



Green Stormwater Infrastructure **Maintenance Manual**

Version 2.0 September 2016



**PHILADELPHIA
WATER**

Table of Contents

1 Introduction	3
1.1 Introduction.....	5
1.2 Stormwater Management Practices	9
1.2.1 Stormwater Tree Trench.....	10
1.2.2 Rain Garden and Stormwater Basin.....	12
1.2.3 Stormwater Bump-out.....	15
1.2.4 Stormwater Planter.....	18
1.2.5 Infiltration/Storage Trench.....	20
1.2.6 Stormwater Wetland.....	24
1.2.7 Stormwater Swale.....	26
1.2.8 Stormwater Tree.....	28
1.2.9 Green Roof.....	30
1.2.10 Pervious Pavement.....	32
1.2.11 Green Wall.....	34
1.2.12 Cistern/Rain Barrel.....	36
1.2.13 Blue Roof.....	38
1.2.14 Green Gutter.....	40
1.2.15 Stormwater Drainage Well.....	42
1.3 Routine Maintenance	45
1.3.1 Description of Routine Maintenance Tables.....	46
1.4 Reactive Maintenance	57
1.4.1 Description of Reactive Maintenance Tables.....	58
1.4.2 Observations.....	58
1.4.3 Possible Responses to Observations.....	58
1.5 Maintenance Event Procedures	63
1.5.1 General.....	64
1.5.2 Pre-maintenance Event.....	64
1.5.3 During Maintenance Event.....	64
1.5.4 Post-maintenance Event.....	65
1.6 General Requirements	67
1.6.1 Documentation.....	68
1.6.2 Health and Safety.....	68
1.6.3 Access Requirements.....	69
1.6.4 Permits and Approvals.....	69
1.6.5 Personnel Training, Experience, and Identification.....	70
1.6.6 Equipment.....	70
1.6.7 Materials.....	71
1.6.8 References.....	71
2 Surface Maintenance	75
2.1 General Site Care	76
2.1.1 Trash, Sediment, and Organic Debris Removal.....	76

2.1.2	Erosion Control and Repair.....	78	3.3	Waste Disposal.....	155
2.1.3	Concrete, Pavement, Masonry and Modification.....	80	4	Pervious Pavement Maintenance.....	165
2.1.4	Settling Repair.....	82	4.1	Routine Maintenance.....	166
2.1.5	Graffiti Removal.....	83	4.2	Restorative Maintenance.....	166
2.1.6	Painting.....	84	4.3	Winter Maintenance.....	168
2.1.7	Hardware Care.....	84	4.4	Decanting.....	169
2.1.8	Winterization.....	86	4.5	Waste Disposal.....	169
2.2	Vegetation Maintenance.....	97	5	Appendices.....	173
2.2.1	Weed Control.....	98	5.1	Personnel Classifications.....	174
2.2.2	Mowing and String Trimming.....	110	5.1.1	Requirements.....	174
2.2.3	Dead and Damaged Vegetation Removal.....	114	5.1.2	Surface Maintenance Personnel.....	175
2.2.4	Pruning, Thinning, and Cutting Back Vegetation.....	116	5.1.3	Subsurface Inspection and Maintenance Personnel.....	175
2.2.5	Pest and Disease Management.....	119	5.1.4	Pervious Pavement Maintenance Personnel.....	175
2.2.6	Mulching.....	122	5.2	Points of Contact.....	176
2.2.7	Soil Management.....	122	5.3	Sample Hydrant Operation Report.....	177
2.2.8	Planting and Transplanting.....	123	6	Glossary.....	179
2.2.9	Seeding.....	126			
2.2.10	Watering.....	128			
3	Subsurface Maintenance.....	141			
3.1	Jetting/Vactoring/Inspection.....	142			
3.2	Decanting.....	155			

Introduction

division **1**





1.1 Introduction

The City of Philadelphia relies in part on Green Stormwater Infrastructure (GSI) systems—comprised of one or more decentralized stormwater management practices (SMPs) such as rain gardens, stormwater tree trenches, and green roofs—to reduce stormwater volume and pollutants delivered to the City’s combined sewer system.

