vegetation in areas without bioretention cells.

Maintenance:

Maintenance is the set of activities to preserve a good, stable condition and keep operations running. Maintenance is typically considered as a subset of overall operations management. Operations is the set of activities directly responsible for achieving GSI objectives.

Natural Drainage System (NDS):

A term used by SPU for the natural approach to manage urban stormwater. NDS is also a term SPU uses with the public in a project's outreach materials in lieu of using the term bioretention facilities. See definition for "bioretention" in this section

"NDS partnering" is the program where SPU partners with city departments, agencies and/ or private partners on a project for the construction of NDS facilities.

Noxious Weed:

A non-native plant that when established is highly destructive, competitive or difficult to control. (RCW 17.10, WAC 16-750) King County Department of Natural Resources and Parks (DNRP), Water and Land Resources Division's, Noxious Weed Control Program. See www.kingcounty.gov/weeds

Operations:

Operations is the set of activities directly responsible for achieving GSI objectives. Maintenance is the set of activities to keep operations running. Maintenance is typically considered as a subset of overall operations management.

Permeable Pavement Facilities:

Permeable pavement is a paving system that allows rainfall to infiltrate into an underlying aggregate storage reservoir/subbase, where stormwater is stored and infiltrated to the underlying subgrade or (for larger storms where it cannot infiltrate) removed by an overflow drainage system (such as an elevated perforate pipe) that discharges into the drainage system. Permeable pavement typically consists of a wearing course (e.g. porous asphalt, pervious concrete) and an underlying aggregate storage reservoir/subbase(s), which are designed to both temporarily store water and provide structural support for the pavement loads. Permeable pavement facilities can be designed to treat pollution generating surfaces (neighborhood alleys) and/or receive sheet flow from adjacent non-pervious surfaces. See COS 2017 SWM Volume 3, Section 5.4.6.

Permeable Pavement Surfaces:

A permeable pavement surface is a paving system like permeable pavement facilities (pervious concrete sidewalk or porous asphalt path). The aggregate subbase is designed to manage only the water which falls upon it. Because permeable pavement surfaces are designed to function as a permeable land surface and not intended to manage runoff from other surfaces, they are not considered infiltration facilities and have less onerous siting and design requirements. See COS 2017 SWM, Volume 3, Section 5.6.2.

Planting Strip:

The term planting strip means that part of a street right of way between the abutting property line and the curb or traveled portion of the street, exclusive of any sidewalk (Seattle Municipal Code 10.52.01H)

Rain Garden:

Rain gardens are non-engineered shallow landscape depressions with compost-amended native soil (or imported bioretention soils) and plants adapted to the local climate and soil moisture conditions. Rain gardens may only be used to meet “On-Site Stormwater Management (OSSM)” requirements and are not defined as a water quality treatment or flow control facilities (see COS 2017 SWM, Volume 3, Section 5.4.5, and Ecology’s 2019 Stormwater Management Manual for Western Washington). Rain gardens may be used to manage runoff from new sidewalks to meet “OSSM” requirements described in COS 2017 SWM and SPU’s Client Assistance Memo 1190. The term “rain garden” may be used to describe bioretention systems to the public; however, a rain garden is defined as a different type of facility in the COS 2017 SWM.

Regulatory:

Generally used to refer to organizations or agencies enforcing compliance with laws, polices rules, and regulations.

Report / Reporting:

Generally used to mean a written account of what occurred or what was observed or what was accomplished. The intent is to document both for the agency and to improve the implementation and O&M for GSI as a new infrastructure asset. Refer to specific agency requirements for definition of compliance reporting.

Right of Way (ROW):

The strip of land platted, dedicated, condemned, established by prescription or otherwise legally established for the use of pedestrians, vehicles and/or utilities.

Road:

The road or also referred to as roadway is the portion of a street improved, designed, or ordinarily used for vehicular travel and parking, exclusive of the sidewalk or shoulder. Where there are curbs, the roadway is the curb to curb width of the street. In the ROWIM, the general rule is to use "street" when referring to the full right of way or elements within the right of way and "road" when being specific regarding the vehicular surface area. The roadway may or may not have a curb along the road edge. See Glossary in Seattle's Streets Illustrated, ROWIM.

Rushes:

A plant in the Juncaceae family with solid, round stems; leaves few; fruit several to many-seeded capsule surrounded by 6 scale-like structures (tepals). (source: Steve Eggers).

Sedges:

A plant in the Cyperaceae family with solid, triangular or angular stems ("sedges have edges") with some exceptions; leaves 3-ranked; fruit a nutlet subtended by a scale. (source: Steve Eggers)

Shrub:

A shrub or bush is a small- to medium-sized woody plant. Unlike herbs, shrubs have persistent woody stems above the ground. They are distinguished from trees by their multiple stems and shorter height and are usually under 20 feet tall. Plants of many species may grow either into shrubs or trees, depending on their growing conditions. (source: Wikipedia)

For GSI in the ROW the focus is on low shrubs, generally less than 36 inches however intersection zones are generally 24 inches in height. Accent shrubs is a term used for high shrubs in GSI facilities often used to provide a scale, an indication of a change or for seasonal interest.

Soil

The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants. (source: Soil Science Society of America).

Street:

A public ROW that includes a roadway, shoulder, planting strips and/or sidewalk(s) along other public infrastructure and utilities. For full definition, see Glossary in Seattle's Streets Illustrated ROWIM. See also above definition for "road". "Travelled way" refers to just the portion of the street that receives vehicular traffic.

Street Typology:

See Seattle's Streets Illustrated, ROWIM. Some street types examples include Neighborhood Yield, Neighborhood Curbless, Urban Village Neighborhood Access, etc.

Tree:

Generally, a woody plant with single or dominate stems and few or no lower branches and over 20 feet in height. See Appendix G Tree List for Bioretention in the Right of Way, SDOT Street Tree Manual, and Streets Illustrated; ROWIM for further information.

Trenching:

Any excavation to install or repair foundations, utility lines, services, pipe, drainage, irrigation infrastructure or other property improvements below grade.

Note: Trenching within the critical root zone (CRZ) of a tree is injurious to roots and tree health and is prohibited, unless approved through review with SDOT and Urban Forestry. If trenching is approved within a tree's CRZ, it must be done according to instructions outlined in the SDOT Street Tree Manual.

Underground Injection Control (UIC):

For the GSI program purpose this refers to the EPA program that consists of six classes of injection wells. Each class is based on the type and depth of injection activity and the potential for that activity to result in endangerment of a USDW (underground sources of drinking water). Ecology regulates and permits UIC's for the EPA. UICs used with GSI for deep infiltration of stormwater are described in Section 6 of this volume and Section 10 of GSI Manual, Volume III: Design.

Vegetation:

Plants considered collectively or "total plant cover". (source: Merriam Webster)

Weed:

In simple terms, an unwanted plant in a bioretention cell. Generally, more aggressive and spreading. A plant can become a weed if it is in the wrong place.

Table I-1: SPU's Identification of Work Types for Preparing Maintenance Work Plans

Work Type	Work Type Description	Work Type Use
RM	Reactive Maintenance	<p>Includes work required (perceived or actual) because something else happened to trigger the need for the work; otherwise it would not have been done.</p> <p>Reactive maintenance occurs with a failure such as a plugged cell or clogged underdrain.</p>
PDM	Predictive Maintenance	<p>Inspection and Maintenance</p> <p>PM program: Time or meter-based inspections detecting the possibility of failure/condition assessment activities. Inspection may include cleaning or other minor maintenance.</p> <p>Predictive Maintenance is used for inspection to see if an asset is failing its performance standards such as how often the pre-settling cell needs to be vacated or the cleaning of a UIC.</p>
PM	Preventive Maintenance	<p>Maintenance</p> <p>PM program: Time or meter-based maintenance</p> <p>Preventative Maintenance is a proactive maintenance activity such as clearing of leaves in fall to prevent clogging and overflows. PM tasks are set up on a regular schedule so that Maximo can generate work orders automatically and ensure regulatory requirements are met.</p>
CBM	Condition Based Maintenance	<p>Maintenance performed as a direct result of inspections determining that an asset's condition has declined and/or that performance no longer meets defined minimum SPU standards.</p> <p>Includes opportunistic work performed to ensure assets are maintained to minimum SPU standards.</p> <p>Corrective maintenance is typically performed, based on the result of a PDM/PM, if the PDM has determined that an asset's condition or performance no longer meets the service levels. CBM is especially applicable in GSI facilities if the plantings have overgrown the step out zone or the height of plants is obstructing sightlines.</p>
PROJ	Project	Intentional, pre-planned improvements, enhancements, new installations. Includes routine rehab.
OH	Overhead	Use of O&M resources for activities outside of their normal functions such as training, equipment maintenance/cleaning, meetings, PPE issues, etc.
DM	Demand	Work performed in response to external or internal request to perform non-repair/maintenance work , QA/QC, studies, new customer installations not associated with a project, etc.

Note: The above table is from Seattle Public Utilities Asset Management Plan (AMP), Green Stormwater Infrastructure, Right of Way Facilities, May 2018. This is for identification of work types in SPU's Maximo.

Section 1

Introduction to GSI Operations and Maintenance for Right-of-Way Projects

1.1 Introduction

Green Stormwater Infrastructure (GSI) is being implemented within the public right-of-way (ROW) for stormwater code compliance, creek basin projects, combined sewer overflow control projects, and capital improvement retrofit projects. Generally, these are within the ROW however as GSI expands there will be publicly maintained, parcel-based facilities. GSI is a new asset class and the management, operations planning, and maintenance protocols are evolving as our agencies adapt to using GSI tools to help manage rain naturally. Like a forest, green solutions such as roadside bioretention systems (also referred to as “natural drainage systems” for Seattle Public Utilities (SPU) projects) filter out pollution and help rain soak into the ground rather than rush over yards, parking lots, and streets, washing pollutants into our waterways. Seattle and King County (specifically King County Wastewater Treatment Division (WTD) have prioritized the use of GSI where feasible because it is effective, cost-comparable with conventional approaches, and high value. In addition to helping us prevent water pollution, GSI, specifically roadside bioretention facilities, can beautify neighborhoods, create habitat corridors in the urban environment, provide access to nature, calm traffic, improve pedestrian safety, and capture rain for reuse.

GSI is a community centered utility solution that helps make Seattle a sustainable and resilient city.

1.2 Purpose and Regulatory Context

The purpose of this volume of the GSI Manual for Capital Improvement Projects (GSI Manual) is to provide guidance and some standard procedures for operations and maintenance including annual inspections of constructed GSI facilities under the responsibility of SPU/WTD along streets in the City of Seattle (City/COS) ROW. Portions of this manual may also apply to publicly maintained GSI facilities on SPU parcels. Maintenance of regulated GSI Facilities is a requirement of the agencies respective permits with Washington State Department of Ecology (Ecology). In addition, implementation of GSI is one of the methods used by each agency (SPU and WTD) to meet their Consent Decrees to reduce combined sewer overflows and reduce polluted stormwater flowing into local waters (e.g. Puget Sound, creeks, rivers, lakes, etc.).

The end users of this volume of the GSI Manual may include staff from SPU, WTD, and/or their service contractors contracted to support assistance. The maintenance components generally follow the Washington State Department of Ecology (Ecology)'s *Guidance Document for Western Washington Low Impact Development (LID) Operation and Maintenance (O&M)*, dated

July 8, 2013, (Ecology O&M 2013) for consistency; however, as this manual's focus is on the public works aspect of bioretention facilities in the City's right of way, some elements may vary from guidance in Ecology O&M 2013 due to specific protocols for public work or function.

This manual is a living document that will be updated periodically based on input from SPU and WTD staff and maintenance crews as the strategies and techniques for GSI maintenance are refined with more facilities coming into practice. Updates are suggested in 2019 after the Venema, Ballard II and Delridge projects are fully established and other projects currently in early design come on-line. Feedback from the community should be considered to monitor community goals and promote continued acceptance of GSI facilities. (See Section 11).

The Washington State Department of Ecology National Pollutant Discharge Elimination System (NPDES) Phase I and Western Washington Phase II Municipal Stormwater Permits includes provisions for municipalities to adopt and implement O&M programs and to facilitate proper O&M of LID BMP's (S5.C10 of 2019-2024 permit).

This manual is intended to be used for various types of projects implementing GSI in the public right-of-way (ROW) to meet varying stormwater performance goals.

- For WTD-led projects: The project goal is to maintain the function of GSI technologies (such as roadside bioretention cells; permeable pavements or other GSI tools) to reduce combined sewer overflow (CSO) events (*Flow Control BMP's/Facilities*) in combined sewer basins where the overflow is managed by WTD.
- For SPU-led projects: The target function will vary depending upon the basin. GSI may be installed for creek protection, water quality treatment, flow mitigation, CSO control, address localized flooding and/or other project targets (*Stormwater Treatment and Flow Control BMP's/Facilities*). SPU has initiated a NDS partnering program that seeks to partner with departments, agencies and private parties to implement GSI. (See SPU's NDS Program Implementation Plan)
- For Other-led projects: This manual is currently not intended to be used by other entities (e.g. private developers/ property managers) for maintaining non-SPU/WTD GSI assets in the City's right-of-way as those installations may be under differing permit requirements.

This is the fifth volume in a series for the GSI Manual. Consult with other volumes for additional information:

- Volume I: Project Initiation / Partnering Framework
Volume II: Options Analysis
Volume III: Design Phase
Volume IV: Construction, On-Boarding & Commissioning
Volume V: Operations & Maintenance

In addition to reviewing materials that were prepared for SPU/WTD's other GSI Manual

Volumes, Appendix J includes references and resources specific for the Operations and Maintenance of GSI, regulatory references and general resources.

The focus of the GSI Manual is on the more commonly used GSI technique of roadside bioretention cells and their associated supporting infrastructure (such as underdrains, drain curb cuts, deep infiltration facilities, etc.). In general, where GSI is referred to herein it is regarding roadside bioretention cells and their associated supporting infrastructure. For other GSI techniques note the following:

- **Pervious concrete sidewalks** are maintained by Seattle Department of Transportation (SDOT) in accordance with Memorandum of Agreement (MOA) 17-058-A between SPU and SDOT for Maintenance and Operations of GSI in the Public ROW. (see Appendix H); however, permeable pavements may be used for paved paths between bioretention cells and so guidance is included herein.
- **Pervious concrete public alleys** are considered a “pilot” under the SPU/SDOT MOA, so specific O&M guidance is not included herein. Projects implementing pervious concrete alleys require development of a MOA with SDOT to determine if it will be allowed for a specific site and to determine which entity will be responsible for maintenance and ownership of the asset. See SPU SDOT MOA 17-058-A and Section 9 of GSI Manual, Volume III-Design.
- **Rain gardens** which receive runoff from non-pollution generating surfaces (sidewalks) is not a water quality or flow control facility according to COS Stormwater Manual V.3 Section 5.4.5 consequently this volume does not focus on its maintenance. Guidance herein related to bioretention cells and plants are also applicable to routine maintenance for rain gardens. SPU is responsible for routine maintenance of City rain garden assets in the ROW. See SPU SDOT MOA 17-058-A.

1.3 GSI – New Infrastructure and Assets

Green Stormwater Infrastructure, specifically roadside bioretention facilities, is still relatively new to the community as well as to public works staff in relation to other infrastructure systems such as water, sewer, electricity, roads, sidewalks and even trees.

As a new infrastructure that is generally visible on the surface (as opposed to underground) there is a need to frame maintenance expectations and to be transparent to intended function. It is expected that there will be hurdles and a range of opinions. This document is intended to provide consistent guidance yet some flexibility in approach and outreach. It is intended to assist management and field staff in determining best methods for specific conditions. Due to the relative newness of GSI the intent is to give guidance steps allowing supervisors some flexibility to manage conditions as this is still a new infrastructure, the tasks, steps, tools and materials used

If a project is utilizing new or non-standard GSI technologies, the O&M guidance will be prepared specifically for that technology with standard operating procedures (SOPs) documented in a project document such as a “Blue Book” for SPU Assets.

in maintenance are being tested. As GSI is a living system it will require adaptive management to address drought, climate change, human attitudes, encampments, changes in adjacent use etc.

This O&M guidance is a living document; users of GSI Manual Volume V should feel empowered to provide written comment, add to Appendices and provide new information to improve future updates to the manual. Maintenance staff should document their practices and review procedures annually, so their knowledge can be passed along to future staff along with providing input for updates to planning, design and operation and maintenance sections and checklists.

1.4 Maintaining within Public View

Seattle's rights-of-way make up approximately 27 percent of all land area in the city (source: Streets Illustrated ROWIM). As such, right of way space is a valuable community resource that supports diverse mobility needs, community identity, civic activities, vital infrastructure, and critical environmental services. GSI facilities and associated elements should be maintained to align with these systems and provide multiple benefits. The first step in GSI maintenance is observation. Ideally this observation will occur in both wet and dry seasons. As GSI is a treatment that captures and treats localized runoff, understanding the subtleties in grade, adjacent land use and even aspect will contribute to successful long-term performance.

O&M staff should observe GSI facilities during and immediately after storm events to understand function, conditions and adjacent uses.



Figure 1-1: SPU and Conservation Corp in field at SPU's Ballard Phase 1

This volume in concert with the other four GSI Manual volumes is intended to facilitate a consistent maintenance approach toward the successful function and community acceptance of GSI for stormwater management within the right-of-way. Currently maintenance of the GSI facilities is performed by Agency directed crews. As GSI facilities expand onto parcels there may be more interaction with neighborhood image groups, schools or residents in bioretention planting and maintenance.

The community is a valued resource for GSI maintenance as they may be the first ones to report an issue or a change of conditions. See Community Engagement Section 11

1.5 Right-of-Way Context

Figure 1-2 and 1-3 illustrates typical bioretention cells with and underdrain conveying flows to a deep infiltration screen well along a Neighborhood Yield street (image from WTD's Barton CIP).

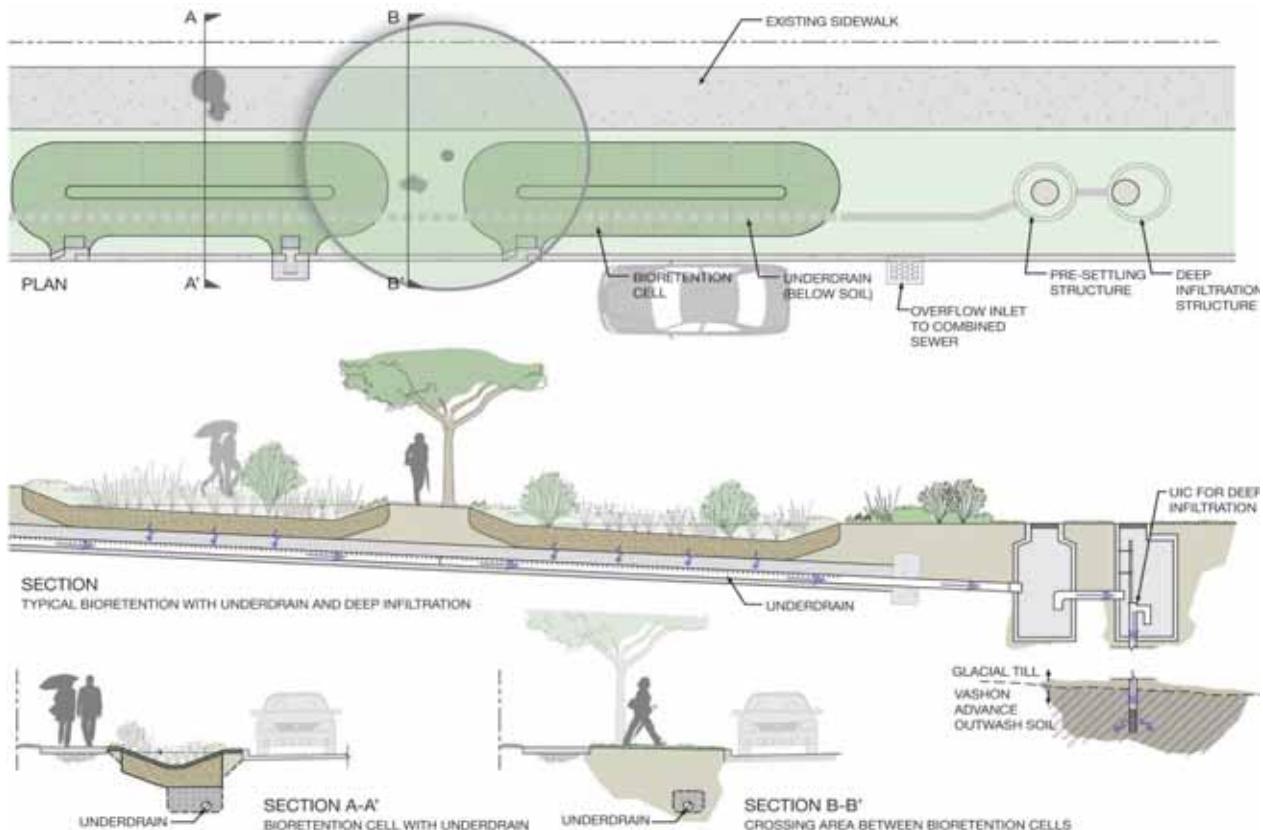


Figure 1-2: Concept of typical bioretention with underdrain & deep infiltration well

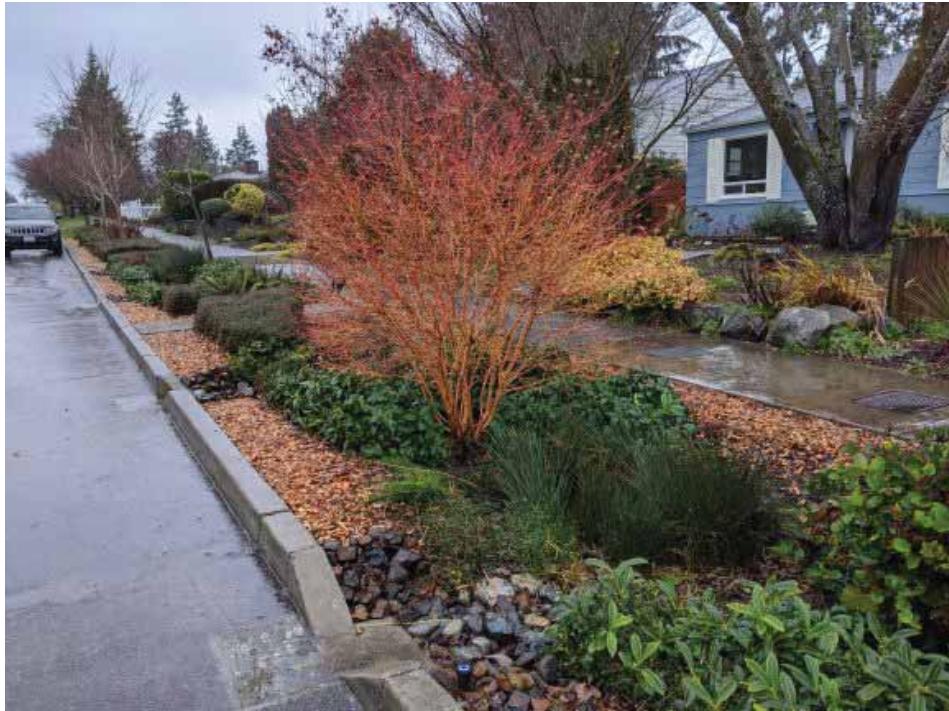


Photo of roadside bioretention cells during heavy rain. Gutter flow can be observed in the background where the drain curb cuts at the upstream bioretention cells are receiving most of the road's runoff. The volume (as observed by the width of the flow in the gutter) decreases at the downstream cell/drain curb cuts in the foreground indicating that the upstream cells are managing the flow for the block.

Figure 1-3: Example of constructed bioretention concept shown in Figure 1-2

Section 2

Coordination with O&M, GIS and Asset Management Staff from Design through Construction

2.1 Design Coordination

The key to successful operations and maintenance is early and often coordination between GSI Asset Manager/O&M leads with the policy, planning, design, community engagement and outreach leads as changes in approach to GSI infrastructure will affect operation planning and maintenance protocols.

At the Options Analysis Phase the project team will be modeling basin needs and testing which GSI tools will address performance goals for a basin and selecting a preferred alternative. During the Design Phase the GSI project team will be reviewing and refining the selected GSI tools, elements and/or components applicable to the project goals and location or context. These components are ones that have generally been reviewed and approved for citywide use in the right-of-way. Each project encounters some unique conditions or concerns, so it is anticipated that a modification or new approach may be recommended for a specific condition.

During the Options Analysis Phase the project planning teams should involve the O&M leads and brief them on the scale of the problem and receive input on the early analysis of viable GSI tools.

To ensure the design recommendations involve the O&M perspective, the project design teams are required to submit to Agency O&M Leads the 30-60-90 percent plans and specifications along with *GSI Component Design Checklist for O&M Approval* (See Appendix E in GSI Manual, Volume III: Design Phase). This checklist signals O&M staff of new or modified tools or components for their review and concurrence. These submittals should alert O&M staff to potential new elements and project specific spatial

Examples of past Asset Managers/O&M review of project elements during Design phase:

- design covered curb inlets to self-clean
- reviewing covers for ease of lifting and space to place
- reviewing location of weirs in relation to inlets
- reviewing inflow points to be sure they are sloped to move debris
- review curb inlet spacing so maturing plants will not block them
- physical space needs for O&M staff to work in or adjacent to cells
- area extents of agency maintenance responsibility

conditions. It is important that the respective details for these elements are reviewed to address long term maintenance and identify standard operating procedures.

2.2 Construction Coordination

The assigned Resident Engineer or Construction Manager should notify O&M leads/ GSI Asset Manager (AM) of construction progress so they can be on alert for changes. While every project has its own “construction life”, field changes or exceptions to the plans should be expected; the key is to build a relationship with the construction managers and field leads so they are aware for O&M considerations. The AM/O&M lead should meet with the agency construction manager and field staff to review the plans and the specific concerns a few weeks prior to construction. It is recommended that the AM/O&M leads be copied on construction meeting notes and if possible, attend the meetings or visit the site periodically during construction. This ongoing interaction will assist in strengthening the team understanding of the long-term intent.

2.3 GSI Construction Period Establishment Maintenance

Maintenance during and immediately following construction is often part of the construction contract or handled as a specific work order. This type of maintenance often involves some tasks that may be considered “commissioning” or “establishment” as new facilities are integrated into the overall system. The maintenance protocols during this construction period are typically defined by the project construction documents and may or may not respond to guidance included in this document. This period may also be used to allow soils to stabilize prior to the system coming on-line and handling the stormwater.

2.4 Transition from Construction & Commissioning Period

At end of construction contract (for SPU this is referred to as the contract’s “Completion Date”), the following will have been completed or underway for projects implementing GSI within the public right-of-way:

- Construction establishment period sign off (period may vary by contract)
- Punch list completed and issues addressed
- Commissioning review (if applicable)
- Record drawings submitted
- Assets updated into agency's Geographic Information Systems (GIS) for tracking
- Project specific O&M (SPU's Blue Book) for:
 - New/non-standard project specific GSI technologies
 - A project's deep infiltration facilities (if applicable)

Agency Asset Manager and O&M leads are notified when the construction establishment phase is nearing completion so they can attend the punch list walk-through. The facility is formally transitioned to O&M responsibility. See GSI Manual Vol IV Construction and Commissioning.

- Map or document of location specific/ GSI tool storm event protocols or Standard Operating Procedures (SOP).
- Identification of any special maintenance agreements, MOA's, MOU's, ADA access properties
- Community engagement activities (See Section 11)
- Regulatory agency approvals obtained
- If applicable, identification of potential maintenance partners such as another department, agency, NGO or business
- Other elements described in Volume IV of the GSI Manual and the agency's construction management manuals for capital improvement projects (CIPs).

2.5 Differentiating Operations, Maintenance and Annual Inspection

For this volume, operations, maintenance and annual inspection will be discussed separately however they are integrated in the terms of a functioning public GSI Asset Management Program.

2.6 GSI Maintenance Guidance Tables

The purpose of the maintenance guidance tables is twofold:

- To provide an overview for Operations and Maintenance supervisors; and
- To provide general guidance on tasks for field crews.

The maintenance guidance tables cover when and what to inspect or observe in the field to determine staffing and task requirements. The tables group the GSI Facility Components into categories such as "Facility Footprint", "Inlets/Outlets/Pipe/Grates – Surface", "Vegetation", etc. and include an overview of maintenance activities and timing for field crews.

The maintenance guidance tables in the Appendices are as follows:

- Routine Surface Maintenance At-A-Glance for GSI in the ROW (Appendix A)
- Routine Maintenance Guidance for Mature GSI in the ROW (Appendix A)
- Establishment Period Maintenance Guidance for GSI in the ROW (Appendix B)
- Major Corrective Action and Long-Term Maintenance Guidance for GSI in the ROW (Appendix C)
- Examples of Acceptable / Unacceptable Routine Maintenance (See Appendix D)

The GSI Program should strive to update the appendices every two years as facility maintenance experience grows.

2.7 Routine Maintenance Guidance for GSI in the ROW

Routine GSI maintenance activities for established bioretention cells have been identified based on observations and input from O&M field staff that have been managing these facilities for several years. The guidance includes activities, typical frequency of the activities and definitions of acceptable and unacceptable standards. Living systems are more difficult to classify as functioning or maintained as some aspects are subjective. The acceptable performance standards are the targeted standards while the unacceptable performance standards indicate that maintenance, corrections or improvements are required to the GSI facility components.

It is recommended to notify the community yearly of routine O&M tasks that may occur in the GSI facilities along their neighborhood street.

It is recommended to notify the community yearly, especially the adjacent neighbors of routine O&M tasks that may occur in the GSI facilities. This can be via the website, social media and more direct contacts. (See Section 11)

Figure 2-1 is an “At-A-Glance” table for routine surface maintenance for GSI in the ROW. (See more detailed information in Appendices A and D). Figure 2-2 is a planting zone diagram for bioretention cells with graded side slopes (See Appendix G for more information).

Maintenance Activity*	Frequency (Recommended Minimum)											
	Winter		Spring		Summer		Fall		Oct		Nov	
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Remove Trash, Debris, Pet Waste, etc.	Every Visit		Every Visit				Every Visit			Every Visit		
Clear Vegetation Blocking Visibility Sight Lines and Hydrants				1 Time			1 Time			1 Time		
Clear Drain Curb Cuts and Inlets	1-2 Times/Mo		1 Time			1 Time			1 Time			
Remove Sediment Build-Up (Presettling, Grates, Check Dams, Weirs, etc.)			1 Time							1 Time/Mo		
Clean Leaf Litter and Gutter Line	1-2 Times/Mo		1 Time								Weekly	
Maintain Curbside and Sidewalk Clearance			1 Time			1 Time			1 Time		1 Time	
Maintain Access Surfacing (Zone 5)			1 Time			1 Time			1 Time		1 Time	
Remove Invasive Plants	1 Time		1 Time							1 Time		
Remove Weeds	1 Time		1 Time/Mo			2 Times/Mo			1 Time		1 Time	
Apply Wood Chip Mulch (Zones 2-4)			1 Time							1 Time		
Watering (By Hand or Truck), for Irrigation See Project Plans.			1-3 Times/Wk	20 min hose watering per cell as needed		3 Times/Wk	20 min hose watering per cell		1-3 Times/Wk	20 min hose watering per cell as needed		
Prune Trees within Bioretention Cell	1 Time											
Prune Shrubs, Grasses, Sedges and Fern Foliage	1 Time								1 Time			
Cut Back Dead or Flopping Foliage	1 Time								1 Time		1 Time	

*Refer to GSI Manual, Vol. V, Appendix A for detailed description of routine maintenance activities.

Figure 2-1: Routine Surface Maintenance At-A-Glance for GSI in the Right-of-Way



Figure 2-2: Bioretention planting zone diagram for cells with graded side slopes

2.8 Establishment Period Maintenance Guidance for GSI in the Right-of-Way

Maintenance of bioretention facilities for the first three years is critical to project performance as this is the period where O&M crews may need to refine (grind down) the gutter line to improve flow paths into the cells (during commissioning), observing location specific conditions such as amount of litter, pet waste, leaf drop and controlling weeds. The Establishment Period Maintenance Guidance has the highest performance standards with higher frequency to allow the plantings to establish, minimize weed growth and check the designated inlet, drain curb cuts and discharge systems to monitor that they are handling the stormwater flows as anticipated. Maintenance guidance for the establishment period is initially described in the construction contract documents for the CIP (e.g. construction specifications/Project Manual). Once the agency accepts the project, the GSI maintenance guidance in Appendix B is followed by the agency responsible for the asset.

O&M staff should submit establishment period lessons learned to the GSI Program Lead as a feedback loop to Construction and Design.

2.9 Major Corrective Action and Long-term Maintenance

Major Corrective Action Guidance covers emergency conditions/extreme events, major repairs and extensive changes due to adaptive management. Long Term Maintenance Guidance covers planned activities such as video inspection of underdrain pipe systems.

See Appendix C for more information on Major Corrective Action Guidance and Long-Term Maintenance Guidance for GSI in the ROW.

2.10 Deviations or Non-Standard Design Elements

A facility design may have new GSI tools and components (not in COS Standard Plans or GSI Manual) which will require the project team to prepare specific guidance and SOP's that may be referenced. For SPU GSI assets, this project-specific O&M document is called the project's "Blue Book".

Examples of elements that require CIP project team to prepare specific O&M guidance and SOP's (e.g. SPU's Blue Book):

- Projects using deep infiltration facilities (horizontal/vertical pit drains, drilled drains, screen wells) for discharge of stormwater.
- Bioretention cells with structural soil cell systems.
- Pervious concrete alleys.
- Elements not in COS Standard Plans.
- Facilities with non-cast-in-place concrete walls.

- Facilities that are proprietary or have proprietary elements.
- Elements not within an agency's asset management plan for other infrastructure.
- Other elements not covered or are a placeholder in this volume.



Photo on left is an access lid over a deep infiltration facility (UIC screen well). Photo on the right is for a bioretention cell facility with horizontal pit drain, structural soil cells below the sidewalk and perforated corten steel wall along the sidewalk side of the facility.

Figure 2-3: Examples of elements requiring project specific O&M manual/SOPs.

Section 3

Operations

3.1 Defining Parameters and Resources

Even though roadside bioretention facilities have been installed in the City's ROW since the early 2000s, this infrastructure is "young" in the context of utility operations and maintenance. As the systems are designed in context with local physical conditions and often have differing performance requirements, the supporting data on frequency of inspections and resource requirements for maintenance is limited. The understanding of which GSI elements should be monitored for function is more understood than the staff time and material resources needed to maintain. This section is a guide to GSI Operations and Maintenance from the perspective of public work infrastructure management. It will be important to track and document activities so that more informed operations planning can improve. Tables and checklists included herein have been updated from recent maintenance discussions and it is anticipated that these will be updated periodically while the GSI program grows.

Table 3-1 includes a list of an agency's team for operation decisions may include the following staff:

Future Volume Updates

In this Volume, the focus of the Operations content is for bioretention systems; however as with other sections of this volume there are placeholders for future content as other GSI elements and systems are planned for installation in the City's right-of-way.

Table 3-1: Agency Staff for Team of Operation Decisions

SPU	WTD
Asset Manager Urban Ecosystems	Facility O&M Representative
Project Delivery Branch Manager	Capital Projects Planning & Delivery Unit Manager
	Lead Civil Engineer for GSI
	Lead or On-Call Landscape Architect for GSI
	Restoration Lead
	Agency Arborist or On-call arborist
	IT staff
	GIS staff
	Asset Management Lead
	Community Outreach and Communications Lead
SPU Line of Business Representative (for SPU projects only)	

3.2 Contract Coordination for Commissioning

GSI systems typically require a period to adjust and “settle in” to manage stormwater functions. Below are the following key steps:

- Construction Phase Maintenance
- Warranty Documentation
- Construction Commissioning
- Establishment Maintenance
- Establishment Commissioning

3.2.1 Construction Phase Maintenance

GSI construction maintenance will be project specific depending on project scale and sequencing however at the minimum the GSI installations require maintenance through the contract’s “Completion Date” (also may be referred to as Final Acceptance by other agencies) as part of the construction process. Often the construction contract includes extended maintenance to minimize problems due to erosion, weeds and watering. See below for establishment maintenance procurement options.

3.2.2 Warranty Documentation

This step involves the Contractor providing the Construction Contract lead with the documentation on final materials specifications, sources, warranties and system specific manufacturer information. GSI warranty documentation will be project specific depending on which elements or systems are employed.

3.2.3 Construction Commissioning

GSI commissioning for right-of-way bioretention has some general requirements that should be tailored to the project. Operations staff are involved in commissioning as they want to know the facility they are going to manage is set up to function appropriately. See Volume IV Construction, On-Boarding and Commissioning.

Commissioning activities during construction (also referred to as quality assurance construction testing by the agency inspector) generally involve:

- Gutter flow test to review the effectiveness of the drain curb cuts/ inlets or pavement edge sheet flow in capturing the runoff; review if spot grinding is needed to ensure flow into the drain curb cuts and/or at catch basins with pipes daylighting into the cells.
- Flow test of the drain curb cut to the presettling zone of the cell to adjust placement of the concrete pad, culvert pipe (if applicable) and adjacent boulders as applicable
- Flow test for the weirs especially if they are used for flow control
- Flow test for pipe inlets to be sure there is adequate flow dissipation to minimize erosion
- Review of grades at the edges along walks to be sure there is positive sheet flow

- Review to be sure that plants are not placed within 12 inches (minimum depending on plant type) of drain curb cut and pipe inlets in order to not block flow into the cell.
- Review of plants immediately upstream of weir orifices or notches so they are not blocking flow
- Review of plant placement with required minimum setbacks from the access edges of sidewalks, paths, curbs, step out zones along the road, etc.
- Review of tree placement to be sure newly planted trees are not in line with property pedestrian access (often obscure on plans) or blocking casual access paths
- Review of structures access lids so that they are operable and the assembly within the maintenance hole (MH) is aligned for operations and maintenance access from the surface
- If not specified for installation, review establishment O&M reports to see if an area along a street with GSI requires the installation of a pet waste bag dispensers
- There may be other elements to test depending on the specific facility design such as the set up and function of various deep infiltration facilities (UICs), drain curb cuts along the sidewalk if facility has a wall, etc.

3.2.4 Establishment Maintenance

GSI establishment maintenance for bioretention plantings will continue until approximately three years after construction. See below for establishment maintenance procurement options.

3.2.5 Establishment Commissioning

While formal commissioning is typically a signal event, it is expected that establishment commissioning activities will continue through the GSI establishment maintenance phase as the bioretention plantings mature. Activities in this stage may include:

- Review of drain curb cuts/inlets into bioretention cells during a rain event to ensure water is freely flowing into the facility
- Review of plants near drain curb cut and pipe inlets and weirs so they are placed for filtering but not blocking flow as the plants mature
- Review of plant placement with required minimum setbacks from the access edges of sidewalks, paths, curbs, step out zones along the road, etc.
- There may be other elements to test depending on the specific facility design such as the set up and function of various deep infiltration facilities and their associated infrastructure; flow through the drain curb cuts along the sidewalk if facility has a wall; adjustment of weirs at flow splitters or catch basins with pipes daylighting into bioretention cells, and/or other elements, etc.
- Addressing community related comments/concerns (See Section 11)

3.3 Contract Coordination for Construction Phase Establishment of Plantings

GSI systems typically require a period for plantings to establish and soils to stabilize prior to allowing the system to come on-line and handle the stormwater. Decisions need to be made during final design regarding:

- Establishment time period
- Contract procurement approach
- O&M staff resources

Establishment is the term used for the period before a GSI facility is stable in plant growth and soils. For most plantings this is typically reached a full three years following construction completion; however, a facility typically comes “on-line” or provides a stormwater management function prior to full plant establishment. The construction phase establishment timing (See GSI Manual Vol. IV) will vary according the planned construction season and project completion date. For example, a late spring completion for a project without an underdrain might be open to receiving flow as early as six weeks but a late fall completion date could require waiting for several months prior to receiving stormwater flow.

It is critical that Operations staff be involved in the decision to determine the length of the construction phase establishment indicated in the CIP's Project Manual for the construction contract.

It is important for Operations staff to review design plans so they can forecast resource needs. The construction managers/ Resident Engineer should review the timing of the formal turnover with SPU/WTD Operations staff at least 3 months prior so O&M leads can schedule routine maintenance. If a facility is intended to be turned over to Operations prior to two years, then it will be important to address the resources required for establishment maintenance as this requires more labor hours and higher frequency for maintenance activities. Generally, the contract procurement options include:

- 3 to 12 months following project acceptance for a three to five block GSI focused CIP construction contract
- 12 months to 3 years for a larger CIP construction contract
- Term based – maintenance focused work order contracts

3.4 Performance Standards

As discussed in Section 1, GSI systems are required to be maintained to meet agency performance standards and report under their specific Key Performance Indicators (KPIs). These KPI's may change as the agency evaluates their long-term goals. A facility may have additional performance standards which should be included in project specific O&M guidance. See Appendix I for current KPI's and reporting forms.

See Section 2 for detailed maintenance guidance. Routine maintenance will keep facilities functioning to meet their standard. Maintenance alerts will be triggered when a facility falls

below this standard. Generally, the reporting will be:

- Acceptable: “meets agency standard”
- Unacceptable: “corrections required”
- Compliant: “meets regulatory requirements”
- Complaint: “community comment”

There may be discussion or comment on a “failed” system or component. As these are regulatory facilities a system considered failed means that the system is a candidate for major corrective action or extensive maintenance requiring authorized funding.

Due to the location of these facilities within the “public realm” there may be other non-regulatory maintenance requests that the O&M staff will be asked to address.

3.5 GIS Based Asset Tracking for GSI Facilities

GSI facilities and best management practices (BMPs) include a range of technologies, components and materials. As the GSI program matures and these facilities become widespread, streamlining the tracking method within each agency’s asset management program will become routine. The specific GSI elements may require refined terms and titles to meet the various asset management and computerized tracking programs (e.g. Computerized Maintenance Management System –CMMS). While SPU uses “Maximo” and tracks CSO control efforts through CMOM (Capacity Management Operations and Maintenance); WTD tracks with SCADA. Furthermore, SDOT uses the program “Hansen” and Seattle Parks and Recreation uses “PLANT” for asset management. Future updates to this volume of the GSI Manual should include a briefing of these various asset management software programs and how the GSI facilities will be included.

As discussed in Section 1 there will be coordination with the O&M team during the design phase. The O&M representative (i.e. Agency’s GSI Asset Manager (AM)) is key member of the Project Team during the design phase and will coordinate with agency GIS staff to prepare for new asset on-boarding. Upon completion of the as-built construction drawings, the O&M representative (SPU’s AM) in coordination with agency GIS staff will assign the required facility tracking numbers or identification codes.

The consistent use of asset management terms is important to spatially locate facilities using a GIS database and for tracking metrics over time. Consider following terms that are consistent with COS Standard Plans/Stormwater Manual. However, this can be challenging when terms change within these other manuals/codes over time.

3.6 Regulatory Reporting

For SPU-led projects: Through the August 19, 2016 Phase I Municipal Stormwater Permit, Ecology requires annual inspections of all Stormwater Treatment and Flow Control BMPs/Facilities owned or operated by the Permittee (NPDES Phase I Permit S5.C.9.c.i). This reporting includes:

- Bioretention facilities – located in MS4 (municipal separate storm sewer system) area
- Other elements designed to provide water quality treatment and/or flow control in accordance with City's Stormwater Code.

3.7 Internal Agency Reporting and Updates

For SPU-led projects: This reporting should include a feedback loop to update the guidance in Volume II and III of the GSI Manual for the Options Analysis and Design phases.

For WTD-led projects: This reporting should include a feedback loop to update the guidance in Volume II and III of the GSI Manual for WTD's Problem Definition, Alternative Analysis and Design phases.

See Appendix E for an example of a maintenance checklist prepared for a specific project.

3.8 Staffing

The O&M team will include a variety of disciplines however the need for full time equivalents (FTE) will depend on the extent of facilities and types. The following are general categories for staffing in addition to operations management staff.

Technical support:

- Civil Engineer
- Landscape Architect
- Horticulturalist or Plant Ecologist
- Arborist
- GIS Tracking Specialist
- IT Business Analyst
- Community Relations Lead/ Public Engagement Specialist
- Post Construction Monitoring - Instrumentation and Control staff

Field support:

- Supervisors
- Gardeners (recommend teams of 3 to 5)
- Equipment Operators
- SPU DWW crew chief
- Crews for underground utility, surface water and maintenance

Specialized or Outsourced support:

- Vactor Truck Crew
- Pipe Cleaning and Inspection
- Deep Infiltration Facility Maintenance and Repair Crews (See Section 6)
- Street Signage Repairs (SDOT crews)

- Arborist (qualifications per SDOT Street Tree Manual Director's Rule 3-2014)

Resource staff:

- Civil Engineer(s) for assistance with corrective actions that may impact regulatory function.
- Landscape Architects for GSI, street improvements field adjustments and analysis
- Geotechnical Engineer/Geologist/Hydrogeologist
- Structural Engineer (e.g. vertical wall designs)
- Permit Specialist
- Procurement Specialist for seasonal support, work order or material contracts
- Public communications/outreach specialist

3.9 Training

Even though roadside bioretention facilities have been installed in the City's ROW over the last 20 years, this infrastructure is relatively new to the field of public works maintenance and as such it is recommended to define a base level of skills and a training regime to support the expanding GSI program in the context of the regulatory requirements. As these are public facilities meeting a prescribed function the field crews should be trained in this regard. Currently the program sponsored by the Washington Association of Landscape professionals (WALP) ecoPRO Certified Sustainable Landscape Professional Program may be the most well-rounded training for maintenance staff however agency specific GSI training will still be required. Also, consider having apprentice program training. (See https://www.mediafire.com/folder/bhtkl2b5iq7mu/Sustainable_Landscape_Professional_Cert)

While it is often noted that vegetation maintenance skills support GSI (bioretention) maintenance requirements, there are distinctions in approach that require crew training and orientation.

3.10 Equipment

Roadside bioretention systems and associated supporting infrastructure have specialized materials and design elements that may require a review of the agency's readily available equipment resources. The operations management staff should receive the project specific design elements checklist at turnover to confirm that suitable equipment is available for maintenance and inspection.

Typical Equipment includes:

- Crew specific needs such as reflective clothing, gloves, boots, etc.
- Routine landscape maintenance tools such as shovels, brooms, pruners, etc.
- Soil monitors such as soil moisture sensors, T-handle core sampler; soil auger and infiltration testing equipment
- Watering equipment (see facility design or GIS tracking for automatic irrigation system)
- Small pipe inspection/maintenance tools for the underdrains

- Storm drain maintenance equipment for MH structures, CB's and inlet/outlet pipes
- Specialized equipment such as blowers (use should be carefully reviewed, i.e. do not use blowers to blow debris onto permeable pavements/pervious concrete sidewalks or into bioretention areas or out of bioretention areas)

Large Equipment /Outsource requirements typically include:

- Trucks
- Small excavator
- Sweepers (vacuum based preferred)
- Industrial shop vacs
- Vactor truck
- CCTV/Electromagnetic/Ultrasonic pipe inspection
- Specialized equipment for deep infiltration facilities maintenance (See Section 6)

3.11 Materials for Bioretention

Roadside bioretention systems and their supporting infrastructure have specialized materials and design elements that may require a review of the agency's readily available maintenance material supplies and equipment resources. Materials typically for bioretention cells include:

(Note: COS Section #s herein refers to the City of Seattle Standard Specifications for Road, Bridge and Municipal Construction 2020 Edition. Specification Section numbering and specifications may change for future updates of the COS Standard Specifications. Check for current edition.)

- **Bioretention Soil Mix (BSM) (including Mineral Aggregate and Fine Compost):**
 - BSM per COS 2020 Section 9-14.1(4) unless location notes a special mix that was done for the project (e.g. SPU's Swale on Yale has project specific BSM with an added polishing layer for the biofiltration swale section, other projects may use a BSM with no compost as one of its media components within the mix).
- **Bioretention Soil Mix for minor repairs** (for areas smaller than two cubic feet of material), either of the following may be used:
 - A mix of materials that are available at a local hardware store can be mixed well and used for areas requiring less than two cubic feet of material:
 - 2 bags of pea gravel (one cubic foot)
 - 2 bags of play sand (1/2 cubic foot)
 - 1 bag of certified organic compost (one cubic foot)
 - Approved supplier Bioretention/Rain garden soil mix

- **Mulch for Top Dressing:**
 - Arborist Wood Chip Mulch - COS 2020 Section 9.14.4(4) – with the exception that it shall not be longer than 4-inches and shall not be derived from recycled lumber; or
 - 50/50 Mix of Coarse Bark Mulch and Arborist Wood Chip Mulch
- **Culvert Geotextile Fabric** for reducing erosion and providing separation (if shown on plans as part of the pipe outlet protection/splash pad section below rock/cobbles):
 - shall conform to type identified on plans, preferred; or
 - Mirafi® 140N, US Fabrics US 120 NW, or an approved equivalent product.
- **Wattles or Compost Socks** (also referred to as coir logs):
 - shall conform to COS 2017 SWM Volume 2 – Construction Stormwater Control BMP E3.35 and COS 2020 Section 9-14.16 or 2020 edition of Washington State Department of Transportation Standard Specifications for Road, Bridge and Municipal Construction (WSDOT) Section 9-14.6(5), 9-14.6(6) or 9-14.6(7).
- **Bioretention Underdrain Pipes and Cleanouts:**
 - Pipe and slot perforations shall conform to the size and material specified on the plans
 - Bioretention Underdrain Cleanout and Observation Port shall conform to type shown on plans or refer to COS 2020 Standard Plan 281 and COS Standard Specifications
- **Drain Curb Cuts and Presettling Zones:**
 - See Section 3.12
- **Liner repairs:**
 - Refer to the specific project's CIP Project Manual for construction specifications and plans and the project's O&M manual.
- **Bioretention Plant replacements:**
 - See Section 3.13 and Appendix G.

For materials not listed herein, see COS Standard Specifications and Standard Plans; and refer to the specific project's CIP Project Manual for construction specifications and plans and the project's O&M manual.

3.12 Pavement/Hard Surfacing Materials for Repair/Replacement

Roadside bioretention systems often have hard surface elements such as those listed in this section. When sourcing replacements, the materials shall meet the project plans specifications or COS Standard Plans and Specifications.

- **Standard Presettling Zone Precast Concrete Pad:** Replace to match or refer to COS 2020 Standard Plan 299 and COS Standard Specifications.
- **Non-Standard Presettling Zone Concrete Pad:**
Refer to the specific project's CIP Project Manual for construction specifications and plans and the project's O&M manual.
- **Standard Drain Curb Cuts Types 1-3:**
Replace to match type and refer COS 2020 Standard Plans 295a-295d and COS Standard Specifications.
- **Non-standard Drain Curb Cuts and Inlets:**
Refer to the specific project's CIP Project Manual for construction specifications and plans and the project's O&M manual
- **Standard cement concrete sidewalks:**
Refer to COS 2020 Standard Plan 420 and COS Standard Specifications.
- **Cement Concrete Paths (between bioretention cells in the planting strip):**
Replace to match or refer to COS 2020 Standard Plan 420 and COS Standard Specifications.
- **Pervious concrete sidewalks or paths:**
Refer COS 2020 Standard Plan 425, COS 2020 Section 5-06 and Supplemental Guidance for Pervious Concrete Sidewalk Maintenance and Repair for major repairs (See Appendix L).
- **Other types and applications of permeable pavements** and pavers (non-standard or not common within City):
See the specific project's CIP Project Manual for construction specifications and plans and the project's O&M Manual (for SPU led CIPs this would be the "Blue Book")

Community Engagement for plant replacements

Community outreach will be required to inform adjacent residents of work happening in the right-of-way for significant repairs. Review the project's basis of design to determine if some of the plants being replaced were driven through community input. See Section 11 for public engagement during O&M.

3.13 Plant Replacement Materials

Bioretention facilities have specifically approved plant materials - See Appendix G for Bioretention Plant Lists and Tree Lists. When sourcing replacements, plant materials shall meet the requirements in Table 3-2.

Table 3-2: Plant Material Requirements & Considerations

Plant Materials	Requirements & Considerations
Plant Stock	<ul style="list-style-type: none"> Plants to be nursery grown in similar climatic to Puget Sound. Measurements, caliper, branching, grading, quality, balling and burlapping are to follow standards in the American Standard for Nursery Stock published by AmericanHort and approved April 14, 2014 (or current edition) See As-built Project Plans for specific plants when substituting a plant with another species. The substituted plant shall be on the Bioretention Plant List (Appendix G) and variety. The substituted plant must not exceed height and growth pattern of the original plant for right-of-way use (e.g. maintain sightlines).
Form	<ul style="list-style-type: none"> Trees to have an overall form typical of the species, uniformly branched, with a symmetrical crown. Trees with curved or leaning trunks, damaged leaders, uneven canopies, damaged bark, sunscalds, disfiguring knots or fresh cut limbs over 3/4" will be rejected. Coniferous trees to be in native form (not sheared) with a single dominant leader. Shrubs to have an overall form typical of the species, uniformly branched, with a symmetrical crown.
Bare Root Trees and Shrubs	<ul style="list-style-type: none"> Bare root plants are acceptable from late fall to early spring.
Container Grown	<ul style="list-style-type: none"> Plants to have been grown in container for enough length of time for the root system to have developed to hold its soil together, firm and whole. No plants shall be loose in the container. Container stock shall not be pot bound.
Balled and Burlapped	<ul style="list-style-type: none"> Plants to have firm, natural balls of soil, wrapped firmly with burlap or approved material, and bound carefully with twine, cord or wire mesh.
Grasses and Emergents	<ul style="list-style-type: none"> Grasses and emergents may be available in a variety of forms. Typically, it is best to plant small (<1 gallon) containers or 5 to 10 cubic inch plugs. Bare root plugs are acceptable if they are well-rooted and watered by an automatic irrigation system. It may be an option to divide a larger grass container into two or three plants.

3.14 Other Materials Required during Plant Replacement

When replacing plants, other materials are often required for the installation and other plants may be impacted. When sourcing replacements, the materials shall meet the requirements listed in Table 3-3.

Table 3-3: Other Planting Component Requirements & Considerations

Surface Cell Components	Requirements & Considerations
Soil Amendments	<ul style="list-style-type: none"> • Natural leaf mulch or compost that may be applied annually provides the nutrients required for the living system • Arborist wood chip mulch on edges of cells • Humic acid if recommended
Cobbles	<ul style="list-style-type: none"> • 3-inch minimum to 6-inch maximum well-graded washed rounded cobblestone rock or an approved equivalent product. Cobbles shall not be procured from natural stream bed channels.
Boulders	<ul style="list-style-type: none"> • Pipe protection boulders shall be of a similar color and type in accordance with the size noted on the plans. • Weir boulders shall be in accordance with the size noted on the plans and COS 2020 Section 9-03.15 (rock facing material). • Boulders shall be High Cascade Granite smooth finish, free of cracking
Replacement Tree Staking	<ul style="list-style-type: none"> • Tree tie shall conform to COS 2020 Section 9-14.7. • Wood stakes shall be 2-inch by 2-inch by 8-foot long Lodgepole pine wood stakes. • Remove at one year
Irrigation	<ul style="list-style-type: none"> • Hand water replacement plants • See project specific record drawings and manual for repairs.

The following shall be used only upon approval from Asset Manager and WQ lead:

Fertilizers	<ul style="list-style-type: none"> • Generally, not required in planting cells • Tree fertilizers, if determined needed by an ISA certified arborist, shall contain all-natural ingredients. • Approved products may include: <ul style="list-style-type: none"> ◦ Plant Health Care, MycorTree Injectable ◦ Plant Health Care (PHC) for Trees (select specific blend based on tree health, soil testing and location) • Humic acid
Herbicides	<ul style="list-style-type: none"> • See King County Integrated Pest Management document (Appendix J). • Follow the recommendations of herbicide use within Class B streamside buffers (waterways).
Pesticides	<ul style="list-style-type: none"> • See King County Integrated Pest Management document (Appendix J). • Follow the recommendations of pesticide use within Class B streamside buffers (waterways).

3.15 GSI Facility Component Corrective Actions

First it is important to confirm that the facility in question is part of the agency's specific compliance with their NPDES permit, either installed to bring the system into compliance (e.g. retrofit) or installed as part of development code compliance (e.g. new development/redevelopment). A voluntary installation such as neighborhood roadside rain garden is not likely part of the compliance. If a voluntary system is failing and requires major repairs the agency may choose to take it offline and return the area to standard right-of-way treatment. (See Section 3.16)

For SPU Facilities: If a code required GSI facility component is not properly functioning and needs major corrective action, operations supervisors are to work with agency technical staff to determine if the component or portion of the system is repairable.

3.15.1 Major Repair due to Failure

If a major repair is required and the facility will be offline, then accommodations may be required to maintain the compliance threshold for that basin. This will require location specific analysis and review by compliance staff. Depending on the decision and how the asset was permitted/recorded, consultation with Ecology or City (such as Term Permit) may be required. For example, if a new screen well is to be constructed then a permit with Ecology for the UIC would be required.

Triggers for failure (see Definitions section) may include:

- The component or asset no longer meets its design objectives, requires major repair and is not needed to meet the design capacity. Some examples of this include piped inlet is crushed; upstream conditions have changed so flow is redirected; UIC drilled drain/screen well plugged, etc.
- Ponded water that is not corrected through routine maintenance (standard operating procedures).
- Vegetation height exceeds sightline clearance and safety and requires frequent maintenance so removal of problem plant and replacement with lower growing plant is required.
- Major storm has caused a downed tree over system and is compromising underground system components.
- Reports of visible water on adjacent properties requiring investigation of underdrain and liner.

Consult with SPU/WTD Compliance Staff

Each facility (e.g. a series of cells managing flow of a basin, UIC screen well/drilled drain, etc.) constructed to meet an agency's NPDES permit, Consent Decree or other requirement, may require involvement and consultation of the agency's compliance staff if there is a major repair, replacement that would affect the performance and terms of the permit / regulatory requirements.

Issues to consider prior to taking a code required facility offline for a temporary period may include:

- Review seasonal options - can the work be delayed to the dry season?
- Review options for temporary treatment.
- Is there a downstream facility in the same basin that can be adjusted to temporarily address the flow and water quality needs?
- If the cell is lined what is a reasonable amount of time before the area becomes anaerobic due to saturation from direct rainfall? Will there be a vector issue?
- Can the component or system be taken offline while kept in place?
 - For example, if a bioretention cell does not drain could it be filled with soil to the gutter line to eliminate ponding and create a flow-in / flow-out movement of water? If the cell is part of a series of cells, this would maintain the general aesthetics once the cell is replanted. If the cell is isolated and surrounded by lawn, an option might be to fill the cell with soil, fill in the curb cut inlets, and restore to lawn.
- What community notification should take place for doing major corrective maintenance actions? See Section 11.

Major corrective maintenance actions that require taking a cell or facility offline for more than 14 days in the dry season and more than three days in the wet season will require a specific work plan to be approved prior to start of work.

3.15.2 Major Repair due to Oversizing

If through monitoring of a facility over time it is observed that a facility appears to be oversized or managing flow better than expected (such as faster infiltration and/or minimal ponding), then an agency may want to consider if the facility should be adjusted or portions of it removed to improve Operations. As with Major Repairs due to Failure, adjustments of a facility require review with both technical design staff and compliance staff. For example, if a facility is a series of cells on a block and it is observed that a cell midblock receives little to no flow or rarely has ponded water (e.g. compared to the 6-inch design depth) then an agency may want to consider if it should be adjusted to improve on Operations.

3.16 Removal of Voluntary GSI Facilities

For voluntary bioretention facilities or voluntary rain garden facilities the following is guidance for their removal:

- Notify the responsible party (neighborhood group or owner) that the facility is noted as failed and corrective active or removal is required. See Section 11.
- The first choice would be to review if an adaptive management approach would allow some continued stormwater function. For example:

- If it is an unlined system, would it be suitable to regrade to a few inches below gutter line and allow a shallow flow in/flow out conveyance treatment to occur in place of full bioretention?
- If the “failed” cell is within a series of cells, this approach would maintain the general aesthetics once the cell is replanted.
- If the cell is isolated and surrounded by lawn, an option might be to fill the cell with soil, fill in the curb cut inlets, and restore to lawn.
- If facility is tagged for removal, then Operations staff should refer to the ROW use agreements and the responsible party notified that removal and restoration is required per terms of the agreement. If the failed condition is ponded water, then O&M staff should block the curb cuts and inlet pipes as applicable to minimize impacts of standing water such as anaerobic conditions and mosquito habitat.
- Update agency's GIS map, GTE, and Maximo or work management system for tracking the voluntary facility in City records.

3.17 Coordination with Other Right-of-Way Uses, Policies and Programs

To ensure coordination of maintenance with other right-of-way infrastructure uses of the ROW and adjacent parcel improvements, the use of GIS for locating facilities and tracking maintenance is strongly recommended. O&M staff should also maintain awareness of city policies and programs (some of which are identified for a particular street on the Streets Illustrated Map in Seattle's Right-of-Way Improvements Manual (ROWIM) <http://streetsillustrated.seattle.gov/map/>)

O&M staff should maintain awareness of city policies and programs for use of the right of way

Relevant uses, programs and plans such as:

Special Routes

- KC Metro Transit Routes and Major Transit Centers
- Fire/Emergency Vehicle Routes on Residential Streets (check with local fire station)
- School Bus Routes
- Safe Routes to School
- Greenways
- SPU Recycling/Garbage/Yard Waste Management Route Maps

Programs

- Safe Routes to School
- RainWise Program
- reLeaf Program
- Utility infrastructure improvements (franchise, Seattle City Light, Water, Sewer, etc.)

- Other capital improvement projects planned for the area
- Other City/Community plans and activities

Policies & Plans

- Pedestrian Master Plan Implementation
- Complete Streets
- SDOT Street Tree Manual
- SDOT Trees and Sidewalks Operation Plan
- Bicycle Master Plan Implementation
- Neighborhood Greenways Implementation
- Transit Master Plan
- Urban Forest Stewardship Plan
- Freight Master Plan
- Franchise Repairs and Improvements

Example of OM review on City policies:

A change from Single Family to Multi-family along a GSI frontage may require a review of elements such as the access points or structures. The zoning change could also affect the street typology and require new sidewalks to be constructed in the new multi-family zone. O&M staff should maintain awareness of city policies and programs for use of the ROW.

3.18 Emergency Management: Response

For SPU-led: refer to City if Seattle Emergency Operations Center.

SPU 24-hour emergency (206) 386-1800.

For WTD-led: refer to King County's Comprehensive Emergency Management Plan

WTD's 24-hour emergency service line (206) 263-3801.

See also Section 9: Storm Events, Extreme Weather or Emergency Maintenance

3.19 Update Risk Management

A yearly reporting of issues that affect risk management should be prepared and submitted by SPU/WTD staff to their GSI Program leads (see page i herein). This report may include observed conditions such as storm event resilient design features or recommendations for adaptations to improve resiliency, physical conditions related to specific locations such as a change in the adjacent sidewalk or even a change in the adjacent land use and other problematic issues or observance. This reporting should provide a feedback loop to update other volumes of the GSI Manual (See Section 1). Finally, this report should include documentation if a facility has been determined as requiring major corrective action. (See Appendix C).

3.20 Feedback Loop / Lessons Learned for Updates to GSI Manual

O&M staff for SPU/WTD-led CIPs shall have a feedback loop to update guidance in the GSI Manual for Capital Improvement Projects for the following volumes:

- Volume II: Options Analysis Phase (for WTD-led projects this volume covers Problem Definition and Alternative Analysis)
- Volume III: Design Phase
- Volume IV: Construction, On-Boarding and Commissioning
- as well as this Volume V: Operation & Maintenance.

Lead Operation and Maintenance representatives (for SPU it is the Asset Manager) are also to be part of the CIP's Project Team during Options Analysis through Construction phases. At the closeout meeting of each phase, the Lead O&M managers/AM can also provide feedback for updates to the GSI Manual.

For SPU and WTD contacts to report feedback on the GSI Manual, see page i of this document.

3.21 Community Engagement Information

See Section 11 of this Volume.

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Section 4

Maintenance of Bioretention Facilities

4.1 Overview

The GSI bioretention facilities implemented in the right-of-way are considered living systems that adapt over time to specific conditions and are subject to weather patterns. Consistent maintenance is essential to ensure that the systems are efficient, long lasting and the prescribed performance for the BMP's are being achieved. This manual discusses routine performance and timing of procedures. It outlines this procedure through the Maintenance Guidance Tables in Appendices A, B and C. A list of resources (See Appendix K) is included for additional information.

The focus of this content is currently bioretention however as with other sections of this volume there are placeholders for future content as other GSI strategies, components, elements and systems are planned for and/or become more frequent for installation in the right-of-way.

Surface facilities are considered to include the following: facility footprint, soils, earthen berms/dams, weirs, inlets/outlet pipes, curb inlets, grates, structures, vegetation, mulch, and hardscape. Depending on the specific facility some elements may or may not be considered part of the GSI maintenance however excluded elements should be documented in the agency's asset management tracking and/or CMMS.

Maintenance limits should also be indicated by the facility tracking number. Generally, the maintenance area for a bioretention facility includes the area between curb and sidewalk and longitudinally from cell to cell. If deep infiltration components are included in the facility, then the maintenance area may extend further depending on the surface treatment. Finally, if the facility is intercepting flow from an upstream drainage structure, the upstream drainage structure and pipe daylighting into the facility may be included in the facilities maintenance limits. (See Section 3 for GIS based asset tracking for GSI facilities).

4.2 Establishment Period

The establishment period is an important time for GSI implementation and function. During this period, it is important to observe how the bioretention facility is performing both in terms of function and aesthetics. Construction completion may be considered the end of installation/active construction; however, a contract acceptance is generally through a procurement contract with a defined construction contract establishment period. The full establishment period for bioretention plantings is typically three years and likely extends beyond the construction contract establishment period.

4.2.1 Construction Contract Establishment – typically 3 months to 1 year

Construction contracts will vary in the time allocated for establishment. This variance is due to several factors such as funding, construction season, project specific design elements and staffing. Typically, construction establishment is not less than three months as this is the period that the bioretention facility is being observed and commissioning occurs. The bottom area and lower slopes should have roughly 75% plant coverage however most importantly plants should be visibly thriving. The bioretention facility should be weed free, sediment removed and no eroded channels/soil at time of turnover. Trees should be thriving and leaders straight with visible sign of growth. Low tree branches (under four feet) should be pruned. See Section 8 for additional information on contracting for establishment.

A standalone permeable pavement facility may have a limited establishment period as the primary need is to ensure that the adjacent (landscape and paved) areas have been restored to minimize erosion of sediment onto the surface.

4.2.2 Establishment Period – 1 year to 3 years

The first three years of any vegetation (including City's typical landscape planters) is a 'test period' for trees and plants. The time from construction completion turnover to facility establishment is typically a two to three-year duration for bioretention facilities. During this period the facilities will be maintained to a higher level with two objectives:

- 1) maintaining an environment to allow the plantings to mature to full coverage; and
- 2) minimizing weed infestation.

During this establishment period it is recommended to schedule a higher frequency of maintenance. The plants should be thriving; the facility should be weed free, sediment removed and no eroded channels at time of turnover. (See Appendix B – Establishment Period Maintenance Guidance for GSI in the Right-of-Way)

4.2.3 Establishment Transition to Routine Maintenance

During the third year of establishment it is important to review conditions and adjust elements that may be causing higher than normal maintenance. These may include slope on the drain curb cuts and inlets to the bottom of the bioretention, placement of cobbles at the drain curb cuts to ensure water flows into facility, presettling zone designated in a cell may be too large or too small, a plant shifted to provide clearance at step out zone as it matures, a grate may need to be replaced or a problem plant removed. The intent is to identify facility adaptations necessary to shift from the higher frequency inspection and maintenance to a routine schedule. (See Appendix B)

4.3 Maintenance for Established Facilities

4.3.1 Routine Maintenance

The Routine Maintenance Guidance Table (See Appendix A) outlines maintenance tasks and procedures that occur throughout the year.

4.3.2 Major Corrective Action and Long-Term Maintenance

The Major Corrective Actions and Long-Term Maintenance Guidance Table (Appendix C) outlines procedures when more difficult, timely or costly task are required.

4.4 Maintenance for Specific Components within Facility

Table 4-1 provides a general example of components with the facility footprint. See Appendix A, B and C.

Table 4-1: Component Examples of a Bioretention Facility for Appendices A-C Tables

Component	Description
Facility Footprint	<ul style="list-style-type: none"> Soils, check dams, weirs, vertical walls, extents.
Inlet/Outlets/Pipes/ Structures – Surface	<ul style="list-style-type: none"> Grates, trash racks, drain curb cuts, presettling cells, direct connection catch basins, inlet pipes, outlet pipes.
Inlet/Outlets/Pipes – Subsurface	<ul style="list-style-type: none"> Maintenance holes, catch basins, inlets, underdrains, liners, storm drains, and service drains.
Vegetation	<ul style="list-style-type: none"> Cell bottom, cell slope, step out zone, crossings, intersections zones, trees and other.
Mulch	<ul style="list-style-type: none"> Compost, arborist wood chip, coarse bark and other.
Watering	<ul style="list-style-type: none"> Hand or truck watering, quick couplers and automated irrigation.
Deep Infiltration (over 6 feet)	<ul style="list-style-type: none"> The access covers/lids for these elements will require routine maintenance. Include: Underground injection control, upstream maintenance holes, as applicable pit drain observation port, drilled drains and other.
Permeable Pavement Facility	<ul style="list-style-type: none"> Pavements in residential alleys (or potentially streets) that perform for GSI management function including underdrains and check dams.
Hardscape	<ul style="list-style-type: none"> Special surface treatment on streets, sidewalks, curb edge cells, lids, paved crossings, step out zones, facility related traffic control signage.
Specialty Elements	<ul style="list-style-type: none"> A facility may include specialty elements such as interpretive signage, street furnishings such as benches, trash cans or mutt mitts stations or public art. These elements should be reflected for specific maintenance requirements within the project specific O&M Asset Management list and the CMMS.

4.5 Future

Placeholder section for future updates.

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Section 5

Maintenance of Structures and Subsurface Storm Drainage

5.1 Overview

The GSI facilities implemented in the right-of-way are considered living systems however these systems are engineered to meet the performance required by Ecology for the prescribed BMP's. This volume discusses and outlines routine inspection, maintenance tasks, timing of procedures and performance (See Appendices A, B and C). A list of resources (See Appendix J) is included for additional information.

Structures and subsurface storm drainage facilities are considered to include the following:

- vertical walls
- catch basins
- maintenance holes
- inlets/culverts
- subsurface trench dams
- liners
- underdrains
- clean outs for underdrains, and
- observation ports.

Depending on the specific facility some elements may or may not be considered part of the GSI maintenance however this should be documented in the agency's asset management system and/or CMMS.

See Appendices A-C for further information.

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Section 6

Maintenance of Deep Infiltration Infrastructure

Guidance and updates in this section was developed from a joint SPU and WTD UIC working group in the fall and winter of 2019 along with testing of SPU's Underground Injection Control (UIC) screen wells and drilled drains assets funded through a grant with King County Waterworks.

6.1 Overview

Deep infiltration infrastructure is used to direct stormwater past near surface soil layers with low infiltration (such as glacial till) to soils below with higher infiltration potential (such as glacial outwash sand and gravel). This section provides guidance on using deep infiltration methods when shallow infiltration is not feasible or when augmenting infiltration capacity with deeper infiltration methods. Deep infiltration facility strategies are dependent on the unsaturated thickness between the base of the low-permeability unit at the surface and the depth to groundwater in the infiltration receptor horizon.

GSI Manual, Volume III: Design's Section 10 provides descriptions on the different types of deep infiltration facilities (horizontal and vertical pit drains, drilled drains, and screen wells) and their design methodologies. As with all types of stormwater assets, deep infiltration facilities will require monitoring, maintenance, and possibly rehabilitation, regardless of construction methods or materials used. This time span depends upon many factors including water quality, aquifer characteristics, sediment loading, subsurface soil characteristics, design and materials, installation procedures, inflow rates and as applicable equipment quality. Each project will have site-specific design based on location, geologic conditions, stormwater performance and function and/or design parameters. Due to this, project specific approach to maintenance protocols need to be developed for each project and type and revised as necessary.

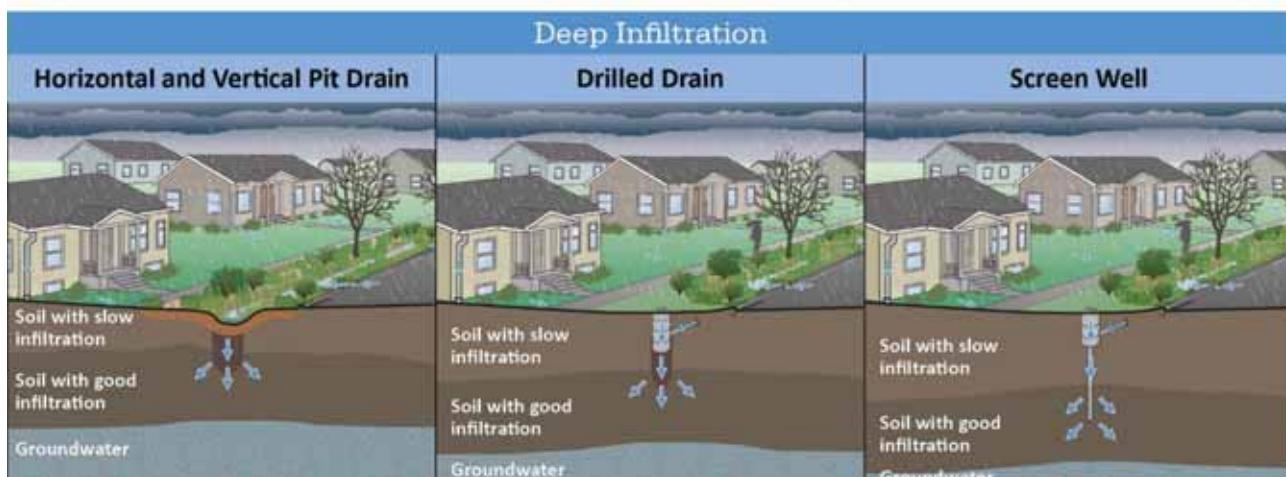
Note: Terminology for pit drain, drilled drain and screen wells is specific to this manual. Ecology and other designers, agencies, engineers, architects, hydrogeologists and geotechnical engineers may use different terms than herein.

Maintenance of deep infiltration will require the participation of a variety of persons depending on the facility type and design including field inspectors, contractors, licensed well drillers and licensed hydrogeologists and/or professional engineers.

6.2 Underground Injection Control (UIC) Wells for Stormwater

Depending upon the design of the deep infiltration facility, it may or may not be defined as a "Class V Underground Injection Control" well (referred to as UIC in this section) for discharge of stormwater by Washington State Department of Ecology (Ecology). UICs may be used for

discharging treated stormwater when it is designed to meet Ecology's requirements in accordance with the 2019 Stormwater Management Manual for Western Washington, Volume I-4 UIC Program. A typical UIC may extend through the underlying low permeability soils and discharge treated stormwater runoff. Stormwater is discharged via a slotted well screen pipe or media backfilled trench located in permeable soils that are suitable for infiltration. Ecology also additional requirements for a "deep" UIC. Ecology defines "deep" UIC as an infiltration facility that extends below an upper confining layer and discharges into the underlying vadose zone (SWMMWW, 2019, Volume I-4.15). The permitting and registering of UICs is through Ecology.



Graphic from SPU/WTD GSI Program outreach materials. See GSI Manual, Vol. III: Design for an overview on types.

Figure 6-1: Deep infiltration facility types general overview

6.3 Testing, Inspection, and Monitoring of Deep Infiltration Facilities

Testing, inspection, and monitoring of deep infiltration facilities are important for understanding the performance of these assets and informing asset managers when well rehabilitation is required.

Testing, inspection, and monitoring of deep infiltration facilities are generally performed by the Owner's Monitoring group, specialty well drilling contractors, and consultants. These activities are not expected to be performed by O&M staff. However, the results of O&M regular inspections can result in triggering of necessary testing, inspection, and monitoring of UICs.

Once the infiltration capacity of a UIC degrades more than 20% due to plugging or biofouling, it is very unlikely to re-establish the original infiltration capacity that was achieved immediately following construction. Regular testing, inspection, and monitoring is important to the long-term performance of UICs and should be programmed into the life cycle cost.

6.4 Routine Deep Infiltration Maintenance

The following appendices provide general guidance for horizontal and vertical pit drains, drilled drains, and screen wells in the deep infiltration sections of these documents:

- Appendix A for routine maintenance guidance for mature GSI in the ROW
- Appendix B for establishment period maintenance for GSI in the ROW
- Appendix C for major corrective action and long-term maintenance guidance for GSI in the ROW

Since many design items for deep infiltration facilities are project-specific, each project should prepare an Operations and Maintenance Manual (also referred to by SPU as a project's Blue Book) to inform specific maintenance items and recurrence for each project with deep infiltration facilities.

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Section 7

Maintenance of Permeable Pavements

7.1 Overview

This section describes the guidance for maintenance of permeable pavement systems in the right-of-way for sidewalks, neighborhood streets and alleys between neighborhood streets. Permeable pavement is a paving system that allows rainfall to percolate through the surface and into the underlying soil. The two guiding operations and maintenance principles for ensuring long term performance of a permeable pavement system are: drainage function and structural condition. The routine, establishment and major corrective action maintenance activities described in Appendices A, B and C are based on ensuring that these perform over the long term.

7.1.1 Use of Pervious Concrete in City ROW

Currently, pervious concrete is the only approved permeable pavement material for public sidewalks and full neighborhood public alley applications in the City. Use of pervious concrete in alleys requires obtaining approval from SDOT and a Memorandum of Agreement for maintenance of the alley. See Streets Illustrated, ROWIM and the GSI Manual, Volume III: Design for further information about use of pervious concrete in the ROW. The guidance in this section is a **PLACEHOLDER** since pervious concrete alleys are not commonly constructed in the City's ROW.

7.2 Components of Permeable Pavement System

The components of a permeable pavement system depend upon the design of the pavement section. The main components are:

- Wearing Course (surface layer of pervious concrete, porous asphalt or permeable interlocking pavers)
- Subbase material (for structural support and/or storage of rainwater as it infiltrates)

Other secondary components that may or may not apply to a pavement section include:

- Geotextile
- Subsurface Check Dams
- Utility Trench Dams
- Underdrains/Elevated Subsurface Overflow Pipe

Review record drawings and city asset tracking systems for components at a specific location.

7.3 Public Sidewalks

Maintenance of pervious concrete sidewalks is described in the guidance tables (routine, establishment, corrective action/long-term) in Appendices A, B, and C.

Maintenance responsibility for public pervious concrete sidewalks is defined in the MOA between SDOT and SPU. See Appendix H for a copy of the MOA.

Maintenance responsibility for pervious concrete pathways installed between the public sidewalk and the road edge that were constructed as part of the bioretention facility is by the agency that led the CIP unless a MOA was developed specifically for the project.



Photo on left is a pervious concrete path between bioretention cells for access between public sidewalk and curb. Photo on right is public pervious concrete sidewalk.

Figure 7-1: Pervious concrete sidewalks and paths

7.4 Pervious Concrete Neighborhood Alleys

Maintenance of pervious concrete neighborhood alleys are described in the guidance tables (routine, establishment, corrective action/long-term) in Appendices A, B, and C and are placeholders since pervious concrete alleys are not commonly constructed in the City's ROW.

Use of pervious concrete in alleys requires obtaining approval from SDOT and a Memorandum of Agreement for maintenance of the alley.

7.5 Future

This section is a **PLACEHOLDER** for future updates.

Section 8

Outsourced and Stewardship Maintenance

8.1 Overview

Ecology requires LID BMP *maintenance of all permanent Stormwater Treatment and Flow Control BMPs/Facilities that are regulated by the Permittee (S5.C.9.b.i)*

8.2 Outsourced and/or Work Order Contracts

If maintenance (all or portions) is outsourced or performed under a work order contract, it is preferable to start the contract in the summer months to allow the crews to get up to speed and educated on the maintenance requirements prior to the start of the rainy season. This timing also prevents contract gaps from occurring during the fall or winter months when facility maintenance is critical to allow the facilities to properly function. See Appendix F for example of a GSI Maintenance Work Order Specification or contact SPU GSI Asset Manager or WTD O&M manager for past examples.



Seattle Conservation Corp Supervising Crew Lead, Bernard Mc Morris, watering SPU's Venema project. (Photo from SPU's AMP for GSI facilities.)

Figure 8-1: Example of outsourcing maintenance

8.3 Stewardship

When residents seek to volunteer to do maintenance for bioretention cells in the right-of-way, a guide for voluntary Roadside Bioretention Cell Care Guide can be provided. See Appendix K for Roadside Bioretention Cell Care Guide.

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Section 9

Storm Events, Extreme Weather or Emergency Maintenance

9.1 Storm Events

9.1.1 Regulatory:

Ecology requires spot checks of potentially damaged permanent Stormwater Treatment and Flow Control BMPs/Facilities after major storm events (more than 1-inch rain in 24 hours or wind above 20 mph). If spot checks indicate widespread damage/maintenance needs, inspect all Stormwater Treatment and Flow Control BMPs/Facilities that may be affected (see S5.C.10 in Ecology's NPDES, Phase I Municipal Stormwater Permit, 2019-2024). Conduct spot repairs or perform maintenance in accordance with the maintenance guidance tables (See Appendices A, B and C).

9.1.2 Practical:

Storm events require special attention for GSI facilities. It is recommended to address larger events (versus major) defined as 1/2-inch or more of rainfall in 24 hours. The elements below are the key places and issues to review. See Appendix B

- Curb cuts- check for blocking sediment; gutter flows in.
- Covered curb inlets- check that debris is not blocking flow
- Catch basins- check that grate surface is open
- Weirs- check that overflows/orifices are free flowing
- Street surface- review that street and gutters are free of debris
- Trash rack- check that racks and upstream cells are clear of litter

9.2 Extreme Weather

9.2.1 Temperature

Bioretention systems are living systems and as such they are subject to impacts due to extreme heat and cold.

- In extreme heat such as temperature over 90 degrees F for over a period of one week it is recommended that the bottom zone of established bioretention be watered deeply (+/-2inch depth) once a week to minimize die off and resultant loss of root function.
- In extreme cold such as temperature below 12 degrees F for over a period of three days or a deep snow of more than 12 inches followed by an erratic warming freezing cycle, it is recommended that surface features such as

sediment bays, weirs, inlets and catch basins be reviewed for damage and repaired as needed per Appendix C or Agency standards for structures.

9.2.2 Wind

GSI systems are typically not directly affected by wind however high winds may result in debris clogging inlets and potential for tree damage.

9.3 Spills

The following are spill procedures for SPU and WTD, respectively:

SPU GSI staff and contractors shall be trained to recognize, prevent and clean up hazardous waste, small spills, light oil polluted soil surfaces and sediment. Spills going into water bodies shall be immediately reported to spill response team. The following web site has contains information regarding spill response.:
<http://www.seattle.gov/util/MyServices/DrainageSewer/PollutionControl/index.htm>

WTD staff and contractors shall be trained to recognize, prevent and clean up hazardous waste, excessive oil, spills and sediment. Follow WTD's Environmental Management Specification for spill prevention and response. The King county Stormwater Manual contains information in developing a spill plan.

9.4 Vandalism

Acts of vandalism may occur and might range from minor tree limb damage, plant removals, cobble displacement to more extensive damage such as concrete curbs broken or walls damaged. These situations should be reported to the SPU/WTD Operations Manager, so they can track trouble spots and assess if further investigation is warranted. If possible, field staff should photograph conditions. For graffiti removal, call: 206-386-1800.

If vandalism involves large waste deposits (more than 3 cubic feet (extra-large bag) within a SPU bioretention cell or the material is hazardous call 206-684-7587 and notify SPU GSI O&M manager immediately for direction.

9.5 Vehicular Damage

In the event it is observed that a vehicle has damaged a facility edge or gone into the facility, field staff should evaluate surface conditions, take photos and submit a request for further investigation of potential damage. As each facility may have differing underground elements such as liners, pipes or soil depth a more detailed review may be required to ascertain damage.

Section 10

Inspection

10.1 Overview

Inspections of GSI assets are an important task to assess how facilities are functioning and identify if modifications are needed in the routine maintenance activities for the facilities.

The regulatory reporting requirements for inspections and tracking of maintenance activities is dependent upon what permit the asset facility was constructed under and the agency's permit requirements. For example, GSI facilities that were designed to meet a water quality treatment and/or flow control requirement as part of the City of Seattle stormwater code are required to be inspected in accordance with the City's municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) permit with Ecology (see S5.C.10 in Ecology's *NPDES, Phase I Municipal Stormwater Permit, 2019-2024*). Systems that were permitted to meet on-site stormwater requirement and do not provide water quality treatment or flow control (such as rain gardens) have different reporting in the permit. Regulatory reporting of inspections of GSI facilities installed for MS4 or addressing combined sewer overflows as part of Consent Decree is agency specific for their permits. Contact each agency's compliance staff for regulatory reporting and inspection requirements.

- For WTD facilities, contact WTD's Maintenance Section's West Section Manager.
- For SPU facilities, contact SPU's regulatory compliance point of contact.

This section is intended for non-regulatory inspection reporting and feedback.

10.2 Asset Management

For SPU GSI assets, refer to SPU's Asset Management Plan for Green Stormwater Infrastructure Right-of-Way Facilities (AMP), current edition.

For WTD GSI assets, contact WTD Operations Manager(s) for asset management.

10.3 Complaint-Based

This is a **placeholder** for SPU/WTD input in future edition.

10.4 Role of O&M Inspector

This is a **placeholder** for SPU/WTD input in a future edition.

The agency's Asset Manager and/or Operations manager may conduct and/or assign inspectors for routine facility inspection and/or to review major or corrective maintenance and repairs.

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Section 11

Community Engagement and Outreach

11.1 Purpose and Objective

The Public outreach effort that began during the Options Analysis and then through Design, Construction phases will be the basis for ongoing effort to help establish trust and transparency in the maintenance for GSI function and safety.

During Operations and Maintenance Activities:

Community engagement goals are to:

- Demonstrate to neighbors that SPU and WTD remain invested in the project beyond construction.
- Encourage neighbors to stay engaged and invested in the project.
- Ensure the project remains an enduring and successful example of GSI so other neighborhoods will get excited about the possibility of having a similar project in their community.

Community engagement objectives are to:

- Clarify SPU/WTD's roles and responsibilities for maintaining the GSI and informing residents on the acceptable level of maintenance that the agency uses for the infrastructure asset.
- Transition public engagement responsibilities to the GSI Asset Managers/O&M leads.
- Encourage neighbors—including historically-underserved and limited-English proficient residents and renters—to take interest in the new public infrastructure.
- Create opportunities for neighbors to showcase their street with GSI, such as posting images online and holding GSI tours.
- Keep neighbors informed of any potentially disruptive maintenance activities by providing advance notifications with information about what to expect.
- Update the community engagement plan for a specific capital improvement project and note any project specific O&M outreach requirements.

Community engagement at the start of O&M phase will inform the Public Engagement Plan (PEP) for O&M activities described herein this Volume. The updated PEP should provide

strategies to address community issues and activities to support ongoing work.

11.2 Outreach Tools

The PEP update (if applicable to a specific CIP) will be relatively short for the operation and maintenance of the public assets. The SPU/WTD community relations lead will plan and implement all outreach tools in coordination with the O&M staff. Outreach tools will be aligned to share information and/or gather comments about activities or changes that may occur over time. Specific outreach tools may include, but are not limited to, items identified in Table 11-1:

Table 11-1: O&M Outreach Tools

Project Milestone	Potential Outreach Tools	Purpose of Outreach
End of construction	See GSI Manual, Vol. IV: Construction, On-Boarding and Commissioning.	<ul style="list-style-type: none"> To celebrate with the community the completion of the project.
Prior to disruptive maintenance activities	<ul style="list-style-type: none"> Listserv announcement Website update Flyer distribution Posters Social media One-on-one communication Project communication log Door-to-door (for highly disruptive activities) Interpreter/translation as needed 	<ul style="list-style-type: none"> Keep neighbors informed of maintenance activities especially those that may cause disruption (e.g. access, utilities, detours) or noise.
Periodically	<ul style="list-style-type: none"> Website notices GSI in-person and virtual (video, online) tours Roving interpretative signage Social media Flyer distribution/mailers Door hanger flyer after routine maintenance 	<ul style="list-style-type: none"> Inform residents of the GSI along their street Inform residents of the agency's maintenance responsibility for the GSI Explain how residents can protect the public asset for its stormwater function in protecting local creeks, rivers and Puget Sound (e.g. pick up litter or where to set waste containers).

11.3 Work Plan

Table 11-2 outlines a draft work plan for the operations and maintenance. The level of activity will vary with each project depending upon the complexity of the maintenance of the assets.

Table 11-2: Work Plan Draft Outline

Task	Participants	Approximate Duration
Update PEP	<ul style="list-style-type: none"> • SPU/WTD community relations lead • O&M team/GSI Asset Managers 	Two weeks
Confirm ongoing communications infrastructure (e.g. website, maintenance hotline, listserv)	<ul style="list-style-type: none"> • SPU/ WTD community relations lead 	One month
Plan outreach activities	<ul style="list-style-type: none"> • SPU/ WTD community relations lead • O&M team 	Ongoing
Implement outreach activities	<ul style="list-style-type: none"> • O&M team 	Ongoing
Draft report to agency management on public engagement activities	<ul style="list-style-type: none"> • O&M team 	Annual

11.4 Training and Handoff

Operations and Maintenance represents a project milestone when public engagement responsibilities transition from the SPU/WTD community relations lead to the O&M team. To support that transition, the SPU/WTD community relations lead will update the PEP and train the O&M team. Training will focus on project background, including unique characteristics of the neighborhood that are relevant to public engagement and existing communications tools, such as the project hotline (if it is intended to continue to be used for the agency's operations and maintenance).

11.5 Reporting

SPU's or WTD's communication and outreach leads, in coordination with the Asset Management / O&M team will provide ongoing documentation of outreach activities and public

comments on an annual basis. The Asset Management / O&M team may summarize the results of the outreach for feedback to the GSI program to inform on future project's design and maintenance processes.



Image: Residents and visitors along a street with roadside bioretention cells.

Section 12

Voluntary Installations - Future

12.1 Overview

This section is a **PLACEHOLDER** for SPU and WTD to provide input on O&M for GSI facilities that were installed as a “Voluntary” project. Voluntary installations in the ROW are described in SDOT’s Client Assistance Memos CAM 2308 for Voluntary Curbside Rain Gardens and CAM 2309 for Voluntary Curbside Bioretention.

Routine maintenance and periodic inspection of voluntary roadside bioretention facilities would be by the group (e.g. adjacent property owner or neighborhood group) that led the construction of the volunteer GSI facilities. Both SDOT CAM 2308 and 2309 denote that the maintenance responsibility for the voluntary curbside bioretention and rain gardens is by the adjacent property owner(s) in accordance with SMC 10.52.030. See CAMs for more information.

12.2 Tracking

SPU identifies volunteer bioretention facilities and rain gardens through its mapping system when it is notified by SDOT that the facility has been permitted.

12.3 Inspection

As noted in the MOA between SDOT and SPU (see Appendix H) SPU does not periodically inspect voluntary installations.

If a complaint arises and is reported to SPU, then SPU would conduct reactive maintenance after assessing the facility.

If the facility fails to drain, resulting in standing water for more than 72 hours and cannot be easily remedied by the property owner, as described in CAMs 2308 and 2309 the adjacent property owner(s) or responsible party will be required to restore the right of way to the condition that existed before it was installed.

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Section 13

Maintenance Agreements and Related Policies - Future

13.1 Overview

SPU and WTD are active in developing partnering between agencies and city departments as they innovate on ways to manage urban stormwater.

This section is a **PLACEHOLDER** for SPU and WTD to provide input in a future edition.

13.2 Existing Memorandum of Agreements

The following are existing Memorandum of Agreements/partnerships between various agencies/departments:

- SPU and SDOT Memorandum of Agreement #17-058-A for “Maintenance and Operations of Green Stormwater Infrastructure Assets in the Public Right of Way.” See Appendix H for a copy of the agreement.
- Seattle Public Utilities and King County Wastewater Treatment Division Memorandum of Agreement for the joint GSI Program including but not limited to information sharing between agency staff for design, construction and operations and maintenance
- SPU and SDOT NDS program partnering agreements
- SPU, Seattle Parks and Recreation and Seattle Conservation Corps O&M

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Appendix A: Routine Maintenance Guidance for Mature GSI in the Right-of-Way

- Routine Surface Maintenance At-A-Glance for GSI in the Right-of-Way
- Figure A-1: ROW Bioretention Cell with graded side slopes planting zone diagram
- Figure A-2: ROW Bioretention Cell with vertical wall(s) planting diagram
- Table for Routine Maintenance Guidance for Mature GSI in the Right-of-Way



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Routine Surface Maintenance At-A-Glance for GSI in the Right of Way

Maintenance Activity*	Frequency (Recommended Minimum)											
	Winter			Spring			Summer			Fall		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Remove Trash, Debris, Pet Waste, etc.	Every Visit			Every Visit			Every Visit			Every Visit		
Clear Vegetation Blocking Visibility Sight Lines and Hydrants				1 Time			1 Time			1 Time		
Clear Drain Curb Cuts and Inlets	1-2 Times/Mo			1 Time			1 Time			2 Times/Mo		
Remove Sediment Build-Up (Presettling, Grates, Check Dams, Weirs, etc.)				1 Time			1 Time			1 Time/Mo		
Clean Leaf Litter and Gutter Line	1-2 Times/Mo			1 Time			1 Time			Weekly		
Maintain Curbside and Sidewalk Clearance				1 Time			1 Time			1 Time		
Maintain Access Surfacing (Zone 5)				1 Time			1 Time			1 Time		
Remove Invasive Plants				1 Time			1 Time			1 Time		
Remove Weeds	1 Time			1 Time/Mo			2 Times/Mo			1 Time		
Apply Wood Chip Mulch (Zones 2-4)				1 Time			1 Time			1 Time		
Watering (By Hand or Truck), for Irrigation See Project Plans.				1-3 Times/Wk	20 min		3 Times/Wk	20 min	hose watering per cell as needed	1-3 Times/Wk	20 min	hose watering per cell as needed
Prune Trees within Bioretention Cell				1 Time								
Prune Shrubs, Grasses, Sedges and Fern Foliage				1 Time						1 Time		
Cut Back Dead or Flopping Foliage				1 Time						1 Time		1 Time

*Refer to GSI Manual, Vol. V, Appendix A for detailed description of routine maintenance activities.

Figure A-1: ROW Bioretention cell with graded side slopes planting zone diagram

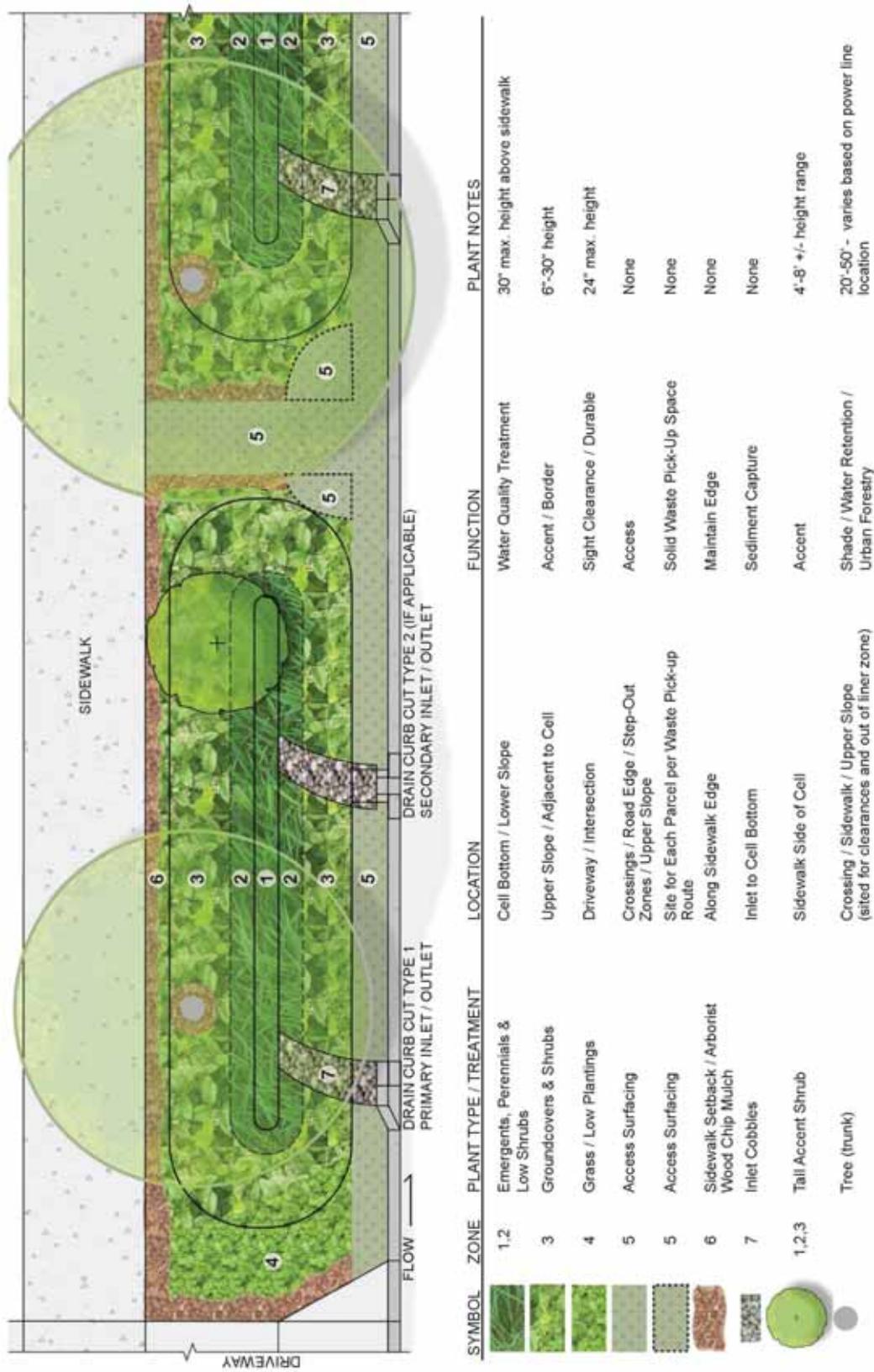
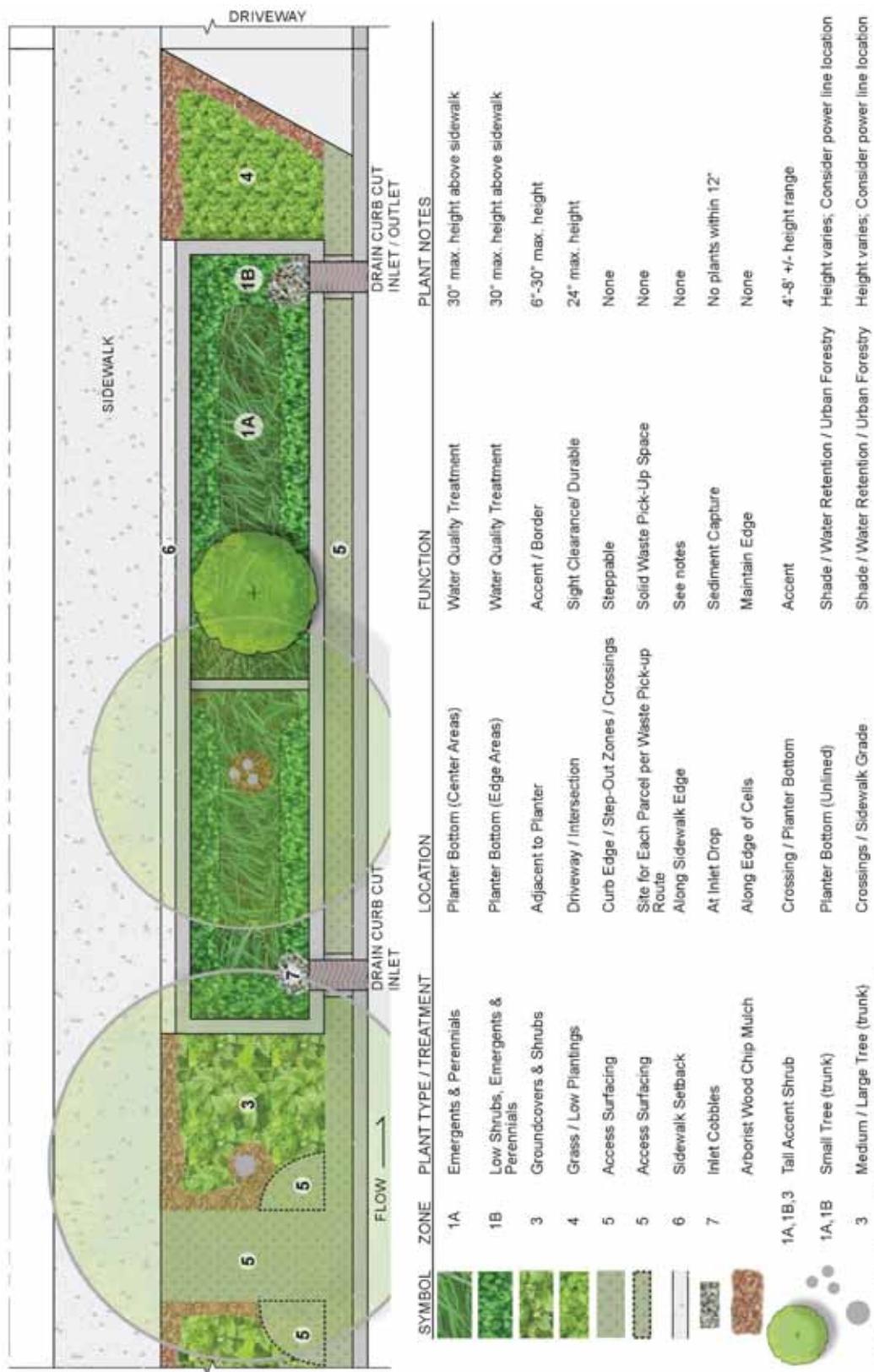


Figure A-2: Bioretention cell with vertical wall(s) planting zone diagram





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ROUTINE MAINTENANCE GUIDANCE FOR MATURE GSI IN THE RIGHT-OF-WAY

Notes:

1. The following table format is based on the "Guidance Document: Western Washington Low Impact Development (LID) Operation and Maintenance (O&M)" prepared for Ecology Water Quality Program - July 8, 2013 and the 2014 update to City of Seattle's Stormwater Manual.
2. Timing is guidance and may be adjusted to site specific conditions.
3. See Examples: Acceptable /Unacceptable Guidance in the Appendix of GSI Manual, Volume V.
4. See separate tables for specific guidance for establishment and major corrective action / long-term maintenance.
5. **Bold Text = High priority for function or safety**
6. Yellow indicates activities performed by SPU/WTD monitoring group/staff for deep infiltration facilities.
7. Orange indicates topics areas that are under development. The guidance included is a placeholder. Refer to project specific O&M guidance in the interim.
8. Deep infiltration guidance (Section G) was updated by a joint SPU and WTD working group in the fall of 2019.

OPERATIONS-SUPERVISOR				MAINTENANCE-CREW				PERFORMANCE STANDARD				ADDITIONAL INFO	
GSI Facility Component	Observation	Frequency	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger-Corrections/Improvements Required)	Comments	Special Issues					
Major Storm Events (more than 1" rain in 24 hours or wind above 20 mph)			<input type="checkbox"/> Before Storm: Notification of Storm Event <input type="checkbox"/> After Storm Event <input type="checkbox"/> After CSO Notification			<input type="checkbox"/> Remove at a minimum blockages/leaves from drain curb cuts at tree/zeling zones, from the curb cut at the first call after presettling and from the curb cut at the low point or corner <input type="checkbox"/> Remove blockages from all curb cuts if time allows. <input type="checkbox"/> Remove debris from curbs and use CB	<input type="checkbox"/> Facility is ready for a storm event: minor blockage from debris, sediment or vegetation, minor ponding	<input type="checkbox"/> Facility is NOT ready for a storm event: moderate to heavy blockage from debris, sediment or vegetation, damaged structures, and/or visible ponding					
<i>See Major Corrective Action Long-Term Maintenance Table for Emergency Conditions / Extreme Events</i>													
A. Facility Footprint													
A1 Soils	<input type="checkbox"/> Erosion and washouts <input type="checkbox"/> Sediment accumulation	March September	<input type="checkbox"/> Fill in erosion gullies and clean up washouts <input type="checkbox"/> Install temporary erosion control measures until permanent repairs are made <input type="checkbox"/> Identify and remedy what is causing erosion and/or washouts <input type="checkbox"/> Add cobble or other erosion protection measure where concentrated water flows <input type="checkbox"/> See Major Corrective Table <input type="checkbox"/> Add mulch when settlement is 2 inches or less - see E. Mulch. <input type="checkbox"/> Maintain design width of compacted shoulder (18 inches min.) <input type="checkbox"/> See Major Corrective Maintenance Table when settlement is reaches unacceptable levels (more than 2 inches)	March July September October	<input type="checkbox"/> Moderate erosion, channelization or scouring with less than 40% bare spots	<input type="checkbox"/> Heavy erosion, channelization or scouring with greater than 40% bare spots							
A2 Check Dams	<input type="checkbox"/> Blockage <input type="checkbox"/> Backed up water <input type="checkbox"/> Undercutting	September and after 1 inch and greater storms	<input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Put out rock or boulders to remove surface blockages, debris, sediment and fall leaf litter, then reinstall	Every visit As needed	<input type="checkbox"/> Soils free draining with no standing water observed 24 hours after storm event	<input type="checkbox"/> Soils appear compressed and ponding observed 24 hours following rain							

GSI Facility Component	OPERATIONS-SUPERVISOR	MAINTENANCE-CREW		PERFORMANCE STANDARD		Comments Special Issues	ADDITIONAL INFO
		Frequency (Schedule for Full Review 5X per year: Jan, March, June, Sept, Nov. below are specialized visits that may be concurrent)	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)		
A. Facility Footprint Cont.							
A3	Weirs	Blockage □ Backed up water □ Undercutting Damaged weirs □ Dislodged cobble	March September	March October January	<input type="checkbox"/> Moderate blockage, trash, debris, sediment and fall leaf litter at weirs <input type="checkbox"/> Boulder weirs are intact and relatively level <input type="checkbox"/> Weir plates are attached	<input type="checkbox"/> Heavy blockages, trash, debris, sediment and fall leaf litter at weirs <input type="checkbox"/> Damaged weirs <input type="checkbox"/> Weir plates are not attached	<input type="checkbox"/> Heavy blockages, trash, debris, sediment and fall leaf litter at weirs <input type="checkbox"/> Damaged weirs <input type="checkbox"/> Weir plates are not attached
A4	Vertical Walls; Concrete, Segmental, Rockery	Separation from sidewalk or curb edge □ Leaning □ Cracked	April August	March	<input type="checkbox"/> Minor undercutting, weir base not exposed <input type="checkbox"/> Minor cracks in concrete walls <input type="checkbox"/> Separation of joints in segmental walls of 1/4 inch 3 feet apart	<input type="checkbox"/> Minor undercutting, weir base not exposed <input type="checkbox"/> Minor cracks in concrete walls <input type="checkbox"/> Separation of joints in segmental walls greater than 1/4 inch 2 feet apart	<input type="checkbox"/> Undercutting exposes base of weir <input type="checkbox"/> Displacement of wall at cracks <input type="checkbox"/> Separation of joints in segmental walls greater than 1/4 inch 2 feet apart <input type="checkbox"/> See Major Corrective Maintenance Table
A5	Boulders, cobbles etc	Rockery loose Segmental wall top uneven/ cap missing □ Accumulation of moss	March September	March	<input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Take corrective action to repair or prevent minor displacement <input type="checkbox"/> Major issues see Major Corrective Maintenance Table <input type="checkbox"/> Remove moss/preserve wash	<input type="checkbox"/> Every visit <input type="checkbox"/> Minor weeds in rockery <input type="checkbox"/> Minor accumulation of moss that's moving into vegetation or onto sidewalk.	<input type="checkbox"/> Top segmental wall loose <input type="checkbox"/> Rockery unstable or missing rocks <input type="checkbox"/> Rockery embedded with weeds <input type="checkbox"/> Weeds coming through segmental joints <input type="checkbox"/> Heavy accumulation of moss that's moving into vegetation or onto sidewalk.
A6	Compacted shoulder at curb and edge of sidewalk □ Settlement or insufficient edge surfacing (pavers)	Settling, undercutting or blocked cobbles at drain curb cuts and grates □ Displaced cobbles □ Displaced boulders	March September	March September	<input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Reset cobbles at drain curb cut entries and at base of walls and rates. <input type="checkbox"/> See D. Vegetation for blockage <input type="checkbox"/> Check boulders at pipe outfalls and reset if displaced <input type="checkbox"/> Receive approval prior to removal of boulders <input type="checkbox"/> Maintain design width of compacted shoulder by topdressing and recompacting edges	<input type="checkbox"/> Every visit <input type="checkbox"/> Minor blockage <input type="checkbox"/> Pipe outfalls protected	<input type="checkbox"/> Heavy blockage <input type="checkbox"/> Setting, undercutting or erosion <input type="checkbox"/> Pipe outfalls without boulder or other type of armour protection <input type="checkbox"/> Displaced, random boulders <input type="checkbox"/> Curb side: width of compacted shoulder is less than 18 inches <input type="checkbox"/> Shoulder has weed cover of less than 25% <input type="checkbox"/> Vegetation growing in the road shoulder or plants overhanging into the shoulder less than 12 inches <input type="checkbox"/> Sidewalk side: width of compacted shoulder is less than 8 inches <input type="checkbox"/> Shoulder has weed cover of more than 25% <input type="checkbox"/> Vegetation growing in the road shoulder or plants overhanging into the shoulder less than 12 inches <input type="checkbox"/> Sidewalk side: width of compacted shoulder is less than 8 inches <input type="checkbox"/> See Major Corrective Maintenance Table
B. Surface- Inlets/Outlets/Pipes/Grates, Etc.							
B1	Drain Curb Cuts (Gutter Line)	Trash, debris, sediment and leaf litter □ Blockages	March September	March September	<input type="checkbox"/> Remove surface trash, sediment and fall leaf litter <input type="checkbox"/> Remove blockages <input type="checkbox"/> Remove thick vegetation	<input type="checkbox"/> Weekly: Sept thru Mar Monthly: Apr thru Aug January March July September October November <input type="checkbox"/> Minor blocking at drain curb cuts on planter side of curb	<input type="checkbox"/> Moderate trash, debris and sediment at drain curb cuts because these are the primary points of water entry <input type="checkbox"/> Heavy blockage at drain curb cuts causing stormwater to bypass biofiltration
B2	Trench Drain Grates (including covers at some Drain Curb Cuts)	Debris, sediment and leaf litter	March September	March September	<input type="checkbox"/> Remove surface trash, sediment and fall leaf litter	Monthly	<input type="checkbox"/> Moderate trash, debris and sediment at trench drain grates <input type="checkbox"/> Heavy trash, debris and sediment plugging trench drain grates
B3	Planter Wall Openings (along Sidewalk)	Damage to wall opening □ Trash, debris, sediment and leaf litter blockages	April August	April August	<input type="checkbox"/> Report if exposed opening exceeds 5 inches. See Major Corrective Maintenance Table <input type="checkbox"/> Trash, debris, sediment and leaf litter blockages	<input type="checkbox"/> Every visit <input type="checkbox"/> April before school starts <input type="checkbox"/> August before school starts <input type="checkbox"/> Heavy damage to wall opening leaves opening less than 5 inches wide <input type="checkbox"/> Minor damage to wall opening leaves opening more than 5 inches wide	<input type="checkbox"/> Heavy damage to wall opening leaves opening more than 5 inches wide <input type="checkbox"/> Minor damage to wall opening leaves opening less than 5 inches wide <input type="checkbox"/> See B. Drain Curb Cuts (Gutter Line)

GSI Facility Component	OPERATIONS-SUPERVISOR Observation (Walk facility/look for conditions that may trigger maintenance activity)	MAINTENANCE-CREW		Month (Typical)	Acceptable (Targeted Standard)	PERFORMANCE STANDARD		Comments Special Issues	ADDITIONAL INFO
		Frequency (Schedule for Full Review 5X per year: Jan., March, June, Sept., Nov.; below are specialized visits that may be concurrent)	Maintenance Activity			Unacceptable (Maintenance Trigger-Corrections/Improvements Required)			
B. Surface- Inlets/Outlets/Pipes/Grates, Etc. (cont.)									
B4	Presettling	<input type="checkbox"/> Trash, debris, sediment and leaf litter	March September	<input type="checkbox"/> Remove surface trash debris, sediment and leaf litter	January March September October November	<input type="checkbox"/> Moderate trash, debris and sediment at entry and pad zone	<input type="checkbox"/> Heavy trash, debris and sediment at entry points and setting or energy pad zones.		
B5	Grates and Trash Racks	<input type="checkbox"/> Trash, debris, sediment and leaf litter <input type="checkbox"/> Blockages	March September January September	<input type="checkbox"/> Remove surface trash debris, sediment and fall leaf litter <input type="checkbox"/> Look into structure for debris especially on beehive structures with open sides. Report if debris at base of structure. <input type="checkbox"/> Remove blockages	Weekly: Sept thru Mar Monthly: Apr thru Aug January March September October November	<input type="checkbox"/> Moderate trash, debris and sediment at grates and trash racks <input type="checkbox"/> Moderate blockage at pipe outfalls and CB grates	<input type="checkbox"/> Heavy trash, debris, and/or sediment at grates and trash racks <input type="checkbox"/> Heavy blockage of sediment and/or plants blocking at trash racks and grates	<input type="checkbox"/> Specialized crew may be required to clean out structure	
B6	Catch Basins with pipes discharging to swales	<input type="checkbox"/> Damage <input type="checkbox"/> Debris, sediment and leaf litter <input type="checkbox"/> Blockages	March September March September	<input type="checkbox"/> Check for and repair damage to grates and trash racks <input type="checkbox"/> Remove surface trash debris, outfall sediment and fall leaf litter <input type="checkbox"/> Sediment in pipe appears to be accumulating to more than 2 inches then jet vacuum or use high pressure nozzle at upstream end to move sediment to Presettling and then remove. <input type="checkbox"/> Remove blockages	As directed	<input type="checkbox"/> See Major Corrective Maintenance Table <input type="checkbox"/> Moderate sediment at CBs and storm drains discharging to swales	<input type="checkbox"/> Heavy debris and sediment in upstream CBs 1/-6 inches in jump <input type="checkbox"/> Heavy debris and sediment blocking discharge to swales 1/-2 inches in pipes	<input type="checkbox"/> See Major Corrective Maintenance Table	
B7	Surface Clean Outs / Observation Ports	<input type="checkbox"/> Damaged structures	March September	<input type="checkbox"/> Check for and repair damage	January March September October November	<input type="checkbox"/> Minor blockage at CB grates and pipe outfalls <input type="checkbox"/> Minor damage	<input type="checkbox"/> Heavy blockage at CB grates and pipe outfalls <input type="checkbox"/> Heavy damage such as cracked structure or displaced lid	<input type="checkbox"/> See Major Corrective Maintenance Table	
B8	Geotextile Fabrics	<input type="checkbox"/> Exposed fabric	Yearly	<input type="checkbox"/> If cover missing immediately cover with temporary cover and report. <input type="checkbox"/> Remove clean out cover and do a visibility check for water or debris - see B. Subsurface if water present <input type="checkbox"/> Inform crews that geotextile fabric may be present if encountered <input type="checkbox"/> Check for pulled up or unsightly geotextile fabric that may be under cobbles or boulders etc. Reininstall under boulder or cover with mulch. Trim as applicable.	As directed	<input type="checkbox"/> Cover present but has some vegetation growing over <input type="checkbox"/> Clean out port has no accumulated water or sediment	<input type="checkbox"/> Cover missing <input type="checkbox"/> Water or debris in clean out. <input type="checkbox"/> See Major Corrective Maintenance Table	<input type="checkbox"/> Cover missing <input type="checkbox"/> Water or debris in clean out. <input type="checkbox"/> See Major Corrective Maintenance Table	Typically this might be a black or gray woven material or it might be a manufactured coil blanket material