An effective and rigorous maintenance program is crucial for the long-term sustainability and function of GSI systems. Because many GSI systems incorporate vegetation, they can change over time as plant communities grow and establish. In urban environments in particular, GSI may be subject to temperature extremes, pollution, heavy sediment and trash accumulation, and an aggressive weed community—all of which can create a challenging environment for plants. Furthermore, sediment and trash, if allowed to accumulate, can create unsightly conditions and encumber the functionality of the SMP. Proper maintenance can ensure that GSI systems remain effective, beautiful, and safe for many years to come.

This document describes routine maintenance tasks for surface and subsurface features and contains 6 major divisions:

Division 1

Provides a brief description of each type of SMP included in Philadelphia’s GSI program; tables of recommended routine and reactive maintenance tasks and associated frequencies; an overview of maintenance event procedures; and an overview of general requirements.

Division 2

Provides general procedures, standard operating procedures, equipment, and materials for executing specific tasks for surface maintenance, related to both general care and vegetation management.

Division 3

Provides general procedures, standard operating procedures, equipment, and materials for executing specific tasks for subsurface maintenance.

Division 4

Provides general procedures, standard operating procedure, equipment, and materials for executing specific tasks for pervious pavement maintenance.

Division 5

Consists of appendices which provide supplementary materials including personnel classifications, points of contact, and a sample hydrant operation report.

Division 6

Contains a glossary with definitions for common technical terms used throughout this document.

Stormwater Management Practices

division 1.2



SMPS CURRENTLY IN PRACTICE BY PWD

1.2.1 STORMWATER TREE TRENCH

Description

A stormwater tree trench is a subsurface infiltration/storage trench, typically filled with stone, which is planted with one or more trees. Trees are planted within soil pits throughout the trench to allow the tree roots to access water stored in the system. Stormwater runoff is conveyed to the trench via green inlets and perforated distribution pipes. Green inlets are typically fitted with pretreatment devices to prevent trash and debris from entering the stormwater tree trench. Stormwater infiltrates into the stone trench and is either further infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipe conveyance. Trees help reduce the volume of stormwater runoff through evapotranspiration.

Stormwater tree trenches are often constructed beneath sidewalks and adjacent to streets to capture street runoff. Figure 1-1 provides examples of stormwater tree trench SMPs. Figure 1-2 shows typical stormwater tree trench features.