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			Maintenance Activity				Unacceptable (Maintenance Trigger-Corrections/Improvements Required)			
C. Subsurface- Inlets/Outlets/Pipes -Etc										
Catch Basins (CB) with Storm Drains Discharging to CBs with Flumes or Discharges from Cells to Downstream System	Pipe blockages	March September	<input type="checkbox"/> Check for and remove blockages and sediment from storm drain pipes	<input type="checkbox"/> Remove a sediment build-up and/or obstructions from catch basin sump if more than 6 inches of blocking pipes	March September	<input type="checkbox"/> Moderate blockage at storm drain pipe. Water flow has minor restriction through pipe.	<input type="checkbox"/> Heavy blockage at storm drain pipe. Water does not flow through pipe.			
C1	CB Sediment Swales	March September	<input type="checkbox"/> Remove sediment in CB interior damage		March September	<input type="checkbox"/> Less than 6 inches of sediment in the CB	<input type="checkbox"/> 6 inches or more of sediment in the CB			
C2	Flow splitters	March September	<input type="checkbox"/> Check for and report interior damage to CB		March September	<input type="checkbox"/> Minor damage to interior CB		<input type="checkbox"/> Heavy damage to interior of CB		
C3	Trench Drains	Blockage Damaged structures	<input type="checkbox"/> Pipe or well blockages	<input type="checkbox"/> Remove blockages	March September	<input type="checkbox"/> Water flow has minor restrictions	<input type="checkbox"/> Heavy blockage and water is not flowing freely into cells	<input type="checkbox"/> Heavy blockage in trench drain and water does not flow through		
C4	Underdrain System (Maintenance Holes (UMH), Pipes, Cleanouts and Observation Ports)	Water ponding		<input type="checkbox"/> Check for and repair damage to grates or frames				<input type="checkbox"/> See Major Corrective Maintenance Table	<input type="checkbox"/> See Major Corrective Maintenance Table	
				<input type="checkbox"/> Check underdrain outlet point for standing water (e.g. a M/H outlet plugged, UIC, MH or drilled drain access structure plugged) causing water to backup into underdrain			<input type="checkbox"/> Minor ponding that dissipates within 48 hours - report ponding more than 48 hours	<input type="checkbox"/> Ponding (i.e. water surface) that lasts more than 72 hours beyond a storm event		
				<input type="checkbox"/> Standing water observed in underdrain outlet point, see maintenance activities for corresponding downstream infrastructure (e.g. UIC, drilled drain or downstream M/H)			<input type="checkbox"/> Saturated soil in November, December, January, February	<input type="checkbox"/> Saturated soil (when non-irrigated) in June, July, August, September		
				<input type="checkbox"/> Check for and report damage to UMH, cleanout or underdrain						
				<input type="checkbox"/> Video the underdrain if it appears broken/damaged						
				<input type="checkbox"/> Remove blockages and sediment from UMHs, cleanouts and underdrain pipes			<input type="checkbox"/> Moderate blockage at UMHs, cleanouts and underdrain pipes	<input type="checkbox"/> Heavy blockage at UMHs, cleanouts and underdrain pipes		
				<input type="checkbox"/> Check for and report damage to UMH, cleanout or underdrain			<input type="checkbox"/> Minor damage to interior of UMH, cleanout or underdrain	<input type="checkbox"/> Heavy damage to interior of UMH, cleanout or underdrain		
				<input type="checkbox"/> Remove clean out cover and do a visibility check for debris			<input type="checkbox"/> Minor damage to interior of UMH, cleanout or underdrain	<input type="checkbox"/> Heavy damage to interior of UMH, cleanout or underdrain		
				<input type="checkbox"/> Video the underdrain if it appears broken/damaged						
				<input type="checkbox"/> Inform new crew members of lined cell locations and special liner requirements			<input type="checkbox"/> Crews are informed of lined cell locations and liner requirements	<input type="checkbox"/> Crews are not informed of lined cell locations and the liner requirements		
				<input type="checkbox"/> Check for and report damage to liner			<input type="checkbox"/> Location of possible accidental puncture/damage to liner due to activity are reported and flagged	<input type="checkbox"/> Accidental puncture of liner due to activity is unreported		
				<input type="checkbox"/> Remove clean out cover and do a visibility check for debris			<input type="checkbox"/> Report of down slope seepage may trigger need to investigate related to liner, see Major Corrective Maintenance Table	<input type="checkbox"/> Report of down slope seepage		
				<input type="checkbox"/> Video the underdrain if it appears broken/damaged						
				<input type="checkbox"/> Inform new crew members of lined cell locations and special liner requirements						
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GSI Facility Component	OPERATIONS-SUPERVISOR	MAINTENANCE-CREW			PERFORMANCE STANDARD			ADDITIONAL INFO
		Frequency	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger-Corrections/Improvements Required)	Comments	
D. Vegetation								
D1	General Facility bottom, slope and top vegetation	<input type="checkbox"/> Geotextile fabrics exposed <input type="checkbox"/> Trash debris and pet waste <input type="checkbox"/> Contaminants <input type="checkbox"/> Sharps, needles, broken glass <input type="checkbox"/> Plant blockage <input type="checkbox"/> Aggressive/spreading plants	Yearly and as part of crew instruction March April September	As directed As directed	<ul style="list-style-type: none"> <input type="checkbox"/> Inform crews that fabric may be present under mulch, rock, cobbles or boulders and to reinstall if encountered. <input type="checkbox"/> See comments under B. Surface above <input type="checkbox"/> Divide perennials, grasses and emergents to remove dead plants or fill in bare areas - see Perennials and Deciduous Evergreen Grasses and Emergents <input type="checkbox"/> Remove trash, debris and pet waste <input type="checkbox"/> Report to manager repeated pet waste immediately illegal dumping 206-684-7587 <input type="checkbox"/> Junk storage 206-615-0808 contaminants with Agency safety standards <input type="checkbox"/> Maintain 1 foot zone clear of vegetation around all holes and outlets <input type="checkbox"/> Report problem prior to removal or replacement of problem vegetation <input type="checkbox"/> See Major Corridor Maintenance Table for difficult plants to remove <input type="checkbox"/> Prune, trim or thin overhanging plants <input type="checkbox"/> Redefine planting area edges - if trimmers are used keep them 2 feet back from tree trunks <input type="checkbox"/> Report prior to removal or replacement of problem vegetation <input type="checkbox"/> Trim or thin overhanging plants <input type="checkbox"/> Redefine planting area edges (keep trimmers 2 feet back from tree trunks) <input type="checkbox"/> Report prior to removal or replacement of problem vegetation <input type="checkbox"/> Overgrowth <input type="checkbox"/> Blocked sight clearance 	<ul style="list-style-type: none"> <input type="checkbox"/> Typically this might be a black or gray woven material or it might be a manufactured coir blanket material. <input type="checkbox"/> See comments under B. Surface above <input type="checkbox"/> Swale bottom coverage by emergents and vegetation is greater than 70% <input type="checkbox"/> Minor trash, debris and pet waste. <input type="checkbox"/> No contaminants or sharps. <input type="checkbox"/> Minor blockage from plants at drain curb cuts, weirs, and CB grates. <input type="checkbox"/> One plant species is spreading more than other plants <input type="checkbox"/> Removal of individual plants solves issue <input type="checkbox"/> Minor blockage from plants at drain curb cuts, weirs, and CB grates. <input type="checkbox"/> One plant species is spreading more than other plants <input type="checkbox"/> Removal of individual plants solves issue <input type="checkbox"/> Plants are growing 6 inches or less over adjacent paved areas or the adjacent bed or lawn areas maintained by others <input type="checkbox"/> Plants are growing 6 inches or less over adjacent paved areas or the adjacent bed or lawn areas maintained by others <input type="checkbox"/> Vegetation is slightly over 24 inches along sidewalks and light clearance zones and slightly over 30 inches along swales <input type="checkbox"/> Vegetation overhangs sidewalks, curbs and/or ramps by less than 6 inches <input type="checkbox"/> Visibility is partially impaired through planter <input type="checkbox"/> Clear vegetation for sight clearance <input type="checkbox"/> See Major Corridor Maintenance Table for Excessive Vegetation <input type="checkbox"/> Clear vegetation from within 24 inches of fire hydrants <input type="checkbox"/> Clear vegetation around maintenance holes for access <input type="checkbox"/> Review water coverage <input type="checkbox"/> Apply compost or carbon wood chip mulch as fertilizer (See E. Mulch) <input type="checkbox"/> Send a sample of soil to soil testing laboratory to determine what nutrients are deficient <input type="checkbox"/> Report multiple dead or dying plants, and coordinate removal and replacement within 30 days <input type="checkbox"/> Disinfect gardening tools after pruning diseased plants <input type="checkbox"/> Prune up limbs for clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Prune to remove obstructions of street signs, traffic signs or street lights <input type="checkbox"/> Remove deadwood and crossing branches <input type="checkbox"/> Remove suckers 	<ul style="list-style-type: none"> <input type="checkbox"/> See comments under B. Surface above <input type="checkbox"/> Do not use fabric for weed control <input type="checkbox"/> Swale bottom coverage by emergents and vegetation is less than 70% <input type="checkbox"/> Trash, petwaste, heavy leaf litter and/or downed branches. <input type="checkbox"/> Contaminants or sharp objects present in soil. <input type="checkbox"/> One or more plant species is crowding out and harming the vitality of other plants <input type="checkbox"/> Plant growth over curbs or across pavement by 6 +/- inches <input type="checkbox"/> Heavy blockage from plants at drain curb cuts, weirs, and CS grates <input type="checkbox"/> Plants are growing more than 6 inches over adjacent paved or lawn and planting areas maintained by others <input type="checkbox"/> Plants are growing more than 6 inches over adjacent paved or lawn and planting areas maintained by others <input type="checkbox"/> Vegetation is over 24 inches at intersection and sight clearance zones <input type="checkbox"/> Vegetation overhangs sidewalk, curbs and/or ramps more than 6 inches <input type="checkbox"/> Predominant vegetation along swale is over 36 inches <input type="checkbox"/> Visibility is impaired through planter <input type="checkbox"/> Vegetation is slightly over 24 inches along sidewalks and light clearance zones and slightly over 30 inches along swales <input type="checkbox"/> Vegetation overhangs sidewalks, curbs and/or ramps by less than 6 inches <input type="checkbox"/> Visibility is partially impaired through planter <input type="checkbox"/> Fire hydrant access clearly visible and accessible <input type="checkbox"/> Maintenance hole access visible and accessible <input type="checkbox"/> Fire hydrant is not clearly visible or accessible <input type="checkbox"/> Maintenance hole access not visible and/or access is blocked <input type="checkbox"/> Less than 70% of planted vegetation is healthy and with a generally good appearance <input type="checkbox"/> Plants exhibit signs of significant stress, wilting, spotting or holes in leaves <input type="checkbox"/> Most branches meet clearances over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Tree has a developed leader or prune to create one <input type="checkbox"/> Tree does not obstruct street signs, traffic signs and/or street lights <input type="checkbox"/> There is little deadwood, crossing branches or suckers 	
D2	Vegetation adjacent to areas where visibility or access needs to be maintained	<input type="checkbox"/> Blocked visibility <input type="checkbox"/> Blocked access	March September	As directed	<ul style="list-style-type: none"> <input type="checkbox"/> Cut back vegetation for sight clearance <input type="checkbox"/> See Major Corridor Maintenance Table for Excessive Vegetation <input type="checkbox"/> Clear vegetation from within 24 inches of fire hydrants <input type="checkbox"/> Clear vegetation around maintenance holes for access 	<ul style="list-style-type: none"> <input type="checkbox"/> Over 70% of planted vegetation is healthy and with a generally good appearance <input type="checkbox"/> Plants exhibit signs of minor stress, wilting, spotting or holes in leaves 	<ul style="list-style-type: none"> <input type="checkbox"/> Branches do not meet clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Trees obstruct street signs, traffic signs and/or street lights <input type="checkbox"/> Do not prune more than 1/4 of a tree's canopy 	
D3	Plant Health	<input type="checkbox"/> Unhealthy plants	March September	As directed	<ul style="list-style-type: none"> <input type="checkbox"/> Review water coverage <input type="checkbox"/> Apply compost or carbon wood chip mulch as fertilizer (See E. Mulch) <input type="checkbox"/> Send a sample of soil to soil testing laboratory to determine what nutrients are deficient <input type="checkbox"/> Report multiple dead or dying plants, and coordinate removal and replacement within 30 days <input type="checkbox"/> Disinfect gardening tools after pruning diseased plants 	<ul style="list-style-type: none"> <input type="checkbox"/> Prune up limbs for clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Prune to remove obstructions of street signs, traffic signs or street lights <input type="checkbox"/> Remove deadwood and crossing branches <input type="checkbox"/> Remove suckers 	<ul style="list-style-type: none"> <input type="checkbox"/> Most branches meet clearances over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Tree has a developed leader or prune to create one <input type="checkbox"/> Tree does not obstruct street signs, traffic signs and/or street lights <input type="checkbox"/> There is little deadwood, crossing branches or suckers 	
D4	Trees	<input type="checkbox"/> Pruning for clearance and form	June October	January	<ul style="list-style-type: none"> <input type="checkbox"/> Prune up limbs for clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Prune to remove obstructions of street signs, traffic signs or street lights <input type="checkbox"/> Remove deadwood and crossing branches <input type="checkbox"/> Remove suckers 	<ul style="list-style-type: none"> <input type="checkbox"/> Prune up limbs for clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Prune to remove obstructions of street signs, traffic signs or street lights <input type="checkbox"/> Remove deadwood and crossing branches or suckers 	<ul style="list-style-type: none"> <input type="checkbox"/> Most branches meet clearances over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Tree has a developed leader or prune to create one <input type="checkbox"/> Tree does not obstruct street signs, traffic signs and/or street lights <input type="checkbox"/> There is little deadwood, crossing branches or suckers 	

GSI Facility Component	OPERATIONS-SUPERVISOR Observation (Walk facility/look for conditions that may trigger maintenance activity)	MAINTENANCE-CREW			PERFORMANCE STANDARD		Comments Special Issues	ADDITIONAL INFO
		Frequency (Schedule for Full Review 5X per year: Jan, March, June, Sept, Nov, below are specialized visits that may be concurrent)	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger-Corrections/Improvements Required)		
D. Vegetation (cont.)								
D5	Shrubs □ Dead foliage	Pruning □ Dead foliage	June October	June September	February September	Small shrubs need minor pruning and pruning is easy and not frequently required □ Prune/ thin shrubs for visibility and access while maintaining natural shape □ Remove deadwood as needed	Pruning is intense and frequently required - consider plant species replacement □ Shrubs need pruning □ Shrubs block access and visibility	
D6	Evergreen Grasses and Emergents □ Flopping foliage	Center dieback Bare areas	March	March	May	Small shrubs need minor pruning and pruning is easy and not frequently required □ Large accent shrubs are pruned up and thinned (windowed) for access and visibility □ Shrubs are pruned	Dead foliage is not removed	
D7	Deciduous Grasses and Emergents □ Dead foliage	Flopping foliage □ Dead foliage	June	June	September	Handrake in spring before new growth emerges □ Cut back flopping foliage 14-18 inches from ground if foliage falls over onto other plants or sidewalk □ Divide plants with center dieback □ Divide plants to cover bare areas	Moderate coverage of adjacent plants and / or sidewalk by evergreen grass and emergent foliage □ More than 70% of deciduous grasses are healthy and with a generally good appearance and no center dieback	
D8	Ferns □ Old foliage	Old foliage	February	February	May	Leave foliage and seedheads however it should be cut back if foliage collapses especially onto other plants or sidewalks □ Cut back leaving 4-8 inches in late winter/early spring before new growth emerges □ Cut off seed heads that extend above 24 inches at intersections, driveways, etc. □ Cut back before fronds appear	Less than 70% of deciduous grasses are cut back to growth emerges □ Plants not crowding out other plants □ Moderate coverage of adjacent plants and / or sidewalk by deciduous grass and emergent foliage	
D9	Perennials and Bulbs □ Dead foliage	Center dieback Bare areas	April	May	September	Divide plants with center dieback □ Divide plants to cover bare areas □ Divide/remove overcrowded plants	Less than 70% of perennials are healthy and with a generally good appearance and no center dieback □ Approximately 60% of perennials are cut back in spring before new growth emerges	
D10	Weeds □ Weeds	Spent seed heads □ Flowers	April	May	September	Leave foliage and seedheads (cut back if foliage collapses) □ Cut back in early spring before new growth emerges □ As time allows remove spent flowers (deadhead) by cutting just above the nearest branch or bud	More than 60% of previous year's perennial foliage is not cut back □ Spring bulb foliage remains (optional)	
D11	Noxious and Invasive Weeds □ Noxious weeds □ Invasive weeds	Noxious weeds Invasive weeds Class A, B & C or non-regulated noxious weeds Invasive weeds of concern such as bindweed, black locust and buttercup Volunteers such as alder, poplar and scotch broom	March June September	March May July September October	May September	Mechanically remove weeds with their roots before they go to seed □ Apply mulch in Zones 3-4, 5, after first spring and fall weeding (See E. Mulch) □ Routine use of herbicides is prohibited. (Refer to Major Corrective Action Table) □ For weed infestations see Major Corrective Maintenance Table □ Weeds in pavement (joints, cracks) or between pavers □ Class A, B & C or non-regulated noxious weeds □ Invasive weeds of concern such as bindweed, black locust and buttercup □ Volunteers such as alder, poplar and scotch broom	If weed growth causes pavement cracking or becomes over 1 inch in height □ If weed growth causes pavement cracking or becomes over 1 inch in height □ All noxious and invasive weeds □ Mechanically remove weeds with their roots before they go to seed □ Routine use of herbicides is prohibited (Refer to Major Corrective Action Table) □ For weed infestations see Major Corrective Maintenance Table □ Less than 5% noxious weeds present - goal is for no noxious weeds □ Greater than 5% noxious weeds present - goal is for no noxious weeds □ For weed infestations see Major Corrective Maintenance Table	

OPERATIONS-SUPERVISOR		MAINTENANCE-CREW		PERFORMANCE STANDARD		ADDITIONAL INFO	
GSI Facility Component	Observation (Walk facility look for conditions that may trigger maintenance activity)	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)	Comments Special Issues	
E. Mulch	<ul style="list-style-type: none"> <input type="checkbox"/> Areas bare of mulch and plants <input type="checkbox"/> Excessive mulch <input type="checkbox"/> Exposed soil fabric or liner fabric. <input type="checkbox"/> See B. Surface 	<ul style="list-style-type: none"> <input type="checkbox"/> Weeded prior to applying mulch <input type="checkbox"/> Use arborist wood chip mulch in Zones 3, 4, 5 <input type="checkbox"/> Use approved source compost mulch if amendment is needed. <input type="checkbox"/> Remove mulch within 8-12 inches of tree trunk flares <input type="checkbox"/> Add or remove mulch to maintain depth of 2-4 inches keeping it back from stems or plants <input type="checkbox"/> Remove mulch that is blocking inlets and structures 	<ul style="list-style-type: none"> <input type="checkbox"/> February <input type="checkbox"/> September 	<ul style="list-style-type: none"> <input type="checkbox"/> March <input type="checkbox"/> October 	<ul style="list-style-type: none"> <input type="checkbox"/> Mulch coverage is at least 70% and is at least 2 inches deep <input type="checkbox"/> Mulch within 8-12 inches of tree trunk flares <input type="checkbox"/> Much against shrub stems 	<ul style="list-style-type: none"> <input type="checkbox"/> Mulch coverage is less than 70% and less than 2 inches deep <input type="checkbox"/> Much within 8-12 inches of tree trunk flares <input type="checkbox"/> Much against shrub stems 	
F. Watering	<ul style="list-style-type: none"> <input type="checkbox"/> Drought (nearest source or water truck) <input type="checkbox"/> Wilted or stressed plants <input type="checkbox"/> Areas bare of plants 	<ul style="list-style-type: none"> <input type="checkbox"/> June <input type="checkbox"/> July <input type="checkbox"/> August 	<ul style="list-style-type: none"> <input type="checkbox"/> May 	<ul style="list-style-type: none"> <input type="checkbox"/> June 	<ul style="list-style-type: none"> <input type="checkbox"/> Plants show a few signs of stress, including pests and disease, or wilting, and there are no areas bare of plants due to poor coverage <input type="checkbox"/> Irrigation system is working (e.g. there are a few broken parts; coverage is slightly uneven; broken equipment or lines to be capped - hard water until system is replaced) <input type="checkbox"/> Plants show a few signs of stress, including pests and disease, or wilting, and there are no areas bare of plants due to poor coverage 	<ul style="list-style-type: none"> <input type="checkbox"/> Plants are stressed (pests and disease), leaves wilting or visible branch die off <input type="checkbox"/> Irrigation system is not working, (e.g. coverage is uneven, areas unusually dry or wet; there are areas of plants due to coverage; soils washed out) <input type="checkbox"/> System needs immediate repair <input type="checkbox"/> Plants are stressed, wilting or dying 	<p>Tips: Pulse water if possible such as 2 days in a row. Turn the watering using a portable timer on the hose or first time the watering. Hand watering assume 2-3 min. for trees; 2-3 min for shrubs, glasses, and ground covers.</p> <p>See Major Corrective Maintenance Table for drought conditions</p>
F1	<ul style="list-style-type: none"> <input type="checkbox"/> System start up 			<ul style="list-style-type: none"> <input type="checkbox"/> June 	<ul style="list-style-type: none"> <input type="checkbox"/> Irrigation system is working and/or add heads as needed for head-to-head coverage <input type="checkbox"/> Activate system earlier or adjust timer schedule if top 1 to 2 inches of soil are dry or if plants are wilted or stressed. 	<ul style="list-style-type: none"> <input type="checkbox"/> Failed test: make repairs and repeat test until pass 	
F2	<ul style="list-style-type: none"> <input type="checkbox"/> Drought <input type="checkbox"/> Wilted or stressed plants <input type="checkbox"/> Areas bare of plants 		<ul style="list-style-type: none"> <input type="checkbox"/> June <input type="checkbox"/> August 	<ul style="list-style-type: none"> <input type="checkbox"/> October 	<ul style="list-style-type: none"> <input type="checkbox"/> Plants were bare of soil <input type="checkbox"/> Irrigation system <input type="checkbox"/> Backflow assembly test <input type="checkbox"/> and if repairs are made 	<ul style="list-style-type: none"> <input type="checkbox"/> Irrigation system was not winterized prior to freezing weather <input type="checkbox"/> System was not winterized prior to freezing weather <input type="checkbox"/> Failed test: make repairs and repeat test until pass 	<p>Backflow testing is required for systems off domestic water mains</p>
G. Deep Infiltration (over 6 feet) and/or Underground Infection Control (UIC) Wells for deep infiltration of treated stormwater							
G1	<ul style="list-style-type: none"> <input type="checkbox"/> Maintenance of UIC Screen Well & Maintenance Hole (UICMH) and Underdrain Maintenance 	<ul style="list-style-type: none"> <input type="checkbox"/> Sediment Accumulation in UICMH <input type="checkbox"/> Damaged monitoring port, well cap or air vent 	<ul style="list-style-type: none"> <input type="checkbox"/> March <input type="checkbox"/> September 	<ul style="list-style-type: none"> <input type="checkbox"/> Remove sediment from UICMs & UICMHs <input type="checkbox"/> Review biorientation facility as possible source of heavy sediment 	<ul style="list-style-type: none"> <input type="checkbox"/> March <input type="checkbox"/> September 	<ul style="list-style-type: none"> <input type="checkbox"/> Less than one inch of sediment has accumulated in UIC screen well MH or underdrain MH <input type="checkbox"/> Heavy damage is observed to monitoring port, well cap or air vent. 	<p>More than 1 inch of sediment has accumulated in UIC screen well MH or underdrain MH</p> <p>Heavy damage is observed to monitoring port, well cap or air vent.</p>
	<ul style="list-style-type: none"> <input type="checkbox"/> Monitoring of UIC Screen Well & Maintenance Hole (UICMH) and Underdrain Maintenance 	<ul style="list-style-type: none"> <input type="checkbox"/> Automated water level measurement <input type="checkbox"/> Manual water level measurement 	<ul style="list-style-type: none"> <input type="checkbox"/> March <input type="checkbox"/> September 	<ul style="list-style-type: none"> <input type="checkbox"/> Download and replace electronic datalogger (if installed) <input type="checkbox"/> Create visual record (hydrograph) of water level fluctuations from datalogger. <input type="checkbox"/> Report datalogger data if more than 2 feet of standing water or anomalous water level measurements. 	<ul style="list-style-type: none"> <input type="checkbox"/> March <input type="checkbox"/> September 	<ul style="list-style-type: none"> <input type="checkbox"/> Less than 2 feet of standing water in UIC Well when no inflow is occurring into MH <input type="checkbox"/> No anomalous water level measurements 	<p>Decision for long-term water level monitoring is project-specific</p> <p>2 feet or more of standing water when no inflow is occurring in MH</p> <p>Anomalous water level measurements that indicate change in conditions (e.g. screen plugging or other reduction in well performance)</p>
G2	<ul style="list-style-type: none"> <input type="checkbox"/> Monitoring of Downhole Video Survey 		<ul style="list-style-type: none"> <input type="checkbox"/> Yearly on the same month (min. 24 hours after end of rain event) 		<ul style="list-style-type: none"> <input type="checkbox"/> Condition of well to be assessed by qualified hydrogeologist <input type="checkbox"/> Provide recommendations if issues are observed 	<ul style="list-style-type: none"> <input type="checkbox"/> Yearly 	<p>Sediment in well is not more than 6 inches from asphalt bottom</p> <p>Biofouling accumulation is limited or typical for well age</p> <p>No structural problems with the well screen</p>
	<ul style="list-style-type: none"> <input type="checkbox"/> Infiltration testing for specific capacity 		<ul style="list-style-type: none"> <input type="checkbox"/> Year 1: August <input type="checkbox"/> Every 5 years thereafter or if video survey or water level measurements indicate decreased performance 		<ul style="list-style-type: none"> <input type="checkbox"/> Submit a screen well infiltration testing plan <input type="checkbox"/> Report results from screen well testing procedure <input type="checkbox"/> Compare data from each inflow test with the initial specified capacity, and during post-construction testing. <input type="checkbox"/> Report if target performance standard not achieved. Rehabilitation plan. 	<p>Every 5 years</p>	<p>The specific capacity of the well has declined by between 1 and 19% from last established capacity, or other percentage as determined by the Project Engineer.</p> <p>Allowable decline of specific capacity is project specific. 20% limit is a general guideline.</p>

GSI Facility Component	OPERATIONS-SUPERVISOR	MAINTENANCE-CREW			PERFORMANCE STANDARD		ADDITIONAL INFO
		Frequency	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger-Corrections/Improvements Required)	
G. Deep Infiltration (over 6 feet) and/or Underground Infection Control (UIC) Wells for deep infiltration of treated stormwater							
Maintenance of Pit Drains & Observation Port G2	□ Standing water	March September	Check Observation Port Standpipe for standing water and sediment build-up □ Report standing water for follow up visit □ Check for sediment build-up on surface of cell with pit drain □ Remove sediment □ Standing water observed, ensure sediment removal alleviates issue. If not, report standing water. See Major Corrective Maintenance Table.	March September	□ Observation Port/ Standpipe has less than 6 inches of standing water within 72 hours following storm event □ No standing water within 24 hours following storm event	□ Observation Port/ Standpipe has more than 6 inches of standing water within 72 hours following storm event □ Standing water observed in cell with pit drain more than 48 hours after storm even	Allowable height of standing water may be project specific depending on depth of pit drain.
	□ Blockages	March September	□ Clear blockages	March September	□ Moderate blockage at UMHs, cleanouts and underdrain pipes	□ Heavy blockage at UMHs, cleanouts and underdrain pipes	
	□ Damage	September	□ Check for and report damage to UMH, cleanout or underdrain □ Video the underdrain if it appears broken/damaged	March September	□ Minor damage to interior of UMH, cleanout or underdrain pipes	□ Heavy damage to interior or UMH, cleanout or underdrain	
Maintenance of UIC Drilled Drain Hole & Maintenance & Underdrain Maintenance Holes (UHM)	○ Standing water in drilled drain - manual water level measurement ○ Sediment accumulation in well screen	March September	□ Remove sediment from drilled drain well screen □ Report standing water observed. See Major Corrective Maintenance Table	March September	□ Less than 2 feet of standing water 24 hours after storm event □ Less than 6 inches of sediment accumulation in bottom of well screen. Depth of sediment estimated based on depth of well screen pipe during inspection compared to depth of well screen pipe post-construction (as measured from rim of structure).	□ More than 2 feet of standing water 24 hours after storm event □ More than 6 inches of sediment accumulation in bottom of well screen. Depth of sediment estimated based on depth of well screen pipe during inspection compared to depth of well screen pipe post-construction (as measured from rim of structure).	
	○ Sediment accumulation in access structure (Reinforced Concrete Pipe) ○ Standing water in access structure	March September	□ Remove sediment and hauled sand layer(s) from drilled drain with hand tools or vactor equipment □ Replace sand layer(s) □ Review biorretention facility components as possible source of sediment loading (e.g., cracked cleanout or underdrain pipe) □ Standing water observed, ensure sand replacement alleviate issue. If not, report. See Major Corrective Maintenance Table	March September	□ No standing water in drilled drain structure (above sand layers) when no inflow from underdrain is occurring	□ Standing water in drilled drain structure (above sand layers) when no inflow from underdrain is occurring □ Facility components are damaged causing increase of sediment load.	
	○ Damaged access structure ○ Damaged or missing frame or cover ○ Damaged or missing vertical conveyance pipe top section, cap, screen, or hose clamps.	March September	□ Report damage or missing components □ Repair and replace as necessary	March September	□ Minor damage not impacting drilled drain performance □ No missing components	□ Heavy damage potentially impacting drilled drain performance □ Missing components	
Monitoring of UIC Drilled Drain Hole & Maintenance & Underdrain Maintenance Holes (UHM)	□ Automated water level measurement □ Manual water level measurement □ Downhole Video Survey	March September	□ Download and replace electronic datalogger (if installed) □ Create visual record (hydrograph) of water level fluctuations from datalogger. □ Report datalogger data and perform and report downhole video survey if more than 2 feet of standing water or anomalous water level measurements	March September	□ Less than 2 feet of standing water when no inflow is occurring into UMH □ No anomalous water level measurements	□ 2 feet or more of standing water when no inflow is occurring in MH □ Anomalous water level measurements that indicate change in conditions (e.g. screen plugging or other reduction in well performance)	Decision for long-term water level monitoring is project-specific
	□ Inflow testing	Yearly on the same month (min. 24+ hours after end of rain event)	□ Condition of well to be assessed by qualified hydrogeologist. □ Provide recommendations if issues are observed	Yearly	□ Sediment in well screen is not more than 6 inches from as-built depth □ Biofouling or clogging accumulation is limited or typical □ No structural problems with the well screen	More than 6 inches sediment in well □ Biofouling accumulation is blocking large portions of well screen □ Structural problems with the well screen	Depth of sediment estimated based on depth of screened pipe during inspection compared to depth of screened pipe post-construction (as measured from rim of structure).
		Year 1: August Year 5: August Every 5 years thereafter or if video survey or water level measurements indicate decreased performance	□ Submit a screen wall inflow Testing Plan □ Report results from screen well testing procedure □ Compare data from each inflow test with the initial values established during post-construction testing. □ Specified capacity, and available head rise □ Report if target performance standard not achieved. Rehabilitation may be required.	Every 5 years	□ The specific capacity of the well has declined by between 1 and 19% from last established capacity, or other percentage as determined by the Project Engineer.	□ The specific capacity of the well has declined greater than 20% from last established capacity, or other percentage as determined by the Project Engineer. □ 20% limit is a general guideline.	

GSI Facility Component	OPERATIONS-SUPERVISOR		MAINTENANCE-CREW		PERFORMANCE STANDARD		ADDITIONAL INFO
	Observation (Walk facility/look for conditions that may trigger maintenance activity)	Frequency (Schedule for Full Review 5X per year; Jan, March, June, Sept, Nov. below are specialized visits that may be concurrent)	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger-Corrections/Improvements Required)	
H. Permeable Pavement This section is a placeholder - further discussion on GSI facility applications for permeable pavements							
H1 Previous Concrete (Full Street Length & Width)	<input type="checkbox"/> Sediment/ leaf debris/ moss	March October (after leaf drop)	<input type="checkbox"/> Vacuum Sweep both curb lines of entire street and through each intersection	March October (after leaf drop)	<input type="checkbox"/> Moderate debris on pavement but not affecting drainage function during rain event	<input type="checkbox"/> Heavy amount of debris on permeable pavement and during rain events water ponds or runs off permeable pavement	
H2 Previous Concrete in partial width or length of street	<input type="checkbox"/> Sediment/ leaf debris/moss	March October (after leaf drop)	<input type="checkbox"/> Vacuum Sweep both curb lines of entire street and through each intersection	March October (after leaf drop)	<input type="checkbox"/> Moderate debris on pavement but not affecting drainage function during rain event	<input type="checkbox"/> Heavy amount of debris on permeable pavement and during rain events water ponds or runs off permeable pavement	
H3 Previous Concrete Alley (Full or Partial)	<input type="checkbox"/> Sediment/ leaf debris/moss	March October (after leaf drop)	<input type="checkbox"/> Vacuum Sweep alley (edge to edge) of entire alley through each intersection	March October (after leaf drop)	<input type="checkbox"/> Moderate debris on pavement but not affecting drainage function during rain event	<input type="checkbox"/> Heavy amount of debris on permeable pavement and during rain events water ponds or runs off permeable pavement	
H4 Previous Concrete Sidewalk	<input type="checkbox"/> Sediment/ leaf debris/moss	1x/year	<input type="checkbox"/> Vacuum Sweep/Pressure Wash	Fall Spring	<input type="checkbox"/> Moderate debris on pavement but not affecting drainage function during rain event	<input type="checkbox"/> Heavy amount of debris on permeable pavement and during rain events water ponds or runs off permeable pavement	
H5 Areas Adjacent to Porous Pavement that drain onto porous	<input type="checkbox"/> Check if adjacent areas are stabilized. No exposed soil.	1x year	<input type="checkbox"/> Remove debris, soil that has deposited onto the pavement. <input type="checkbox"/> Vacuum area of impacted permeable pavement <input type="checkbox"/> Mulch and/or plant exposed soils that may erode to pavement surface	Fall Spring	<input type="checkbox"/> Minor amount of soil erosion and moderate debris on pavement but not affecting drainage function during rain event	<input type="checkbox"/> Soils are eroding and heavy amount of debris has been deposited onto permeable pavement and during rain events water ponds or runs off permeable pavement	
H6 Maintenance and Repairs Adjacent to porous Pavements	<input type="checkbox"/> Repairs adjacent to porous pavement	—	<input type="checkbox"/> Cover porous pavement when working on adjacent landscape areas to prevent debris accumulation	—	<input type="checkbox"/> Porous pavement is completely covered and protected during repairs	<input type="checkbox"/> Porous pavement is not completely covered and protected during repairs	

GSI Facility Component	OPERATIONS-SUPERVISOR	MAINTENANCE-CREW		PERFORMANCE STANDARD		Comments Special Issues	ADDITIONAL INFO
		Frequency (Schedule for Full Review 5X per year: Jan, March, June, Sept., Nov. below are specialized visits that may be concurrent)	Maintenance Activity	Month (Typical)	Acceptable (Targeted Standard)		
I. Hardscape/Specialty Elements							
11	Street Surface	<input type="checkbox"/> Road gutter debris	March September	<input type="checkbox"/> Sweep both curb lines of entire street <input type="checkbox"/> Sweep both curb lines for 1 block of intersecting streets upstream of the bioretention facilities	Per COS	<input type="checkbox"/> Moderate road gutter debris on blocks with bioretention facilities	<input type="checkbox"/> Heavy road gutter debris on blocks with bioretention facilities
12	Sidewalks (see also H. Permeable Pavement)	<input type="checkbox"/> Moss <input type="checkbox"/> Debris, leaves and sediment	March September	<input type="checkbox"/> Clean pavement <input type="checkbox"/> Clean pavement <input type="checkbox"/> Rake or add mulch to level it out - see E. Mulch <input type="checkbox"/> Remove weeds - see D. Vegetation <input type="checkbox"/> See A. Facility Footprint and E. Mulch for Settlement.	March September March October (after leaf drop)	<input type="checkbox"/> Less than 40% of pavement is covered with light moss <input type="checkbox"/> Less than 20% of pavement is covered with debris, leaves and sediment <input type="checkbox"/> Less than 20% of mulch is uneven or weedy	<input type="checkbox"/> More than 40% of pavement is covered with moss <input type="checkbox"/> Thick moss is more than 20% continuous <input type="checkbox"/> More than 20% of pavement is covered with debris, leaves and sediment <input type="checkbox"/> More than 20% of mulch is uneven or weedy
13	Paved Paths, Step Out Zones, Curb Edges, Access	<input type="checkbox"/> Weeds in mulch <input type="checkbox"/> Mulch Settlement <input type="checkbox"/> Gravel Settlement <input type="checkbox"/> Random pavers placed by others <input type="checkbox"/> Uneven pavers <input type="checkbox"/> Spaced Pavers with extensive weeds	March September March October March October March October March October	<input type="checkbox"/> Rake or add gravel to level it out <input type="checkbox"/> Remove weeds. See D. Vegetation. <input type="checkbox"/> See A. Facility Footprint for compacted shoulder at curb and edge of sidewalk. <input type="checkbox"/> Add gravel when settlement is 2 inches or less to level with adjacent surface <input type="checkbox"/> See A. Facility Footprint for compacted shoulder at curb and edge of sidewalk. <input type="checkbox"/> Report random pavers placed by others <input type="checkbox"/> Reset uneven pavers <input type="checkbox"/> Weed between pavers - see D. Vegetation	March July September October March October March September March September March September	<input type="checkbox"/> Less than 20% of gravel is uneven or weedy <input type="checkbox"/> Settlement is less than 2 inches <input type="checkbox"/> Less than 25% of pavement is covered with moss, debris, leaves and sediment <input type="checkbox"/> More than 80% pavers are even <input type="checkbox"/> Less than 20% of paver joints contain weeds	<input type="checkbox"/> More than 20% of gravel is uneven or weedy <input type="checkbox"/> Settlement is 2 inches or greater - see Major Corrective and Long-Term Maintenance Table <input type="checkbox"/> More than 25% of pavement is covered with moss, debris, leaves and sediment <input type="checkbox"/> Less than 80% pavers are even <input type="checkbox"/> More than 20% of paver joints contain weeds
14	Signage and Traffic Markers	<input type="checkbox"/> Review interpretive signs if applicable <input type="checkbox"/> Review interpretive signs if applicable	March October	<input type="checkbox"/> Report knocked over signs <input type="checkbox"/> Report inapplicable interpretive signs <input type="checkbox"/> Prune trees and shrubs for clearance/ visibility	March September	<input type="checkbox"/> Signs are visible and upright <input type="checkbox"/> Interpretive signs if applicable <input type="checkbox"/> Check and report displaced vertical or on edge traffic markers	<input type="checkbox"/> Signs are knocked over <input type="checkbox"/> Interpretive signs are inapplicable <input type="checkbox"/> Trees and shrubs are not pruned for clearance / visibility <input type="checkbox"/> Vertical or on edge traffic markers are in place
15	Street Furnishings / Public Art	<input type="checkbox"/> Review placement of vertical or on edge traffic markers at curb bulbs <input type="checkbox"/> Damage <input type="checkbox"/> Vandalism <input type="checkbox"/> Cleanliness <input type="checkbox"/> Visibility	March October	<input type="checkbox"/> Report damage or vandalism <input type="checkbox"/> Prune trees and shrubs for clearance / visibility	March September	<input type="checkbox"/> Furnishings and art are visible, undamaged or damaged	<input type="checkbox"/> Furnishings and art are blocked, vandalized or damaged



Appendix B: Establishment Period Maintenance Guidance for GSI in the Right-of-Way



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Seattle
Public
Utilities

Department of
Natural Resources and Parks
Wastewater Treatment

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

Notes:

- The following table is based on the "Guidance Document: Western Washington Low Impact Development (LID) Operation and Maintenance (O&M)" prepared for Ecology Water Quality Program - July 8, 2013 and the 2014 update to City of Seattle's Stormwater Manual.
- This table is guidance for the first 3+ years after installation. Timing is guidance and may be adjusted to site specific conditions.
- See Examples: Acceptable /Unacceptable Guidance in the appendix of GSI Manual. Volume V.
- See separate tables for specific guidance for routine and major corrective action / long-term maintenance.

- 5. Bold Text = High priority for function or safety**
- 6. Yellow indicates activities performed by SPU/WTD monitoring group/staff for deep infiltration facilities.**
- 7. Orange indicates topics areas that are under development, the guidance included is a placeholder. Refer to project specific O&M guidance in the interim.**

8. Deep infiltration guidance Section G, was updated by a joint SPU and WTD working group in the fall of 2019.

GSI Facility Component		Observation (walk facility-look at conditions that may trigger maintenance activity)	Frequency (Schedule for monthly review, below are specialized visits that may be concurrent)	Maintenance Activity	Frequency (Typical)	Maintainance-Crew
Emergency Conditions /Extreme Events		See Major Corrective Maintenance Table for Emergency Conditions / Extreme Events				
A1	Soils	<ul style="list-style-type: none"> <input type="checkbox"/> Soil protection during maintenance <input type="checkbox"/> Drain Out Cuts, Catch Basins (CB) and Weirs <input type="checkbox"/> Blockage 	<ul style="list-style-type: none"> <input type="checkbox"/> Before Storm Notification of Storm Event <input type="checkbox"/> After Storm Event <input type="checkbox"/> After CSO Notification 	<ul style="list-style-type: none"> <input type="checkbox"/> Remove at a minimum blockages/leaves from drain curb cuts at presenting zones, from the curb cut at the first cell after presenting and from the curb cut at the low point or corner <input type="checkbox"/> Remove blockages from all curb cuts if time allows <input type="checkbox"/> Remove blockages from weirs and last CB 	As directed following weather event	<ul style="list-style-type: none"> <input type="checkbox"/> Facility is ready for a storm event; minor blockage from debris, sediment or vegetation, minor pending
A1	A. Facility Footprint	<ul style="list-style-type: none"> <input type="checkbox"/> Erosion and washouts <input type="checkbox"/> Settlement <input type="checkbox"/> Excessive exposed soils <input type="checkbox"/> Sediment accumulation <input type="checkbox"/> Water is not draining 	<ul style="list-style-type: none"> <input type="checkbox"/> Monthly <input type="checkbox"/> March September <input type="checkbox"/> March September <input type="checkbox"/> Monthly <input type="checkbox"/> Monthly and after 1 inch and greater storms 	<ul style="list-style-type: none"> <input type="checkbox"/> Reform maintenance work when soils are not saturated to prevent compaction and damage to soil structure <input type="checkbox"/> For extensive maintenance place boards to step on to avoid foot compaction <input type="checkbox"/> Fill in erosion gullies and clean up washouts <input type="checkbox"/> Install temporary erosion control measures until permanent repairs are made <input type="checkbox"/> Identify and remedy what is causing erosion and/or washouts <input type="checkbox"/> Add cobbles or other erosion protection measure where concentrated water flows <input type="checkbox"/> Add mulch when settlement is 2 inches or less - see E. Mulch <input type="checkbox"/> Maintain design width of compacted shoulder (18 inches min.) <input type="checkbox"/> See Major Corrective Maintenance Table when settlement reaches unacceptable levels (more than 2') <input type="checkbox"/> Add plants - see D. Vegetation <input type="checkbox"/> Perform weeding and routine maintenance work when soils are not saturated to prevent compaction and damage to soil structure <input type="checkbox"/> Attempt to identify clogging issue and remedy source of sediment <input type="checkbox"/> Remove sediment in clogged area using a rake or vacuum and removing 1 to 3 inches of mud and replacing with new mulch at least in step out zone <input type="checkbox"/> If sediment affects more than a 3-foot by 3-foot area or is more than 1-inch deep see Major Corrective Maintenance Table <input type="checkbox"/> Observe surface conditions especially downstream from nesting and curb cuts and report non-draining swales <input type="checkbox"/> Check cleanouts / observation ports for standing water. See Underdrain System if standing water observed. <input type="checkbox"/> If no standing water observed in cleanouts or observation ports use pitchfork or other tined or aerating tool to aerate soil. <input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Pull out rock or boulders to remove surface blockages, debris, sediment and fall leaf litter, then reinstall <input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Remove surface blockages, debris, sediment and fall leaf litter <input type="checkbox"/> Check that boulder weirs are intact and relatively level <input type="checkbox"/> Repair undercutts at sides by replacing soil with clay dam and installing cobbles <input type="checkbox"/> Reset cobbles if they have become dislodged <input type="checkbox"/> Observe and report issues to manager after every visit <input type="checkbox"/> Visit after large storms; remove blockages and repair as needed <input type="checkbox"/> Take corrective action to repair or prevent minor displacement <input type="checkbox"/> See Major Corrective Maintenance Table <input type="checkbox"/> Remove moss/pressure wash 	<ul style="list-style-type: none"> <input type="checkbox"/> Every visit <input type="checkbox"/> As needed <input type="checkbox"/> March July September October <input type="checkbox"/> As directed <input type="checkbox"/> March July September October <input type="checkbox"/> Every visit <input type="checkbox"/> As needed <input type="checkbox"/> March July September October <input type="checkbox"/> As directed <input type="checkbox"/> March July September October <input type="checkbox"/> Every visit <input type="checkbox"/> As directed <input type="checkbox"/> March July September October <input type="checkbox"/> As directed <input type="checkbox"/> March July September October <input type="checkbox"/> Every visit <input type="checkbox"/> As directed <input type="checkbox"/> March July September October <input 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ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Operations-SUPERVISOR Observation (walk facility/look at conditions that may trigger maintenance activity)	MAINTENANCE-CREW	
		Maintenance Activity	Frequency (Typical)
A. Facility Footprint (cont.)			
A5 Boulders, cobbles etc	<input type="checkbox"/> Setting, undercutting or blocked cobbles <input type="checkbox"/> at drain curb cuts and grates <input type="checkbox"/> Displaced boulders	March September	<input type="checkbox"/> Observe conditions every visit <input type="checkbox"/> Reset cobbles at drain curb cut entries and at base of weirs and grates <input type="checkbox"/> Check boulders at pipe outfalls and reset if displaced <input type="checkbox"/> Receive approval from manager prior to removal of boulders
A6 Compacted shoulder at curb and edge of sidewalk (surfacing varies)	<input type="checkbox"/> Settlement or insufficient edge	March September	<input type="checkbox"/> Curb side: width of compacted shoulder is 24+/- inches. <input type="checkbox"/> Shoulder has weed cover of less than 10% inches <input type="checkbox"/> Sidewalk side: width of compacted shoulder is 8 to 12 inches
B. Inlets/Outlets/Pipe/Grates - Surface			
B1 Drain Curb Cuts (Gutter Line)	<input type="checkbox"/> Blockages	March September	<input type="checkbox"/> Maintain design width of compacted shoulder by topressing and recompacting edges <input type="checkbox"/> Remove surface trash debris, sediment and fall leaf litter <input type="checkbox"/> Remove blockages <input type="checkbox"/> Remove blocking vegetation <input type="checkbox"/> Check that gutter line flows into curb cut; if not report issue to manager for corrective action.
B2 Trench Drain Grates (including covers at some Drain Curb Cuts)	<input type="checkbox"/> Damage <input type="checkbox"/> Debris, sediment and leaf litter	March September	<input type="checkbox"/> Check for and report damage to grates and trash racks <input type="checkbox"/> Remove surface trash debris, sediment and fall leaf litter
B3 Planter Wall Openings (along Sidewalk)	<input type="checkbox"/> Damage to wall opening <input type="checkbox"/> Trash, debris, sediment and leaf litter <input type="checkbox"/> Blockages	April August	<input type="checkbox"/> Report to manager if exposed opening exceeds 5 inches <input type="checkbox"/> See Major Corrective Maintenance Table <input type="checkbox"/> See B. Drain Curb Cuts (Gutter Line)
B3 Presettling	<input type="checkbox"/> Trash, debris, sediment and leaf litter	Monthly	<input type="checkbox"/> Remove surface, trash debris, sediment and leaf litter
B4 Grates and Trash Racks	<input type="checkbox"/> Blockages	Monthly	<input type="checkbox"/> Remove surface trash debris, sediment and fall leaf litter <input type="checkbox"/> Look into structure for debris especially on beehive grates with open sides. Report if debris at base of structure.
B5 Catch Basins (CBs) with Pipes Discharging to Swales	<input type="checkbox"/> Debris, sediment and leaf litter <input type="checkbox"/> Blockages <input type="checkbox"/> Damaged structures	Monthly	<input type="checkbox"/> Remove surface trash debris, sediment and fall leaf litter <input type="checkbox"/> Remove blockages <input type="checkbox"/> Check for any report damage <input type="checkbox"/> See Major Corrective Maintenance Table
B6 Surface Clean Outs	<input type="checkbox"/> Cover intact <input type="checkbox"/> No water observed	March September	<input type="checkbox"/> Cover missing immediately cover with temporary cover and report <input type="checkbox"/> Remove clean out cover and do a visibility check for water or debris <input type="checkbox"/> See B. Surface Clean Outs <input type="checkbox"/> Inform crews that geotextile fabric may be present under mulch, rock cobbles or boulders
B7 Geotextile Fabrics	<input type="checkbox"/> Exposed fabric	Monthly	<input type="checkbox"/> Check for pulled up or unsightly geotextile fabric that may be under cobbles or boulders etc. <input type="checkbox"/> Reinstall under boulder or cover with mulch. Trim as applicable. <input type="checkbox"/> Minor exposure of fabric (less than 2 inches)

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Operations-SUPERVISOR Observation (walk facility/look at conditions that may trigger maintenance activity)	MAINTENANCE-CREW	
		Maintenance Activity	Frequency (Typical)
C. Inlets/Outlets/Pipes - Subsurface			
C1 Catch Basins (CB) and Storm Drains Discharging to Swales	<input type="checkbox"/> Pipe blockages <input type="checkbox"/> CB Sediment <input type="checkbox"/> CB interior damage	March September March September March September	<input type="checkbox"/> Check for and remove blockages and sediment from storm drain pipes <input type="checkbox"/> Remove sediment build-up and/or obstructions from catch basin sump if more than 6 inches or blocking pipes <input type="checkbox"/> Check for and report to manager the interior damage to CB
C2 Flow Splitters	<input type="checkbox"/> Pipe or weir blockages	March September March September	<input type="checkbox"/> Check for and remove blockages <input type="checkbox"/> Remove blockages
C3 Trend Drains	<input type="checkbox"/> Blockage <input type="checkbox"/> Damaged structures	March September Monthly	<input type="checkbox"/> Check for and report damage to grates or frames <input type="checkbox"/> Check underdrain outlet point for standing water (e.g., MH outlet plugged, UIC MH or drilled drain access structure plugged) causing water to back-up into underdrain <input type="checkbox"/> If standing water observed in underdrain outlet point, see maintenance activities for corresponding downstream infrastructure (e.g., UIC drilled drain or downstream MH) <input type="checkbox"/> Check for and report damage to UMH, cleanout or underdrain <input type="checkbox"/> Video the underdrain if it appears broken/damaged
C4 Underdrain System (Maintenance Holes (UMH), Underdrain Pipes and Cleanouts)	<input type="checkbox"/> Water ponding <input type="checkbox"/> Blockages <input type="checkbox"/> Damage	March September September New Crews Yearly	<input type="checkbox"/> Remove blockages and sediment from UMHs, cleanouts and underdrain pipes <input type="checkbox"/> Check for and report damage to UMH, cleanout or underdrain <input type="checkbox"/> Remove clean out cover and do a visibility check for water or debris <input type="checkbox"/> Video the underdrain if it appears broken/damaged
C5 Liners	<input type="checkbox"/> Crews informed on special requirements for digging at their locations <input type="checkbox"/> Accidental puncture (not visible) <input type="checkbox"/> Observed vehicle wheel track in cell side or bottom <input type="checkbox"/> Water not ponding and no water in underdrain during rain, event <input type="checkbox"/> Downslope seepage <input type="checkbox"/> Liner exposed <input type="checkbox"/> Visible puncture, tear, cracking or other degradation of liner <input type="checkbox"/> Stormwater function <input type="checkbox"/> Pounding <input type="checkbox"/> Adjacent on edges or surface <input type="checkbox"/> Grade breaks & sloughs	– – – March October March September February September	<input type="checkbox"/> Inform new crew members of lined cell locations and special liner requirements <input type="checkbox"/> Flag in the field, mark address and location on a plan and report if there is the possibility a liner was accidentally punctured or damaged <input type="checkbox"/> See Major Corrective Maintenance Table <input type="checkbox"/> Report to manager if there is no ponding water and no water is coming through underdrain to UMH during an extended or major rain event <input type="checkbox"/> Report to manager if there are reports of downslope seepage <input type="checkbox"/> Inspect exposed liner for damage. If no damage observed, replenish soil and mulch above liner to design depths <input type="checkbox"/> If damage observed, note location of damage and notify Project Representative <input type="checkbox"/> Observe and Report issues such as adjacent area ponding or presence of algae <input type="checkbox"/> Corrective action to repair see Major Corrective Maintenance Table <input type="checkbox"/> Observe and Report issues such as pavement cracking in the area or settlement <input type="checkbox"/> Corrective action to repair see Major Corrective Maintenance Table
C6 Soil Cells (Swale Cell ®)			
D. Vegetation			
D1 General facility bottom area, slope and top vegetation	<input type="checkbox"/> Geotextile fabrics exposed <input type="checkbox"/> Dead plants or bare areas in facility bottom <input type="checkbox"/> Trash and pet waste <input type="checkbox"/> Contaminants	Monthly Monthly	<input type="checkbox"/> Inform crews that fabric may be present under mulch, rock cobbles or boulders and to reinstall if encountered <input type="checkbox"/> Typically this might be a black or gray woven material or it might be a manufactured coir blanket material <input type="checkbox"/> Do not use fabric for weed control <input type="checkbox"/> Divide perennials, grasses and emergents to replace dead plants or fill in bare areas <input type="checkbox"/> See Perennials, Evergreen and Deciduous Grasses and Emergents
	<input type="checkbox"/> Plant blockage <input type="checkbox"/> Aggressive / spreading plants	Monthly	<input type="checkbox"/> Maintain 1 foot zone clear of vegetation around all inlets and outlets <input type="checkbox"/> See Major Corrective Maintenance Table for difficult plants to remove
	<input type="checkbox"/> Pavement overhanging evergreen shrubs and ground covers	March September	<input type="checkbox"/> Prune, trim or thin overhanging plants <input type="checkbox"/> Redeline planting area edges - if trimmers are used keep them 2 feet back from tree trunks <input type="checkbox"/> Report to manager prior to removal or replacement of problematic vegetation.
	<input type="checkbox"/> Pavement overhanging perennials, deciduous shrubs and grasses	May September	<input type="checkbox"/> Trim or thin overhanging plants. <input type="checkbox"/> Redeline planting area edges - keep trimmers 2 feet back from tree trunks <input type="checkbox"/> Report to manager prior to removal or replacement of problematic vegetation