Figure 1-1. Examples of Stormwater Tree Trenches in Philadelphia

Stormwater Tree Trench

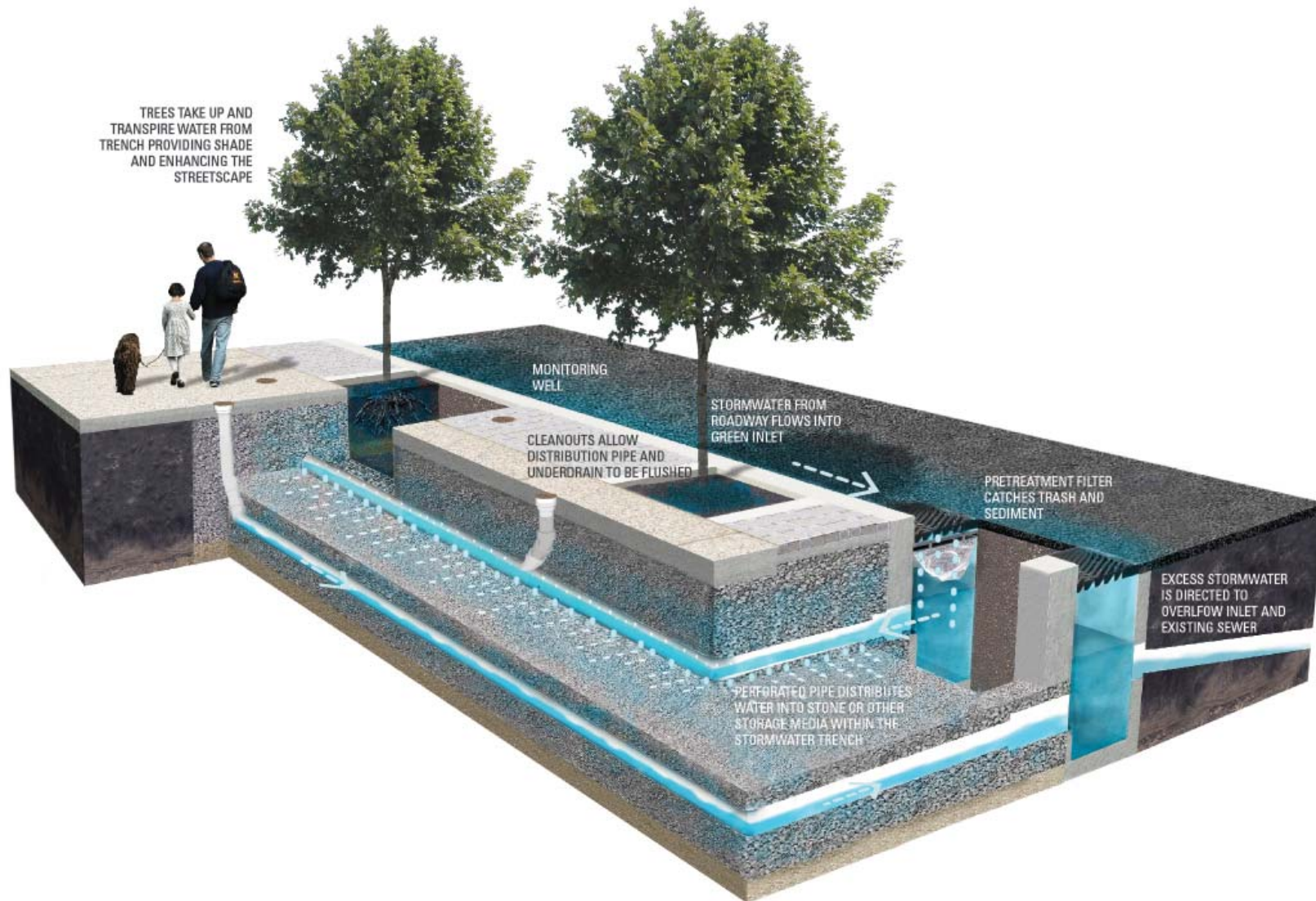


Figure 1-2. Stormwater Tree Trench with Typical Features

1.2.2 RAIN GARDEN AND STORMWATER BASIN

Description

A rain garden or stormwater basin is a vegetated area designed to collect runoff from impervious surfaces such as roofs, walkways, streets and parking lots, allowing water to be evapotranspired by vegetation, infiltrated into the ground and/or slowly released back to the existing sewer system via underdrain pipe conveyance. The bottom soil layer may be constructed over a stone storage area.

Rain gardens are shallow areas that are commonly planted with a variety of native grasses and shrubs and are often integrated into surrounding landscape features. Stormwater basins are often vegetated with mowed grass or a mix of naturalized meadow vegetation. Figure 1-3 provides examples of rain gardens and basins. Figures 1-4 and 1-5 show typical rain garden and stormwater basin features.