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Operations-SUPERVISOR Observation (walk facility/look at conditions that may trigger maintenance activity)	MAINTENANCE-CREW	
		Maintenance Activity	Frequency (Typical)
D. Vegetation (cont.)			
D2	Vegetation adjacent to areas where visibility or access needs to be maintained	<ul style="list-style-type: none"> <input type="checkbox"/> Overgrowth <input type="checkbox"/> Blocked sight clearance <input type="checkbox"/> Blocked visibility <input type="checkbox"/> Blocked access 	<p>Monthly</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cut back vegetation for sight clearance <input type="checkbox"/> See Major Corrective Maintenance Table for Excessive Vegetation
D3	Plant Health	<ul style="list-style-type: none"> <input type="checkbox"/> Unhealthy plants 	<p>Monthly</p> <ul style="list-style-type: none"> <input type="checkbox"/> Clear vegetation from within 24 inches of fire hydrants <input type="checkbox"/> Clear vegetation around maintenance holes for access
D4	Trees	<ul style="list-style-type: none"> <input type="checkbox"/> Pruning 	<p>June October</p> <ul style="list-style-type: none"> <input type="checkbox"/> Review water coverage <input type="checkbox"/> Apply compost or batonist wood chip mulch as fertilizer - see E. Mulch <input type="checkbox"/> Send a sample of soil to soil testing laboratory to determine what nutrients are deficient <input type="checkbox"/> Report multiple dead or dying plants and coordinate removal and replacement within 30 days <input type="checkbox"/> Disinfect gardening tools after pruning diseased plants <input type="checkbox"/> Prune up limits for clearance over sidewalk (8 feet) and road (14 feet) <input type="checkbox"/> Remove obstructions of street signs, traffic signs or street lights <input type="checkbox"/> Remove deadwood and crossing branches <input type="checkbox"/> Remove suckers <input type="checkbox"/> Do not prune more than 1/4 of a tree's canopy. <input type="checkbox"/> Prune vegetation, curvching/gapping <input type="checkbox"/> Prune/trim shrubs for visibility and access while maintaining natural shape. <input type="checkbox"/> Remove deadwood
D5	Shrubs	<ul style="list-style-type: none"> <input type="checkbox"/> Pruning 	<p>March</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hand-prune in spring before new growth emerges. <input type="checkbox"/> Cut back to 5-8 inches or trim every 2-3 years as needed. <input type="checkbox"/> Cut back/ toppling foliage to 14-18 inches from ground if foliage falls over onto other plants <input type="checkbox"/> Remove deadwood
D6	Evergreen Grasses and Emergents	<ul style="list-style-type: none"> <input type="checkbox"/> Flipping foliage 	<p>May</p> <ul style="list-style-type: none"> <input type="checkbox"/> Hand-prune in spring before new growth emerges. <input type="checkbox"/> Cut back/ toppling foliage to 14-18 inches from ground if foliage falls over onto other plants <input type="checkbox"/> Remove deadwood
D7	Deciduous Grasses and Emergents	<ul style="list-style-type: none"> <input type="checkbox"/> Center dieback <input type="checkbox"/> Bare areas <input type="checkbox"/> Dead foliage <input type="checkbox"/> Spent seed heads <input type="checkbox"/> Flipping foliage <input type="checkbox"/> Old foliage 	<p>May October May February</p> <ul style="list-style-type: none"> <input type="checkbox"/> Divide plants with center dieback <input type="checkbox"/> Divide plants to cover bare areas <input type="checkbox"/> Leave foliage and seedheads however it should be cut back if foliage collapses especially on other plants & sidewalk walls <input type="checkbox"/> Cut back/ leaving 5-8 inches in late winter/early spring before new growth emerges <input type="checkbox"/> Cut off seed heads that extend above 24 inches at locations where sight clearance is critical. <input type="checkbox"/> Cut back foliage to 14-18 inches from ground if foliage falls over (due to excessive growth from compost in bioretention soil mix and extra watering for establishment) <input type="checkbox"/> Cut back before frosts appear <input type="checkbox"/> Divide plants with center dieback <input type="checkbox"/> Divide plants to cover bare areas <input type="checkbox"/> Divide/remove over crowded plants <input type="checkbox"/> Leave foliage and seedheads (cut back if foliage collapses) <input type="checkbox"/> Cut back in early spring before new growth emerges <input type="checkbox"/> As time allows remove spent flowers (deadhead) by cutting just above the nearest branch or bud <input type="checkbox"/> Mechanically remove weeds with their roots before they go to seed <input type="checkbox"/> Apply mulch after weeding - see E. Mulch (option to apply only in step out zone) <input type="checkbox"/> Routine use of herbicides is prohibited. <input type="checkbox"/> For weed infestations see Major Corrective Maintenance Table.
D9	Perennials and Bulbs	<ul style="list-style-type: none"> <input type="checkbox"/> Center dieback <input type="checkbox"/> Bare areas <input type="checkbox"/> Dead foliage <input type="checkbox"/> Spent flowers 	<p>April September March</p> <ul style="list-style-type: none"> <input type="checkbox"/> Leave foliage and seedheads (cut back if foliage collapses) <input type="checkbox"/> Cut back in early spring before new growth emerges <input type="checkbox"/> As time allows remove spent flowers (deadhead) by cutting just above the nearest branch or bud <input type="checkbox"/> Mechanically remove weeds with their roots before they go to seed <input type="checkbox"/> Apply mulch after weeding - see E. Mulch (option to apply only in step out zone) <input type="checkbox"/> Routine use of herbicides is prohibited. <input type="checkbox"/> For weed infestations see Major Corrective Maintenance Table.
D10	Weeds	<ul style="list-style-type: none"> <input type="checkbox"/> Weeds 	<p>March September</p> <ul style="list-style-type: none"> <input type="checkbox"/> Weeds in pavement (joints, cracks) or between pavers <input type="checkbox"/> Class A, B & C or non-regulated noxious weeds <input type="checkbox"/> Invasive weeds of concern such as bindweed, horsetail and buttercup <input type="checkbox"/> Volunteers such as alder, poplar and scotch broom
D11	Noxious and Invasive Weeds		<p>March June September</p> <ul style="list-style-type: none"> <input type="checkbox"/> Immediately remove, bag and dispose as garbage all noxious and invasive weeds. <input type="checkbox"/> Mechanically remove weeds with their roots before they go to seed <input type="checkbox"/> Routine use of herbicides is prohibited. <input type="checkbox"/> For weed infestations see Major Corrective Maintenance Table

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Operations-SUPERVISOR	MAINTENANCE-CREW							
		Maintenance Activity	Frequency (Typical)						
E1	Observation (walk facility-look at conditions that may trigger maintenance activity)	(Schedule for monthly review, below are specialized visits that may be concurrent)							
E. Mulch	<ul style="list-style-type: none"> <input type="checkbox"/> Areas bare of mulch and plants <input type="checkbox"/> Excessive mulch <input type="checkbox"/> Exposed coil fabric or filter fabric. See B. Surface 	<ul style="list-style-type: none"> <input type="checkbox"/> Weeds prior to applying mulch <input type="checkbox"/> Use arborist wood chip mulch in cell bottom areas <input type="checkbox"/> Use approved source compost mulch for amendment <input type="checkbox"/> Remove mulch within 8-12 inches of tree trunk flares <input type="checkbox"/> Add or remove mulch to maintain depth of 2-3 inches <input type="checkbox"/> Remove mulch that is blocking inlets and structures 	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">March</td> <td style="width: 50%;">September</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/> Minor mulch is blocking the drainage structures and/or curb inlets</td> <td style="text-align: center;"><input type="checkbox"/> Mulch coverage is at least 90%</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/> Mulch is approximately 2-3 inches deep</td> <td style="text-align: center;"><input type="checkbox"/> Mulch coverage is at least 90%</td> </tr> </table>	March	September	<input type="checkbox"/> Minor mulch is blocking the drainage structures and/or curb inlets	<input type="checkbox"/> Mulch coverage is at least 90%	<input type="checkbox"/> Mulch is approximately 2-3 inches deep	<input type="checkbox"/> Mulch coverage is at least 90%
March	September								
<input type="checkbox"/> Minor mulch is blocking the drainage structures and/or curb inlets	<input type="checkbox"/> Mulch coverage is at least 90%								
<input type="checkbox"/> Mulch is approximately 2-3 inches deep	<input type="checkbox"/> Mulch coverage is at least 90%								
F. Watering									
F1	Watering (hand from nearby source or water truck)	<ul style="list-style-type: none"> <input type="checkbox"/> Drought <input type="checkbox"/> Wilting or stressed plants <input type="checkbox"/> Areas bare of plants 	<ul style="list-style-type: none"> <input type="checkbox"/> Confirm water source for crews some sites have irrigation systems and others require source. Special permits may be required if using Fire hydrants as source <input type="checkbox"/> Water deeply applying approximately 1-inch of water per week <input type="checkbox"/> Use tree watering bags for newly planted trees 						
	System start up	<ul style="list-style-type: none"> <input type="checkbox"/> System start up 	<ul style="list-style-type: none"> <input type="checkbox"/> Turn on system and check the coverage. Repair heads and/or add heads as needed for head-to-head coverage <input type="checkbox"/> Adjust watering rates down annually to acclimate plants for routine watering 						
F2	Irrigation system	<ul style="list-style-type: none"> <input type="checkbox"/> Drought <input type="checkbox"/> Wilting or stressed plants <input type="checkbox"/> Areas bare of plants 	<ul style="list-style-type: none"> <input type="checkbox"/> Water deeply applying approximately 1 inch of water per week <input type="checkbox"/> Activate system earlier or adjust timer schedule if top 1 to 2 inches of soil are dry or if plants are wilting or stressed 						
F3	Drought	<ul style="list-style-type: none"> <input type="checkbox"/> Backflow assembly annual test 	<ul style="list-style-type: none"> <input type="checkbox"/> May and if repairs are made 						
			See Major Corrective Maintenance Table						

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Operations-Supervisor	MAINTENANCE-CREW	
		Maintenance Activity	Frequency (Typical)
G. Deep Infiltration (over 6 feet) and/or Underground Injection Control (UIC) Wells for deep infiltration of treated stormwater			
Maintenance of UIC Screen Wall & Maintenance Hole (UICMH) and Underdrain Maintenance Holes (UHM)	Sediment Accumulation in UICMH & UHM <input type="checkbox"/> Review biorentention facility as possible source of heavy sediment	March September	<input type="checkbox"/> Remove sediment from UICMHs and UHM with hand tools or vactor truck <input type="checkbox"/> Review biorentention facility as possible source of heavy sediment
G1 Monitoring of UIC Screen Wall & Maintenance Hole (UICMH) and Underdrain Maintenance Holes (UHM)	Damaged monitoring port, well cap or air vent <input type="checkbox"/> Automated water level measurement <input type="checkbox"/> Manual water level measurement <input type="checkbox"/> Manual UIC well depth measurement <input type="checkbox"/> Downhole Video Survey <input type="checkbox"/> Infiltration testing for specific capacity	March September Monthly through June (min. 24 hours after end of rain event)	<input type="checkbox"/> Report if damage is observed <input type="checkbox"/> Measure water level and total depth in UIC Well and UICMH <input type="checkbox"/> Download and replace electronic datalogger (if installed) <input type="checkbox"/> Create visual record (hydrograph) of water level fluctuations from datalogger info <input type="checkbox"/> Report datalogger data at more than 2 feet of standing water or anomalous water level measurements or anomalous well depth measurements <input type="checkbox"/> See Major Corrective Maintenance / Long Term Maintenance Table
G2 Maintenance of Pit Drains & Observation Port	Standing water <input type="checkbox"/> Blockages <input type="checkbox"/> Damage	March September Year 1: August (min. 24 hours after end of rain event)	<input type="checkbox"/> Condition of well to be assessed by qualified hydrogeologist <input type="checkbox"/> Provide recommendations if issues are observed <input type="checkbox"/> Submit a screen well infiltration testing plan <input type="checkbox"/> Report results from screen well testing procedure <input type="checkbox"/> Compare data from each infiltration test with the initial values (established during post-construction testing), specified capacity, and available head rise <input type="checkbox"/> Report if target performance standard not achieved. Rehabilitation may be required. <input type="checkbox"/> Check Observatory Port/ Standpipe for standing water and sediment build-up <input type="checkbox"/> Report Standing water for follow up visit <input type="checkbox"/> Check for sediment build-up on surface of seal with pit drain <input type="checkbox"/> Remove sediment; see also 'A. Facility Equipment A1' in this document <input type="checkbox"/> If standing water observed, ensure sediment removal alleviates issue. If not, report standing water. See Major Corrective Maintenance Table.
G3 Monitoring of UIC Drilled Drain & Maintenance Hole (UICMH) and Underdrain Maintenance Holes (UHM)	Sediment accumulation in UICMH and/or UHM <input type="checkbox"/> Standing water in access structure <input type="checkbox"/> Damaged access structure <input type="checkbox"/> Damaged or missing frame or cover plate (or section, cap, screen, or hose clamps) <input type="checkbox"/> Damaged monitoring port, well cap or air vent	Year 1: September through May Year 2: March September March September	<input type="checkbox"/> Clear blockages <input type="checkbox"/> Check for and report damage to UMH, cleanout or underdrain <input type="checkbox"/> Video the underdrain if it appears broken/damaged <input type="checkbox"/> Remove sediment and foul sand layer(s) from drilled drain <input type="checkbox"/> Replace sand layer(s) to design depth <input type="checkbox"/> Review biorentention facility components as possible source of sediment loading (e.g., cracked cleanout or underdrain pipe) <input type="checkbox"/> If standing water observed, ensure sand replacement alleviates issue. If not, report standing water. See Major Corrective Maintenance Table. <input type="checkbox"/> Report damage or missing components <input type="checkbox"/> Repair and replace as necessary <input type="checkbox"/> Report if damage is observed <input type="checkbox"/> Measure water level and total depth in UIC Well and UICMH <input type="checkbox"/> Download and replace electronic datalogger (if installed) <input type="checkbox"/> Create visual record (hydrograph) of water level fluctuations from datalogger info <input type="checkbox"/> Report datalogger data at more than 2 feet of standing water or anomalous water level measurements <input type="checkbox"/> See Major Corrective Maintenance / Long Term Maintenance Table
			<input type="checkbox"/> Less than one inch of sediment has accumulated in UIC MH and underdrain MH <input type="checkbox"/> No damage is observed to monitoring port, well cap or air vent
			<input type="checkbox"/> Less than 2 feet of standing water when no inflow is occurring into MH <input type="checkbox"/> No anomalous water level measurements
			<input type="checkbox"/> Sediment in well is not more than 6 inches from as-built depth <input type="checkbox"/> Biofouling and clogging accumulation on the well screen is limited <input type="checkbox"/> No structural problems with the well screen
			<input type="checkbox"/> Biofouling and clogging accumulation on the well screen is limited <input type="checkbox"/> No structural problems with the well screen
			<input type="checkbox"/> The specific capacity of the well has declined by between 1 and 19% from initial value established during post construction testing, or other percentage as determined by the Project Engineer
			<input type="checkbox"/> Observation Port Standpipe has less than 6 inches of standing water within 48 hours following storm event <input type="checkbox"/> Minor blockage at UMHs, cleanouts and underdrain pipes
			<input type="checkbox"/> Minor damage to interior of UMH, cleanout or underdrain pipes
			<input type="checkbox"/> No standing water in drilled drain structure (above sand layers) when no inflow from underdrain is occurring <input type="checkbox"/> Facility components are not found to be delivering high sediment load
			<input type="checkbox"/> Minor damage not impacting drilled drain performance <input type="checkbox"/> No missing components
			<input type="checkbox"/> No damage is observed to monitoring port, well cap or air vent

ESTABLISHMENT PERIOD MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	Observation (walk facility & look at conditions that may trigger maintenance activity)	OPERATIONS-SUPERVISOR		MAINTENANCE-CREW	
		Frequency (Schedule for monthly review, below are specialized visits that may be concurrent)	Maintenance Activity	Frequency (Typical)	Acceptable (Targeted Standard)
H. Permeable Pavement Facility					
H1 Pervious Concrete Full Street Length & Width	<input type="checkbox"/> Sediment/ leaf debris/moss	March (after leaf drop)	<input type="checkbox"/> Vacuum Sweep both curb lines of entire street and through each intersection	March (after leaf drop)	<input type="checkbox"/> Minor debris or pavement but not affecting drainage function during rain event
H2 Previous Concrete in partial width or length of street	<input type="checkbox"/> Sediment/ leaf debris/moss	March (after leaf drop)	<input type="checkbox"/> Vacuum Sweep both curb lines of entire street and through each intersection	March (after leaf drop)	<input type="checkbox"/> Minor debris on pavement but not affecting drainage function during rain event
H3 Previous Concrete Alley (Full or Partial)	<input type="checkbox"/> Sediment/ leaf debris/moss	March (after leaf drop)	<input type="checkbox"/> Vacuum Sweep alley (edge to edge) of entire alley through each intersection	March (after leaf drop)	<input type="checkbox"/> Minor debris on pavement but not affecting drainage function during rain event
H4 Previous Concrete Sidewalk	<input type="checkbox"/> Sediment/ leaf debris/moss	1x / year	<input type="checkbox"/> Vacuum Sweep/Pressure Wash	Fall Spring	<input type="checkbox"/> Minor debris or pavement but not affecting drainage function during rain event
Areas Adjacent to Porous Pavement that drain onto Porous Pavement	<input type="checkbox"/> Check if adjacent areas are stabilized; No exposed soil.	1x / year	<input type="checkbox"/> Remove debris, soil that has deposited onto the pavement <input type="checkbox"/> Vacuum area of impacted permeable pavement <input type="checkbox"/> Mulch and/or plant exposed soils that may erode to pavement surface	Fall Spring	<input type="checkbox"/> Minor soil erosion and moderate debris on pavement but not affecting drainage function during rain event
H6 Maintenance and Repairs Adjacent to Permeable Pavements	<input type="checkbox"/> Repairs adjacent to porous pavement	—	<input type="checkbox"/> Cover porous pavement when working on adjacent landscape areas to prevent debris accumulation	—	<input type="checkbox"/> Porous pavement is completely covered and protected during repairs
I. Hardscape/Specialty Elements					
11 Street Surface	<input type="checkbox"/> Road gutter debris	March September	<input type="checkbox"/> Sweep both curb lines of entire street facilities	Per COS	<input type="checkbox"/> Minor road gutter debris on blocks with bioretention facilities
12 (see H. Permeable Pavement)	<input type="checkbox"/> Moss <input type="checkbox"/> Debris, leaves and sediment	March September March September	<input type="checkbox"/> Clean pavement <input type="checkbox"/> Clean pavement	March September March September	<input type="checkbox"/> Less than 20% of pavement is covered with light moss <input type="checkbox"/> 10% of pavement is covered with debris, leaves and sediment <input type="checkbox"/> 4 foot continuous clearance required
13 Paved Paths, Step Out Zones, Curb Edges, Access	<input type="checkbox"/> Weeds in mulch <input type="checkbox"/> Mulch settlement <input type="checkbox"/> Gravel settlement	March September March September March September	<input type="checkbox"/> Rake or add mulch to level it out - see E. Mulch <input type="checkbox"/> Remove weeds - see D. Vegetation <input type="checkbox"/> See A. Facility Footprint and E. Mulch for settlement <input type="checkbox"/> See A. Facility Footprint for compacted shoulder at curb and edge of sidewalk <input type="checkbox"/> Remove weeds - see D. Vegetation <input type="checkbox"/> See A. Facility Footprint for settlement <input type="checkbox"/> Add gravel when settlement is 2 inches or less to level with adjacent surface <input type="checkbox"/> See A. Facility Footprint for compacted shoulder at curb and edge of sidewalk	March September March September March September March September March September March September	<input type="checkbox"/> 10% of mulch is uneven or weedy <input type="checkbox"/> See A. Facility Footprint and E. Mulch for settlement <input type="checkbox"/> Remove weeds - see D. Vegetation <input type="checkbox"/> See A. Facility Footprint for settlement <input type="checkbox"/> Settlement is less than 1 inch <input type="checkbox"/> Settlement is less than 1 inch
14 Signage and Traffic Markers	<input type="checkbox"/> Random pavers placed by others <input type="checkbox"/> Uneven pavers <input type="checkbox"/> Spaced Pavers with extensive weeds	March October	<input type="checkbox"/> Clean pavement	March September	<input type="checkbox"/> More than 90% pavers are even <input type="checkbox"/> Less than 20% of paver joints contain weeds
15 Street Furnishings / Public Art	<input type="checkbox"/> Review placement of vertical or on edge traffic markers at curb bulbs <input type="checkbox"/> Damage <input type="checkbox"/> Vandalism <input type="checkbox"/> Cleanliness <input type="checkbox"/> Visibility	March October March October	<input type="checkbox"/> Report random pavers placed by others <input type="checkbox"/> Reset uneven pavers <input type="checkbox"/> Weed between pavers - see D. Vegetation <input type="checkbox"/> Report knocked over signs <input type="checkbox"/> Prune trees and shrubs for clearance/ visibility <input type="checkbox"/> Check and report displaced vertical or on edge traffic markers <input type="checkbox"/> Report damage or vandalism <input type="checkbox"/> Prune trees and shrubs for clearance / visibility <input type="checkbox"/> Furnishings and art are visible, undamaged and/or unvandalized	March September March September	<input type="checkbox"/> Signs are visible and upright <input type="checkbox"/> Interpretive signs if applicable <input type="checkbox"/> Vertical or on edge traffic markers are in place <input type="checkbox"/> Furnishings and art are visible, undamaged and/or unvandalized

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Appendix C: Major Corrective Action and Long-Term Maintenance Guidance for GSI in the Right-of-Way



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MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

Notes:

1. The following table is based on the "Guidance Document - Western Washington Low Impact Development (LID) Operation and Maintenance (O&M)" prepared for Ecology Water Quality Program - July 6, 2013 and the 2014 update to City of Seattle's Stormwater Manual.
2. Frequency/Timing/Month shown is for guidance and may be adjusted to site specific conditions.
3. Acceptable /Unacceptable Guidance in the appendix of GSI Manual /Volume V.
4. See separate tables for specific guidance for Establishment and Routine Maintenance.
5. See discussion on corrective action and failure of failed systems in GSI/VOLUME V.
6. Yellow indicates activities performed by SPWTD monitoring group/staff for deep infiltration facilities.
7. Orange indicates topic areas that are under development; the guidance included is a placeholder. Refer to project specific O&M guidance in the interim.
8. Deep infiltration guidelines (Section G) were developed by a joint SPU and WTD working group in the fall of 2019.

GSI Facility Component	Observation or Troubleshooting	OPERATIONS			MAINTENANCE			PERFORMANCE STANDARD			ADDITIONAL INFO	
		Major Storm Events (more than 1' rain in 24 hours or wind above 20 mph)	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (Typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)			Comments	Special Issues
Drain Curb Cuts, Catch Basins (CB), Trench Drains and Wells	□ Blockage	□ Before Storm / Notification of Storm Event □ After Storm Event □ After CSO Notification			□ Remove at a minimum blockages/leaves from drain curb cuts at presenting zones, from the curb cut at the first cell after presetting and from the curb cut at the bay point or corner □ Remove blockages from all curb cuts if time allows □ Remove blockages from wells and last CB	As directed following weather event	□ Facility is ready for a storm event: Minor blockage from debris, sediment or vegetation, minor ponding	□ Facility is NOT ready for a storm event: Moderate to heavy blockage from debris, sediment or vegetation, damaged structures, and/or visible ponding				
Street Surface	□ Sand or salt present	□ After snow storm			□ Sweep if sand or salt is used during a snow event and the City does not sweep	As directed following weather event	□ Sand and salt is removed from streets and is not allowed to enter bioretention facilities	□ Sand and salt is left on streets and gutter and is allowed to enter bioretention facilities, damaging plants and clogging soils				
Swale/Planter Soils	□ Water is not draining	□ After Storm Event			□ Crew to observe for next 30 days, if problem persists see At, Soils	As directed following rain	□ Soils tree draining	□ Soils appear compressed and ponding observed 24 hours following rain				
Vegetation during Drought	□ Extreme drought restrictions	□ Water restrictions			□ Water vegetation in facility bottom and sloped zone as priority	As directed	□ Plants surviving (no thriving) during extreme drought	□ No watering of bottom area during extreme drought for over four weeks				
Facility after Earthquake	□ Earthquake of Richter Magnitude 5.0 or greater	—			□ Check pipes, maintenance holes, bioretention swales for settlement, slumps, cracks, seeps and leakage □ Report observations and discuss next steps	As directed						
Facility after Car Accident/Car Enters Facility	□ Damage to facility caused by vehicle	—			□ Check facility, including structures, soil and vegetation, for damage. □ Report observations and discuss next steps for repair	As directed						
A. Facility Footprint												
A1	□ Erosion	March and September			□ Repair erosion damage, If channels are minor (less than 3 inches deep or wide) they can be filled with 3 inches of mulch. □ Remedy cause - causes may include excessively steep slopes, water velocity, water flow and lack of vegetation cover □ If repeated erosion occurs install rounded cobblestones at top of erosion channel without blocking stormwater flow into facility	As directed	□ Erosion gullies are between 1 inch and 3 inches deep or wide	□ Erosion gullies are greater than 3 inches deep or wide	□ Erosion gullies are greater than 3 inches deep or wide			
	□ Soil protection during maintenance	March			□ Perform maintenance work when soils are dry to prevent compaction and damage to soil structure □ For extensive maintenance place boards to step on to avoid foot compaction.	Every visit						
Soils	□ Settlement	March			□ In Zones 3, 4 add mulch when settlement is 2 inches or less □ When settlement is more than 2 inches, adjacent to pavement, more than 4 inches, in pipe outfalls and grates, and more than 6 inches at lower slopes and bottom areas, remove plants and mulch and add biofiltration soils to 2 inches below adjacent pavement or landscape area, replace plants. Add mulch to Zones 3 & 4 to finish work. □ In Zone 1, add mulch to the level of adjacent pavement, curbs, or remaining mulched areas □ Maintain design width of compacted shoulder (18 inches min.)	As directed	□ Adjacent to pavement, maintenance holes and at crossings: settlement is less than 2 inches □ Adjacent to pipe outfalls and overflow structures: settlement is less than 4 inches □ Lower slopes and bottom areas: settlement is less than 6 inches	□ Adjacent to pavement, maintenance holes and at crossings: settlement is less than 2 inches or greater □ Adjacent to pipe outfalls and overflow structures: settlement is 4 inches or greater □ Lower slopes and bottom areas: settlement is 6 inches or greater				
	□ Water is not draining 24 hours after storm and after routine soil remediation is performed □ Sediment accumulation more than 2 inches				□ Attempt to identify clogging issue and remedy source of sediment □ Check cleanouts/observation ports for standing water □ Remove plants and mulch in areas clogged by sediment □ See D. Vegetation below for difficult plants to remove □ Remove and replace soil to 6 inches depth □ Apply mulch to match the level of surrounding area □ Do not work soil when saturated	As directed	□ Soils free draining	□ Ponding water 24 hours after rain event				

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	OPERATIONS			MAINTENANCE			PERFORMANCE STANDARD			ADDITIONAL INFO	
	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)	Comments Special Issues			
A. Facility Footprint (cont.)											
A2 Earthside slopes, berms and top slope level areas.	<input type="checkbox"/> Downstream face of berm wet (seeps or leaks)	September		<input type="checkbox"/> Fill and compact surrounding soil. <input type="checkbox"/> Report compaction seeps and discuss next steps.		As directed	<input type="checkbox"/> No visible sign of seeps or saturated zones for extended period more than 3 days	<input type="checkbox"/> Side slopes are saturated with many visible seeps or leaks.			
A3 Check dams	<input type="checkbox"/> Failures <input type="checkbox"/> Undercutting	September		<input type="checkbox"/> Repair and remedy undercutting <input type="checkbox"/> Restore failed dams <input type="checkbox"/> If repair approach is unknown, report and discuss next steps		As directed	<input type="checkbox"/> There are significantly damaged check dams and weirs. <input type="checkbox"/> Check dams appear shifted, not level or seem off from original position	<input type="checkbox"/> There are significantly damaged check dams and weirs. <input type="checkbox"/> There is significant undercutting. <input type="checkbox"/> Check dams appear shifted, not level or seem off from original position			
A4 Weirs	<input type="checkbox"/> Failures <input type="checkbox"/> Undercutting	September		<input type="checkbox"/> Repair and remedy undercutting <input type="checkbox"/> Restore failed weirs <input type="checkbox"/> If repair approach is unknown, report and discuss next steps		As directed	<input type="checkbox"/> There are moderately damaged weirs <input type="checkbox"/> Weir is level.	<input type="checkbox"/> There are moderately damaged weirs <input type="checkbox"/> Weir is level.			
A5 Vertical Walls; Concrete Segmental, Rockery	<input type="checkbox"/> Failures <input type="checkbox"/> Leaning walls <input type="checkbox"/> Gapping at interface with adjacent concrete surface elements <input type="checkbox"/> Cracking in concrete <input type="checkbox"/> Fault or discontinuity in top of wall	September		<input type="checkbox"/> Report structurally failing walls (gapping or any movement of walls) and discuss next steps for repair or replacement <input type="checkbox"/> Patch concrete cracks <input type="checkbox"/> Repair or discontinuity in top of wall with skim coat or grind concrete to smooth transition		As directed	<input type="checkbox"/> Walls are secure with minimal damage, gapping, or movement of walls <input type="checkbox"/> Walls are vertical +/-2 degrees (less than approximately 1/2 inch deflection per foot) <input type="checkbox"/> Gaps at interface with adjacent concrete surface elements are greater than 1 inch wide	<input type="checkbox"/> Significant damage, gapping, or movement of walls <input type="checkbox"/> Walls are leaning +/-2 degrees (more than approximately 1/2 inch deflection per foot) <input type="checkbox"/> Gaps at interface with adjacent concrete surface elements are greater than 1 inch wide			
A6 Ponded Water	<input type="checkbox"/> Water is not draining	March September		<input type="checkbox"/> Check underdrain for standing water and blockages (see Maintenance Holes (MH) Cleanouts and Underdrain Pipes) <input type="checkbox"/> Check drainage structures (CBs, Underdrain MH, Underdrain Pipe, UIC MH, etc.) for blockages. May need suction vacuum. See G. Deep Infiltration for blockage of UIC Well and Drip Drain. <input type="checkbox"/> If underdrain is dry and clear, check for soil compaction and excessive sedimentation <input type="checkbox"/> Remove plants and set aside and cover temporarily - see D. Vegetation below for difficult plants to remove <input type="checkbox"/> Remove sediment plus 2 inches additional soil by hand shovel or with industrial shop vac, vector truck or other <input type="checkbox"/> Hand till compost into surface or aerate if soil is compacted. <input type="checkbox"/> Reinstall plants <input type="checkbox"/> In Zones 3 & 4, place a 1/2 inch mulch <input type="checkbox"/> Do not work soil when saturated		As directed	<input type="checkbox"/> Soil is slightly compacted <input type="checkbox"/> Signs of slower infiltration	<input type="checkbox"/> Soil highly compacted <input type="checkbox"/> Water is ponding more than 24 hours following rain			
B. Inlets/Outlets/Pipes - Surface											
B1 Grates, Trash Racks, Trench Drain Grates, and Drain Curb Cuts	<input type="checkbox"/> Damaged structures	March		<input type="checkbox"/> Check for and report damage to grates, trash racks, trench drain grates, and drain curb cuts		As directed	<input type="checkbox"/> Minimal damage is observed	<input type="checkbox"/> Significant damage is observed			
B2 Catch Basins (CBs) with pipes discharging to swales	<input type="checkbox"/> Damaged structures	September		<input type="checkbox"/> Report damage and discuss next steps for repair		As directed	<input type="checkbox"/> Minimal damage is observed	<input type="checkbox"/> Significant damage is observed			
C. Inlets/Outlets/Pipes - Subsurface											
C1 Storm Drains, Catch Basins (CBs), with pipes discharging to swales	<input type="checkbox"/> Damaged pipe	March September		<input type="checkbox"/> Report damage and discuss next steps for repair <input type="checkbox"/> Video the pipe interior to review the condition		As directed	<input type="checkbox"/> Minimal damage is observed to pipes and flow is not impacted	<input type="checkbox"/> Significant damage is observed to pipes			
C2 Catch Basins (CBs) with pipes discharging to swales	<input type="checkbox"/> Damaged structures	March September		<input type="checkbox"/> Report damage and discuss next steps for repair			<input type="checkbox"/> Minimal damage is observed	<input type="checkbox"/> Significant damage is observed			
C3 Trench Drain	<input type="checkbox"/> Damaged structures	March September		<input type="checkbox"/> Report damage and discuss next steps for repair <input type="checkbox"/> Video the trench drain interior to review the condition			<input type="checkbox"/> Minimal damage is observed	<input type="checkbox"/> Significant damage is observed			
C4 Underdrain Clean Outs	<input type="checkbox"/> Damaged structures	March September		<input type="checkbox"/> Report damage and discuss next steps for repair <input type="checkbox"/> Video the underdrain interior to review the condition			<input type="checkbox"/> Minimal damage is observed	<input type="checkbox"/> Significant damage is observed			
C5 Liners	<input type="checkbox"/> Puncture, tear, cracking or other degradation of liner causing leaks into neighboring buildings	-		<input type="checkbox"/> Report damage and discuss next steps for repair <input type="checkbox"/> Verify if any seepage issues in the area <input type="checkbox"/> If tear location is unknown, discuss next steps. Next steps may include flood test to verify and locate puncture.		As directed	<input type="checkbox"/> Minimal damage to liner (punctures, tears, or cracking) less than 1 inch measured in longest direction <input type="checkbox"/> Water is entering underdrain system.	<input type="checkbox"/> Damage to liner (punctures, tears, or cracking) greater than 1 inch measured in longest direction <input type="checkbox"/> Water is bypassing underdrain system and infiltrating into soils through puncture			
C6 Soil Cells (Silva Cell ®)	<input type="checkbox"/> Pounding <input type="checkbox"/> Atole on edges or surface <input type="checkbox"/> Grade breaks or sloughs	February September		<input type="checkbox"/> Observe and report issues such as pavement cracking in the area or settlement		March September	<input type="checkbox"/> No issues observed	<input type="checkbox"/> Pounding adjacent to soil cell zone			

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	MAINTENANCE				PERFORMANCE STANDARD		Comments Special Issues
	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	Acceptable (Targeted Standard)	
D. Vegetation							
D1 Excessive Vegetation Overgrowth/Plant Species Removal or Replacement	<input type="checkbox"/> Plant blockage of inlets, structures, access or sight lines <input type="checkbox"/> Excessive overgrowth	March September		<input type="checkbox"/> Report condition to manager prior to removal or replacement of vegetation. <input type="checkbox"/> Remove selected plants or replace plant species. Replacement species See below for difficult plants to remove	As directed		<input type="checkbox"/> One or more plant species is crowding out and harming the vitality of other plants <input type="checkbox"/> Plant growth preventing flow <input type="checkbox"/> Plant growth over curbs or over pavement by 6+ inches <input type="checkbox"/> There is significant blockage from plants at drain curb cuts, weirs, CS grates, etc.
D2 Worn or Dead Plants	<input type="checkbox"/> Plant mortality <input type="checkbox"/> Wear due to vehicles or pedestrians	March September		<input type="checkbox"/> Report condition to manager prior to removal or replacement of vegetation. <input type="checkbox"/> Remove selected plants or replace plant species. <input type="checkbox"/> Replacement species must meet height restrictions. <input type="checkbox"/> Take note of liner locations to prevent puncturing of liner. Cells with liners are designed with specific locations to accommodate trees and large shrubs <input type="checkbox"/> See below for difficult plants to remove	As directed	<input type="checkbox"/> 25% or less of plant material is dead <input type="checkbox"/> Impacted by pedestrians or vehicles	<input type="checkbox"/> More than 25% of plant material is dead. Large groupings of plant species are dead.
D3 Plant Health	<input type="checkbox"/> Diseased plants <input type="checkbox"/> Unhealthy Plants	March September		<input type="checkbox"/> Report condition to manager prior to removal or replacement of vegetation. <input type="checkbox"/> Replace fragile/worn species with more durable species or if small area (4'x8') in Zones 3 & 4 fill in spot with arborist wood chip mulch	As directed	<input type="checkbox"/> Less than 20% of plants species at high traffic areas are impacted by pedestrians or vehicles	<input type="checkbox"/> More than 20% of plants species at high traffic areas are impacted by pedestrians or vehicles
D4 Weeds	<input type="checkbox"/> Weed Infestation <input type="checkbox"/> Trees blocking pedestrian movement or sightlines	March September		<input type="checkbox"/> Look for plants to have a color, growth habit and character not typical of their species. Spotting, rust, blackened leaves and other irregularities can be signs of disease. <input type="checkbox"/> Use care such as keep diseased plants and their soil separate so as to minimize the spread of disease or track any soil or plant material from site of diseased plants to other areas of site. <input type="checkbox"/> Before using equipment begin clean and disinfect any equipment used to remove, handle, or transport any diseased plant material or soil. <input type="checkbox"/> Any whole diseased plants and all plant material removed from plants that appear to be diseased should be removed from site and disposed of in commercial compost or landfill, to avoid risk of spreading the disease to other plants. Pay particular attention to potentially disastrous coniferous trees, especially cypress and cedar.	As directed		<input type="checkbox"/> 25% or less of plant material is diseased or unhealthy
D5 Trees	<input type="checkbox"/> Trees in right of way that are underoverhanging trees on private property <input type="checkbox"/> Street Trees	March September		<input type="checkbox"/> Report multiple dead and dying plants with suspected causes of death <input type="checkbox"/> Review water coverage and condition of irrigation system <input type="checkbox"/> Coordinate removal and replacement of dead and dying plants within 30 days <input type="checkbox"/> Replacement vegetation shall be of equal size, conditions, and variety (when appropriate) to original plantings <input type="checkbox"/> Confirm that as-built conditions are appropriate for species planted there	As directed	<input type="checkbox"/> Less than 20% of the vegetation are weeds <input type="checkbox"/> Trees do not block pedestrian movement or sightlines	<input type="checkbox"/> More than 20% of the vegetation are weeds <input type="checkbox"/> Trees block pedestrian movement or sightlines
D6 Plants Difficult to Remove or Dig Up	<input type="checkbox"/> Species that are difficult to remove for maintenance	*		<input type="checkbox"/> Prune for clearance as needed to maintain 8 feet at sideleaves and 14 feet over road. Prune culverts to have 3-4 feet of clearance at base. <input type="checkbox"/> If tree is overhanging the ROW and blocks pedestrian movement or sightlines trim or cut down. <input type="checkbox"/> Report if tree is blocking signage or lighting at facility. Coordination with homeowner is required prior to pruning of trees on private property.	As directed		<input type="checkbox"/> Trees on private property do not block pedestrian movement or sightlines
				<input type="checkbox"/> Some species, such as Juncus, may be challenging to remove <input type="checkbox"/> First, try using a sharp shovel or knife <input type="checkbox"/> Power equipment may be required - take care not to puncture lined cells		<input type="checkbox"/> Plants are removed without damaging other components <input type="checkbox"/> Plants are removed damages other components	<input type="checkbox"/> Problem plants are not able to be removed <input type="checkbox"/> Plants are removed damages other components

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OFF-WAY

GSI Facility Component	OPERATIONS			MAINTENANCE			PERFORMANCE STANDARD			ADDITIONAL INFO	
	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)			Comments	Special Issues
E. Mulch											
E1	Mulch	Clogged Sediment build up/Visibly dirty	3 to 5 years	<ul style="list-style-type: none"> <input type="checkbox"/> Weed area <input type="checkbox"/> Rake out 2- 3 inches of mulch from between plants small cells to expose the soil; haul off old mulch <input type="checkbox"/> Weed area again <input type="checkbox"/> In Zones 3 & 4 Add arborist wood chip mulch <input type="checkbox"/> For large cells vacuum removal may be utilized with care to protect plants and smaller cobble or gravel 	preferably in early fall	<ul style="list-style-type: none"> <input type="checkbox"/> Replaced arborist wood chip mulch improves permeability 	<ul style="list-style-type: none"> <input type="checkbox"/> Do not replace with fresh compost to avoid triggering flushing <input type="checkbox"/> Do not replace with medium or fine grade bark mulch due to fines tending to hold water from penetrating soil. 				
F. Watering											
F1	Irrigation system	<ul style="list-style-type: none"> <input type="checkbox"/> Certified irrigation audit <input type="checkbox"/> Watering schedule and rate 	Every 3 Years	<ul style="list-style-type: none"> <input type="checkbox"/> Conduct certified irrigation audit <input type="checkbox"/> Adjust controller schedule to reflect the site's exposure, plants water requirements, planter size, etc. so that plants are neither over nor under-watered and are not stressed nor wilted <input type="checkbox"/> Water the plants infrequently but deeply to encourage root growth 	Every 3 Years	<ul style="list-style-type: none"> <input type="checkbox"/> Irrigation system is working, a few broken parts. Coverage is slightly uneven. Cap broken equipment or lines and hand water until system is repaired. <input type="checkbox"/> Plants are neither over nor under-watered and are not stressed nor wilted 	<ul style="list-style-type: none"> <input type="checkbox"/> Irrigation system is not working (e.g. coverage is uneven; areas unusually dry or wet; soils washed out) <input type="checkbox"/> Plants are being overwatered and there is excess plant and weed growth <input type="checkbox"/> Plants are being underwatered and plants are stressed or wilted 	<ul style="list-style-type: none"> <input type="checkbox"/> Irrigation system needs immediate repair. <input type="checkbox"/> System needs immediate repair. 			
F2	Watering Replacement Trees and Plants	<ul style="list-style-type: none"> <input type="checkbox"/> Supplemental watering 	-	<ul style="list-style-type: none"> <input type="checkbox"/> If there is no irrigation system, hand water plants twice a week during the dry weather until they are established <input type="checkbox"/> In drought condition such as no rain for 30 days, established trees and shrubs should be watered deeply (1 inch), a minimum of 1 time per month <input type="checkbox"/> Use tree watering bags for newly planted trees 		<ul style="list-style-type: none"> <input type="checkbox"/> Newly installed plants are watered until they are established <input type="checkbox"/> In drought conditions water mature trees 	<ul style="list-style-type: none"> <input type="checkbox"/> Newly installed plants are not adequately watered and become stressed, more susceptible to pests and disease and death 				

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OFF-WAY

GSI Facility Component	MAINTENANCE				PERFORMANCE STANDARD		Comments Special Issues
	OPERATIONS	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	(Maintenance Trigger Corrections/Improvements Required)
G. Deep Infiltration (over 6 Feet) and/or Underground Injection Control (UIC) Wells for deep infiltration of treated stormwater							
G1 UIC Screen Well	<input type="checkbox"/> Wall Screen Rehabilitation <small>deemed necessary based on routine monitoring, video survey, and/or inflow testing.</small>	~ Year 5 to 10			<input type="checkbox"/> Downhole video survey of the well screen <input type="checkbox"/> Qualified personnel to assess condition of well screen <input type="checkbox"/> Record rehabilitation techniques <input type="checkbox"/> Flow test following rehabilitation		<input type="checkbox"/> The specific capacity of the well has improved to between 90 to 100% from last established capacity, or as determined acceptable by the Project Engineer.
	<input type="checkbox"/> Partial Pit Drain Rehabilitation	~ Year 10 or when bio retention soils are replaced			<input type="checkbox"/> Pump water from facility or temporarily divert water from facility by plugging inlet, if necessary <input type="checkbox"/> Remove overburden atop pit drain areas with vector truck (vegetation, compost, beretonent soil, conveyance trench) <input type="checkbox"/> Provide shoring as required <input type="checkbox"/> Remove areas of media backfill within the pit drain using a vector truck to a depth where sediment within the aggregate is no longer encountered <input type="checkbox"/> Rake side walls of excavated pit drain sidewalls with garden rake or similar tool to remove sediment lines <input type="checkbox"/> Protect exposed pit drain aggregate with plastic sheeting or geotextile prior to backfilling sidewalls and remove materials after completion <input type="checkbox"/> Replace media backfill to the elevations shown in the Record Drawings <input type="checkbox"/> Record rehabilitation techniques <input type="checkbox"/> Perform flow test following rehabilitation	<input type="checkbox"/> As directed	<input type="checkbox"/> Flow test after partial rehabilitation meets project-specific pit drain infiltration performance requirements <input type="checkbox"/> Flow test after partial rehabilitation does not meet project-specific pit drain infiltration testing performance requirements
	<input type="checkbox"/> Full Pit Drain Rehabilitation	~ Year 20 or when bio retention soils are replaced			<input type="checkbox"/> Construct new pit drain per the details in the original Record Drawings <input type="checkbox"/> Remove overburden atop pit drain areas with vector truck (vegetation, compost, beretonent soil, conveyance trench) <input type="checkbox"/> Provide shoring as required <input type="checkbox"/> Fully remove all media backfill material <input type="checkbox"/> For horizontal pit drains, rake side walls of excavated pit drain sidewalls with garden rake or similar tool to remove sediment fines <input type="checkbox"/> Excavate or drill below base of original pit drain until soil that has been plugged with sediment is fully removed <input type="checkbox"/> Replace media backfill to the elevations shown in the Record Drawings <input type="checkbox"/> Record replacement techniques <input type="checkbox"/> Perform flow test following replacement	<input type="checkbox"/> As directed	<input type="checkbox"/> Flow test after replacement meets project-specific performance requirements, typically no standing water observed in facility 12 hours after a large storm event (based on 24 hour drawdown time and safety factor of 2)
G2 Pit Drains					<input type="checkbox"/> As directed		<input type="checkbox"/> Flow test after replacement meets project-specific performance requirements, typically no standing water observed in facility 12 hours after a large storm event (based on 24 hour drawdown time and safety factor of 2)
	<input type="checkbox"/> Pit Drain Replacement				<input type="checkbox"/> As directed		<input type="checkbox"/> Flow test after replacement meets project-specific performance requirements, typically no standing water observed in facility 12 hours after a large storm event (based on 24 hour drawdown time and safety factor of 2)

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OFF-WAY

GSI Facility Component	OPERATIONS			MAINTENANCE			PERFORMANCE STANDARD			ADDITIONAL INFO	
	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)	Comments Special Issues			
G. Deep Infiltration (over 6 Feet) and/or Underground Injection Control (UIC) Wells for deep infiltration of treated stormwater											
G3	□ Partial Drilled Drain Rehabilitation deemed necessary based on routine monitoring, video survey, and/or inflow testing.	~ Year 10		□ Pump water from drilled drain, if necessary □ Contact owner for well screen or pipe rehabilitation □ Perform flow test following rehabilitation □ Report if target performance standard not achieved. Full drilled drain replacement or new drilled drain may be required.		As directed	□ The specific capacity of the well has improved to between 90 to 100% from last established capacity, or as determined acceptable by the Project Engineer.	□ The specific capacity of the well still shows a decline greater than 10% of last established capacity, or from capacity determined acceptable by the Project Engineer.			
	□ Full Drilled Drain Rehabilitation	~ Year 20		□ Remove sand layers, media backfill material, and wall screen □ Rebuild with cleaned well screen, new backfill material, and sand layers □ Flow test following rehabilitation □ Report if target performance standard not achieved. Drilled drain replacement may be required.		As directed	□ The specific capacity of the well has improved to between 90 to 100% from last established capacity, or as determined acceptable by the Project Engineer.	□ The specific capacity of the well still shows a decline greater than 10% of last established capacity, or from capacity determined acceptable by the Project Engineer.			
	□ Drilled Drain Replacement	As directed		□ Remove sand layers, media backfill material, and wall screen □ Overdrill side walls and drill below base of original drilled drain until soil that has been plowed with sediment is fully removed □ Rebuild with new well screen, backfill material, and sand layers □ Flow test following replacement □ Report if target performance standard not achieved. GSI facility may require abandonment as directed by the Project Representative.		As directed	□ The specific capacity of the well meets the original design performance requirements.	□ The specific capacity of the well does not meet the original design performance requirements.			
	H. Hardscape										
H1	Paved Pathways and Public Sidewalks	□ Uplifted surface □ Cracks	September	□ Repair grade changes with skim coat or shim, or grind concrete for smooth transition □ Patch concrete cracks □ Report if sidewalk section requires replacement		As directed	□ There are grade changes or spurious fissures less than 1 inch. Cracks are less than 1 inch wide. The surface is moderately smooth.	□ There are grade changes or upheavals greater than 1 inch. Cracks are greater than 1 inch wide. The surface is very uneven or rough.			
I. Pest Control											
I1	Mosquitoes	□ Mosquitoes □ Water is not draining (See Pored Water)	July August	□ Report to manager and non-draining swales		As directed	□ Standing water observed in the basin for long periods suitable for insect development (designed to drain in 24 hours)	□ Standing water observed in the basin for long periods suitable for insect development (designed to drain in 24 hours)			
I2	Nuisance Animals	□ Nuisance animals □ Rodent Holes	March September	□ Remove all trash, fruit, and nuts that have fallen to the ground to avoid attracting rodents □ Fill rodent holes with soil and lightly compact soil around the holes □ Reposition plants away from the holes		As directed	□ Few or no rodent holes are present. □ Impacted plants are repositioned to avoid repaired impact/damage	□ Nuisance animals are digging holes, causing erosion, damaging plants or depositing large volumes of feces			
I3	Insect Pests	□ Insect pests	March September	□ Remove diseased and dead plants □ Follow Integrated Pest Management (IPM) protocols		As directed	□ A few signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	□ Significant signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators			
I4	Spill Response	□ Spills	—	□ Immediately report to manager spills and any contaminants found in facility areas, pipes and structures (paint, oil, gas, antifreeze, or other spilled/dumped pollutants) □ Block drain curb cuts, drain structures (inlets, outlet, CBs, culverts) to prevent spill from flowing into biofiltration or onto porous pavements □ Immediately clean spills associated with work in accordance with SPU's Spill Plan. SPU to assess conditions and determine if full/partial biofiltration cell and/or porous pavement replacement is required. □ Record and report to manager the license number if a vehicle is associated with spill.		As directed					

MAJOR CORRECTIVE ACTION AND LONG-TERM MAINTENANCE GUIDANCE FOR GSI IN THE RIGHT-OF-WAY

GSI Facility Component	OPERATIONS			MAINTENANCE			PERFORMANCE STANDARD			ADDITIONAL INFO
	Observation or Troubleshooting	Frequency	Est. Crew Hours	Maintenance Activity (Crew)	Month (typical)	Acceptable (Targeted Standard)	Unacceptable (Maintenance Trigger Corrections/Improvements Required)	Comments Special Issues		
J. Utility Service Lines										
K. Permeable Pavement Facility										
J1 Utility service lines	<input type="checkbox"/> Service line repair by homeowner or other.	—	—	<input type="checkbox"/> Provide appropriate information so repairs can be made to like conditions and maintain function.	—	—	—	—		
K1 Pavement Condition	<input type="checkbox"/> Pavement is cracked, spalling, raveling	1x year	—	<input type="checkbox"/> Provide appropriate information so repairs can be made to like conditions and maintain function.	—	—	—	—		
K2 Areas Adjacent to Porous Pavement that drain onto porous	<input type="checkbox"/> Check if adjacent areas are stabilized. Not exposed soil.	1x year	—	<input type="checkbox"/> Previous concrete: Sawcut panelportion of panel and replace with pervious concrete	—	—	—	—		
K3 Underdrain pipe	<input type="checkbox"/> Water is not draining out of underdrain pipe after rain event. Observation port is observed in underdrain system.	1x year	—	<input type="checkbox"/> Porous asphalt: Sawcut and patch with conventional HMA. Use open graded aggregate for subbase (same as in GSI facilities for porous). Take appropriate measures to prevent adjacent porous pavement from becoming clogged during repairs of the pavement	—	—	—	—		
K4 Spill Response	<input type="checkbox"/> Spills	—	—	<input type="checkbox"/> Remove debris, soil that has deposited onto the pavement	—	—	—	—		
K5				<input type="checkbox"/> Mulch and/or plant exposed soils that may erode to pavement surface	—	—	—	—		
L. Hardscape Specialty Elements										
L1 Step Out Zones, Curb Edges, Access	<input type="checkbox"/> Much settlement greater than 2 inches	March	September	<input type="checkbox"/> See A. Facility Footprint for settlement	March	September	<input type="checkbox"/> See A. Facility Footprint for soil settlement	<input type="checkbox"/> See A. Facility Footprint for soil settlement		
	<input type="checkbox"/> Gravel settlement greater than 2 inches	March	September	<input type="checkbox"/> Remove gravel. Add and compact soil to 2 inches below adjacent pavement. Replace gravel to 1 inch minimum compacted depth. Maintain design width of compacted shoulder (2 feet min.)	March	July	<input type="checkbox"/> Settlement is between 1 and 2 inches	<input type="checkbox"/> Settlement is 2 inches or greater		

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Appendix D: Routine Maintenance - Acceptable / Unacceptable Examples

The purpose of this section is to give O&M staff a general idea of what conditions to look for in the field and to guide their level of service. This document is intended to be filled in or updated as more examples become available.

- Acceptable / Unacceptable Examples:
 - Facility Footprint
 - Surface – Inlets, Outlets, Pipes, Etc.
 - Access and Visibility
 - Vegetation, Mulch and Watering
 - Permeable Pavement, Street Surface, Etc.



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FACILITY FOOTPRINT

SOIL EROSION



Acceptable

Moderate erosion, channelization, or scouring with less than 40% bare spots.



Unacceptable

Heavy erosion, channelization, or scouring with greater than 40% bare spots.

Maintenance Activities

- Fill in erosion channels and clean up washouts
- Install temporary erosion control measures such as rock, check dams or coir rolls
- Add cobbles or other erosion protection measure where concentrated water flows

SETTLEMENT



Acceptable

Adjacent to pavement, maintenance holes and at crossings: settlement is 2" or less.



Unacceptable

Adjacent to pavement, maintenance holes and at crossings: settlement is 3" or greater

Maintenance Activities

- Add wood chip mulch when settlement is 2" or less
- See Major corrective Maintenance Table when settlement is more than 2"

EXCESSIVE EXPOSED SOILS



Acceptable

Bottom zone plant coverage approximately 70%



Unacceptable

Bottom zone plant coverage less than 70%

Maintenance Activities

- Add plants and emergents in bottom area - see GSI Manual Vol. V, Appendix G, for zones 1 and 2 plant list

SEDIMENT ACCUMULATION

WATER IS NOT DRAINING

CHECK DAM



Moderate sediment and water is draining



Heavy sediment and water is not draining

Maintenance Activities

- Observe surface conditions at presettling cell and curb cuts
- See “Water Not Draining” for additional actions

Maintenance Activities

- Check cleanouts/observation ports for standing water - see Underdrain System if standing water observed in parts
 - If no standing water observed in cleanouts or observation ports use pitchfork or aerating tool to aerate soil throughout bottom area of cell
 - Report non-draining swales



Soils free draining with no standing water observed 72 hours after storm event



Soils appear compressed and ponding observed 72+ hours following rain period



Moderate blockage, trash, debris, sediment and fall leaf litter at check dam



Heavy trash, debris, sediment and fall leaf litter at check dams

Maintenance Activities

- Pull out rock or cobbles to remove surface blockages, debris, sediment and fall leaf litter, then reinstall rock cobble check dam

FACILITY FOOTPRINT

WEIRS



Acceptable

Moderate blockage at weirs; boulders weirs are intact and relatively level; weir plates are attached



Unacceptable

Heavy blockages, trash, debris, sediment and fall leaf litter; check and report damaged or unlevel boulder weirs

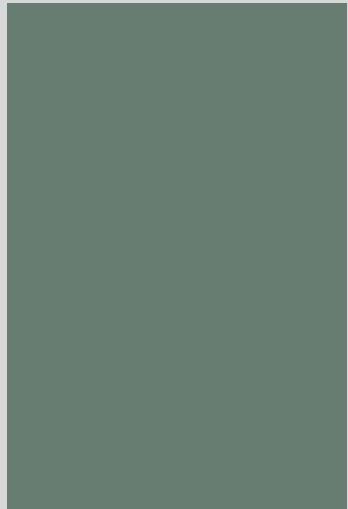
Maintenance Activities

- Check and report damaged or unlevel boulder weirs
- Remove surface blockages, debris, sediment and fall leaf litter
- Check that weir plates are secure and reattach as needed
- Clear vegetation so 4" to 6" weir surface is visible



Acceptable

Moderate blockage at weirs; boulders weirs are intact and relatively level; weir plates are attached



Unacceptable

Heavy blockages, trash, debris, sediment and fall leaf litter; check and report damaged or unlevel boulder weirs

Maintenance Activities

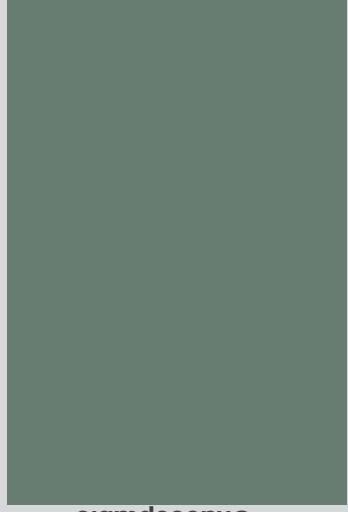
- Check and report damaged or unlevel boulder weirs
- Remove surface blockages, debris, sediment and fall leaf litter
- Check that weir plates are secure and reattach as needed
- Clear vegetation so 4" to 6" weir surface is visible

WEIRS



Acceptable

Moderate blockage at weirs; boulders weirs are intact and relatively level; weir plates are attached



Unacceptable

Heavy blockages, trash, debris, sediment and fall leaf litter; check and report damaged or unlevel boulder weirs

Maintenance Activities

- Check and report damaged or unlevel boulder weirs
- Remove surface blockages, debris, sediment and fall leaf litter
- Check that weir plates are secure and reattach as needed
- Clear vegetation so 4" to 6" weir surface is visible

WALLS: CONCRETE/STEEL

Acceptable

Minor cracks in concrete walls; low accumulation of moss

Unacceptable

Displacement of wall at cracks; heavy accumulation of moss that's migrating into vegetation or onto sidewalk

Maintenance Activities

- Report issues
- Remove moss/pressure wash
- See Major Corrective Maintenance Table (Appendix C)

Maintenance Activities

- Report unstable rockery, displacement of wall or major gaps in wall
- Remove moss/pressure wash; weed
- See Major Corrective Maintenance Table (Appendix C)

Maintenance Activities

- Report unstable rockey, displacement of wall or major gaps in wall
- Remove moss/pressure wash
- See Major Corrective Maintenance Table (Appendix C)

WALLS: SEGMENTAL BLOCKS, GABION & ROCKERY

Acceptable

Separation of joints in segmental walls of 1/4" 3 ft apart; low accumulation of moss

Unacceptable

Displacement of wall at joints; weeds coming through joints; heavy accumulation of moss that's moving into vegetation or onto sidewalk

Maintenance Activities

- Report unstable rockery, displacement of wall or major gaps in wall
- Remove moss/pressure wash; weed
- See Major Corrective Maintenance Table (Appendix C)

Maintenance Activities

- Report unstable rockey, displacement of wall or major gaps in wall
- Remove moss/pressure wash
- See Major Corrective Maintenance Table (Appendix C)

MECHANICALLY STABILIZED EARTHWALL (MSE)

Acceptable

Separation of joints in segmental walls of 1/4" 3 ft apart; low accumulation of moss

Unacceptable

Displacement of wall at joints; weeds coming through joints; heavy accumulation of moss that's moving into vegetation or onto sidewalk

Maintenance Activities

- Report unstable rockey, displacement of wall or major gaps in wall
- Remove moss/pressure wash
- See Major Corrective Maintenance Table (Appendix C)

SURFACE - INLETS, OUTLETS, PIPES, ETC.

DRAIN CURB CUTS



Acceptable

Minor trash, debris and sediment at drain curb cuts because these are the primary points of water entry



Unacceptable

PLANT BLOCKAGE



Acceptable

Minor blockage from plants at drain curb cuts, weirs and CB grates



Unacceptable

Heavy blockage from plants at drain curb cuts, weirs and CB grates

Maintenance Activities

- Remove surface trash debris, sediment and fall leaf litter
- Remove blockages
- Remove thick vegetation
- Replace or add cobbles for free draining to bottom

Maintenance Activities

- Report problem prior to removal or replacement of problem vegetation
- Maintain 1 ft zone clear of vegetation around all inlets and outlets
- See Major Corrective Table (Appendix C) for difficult plants to remove

PLANTER INLETS AT SIDEWALKS



Acceptable

Minor damage to wall opening less than 5" wide



Unacceptable

Opening plugged with leaf/debris; Heavy damage to wall opening

Maintenance Activities

- Remove any blockages
- Report if exposed opening exceeds 5"
- See Major Corrective Maintenance Table

SURFACE - INLETS, OUTLETS, PIPES, ETC.

TRENCH DRAIN GRATES



Moderate trash, debris and sediment at trench drain grates



Heavy trash, debris and sediment plugging trench drain grates

Maintenance Activities

- Remove surface trash debris, sediment and fall leaf litter from trench
- Clean discharge point

Maintenance Activities

- Reset cobble at base of weirs and grates
- See Routine Maintenance for Vegetation blockage

BOULDERS, COBBLES, ETC.

PRESETTLING AREAS



Minor blockage



Unacceptable



Acceptable

Moderate trash, debris and sediment at discharge pad zone, minor damage to presetting pad



Unacceptable

Heavy trash, debris and sediment at entry points and settling or energy pad zones

Maintenance Activities

- Remove surface trash debris, sediment and leaf litter
- Add cobbles as needed

SURFACE - INLETS, OUTLETS, PIPES, ETC.

FEBRUARY 2020

GRATES & TRASH RACKS



Acceptable

Moderate trash, debris and sediment at grates and trash racks



Unacceptable

Heavy trash, debris and/or sediment at CB grates and trash racks

Maintenance Activities

- Remove surface trash debris, sediment and leaf litter
- If damaged, See Major Corrective Maintenance Table (Appendix C)

Maintenance Activities

- Check for and report interior damage to CB
- Check for and remove blockages and sediment from storm drain pipes
- Remove sediment build-up and/or obstructions from catch basin sump if more than 6 inches or blocking pipes

CATCH BASINS WITH PIPES DISCHARGING TO SWALES



Acceptable

Moderate sediment at upstream CBs and storm drains discharging to swales



Unacceptable

Heavy sediment, blockage and/or major damage to pipe

Maintenance Activities

- Check for and report interior damage to CB
- Check for and remove blockages and sediment from storm drain pipes
- Remove sediment build-up and/or obstructions from catch basin sump if more than 6 inches or blocking pipes

ACCESS AND VISIBILITY

ACCESS EDGE



Curb side: width of compacted shoulder is 24" +/-; Shoulder has weed cover of less than 25%; Minor debris in curb inlet



Curb side: width of compacted shoulder is less than 12"; vegetation growing in the road shoulder or plants overhanging into the shoulder more than 12"

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match
- Reset uneven pavers
- Weed between pavers

PEDESTRIAN ACCESS AT CURB EDGE



Curb side: width of compacted shoulder is 24" +/-; Shoulder has weed cover of less than 25%; Less than 20% of paver joints contain weeds



Curb side: width of compacted shoulder is less than 12"; vegetation growing in the road shoulder or plants overhanging into the shoulder more than 12"; More than 20% of paver joints contain weeds

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match
- Reset uneven pavers
- Weed between pavers

VISIBILITY/ACCESS



Vegetation is slightly over 24" at intersections and sight clearance zones

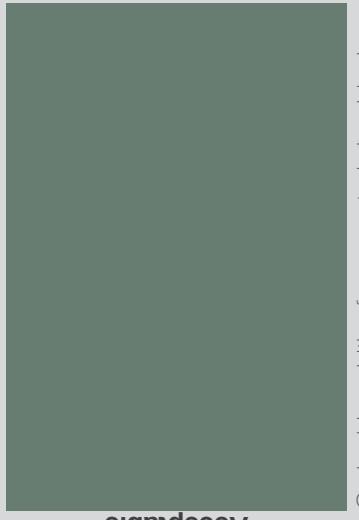


Vegetation is over 24" at intersections and sight clearance zones

- Cut back vegetation for sight clearance
- Clear vegetation within 36" of fire hydrants
- Clear vegetation around maintenance holes for access
- See Major Corrective Table (Appendix C) for Excessive Vegetation

ACCESS AND VISIBILITY

ACCESS PATH



Acceptable

Curb side: width of compacted shoulder is 24"+/-; Shoulder has weed cover of less than 25%



Unacceptable

Curb side: width of compacted shoulder is less than 12"; vegetation growing in the road shoulder or plants overhanging into the shoulder more than 12"

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

ACCESS SIDEWALK



Acceptable

Curb side: width of compacted shoulder is 24"+/-; Shoulder has weed cover of less than 25%



Unacceptable

Curb side: width of compacted shoulder is less than 12"; vegetation growing in the road shoulder or plants overhanging into the shoulder more than 12"

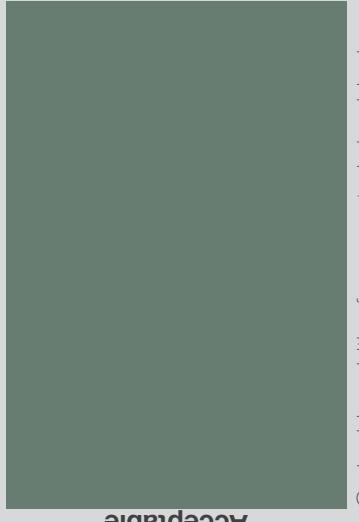
Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

Maintenance Activities

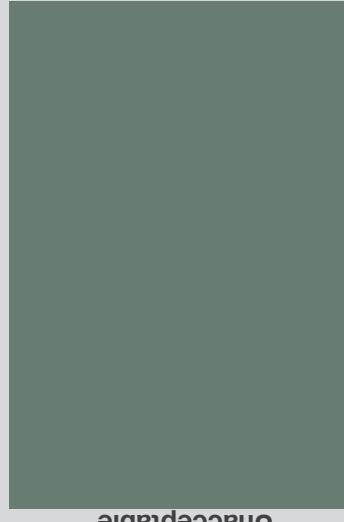
- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

ACCESS



Acceptable

Curb side: width of compacted shoulder is 24"+/-; Shoulder has weed cover of less than 25%



Unacceptable

Curb side: width of compacted shoulder is less than 12"; vegetation growing in the road shoulder or plants overhanging into the shoulder more than 12"

Maintenance Activities

- Prune edges back
- Remove weeds
- Compact soil
- Top dress with mulch to match

VEGETATION, MULCH, AND WATERING

PLANTS AT BOTTOM AREA



Acceptable

Bottom area plant coverage



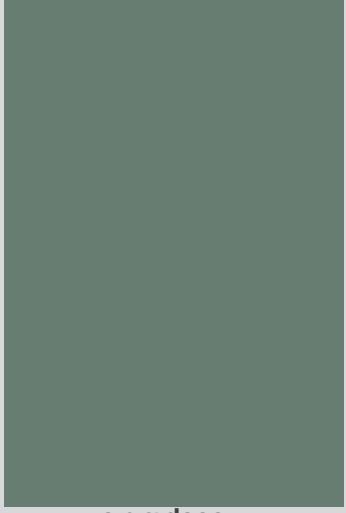
Unacceptable

Fully exposed bottom area

Maintenance Activities

- Inform crews that geotextile fabric may be present under mulch, rocks, cobbles or boulders and to reinstall if encountered
- Check for pullup or unsightly geotextile fabric that may be under cobbles or boulders etc. Reininstall under boulder or cover with mulch. Trim as applicable

SHRUB PRUNING



Acceptable

Low shrubs meet clearance requirements so they do not obstruct sight lines. Minimal pruning



Unacceptable

Shrub pruning is intense and frequently required, shrub block ped, access & visibility; branches do not meet clearance requirements

Maintenance Activities

- Prune overhanging vegetation; remove deadwood
- Prune or thin vegetation for visibility sight lines while maintaining natural shape
- Remove deadwood and crossing branches from shrubs

EVERGREEN GRASSES AND PERENNIALS



Acceptable

Moderate coverage of adjacent plants/ sidewalk by flopping foliage; dead foliage removed in spring



Unacceptable

Evergreen grasses cut back too often and die; heavy coverage of adjacent plants/ sidewalk by flopping foliage; dead foliage not removed in spring

Maintenance Activities

- Hand-rake in spring before new growth emerges
- Cut back to 5-8" from edges
- Thin every 3-5 years as needed
- Cut back flopping foliage to 24" height from ground if foliage falls over onto other plants or sidewalk

VEGETATION, MULCH, AND WATERING

FEBRUARY 2020

DECIDUOUS GRASSES AND EMERGENTS

Acceptable

Deciduous grasses cut back in late winter



Deciduous grasses cut back too early (late fall/early winter) and die; vegetation blocking critical sight lines

- Leave foliage and seedheads however it should be cut back if foliage collapses especially onto other plants or sidewalks or blocks critical sight lines
- Cut back leaving 5-8" in late winter/early spring before new growth emerges

WEEDS

Acceptable

Less than 20% of the vegetation are weeds; less than 5% noxious weeds



More than 20% of vegetation are weeds; more than 5% noxious weeds

- Immediately remove, bag and dispose as garbage; all noxious and invasive weeds
- Mechanically remove weeds with their roots before they go seed
- Apply mulch after first spring and fall weeding (See Appendix E. Mulch)

MULCH

Acceptable

Mulch coverage is more than 80%, at least 2" deep and is not blocking structures or inlets



Mulch coverage is less than 80%, less than 2" deep and/or is blocking structures or inlets

- Weed prior to applying mulch
- Use arborist wood chip mulch only
- Remove mulch within 12" of tree trunk flares
- Add or remove mulch to maintain depth of 2" keeping it back from stems of plants and structures
- Remove mulch that is blocking inlets and structures

PERMEABLE PAVEMENT, STREET SURFACE, ETC.

PERMEABLE PAVEMENT

SIDEWALKS

STREET SURFACE



Acceptable



Unacceptable

Minor amount of soil erosion and/or debris deposited onto pavement

Heavy debris and/or eroded soil on pavement affecting drainage function during rain events; water pond/runoffs

Maintenance Activities

- Vacuum sweep/pressure wash
- Completely cover porous pavement when working on adjacent landscape areas to prevent debris accumulation
- See sidewalk routine maintenance guide



Acceptable



Unacceptable

Less than 40% pavement is covered with moss

More than 40% pavement is covered with moss, with thick moss more than 20%

Maintenance Activities

- Clean pavement



Acceptable



Unacceptable

Moderate road gutter debris on blocks with bioretention facilities

Heavy road gutter debris on Blocks with Bioretention Facilities

Maintenance Activities

- Sweep both curb lines of entire street
- Sweep both curb lines for 1 block of intersecting streets upstream of the bioretention facilities

PERMEABLE PAVEMENT, STREET SURFACE, ETC.

FEBRUARY 2020

WOOD CHIP MULCH/ GRAVEL ACCESS PATHS



Acceptable

More than 20% mulch/gravel is uneven or weedy



Unacceptable

Less than 20% mulch/gravel is uneven or weedy

Maintenance Activities

- Rake or add mulch to level it out - see E. Mulch
- Remove weeds; see vegetation guidance
- Maintain width of design by adding top dressing and recompacting edges

PAVED ACCESS PATHS



Acceptable

Less than 25% pavement covered with moss, debris, leaves and sediment



Unacceptable

More than 25% pavement covered with moss, debris, leaves and sediment

Maintenance Activities

- Clean pavement

PAVER ACCESS PATHS



Acceptable

More than 80% pavers are even and/or less than 20% paver joints with extensive weeds



Unacceptable

Less than 80% pavers are even and/or more than 20% paver joints with extensive weeds

Maintenance Activities

- Report random pavers placed by others
 - Reset uneven pavers
 - Weed between pavers

Appendix E: GSI Maintenance Checklists – Examples SPU and WTD

- Examples:
 - Barton CSO Control Project GSI Surface Facilities Maintenance Checklist for Establishment, July 2015
 - Barton CSO Control Project GSI Storm Drainage System Maintenance Checklist, July 2014
- SPU Checklists TBD*
- WTD Checklists TBD*

*Contact agency's O&M representative for current checklists



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GSI Surface Facilities Maintenance Checklist for Establishment

Barton CSO Control Project with GSI



Street Name (btw streets: intersection to intersection):

Checked By:	Ph:	Date of Last Inspection:	As-Built Plan Available	Yes	No	Date of Site Visit:	Time of Site Visit :
Weather at time of site visit:						<input type="checkbox"/> Does site need maintenance action? (Yes, if condition/fuction Moderate or Low)	Ok <input type="checkbox"/> Action Required <input type="checkbox"/>
Purpose of visit:						<input type="checkbox"/> Does site need follow-up review upon completion of maintenance action (condition moderate or low)?	Ok <input type="checkbox"/> Action Required <input type="checkbox"/>
						<input type="checkbox"/> Rain Precipitation (inches) in last 72 hours (note source for information):	
Drain Structure Inlets, Grates, Curb Cuts & Weirs							
HIGH	MODERATE	LOW					
<input type="checkbox"/> Facility is ready for a storm event: Minor blockage from sediment or vegetation, no damaged structures, and no ponding.	<input type="checkbox"/> Facility is partially ready for a storm event: Moderate blockage from sediment or vegetation, some damaged structures, and/or some ponding.	<input type="checkbox"/> Facility is NOT ready for a storm event: Heavy blockage from sediment or vegetation, many damaged structures, and/or ponding.				Comment:	
<input type="checkbox"/> There is minor blockage from plants at drain curb cuts, weirs, and CB grates.	<input type="checkbox"/> There is moderate blockage from plants at drain curb cuts, weirs, and CB grates.	<input type="checkbox"/> There is heavy blockage from plants at drain curb cuts, weirs, and CB grates.				Comment:	
<input type="checkbox"/> There is minor amount of trash, debris, fall leaf litter or sediment at drain curb cuts, weirs, and CB grates.	<input type="checkbox"/> There is moderate trash, debris, fall leaf litter and sediment at drain curb cuts, weirs, and CB grates.	<input type="checkbox"/> There is heavy amounts of trash, debris, fall leaf litter and sediment at drain curb cuts, weirs, and CB grates.				Comment:	
<input type="checkbox"/> No damaged drain curb cuts, grates or weirs.	<input type="checkbox"/> One or two damaged drain curb cuts, grates or weirs.	<input type="checkbox"/> Several damaged drain curb cuts, grates or weirs.				Comment:	
Paved Paths & Sidewalks							
HIGH	MODERATE	LOW					
<input type="checkbox"/> Less than 25% of pavement is covered with Moss, debris, leaves and sediment .	<input type="checkbox"/> Between 25-40% of pavement is covered with Moss, debris, leaves and sediment .	<input type="checkbox"/> More than 40% of pavement is covered with Moss, debris, leaves and sediment .				Comment:	
<input type="checkbox"/> There are no grade changes, cracks or upheaval. The surface is smooth.	<input type="checkbox"/> There are slight grade changes, cracks or upheaval. The surface is moderately smooth.	<input type="checkbox"/> There are grade changes greater than 1" or significant cracks or upheavals. The surface is uneven or very rough.				Comment:	
Bioretention Soils in Swale							
HIGH	MODERATE	LOW					
<input type="checkbox"/> Minor erosion, channelization or scouring with less than 25% bare spots. Settlement is less than 1 inch.	<input type="checkbox"/> Moderate erosion, channelization or scouring with less than 40% bare spots. Settlement is between 1" and 3" inches.	<input type="checkbox"/> Heavy erosion, channelization or scouring with greater than 40% bare spots. Settlement is greater than 3 inches.				Comment:	
<input type="checkbox"/> Soil is loose, not compacted and water drains within 24 hours and is not ponding.	<input type="checkbox"/> Soil is slightly compacted and/or signs of slower infiltration.	<input type="checkbox"/> Soil highly compacted and water is ponding.				Comment:	
Spill Prevention and Response, and Pest Control							
HIGH	LOW						
<input type="checkbox"/> Exercise spill prevention measures whenever handling or storing potential contaminants. Fertilizers, Herbicides, Fungicides and Insecticides are prohibited in GSI.						Comment:	
<input type="checkbox"/> Clean up spills as soon as possible to prevent contamination of stormwater. See O&M Manual and follow Specification 01560, Environmental Management, for spill prevention and response.						Comment:	
<input type="checkbox"/> Insects: No standing water observed in the basin for time periods suitable for insect development (designed to drain in 24 hours).						Comment:	
<input type="checkbox"/> Rodents: Few or no rodent holes are present.						Comment:	

GSI Surface Facilities Maintenance Checklist For Establishment

Barton CSO Control Project with GSI



Vegetation	HIGH	MODERATE	LOW
<input type="checkbox"/> Minor amount of trash, pet waste, No contaminants.	<input type="checkbox"/> Minor amount of trash, pet waste. No contaminants.	<input type="checkbox"/> Heavy amount of trash, pet waste. No contaminants.	Comment:
<input type="checkbox"/> Little or minor amount of weeds (Less than 15% of the vegetation are weeds). No class A, B, C or non-regulated noxious weeds present.	<input type="checkbox"/> Between 15% and 35% of the vegetation are weeds. Less than 2% noxious weeds present. Goal is for no noxious weeds.	<input type="checkbox"/> Great than 35% of the vegetation are weeds. Greater than 2% noxious weeds present. Goal is for no noxious weeds.	Comment: Estimate percent coverage of representative 10 square foot area.
<input type="checkbox"/> Swale bottom coverage by emergents, vegetation and mulch is 90% .	<input type="checkbox"/> Swale bottom coverage by emergents, vegetation and mulch is between 75% and 100%.	<input type="checkbox"/> Swale bottom coverage by emergents, vegetation and mulch is between 60% and 75%.	Comment:
<input type="checkbox"/> Mulch covers 100% of the swale side slopes and is approximately 3" to 4" deep.	<input type="checkbox"/> Mulch covers at least 70% of the swale side slopes and is at least 2" deep.	<input type="checkbox"/> Mulch covers at least 60% of the swale side slopes or is less than 2" deep.	Comment:
<input type="checkbox"/> Vegetation at intersection is under 24 inches. Vegetation is clear from sidewalk, curbs and ramps. Visibility through planter is good. Perennials and grasses are trimmed. <input type="checkbox"/> Fire hydrant access clearly visible and accessible . <input type="checkbox"/> Pruning: Branches meet clearance over sidewalk (8') over road (14'). Accent shrubs pruned. <input type="checkbox"/> Plants species are growing well together and not blocking drainage. Pruning is easy and not frequently required. No bare spots.	<input type="checkbox"/> Vegetation is slightly over 24 inches at intersection and slightly over 36 inches along swale. Vegetation partially overhangs sidewalk, curbs and/or ramps. Visibility is partially impaired through planter. Perennials and grasses are not trimmed. <input type="checkbox"/> Fire hydrant access clearly visible and accessible . <input type="checkbox"/> Pruning: Branches meet most clearances over sidewalk (8') and road (14'). Accent shrubs need pruning. <input type="checkbox"/> One plant species is overtaking other plants and/or pavement and plants are blocking drainage. Pruning for that species is frequently required. Consider removal of selective plants.	<input type="checkbox"/> Vegetation at intersection is over 24 inches. Vegetation overhangs sidewalk, curbs and/or ramps. Predominant vegetation along swale is over 36 inches and visibility is impaired through planter. Perennials and grasses are not trimmed. <input type="checkbox"/> Fire hydrant access clearly visible and accessible . <input type="checkbox"/> Pruning: Branches do not meet clearance over sidewalk (8') and road (14'). Accent shrubs need pruning. <input type="checkbox"/> More than one plant species is overtaking other plants and/or pavement and plants are blocking drainage. Pruning is intense and frequently required. Consider plant species replacement.	Comment:
<input type="checkbox"/> At least 95% of planted vegetation is healthy and with a generally good appearance. Plants are healthy and growing, minor amount of wilting, spotting, holes in leaves, broken leaders, dead wood , suckers or wood , suckers or branches, trees are plumb. <input type="checkbox"/> Irrigation system is working, no broken heads, equipment or lines. Coverage is even.	<input type="checkbox"/> Between 60%-95% of planted vegetation is healthy and with a generally good appearance. Plants exhibit signs of moderate stress, wilting, spotting or holes in leaves, broken leaders, dead wood , suckers or branches, leaning trees.	<input type="checkbox"/> Less than 60% of planted vegetation is healthy and with a generally good appearance. Plants exhibit signs of significant stress, wilting, spotting or holes in leaves, broken leaders or branches, leaning trees.	Comment: Provide Pictures of Stress or Dead Plants
Other Comments or Issues?	<input type="checkbox"/> Irrigation system is working, a few broken parts. Coverage is slightly uneven. Broken equipment or lines to be capped and hand water until system is repaired.	<input type="checkbox"/> Irrigation system is not working. Coverage is uneven, areas unusually dry or wet. Soils washed out. System needs immediate repair.	Comment: Perform annual backflow test. Startup in spring and winterize in the fall.

Conversations with Home Owners:



GSI Storm Drainage System Maintenance Checklist

Barton CSO Control Project

Street Name (btw streets: intersection to intersection):

Checked By:	Ph:	Email:	Date of Site Visit:	Time of Site Visit :																				
Date of Last Inspection:			As-Built Plan Available Yes <input type="checkbox"/> No <input type="checkbox"/>	Does site need maintenance action? (Yes, if Condition Moderate or Low)																				
Weather at time of site visit:	Does site need follow-up review upon completion of maintenance action?																							
Purpose of visit:	<input type="checkbox"/> Routine Maintenance <input type="checkbox"/> Check swales after rain event <input type="checkbox"/> Check swales before rain event <input type="checkbox"/> Other _____																							
Catch Basins, Drain Curb cuts and Storm Drain Pipes Discharging to Swales <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 15%;">HIGH</th> <th style="text-align: center; width: 15%;">MODERATE</th> <th style="text-align: center; width: 15%;">LOW</th> <th colspan="2"></th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/> There is minimal trash, debris and sediment at drain curb cuts, weirs, and CB grates</td> <td><input type="checkbox"/> There is moderate trash, debris and sediment at drain curb cuts, weirs, and CB grates</td> <td><input type="checkbox"/> There is significant trash, debris and sediment at drain curb cuts, weirs, and CB grates</td> <td colspan="2">Comment:</td> </tr> <tr> <td><input type="checkbox"/> There is none to minimal blockage at drain curb cuts, weirs, pipe outfalls and CB grates</td> <td><input type="checkbox"/> There is moderate blockage at drain curb cuts, weirs, pipe outfalls and CB grates</td> <td><input type="checkbox"/> There is significant blockage at drain curb cuts, weirs, pipe outfalls and CB grates</td> <td colspan="2">Comment:</td> </tr> <tr> <td><input type="checkbox"/> No damage to interior of CB</td> <td><input type="checkbox"/> Minor damage to interior CB</td> <td><input type="checkbox"/> Major damage to interior of CB</td> <td colspan="2">Comment:</td> </tr> </tbody> </table>					HIGH	MODERATE	LOW			<input type="checkbox"/> There is minimal trash, debris and sediment at drain curb cuts, weirs, and CB grates	<input type="checkbox"/> There is moderate trash, debris and sediment at drain curb cuts, weirs, and CB grates	<input type="checkbox"/> There is significant trash, debris and sediment at drain curb cuts, weirs, and CB grates	Comment:		<input type="checkbox"/> There is none to minimal blockage at drain curb cuts, weirs, pipe outfalls and CB grates	<input type="checkbox"/> There is moderate blockage at drain curb cuts, weirs, pipe outfalls and CB grates	<input type="checkbox"/> There is significant blockage at drain curb cuts, weirs, pipe outfalls and CB grates	Comment:		<input type="checkbox"/> No damage to interior of CB	<input type="checkbox"/> Minor damage to interior CB	<input type="checkbox"/> Major damage to interior of CB	Comment:	
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<input type="checkbox"/> There is none to minimal blockage at drain curb cuts, weirs, pipe outfalls and CB grates	<input type="checkbox"/> There is moderate blockage at drain curb cuts, weirs, pipe outfalls and CB grates	<input type="checkbox"/> There is significant blockage at drain curb cuts, weirs, pipe outfalls and CB grates	Comment:																					
<input type="checkbox"/> No damage to interior of CB	<input type="checkbox"/> Minor damage to interior CB	<input type="checkbox"/> Major damage to interior of CB	Comment:																					
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Appendix F: GSI Maintenance Work Order Specification – Example WTD

- Barton CSO Control Project Specification Section 02961 – GSI Surface Facilities Maintenance, January 30, 2014*

*Contact WTD for latest examples of work order specifications.



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SECTION 02961

GSI SURFACE FACILITIES MAINTENANCE

PART 1 GENERAL

1.01 PURPOSE

- A. The primary purpose of the Barton CSO Control Project Facilities is to intercept the stormwater runoff from the street and sidewalks into the bioretention swales for treatment and into the UIC wells for deep infiltration in order to reduce the amount of stormwater flowing into the combined sewer system and causing a CSO event downstream at the Barton pump station. Gutter flow discharges into the bioretention swales via drain curb cuts. Stormwater then filters downward through the bioretention plants and soil for treatment. Once it has been filtered it flows into an underdrain pipe that conveys the flows to a UIC well located in a MH for deep infiltration.

1.02 SUMMARY

- A. This section specifies maintenance of GSI surface facilities to ensure that the facilities function properly for CSO control. Maintenance of the GSI surface facilities includes the drainage grate collection structures and drain curb cuts, paved pathways and sidewalks, swales, vegetation (landscape), irrigation and other miscellaneous items.
- B. This is an inclusive specification for GSI landscape maintenance, but not major repairs.
- C. Do NOT refer to the following specifications:
1. Section 02110 – Site Clearing
 2. Section 02200 – Earthwork
 3. Section 02270 – Erosion and Sediment Control
 4. Section 02900 – Landscaping
 5. Section 02910 – Mitigation Landscaping
 6. Section 02920 – Landscape Soil Materials
 7. Section 02930 – Lawns and Grasses

1.03 REFERENCES

- A. Referenced Standards: This section incorporates documents by reference. These references are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of a listed document, the requirements of this Section shall prevail. Also see section 01012 – Reference Material. For the work related to the Contract, the latest revision of the following are considered reference documents:
- B. See Appendix D – Equipment Manuals
- C. See Appendix E – Draft King County Integrated Pest Management Document
 1. Use of pesticides and herbicides is prohibited.
 2. This reference covers use of natural landscape practices.
- D. See Appendix F – GSI Maintenance Reference List for recommended publications, resources and references
- E. See Appendix H – Project Plans & Link to COS Details
- F. See Appendix G - Checklists
- G. Project Record Drawings for SDOT Project No.163005, SDOT Vault Serial No. 774-991.

1.04 DEFINITIONS

- A. Large Storm Event / Large Storm: 1/2 inch or more rainfall in 24 hours.





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Appendix G: Planting Guidance for Trees and Vegetation

- Figure G-1: ROW Planting Zone diagram for Bioretention Cells with graded side slopes
- Figure G-2: ROW Planting Zone diagram for Bioretention Cells with vertical wall(s)
- Notes and References re. Development of the Bioretention Plant Lists
- Bioretention Plant List for Development of Palettes in the Right-of-Way
 - Part Shade List (*for bioretention cells with graded side slopes*)
 - Sun List (*for bioretention cells with graded side slopes*)
 - Native List (*for bioretention cells with graded side slopes*)
 - Intersection & Sightline List (under 24" Ht.) (*for bioretention cells with graded side slopes*)
 - Plant List for Bioretention Cells with Vertical Wall(s) (primarily Evergreen)
 - Pollinator Plant List
 - Short Term Infill Plant List
 - Vertical Shrubs and Accent Plant List
 - Groundcover Plant List (if low profile is required)
 - Steppable Plants List
 - Low Nutrient Bioretention Soil Mix Plants, Vertical Accent Shrubs and Trees List (*for bioretention cells with graded side slopes*)
- Tree Lists for Bioretention in the Right-of-Way
 - Conifers (Deciduous & Evergreen)
 - Medium/Large Broad-Leaved Evergreen Trees
 - Large Deciduous Columnar Trees
 - Large Deciduous Trees
 - Medium/Large Deciduous Trees
 - Medium Columnar Deciduous Trees
 - Medium Deciduous Trees
 - Small Conifer/Broad-Leaved Evergreen Trees
 - Small Deciduous Trees
- Template for Vegetation Management Plan

Note: The above documents are excerpts from the GSI Manual, Volume III: Design Phase, February 2020 edition. Check SPU's Design Standards and Guidelines for latest edition of the GSI Manual, Volume III if updates are issued after February 2020. See Chapter 8 in SPU's Design Standards and Guidelines for link to current GSI Manual Volume III: Design.

<http://www.seattle.gov/UTIL/Engineering/DSG/index.htm>

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Figure G-1: ROW Planting Zone diagram for Bioretention Cells with graded side slopes

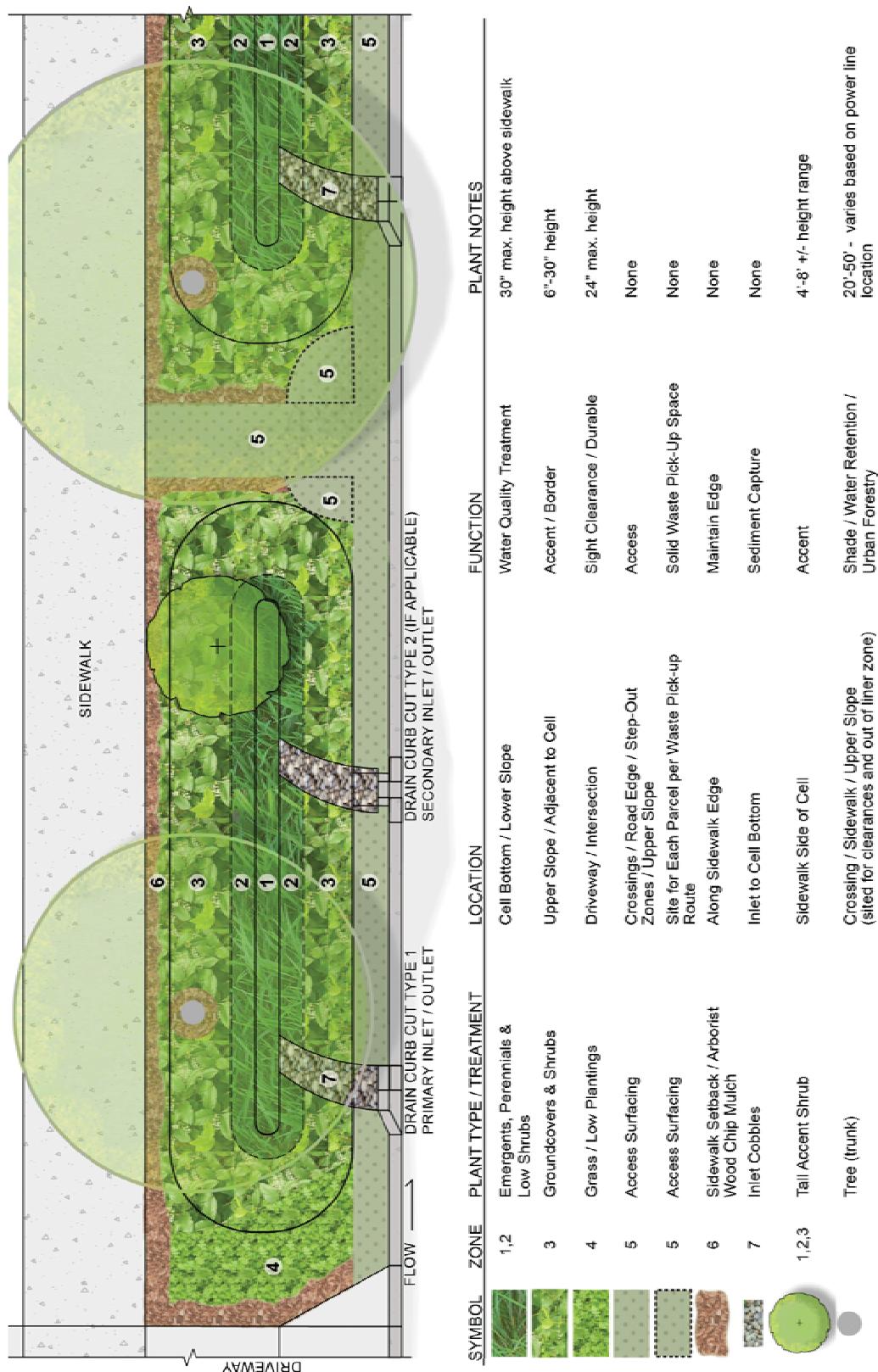


Figure G-2: ROW Planting Zone diagram for Bioretention Cells with vertical wall(s)



NOTES AND REFERENCES REGARDING DEVELOPMENT OF THE BIORETENTION PLANT LISTS

The bioretention plant lists are not intended to be all encompassing but rather bioretention facility plants were selected for the purpose of:

- Facilitating design for specific conditions
- Allowing variety in the streetscape
- Providing some consistency for construction inspectors and O&M staff to gain familiarity with the plants
- Facilitating review and QC
- Providing industry with the list to improve availability
- Addressing the specific requirements of plants within the public right-of-way (e.g. height and sight lines)

The bioretention plant lists and related notes have been developed and updated several times over the past 20 years and are based on feedback from agency discipline staff, O&M staff, horticulturalists, landscape architects, arborists, community members and plant growers. Plants were also reviewed and cross checked across several references, including books and web-based resources. These include but are not limited to:

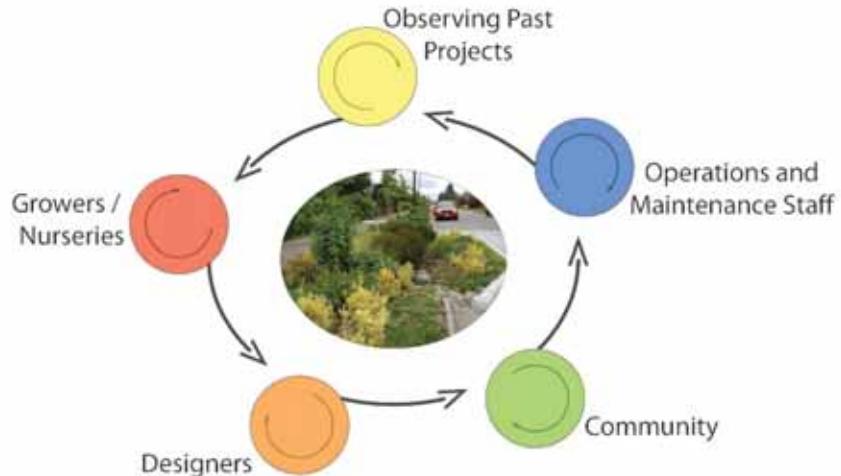


Figure 1. Bioretention Plant Lists Development and Feedback Loop

Book References:

- Attracting Native Pollinators: Protecting North America's Bees and Butterflies. North Adams, MA: Storey Pub., 2011.
- Creso, Irene. Vascular Plants of Western Washington. Tacoma, WA: I. Creso, 1984.
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- Harlow, Nora, and Barrie D. Coate. *Plants and Landscapes for Summer-Dry Climates of the San Francisco Bay Region*. Oakland, CA: East Bay Municipal Utility District, 2004.
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GSI Manual, Vol V: Operations & Maintenance

Appendix

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- Kruckeberg, Arthur R. *Gardening with Native Plants of the Pacific Northwest/ Arthur R. Kruckeberg and Linda Chalker-Scott*. Seattle, WA: University of Washington Press, 2019.
- Neely, Dan, and Gary W. Watson. *Trees and Building Sites: Proceedings of an International Workshop on Trees and Buildings*. Illinois: International Society of Arboriculture, 1995.
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- Pojar, Jim, A. MacKinnon, and Paul B. Alaback. *Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia & Alaska*. Auburn, WA, USA: Lone Pine, 2016.
- Taylor, Jane. *Drought-Tolerant Plants*. NY: Prentice Hall, 1993.
- *The New Sunset Western Garden Book: the Ultimate Gardening Guide*. New York: Sunset, 2012.
- Turnbull, Cass. *Cass Turnbull's Guide to Pruning: What, When, Where & How to Prune for a More Beautiful Garden*. Seattle, WA: Sasquatch Books, 2012.
- Urban, James. *Up by Roots: Healthy Soils and Trees in the Built Environment*. Champaign (Illinois): International Society of arboriculture, 2008.
- Wasson, Ernie. *The Complete Encyclopedia of Trees and Shrubs*. San Diego, CA: Thunder Bay Press, 2003.

Website References:

- American Meadows. <https://www.americanmeadows.com>
- Dave's Garden - Tips and Advice on Outdoor Gardening. <https://davesgarden.com/>
- Gardening for Wildlife. Attract Birds, Butterflies and Small Mammals. <http://www.gardening-for-wildlife.com>
- Gardening in Washington State | Washington State University. 2020. <http://gardening.wsu.edu>
- Great Plant Picks: Unbeatable Plants for the Maritime Northwest Garden. <http://www.greatplantpicks.org>
- Landscape Plants | Oregon State University. <https://landscapeplants.oregonstate.edu>
- Missouri Botanical Garden. Accessed February 24, 2020. <http://www.missouribotanicalgarden.org>
- Monrovia. <https://www.monrovia.com>
- Native Plant Resources for the Pacific Northwest. <https://www.kingcounty.gov/services/environment/stewardship/nw-yard-and-garden/native-plant-resources-nw.aspx>
- Native Plants of North America. Lady Bird Johnson Wildflower Center. <https://www.wildflower.org/plants-main>
- Native Plants PNW. <http://nativeplantspnw.com>
- Right Plant / Right Place. Master Gardener Foundation of King County. <http://www.mgfkc.org/plants/great-plant-finders>
- Sound Native Plants. Ecological Restoration Specialists. <https://soundnativeplants.com>
- Trees and Shrubs for Urban/Suburban Streambank Landscapes. <http://public.wsu.edu/~lohr/StreamsidesLandscapes/Clarks Creek Plant List EXPANDED.pdf>
- U.S. Forest Service. https://www.fs.fed.us/wildflowers/Native_Plant_Materials
- USDA Plants. <http://www.plants.usda.gov>
- Wikipedia. Wikimedia Foundation. <https://www.wikipedia.org>

Prepared by MIG|SvR for the GSI Manual. 2/21/2020



Bioretention Plant List for Development of Palettes in the Right of Way

Notes:

- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SPOT Urban Forestry and Landscape Architecture, SPL/GSI, OKM, SPUSQOT IDT, and KCWTD Water Quality and OEM staff.
- SDOT's Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection or at the upper slopes of the bioretention areas. Zone 1 plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are typically tolerant of both wet and dry conditions. Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in tight clearance areas or as accents at the edge of the facility.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WA Noxious Weed List and WA Dept of Ag Prohibited Plant List.
- Size/Spacing: initial planting of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

- Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are able to be viable in this zone.
- Zone 2 plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in tight clearance areas or as accents at the edge of the facility.
- Zone 5 is the designation for plants used in the crossing zones and access areas along the curb.

Part Shade List (for bioretention cells with graded side slopes)

Guidance Statement: Designer should group plants for maintenance needs to allow ease of pruning and weed control.

Height from Ground		Common Name		Planting Zone	Size/Spacing (see notes)	Exposure	Design Comments	O&M Code	Additional O & M Comments	Abbreviations/legends/O&M Code	
SEM	DT	<i>Abelia grandiflora Prostrata'</i>	Prostrate white astilbe	3.4	1 Gal. / 30° o.c..	:x,:x,:x	Spreading by rhizomes. Place min 3 feet back of curb or sidewalk; min group of 3	E		EG = Evergreen SEM = Semi-Evergreen DT = Drought Tolerant NWN = Northwest Natives or cultivars	
	DT	<i>Aster divaricatus</i>	White wood aster	3	1 Gal. / 24° o.c..	:x	Place min 3 feet back of curb or sidewalk; min group of 3	B	Observe growth habit - height exceeds 3 feet suggest removing		
EG	DT	<i>Carex divisa</i>	European Gray sedge	1.2	10 Cu. In. Plug/ 10' o.c..	:x,:x	(Lower option - ok with wet feet)	DS	Cut back in spring		
EG		<i>Carex elata 'Boyne Golden'</i>	Bowles Golden sedge	1.2	10 Cu. In. Plug/ 10' o.c..	:x,:x	Limit to areas of approx. 36'x36'.	B		:x= Full Sun G= Part Sun/ Part Shade	
EG		<i>Carex fakouensis 'Habib'</i>	Bunny Blue sedge	1.2	2 Cu. In. Plug/ 3 inch pots 10'	:x	Select for shady areas	C		OA = Optional Attention	
EG	DT	<i>Carex obnupta</i>	Slough sedge	1	10 Cu. In. Plug/10' o.c..	:x,:x	Recommend only for wider facilities >12' due to the large and floppy nature. Locate in center of cell. Select adjacent plants that support/enclose the floppy foliage. Do not plant in walled cells as the floppy appearance detracts from residents.	C	Can be sheared more frequently if overcrowding other occurs.		
SEM	NN/N	<i>Carex stipata</i>	Beaked sedge	1.2	10 Cu. In. Plug/ 10' o.c..	:x,:x	Do not plant near intersections. Not recommended for maintenance comments from residents.	B	Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in spring (Mid-January to Mid-March) before new growth emerges.		
EG	NN/N	<i>Carex testacea or dispicea</i>	Orange New Zealand or Autumn Sedge	1.2	10 Cu. In. Plug/ 10' o.c..	:x,:x	Avoid areas with sun and wind as they need water	C	Can be lightly sheared in Spring		
DT	24°-36°	<i>Coronis servia 'Kississ'</i>	Kaleidoscopic dogwood	1.2	5 Gal. / 48° o.c.. 1 Gal. / 24° o.c..	:x,:x	Plant 2 Gall. at 30° o.c., if used to support emerging grasses. May be planted in zone 3 if in a wide cell.	E	Stems fragile until established.		
	36°	<i>Fuchsia magellanica 'Aurea'</i>	Dwarf Hardy Fuchsia	3	2 Gal. / 30° o.c..	:x,:x	Plant 2 Gall. at 30° o.c., if used to support emerging grasses. May be planted in zone 3 if in a wide cell.	E	Dormant in winter		
	<24"	<i>Gaultheria shallon</i>	Giant Snowdrop	3.4	Bulb	:x,:x	Prefers part shade. May be short-lived if too hot.	F			
EG	DT	NN/N	Salal	3	1 Gal. / 24° o.c..	:x,:x	Recommend placement only along sidewalk sides due to potential height or if along streetside place back 4 feet from face of curb. Note groupings as it will spread and may take time to establish.	DS	Salt take 3+ years to get established. If used near a problem, Salt can be applied to 1/2 inches with hedge trimmer.		
EG		<i>Geum (Forsythia) Bazing Sunset'</i>	Blazing Sunset Avens	3.4	1 Gal. / 10° o.c..	:x,:x	Plant in groups for effect and a minimum of 24 inches from curb and 18 inches from sidewalk.	DS	May require trimming back along curbs or sidewalks		
EG		<i>Iris pallida 'Variegata'</i>	Variiegated sweet Iris	3	1 Gal. / 18° o.c..	:x,:x	Plant 30 inches from edge of walk and curb zone	DS	If spreading more than desired thin rhizomes		
EG	DT	NN/N	Mahonia repens	3.4	1 Gal. / 18° o.c..	:x,:x	Mix sizes; Will not do well in heat exposure or in drying winds	E	Requires water during full establishment period		
EG	DR	NN/N	Polystichum munitum	Western swordfern	3	2 Gal. / 24° o.c.. 5 Gal. / 48° o.c..	:x,:x	Limit to group of 5, plant min 3 feet back of sidewalk. Do not plant within 4 feet of curb to allow curb edge (step out zone) and room for 'flop'. There are some cultivars that are smaller but availability varies.	B	It looks messy along walks and curbs, cut back old fronds in winter before new fronds appear. Key plant for winter green color; be cognizant if reports of sword fern pathogens increase.	
EG	DT	24°-36°	<i>Prunus laurocerasus Mount Vernon'</i>	Mount Vernon cherry laurel	3	2 Gal. / 36° o.c..	:x,:x	May be used along edge of dry plants to hold up. Plant 18 inches from top of step out zone.	E	Habit can vary with clones - some plants may need pruning	
EG		36°	Rhododendron Yak Hybrids, such as 'Ken Janeck'	Yak Hybrid	3	2 Gal. / 24° o.c..	:x,:x	Several other Yak hybrids stay low and neat; plant minimum 24 inches from sidewalk	E	OK. May produce more flowers if pruned and/or deadheaded after blooming.	
EG	DT	<24"	<i>Sarcococca hookeriana humilis</i>	Himalayan Sweet Box	3	2 Gal. / 24° o.c..	:x	Winter fragrance; plant 36 inches minimum back of pavement	E	May get leggy, ok to prune	
EG		30"	<i>Taxus Emerald Spreader'</i>	Emerald Spreader Yew	3	2 Gal. / 36° o.c..	:x,:x	Initial spacing tighter for stronger impact	E	prune or remove some plants after 10 years; spreading	
	NN/N	<24"	<i>Tolmiea menziesii</i>	Youth on Age	1.2,3	quart / 18° o.c..	:x	Group in fives	G	if spreading, ok to remove some plants	
EG	DT	<24"	<i>Veronica avansii</i>	Speedwell	3.4,5	4" Pot 12° o.c..	:x,:x	Low groundcover; plant minimum 18 inches back of curb and 12 inches back of sidewalk	E	OK; Cut back for neater appearance.	

Bioretention Plant List for Development of Palettes in the Right of Way

Notes: This plant list was developed to provide consistency in the right of way for installation and long term operations, and maintenance. The trees and plants have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU LID, and KCWDT Water Quality and OEM staff. SDOT's Streets Illustrated recommends tree plantings in rights-of-way. Plant drawings show 30' feet of intersection (as measured from the corner face of the curb) is 24 inches above grade. Plant drawings above curb elevation, the remaining 6' planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of shrubs or spikes that may be higher than noted.

Sun List (for bioretention cells with graded side slopes) Designer should group plants for maintenance needs to allow ease of pruning and weed control.. Bulbs and perennials that are tough, long-lived and minimal maintenance can be added at designer's discretion.												
Guidance Statement: Designer should group plants for maintenance needs to allow ease of pruning and weed control.. Bulbs and perennials that are tough, long-lived and minimal maintenance can be added at designer's discretion.				Design Comments				O&M Code				
Scientific Name		Common Name		Planting Zone	Size/Spacing	Exposure					Abbreviations/Legend/O & M Code	
EG	DT	NNW	Height from Ground									
SEMI		<24"	Asteria grandiflora 'Prostrata'	Prostrate white abelia	3.4	1 Gal / 30' o.c.	⊗, ⊖	Spreading by rhizomes. Place min. 3 feet back of curb or sidewalk; min. group of 3	E			
DT		<24"	Aster novae-angliae 'Wood's Blue'	Wood's Blue New York Aster	3	1 Gal / 18' o.c.	⊗	Place min. 3 feet back of curb or sidewalk; min. group of 3	B, G			
		24"-36"	Carex muskingumensis	Palm sedge	1.2	10 Cu in Plug / 10' o.c.	⊗, ⊖	Limit to areas of approx. 36'-325'.	B			
		24"-36"	Carex elata 'Boyton's Golden'	Bowles Golden Sedge	1.2, 3	10 Cu in Plug / 10' o.c.	⊗, ⊖	Limit to areas of approx. 36'-325'.	B			
		24"-36"+	Carex grayi	Gray's sedge	1.2	10 Cu in Plug / 10' o.c.	⊗, ⊖	Limit to areas of approx. 36'-325'.	B			
NNW		24"-36"	Carex stipata	Beaked sedge	1.2	10 Cu in Plug / 10' o.c.	⊗, ⊖	Limit to areas of approx. 36'-325'.	B			
EG		24"-30"	Carex stans or diseased	Orange New Zealand or Autumn Sedge	1.2, 3	10 Cu in Plug / 10' o.c.	⊗, ⊖	Avoid areas with sun and wind as they need water	C			
DT		24"-36"	Caryopteris incana 'Sunshine Blue'	Sunshine Blue Bluebeard	3.4	1 Gal / 18' o.c.	⊗	Plant 2 Gal. at 30' o.c.; If used to support emergent grasses, May be planted in zone 3	BJDF			
DT		24"-30"	Corinus sericea 'Kelseyi'	Kelsey redstem dogwood	1.2	5 Gal / 48" o.c. 1 Gal / 24" o.c.	⊗, ⊖	Plant 2 Gal. at 30' o.c.; If used to support emergent grasses, May be planted in zone 3	E			
DR		24"-36"	Echinacea purpurea	Coneflower	3	1 Gal / 18' o.c.	⊗	Use irrigation system; plant in groups of 3 min	B			
EG	DT	NNW	24"-36"+	Gaultheria shallon	Salal	3	1 Gal / 24" o.c.	⊗, ⊖	Recommend placement only along sidewalk side due to potential height or if along streetside place back 4 feet from face of curb. Note groupings as it will spread and take time to establish.	E		
EG	DT	NNW	24"-36"	Hebe 'Red Edge'	Red Edge Hebe	3.4	1 Gal / 24" o.c.	⊗	If height is a problem, Salal can be sheared with hedge trimmer	C		
DT		<24"	Heuchera - later flowering varieties	Late Flowering Daylily Varieties	3.4	1 Gal / 15' o.c.	⊗, ⊖	Shear if floppy or too woody	E			
EG	DT		<24"	Geranium x cantabrigiæ Cambridge'	Perennial Geranium	3.4	1 Gal / 15' o.c.	⊗, ⊖	Stems fragile until established.	B		
SEMI	DT		<24"	Helenium 'Herald Brillant'	Sunrose	3.4	1 Gal / 10' o.c.	⊗	Difficult to establish	OA		
EG	DT		24"-36"	Helictotrichon sempervirens	Blue cat grass	3	1 Gal / 18' o.c.	⊗	OA: For neat appearance deadhead.	B		
EG	DT	NNW	<24"	Ilex X 'Morden'	Little Rascal Holly	3.4	1 Gal / 18' o.c.	⊗, ⊖	OA: For neat appearance deadhead.	A		
EG	DT	NNW	<24"	Iris douglasiana	Pacific Coast Iris	3.4	1 Gal / 18' o.c.	⊗	Daybedding not required if even 2-3 years as needed.	B		
SEMI	DT	NNW	<24"	Iris ensiformis	Rocky Mountain Iris	1.2	1 Gal / 12' o.c.	⊗	Daybedding not required if even 2-3 years as needed.	B		
SEMI	NNW	12"-24"	Iris sibirica dwarf cultivars such as 'Baby Sis'/'Sister'	Dwarf Siberian Iris	1.2, 3	1 Gal / 18' o.c.	⊗, ⊖	Daybedding not required if even 2-3 years as needed.	C			
EG	NNW	12"-36"	Juncus balticus	Baltic rush	1	10 Cu in Plug / 10' o.c.	⊗	Daybedding not required if even 2-3 years as needed.	E			
EG	NNW	18"-36"	Juncus effusus 'Quartz Creek'	Quartz Creek Soft Rush	1	10 Cu in Plug / 10' o.c.	⊗	Daybedding not required if even 2-3 years as needed.	G			
EG	NNW	12"-24"	Juniperus communis 'Monteþ'	Alpine carpet Juniper	4, 5	1 Gal / 24" o.c.	⊗	Groups of 3. Many colors available.	G			
EG	NNW	12"-36"	Juniperus conferta 'Blue Pacific'	Blue Pacific Shore juniper	3.4	1 Gal / 3' o.c.	⊗	Groups of 3. Many colors available.	G			
EG	NNW	<24"	Mahonia repens	Creeeping Oregon grape	3.4	1 Gal / 18' o.c.	⊗, ⊖	Note - review use of this with agency O&M staff. This is a smaller version	G			
DR	NNW	36"	Miscanthus sinensis 'Little Kitten'	Little Kitten Maiden Grass	3	1 Gal / 15' o.c.	⊗	Locate in center of plants that will support foliage.	C			
DT	NNW	30"	Nepeta 'Walker's Low'	Catmint	3	1 Gal / 18' o.c.	⊗, ⊖	Locate in center of plants that will support foliage.	C			
EG	NNW	36"	Rhodohieracium 'Yak Hybrids' such as 'Ken Jacobek'	Yak Hybrid	3.4	2 Gal / 30' o.c.	⊗, ⊖	Spreading nature however dry summer months help to control. May go brown in drought conditions.	E			
DT	NNW	24"-36"	Rudbeckia fulgida 'Goldsturm'	Black-Eyed Susan	3.4	1 Gal / 18' o.c.	⊗	May require pruning in edge conditions	E			
EG	NNW	<24"	Sedum 'Autumn Joy' or 'Matrona'	Stonecrop	3.4	1 Gal / 12' o.c.	⊗	May want some water in drought conditions.	C			
DT	NNW	<24"	Solidago canadensis 'Baby Gold' or 'Dazzleberry'	Baby Gold or Little Lemon	3.4	1 Gal / 18' o.c.	⊗	Can be sheared more frequently if foliage collapses. This plant has a spreading nature however dry summer months help to control. May go brown in drought conditions.	G			
NNW	NNW	24"-48"	Spirea 'Betulafolia' or 'Spraysse' 'nebulosa'	Birchleaf spirea	3	1 Gal / 24" o.c.	⊗	May need dividing every few years. Reasons for division include dieback in center and to increase coverage.	A			
EG	NNW	<24"	Sedum 'engelmannii'	Stonecrop	3.4, 5	4" Pot / 12" o.c.	⊗	May require pruning in edge conditions	E			
EG	DT	NNW	<24"	Tectonotis chamaedrys	Wall germander	3.4	1 Gal / 18' o.c.	⊗	Spreading; plant 2 ft back of pavement and 3 feet back of curb	F		
FG	NNW	<24"	Theophrasta resinosa	Thymeleaf Thyme	3.4, 5	4" Pot / 12" o.c.	⊗	Spreading; plant 2 ft back of pavement and 3 feet back of curb	F			



Bioretention Plant List for Development of Palettes in the Right of Way

Notes:

- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SPOT Urban Forestry and Landscape Architecture, SPL/GSI, OKM, SPUSCO, IDT, and KCWTD Water Quality and QA staff.
- SDOT Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection or 30 feet of the curb is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of hedges or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WA Noxious Weed Control Board List and WA Dept of Ag Prohibited Plant List.
- Size/spacing: initial planting of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

Native List - Sun to Part Shade, Includes Cultivars (for bioretention cells with graded side slopes)

Guidance Statement: Designer should group plants for maintenance needs to allow ease of pruning and weed control. Plants with mature heights over 24 inches (intersections & driveways), 30 inches (along) to be located in downslope conditions where height requirements from curb stay under the 24"-30" height criteria. Exception: singular plants used as accent shrub. Native bulbs and perennials that are within height criteria, are tough, are long-lived and require minimal maintenance (2 x) can be added at designer's discretion.