Figure 1-3. Examples of Rain Gardens and Stormwater Basins in Philadelphia

Rain Garden



Figure 1-4. Rain Garden with Typical Features

Stormwater Basin

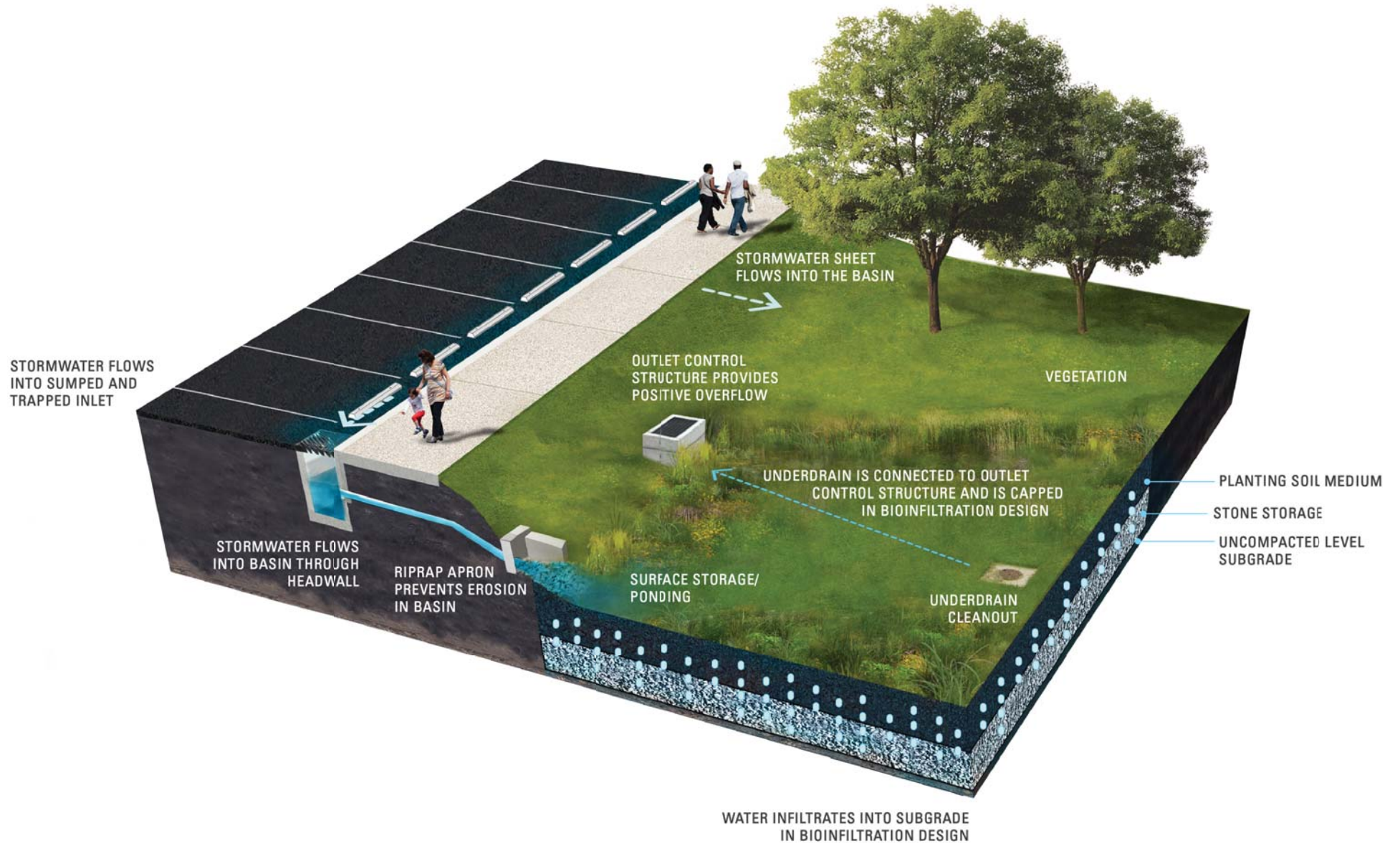


Figure 1-5. Stormwater Basin with Typical Features

1.2.3 STORMWATER BUMP-OUT

Description

A stormwater bump-out is a vegetated curb extension that intercepts gutter flow. A bump-out is composed of a layer of stone that is topped with soil and plants. An inlet or curb-cut directs runoff into the bump-out structure where it can be stored, infiltrated, and taken up by the plants through the evapotranspiration process. Excess runoff is permitted to leave the system and flow to an existing inlet. Aside from managing stormwater, bump-outs can also help with traffic-calming, and when located at crosswalks, they can provide a pedestrian safety benefit by reducing the street crossing distance and by providing a barrier for pedestrians waiting at crosswalks.

Stormwater bump-outs are usually located within the public right-of-way either mid-block or at intersections, and are commonly planted with a variety of grasses and flowering perennials. Figure 1-6 provides examples of stormwater bump-out SMPs. Figures 1-7 and 1-8 show typical stormwater bump-out features.