EG	DT	NWN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	O&M Code		Additional O & M Comments	Abbreviations/legend/O&M Code
										Group in rows	Group in rows		
DR	NWN	24"-36"	<i>Aquilegia formosa</i>	Western Columbine	2.3	1 Gal. / 18" o.c.	⊗,⊗	Possible use at vertical wall or single use low accent. Requires approval by Project Manager and Maintenance prior to use.	E	Krinkkrink' is the longest palindrone (a word spelled the same forwards or backwards) in the English language ok to pull out if it spreads too much	B	EG = Evergreen SEMI = Semi-Evergreen DT = Drought Tolerant DR = Drought Resistant NWN = Northwest Natives or cultivars UF = Urban Frontage (Mixed Use/Commercial) appropriate plants ⊗ = Full Sun ∅ = Part Sun Part Shade OA = Optional Attention	
EG	DT	<12"	<i>Arcostaphylos uva-ursi</i> Waxcapheath or "Prae-Rays"	Kinnikinnick	3.4	1 Gal. / 24" o.c. 4 inch pots / 12" o.c.	⊗,⊗						
DT	NWN	36"	<i>Asclepias speciosa</i>	Showy Milkweed	1.2	3" pots	⊗	Mix with Rush. Do not use the common form because it can be too invasive. Fall plant for in groups of 15+ bulbs for effect and maintenance visibility. Can be planted as a bulb. Consider creating a market unit grouping it on real Rocky Mountain Iris in milk locations.	DF	Suggest reviewing field locations if you see this on plan as they die back above ground in Fall (October/November)	C		
DT	NWN	18"-25"	<i>Camassia esculenta</i> or <i>Camassia quamash</i>	Great Camas or Common Camas	2.3,4	Bulbs in fall 1 Gal. / 12" o.c.	⊗,⊗						
EG	NWN	30"	<i>Carex densa</i>	Dense sedge	1.2	10 Cu. In. Plug/ 10" o.c.	⊗						
DR	NWN	26"(48")	<i>Carex deweyana v. leptocephala</i>	Slender-foot Dewey's sedge	1.2	10 Cu. In. Plug/ 10" o.c.	⊗	If using the species limit to areas of approx. 36"-36"	B				
NNW	NWN	30"	<i>Carex falcata</i>	Shore Sedge	1	10 Cu. In. Plug/ 10" o.c.	⊗	Tolerates water fluctuations but prefers wet					
DT	NWN	24"-36"	<i>Carex gracilis</i>	Chamisso sedge	1.2	10 Cu. In. Plug/ 10" o.c.	⊗,⊗	Limit to areas of approx. 36"-36"	B				
NNW	NWN	24"-40"	<i>Carex stipata</i>	Beaked sedge	1	10 Cu. In. Plug/ 10" o.c.	⊗,⊗	Limit to areas of approx. 36"-36"	B				
DT	NWN	24"-30"	<i>Coronaria sericea "Kelseyi"</i>	Kelsey's redbud dogwood	1.2,3	2 Gal. / 36" o.c..	⊗,⊗	Stems fragile until established.	E				
DT	NWN	12"	<i>Dodecatheon pulchellum</i>	Broad-leaved shooting star	2.3,4	1 quart/ 18" o.c.	⊗,⊗	Perennial, magenta to pink blooms					
DT	NWN	<24"	<i>Erigeron peregrinus</i>	subspineless Fleabane Daisy	3,4	1 Gal. / 12" o.c.	⊗	Use minimum of 3	DF				
DT	NWN	36"	<i>Festuca idahoensis</i>	Idaho fescue	3,4	1 Gal. / 18" o.c.	⊗						
EG	DT	24"-36"	<i>Gaultheria shallon</i>	Salal	2.3,4	1 Gal. / 30" o.c. 4" pots / 18" o.c.	⊗	Show to establish, suggest planting with short term mix to cover bare soil until established. If Whitingreen is desired or substituted, note it is difficult to establish. Many colors available.		If height is a problem, can be sheared with hedge trimmer.	G	OA = For neater appearance cut back dead leaves and flower stalks.	
EG	DT	NWN	<i>Iris douglasiana</i>	Pacific Coast Iris	3,4	1 Gal. / 18" o.c.	⊗					OA = For neater appearance cut back dead leaves and flower stalks.	
SEMI	DT	NWN	<24"	<i>Iris missouriensis</i>	Rocky Mountain Iris	1.2	1 Gal. / 12" o.c.	⊗	Use minimum of 3	DF			
EG	NWN	<24"	<i>Juniperus chinensis</i>	Baltic juniper	1	10 Cu. In. Plug/ 9" o.c.	⊗	Locate in center of plants that will support foliage.					
EG	NWN	24"-48"	<i>Juniperus effusa</i>	Common nush	1	10 Cu. In. Plug/ 9" o.c.	⊗	Selective use in cells that will be watered, locate in center of cells surrounded by plants that will support foliage. Do not intermix with other emergents.	C	Cut back in early spring, spreading nature dry summer months should help to control. May go brown in drought conditions	C	OA = For neater appearance cut back dead foliage, encourage reblooming/ new leaves and for neater appearance.	
EG	NWN	<24"	<i>Juniperus ensifolia</i>	Daggerleaf nush	1.2	10 Cu. In. Plug/ 9" o.c.	⊗	Locate in center of plants that will support foliage. Limit to areas of approx. 36"-36"	B			DF = Deadhead perennials in fall for neater appearance and to prevent re-sowing. Deadheading not required for function.	
EG	DT	NWN	<24"	<i>Lewisia cotyledon</i> or <i>cultivars</i>	Siskiyou Lewisia	3,4	1 Gal. / 12" o.c.	⊗				E = Cut back or prune in over sidewalk or clear areas. Remove deadwood anytime fall to spring.	
EG	NWN	36"	<i>Mahonia aquifolium</i> 'Orange Flame' or 'Canyon'	Compact tall Oregon grape	3	1 Gal. / 36" o.c.	⊗,⊗				F = May need replacing every 5+ years. (Replace not required if coverage requirements)		
EG	DT	NWN	<24"	<i>Mahonia repens</i>	Creeping Oregon grape	3,4	4" pots / 12" o.c.	⊗,⊗	Mix sizes; Will not do well in heat exposure or in drying winds	E	G = May need dividing every few years. Reasons for division include deback in center and to increase coverage.		
DT	NWN	<24"	<i>Mahonia stellata</i>	False Lily of the Valley	1.2,3,4	4" Pot/ 12" o.c.	⊗	Note tendency to spread	E				
EG	NWN	24"-36"	<i>Mimulus guttatus</i>	Yellow monkey flower	1.2	1 Gal. / 18" o.c.	⊗,⊗						
EG	DT	NWN	36"	<i>Pachysandra terminalis</i>	Oregon Boxwood	3	1 Gal. / 36" o.c.	⊗,⊗					
DT	NWN	<24"	<i>Potentilla fruticosa</i> 'Sunset'	Frosty potentilla	3,4	2 Gal. / 30" o.c.	⊗						
DT	NWN	<24"	<i>Potentilla glauca</i> or <i>Potentilla gracilis</i>	Sticky cinquefoil or slender potentilla	3,4	1 Gal. / 18" o.c.	⊗,⊗						
EG	NWN	24"-36"	<i>Polygalum tenuifolium</i>	Narrowleaf tansy fern or Polystichum tenuifolium	3,4	2 Gal/ 30" o.c.	⊗,⊗	If Polystichum tenuifolium is substituted limit groups to 3 and prune yearly	B				
EG	DR	NWN	24"-36"	<i>Polygala munroidii</i>	Western swordfern	3	1 Gal. / 24" o.c.. 2 Gal. / 36" o.c.	⊗	Limit to group of 15 plants min 3 ft back of sidewalk, allow cut edge (step out zone) and room for 10'p.				
DT	NWN	<24"	<i>Solidago canadensis</i> 'Baby Gold' or 'Solidago hybrida' 'Dorothy'	Baby Gold or Little Lemon Goldenrod	3,4	1 Gal. / 18" o.c.	⊗	Last season color accent.	A				
NNW	NWN	24"-36"	<i>Spiraea betulifolia</i> 'Tor'	Birchleaf spirea	3	1 Gal. / 24" o.c.	⊗	Use Tor' because of spreading of other varieties.	E				
EG	DT	NWN	<24"	<i>Sedum divergens</i> or <i>oregano</i>	Stonecrop	3,4	4" Pot/ 12" o.c.	⊗,⊗	Tolerates hot dry sites.	E			
EG	DT	NWN	24"-36"	<i>Xerophyllum tenax</i>	Bear grass	3	1 Gal. / 18" o.c.	⊗	Tolerates hot dry sites.	E			

- Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality. Some trees are able to be viable in this zone.
- Zone 2 plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in sight clearance areas or as accents at the edge of the facility.
- Zone 5 is the designation for plants used in the crossing zones and access areas along the curb.



Bioretention Plant List for Development of Palettes in the Right of Way

- Notes:**
- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU/GSI, OEM, SPURS/OT IDT, and KCW/TD Water Quality and QA staff.
 - SDOT Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection has measured from the corner height is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of hedges or stakes that may be higher than noted.
 - No plants are to be used if they are on the current King Co. Noxious Weed List, WIA Noxious Weed List and WIA Deny or Ag Prohibited Plant List.
 - Size/Spacing: initial planning of smaller sizes of emergents, closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

- Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality. Some trees are able to be viable in this zone.
- Zone 2 plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of a bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in tight clearance areas or as accents at the edge of the facility.
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Intersection & Sighting List (under 24" H.) for bioretention cells with graded side slopes

Guidance Statement: Maximum plant height within an intersection (as measured from the corner of the curb) is 24 inches. Careful placement in the sightline zones so grass stems are transparent; depending on plant a group of three may be the maximum number to maintain open sightlines. Designer should group plants for maintenance needs to allow ease of pruning and weed control.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7									
Bioretention Plant List for Development of Palettes in the Right of Way									
Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7									
Abbreviations/Legend/ID/M Code		Additional O & M Comments		O&M Code		Design Comments		Exposure	
EG = Evergreen		Pull if scraggly.		B & G		Late season color accent.		N & S	
SEMI = Semi-Evergreen		B & G		D1 = Drought Tolerant		B & G		D2 = Drought Resistant	
DR = Native/Natives or cultivars		UF = Urban Frontage (Mixed Use/Commercial) appropriate plants		UF = Urban Frontage (Mixed Use/Commercial) appropriate plants		Stems fragile until established.		E	
O = Full Sun		O = Part Sun		O = Part Shade		Plant in bottom areas for sightlines. Can be used to support emergent grasses.		E	
OK = Optional Attention		Cut back before flower stalks appear.		B		Part shade to shade only without irrigation.		B	
DMC = DMC		Cut back before new growth in Fall (October/November)		A = Cut back these perennials to 4-6"		Cut back these perennials to 4-6" above ground in Fall		A = Cut back in Fall	
A = Cut back these perennials to 4-6" above ground in Fall		B = Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in spring (late March/early April)		B = Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in spring (late March/early April)		B = Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in spring (late March/early April)		B = Cut back in Fall	
C = Hand-take in spring (mid-January to mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.		C = Hand-take in spring (mid-January to mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.		C = Hand-take in spring (mid-January to mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.		C = Hand-take in spring (mid-January to mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.		C = Hand-take in spring (mid-January to mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.	
DS = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neat appearance.		DS = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neat appearance.		DS = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neat appearance.		DS = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neat appearance.		DS = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neat appearance.	
D = Deadheading not required for function.		D = Deadheading not required for function.		D = Deadheading not required for function.		D = Deadheading not required for function.		D = Deadheading not required for function.	
E = OK to pull clumps for ease of weed control.		E = OK to pull clumps for ease of weed control.		E = OK to pull clumps for ease of weed control.		E = OK to pull clumps for ease of weed control.		E = OK to pull clumps for ease of weed control.	
F = May need replacing every 5+ years. (Replace if not required if regeneration coverage needs)		F = May need replacing every 5+ years. (Replace if not required if regeneration coverage needs)		F = May need replacing every 5+ years. (Replace if not required if regeneration coverage needs)		F = May need replacing every 5+ years. (Replace if not required if regeneration coverage needs)		F = May need replacing every 5+ years. (Replace if not required if regeneration coverage needs)	
G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.		G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.		G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.		G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.		G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.	
H = OK: Out back for neat appearance.		H = OK: Out back for neat appearance.		H = OK: Out back for neat appearance.		H = OK: Out back for neat appearance.		H = OK: Out back for neat appearance.	
EG	DT	NWN	24"	Chrysanthemum 'Peach Centerpiece' or 'Blushing'	3.4	1 Gal. / 15" o.c.	⊗	Peach Centerpiece or golden Chrysanthemum	
EG	DT	NWN	<24"	Coreopsis 'lanceolata 'Sterntaler'	3.4	1 Gal. / 15" o.c.	⊗	Tickseed	
DT	DT	24"-30"	<24"	Cornus sericea 'Kelseyi'	1.2	1 Gal. / 28" o.c. 2 Gal. / 36" o.c.	⊗;⊗	Kelseyi red stem dogwood	
EG	DT	NWN	<24"	Epinema rubrum or sulphureum	3.4	4" Pot / 12" o.c. 1 Gal. / 24" o.c.	⊗	Barewort	
EG	DT	NWN	<24"	Euonymus fortunei 'Interbow''	3.4	1 Gal. / 18" o.c.	⊗;⊗	Blody winter creeper	
DT	DT	NWN	<24"	Geranium 'Rozanne'	3.4	1 Gal. / 24" o.c.	⊗;⊗	Rozanne geranium	
EG	DT	NWN	<24"	Grewia flore plena 'Blazing Sunset'	3.4	1 Gal. / 18" o.c.	⊗;⊗	Blazing Sunset Avena	
EG	DT	NWN	<24"	Hibiscus x Champion'	3.4	1 Gal. / 18" o.c.	⊗;⊗	Champion Hibiscus	
SEMI	DT	NWN	<24"	Heliotropium nummularium 'Wisley Prince'	3.4	1 Gal. / 12" o.c.	⊗	Yellow Sunrose	
EG	DT	NWN	24"-36"	Heliotropion sempervirens	3	1 Gal. / 18" o.c.	⊗	Blue oat grass	
EG	DT	NWN	<24"	Ilex x 'Mondo'	3.4	1 Gal. / 18" o.c.	⊗;⊗	Little Rascal Holly	
EG	DT	NWN	<24"	Juncus effusus 'Camren's Japan'	1.2	10 Cu. In. Plug / 10" o.c.	⊗;⊗	Camren's Japanese Rush	
EG	DT	NWN	<24"	Juncus effusus 'Spiralis'	1.2	10 Cu. In. Plug / 10" o.c.	⊗;⊗	Conscrew soft rush	
EG	DT	NWN	18"-30"	Juncus patens	1.2	10 Cu. In. Plug / 10" o.c.	⊗;⊗	California gray rush	
EG	DT	NWN	<24"	Liriope muscari and cultivars	3.4	4" Pot / 12" o.c.	⊗;⊗	Lily Turf	
EG	DT	NWN	24"	Lonicera pileata	3.4	1 Gal. / 36" o.c.	⊗;⊗	Box leaf honeysuckle	
EG	DT	NWN	<24"	Mahonia repens	3.4	1 Quart / 24" o.c. 4" pots / 12" o.c.	⊗;⊗	Creeping Oregon grape	
DT	DT	NWN	<24"	Narcissus 'Dutch Master' or 'King Alfred'	3.4	Bulb As Shown	⊗;⊗	Daffodil	
		NWN	<24"	Potentilla 'fruticosa' 'Sunset'	3.4	2 Gal. / 30" o.c..	⊗;⊗	Frosty potentilla	
EG	DT	NWN	<24"	Veronica 'Ivanka'	3.45	4" Pot / 12" o.c..	⊗;⊗	Speedwell	
								Low groundcover, plant minimum 18 inches back of curb and 12 inches back of sidewalk	
								E	
								OK: Out back for neat appearance.	

Bioretention Plant List for Development of Palettes in the Right of Way



Notes:

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- SDOT's Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection has a maximum height of the curb is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of berm or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WIA Deny or Ag Prohibited Plant List.
- Size/Spacing: initial planting of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

- Zone 1** plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality. Some trees are able to be viable in this zone.
- Zone 2** plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3** includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4** plants are low, durable and drought tolerant. Plants (under 24") are used in tight clearance areas or as accents at the edge of the facility.
- Zone 5** is the designation for plants used in the crossing zones and access areas along the curb.

Plant List for Bioretention Cells with Vertical Wall(s) (Primarily Evergreen)

Height from Ground	EG DT NWN	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	O&M Code	Additional O & M Comments	Abbreviations/Legend/O&M Code
								Code		
48"-72"	DT	<i>Calymagrostis acutiflora Alpinische</i>	Variegated feather reed grass	Unlined	1 Gal. / 24" o.c.	⊗,⊗	Place min. 18 inches from sidewalk edge of wall or centerline of planter if wider than 4 feet. Leave gaps in cell to see across planting strip	B	11 height or thicker forms sheared to 36 inch and remove plants for clearance.	EG = Evergreen SEMI = Semi-Evergreen DT = Drought Tolerant NWN = Northwest Natives or cultivars UF = Urban Fringe (Mixed Use/Commercial) appropriate plants
24"-36"	DR NWN	<i>Camus leichhardtii</i> or <i>Camus quamash</i>	Great Camas or Common Camas	Lined & Unlined	Bulb / 6" o.c. 1 Gal. / 18" o.c..	⊗,⊗	Plant a minimum of 15 bulbs in each group. Plant with Geranium or Carex testacea to mark locations.	DF	Hard to see may want to place marker stake if used until established. Blooms spring to early summer. Do not cut down spent blooms to allow to reseed.	
12"-18"	EG DT	<i>Carex divaricata</i>	European Grey Sedge	Lined & Unlined	1 Gal. / 24" o.c.	⊗,⊗	Shallow planters			
24"-60"	EG DT NWN	<i>Carex obnupta</i>	Slough sedge	Lined & Unlined	10 Cu. In. Plug / 10" o.c., & 1 Gal. / 18" o.c.	⊗,⊗	Use only in industrial zones where the topsoil nature does not draw comments for maintenance staff! Not recommended for planting in walled cells as the floppy plants will trigger maintenance comments from residents. Located in center of intersections so as blooms may reach 5 feet.	C	Can be sheared more frequently if overcrowding other occurs.	
24"-30"	EG	<i>Carex testacea or dissecta</i>	Orange New Zealand or Autumn Sedge	Lined & Unlined	10 Cu. In. Plug / 10" o.c., & 1 Gal. / 18" o.c..	⊗,⊗	Plant with Camas. Do not plant near plant adjacent to wall (Too low).	C	A = cut back these perennials to 4-6" above ground in Fall	
24"-36"	DR NWN	<i>Coronc service Kerssii</i>	Kelley redstem dogwood	Unlined	2 Gal. / 36" o.c..	⊗,⊗	Stems fragile until established.	E	B = Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in Spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.	
36"-48"	DT NWN	<i>Coronc stolonifera 'Neil Z'</i>	Pucker Up Redwing Dogwood	Lined & Unlined	1 Gal. / 24" o.c..	⊗,⊗	Place 18" from edge of wall	E	D = Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming/ new leaves and for neater appearance.	
<12"	EG DT	<i>Epidiophyllum s.</i>	Bishop's hat	Outside of walled cell	1 quart / 18 inches o.c..	⊗	Use along pedestrian access between planter/wall and hard surface.	E	C = Hand-prune in Spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.	
24"-36+	EG DT NWN	<i>Gaultheria shallon</i>	Salal	Unlined	1 Gal. / 24" o.c..	⊗,⊗	Can be used to support emergent grasses.	E	E = Cut back or prune off over sidewalk or clear zones. Remove deadwood anytime fall to spring.	
12"	SEMI	<i>Geranium x candicans 'Bikofero'</i>	Bikofero geranium	Unlined	4 Pots / 12" o.c..	⊗,⊗	Plant with Camas. Do not plant adjacent to wall along sidewalk (too low).	B	F = May need replacing every 5+ years. (Replace/ment not required if vegetation coverage meets requirements)	
>24"	SEMI DT NWN	<i>Heuchera sp.</i>	Coral Bells	Outside of walled cell	1 quart / 18 inches o.c..	⊗	Use along pedestrian access between planter/wall and hard surface.	E	G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.	
<24"	EG DT	<i>Iris foetidissima</i>	Gladwyn iris	Unlined	1 Gal. / 18" o.c..	⊗,⊗	Plant can be toxic to people and pets.	G	H = May need replacing every 5+ years. (Replace/ment not required if vegetation coverage meets requirements)	
24"-48+	EG DT NWN	<i>Juncus effusus</i>	Common rush	Lined & Unlined	10 Cu. In. Plug / 10" o.c., & Gal. / 18" o.c..	1,⊗,⊗	Select for wide deep cells only! Plant 1 gal. in deep sections. Do not plant near intersections.	C	I = Can be sheared more frequently if foliage collapses.	
24"-36"	EG NWN	<i>Juncus effusus Quartz Creek</i>	Quartz Creek Soft Rush	Lined & Unlined	10 Cu. In. Plug / 10" o.c., & 1 Gal. / 18" o.c..	⊗,⊗	Locate in center of plants that will support foliage.	C	J = Can be sheared to 22" with hedge trimmer to encourage compact growth.	
<24"	EG NWN	<i>Juncus ensifolius</i>	Daggerleaf rush	Unlined	10 Cu. In. Plug / 10" o.c., & 1 Gal. / 18" o.c..	⊗,⊗	Locate in center of plants that will support foliage. Limit to areas approx 36x96" due to winter dormancy	B	K = May need summer water until established	
18"-36"	EG DT	<i>Juncus patens</i> or <i>Juncus patens</i> blue	California gray rush	Lined & Unlined	10 Cu. In. Plug / 10" o.c., & Gal. / 18" o.c..	⊗,⊗	Plant in bottom zone for signifiers. Use J. patens 'Elkblue' if blue tone is desired	C	L = May need more frequently if foliage collapses.	
<12"	DT	<i>Liriope muscari</i>	Lily turf	Outside of walled cell	1 Gal. / 18 o.c..	⊗	Use along pedestrian access between planter/wall and hard surface.		M = Can be sheared to 22" with hedge trimmer to encourage compact growth.	
36"	EG NWN	<i>Mahonia aquifolium</i> 'Orange Flame' or 'Compacta'	Compact leaf Oregon grape	Unlined	1 Gal. / 36" o.c..	⊗,⊗	Plant minimum two feet from wall	E	N = May need replacing every 5+ years. (Replace/ment not required if vegetation coverage meets requirements)	
24"	EG DT NWN	<i>Mahonia nervosa</i>	Longleaf Oregon grape	Unlined	1 Gal. / 18" o.c..	⊗,⊗	Minimum of 5	E	O = Can be sheared to 22" with hedge trimmer to encourage compact growth.	
48"	EG DT	<i>Nandina domestica</i> 'Compacta' or 'Sienna Sunrise'	Heavenly Bamboo	Unlined	2 Gal. / 24" o.c..	⊗,⊗	Can be used to support emergent grasses. Plant 2' from edge of wall.	E	P = May need replacing every 5+ years. (Replace/ment not required if vegetation coverage meets requirements)	
36"	EG NWN	<i>Spiraea densiflora var. densiflora</i>	Mountain spiraea	Lined & Unlined	1 Gal. & 2 Gal./36" o.c..	⊗,⊗	Do not confuse or substitute with Spiraea douglasii which forms dense thickets.	E	Q = Prune out oldest cane once a year.	
6"	EG NWN	<i>Symphoricarpos albus</i>	Snowberry	Unlined	2 Gal.	⊗,⊗	Plant in center, minimum two feet from wall.	E	R = Forms thickets will need windrowing/thinning.	
6"	EG NWN	<i>Vaccinium ovatum</i>	Evergreen Huckleberry	Unlined	5 Gal.	⊗,⊗	Plant as single specimen - no groups in cells due to sightlines	E	S = Prune as needed to maintain form	



Bioretention Plant List for Development of Palettes in the Right of Way

Notes:

- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU/GSI, OEM, and KCWTD Water Quality and OEM staff.
- SDOT Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection, as measured from the corner face of the curb, is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of hedges or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WIA Deny or Ag Prohibited Plant List.
- Size/Spacing: initial planning of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

- Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality. Some trees are able to be viable in this zone.
- Zone 2 plants are located in the lower slopes/wet or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in sight clearance areas or as accents at the edge of the facility.
- Zone 5 is the designation for plants used in the crossing zones and access areas along the curb.

Pollinator Plant List

Guidance Statement: plants 24 inches max for intersection/driveway and plants under 30 inch max for rest; you can suggest 3-4 "spike" plants – it taller shrubs but they should not aggressively spread and become a thicket (ie dogwood – willow not allowed).

Recommend signing pollinator planting areas to inform public and maintenance staff of the planting purpose as these tend to have more perennials. See Native Plant List for Zone 1.

Pollinator Plant List							
Racommend signing pollinator planting areas to inform public and maintenance staff of the planting purpose as these tend to have more perennials. See Native Plant List for Zone 1.			Design Comments				
EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	
DT	NNN	12'-24"	Achillea millefolium	Common Yarrow	3-4	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
DT	NNN	24'-36"	Agastache 'Blue Fortune'	Anise Hyssop	3	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
DT	NNN	12'-18"	Allium spp.	Ornamental Onion	3-4	Bulbs 6"-12" o.c. 1 Gal / 18' o.c.	
DR	NNN	24"-36"	Aquilegia formosa	Western Columbine	1.2-3.4	1 Gal / 18' o.c. 1 Gal / 12' o.c.	
EG	DT	NNN	<24"	Arctostaphylos uva-ursi 'Massachusettsensis' or 'Pr. Reyes'	Kinnikinnick	3-4	4" Pots / 12' o.c. 1 Gal / 12' o.c.
DT	NNN	12"	Amorpha canescens	Thrift sea pink	3-4	4" Pots / 12' o.c. 1 Gal / 12' o.c.	
DT	NNN	36"	Asclepias speciosa	Showy Milkweed	1.2	3" pots 1 Gal / 18' o.c.	
DT	NNN	<24"	Aster novae-angliae 'Wood's Blue'	Wood's Blue New York Aster	3-4	1 Gal / 18' o.c. Bulbs 8"-12" o.c.	
DR	NNN	24"-36"	Camassia leichtlinii or Camassia esculenta	Great Camass or Common Camas	1.2-3.4	1 Gal / 18' o.c. 1 Gal / 12' o.c.	
DR	NNN	>24"-36"	Echinacea purpurea	Coneflower	3	1 Gal / 18' o.c. 4" Pots / 12' o.c.	
DT	NNN	30"	Eryngium planum or Eryngium amethystinum	Sea Holly	3	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
EG	DT	NNN	18"	Festuca idahoensis 'Siskiyou Blue'	Idaho fescue	3.4	2 Gal / 30' o.c. 1 Gal / 18' o.c.
EG	DT	NNN	36"	Fuchsia magellanica 'Aurea'	Dwarf Hardy Fuchsia	3.4	2 Gal / 30' o.c. 1 Gal / 24" o.c.
DT	NNN	24"-36+*	Gaultheria shallon	Salal	3	1 Gal / 24" o.c. 1 Gal / 18' o.c.	
SEMI	DT	NNN	12"	Geranium x cantabrigiense 'Bokko' / G. 'Isidor'	Bokko geranium	2	1 Gal / 18' o.c. 1 Gal / 18' o.c.
SEMI	DT	NNN	<24"	Lavandula angustifolia 'Hidcote'	Pacific Coast Iris	3.4	1 Gal / 18' o.c. 1 Gal / 18' o.c.
EG	DT	NNN	18"	Lavender	3.4	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
NNNN	NNN	24"-36"	Lupinus arcticus or sericeus	Arctic lupine / Silky lupine	2.3	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
DT	NNN	30"	Nepeta 'Walker's Low'	Catmint	3	1 Gal / 18' o.c. 4" Pots / 1 Gal /	
DT	NNN	30"	Panstemon serrulatus	Cascade Beard-Tongue	2.3	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
DT	NNN	<24"	Petrosia apalachicola 'Lacey Blue'	Compact Russian Sage	3.4	1 Gal / 24" o.c. 1 Quart / 18" o.c.	
Prunella vulgaris lanceolata	NNN	>20"	Salvia nemorosa 'Caradonna'	Sealbeal	3.4	1 Gal / 18" o.c. 4" Pot / 12" o.c.	
EG	DT	NNN	48"+	Rosmarinus officinalis 'Hill Hardy'	Rosemary	3	1 Gal / 36" o.c. 4" Pots / 12" o.c.
DT	NNN	24"-30"	Rudbeckia fulgida 'Goldsturm'	Black-Eyed Susan	3.4	1 Gal / 18' o.c. 2 Gal.	
DT	NNN	24"-30"	Salvia nemorosa 'Caradonna'	Salvia species	3.4	1 Gal / 24" o.c. 1 Gal / 18" o.c.	
EG	DT	NNN	<24"	Sodium divaricatum or 'Medium orangeum'	Stonecrop	3.4	4" Pot / 12" o.c. Tolerates hot dry sites.
NNNN	NNN	<12"	Solidago malvaefolia 'Palais de l'Orangerie'	Dwarf Checker-mallow	3.4	4" Pots / 12" o.c. Plant as single specimen - no groups.	
DT	NNN	<24"	Solidago canadensis 'Baby Gold' or 'Solidago hybrid 'Dancette'	Elfin Gold or Little Lemon Goldenrod	3.4	1 Gal / 18' o.c. 1 Gal / 18' o.c.	
DT	NNN	36"-48"	Spiraea x bumalda 'Goldflame'	Goldflame Spirea	2.3	2 Gal. Prune plant as single use 36" from curb	
EG	DT	NNN	<24"	Tournefortia chamaedrys	Wall germander	3.4	1 Gal / 18' o.c. Spreading plant 24 inches back of pavement and 36 inches back of curb
EG	DT	NNN	<24"	Thymus serpyllum 'Elfin'	Elfin creeping thyme	3.45	4" Pot / 12" o.c. Plant as single specimen - no groups due to sightlines
EG	NNN	6"	Vaccinium ovalatum	Evergreen Huckleberry	1.2-3	5 Gal. Prune as needed to maintain form	

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- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in sight clearance areas or as accents at the edge of the facility.
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Guidance Statement: plants 24 inches max for intersection/driveway and plants under 30 inch max for rest; you can suggest 3-4 "spike" plants – it taller shrubs but they should not aggressively spread and become a thicket (ie dogwood – willow not allowed).

Recommend signing pollinator planting areas to inform public and maintenance staff of the planting purpose as these tend to have more perennials. See Native Plant List for Zone 1.

Bioretention Plant List for Development of Palettes in the Right of Way						
Notes:			Abbreviations/Legend/O & M Code			
Abbreviations/Legend						
EG = Evergreen SEM = Semi-evergreen DT = Drought Tolerant NWN = Northwest Native or cultivars UF = Urban Frontage Mixed Use/Commercial appropriate plants C = Cut back in Fall (October-November) B = Low foliage and seedheads for winter interest A = Attracts hummingbirds, bees, butterflies O = Optional Attention						
O & M Code						
DS = Design Comments DF = Deadhead G = Cut back in Fall or early spring B = Low foliage and seedheads for winter interest A = Attracts hummingbirds, bees, butterflies O = Optional Attention						
Additional O & M Comments						
A: Cut back in Fall (October-November) B: Low foliage and seedheads for winter interest C: Cut back in Fall (October-November) before new growth emerges D: Cut back in Fall or early spring (Mid-June to Mid-May) before new growth emerges E: Cut back to ground or thin every 2-3 years as needed F: Deadhead perennials or remove faded foliage in Spring/Summer to encourage reblooming, new leaves and/or better appearance. Deadheading not required for duration. G: Cut dead leaves / flower stalks cut back. H: Cut back just below top of green foliage in spring to prevent woody growth. I: Cut back to ground or over side/over or clear zones. Remove deadwood any time. J: May need replacing every 5-10+ years. Replacement means requirements (Coverage means requirements) K: May need dividing every few years. Reasons for division include dieback in center and to increase coverage.						
Design Comments						
Flowers late Plant a minimum of 15 bulbs in each group. Plant with Geranium or Carex testacea to mark locations. Flowers spring to summer however difficult to establish Flowers excellent for pollinators Do not use the common name because it can be too invasive Flowers late Plant a minimum of 15 bulbs in each group. Plant with Geranium or Carex testacea to mark locations. Flowers spring to summer however difficult to establish Flowers excellent for pollinators Do not use the common name because it can be too invasive Many colors available. Flowers early If height is a problem, Salal can be sheared with hedge trimmer. If neatness is required in fall or winter Cut back just below top of green foliage in spring to prevent woody growth. Short-lived. Will need to be deadheaded. Some Lupine are toxic If too aggressive, pull out to keep in a limited 3'x3' area. Attracts hummingbirds, bees, moths Low Maintenance. Accent Plant Highly attractive to various pollinators. Deep roots, use sparingly in groups of three as they may become aggressive. Plant as single specimen - no groups. Prune plant as single use 36" from curb Regular watering, long-lived plant blooms attractive to butterflies Attracts hummingbirds, bees, butterflies Accent plant as single use 36" from curb Tolerates hot dry sites. Plant as single specimen - no groups. Prune as needed to maintain form						
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A: Cut back in Fall or early spring B: Cut back just below top of green foliage in spring to prevent woody growth. C: Cut back to ground or over side/over or clear zones. Remove deadwood any time. D: May need replacing every 5-10+ years. Replacement means requirements (Coverage means requirements) E: May need dividing every few years. Reasons for division include dieback in center and to increase coverage.						
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A: Cut back in Fall or early spring B: Cut back just below top of green foliage in spring to prevent woody growth. C: Cut back to ground or over side/over or clear zones. Remove deadwood any time. D: May need replacing every 5-10+ years. Replacement means requirements (Coverage means requirements) E: May need dividing every few years. Reasons for division include dieback in center and to increase coverage.						



Bioretention Plant List for Development of Palettes in the Right of Way

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- SDOT's Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection has a concern face of the curb is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of hedges or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WA Noxious Weed Control Board List and WA Dept of Ag Prohibited Plant List.
- Size/Spacing: initial planting of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

Short Term Infill Plant List

Guidance Statement: The plants in this palette are annuals or short-lived plants to enhance the cells at the time of installation. These plants are used to quickly fill in and cover the bare soil after construction.

Short Term Infill Plant List										Vertical Shrubs & Accent Plant List										
Guidance Statement: The plants in this palette are annuals or short-lived plants to enhance the cells at the time of installation. These plants are used to quickly fill in and cover the bare soil after construction.										Guidance Statement: Generally single accent plant however unless noted no more than 3 accent plants in a group to preserve sight lines. Generally not on street side of cell. Prefer large sizes to start.										
EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	
EG	DT	18'-24'	Carex testacea (or diseased)	Orange New Zealand (or Autumn Sedge)	1-2,3	4' Pot/18" o.c...	⊗,⊗	⊗		C			18'-24'	Caricaria trifolia	Service Berry	1-2	Multi-stem, B&B, 5'-6' ht.	⊗	Single use - Multi-stems are common.	O&M Code
EG	DT	>24"	Cornus spp.	Cornus	3,4	Bulb groups of 10	⊗,⊗	⊗		E			>24"	Corylus cornuta 'Beachcomber'	Bleeding Heart	1,2	4' Pot / 12" o.c..	⊗	Spring to summer blooming. Will go dormant if dry in summer. May flower.	O&M Code
		NN/N	<24"																	
		NN/N	24"-24"	Dianthus barbatus	Gaura	2,3	1 Quiet / 24" o.c.	⊗,⊗												
		NN/N	(24"-48")	Iberis amara	Rocket Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗												
		NN/N	<24"	Iberis sempervirens	Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗,⊗												
		NN/N	<24"	Nardus stricta 'Dwarf King Alfred'	Daffodil	3,4	Bulb/As Shown	⊗	Plant in fall											
		NN/N	<24"	Sedum 'orange'	Stonecrop	2,3,4,5	4' Pot / 12" o.c..	⊗	Tolerates hot dry sites.											
		NN/N	<24"	Tropaeolum majus 'Alaska Mix'	Nasturtium	3,4	Seeds or 6-Pack Plug 12" o.c..	⊗,⊗	Plant in spring after frost or September, for summer flowering											
		NN/N	<24"	Viola x wittrockiana	Winter Pansy	3,4	4' Pot / 12" o.c..	⊗,⊗	Plant in fall											
		NN/N																		

Short Term Infill Plant List										Vertical Shrubs & Accent Plant List										
EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	O&M Code
EG	DT	25'	Amelanchier alnifolia	Service Berry	1,2	Multi-stem, B&B, 5'-6' ht.	⊗			E			5'	Coronilla varia 'Midwinter Fire'	Mullein/Fire Dogwood	1,2,3	5 Gal.	⊗,⊗	Single use - Multi-stems are common.	O&M Code
DR	NN/N	5'	Coronilla varia 'Midwinter Fire'	Mullein/Fire Dogwood	1,2,3	5 Gal.	⊗,⊗			E			6 to 8'	Corylus cornuta 'Yellow Twig'	Dogwood	1,2,3	5 Gal.	⊗	Single use - Multi-stems are common.	O&M Code
DR	NN/N	4'-12'	Corylus cornuta 'Yellow Twig'	Dogwood	3,4	5 Gal.	⊗,⊗			E			10'	Hamamelis virginiana 'Purpurea'	Bleeding Heart	3	10 Gal.	⊗,⊗	Vase-shaped open growing form, not on stressed side of shrub	O&M Code
		10'	Hamamelis virginiana 'Purpurea'	Bleeding Heart	3	5 Gal.	⊗			E			5'	Hydrangea quercifolia 'Pee Wee'	Oak-Leaf Hydrangea	3	5 Gal.	⊗	Late summer flowers. Fall color. Bold leaves in winter.	O&M Code
EG		3'-4'	Ilex glabra 'Shamrock'	Highberry	1,2	5 Gal.	⊗,⊗			E			6'	Ilex verticillata & cultivars	Winterberry	1,2	5 Gal.	⊗,⊗	Female plants need male pollinator to produce berries.	O&M Code
EG	DR	3'-12'	Ilex verticillata & cultivars	Winterberry	1,2	5 Gal.	⊗,⊗			E			6'-10'	Malus 'Arthur Menzies'	Ornamental Mahonia	3	5 Gal.	⊗,⊗	Upright multi-stemmed. Plant only in wider planting strips.	O&M Code
EG	DR	6'-10'	Malus 'Arthur Menzies'	Ornamental Mahonia	3	5 Gal.	⊗,⊗			E			5'	Malus aquatica	Witch Hazel	3	5 Gal.	⊗,⊗	Single plant, upright multi-stemmed. Plant on side walk only	O&M Code
EG		5'	Malus aquatica	Witch Hazel	3	5 Gal.	⊗			E			6'	Osmunda cinnamomea 'Goshiki'	Variegated Osmunda	3	5 Gal.	⊗,⊗	4 wide. Considered dwarf. New foliage is colorful.	O&M Code
DR	NN/N	6'	Osmunda cinnamomea 'Goshiki'	Variegated Osmunda	3	5 Gal.	⊗			E			6'	Physocarpus opulifolius 'Nanus'	Dwarf Ninebark	1,2	5 Gal.	⊗,⊗	Single - even dwarf form may be tall & wide.	O&M Code
EG		6'	Physocarpus opulifolius 'Nanus'	Dwarf Ninebark	1,2	5 Gal.	⊗,⊗			E			4'-20'	Pyracantha coccinea 'Little Heath'	Little Heath Lilac of the Valley	3	3 Gal.,	⊗	Variegated foliage pink in spring. Flowers in winter.	O&M Code
DR	NN/N	8'	Pyracantha coccinea 'Little Heath'	Little Heath Lilac of the Valley	3	5 Gal.	⊗			E			6'-20'	Rubus sanguineus & cultivated varieties	Red Flowering Currant	3	5 Gal.	⊗	Attracts hummingbirds	O&M Code
EG		8'	Rubus sanguineus & cultivated varieties	Red Flowering Currant	3	5 Gal.	⊗			E			12'-20'	Salix integra 'Hakuro Nishiki'	Dappled Willow	1,2	5 Gal.	⊗,⊗	Provide space for mature growth and surround with understory	O&M Code
		12'-20'	Salix integra 'Hakuro Nishiki'	Dappled Willow	1,2	5 Gal.	⊗,⊗			E			8'-15'	Salix nigra 'Geisha'	Black Beauty Black Elder	1,2	5 Gal.	⊗,⊗	Single plant on sidewalk side of cell; may be suitable in walled lined planter depending on depth of soil.	O&M Code
DT	NN/N	6'	Salix nigra 'Geisha'	Black Elder	1,2	5 Gal.	⊗,⊗			E			6'	Symplocarpus albus	Snowberry	1,2	5 Gal.	⊗,⊗	Forms thickets.	O&M Code
DR	NN/N	6'	Symplocarpus albus	Snowberry	1,2	5 Gal.	⊗,⊗			E			6'-12'	Taxodium distichum 'Pere Marquette'	Dwarf Bald Cypress	1,2,3	5 Gal.	⊗,⊗		O&M Code
EG	DR	NN/N	6'	Taxodium distichum 'Pere Marquette'	Dwarf Bald Cypress	3,4	5 Gal.	⊗		E			12'	Vaccinium ovatum	Evergreen Huckleberry	1,2,3	5 Gal.	⊗	Self-pollinating edible fruits. Good fall color.	O&M Code
EG	NN/N	10'	Vaccinium ovatum	Evergreen Huckleberry	1,2	5 Gal.	⊗,⊗			E			7'-12'	Vaccinium Sunshine Blue'	Blueberry	3	10 Gal.	⊗,⊗	Single plant on sidewalk side of cell only	O&M Code
EG	NN/N	7'-12'	Vaccinium Sunshine Blue'	Blueberry	3	10 Gal.	⊗,⊗			E									Single	O&M Code

Short Term Infill Plant List										Vertical Shrubs & Accent Plant List										O&M Code
EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	
EG	DT	18'-24'	Carex testacea (or diseased)	Orange New Zealand (or Autumn Sedge)	1,2,3	4' Pot/18" o.c...	⊗,⊗	⊗		C			18'-24'	Artemesia alba	Common Yarrow	1,2	Multi-stem, B&B, 5'-6' ht.	⊗	Will gently reseed; could remove when other plantings infill.	EG
EG	DT	>24"	Cornus spp.	Cornus	3,4	Bulb groups of 10	⊗,⊗	⊗		E			>24"	Dicentra formosa 'Bacchus'	Bleeding Heart	1,2	4' Pot / 12" o.c..	⊗	Fall and spring blooming species	SEM
		NN/N	<24"	Dicentra formosa 'Bacchus'	Bleeding Heart	1,2	4' Pot / 12" o.c..	⊗		E										SEM
		NN/N	24"-24"	Dianthus barbatus	Gaura	2,3	1 Quiet / 24" o.c.	⊗,⊗												DT
		NN/N	(24"-48")	Iberis amara	Rocket Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗												DR
		NN/N	<24"	Iberis sempervirens	Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗,⊗												NWN
		NN/N	<24"	Nardus stricta 'Dwarf King Alfred'	Daffodil	3,4	Bulb/As Shown	⊗	Plant in fall											DS
		NN/N	<24"	Sedum 'orange'	Stonecrop	2,3,4,5	4' Pot / 12" o.c..	⊗	Tolerates hot dry sites.											UF
		NN/N	<24"	Tropaeolum majus 'Alaska Mix'	Nasturtium	3,4	Seeds or 6-Pack Plug 12" o.c..	⊗,⊗	Plant in spring after frost or September, for summer flowering											UF
		NN/N	<24"	Viola x wittrockiana	Winter Pansy	3,4	4' Pot / 12" o.c..	⊗,⊗	Plant in fall											UF

Short Term Infill Plant List										Vertical Shrubs & Accent Plant List										O&M Code
EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	
EG	DT	18'-24'	Carex testacea (or diseased)	Orange New Zealand (or Autumn Sedge)	1,2,3	4' Pot/18" o.c...	⊗,⊗	⊗		C			18'-24'	Artemesia alba	Common Yarrow	1,2	Multi-stem, B&B, 5'-6' ht.	⊗	Will gently reseed; could remove when other plantings infill.	EG
EG	DT	>24"	Cornus spp.	Cornus	3,4	Bulb groups of 10	⊗,⊗	⊗		E			>24"	Dicentra formosa 'Bacchus'	Bleeding Heart	1,2	4' Pot / 12" o.c..	⊗	Fall and spring blooming species	SEM
		NN/N	<24"	Dicentra formosa 'Bacchus'	Bleeding Heart	1,2	4' Pot / 12" o.c..	⊗		E									DT	
		NN/N	24"-24"	Iberis amara	Rocket Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗											DR	
		NN/N	<24"	Iberis sempervirens	Candytuft	3,4	6-Pack Plugs or 4" pot 12" o.c..	⊗,⊗											NWN	
		NN/N	<24"	Nardus stricta 'Dwarf King Alfred'	Daffodil	3,4	Bulb/As Shown	⊗	Plant in fall			</td								



Bioretention Plant List for Development of Palettes in the Right of Way

Notes:

- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU/GSI, OEM, SPUDOT IDT, and KCWTD Water Quality and QA staff.
- SDOT's Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection has measured from the corner face of the curb is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of hedges or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WA Noxious Weed List, and WA Dept of Ag Prohibited Plant List.
- Size/Spacing: initial planting of smaller sizes of emergents closer on center (o.c.) is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

- Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality. Some trees are able to be viable in this zone.
- Zone 2 plants are located in the lower slopes/wetted or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality filtration.
- Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the bioretention areas. Zone 3 may include limited vertical accent plants and trees.
- Zone 4 plants are low, durable and drought tolerant. Plants (under 24") are used in tight clearance areas or as accents at the edge of the facility.
- Zone 5 is the designation for plants used in the crossing zones and access areas along the curb.

Groundcover Plant List (if Low Profile is Required)

Guidance Statement: Do not mix groundcovers - plant in groups of 9 to 12 minimum to provide clarity for maintenance.

				Common Name		Planting Zone		Size/Spacing		Exposure		Design Comments		O&M Code		Additional O & M Comments		Abbreviations/Legend/O&M Code	
EG	DT	NWN	Height from Ground	Scientific Name															
EG	DT	<24"		<i>Alyogyne hirsutissima</i>	Bugleweed	3.4	4' Pol / 12' o.c..		:x,:o				E						
EG	DT	<24"		<i>Epinema nudum</i> or <i>staphispermum</i> of <i>ciliolatum</i>	Barewort	3.4	4' Pol / 12' o.c.. 1 Gal / 24' o.c..		:o			B							
EG	DT	<24"		<i>Euryomyrsia formosa</i> 'Kewensis'	Winter creeper euryomys	3.4	1 Gal / 18' o.c..		:x,:o			E							
EG	DT	NWN	<12"	<i>Fragaria chiloensis</i>	Native Strawberry			See Comments											
SEM	DT	<24"		<i>Geranium macrorrhizum</i> 'Album' or other cultivars	Hardy Geranium	3.4	1 Gal / 18' o.c..		:x,:o			B							
DT	NWN	<24"		<i>Melianthus major</i> 'Aureus'	False Lily of the Valley	1.2-3.4	4' Pol / 12' o.c..												
EG	DT	<24"		<i>Pachysandra terminalis</i>	Japanese Spurge	3.4	4' Pol / 12' o.c..		:o										
EG	DT	<24"		<i>Solidago speciosa</i> 'Iridifolia'	'Three-toothed Cirsiefoli'	3.4	4' Pol / 12' o.c..												
EG	DT	<24"		<i>Rubus tricolor</i>	Creeping Chinese Bramble	3.4	4' Pol / 12' o.c..		:o										
EG	DT	NWN	<24"	<i>Sedum divergens</i>	Stonecrop	3.4	4' Pol / 12' o.c..		:x,:o										
EG	DT	<24"		<i>Sedum regelianum</i>	Minature Stonecrop	3.4-5	4' Pol / 12' o.c..		:x,:o										
DT	NWN	<24"		<i>Vancouveria hexandra</i>	Inside Out Flower	3.4	4' Pol / 12' o.c..		:o										
SEM		<24"		<i>Potentilla nemmanniana</i> 'Nana'	Dwarf Cinquefoil	3.4-5	4' Pol / 12' o.c..		:x,:o										
EG		<24"		<i>Ophiopogon japonicus</i> 'Variegatus'	Dwarf mondo grass	3.4-5	4' Pol / 15' o.c..		:x,:o										

Stepable Plants

Guidance Statement: The following are plants that can tolerate some foot traffic.

				Common Name		Planting Zone		Size/Spacing		Exposure		Design Comments		O&M Code		Additional O & M Comments			
EG	DT	NWN	Height from Ground	Scientific Name															
EG		<24"		<i>Ophiopogon japonicus</i> 'Variegatus'	Dwarf mondo grass	3.4-5	4' Pol / 12' o.c..		:x,:o						E				
SEM		<24"		<i>Potentilla nemmanniana</i> 'Nana'	Dwarf Cinquefoil	3.4-5	4' Pol / 12' o.c..		:x,:o						E				
EG	DT	NWN	<24"	<i>Sedum acre</i>	Stonecrop	3.4-5	4' Pol / 12' o.c..		:x,:o										
EG	DT	<24"		<i>Sedum regelianum</i>	Minature Stonecrop	3.4-5	4' Pol / 12' o.c..		:x,:o										
EG	DT	<24"		<i>Thymus serpyllum</i> 'Emin'	Elfin creeping thyme	3.4-5	4' Pol / 12' o.c..		:o										
EG	DT	<24"		<i>Veronica avensis</i>	Speedwell	3.4-5	4' Pol / 12' o.c..		:o						E				

O: Cut back for neater appearance.

DA: Cut back for deadheading not required for function.

DR: Deadhead perennials in fall for neater appearance.

DS: Deadhead perennials or remove faded foliage in spring/summer to encourage reblooming/ new leaves and for neater appearance.

DT: Deadhead in fall to prevent re-sowing.

EW: Deadhead perennials in fall for neater appearance and to prevent re-sowing.

EW: Cut back or prune a over sidewalk

EW: Anytime fall to spring.

F: May need replacing every 5+ years. (Replace if not required if vegetation coverage meets requirements.)

G: May need dividing every few years. Reasons for division include dieback in center and to increase coverage.

H: May need replanting every 5+ years.

I: Cut back before new growth emerges.

J: Hand-take in Spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.

K: Leave foliage and seedheads for winter interest/provide food for birds and cut back if foliage collapses. Cut back in Spring (Mid-January to Mid-March) before new growth emerges.

L: Tolerates hot dry sites.

M: Tolerates hot dry sites.

N: O: For neater appearance deadhead in fall.

O: For neater appearance deadhead in fall to prevent re-sowing.

PA: Cut back for neater appearance.

PE: Cut back for neater appearance.

PF: Cut back for neater appearance.

PG: Cut back for neater appearance.

PH: Cut back for neater appearance.

PI: Cut back for neater appearance.

PJ: Cut back for neater appearance.

PK: Cut back for neater appearance.

PL: Cut back for neater appearance.

PM: Cut back for neater appearance.

PN: Cut back for neater appearance.

PO: Cut back for neater appearance.

PP: Cut back for neater appearance.

PR: Cut back for neater appearance.

PS: Cut back for neater appearance.

PT: Cut back for neater appearance.

PU: Cut back for neater appearance.

PV: Cut back for neater appearance.

PW: Cut back for neater appearance.

PY: Cut back for neater appearance.

QD: Cut back for neater appearance.

QF: Cut back for neater appearance.

QG: Cut back for neater appearance.

QH: Cut back for neater appearance.

QI: Cut back for neater appearance.

QJ: Cut back for neater appearance.

QK: Cut back for neater appearance.

QL: Cut back for neater appearance.

QM: Cut back for neater appearance.

QN: Cut back for neater appearance.

QP: Cut back for neater appearance.

QY: Cut back for neater appearance.

QZ: Cut back for neater appearance.

RA: Cut back for neater appearance.

RB: Cut back for neater appearance.

RC: Cut back for neater appearance.

RD: Cut back for neater appearance.

RE: Cut back for neater appearance.

RF: Cut back for neater appearance.

RG: Cut back for neater appearance.

RH: Cut back for neater appearance.

RJ: Cut back for neater appearance.

RK: Cut back for neater appearance.

RL: Cut back for neater appearance.

RM: Cut back for neater appearance.

RP: Cut back for neater appearance.

RQ: Cut back for neater appearance.

RR: Cut back for neater appearance.

RS: Cut back for neater appearance.

RT: Cut back for neater appearance.

RU: Cut back for neater appearance.

RV: Cut back for neater appearance.

RY: Cut back for neater appearance.

RZ: Cut back for neater appearance.

SA: Cut back for neater appearance.

SB: Cut back for neater appearance.

SC: Cut back for neater appearance.

SD: Cut back for neater appearance.

SE: Cut back for neater appearance.

SG: Cut back for neater appearance.

SH: Cut back for neater appearance.

SI: Cut back for neater appearance.

SP: Cut back for neater appearance.

SR: Cut back for neater appearance.

ST: Cut back for neater appearance.

SV: Cut back for neater appearance.

SW: Cut back for neater appearance.

SY: Cut back for neater appearance.

TB: Cut back for neater appearance.

TC: Cut back for neater appearance.

TD: Cut back for neater appearance.

TE: Cut back for neater appearance.

TF: Cut back for neater appearance.

TH: Cut back for neater appearance.

TI: Cut back for neater appearance.

TR: Cut back for neater appearance.

TS: Cut back for neater appearance.

TR: Cut back for neater appearance.

TS: Cut back for neater appearance.

TR: Cut back for neater appearance.



Bioretention Plant List for Development of Palettes in the Right of Way

Notes:

- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance. The trees and plants have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU/GSI, OEM, SPUR/IDT, and KCWTD Water Quality and OEM staff.
- SDOT's Streets Illustrated recommends new plantings in rights-of-way. Plant height within 30 feet of an intersection has measured from the corner face of the curb is 24 inches above curb elevation. The remaining planting strip should have plants that can be easily maintained to 30 inches with the exception of accent shrubs. Review height of bollards or stakes that may be higher than noted.
- No plants are to be used if they are on the current King Co. Noxious Weed List, WA Noxious Weed Control Board List and WA Dept of Ag Prohibited Plant List.
- Size/Spacing: initial planning of smaller sizes of emergents closer on center (e.g., 1') is suggested especially in Zones 1 & 2 to achieve the desired coverage.

Planting Zone Code - See Planting Zone Diagram, GSI Manual, Vol. III, Section 7.

Low Nutrient Soil Mix Plants, Vertical Accent Shrubs and Trees List (for bioretention cells with graded side slopes)

Guidance Statement: The following are plants that can tolerate low nutrient condition (this palette is an early list that should be observed and refined as the new low nutrient soils are used) of the bioretention soil media (little to no compost).

EG	DT	NNN	Height from Ground	Scientific Name	Common Name	Planting Zone	Size/Spacing	Exposure	Design Comments	O&M Code	Additional O & M Comments	Abbreviations/Legend&DM Code
Trees and Vertical Accent Shrubs (see also tree list for Bioretention)												
25'												
EG		NNNN	10 to 15'	<i>Acer circinatum</i>	Vine maple		10 gal		✓, ✓, E		Prune lower branches for 0 to 4 foot clearance	FG = Evergreen Semi = Semi-Evergreen DT = drought tolerant NNN = Northwest natives or cultivars UF = Urban Frontage (Mixed Use/Commercial) appropriate plants
EG	DT	NNNN	6'-10'	<i>Arbutus unedo</i>	Strawberry tree		10 gal		✓, ✓, E		Prune lower branches as it grows; can take additional branch pruning to lighten	SDOT = drought resistant B = Brought in Fall (October/November)
EG	DT	NNNN	H=6'-8' W=10'	<i>Arctostaphylos patens</i> Lester Rowntree	Lester Rowntree manzanita	1,2,3	10 gal		✓		Prune lower branches once established to achieve small tree form	NWN = Northwest natives or cultivars UF = Urban Frontage (Mixed Use/Commercial) appropriate plants
EG	DR	NNNN	6'-10'	<i>Grevillea victoriae</i>	Royal grevillea	1,2, 4	5 gal	✓	Used as a single shrub where a tree will not fit or at end of a wide cell. Don't use near intersections or driveways. Do not use in high nutrient BSM	Grows fast, Will take pruning to keep lighter; has cluster roots just below surface, drought tolerant except does better with monthly soaking in summer	Q = Full Sun A = Part Sun/Part Shade OA = Optional Attention	
D	DT	NNNN	2'-6'	<i>Mahonia aquifolium</i>	Oregon grape	3	3 or 5 Gal.		✓, ✓, E	Single plant, upright multi-stemmed. Plant 3 feet back on sidewalk side only	Prune to keep 4 feet narrow form and under 8 feet	O & DM Code
D	DT	NNNN	6'	<i>Rosa gymnocarpa</i>	Baldhip (Wood) rose	3	1 Gal / 24" o.c..		✓, ✓, E	Tough plant can handle wide range including wet/dry conditions; could mix with Salal. In areas where infrequent maintenance, don't use along active areas such as commercial or intense residential.	A = Cut back these perennials to 4-6" above ground in Fall (October/November) B = Leave foliage and seed pods for winter interest/provide food for birds and cut back if foliage collapses. Cut back in spring (Mid-March) before new growth emerges.	
EG	DT	NNNN	6'-10'	<i>Symphoricarpos albus</i>	Strawberry bush	1,2	3 Gal.		✓, ✓, E	Plant maximum of 1, because it forms thickets.	Has thorns or prickles. Will need thinning after 2 to 5 years	
EG	DT	NNNN	3 to 5'	<i>Vaccinium ovatum</i>	Evergreen Huckleberry	1,2,3	3 or 5 Gal.		✓, ✓, E	Vertical shrub once per cell and on sidewalk edge of cell.	E = May need pruning to leggy after 1-2 years	
EG	DT	NNNN	3 to 5'	<i>Zauschneria californica 'Catalina'</i>	Catalina California Fuchsia	1,2	3 or 5 Gal.		✓, ✓, E	Plant on sidewalk side, 3 feet back, year-round interest	Mounding habit prune if spreading onto pavement	
Shrubs and Groundcovers												
DT	NNNN	4" to 14"	<i>Allium acuminatum</i>		Taperlip onion	2, 3, 4	Bulb/ groups of 7		✓, ✓, E		Be aware some people may notice the "onion" smell	DS = Drought tolerant
EG	DT	NNNN	<24"	<i>Arctostaphylos uva-ursi</i> (Massachusetts) or Phi. Reyes' carpinella	Kinnikinnick	3,4	4" Pots 12" o.c. 1 Gal / 24" o.c.		✓, ✓, E	Mix sizes: Plant in groups of 7, ok to mix with short term plants (see list) for filler weed control until this fills in. Do not mix with grasses and shrubs due to difficult weeding	General requires wider (>4 feet) planting space to allow spreading	DS = Deadhead perennials or faded foliage in spring/summer to encourage reblooming new leaves and for neat appearance. Deadheading not required for function.
EG	DT	NNNN	8"-18"	<i>Blechnum spicant</i>	Deer fern	2,3	Quart / 18" o.c.		✓	Group minimum of 3 plants	May need to replace some plants if extreme weather cut low - 8-12" in late winter	DS = Deadhead perennials in fall for sowing. Deadheading not required for function.
DT	NNNN	30"	+plus flowers	<i>Buteloua caroliniana</i> var. caripendula	Sideoats grama	3,4	3'-4' o.c.		✓	Clumping perennial. Suitable for large wide cells, happy in clay, sandy or gravelly soils, on slopes and in extreme drought. Pair with Yucca & Rudbeckia. Not for standard planting sites.	Group minimum of 3 plants	C = Hand-take in spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.
Semi	DT	NNNN	8-18"	<i>Epimedium x versicolor "Sulphureum"</i>	Bishops Hat Clumping	3, 4	4" Pots 12" o.c. 1 Gal / 24" o.c.		✓, ✓, E	Recomended placement on along sidewalk side due to potential height if along streetbed place back 4 feet from face of curb. Note groupings as it will spread and takes time to establish.	DS = Hand-take in spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.	
EG	DT	NNNN	24"-36"+ can get 5 ft	<i>Gaultheria shallon</i>	Salal	3	1 Gal / 24" o.c. Quart 18" o.c.		✓, ✓, E	Recomended placement on along sidewalk side due to potential height if along streetbed place back 4 feet from face of curb. Note groupings as it will spread and takes time to establish.	DS = Hand-take in spring (Mid-January to Mid-March) before new growth emerges. Cut back to ground or thin every 2-3 years as needed.	
EG	DT	NNNN	2"	<i>Grevillea juniperina 'Pink Lady'</i>	Pink Lady grevillea	2,3,4	1 Gal / 24" o.c.		✓	Plant as feature on slope, slow growing	F = May need replanting every 5-7 years. (Replacement not required if vegetation coverage meets requirements)	
DT	NNNN	6"-10" (4w)	<i>Gymnospermium droopingis</i>	Western Oakleaf	1,2	Quart / 12" o.c.		✓	Group plants possibly with two orange grape and sedums.	G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.		
EG	DT	NNNN	3'	<i>Halimium lasianthum 'Sandring'</i>	Yellow Rock Rose	3	1 Gal / 24" o.c.		✓	winter dieback - cut redundant to remove.	G = May need dividing every few years. Reasons for division include dieback in center and to increase coverage.	
EG	DT	NNNN	<24"	<i>Urtica mucronata</i>	Urticaceous	2,3	4" pots 12" o.c.		✓	Place min 24 inches back of curb	If spreading beyond desired area, pull out some plants	
EG	DT	NNNN	24"	<i>Mahonia aquifolium</i>	Stonecrop	1,2,3	Quart 12" o.c.		✓	Group minimum of 5 plants	Requires water during 2 yr establishment period	
EG	DT	NNNN	<24"	<i>Dymortea</i> , Frosted Fire, Sedum 'tall'	Creeping Oregon grape	3,4	4" pots 12" o.c.		✓	Mix sizes: Will not do well in heat exposure or in drying winds	E = Mix as accent; group minimum of 5	
EG	DT	NNNN	<24"	<i>Thymus serpyllum 'Elfin'</i>	Elfin creeping thyme	3,4,5	4" Pot / 12" o.c.		✓	Place along curb or sidewalk. Could also be used above discharge points to soften exposed pipe. Group in a length of 8 feet along walks.	DS = expect winter dieback. F = If height is issue can now in spring. To fill in bare spots crew may divide once established.	

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Tree Lists for Bioretention in the Right-of-Way

Issued: August 2018 / Updated February 2020

Notes:

- This tree list has been adapted from the SDOT Street Tree List, with trees added and removed for conditions of bioretention.
- Tree size at planting shall be project specific. Intent is to be 1½" caliper when possible.
- The trees have been reviewed and approved by SDOT Urban Forestry and Landscape Architecture, SPU GSI O&M, SPU/SDOT ITD, KCWTD Water Quality and O&M staff.
- This plant list was developed to provide consistency in the right of way for installation and long term operations and maintenance.
- No plants on the current King County Noxious Weed List, the WA Noxious Weed Control Board List and the WA Dept. of Ag. Prohibited Plant List are to be used.
- Designers should review each neighborhood for tree species diversity and select species to provide variety.
- See GSI Manual Vol III. Design, Section 7, GSI Planting Design.

Planting Zone Code - See Planting Zone Diagram, GSI Manual Vol. III, Section 7

Zone 1 plants are typically tolerant of both wet and dry conditions. Zone 1 plants are typically used for filtration and water quality in the bottoms of the bioretention facilities. Some trees are able to be viable in this zone.

Zone 2 plants are located in the lower slopes / wetted or ponded side area of the bioretention facilities. Zone 2 plants are also typically used for water quality/ filtration.

Zone 3 includes plant species (30 inch mature height) appropriate for planting at the upper slopes of the of bioretention areas. Zone 3 may include limited vertical accent plants and trees.

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Conifers (Deciduous & Evergreen)

Guidance Statement: Plant larger sizes in order to be able to limb them up to 36" minimum clearance.								General O&M Statement: Prune up yearly until sight clearance achieved.
Scientific & Common Name	Mature Urban Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Calocedrus decurrens</i> , Incense Cedar	75	15	No	8	3			
<i>Metasequoia glyptostroboides</i> Dawn Redwood	50	25	No	6	1,2,3	Yes		Fast growing deciduous conifer.
<i>Pinus contorta contorta</i> Shore Pine	45	30	No	5	1,2,3			
<i>Taxodium distichum</i> Bald Cypress	55	35	No	8	1,2,3	Yes		A deciduous conifer, broadly spreading when mature – columnar when young.
<i>Taxodium distichum</i> 'Mickelson' Shawnee Brave Bald Cypress	55	20	No	6	1,2,3	Yes	x	Deciduous conifer - tolerates city conditions
<i>Thuja plicata</i> 'Excelsa' or 'Hogan' Western Red Cedar	40	15-20	No	8	1,2,3			Narrow columnar form.

Medium/Large Broad-Leaved Evergreen Trees

Guidance Statement: Ornamental in appearance, provides year-round function.								General O&M Statement: Prune up yearly until sight clearance achieved.
Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Lithocarpus densiflorus</i> Tan Oak	50	20	No	6	3			
<i>Quercus ilex</i> Holly Oak	40	30	No	5	3	N/A	x	Underside of leaf is silvery-white. Often has a prominent umbrella form. Prune for form.
<i>Umbellularia californica</i> Oregon Myrtlewood	60	30	No	5	1,2,3			Drought tolerant native in S. OR.

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Issued: August 2018 / Updated February 2020

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Large Deciduous Columnar Trees

Guidance Statement: Use columnar trees only in areas that have restricted space or near wires.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer nigrum</i> 'Green Column' Green Column Black Sugar Maple	50	10	No	6	3	Yes	x	
<i>Ginkgo biloba</i> 'Princeton Sentry' Princeton Sentry Ginkgo	40	15	No	6	3	Yes	x	Prune for form
<i>Quercus robur</i> 'fastigiata' Skyrocket Oak	40	15	No	6	3	N/A	x	

Large Deciduous Trees

Guidance Statement: Broad canopy trees provide greater stormwater function and increased shade.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer saccharum</i> 'Commemoration' or 'Bonnfire' Commemoration or Bonfire Sugar Maple	50	35	No	6	1,2,3	Yes	x	Resistant to leaf tatter.
<i>Fagus sylvatica</i> Green Beech	50	40	No	6	3	Yes	x	Silvery-grey bark. Can't handle root disturbance.
<i>Fagus sylvatica</i> 'Asplenifolia' Fernleaf Beech	60	50	No	6	3	Yes	x	Can't handle root disturbance.
<i>Ginkgo biloba</i> 'Magyar' Magyar Ginkgo	50	25	No	6	3	Yes	x	More upright and narrow than 'Autumn Gold'. Needs training when young.
<i>Liriodendron tulipifera</i> Tulip Tree	60+	30	No	8	1,2,3	Yes	x	Fast-growing tree.
<i>Platanus x acerifolia</i> 'Bloodgood' Bloodgood London Planetree	50+	40	No	8	1,2,3	N/A	x	More anthracnose resistant than other varieties – large tree that needs space.
<i>Quercus bicolor</i> Swamp White Oak	60	45	No	8	1,2,3	N/A	x	Shaggy peeling bark. Wet-soil tolerant.
<i>Quercus coccinea</i> Scarlet Oak	60	40	No	6	3	Yes	x	Good fall color
<i>Quercus imbricaria</i> Shingle Oak	60	50	No	6	3	N/A	x	Leaves can persist throughout the winter
<i>Quercus rubra</i> Red Oak	60	45	No	8	1,2,3	Yes	x	Fast growing oak – large tree that needs space. Heavy acorn producer.
<i>Tilia tomentosa</i> Silver Linden	60	50	No	6	3	Yes		Larger leaves than Littleleaf Linden. Fragrant flowers.
<i>Ulmus</i> 'Frontier' or 'Morton Glossy' Frontier or Triumph Elm	50	35	No	6	1,2,3	Yes	x	Resistant to Dutch elm disease
<i>Zelkova serrata</i> 'Greenvase' or 'Village Green' Green Vase or Village Green Zelkova	45	40	No	6	3	Yes	x	Exfoliating bark. Dark green leaves turn orange-red and purple in Fall.

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Medium / Large Deciduous Trees

Guidance Statement: Broad canopy trees provide greater stormwater function and increased shade.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer campestre</i> 'Evelyn' Queen Elizabeth Hedge Maple	40	30	No	5	1,2,3	Yes	x	More upright branching than the species.
<i>Acer freemanii</i> 'Autumn Blaze' Autumn Blaze Maple	50	40	No	6	1,2,3	Yes	x	Cross between red and silver maple – fast growing with good fall color
<i>Acer rubrum</i> 'Scarsen' Scarlet Sentinel Maple	40	25	No	6	1,2,3	Yes	x	Leaves are darker green and larger than those of other Red Maples and hold up well in summer heat. Upright branch habit.
<i>Aesculus x carnea</i> 'Briotii' Red Horsechestnut	30	35	No	6	3	N/A	x	Do not use near greenways or bicycle routes due to litter. Resists heat and drought better than other horsechestnuts
<i>Betula nigra</i> River Birch	40	30	No	5	1,2,3	Yes		Excellent flaky bark. Resistant to Bronze Birch Borer
<i>Cercidiphyllum japonicum</i> Katsura tree	45	40	No	8	1,2,3	Yes		
<i>Eucommia ulmoides</i> Hardy Rubber Tree	50	40	No	6	3	N/A	x	Dark green, very shiny leaves – insignificant fall color
<i>Fagus sylvatica</i> 'Rohanii' Purple Oak Leaf Beech	50	30	No	6	3	N/A	x	Purple leaves with wavy margins.
<i>Ginkgo biloba</i> 'Autumn Gold' Autumn Gold Ginkgo	45	35	No	6	3	Yes	x	Narrow when young.
<i>Nothofagus antarctica</i> Antarctic Beech	50	35	No	5	3	No	x	Rugged twisted branching and petite foliage.
<i>Quercus frainetto</i> Italian Oak	50	30	No	6	3	N/A	X	Drought resistant – green, glossy leaves in summer.
<i>Sophora japonica</i> 'Regent' Japanese Pagoda tree	45	40	No	6	3	Yes	x	Has a rapid growth rate and tolerates city conditions, heat, and drought.
<i>Tilia cordata</i> 'Greenspire' Greenspire Linden	40	30	No	6	3	Yes	x	Symmetrical, pyramidal form. Fragrant flowers.
<i>Ulmus parvifolia</i> 'Emer II' Allee Elm	45	35	No	5	1,2,3	Yes	x	Exfoliating bark and good fall color – Resistant to Dutch Elm Disease

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Medium Columnar Deciduous Trees

Guidance Statement: Use columnar trees only in areas that have very restricted space or near wires.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer rubrum</i> 'Bowhall' Bowhall Maple	40	20	No	6	1,2,3	Yes	x	Upright, pyramidal form
<i>Carpinus betulus</i> 'Fastigiata' Pyramidal European Hornbeam	40	15	No	5	1,2,3	Yes	x	Broadens when older.
<i>Fagus sylvatica</i> 'Dawyck Purple' Dawyck Purple Beech	40	12	No	6	3	Yes	x	Purple foliage.
<i>Oxydendron arboreum</i> Sourwood	35	12	No	5	3	Yes	x	Consistent and brilliant fall color.
<i>Nyssa sylvatica</i> Tupelo	40	20	No	6	1,2,3	Yes	X	Chunky bark. Takes standing water and drought.

Medium Deciduous Trees

Guidance Statement: Use medium deciduous trees where large trees cannot fit or to increase species variety.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer rubrum</i> 'Karpick' Karpick Maple	40	20	No	6	1,2,3	Yes	x	Finer texture than other narrow forms of columnar maple.
<i>Acer truncatum</i> x <i>A. platanoides</i> 'Keithsform' or 'Warrenred' Norwegian or Pacific Sunset Maple	35	25	No	5	3	Yes	x	Reliable reddish orange fall color.
<i>Cladrastis kentukea</i> Yellowwood	40	40	No	5	3	Yes	x	White flowers in spring, resembling wisteria flower – blooms profusely only every 2 to 4 years – yellow/gold fall color
<i>Cornus controversa</i> 'June Snow' Giant Dogwood	40	30	No	5	3	Yes	x	Frothy, 6-inch clusters of white flowers in June
<i>Corylus colurna</i> Turkish Filbert	40	25	No	5	3	Yes	x	Tight, formal, dense crown. Nice central leader. Not for mixed use areas with high ped traffic due to significant debris from nuts. Drought tolerant. Plant smaller sizes in order to facilitate establishment.
<i>Magnolia denudata</i> Yulan Magnolia	40	40	No	5	3	N/A	x	6" inch fragrant white flowers in spring.
<i>Ostrya virginiana</i> Ironwood	40	25	No	5	3	Yes	x	Hop like fruit – slow growing
<i>Pterostyrax hispida</i> Fragrant Epaulette Tree	40	30	No	5	3	Yes	x	Pendulous creamy white flowers – fragrant
<i>Ulmus parvifolia</i> 'Emer I' Athena Classic Elm	30	35	No	5	1,2,3	Yes	x	High resistance to Dutch Elm Disease. Drought resistant. Cinnamon colored exfoliating bark.

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Small Conifer /Broad-Leaved Evergreen Trees

Guidance Statement: Ornamental in appearance, provides year-round function.								General O&M Statement: Prune up yearly for sight clearance.
Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Chamaecyparis obtusa gracilis</i> Slender Hinoki False Cypress	15	6	Yes	5	3			Drought tolerant when established.
<i>Embothrium coccineum</i> Chilean Flame Tree	30	15	No	5	3			Brilliant orange red flowers in late spring. Tree can sucker.
<i>Eucryphia glutinosa</i> Brushbrush	25	15	Yes	5	3			Semi-evergreen. Best in part shade.
<i>Magnolia grandiflora</i> 'Edith Bogue' Edith Bogue Magnolia	18	12	Yes	5	1,2,3			Excellent BLE magnolia due to hardiness.
<i>Magnolia grandiflora</i> 'Victoria' Victoria Evergreen Magnolia	25	20	Yes	5	1,2,3	N/A	x	
<i>Magnolia maudiae</i> (= <i>Michelia maudiae</i>) NCN	25	20	Yes	5	3			
<i>Magnolia virginiana</i> Sweetbay	35	35		5	1,2,3		x	
<i>Quercus hypoleucaoides</i> Silverleaf Oak	30	15	No	5	3			
<i>Quercus myrsinifolia</i> Chinese Evergreen Oak	30	15	No	5	3			

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Small Deciduous Trees

Guidance Statement: Use small trees only in areas that have restricted space, under wires or possibly if room as a large accent shrub. Try to select a species that would add variety to the streetscape.

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Planting Zone	Fall Color	SDOT List	Design Comments
<i>Acer buegerianum</i> Trident Maple	30	30	Yes	5	3	Yes	x	Must train to a single stem – interesting bark.
<i>Acer circinatum</i> Vine Maple	25	25	Yes	5	3	Yes	x	Avoid using on harsh sites - native tree.
<i>Acer griseum</i> Paperbark Maple	30	20	Yes	5	3	Yes	x	Peeling cinnamon colored bark.
<i>Acer tartarium</i> Tartarian Maple	20	20	Yes	5	3	Yes		
<i>Acer triflorum</i> Three-Flower Maple	25	20	Yes	5	3	Yes	x	Multi seasonal interest with tan, exfoliating bark and red, orange/red fall color.
<i>Amelanchier laevis 'Snowcloud'</i> Snowcloud Serviceberry	25	15	Yes	4	3	Yes		
<i>Asimina triloba</i> Paw Paw	30	20	Yes	5	1,2,3	N/A	x	Burgundy flower in spring before leaves.
<i>Betula nigra 'Little King'</i> Little King River Birch	10	12	Yes	5	1,2,3	Yes		Suitable for enclosed vertical walls
<i>Carpinus caroliniana</i> American Hornbeam	25	20	Yes	5	1,2,3	Yes	x	Good fall color (variable – yellow, orange, red)
<i>Cornus kousa x nuttallii 'Starlight'</i> Starlight Dogwood	20	20	Yes	4	3	Yes		
<i>Lagerstroemia 'tuscarora'</i> Tuscarora Hybrid Crape Myrtle	20	20	Yes	4	3	Yes	x	Light cinnamon brown bark lends year round interest – drought resistant – likes a warm site
<i>Maackia amurensis</i> Amur Maackia	30	20	Yes	5	3	N/A	x	Exfoliating bark – flowering in June or July - varies in intensity from year to year
<i>Magnolia 'Elizabeth'</i> Elizabeth Magnolia	30	20	Yes	5	3	N/A	x	Yellowish to cream colored flower in spring.
<i>Magnolia 'Galaxy'</i> Galaxy Magnolia	25	25	Yes	5	1,2,3	Yes	x	Suitable for enclosed vertical walls. Showy pink flowers.
<i>Magnolia kobus 'Wada's Memory'</i> Wada's Memory Magnolia'	30	20	Yes	5	3	Yes	x	Drought tolerant. Does not flower well when young.
<i>Malus 'Lancelot'</i> ('Lanzam') Lancelot Crabapple	15	15	Yes	4	3	Yes	x	Red flower buds, blooming white – red persistent fruit
<i>Parrotia persica</i> Persian Parrotia	30	20	No	5	3	Yes		Blooms before it leafs out – drought tolerant - Varied fall color - reds, oranges and yellows.
<i>Rhamnus purshiana</i> Cascara	30	20	Yes	5	1,2,3	Yes	x	Suitable for enclosed vertical walls
<i>Salix matsudana 'Tortuosa'</i> Corkscrew willow	30	15	Yes	5	1,2,3	Yes		Do not use with underdrain.
<i>Stewartia pseudocamellia</i> Japanese Stewartia	25	15	Yes	5	3	Yes		Camellia-like flowers in summer. Interesting bark. Slow grower.
<i>Styrax japonica</i> Japanese Snowbell	25	25	Yes	5	3	Yes	x	Reliable and easy to grow, it has plentiful, green ½ in. seeds. Flowers similar to lily in the valley.
<i>Tilia cordata 'Chancolle'</i> or 'De Groot' Chancellor or De Groot Littleleaf Linden	30+	20	No	C=6, D=5	3	Yes	x	Pyramidal when young. Fragrant flowers that attract bees. One of the smaller stature littleleaf lindens.

Agency name

VEGETATION MANAGEMENT PLAN

Project Location – Project Name
Agency Project # if applicable

Date xx-xx-xxxx Revision xx-xx-xxxx

Suggest insert photo of site or location map

[Note to Users of this SAMPLE document: This is a template for developing a Vegetation Management Plan to document the project's approach for managing aggressive/invasive vegetation near a bioretention cell asset both prior to construction and into operations and maintenance. This document is intended to explain the why, how, when, who for managing the vegetation. This document was prepared by MIG|SvR under the SPU/WTD GSI program management contract in 2019. Contact SPU GSI Program Manager for editable document in Microsoft Office Word. Project designers shall tailor this document for their project's specific site conditions.]

Prepared for:

name

Project Manager

Agency

address

Seattle, WA 981xx-xxxx

Prime Company name
Address

Sub Company name

Contact: name

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1.0 PROJECT OVERVIEW

1.1 Summary

This Vegetation Management Plan is prepared xxxx

Incl reference to reports such as geotech, ECA, wetlands, arboreal, archaeological, wetland, cultural etc.

The project site is located on xxxxxx (parcel number xxxxxx) and consists of approximately xx acres that were previously used as xxxxxx. The site is currently xxxxxx

Planned improvements include: xxxxxxxx

The project mitigation plan (if applicable) will help to meet some of the goals of this Vegetation Management Plan (see Section 2 for VMP goals). The Conceptual Mitigation Plan will guide the future development of the mitigation plan, as well as a plan drawing (sheet xx) outlining proposed mitigation area. The Vegetation Management Plan will concentrate on the areas and activities not covered by the mitigation plan, focusing on anticipated project construction areas (outlined within the "Approximate Project Vegetation Management Boundary" in Figure #1), including construction impacts (clearing, revegetation), xxxxxx and future maintenance for these and adjacent areas.

Geotechnical considerations (as applicable) for the proposed project plans, including in particular recommendations for grading materials and methods and work in erosion hazard, landslide hazard, and steep slope hazard areas (as defined insert xxxx agency code ref) are addressed in the Technical Memorandum prepared for the project by name /agency/ company, dated xxxxxx.

1.2 Existing Vegetation

The existing vegetation types generally follow the xxxxxxxxxxxxxxxxx. Figure xx (in the Appendix) documents the existing vegetation and Table xx.x lists the existing plant species observed by xxxxxxxxxxx, xxxxxx, and/or xxxxxx. Dominant native species and occurrence of noxious weeds are noted by area.

The site (Areas xx, xx, and xx) consists of xxxxx. These areas are dominated by (fill in such as western red cedar, alder, black cottonwood, salmonberry, horsetail, red osier dogwood, slough sedge, ivy, blackberry etc), refer to xxx Technical Memorandum for more information.

Table 1.a – Existing Vegetation

The table (EXAMPLE) below lists the existing on-site vegetation by area with Dominant Vegetation denoted with an X and invasive species with Limited Presence denoted with an L.

The list is based on xxxx site visit, and xxxx report and xxxx site visits. Additional species may be present on site.

Legend	
X= Dominant Vegetation	Non-native invasive weed
L= Limited Presence Invasive	Ornamental plant not invasive

Scientific Name	Common Name	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
<i>Acer circinatum</i>	vine maple	X		X				X		X	X		
<i>Acer macrophyllum</i>	bigleaf maple				X		X	X		X	X		X
<i>Adiantum pedatum</i>	northern maidenhair fern												
<i>Alnus rubra</i>	red alder	X	X	X	X			X		X	X	X	X
<i>Athyrium cyclosorum</i>	western lady fern												
<i>Buddleja davidii</i>	butterfly bush												X
<i>Carex deweyana</i>	Dewey sedge												
<i>Carex obnupta</i>	slough sedge			X									
<i>Cornus sericea</i>	red osier dogwood	X			X								
<i>Corylus cornuta</i>	beaked hazelnut				X								
<i>Cotoneaster</i>	cotoneaster								X				
<i>Culluna vulgaris</i>	heather									X			
<i>Cupressus x leylandii</i>	Leyland cypress												
<i>Equisetum arvense</i>	common horsetail	X											X
<i>Equisetum telmateia</i>	giant horsetail	X											
<i>Gaultheria shallon</i>	salal												
<i>Geranium robertianum</i>	herb-Robert					L		L					
<i>Hedera helix</i>	English ivy				L	X			X		L		L
<i>Ilex aquifolium</i>	holly	L											L
<i>Impatiens noli-tangere</i>	touch-me-not balsam				L								
<i>Iris pseudoacorus</i>	yellow flag iris (confirm)	L	L										
<i>Juncus effusus</i>	soft rush												
<i>Lamium galeobdolon</i>	yellow archangel					L							
<i>Lonicera involucrata</i>	twinberry												
<i>Lysichiton americanum</i>	skunk cabbage				X								

Scientific Name	Common Name	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
<i>Mahonia nervosa</i>	low oregon grape				X			X		X	X		X
<i>Oemleria cerasiformis</i>	Indian plum or osoberry							X		X	X		
<i>Oplopanax horridus</i>	devil's club												
<i>Phalaris arundinacea</i>	reed canary grass												
<i>Picea sitchensis</i>	Sitka spruce												
<i>Polypodium glycyrrhiza</i>	licorice fern										X		X
<i>Polystichum munitum</i>	sword fern				X	X	X	X		X	X	X	X
<i>Populus balsamifera</i>	cottonwood	X											
<i>Prunus laurocerasus</i>	English laurel					L							
<i>Pseudotsuga menziesii</i>	Douglas fir						X						
<i>Pteridium aquilinum</i>	bracken fern												
<i>Ranunculus repens</i>	creeping buttercup	X	X	L	X	X	L	X		X	X		
<i>Rhamnus purshiana</i>	cascara			X									
<i>Rhododendron</i>	rhododendron								X				
<i>Ribes lacustre (bracteosum)</i>	prickly currant												
<i>Rubus armeniacus</i>	Himalayan blackberry	X	L	L		L	L				L	X	L
<i>Rubus laciniatus</i>	cut-leaf blackberry												L
<i>Rubus parviflorus</i>	thimbleberry												
<i>Rubus spectabilis</i>	salmonberry	X	X	X						X	X		
<i>Rubus ursinus</i>	trailing blackberry				X					X	X		
<i>Salix spp.</i>	willow												
<i>Sambucus racemosa</i>	red elderberry												
<i>Sequoiadendron giganteum</i>	giant sequoia												
<i>Symporicarpos albus</i>	common snowberry												
<i>Tolmiea menziesii</i>	piggy back plant		X	X							X		
<i>Thuja plicata</i>	Western red cedar	X	X	X	X	X	X	X	X	X	X		X
<i>Tsuga heterophylla</i>	Western hemlock				X								
<i>Vaccinium parvifolium</i>	red huckleberry										X		
<i>Vinca minor</i>	vinca				L								

2.0 GOALS AND OBJECTIVES EXAMPLE

2.1 Wildlife habitat protection and enhancement

1. Remove extensive monocultures of noxious weeds to allow opportunities for regrowth of native species to enhance habitat. See Sections 3 & 4.
2. Provide snags and large woody debris to enhance habitat. See Section 4.
3. Retain duff and woody debris on site. See Section 4.

2.2 Water quality protection and enhancement

1. Remove extensive monocultures of noxious weeds to allow infiltration of stormwater and improve water quality. See Sections 3 & 4.
2. Maintain or restore site soils to prevent erosion and maintain or improve soil moisture capacity. See Section 4.

2.3 Protecting the public health and safety from geologic hazards and erosion

1. Stabilize slopes during construction, maintenance and noxious weed removal. See Sections 3 & 4.
2. Remove hazard trees near sidewalks, structures, streets, roads, trails, parking etc. See Section 5.

2.4 Maintaining or improving hydrologic conditions

1. Restore and maintain site vegetation in conjunction with permitted drainage improvements to match or mimic existing hydrologic conditions (forested). See Section 6.

3.0 NOXIOUS WEED MANAGEMENT

3.1 Existing Noxious Weeds EXAMPLE

Table 3.a, below, lists existing noxious identified on the site, locations observed, weed class (per King County- update per current year and confirm if Seattle specific adds) and control requirements.

Table 3.a – Existing Noxious Weeds

Scientific Name	Common Name	Location Dominant*	Location Limited Presence*	King County Class	Control
<i>Buddleja davidii</i>	butterfly bush	A11		B	Recommended
<i>Geranium robertianum</i>	herb-robert		A4, A7	B	Recommended
<i>Hedera helix</i>	English ivy	A4, A7	A3, A9, A12	C	Strongly Recommended
<i>Ilex aquifolium</i>	holly		A1, A12	None	Recommended
<i>Impatiens capensis</i> (<i>noli-tangere</i>)	touch-me-not balsam		A3	None	Recommended
<i>Iris pseudoacorus</i>	yellow flag iris (confirm)		A1, A2	C	Recommended
<i>Lamium galeobdolon</i>	yellow archangel		A4	B	Recommended
<i>Phalaris arundinacea</i>	reed canary grass	A1	A5	C	Recommended
<i>Prunus laurocerasus</i>	English laurel		A5	None	Recommended
<i>Ranunculus repens</i>	creeping buttercup	A1, A2, A4, A5, A7, A9, A10	A3, A6	None	Recommended
<i>Rubus armeniacus</i>	Himalayan blackberry	A1, A11	A2, A3, A5, A6, A10, A12	C	Recommended
<i>Rubus laciniatus</i>	cut-leaf blackberry		A12	C	Recommended
<i>Vinca minor</i>	vinca		A4	None	Recommended

* See Figure #1 for location key. Locations shown in **BOLD** include areas within the Approximate Project Vegetation Management Boundary and/or Mitigation Areas. These areas include A1, A2, A4, A5, A7, and A8.

3.2 Noxious Weed Control EXAMPLE

There are multiple noxious weeds species on-site as noted above in Table 3.a. King

County defines three classes of noxious weeds, of which only Class A legally requires removal/control by the property owner. The classes are defined by King County as follows (King County, 2017- UPDATE WITH CURRENT):

- ❖ Class A Weeds: Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. *Eradication of all Class A plants is required by law throughout Washington.*
- ❖ Class B Weeds: Non-native species presently limited to portions of Washington. Species are designated for control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal.
- ❖ Class C Weeds: Noxious weeds that are typically widespread in Washington or are of special interest to the state's agricultural industry. The Class C status allows counties to require control if locally desired or to choose to provide education or technical consultation.

(insert as applicableNone, or a few or several) of the weeds identified on the project site are listed as Class A, and thus none or xxx require removal, but all are recommended for removal and/or control, particularly in natural environments. Controlling weeds means not letting weeds reproduce. Usually, that means not letting them go to seed. "Legally, control means *to prevent the dispersal of all propagating parts capable of forming a new plant.*" (King County, 2017) The King County noxious weed web site lists control methods.

If feasible, projects should take advantage of the site clearing and grading operations and combine removal of invasives/weeds in large areas with the construction project or removals prior to construction. Follow up removals should occur at least 2x during construction. Clearing smaller areas may be effective if they are contiguous with other work and performed yearly.

Refer to King County Noxious Weed List for removal methods.

<http://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/laws/list.aspx>

Noxious weed removal should focus on areas impacted by proposed project, including the area identified as Project Vegetation Management Area in Figure #1 of this VMP, as well as areas identified for mitigation planting or other mitigation or critical areas measures as identified in xxxxx Report. These are the areas generally referred to below as the "site". Weed control and removal beyond these areas would include that related to regular maintenance of areas as legally required (e.g. Class A weeds) or deemed necessary by the project manager or Asset Manager. The following is recommended in prioritizing weed removal:

A. Mitigation Areas

See the mitigation plan for description of invasive weed removal in mitigation areas. If feasible, remove additional infestation in project or critical areas adjacent to (within xx feet of) the mitigation and replant as noted in the adjacent mitigation area.

(insert area description, photo and specific issues as applicable)

B. Landslide and Steep Slope Areas Requiring Stabilization

There is currently an infestation of xxxxxxxxxxxxxxxxx

After removal place a biodegradable erosion control blanket such as GreenC125BN (2 yr) or C700BN (4 yr) per manufacturer's recommendations. Pocket plant by cutting a cross in the fabric. Replant the area with plants noted on the plant replacement list (Table 4.a EXAMPLE).

If resources are limited remove and replant smaller areas in a sequenced or phased approach starting at the top of the slope and working downhill. If small areas (under 8 foot wide linear strip) are removed an erosion control blanket should not be required. Apply concentrated xxx check current recommendations, per King County Noxious Weed List Website.

Care should be taken when using herbicides as the water flows into a wetland at the base of the hill. Follow BMP's and obtain required permits when using herbicides.

Plant using a benching technique (see Section 4 for recommended plants for revegetation). Monitor areas for seedling repopulation for 3 to 5 years after removal. Dispose of all plant materials off site. Review King County noxious weed site for additional information.

Insert photos as applicable

C. *Hedera helix* (English Ivy) Areas

Removal of *Hedera helix* (English ivy) Remove from trees first, then ground areas, starting in the areas of limited presence within the site, and within or adjacent to mitigation areas. English ivy control and removal will require a moderate but sustained effort. A heavy mulch layer (particularly with an underlayment of cardboard, e.g. sheet mulching) after removal on the ground can be effective in combating its spread. See additional guidance on English ivy removal from King County at

<http://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/weed-identification/english-ivy.aspx>.



Hedera helix (English ivy) spreading in forest area

D. Areas with Limited Presence (L)

Remove weeds from areas with limited weed/invasive presence to avoid having to deal with many different plant species and large land areas. Many of the invasive plants have seeds that can stay viable for several years. Removing the small patches will minimize a large seed base and plants spreading to other areas. See Table 3.a above for plants and areas to target first. If possible, document the removal on a map and return each year to review if the plants have been fully removed for a **3 to 5 years** after the removal



Lamium galeobdolon (yellow archangel)

E. Areas with a Dominant Presence (X)

The future Cougar Squak Corridor Trailhead and Parking Lot mitigation plan (to be developed) will address the removal of dominant invasive weeds from critical

areas and mitigation areas. **EXAMPLE** The *Ranunculus repens* (creeping buttercup) is quite prevalent throughout the site due to all the disturbed old campsite areas. The seeds are viable for more than 20 years so complete removal is nearly impossible. The plant depletes potassium in the soils. Remove, dispose, improve soil nutrient and replant as much of the area(s) as feasible. If removing manually be sure to remove the entire plant, including roots. When replanting choose taller, fast-growing shrubs from the **mitigation plan** or if in the steep slope areas choose from the plant replacement list (Table 4.a). This will provide for a more diverse habitat even if the *Ranunculus repens* is still present.

3.3 Review for New Invasive Weeds

Approximately every 3 years the entire site should be reviewed for invasive plants. Seeds travel by wind, water, mammals, insects and birds from the surrounding areas. Also, occasionally a native species can act invasive and completely dominate an area, limiting habitat diversity. Review mitigation goals and adjust maintenance practices as needed. Watch for slides and eroded areas – these bare earth areas are prime sites for colonization by invasive weeds. This review can help inform maintenance practices on for the site, and can help control spread of invasive plants into or out of the Project Vegetation Management Area, Mitigation Areas, Critical Areas, and other areas of the site.

4.0 VEGETATION REPLACEMENT & WOODY DEBRIS

4.1 Vegetation Clearing & Soil Management

Re-development of the site will require some amount of vegetation removal, as well as soil management. This section contains recommendations for proceeding with these topics.

Further development of project plans should include development of a tree, soil and vegetation protection plan. This plan should identify areas of soil and vegetation to be protected, trees to be preserved, and should provide guidance on how to protect these resources, as well as working around the identified trees and protection zones.

Existing vegetation should be cleared only in designated work areas, and as required for noxious weed removal or mitigation plantings. Noxious weed materials should be removed and disposed of off-site in an approved facility. Project designers should review whether the project construction areas have viable native plants for salvaging, and plan for doing so if feasible. Woody native materials or non-invasive trees may also be chipped on site and the wood chips used as mulch in restoration and erosion control areas.

Soil materials (forest duff and topsoil) should be preserved and re-used on site, except in cases where they had supported significant amounts of noxious weeds. Soils in the project area with any amount of English ivy roots or other parts, reed canary grass, or likely seed accumulation from other noxious weeds, should be left in the original location and treated per the noxious weed removal guidelines, or removed from the site and disposed of at an approved facility. Other topsoil and duff in the project area should be protected from compaction. It may be stockpiled during construction activities replaced at depths to be recommended by project designers.

Any soils or subgrade materials exposed during construction should be covered and protected from erosion per regulatory requirements and accepted best management practices.

See general guidelines at Seattle's website

xxxxx

See general guidelines at King County's website -

<http://www.kingcounty.gov/depts/permitting-environmental-review/info/SpecialInterest/ConstructionIndustry/ErosionControl/ErosionControlBMPs.aspx>. More specific information on these practices is given in the King County Surface Water Design Manual, Appendix D – Construction Stormwater Pollution Prevention Standards. If using seeding, straw, or other organic materials as part of temporary erosion control measures, take care to ensure that these measures do not introduce

unwanted (weedy) species to the site (e.g. species from temporary erosion control seed mixes that become difficult to remove).

Imported planting soil, and/or compost may be necessary to supplement preserved site topsoils in areas to be revegetated. If this is the case, imported compost and soil materials should be certified as weed free, and should be blended into native materials to better mimic the natural soil profiles of the site.

See the [Geotechnical Technical Memorandum or Report](#) for recommendations on soil management and preparation in landslide hazard, erosion hazard and steep slope hazard areas.

4.2 Plant Replacement - General

Plants selected for use in revegetation areas should be native species suitable to the site conditions. Avoid aggressive native species that are likely to form a monoculture. One starting point for plant selection may be King County's Native Plant Guide website, which can be found at <https://green2.kingcounty.gov/gonative/index.aspx>. A qualified professional should help select and plan the plantings as development designs progress.

If necessary, climatically-adapted and non-invasive species (e.g. drought and cold tolerant, non-spreading) may be used near developed areas of the site (e.g. if there are not appropriate native species).

Plants should be selected and located for reduced maintenance needs, as well as ability to establish and thrive in the site conditions, and contribute to site diversity and habitat value. Lastly, plants should be selected to help stabilize slopes and prevent erosion where necessary – by developing robust root systems, leaf and branch structures that help intercept rainfall, and providing year-round benefits.

4.3 Plant Replacement for Steep Slope Areas

Plant replacement will be required as part of site development, after noxious weed removal, and for slope stabilization. Refer to the mitigation plan for plant replacement within mitigation areas. Plant selection for general site areas impacted by site development is addressed in the previous section.

Table 4.a below lists some specific species that are recommended for use in revegetating steep slope and trail edge areas. Species listed for landslides or other steep areas are native species that can tolerate poorer soils and more exposed sites, and should develop robust root structures. Species listed for trail edges are native species that will stay lower in height and not encroach as readily on trails as many larger native species.

Table 4.a – Plant Replacement List for Steep Slope and Edge Areas EXAMPLE

Common Name	Scientific Name	Spacing	Size*
Landslide Area or Other Steep Areas Away From Trail Edge			
vine maple	<i>Acer circinatum</i>	10' O.C.	1 gallon or bareroot
Indian plum or osoberry	<i>Oemleria cerasiformis</i>	4' O.C.	1 gallon
salmonberry	<i>Rubus spectabilis</i>	4' O.C.	1 gallon or bareroot plant
red elderberry	<i>Sambucus racemosa</i>	4' O.C.	1 gallon or bareroot
common snowberry	<i>Symphoricarpos albus</i>	2' O.C.	1 gallon or bareroot
Project or Sidewalk Edges – Within 3' to 5' from Edge			
sword fern	<i>Polystichum munitum</i>	2' O.C.	1 gallon
trailing blackberry	<i>Rubus ursinus</i>	2' O.C.	1 gallon or bareroot
trailing snowberry	<i>Symphoricarpos mollis</i>	2' O.C.	1 gallon or bareroot
false lily of the valley	<i>Maianthemum dilatatum</i>	18" O.C.	4 inch pot
fringe cup	<i>Tellima grandiflora</i>	18" O.C.	4 inch pot, or plug
redwood sorrel	<i>Oxalis oregana</i>	18" O.C.	4 inch pot

*Plants available bare root are an option for fall or winter planting

4.4 Woody Debris and Snags

Construction on the site will require tree removal. If timber harvesting is not occurring the trees can be used as mulch, woody debris and snags.

Bury woody debris a minimum of a 1/3 the diameter and burying the snags a minimum of a third of the height. Snags should be a maximum of 10 feet above ground. Locate the snags at least 12 feet from the edge of the sidewalk. Plants can be added behind the log edge so the soil is stabilized after the logs degrade.

5.0 HAZARD TREES

5.1 Hazard Tree Review and Removal

Consult with an ISA-certified arborist do an assessment ([review agency hazard tree requirements](#)) of the tree health within approximately 50 feet of project area. The review should identify and include trees that may be infected by root rot, especially Douglas fir.

This can help identify trees that are, or may become hazardous near expected use areas, which could be flagged for pruning, snagging or removal during construction, even if not directly impacted by construction activities.

The proposed site plan should be reviewed prior to grading submittal for impacts to existing trees. Modify layout and grading plans and adjust tree removal plans as necessary, based on balance or site development needs and regulations versus tree preservation priorities. Sometimes additional trees can be preserved at little to no cost, or at additional project expense (such as through reducing grading extents by adding rockery/walls etc).

Review site conditions following construction for impacts that may require additional removal. Thereafter review trees on a regular time frame in accordance with agency routine maintenance requirements. As feasible, review and removal should occur during the dry months so that damage to soils will be minimized.

6.0 HYDROLOGIC CONDITIONS

6.1 Existing Hydrology

Insert xxx

The proposed project improvements will maintain, change , alter the existing hydrologic condition (e.g. forested) through use of a xxxxxxx, and/or other drainage features to be approved by permitting agencies.

6.2 Drainage-Related Site and Vegetation Maintenance

During maintenance operations remove any blockages that develop at the ends of the culverts, drainage structures, or other drainage infrastructure to ensure drainage is free flowing. Review the site for signs of erosion and stabilize areas that have bare earth.

Vegetation and soils maintenance operations related to drainage conditions may also include slope mowing or weeding, dry and wet ditch cleaning, repair and replacement of damaged culverts, etc. Maintenance personnel should follow agency approved practices and BMPs, and requirements established by any other regulatory agencies, including Army Corps of Engineers, as part of the permitting and site development process. For example, see those outlined in the 20xx King County Surface Water Design Manual, Appendix A - Maintenance Requirements for Flow Control, Conveyance and Water Quality Facilities.

7.0 MONITORING

7.1 Annual Review and Documentation

Recommend that a basic annual review of the site is conducted during normal

maintenance activities. Document approximate quantities, locations, and species of noxious weeds removed and methods of removal. Include review of specific plant replacement areas and keep a general log of revegetation plantings and mortality rate. Since every site is a little different, keeping a log of the effectiveness of each maintenance activity will help ensure the goals of this plan are met, as well as ensuring the most ecologically- and economically-effective noxious weed control/removal and revegetation practices are being used.

8.0 REFERENCES UPDATE

King County. May 2017. Noxious Weed Lists and Laws.
<http://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/laws.aspx> (accessed June 28, 2017)

King County. Oct 2014. King County Noxious Weed Control Program. Best Management Practices. www.kingcounty.gov/weeds.

King County. June 2003. Ecological Lands Handbook. Department of Natural Resources and Parks, Parks and Recreation Division. Seattle, Washington.

ADD reports, memos etc

9.0 APPENDIX

9.1 Figure 1 – Existing Vegetation Areas

Appendix H: Memorandum of Agreements

- Memorandum of Agreement #17-058-A between Seattle Public Utilities and Seattle Department of Transportation for Maintenance of Green Stormwater Infrastructure Assets in the Public Right of Way.



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Memorandum of Agreement # 17-058-A
Between
Seattle Public Utilities
And
Seattle Department of Transportation
For
Maintenance and Operations of Green Stormwater Infrastructure Assets
In the Public Right of Way

THIS MEMORANDUM OF AGREEMENT ("Agreement") is made by and between the Seattle Public Utilities Department ("SPU"), and Seattle Department of Transportation ("SDOT"). City, SPU and SDOT may also be referred to in this Agreement as "Party" or, collectively, as "Parties."

1. TERM OF AGREEMENT.

The term of this Agreement shall begin on the date when all parties have signed the agreement and shall end on January 1, 2020 unless amended by written agreement or terminated earlier pursuant to the provisions contained in this Agreement. This Agreement supersedes and replaces the "Memorandum of Agreement Between Seattle Public Utilities (SPU) and Seattle Department of Transportation (SDOT) for Green Stormwater Infrastructure (GSI) Operation & Maintenance Roles and Responsibilities, SDOT-SPU MOA No. GSI-1."

2. PURPOSE.

WHEREAS, the National Pollutant Discharge and Elimination System (NPDES) Program was established to protect the environment, human health and quality of life in accordance with the Clean Water Act, and

WHEREAS, Executive Order 01-08 directs all City Departments to coordinate to comply with the requirements of the City's NPDES Municipal Stormwater Permit (MS4 Permit) which has been issued to the City of Seattle by Washington State Department of Ecology (Ecology) under the provisions of the Federal Clean Water Act, and

WHEREAS, the City of Seattle Stormwater Code was amended to comply with MS4 Permit requirements, and the Stormwater Code includes requirements for roadway projects and trail and sidewalk projects to implement green stormwater infrastructure (GSI), and

WHEREAS, City Council Resolution 31549 established GSI as a critical aspect of a sustainable drainage system, and an associated Executive Order 2013-01 set a citywide implementation target to manage 700 million gallons of runoff annually with GSI by 2025, and

WHEREAS, GSI facilities for roadway, trail and sidewalk projects are implemented in the public right of way (ROW), and adjacent property owners may get approval from the City to install voluntary GSI facilities in the right-of-way, and

WHEREAS, SDOT and SPU have obligations for operating and maintaining GSI constructed in the public ROW, and

WHEREAS, SDOT and SPU wish to establish a clear and common understanding of the roles and responsibilities for both departments for operations and maintenance of GSI in the ROW;

NOW THEREFORE, this Agreement defines SDOT's and SPU's approach for GSI facility selection, roles and responsibilities for maintaining and operating GSI and obligations for restoration and replacement of GSI including cost obligations.

3. BACKGROUND.

SPU began installing GSI in the ROW in 1999. The 2009 Stormwater Code established requirements for installing GSI to the maximum extent feasible for all project types.

The 2016 Stormwater Code includes requirements for installation of GSI for roadway, sidewalk and trail projects. Most GSI facilities installed for roadway, sidewalk and trail projects in the ROW are, as of the signing of this Agreement, and will continue to be bioretention, rain gardens and pervious sidewalk. ~~SDOT and SPU agree that, to the extent allowed by the Stormwater Code, bioretention and rain gardens will be the preferred GSI facility types to meet Stormwater Code requirements in the ROW. Pervious surfaces will be installed after installation of bioretention and rain gardens has been evaluated and determined to be infeasible.~~

4. DEFINITIONS.

The definitions of assets are for the sole purpose of identifying and clarifying roles and responsibilities for GSI maintenance. They may vary slightly from or be in addition to GSI types identified in the Stormwater Code and MS4 Permit. They are not intended to replace or alter definitions in the Stormwater Code and MS4 Permit.

Biofiltration swale: An open, gently sloped, vegetated channel designed to treat stormwater.

Bioretention: Shallow earthen depression or vertical walled open bottom boxes with a designed soil mix and plants adapted to the local climate and soil moisture conditions. Treated water is infiltrated into the underlying soil, or in soils with lower infiltration rates, collected by an underdrain and discharged to the drainage system.

Green stormwater infrastructure (GSI): Distributed BMPs, integrated into a project that use infiltration, filtration, storage, or evapotranspiration, or provide stormwater reuse.

Pervious sidewalk: Pervious concrete, asphalt and paving systems that allow rainfall to flow through the sidewalk and infiltrate into the underlying substrate.

Pilot installation: Installation of a GSI facility type that is not specifically listed in Attachment 1. Pervious alleys and roadways, and permeable pavement sidewalks and trails installed for flow control and water quality, shall be considered pilot installations for the purposes of this Agreement. Note that this term does not refer to or involve Ecology's TAPE program for approving new stormwater technologies.

Rain garden: Shallow landscaped depression with compost-amended soil or imported bioretention soil and plants adapted to the local climate and soil moisture conditions. Rain gardens may only be used to meet "on-site" Stormwater Code requirements.

Underdrain: A pipe with either slots or perforations that is located within a BMP that either disperses stormwater for infiltration or conveys stormwater not infiltrated to a discharge point.

Voluntary bioretention and rain garden: Bioretention and rain gardens installed in the ROW typically by an adjacent property owner, that are not required for Stormwater Code compliance.

Voluntary pervious concrete, asphalt and pavers in the planting strip area: Pervious concrete, asphalt and pavers installed in the planting strip area typically by an adjacent property owner, that are not required for Stormwater Code compliance.

5. MAINTENANCE AND OPERATION RESPONSIBILITIES FOR GSI ASSETS.

Operation and maintenance responsibilities for GSI assets in the ROW may include the following:

Ownership: Includes design approval, construction acceptance, recording of asset information and condition tracking. Unless otherwise stipulated asset ownership includes cost responsibility for maintenance.

Design approval: Includes establishing design standards, conducting design review, final design approval, establishing construction inspection and reporting requirements and approving inspection reports.

Construction inspection: Includes conducting and reporting on inspection in accordance with established standards.

Acceptance: Includes assuming ownership of a newly constructed asset and recording it in the department's asset inventory.

Periodic inspection: Inspection done to evaluate performance of a GSI asset installed to meet Stormwater Code requirements. Periodic inspection tasks and schedule shall follow Appendix G of the Stormwater Code Manual and Section S5.C9.c. of the MS4 Permit.

Routine maintenance: Maintenance activities performed on a GSI asset on a regular schedule such as specified in Section S5.C9.c. of the MS4 Permit to maintain performance levels identified in Appendix G of the Stormwater Manual or to restore the asset to an acceptable condition when necessary.

Reactive maintenance: Maintenance performed on a GSI asset to correct a safety hazard or performance deficiency such as identified in Appendix G of the Stormwater Control Manual as a result of observation, complaint or claim.

Replacement: Removal and reconstruction of an asset that cannot be rehabilitated and restored to performance levels identified in Appendix G of the Stormwater Manual or that poses a safety hazard to the public.

Asset tracking: Collecting and maintaining data on an asset in a searchable inventory system.

Regulatory reporting: Collecting and providing information to Ecology to meet reporting requirements stipulated in the City's MS4 Permit.

Attachment 1 includes a table showing the department responsible for each operation and maintenance responsibility by GSI facility type.

6. GSI PILOT INSTALLATIONS.

GSI facility types beyond the types (including the purposes) specifically identified in Attachment 1 may be approved for installation in the ROW as a pilot installation. Pilot installations include permeable pavement alleys and roadways. Pilot installations also include sidewalks and trails installed for flow control and water quality. A pilot installation shall be approved by the SPU and SDOT Joint Executive Team (JET) prior to design and construction. Pilot installation proposals shall include the basis for design, a preliminary design, performance criteria, a performance monitoring plan and roles and responsibilities for ownership, design, construction, acceptance, maintenance, replacement, tracking and reporting.

7. VOLUNTARY GSI INSTALLATIONS.

Voluntary GSI installations include bioretention facilities, rain gardens and pervious concrete, asphalt and pavers in the planting strip area that manage municipal stormwater. SDOT issues permits to construct voluntary GSI in the ROW. SPU and SDOT must approve installation of voluntary GSI facilities prior to construction. Voluntary bioretention facilities and rain gardens will be owned by SPU. Voluntary pervious concrete, asphalt and pavers in the planting strip area will be owned by SDOT. The SDOT permit for a voluntary GSI installation typically obtained by an adjacent property owner shall stipulate that, to the extent allowed by law, the adjacent property owner is responsible for maintenance and operation of a voluntary GSI installation in the ROW adjacent to their property.

SDOT shall respond to complaints regarding condition or performance of a voluntary GSI facility. If the adjacent property owner is unresponsive and does not correct the deficiency of a voluntary bioretention facility or rain garden, SDOT shall notify SPU. SPU will be responsible for restoring the facility to an acceptable condition or removing it and restoring the affected area. SDOT will be responsible for addressing conditions associated with safety and performance of pervious concrete, asphalt and pavers in the planting strip area.

8. PERMEABLE PAVEMENT ALLEYS.

The Stormwater Code requires that GSI facilities be implemented when alleys result in creation of new impermeable surface where runoff discharges to a creek, wetland or small lake. Unless otherwise required by the Stormwater Code, SDOT and SPU agree that traffic areas in alleys will be paved with Portland cement concrete and asphalt concrete meeting the City of Seattle Standard Specifications. To the extent allowed by Code and law, GSI infrastructure required to meet Stormwater Code requirements for alleys will be located outside of the traffic areas in the alley or elsewhere in the same drainage basin.

9. COORDINATION AND REPORTING.

The principal points of contact for coordination and reporting are as follows:

- SDOT/SPU NPDES Coordinators – MS4 Permit reporting on annual maintenance of stormwater facilities in the ROW
- SPU Green Stormwater Infrastructure Lead – all SPU infrastructure-related issues
- SDOT Street Use Operations Manager – permitting and interaction with property owners on issues related to voluntary GSI facilities, including complaints
- SDOT Maintenance & Operations Pavement Management Manager – all SDOT infrastructure-related issues

10. DISPUTE RESOLUTION.

The departments shall make their best efforts to ensure compliance to the tenets of the Agreement. Additionally, staff will work together to successfully execute this Agreement. If a situation arises which has not been identified in this Agreement the principal points of contact shall endeavor to come to an agreement as to a solution. If they cannot reach an agreement after two meetings within a time period that does not adversely affect project schedule or cost and in all cases in less than two weeks' time, the dispute will be elevated to their respective managers. The managers will confer and determine the appropriate solution elevating the issue as necessary. The solution will be communicated in writing to the principal points of contact and affected staff will be informed of the decision.

11. ASSIGNMENT.

This Agreement shall not be assigned in whole or in part by either Party without the prior written approval of the other Party. The Parties agree that such approval will not be unreasonably withheld.

12. COMPLIANCE WITH LAW.

The Parties to this Agreement shall comply with all federal, state, and local law, regulation and ordinances.

13. AMENDMENTS.

This Agreement shall not be amended or modified except in writing and signed by both Parties.

14. ENTIRE AGREEMENT.

This Agreement and any written Attachments thereto, constitute the complete contractual agreement of the Parties, and any oral representations or understandings not incorporated herein are excluded.

IN WITNESS WHEREOF, in consideration of the terms and conditions contained herein, the Parties have executed this Agreement by having their representatives affix their signatures below.

SEATTLE DEPARTMENT OF TRANSPORTATION

By _____
Signature

8/1/17
Date

Rodney Maxie, Director
Maintenance Operations Division

By _____
Signature

8/1/17
Date

Scott Kubly, Director
Seattle Department of Transportation

SEATTLE PUBLIC UTILITIES

By _____
Signature

5-27-17
Date

Madeline Goddard, P.E., Deputy Director
Drainage and Wastewater Line of Business

By _____
Signature

5-27-17
Date

Mami Hara, General Manager/CEO
Seattle Public Utilities

Attachments:

Attachment 1 – SDOT and SPU Roles and Responsibilities for Green Stormwater Infrastructure in the Right of Way.

Attachment 1

SDOT and SPU Roles and Responsibilities for Green Stormwater Infrastructure in the Right of Way

GSI Asset Type	Ownership ¹	Design Approval	Construction Inspection	Acceptance	Periodic ² Inspection	Routine Maintenance	Reactive Maintenance	Replacement	Asset Tracking	Regulatory Reporting
BioRetention (other than Voluntary)	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU
BioRetention (Voluntary)	SPU	SPU	SPU	SPU	N/A ³	N/A	SPU	SPU	SPU	N/A
Biofiltration Swales	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU	SPU
Pervious Sidewalk and Trails (for sidewalk, trail and roadway project on site requirements only)	SDOT	SDOT	SDOT	SDOT	N/A	N/A	SDOT	SPU	SDOT	N/A
Pervious concrete, asphalt and pavers in the planting strip area (Voluntary)	SDOT	SDOT	SDOT	SDOT	N/A	N/A	SDOT	SPU	SDOT	N/A
Rain Gardens (other than Voluntary)	SPU	SPU	SDOT	SDOT	N/A	N/A				
Rain Gardens (Voluntary)	SPU	SDOT	SDOT	SDOT	N/A	N/A	SPU	SPU	SPU	N/A
Underdrains for bioRetention	SPU	SPU	SPU	SPU	N/A	N/A	SPU	SPU	SPU	N/A
GSI walls outside roadway prism	SPU	SDOT/SPU	SPU	SPU	N/A	N/A	SDOT ⁴	SPU	SPU	N/A
Pilot Facility (includes permeable alleys and roadways and all permeable pavement installations for flow control and water quality)	Case by case	Case by case	Case by case	Case by case	Case by case	Case by case	Case by case	Case by case	Case by case	Case by case

Notes:

- 1 Responsible department assumes cost responsibility for activity unless otherwise noted.
- 2 Annual inspection required per MS4 Permit if installed to meet a flow control or water quality standard in the Stormwater Code.
- 3 N/A means that there is no requirement or standard practice to perform the activity.
- 4 SDOT will reimburse SDOT for the maintenance costs.



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Appendix I: Key Performance Indicators and Reporting

- Seattle Public Utilities Key Performance Indicators for Established SPU GSI Facilities
- Seattle Public Utilities Operation and Maintenance Reporting Form
- King County Wastewater Treatment Division Key Performance Indicators for Established WTD GSI Facilities in Seattle



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The following documents are being updated by SPU. Contact SPU GSI Asset Manager for information.

- Seattle Public Utilities Key Performance Indicators for Established SPU GSI Facilities
- Seattle Public Utilities Operation and Maintenance Reporting Form



King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

KEY PERFORMANCE INDICATORS FOR ESTABLISHED KING COUNTY WTD GSI FACILITIES IN SEATTLE

Category	Key Performance Indicator (KPI)	Description/Objective	Unit	Goal	Reporting Frequency (when)	Comments Special Issues
Stormwater		Quality of Space				

For King's
WTD

Consult with WTD
Stakeholder.

This document is a
placeholder.
Comments will be
added later.

Vegetation



Appendix J: GSI Maintenance Resources and Reference List



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GSI MAINTENANCE RESOURCES AND REFERENCE LIST

1.01 INTRODUCTION

This Appendix provides a list of recommended publications, resources and references for use by maintenance personnel to ensure that the system will function as intended for CSO control.

1.02 GENERAL RESOURCES

The following are resources specific for the Operations, Maintenance and Inspection of GSI:

- Seattle Public Utilities and King County Wastewater Treatment Division's joint Green Stormwater Infrastructure Manual for Capital Improvement Projects Volumes I through V.
- City of Seattle Stormwater Manual (Current Edition)
- [http://www.seattle.gov/sdci/codes/codes-we-enforce-\(a-z\)/stormwater-code](http://www.seattle.gov/sdci/codes/codes-we-enforce-(a-z)/stormwater-code)
- Seattle Public Utilities Asset Management Plan (AMP) for Green Stormwater Infrastructure Right of Way Facilities (current edition)
- Washington State Department of Ecology's (Ecology) Guidance Document, Western Washington Low Impact Development (LID) Operations and Maintenance (O&M) (current publication)
<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Low-Impact-Development-guidance>
- SDOT's Street Tree Manual¹
- SDOT's Traffic Control Manual For In-Street Work, Seattle, WA¹ (current edition)
- SDOT's Right of Way Opening and Restoration Rule¹ (Current Edition)
- SDOT's Streets Illustrated, Seattle's Right-of-Way Improvements Manual
<http://streetsillustrated.seattle.gov/>

¹See following link for SDOT Manuals: <https://www.seattle.gov/transportation/document-library/manuals>

- Seattle Public Utilities' Communications and Public Engagement Guidelines, Sewer and Stormwater Pollution Prevention, (Current Edition). A copy of the 2012 version is in Appendix B of the GSI Manual, Volume III: Design Phase
- WTD's Community Engagement Guide
- Ecology's Guidance for UIC Well Registration
- <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Underground-injection-control-program>
- Ecology's Guidance for UIC Wells that Manage Stormwater (current publication)
<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Stormwater-manuals>
- Other regulatory compliance or legal documents, such as the agency's Consent Decrees or NPDES Stormwater Permits

1.03 RECOMMENDED GENERAL PUBLICATIONS, RESOURCES AND REFERENCES

A. General Gardening

1. King County - Going Native brochure
Planting techniques and suggested native plants and layouts
<http://your.kingcounty.gov/dnrp/library/2003/gonative.pdf>
2. Seattle Tilth: A non-profit organic gardening and urban ecology organization. Their website provides links to information on organic gardening, soils, plant selection and many other topics. Their Maritime Northwest Garden Guide may be purchased from their website.
<http://www.seattletilth.org/>
3. Seattle Public Utilities: This agency provides information on natural systems drainage, lawn care, plant selections, water use and other topics.
<http://www.seattle.gov/util/EnvironmentConservation/MyLawnGarden/index.htm>
4. Sunset Western Garden Book, 2001 Edition by Kathleen Norris Brenzel, 2001
5. WSU Extension - Gardening Fact Sheets
<http://county.wsu.edu/king/gardening/mg/factsheets/Pages/default.aspx>
6. WSU Extension - Planting Landscape Plants Fact Sheet
<http://county.wsu.edu/king/gardening/mg/factsheets/Fact%20Sheets/Planting%20Techniques%20for%20Landscape%20Plants.pdf>
7. WSU Snohomish County Extension
An organization that provides year-round advice on landscape issues, such as pests, diseases and plant selection. They are available weekdays by phone at (425) 338-2400.
<http://snohomish.wsu.edu/>

B. Plant Selection and Identification

1. A Field Guide to the Common Wetland Plants of Western Washington & Northwestern Oregon by Sarah S. Cooke, 1997
2. Plants Of The Pacific Northwest Coast: Washington, Oregon, British Columbia & Alaska by Pojar and MacKinnon, 2004
3. Right Plant, Right Place by Nicola Ferguson, 1984

C. Plant Maintenance

1. Tri-County Integrated Pest and Vegetation Management Guidelines
<http://www.lhwmp.org/home/ChemToxPesticides/documents/IPMTriCountyGuidelines.pdf>
2. Cass Turnbull's Guide to Pruning: What, When, Where, and How to Prune for a More Beautiful Garden by Cass Turnbull, 2004
3. Pruning Made Easy : A gardener's visual guide to when and how to prune everything, from flowers to trees by Lewis Hill, 1998
4. Pruning and Training: A fully illustrated plant-by-plant manual by Christopher Brickell and David Joyce, 1996
5. The Compost Tea Brewing Manual by Dr. Elaine Ingham, 2005 (5th ed.)

D. Disease and Pest Control

1. King County Integrated Pest Management (IPM)
<https://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/weed-control-practices/ipm.aspx>
2. American Horticultural Society Pests and Diseases: The Complete Guide to Preventing, Identifying and Treating Plant Problems by Pippa Greenwood and Andrew Halstead, 2000
3. Journal of Pesticide Reform – Nonchemical Methods for Removing Unwanted Blackberry Plants <http://www.pesticide.org/solutions/home-and-garden-toolbox/weed-solutions/blackberries>
4. King County Department of Natural Resources This agency provides information on a variety of natural lawn and garden care topics. Detailed information on pest and weed identification and control are available.
<http://www.kingcounty.gov/environment/stewardship/nw-yard-and-garden.aspx>

5. King County - Noxious Weed Control Brochures
<http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/brochures-reports.aspx>
6. The Organic Gardener's Handbook of Natural Insect and Disease Control: A Complete Problem-Solving Guide to Keeping Your Garden and Yard Healthy Without Chemicals by Barbara W. Ellis, 1992
7. TNC Weed Management - Documents for Reed Canary Grass, English Ivy and Himalayan Blackberry
<http://www.invasive.org/gist/moredocs/phaaru01.pdf>
<http://www.invasive.org/gist/moredocs/hedhel02.pdf>
<http://www.invasive.org/gist/moredocs/rubarm01.pdf>
8. Washington Department of Ecology - Mosquito Control
<http://www.ecy.wa.gov/pubs/0310023.pdf>
9. WSU Extension - Insecticidal Soaps Info Sheet
<http://spokane-county.wsu.edu/spokane/eastside/Fact%20Sheets/C183%20Insecticidal%20Soaps%2005.pdf>

E. Irrigation

1. Rain Bird Winterization Guide
www.rainbird.com/documents/diy/WinterizationGuide.pdf

F. Additional resources and references

1. King County Stormwater Services
<http://www.kingcounty.gov/environment/waterandland/stormwater/problem-investigation-line>.
2. Department of Ecology Stormwater Management Manual for Western Washington, 2014 Edition, Volume V – Runoff Treatment BMPs. <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Stormwater-manuals>
3. Department of Ecology Guidance Document Western Washington Low Impact Development (LID) Operations and Maintenance (O&M), Current edition.
<https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Low-Impact-Development-guidance>
4. Low Impact Development Technical Guidance Manual for Puget Sound, December 2012, Washington State University Extension and Puget Sound Partnership.
<http://www.wastormwatercenter.org/lid-manuals-guides/>
5. Washington State Department of Ecology's Guidance for UIC Wells that Manage Stormwater
<https://fortress.wa.gov/ecy/publications/SummaryPages/0510067.html>
6. Washington Administrative Code 173-160, Minimum Standards for Construction and Maintenance of Wells.
<http://apps.leg.wa.gov/WAC/default.aspx?cite=173-160>
7. City of Seattle Standard Specifications for Road, Bridge and Municipal Construction, Current Edition.
<http://www.seattle.gov/util/Engineering/StandardSpecsPlans/index.htm>
8. City of Seattle Standard Plans, Current Edition
<http://www.seattle.gov/util/Engineering/StandardSpecsPlans/index.htm>
9. Seattle Department of Transportation Right of Way Opening and Restoration Rule (current edition)
<https://www.seattle.gov/transportation/document-library/manuals>



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Appendix K: Roadside Bioretention Cell Care Guide

- Seattle Public Utilities and King County Wastewater Treatment Division's Roadside Bioretention Cell Care Guide, 2019.*

*This document is intended to be printed as a booklet. Contact SPU for native file for printing.



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Roadside Bioretention Cell Care Guide

Rain gardens and bioretention cells capture stormwater runoff and let water soak into the ground as plants and soil filter pollutants.

These facilities convert stormwater from a problem to a resource that replenishes groundwater and protects local waterways.

Built along the street, they also create attractive streetscapes and urban green spaces, provide natural habitat, and enhance pedestrian and bicycle safety.

Bioretention cells are more engineered than rain gardens, and the local government agency has primary operations and maintenance (O&M) responsibility for bioretention cells. This guide is for adjacent property owners or groups interested in understanding how bioretention cells are managed.



Roadside Bioretention Cell Care Program

Thank you for your interest in bioretention cell stewardship. This guide describes the activities of your local agency and what you can do to support those activities.

Maintenance Responsibilities

Seattle Public Utilities and King County Wastewater Treatment Division routinely monitor all roadside bioretention cells to determine the level of work needed to maintain healthy plants and ensure the facilities function properly. Identifying problems early and addressing them will ensure a long and healthy life for the system. Please notify us if you spot concerns (see back page for contact information).

Why Bioretention Cells Matter

Bioretention cells are an innovative and effective way to restore the health of Seattle's urban watersheds. Over the last 150 years, we've covered our watersheds with streets, roofs, driveways and parking lots. In the process, we've increased stormwater runoff that causes pollution to flow into our creeks, lakes, the Duwamish River, and Elliott Bay. Bioretention cells help to protect and restore the Puget Sound and our local waterways.

Anatomy of a Bioretention Cell



① Capture and Treatment Area

Special soils that allow the water to soak in.

② Overflow Drain

Not all bioretention cells have one. These allow stormwater from larger storm events to flow out if the bioretention cell is full.

③ Curb Opening

Also called an inlet or outlet where stormwater can enter and exit.

Plant Establishment Phase (first three years)

Young plants have tender roots and can be susceptible to damage without regular care. During this phase, the city or adjacent site developer contracts with professionals to care for the roadside bioretention cell.

Professional crews will:

- Check for proper function
- Clear curb openings and top of overflow drain
- Remove trash and debris
- Remove weeds
- Water plants
- Prune, replace or remove trees or plants if necessary
- Care for trees
- Remove sediment from cells if needed

Important Safety Guidelines When Working Near a Street

- Do not stand in street when performing maintenance activities.
- Make yourself visible. Wear brightly colored clothing or a safety vest.
- Since bioretention cells are next to the street, take extra caution and be aware of passing bicycles and vehicles.
- Wear sturdy shoes and thick gloves and use a trash-grabber tool to help protect you from broken glass, sharp objects, pollutants, and other obvious or concealed hazards.
- Take care of the bioretention cell during daylight hours and avoid peak traffic times.
- Do not allow children younger than 10 years of age to work with you; older children must be accompanied by an adult volunteer. Keep in mind that adult supervision is critical when working within the street environment.
- Do not leave your tools unattended. Keep them out of the street and off the sidewalk so they don't pose a hazard.

We don't want you to get hurt, so please be safe.

Long-Term Care Phase (after plants are established)

Professional crews will:

- Remove sediment
- Clear curb openings and top of overflow drain
- Remove trash and debris
- Remove weeds
- Water plants and trees if necessary
- Care for all trees, including pruning and removal if necessary

You can help by:

- Removing trash and debris
- Clearing curb openings
- Pushing aside or removing accumulated sediment where blocking curb cuts

Bioretention Cell Care Chart

After notifying us* that you want to help care for your local roadside bioretention cell, use this chart to make sure you know what to do. See the how-to steps on the following pages.

Bioretention Cell Care and Maintenance Activity	Professional Crew Activity		Volunteer Activity	
	Varies, 0-3 Year Establishment Phase	Long-Term Care Phase	Varies, 0-3 Year Establishment Phase	Long-Term Care Phase
Clear curb openings of leaves, trash, and debris	YES	YES	YES	YES
Remove trash	YES	YES	YES	YES
Clear top of street drain (do not lift the grate)	YES	YES	YES	YES
Clear top of overflow drain (do not lift the grate)	YES	YES	NO	NO
Water	YES	YES	NO	NO
Remove or replace trees and plants	YES	YES	NO	NO
Remove built-up sediment from curb inlets	YES	YES	YES	YES
Remove built-up sediment from cells if needed	YES	YES	NO	NO
Structural/ Repairs	To report damage or other repair needs, contact us.*	To report damage or other repair needs, contact us.*	To report damage or other repair needs, contact us.*	To report damage or other repair needs, contact us.*

Please notify the SPU Operations Response Center* or the King County Maintenance Hotline* when:

- The bioretention cell has had standing water for more than 72 hours after it stopped raining
- The facility has been damaged or vandalized
- Something other than rain has spilled into the bioretention cell

Please use the City of Seattle “Find It, Fix It” app* when:

- Plants or trees are damaged or need trimming for clearance
- Walk into the cells when soils are wet (to avoid damaging soils)

The Bioretention Cell Care Chart at right summarizes simple volunteer bioretention cell care activities you can perform (see pages 6–7 for how-to tips).

Please DO NOT:

- Ø Prune or trim plants and trees
- Ø Add or replace plants
- Ø Use chemical herbicides, fertilizers, or insecticides
- Ø Modify or alter the function or design
- Ø Add or remove bioretention soil, compost, mulch, or fill
- Ø Store tools, lumber or other items in the bioretention cell
- Ø Remove dead or dying plants
- Ø Remove sediment from cells
- Ø Walk into the cells when soils are wet (to avoid damaging soils)

* Please see back page for contact information.

Caring for the Bioretention Cell

The most important part of bioretention cell care is making sure the facility captures and filters stormwater. So check the bioretention cell regularly to ensure water flows into it. If you see a problem, let us know or follow the care steps below:

Clear Curb Openings

Clear curb openings so water can flow into the bioretention cell. Rake and remove leaves, trash and debris. Push aside or remove sediment to create a clear path for stormwater flow. The best time to clear curb openings is before a rain storm.



Clear Street Drains

Make sure that street drains aren't blocked. Remove leaves, debris and trash on top of grates. Do not lift grates. Do not attempt to clear if there are more than two inches of water ponded.



What is Debris?

- Grass clippings
- Sticks
- Leaves
- Small branches
- Sediment at curb cut



Remove debris by hand or with a rake. Gather debris and put it in a yard-waste bin or other appropriate disposal container.

Rake leaves from around the curb cut, especially in the fall when leaves can quickly clog inlets.

Remove Trash

Use a grabber-tool to pick up any trash you find and recycle, if appropriate, or throw into a trash can.

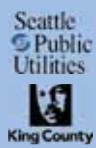


The most important times to remove debris and trash from the bioretention cell are before and after a storm. Heavy rains can cause trash and debris to collect around curb openings and overflow drains and block stormwater flow.

Watering

Although bioretention cell plants can tolerate our dry summer climate, they can benefit from additional watering during extended dry periods or extreme heat.

All watering will be performed by professional crews.



Protecting Seattle's Waterways

700MillionGallons.org

CONTACT INFORMATION:

Seattle Public Utilities
Operations Response Center:
206-386-1800

King County
24-hour Maintenance Hotline:
206-263-3801

City of Seattle
“Find It, Fix It” is a smartphone app offering mobile users one more way to report selected issues to the City of Seattle.
[www.seattle.gov/customer-service-bureau/
find-it-fix-it-mobile-app](http://www.seattle.gov/customer-service-bureau/find-it-fix-it-mobile-app)

Thanks to the Portland Bureau of Environmental Services for permission to base this guide on its publication, *City of Portland Green Street Stewards Guide*.





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Appendix L: Draft Supplemental Guidance for Pervious Concrete Sidewalk Maintenance and Repair

- SPU's Supplemental Guidance for Pervious Concrete Sidewalk Maintenance and Repair, November 2015*

*Preliminary draft under review by SPU.



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Note to reviewers: This document follows SDOT DR 5-2009 and supplements SDOT CAM 2208 to provide guidance on how to repair pervious concrete sidewalk that has spalling, cracks and/or not draining. How this is to be incorporated in 5-2009 or CAM 2208 or other is TBD through discussion between SDOT and SPU via IDT.

MIG

SvR

SUPPLEMENTAL GUIDANCE FOR PERVIOUS CONCRETE SIDEWALK MAINTENANCE AND REPAIR

1.0 PURPOSE:

The purpose of this document is to provide guidance for operations and maintenance personnel involved in the maintenance and repair of pervious concrete sidewalk within the Seattle public right of way. This document supplements, and is to be used in conjunction with the City of Seattle Standard Plans and Specifications (current edition), SDOT CAM 2208 *Sidewalk Maintenance and Repair* and SDOT Director's Rule 5-2009 *Street and Sidewalk Pavement Opening and Restoration*.

1.1 How to use this document: Operations and maintenance personnel, and any additional individuals responsible for the care of the pervious concrete sidewalk in the public right of way, including adjacent property owners, may find sidewalks that have been impacted by a surface or structural failure. When a surface or structural failure is encountered, personnel should use this document, in conjunction with the City of Seattle Standard Plans and Specifications (current edition), SDOT CAM 2208 - *Sidewalk and Maintenance Repair*, SDOT Director's Rule 5-2009 - *Street and Sidewalk Pavement Opening and Restoration*, and DPD Director's Rule 21-2015 - *Title 22.800 Stormwater Code* to determine the appropriate repair or replacement intervention.

Figures 1-4 identify the type and location of the pervious concrete sidewalk damage or failure and include intervention procedures. **Figure 5** identifies the panel replacement geometry. **Figures 6-9** identify the extents of removal and/or replacement of materials based on the location of pavement failure.

Users of this document will:

1. Confirm the type of failure using **Table 2**, "Repair and Procedures for Pervious Concrete Sidewalk in the Right of Way".
2. Follow the flow charts of **Figures 1-4** to identify the intervention procedures.
3. **Use Figures 5-9** to determine the extent of the repair or replacement.

2.0 SUPPLEMENTAL DEFINITIONS:

The following terms, phrases and words shall have the meaning given below and shall supplement the definitions found in Rule 5-2009.

Table 1: Supplemental Definitions

Mineral Aggregate	Rock or gravel or sand or a blend thereof, which may or may not be crushed, screened to size and blended for use in road, bridge and municipal construction. (See Standard Specifications, Section 9-03.16 for aggregate types.)
Pavement Structure	The combination of subbase, base course, and surface course, as applicable, placed on the subgrade to support and distribute the traffic load.
Pervious Concrete	A mixture of Portland cement and blended hydraulic cement, aggregate, and water which result in a surface through which water can pass as admixtures specified in COS 5-06.
Raveling	See "Spalling".
Sawcut	A cut made in hardened concrete by diamond or silicone-carbide blades or discs.
Sidewalk	That portion of the street right-of-way adjacent to an improved driving surface without curbs.
Spalling	Break (ore, rock, stone or concrete) into smaller pieces.
Subbase	The layer(s) of specified or selected material of designated thickness in a pavement structure immediately above the subgrade and below the base course, top wearing course, or leveling course.
Surface Course	The top layer of the pavement structure designed to accommodate the traffic load and to resist skidding, traffic abrasion, and the disintegrating effects of climate; sometimes called the "wearing course."
Surface Infiltration	Stormwater passing through the pavement's wearing course.
Wearing Course	See "Surface Course".

3.0 SUPPLEMENTAL GENERAL PROVISIONS:

See Section 3 of SDOT Director's Rule 5-2009 for General Provisions. The following are supplemental general provisions for repair of pervious concrete sidewalks:

3.1 Pervious concrete streets: During any removal and repair procedures protect the adjacent surfaces. During sawcut procedures, implement measures to remove the sawcut slurry in order to protect the adjacent pervious concrete sidewalk to remain.

4.0 REPAIR PROCEDURES FOR PERVIOUS CONCRETE SIDEWALK IN THE RIGHT OF WAY

Table 2: Repair Procedures for Pervious Concrete Sidewalk in the Right of Way

Pavement Failure Type	Description	Repair Procedures*
Spalling or Raveling	The aggregates at the pavement surface are loose or easily dislodged.	See Figure 1.
Cracking	There is a cracking across the pavement surface.	See Figure 2.
Dislocation	There is a dislocation at the pavement surface resulting in the movement of aggregate and concrete material from the sidewalk edge or within the panel.	See Figure 3.
Clogging	The surface appears to be clogged by sediment or debris.	See Figure 4.

* When panel replacement is required see Figure 5.

Figure 1: Repair Procedures for Spalling or Raveling in Pervious Concrete Sidewalk

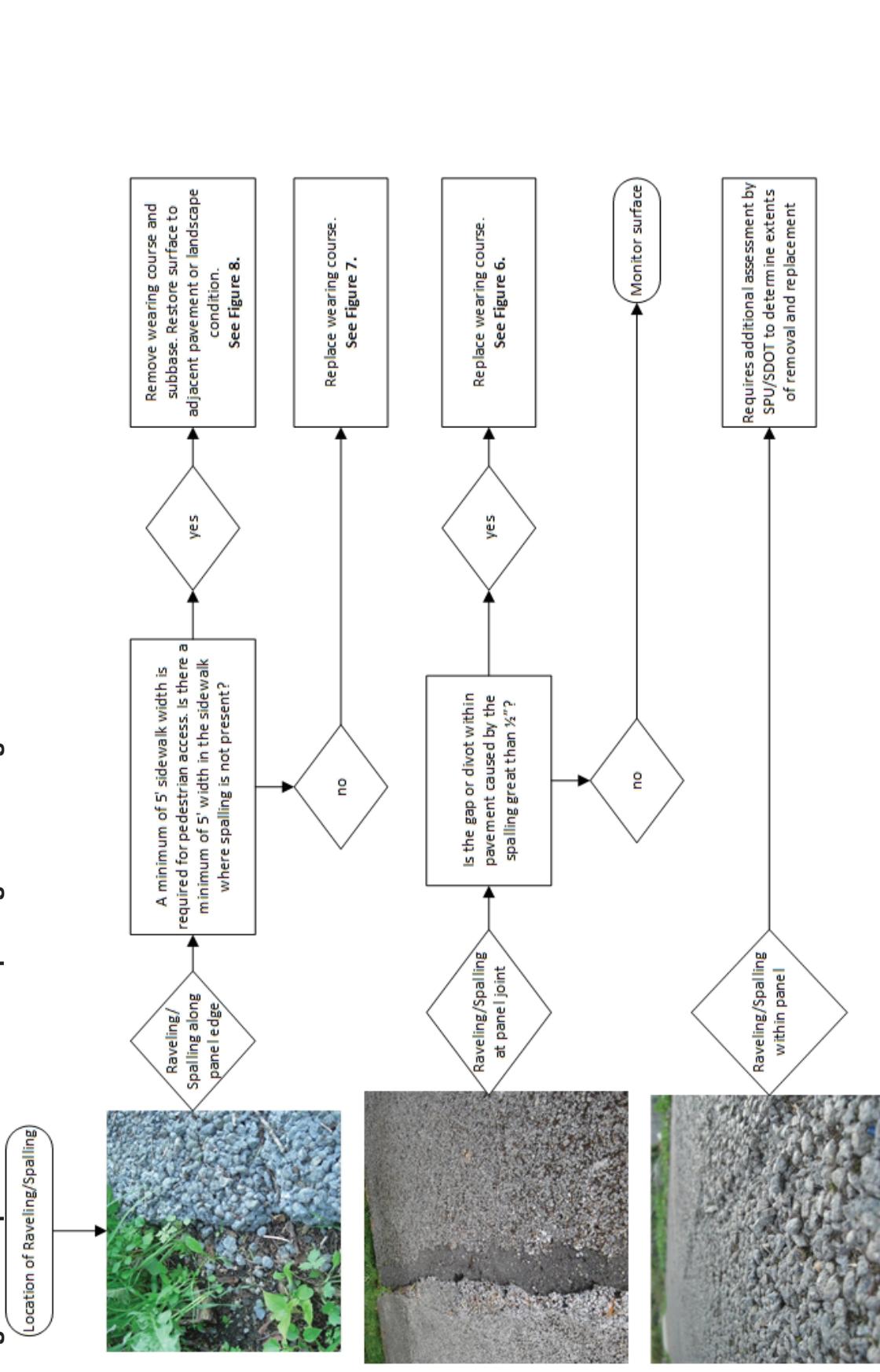


Figure 2: Repair Procedures for Cracking in Pervious Concrete Sidewalk

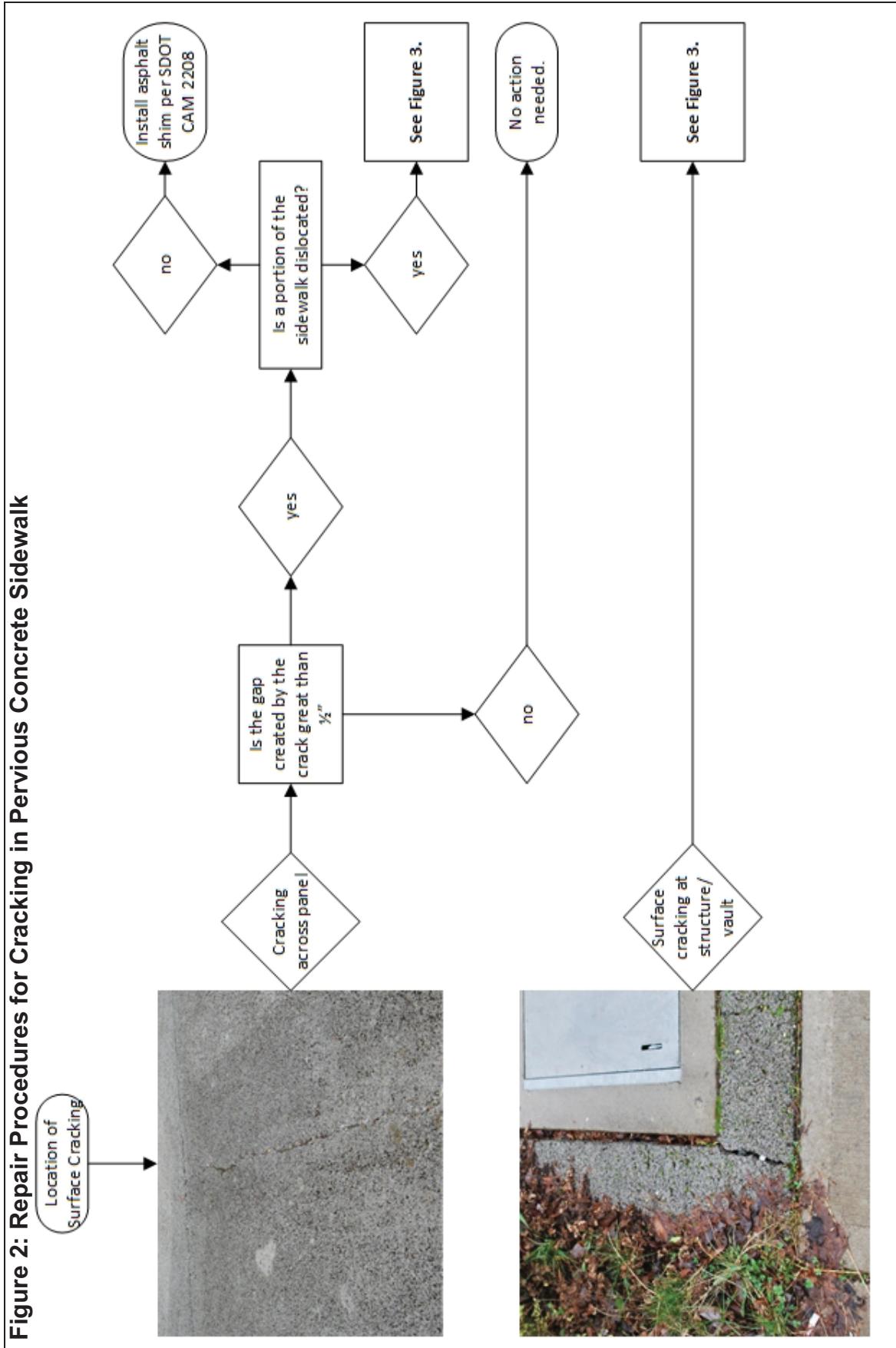


Figure 3: Repair Procedures for Dislocation in Pervious Concrete Sidewalk

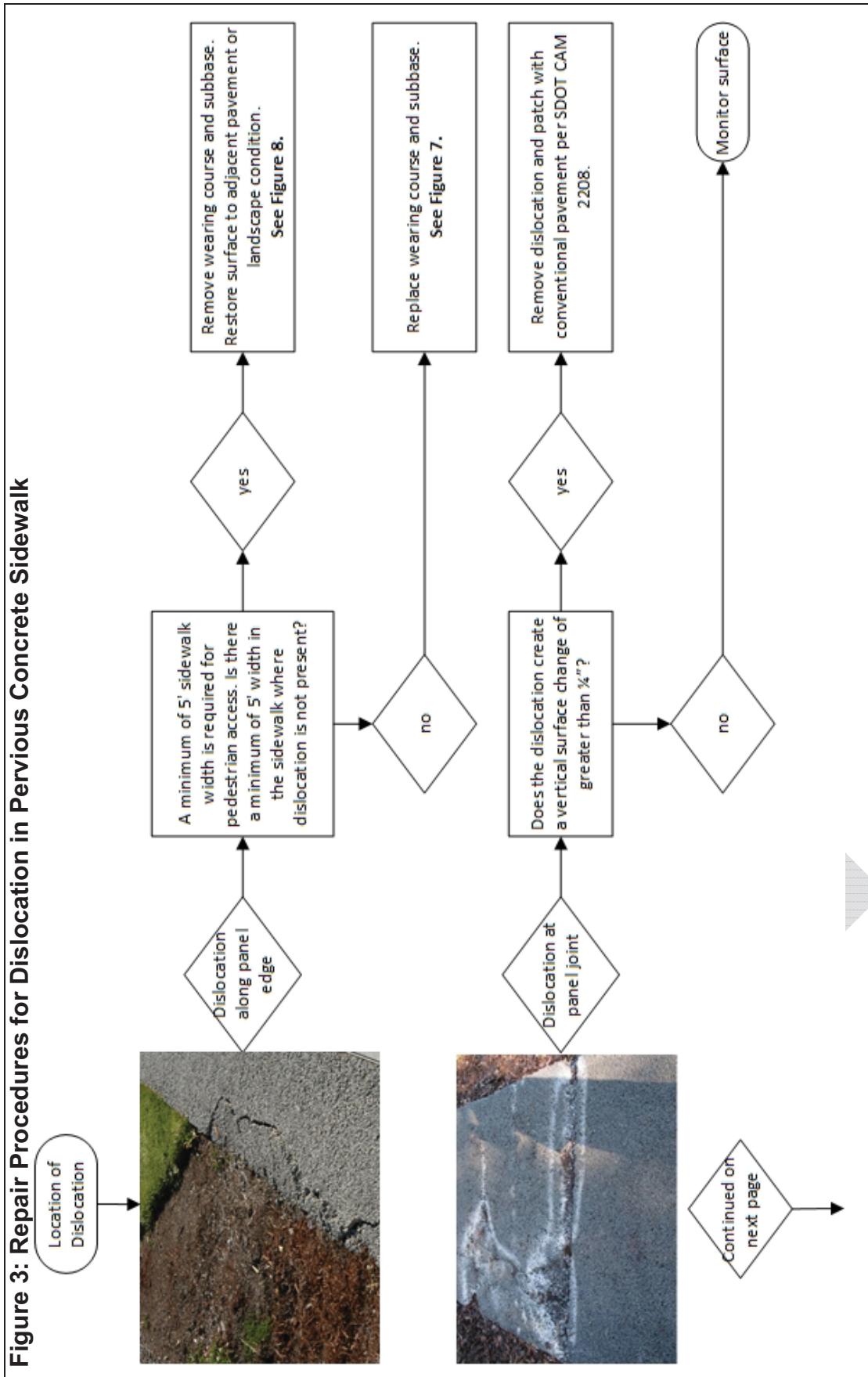


Figure 3: Repair Procedures for Dislocation in Pervious Concrete Sidewalk (continued)

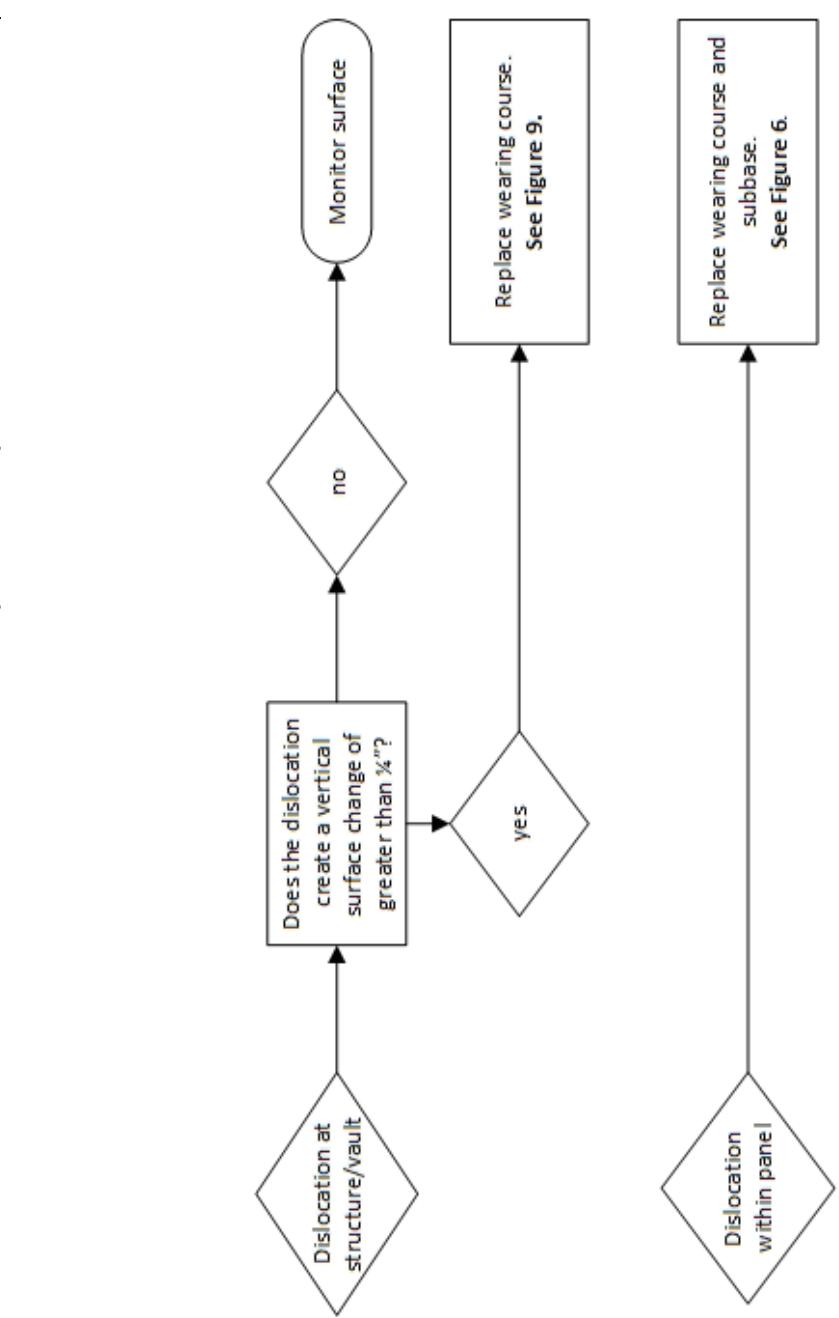


Figure 4: Repair Procedures for the Appearance of Clogging in Pervious Concrete Sidewalk

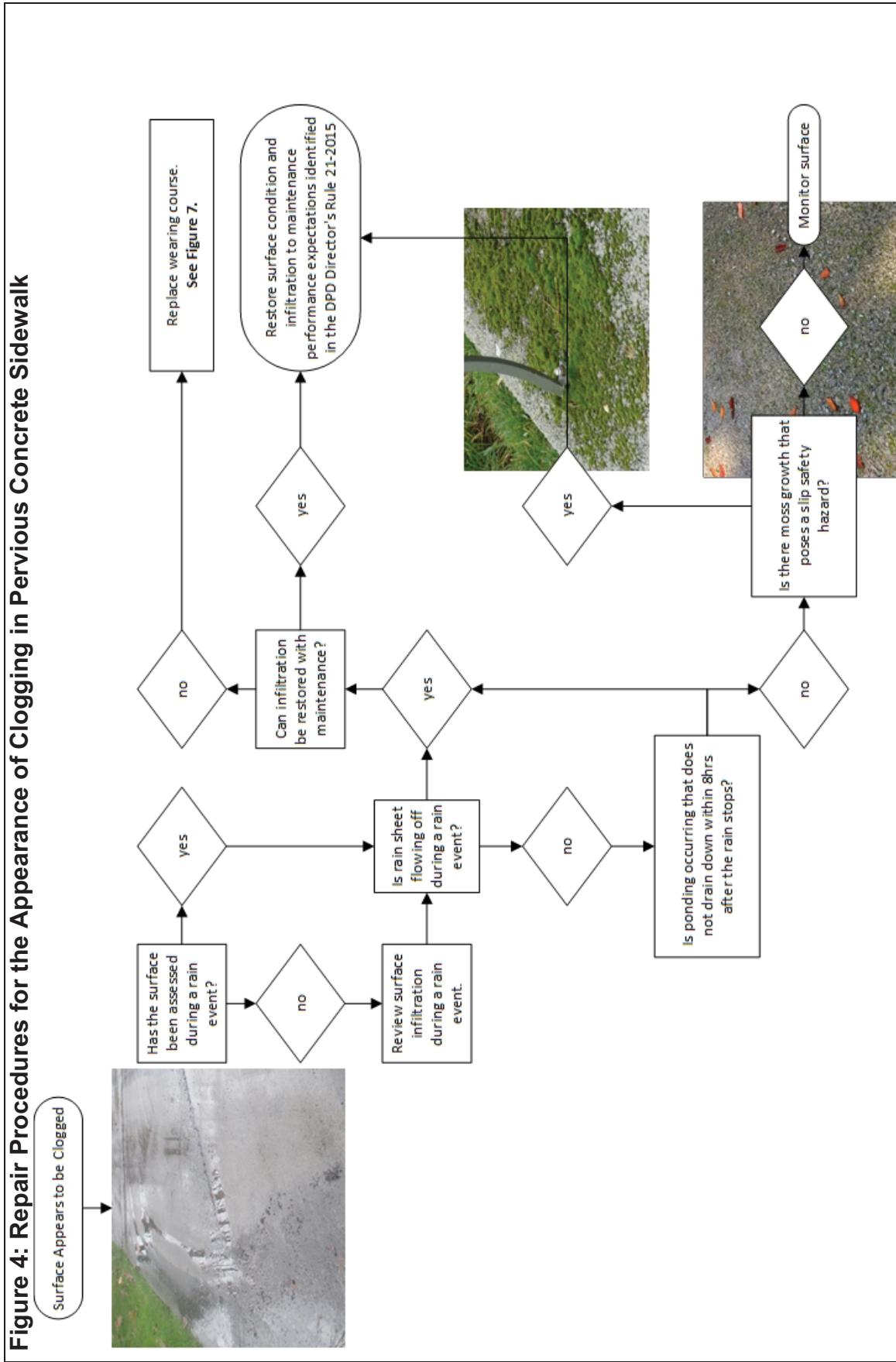
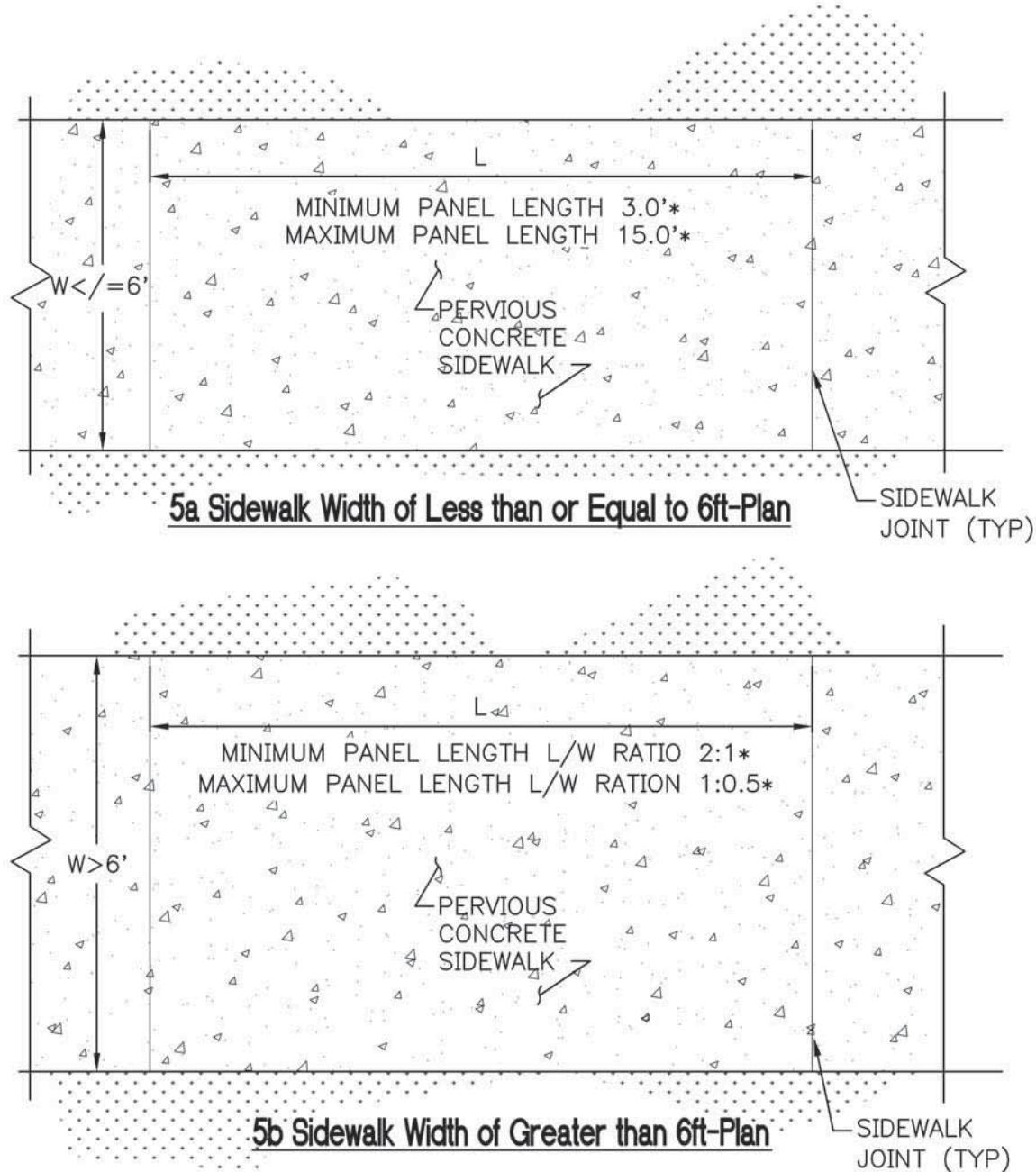
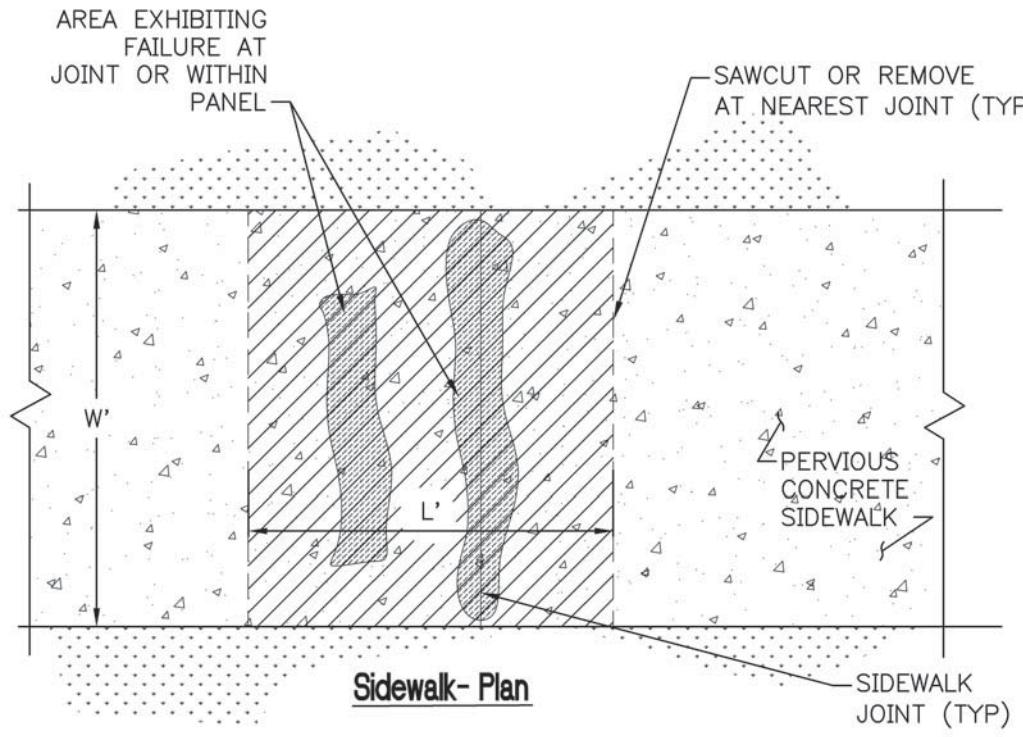


Figure 5: Panel Replacement Geometry Requirements



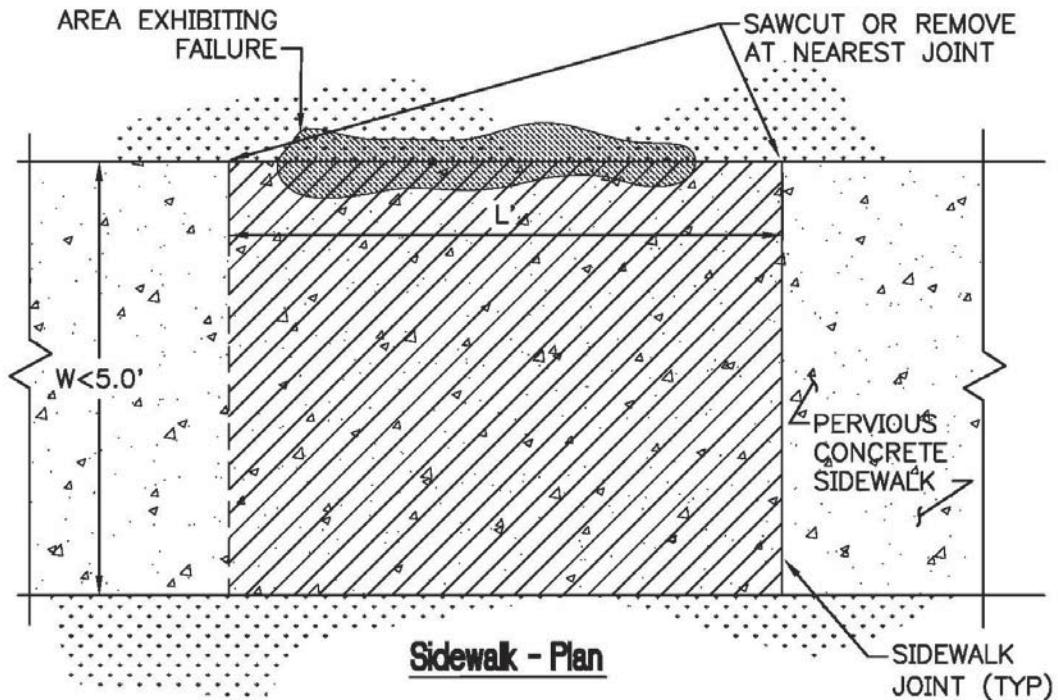
*WHEN REPLACING SIDEWALK PANELS OR A PORTION OF A SIDEWALK PANEL – ANY EXISTING IMPACTED PANELS OR PROPOSED NEW PANELS MUST MEET THE SIZING GUIDELINES SHOWN.

Figure 6: Extents of Replacement due Failure at a Joint or within the Panel



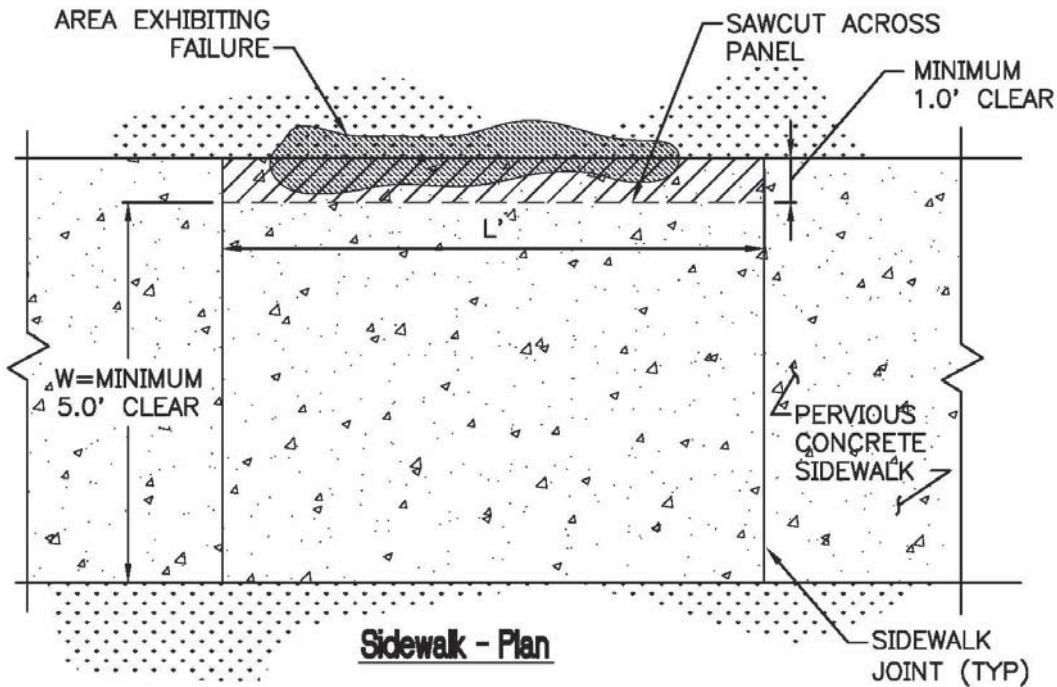
SAWCUT FULL WIDTH OF SIDEWALK PARALLEL TO THE JOINT ON BOTH SIDES OF THE AREA EXHIBITING FAILURE. REMOVE AND REPLACE SECTION AS DETERMINED IN FIGURES 1–4. THE MINIMUM/MAXIMUM PANEL LENGTH SHALL BE PER FIGURE 5.

Figure 7: Extents of Replacement due to Edge Failure - Existing Clearance is less than 5'



SAWCUT FULL WIDTH OF SIDEWALK ON BOTH ENDS OF THE EDGE EXHIBITING FAILURE OR REMOVE AT THE ADJACENT JOINTS. REMOVE AND REPLACE SECTION AS DETERMINED IN FIGURES 1–4. THE MINIMUM/MAXIMUM PANEL LENGTH (L') SHALL BE PER FIGURE 5.

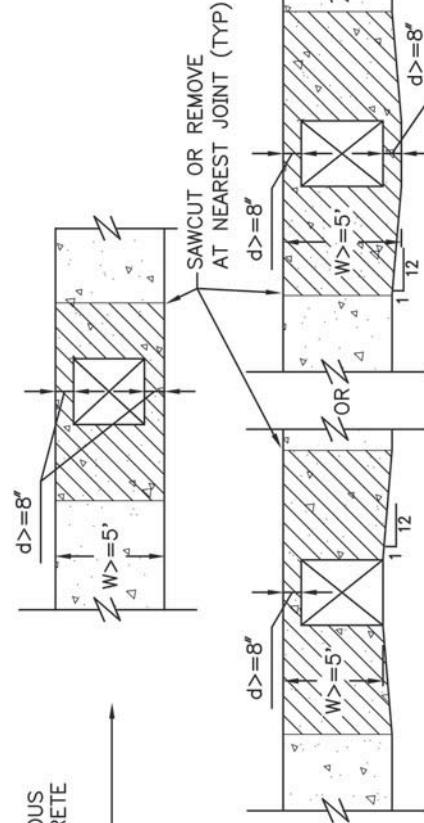
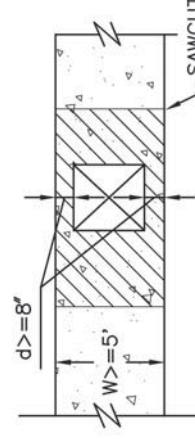
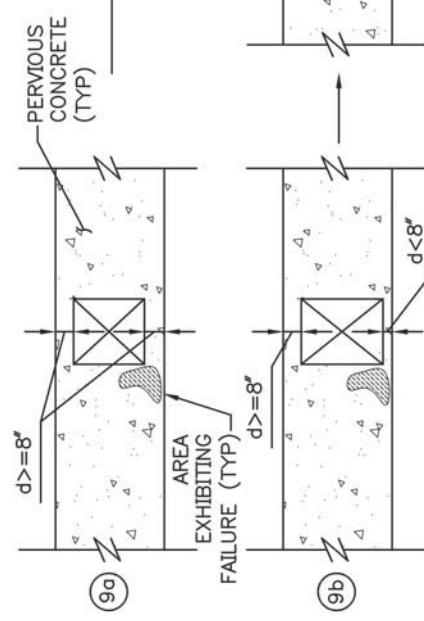
Figure 8: Extents of Replacement due to Edge Failure - Existing Clearance is Equal to or Greater than 5'



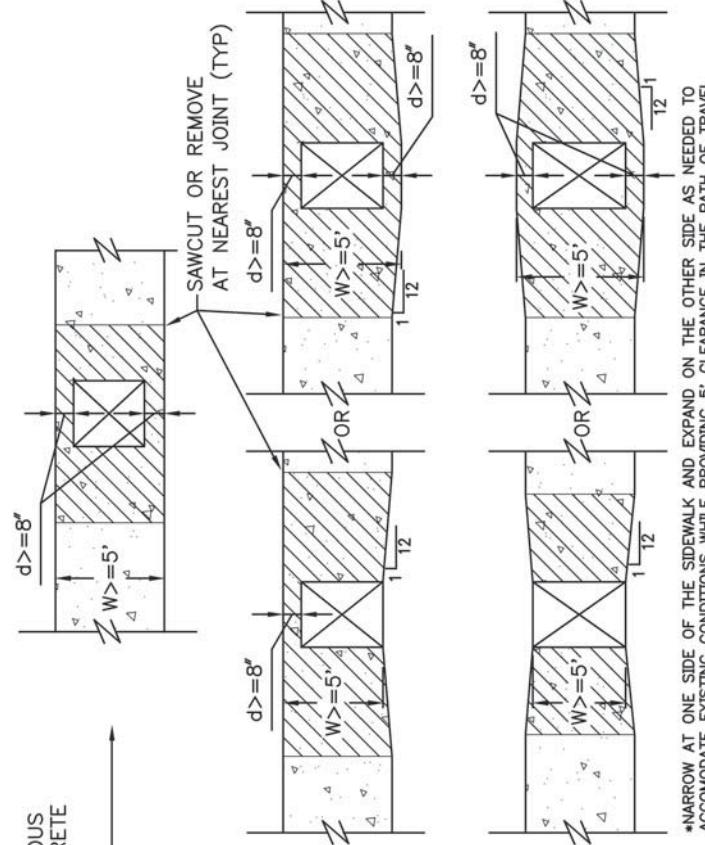
SAWCUT THE FULL LENGTH OF THE SIDEWALK PANEL TO THE EXTENTS EXHIBITING FAILURE. REMOVE AND REPLACE SECTION AS DETERMINED IN FIGURES 1–4. THE MINIMUM/MAXIMUM PANEL LENGTH (L') SHALL BE PER FIGURE 5.

Figure 9: Extents of Replacement due to Failure at Structure/Vault

EXISTING SIDEWALK CONDITION



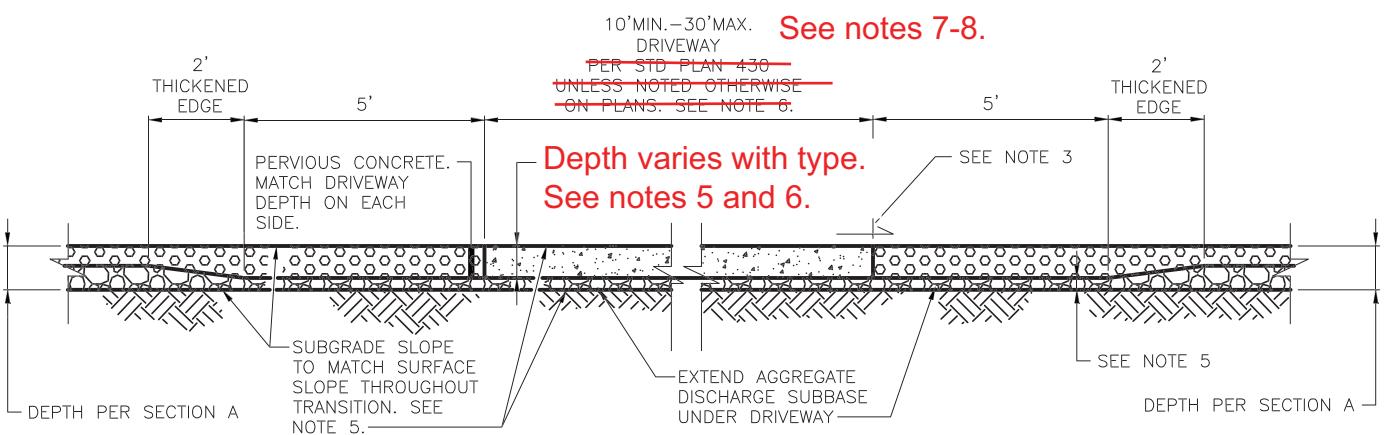
INTERVENTION/PAVEMENT REPAIR GEOMETRY



Sidewalk - Plan

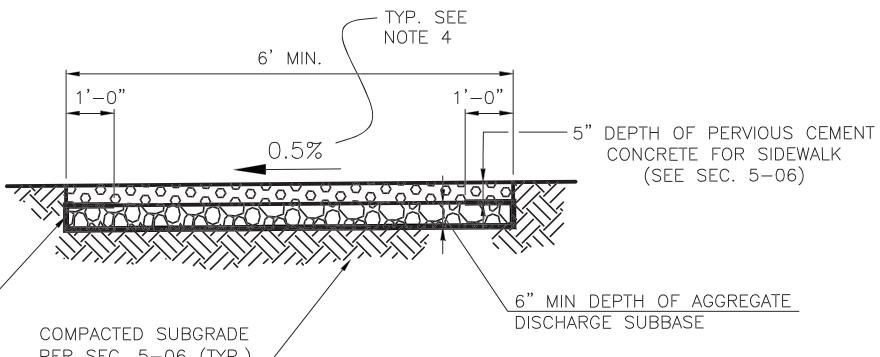
SAWCUT FULL WIDTH OF SIDEWALK ON BOTH SIDES OF THE STRUCTURE OR REMOVE AT THE ADJACENT JOINTS. REMOVE AND REPLACE SECTION AS DETERMINED IN FIGURES 1-4. THE MINIMUM/MAXIMUM PANEL LENGTH SHALL BE PER FIGURE 5. WIDEN THE SIDEWALK AS NEEDED TO MAINTAIN 5' MINIMUM OF CLEARANCE IN THE PATH OF TRAVEL AND A MINIMUM OF 8" AROUND THE STRUCTURE COLLAR.





PERVIOUS CONCRETE SIDEWALK DEPTH
TRANSITION AT DRIVEWAYS PROFILE VIEW

APPLY SEPARATION GEOTEXTILE SEC. 9-37, ON BOTTOM AND SIDES. EXTEND GEOTEXTILE ABOVE PERVIOUS CONCRETE FOR SIDEWALK PAVEMENT. AFTER PAVEMENT HAS CURED AND ADJACENT FINISHED GRADE HAS BEEN STABILIZED, CUT SEPARATION GEOTEXTILE AT FINISHED GRADE (TYP.)



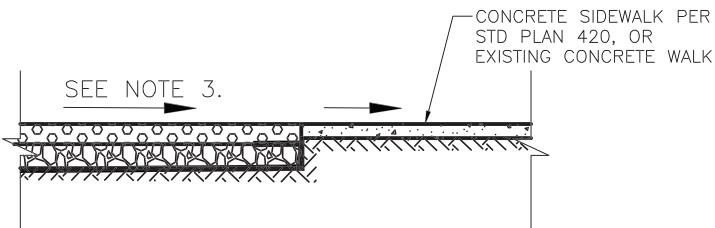
PERVIOUS CONC SECTION A

NOTES:

- 1. DEPTHS SHOWN FOR PAVEMENT SECTIONS ARE COMPAKTED DEPTH.
- 2. SIDEWALK DEPTH AT DRIVEWAY TO MATCH DRIVEWAY PAVEMENT DEPTH.
- 3. ~~5%~~ MAX. PERVIOUS CEMENT CONCRETE. LONGITUDINAL SLOPE.
- 4. IF REPLACING EXISTING SIDEWALK, CROSS SLOPE MAY BE 2% MAX TO MATCH EXISTING CROSS SLOPE OF STD PLAN 420.
- 5. AGGREGATE DISCHARGE SUBBASE VARIES WITH CONCRETE DRIVEWAY THICKNESS. IF CONCRETE DRIVEWAY IS 6-INCHES, THEN SUBBASE IS 5-INCHES. IF DRIVEWAY IS 8-INCHES, THEN SUBBASE IS 3-INCHES.
- 6. WHERE PERVIOUS CONCRETE IS SHOWN ON PLANS FOR DRIVEWAY, THEN PERVIOUS CONCRETE SHALL BE 8" WITH 3" AGGREGATE DISCHARGE SUBBASE.

7. Commercial and alley driveways shall be per Std plan 430.

8. Residential driveways at pervious concrete sidewalk crossings shall be pervious concrete per Std Plan 433.



TRANSITION OF PERVIOUS CONCRETE SIDEWALK
TO CONCRETE SIDEWALK PROFILE VIEW

Prepared by: SvR Design Company