Figure 1-6. Examples of Stormwater Bump-outs in Philadelphia

Mid-Block Stormwater Bump-out

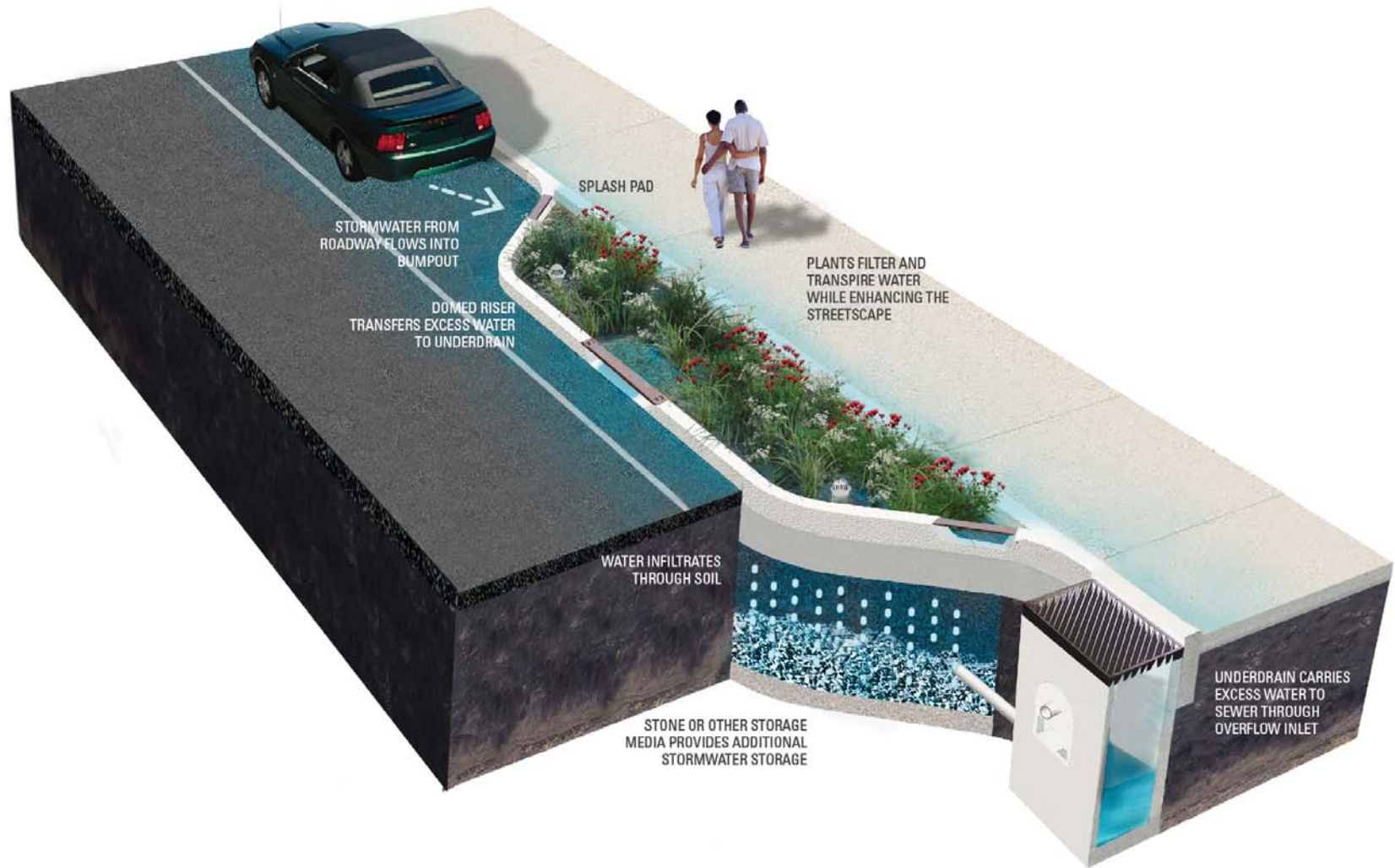


Figure 1-7. Stormwater Bump-out with Typical Features

Corner Stormwater Bump-out

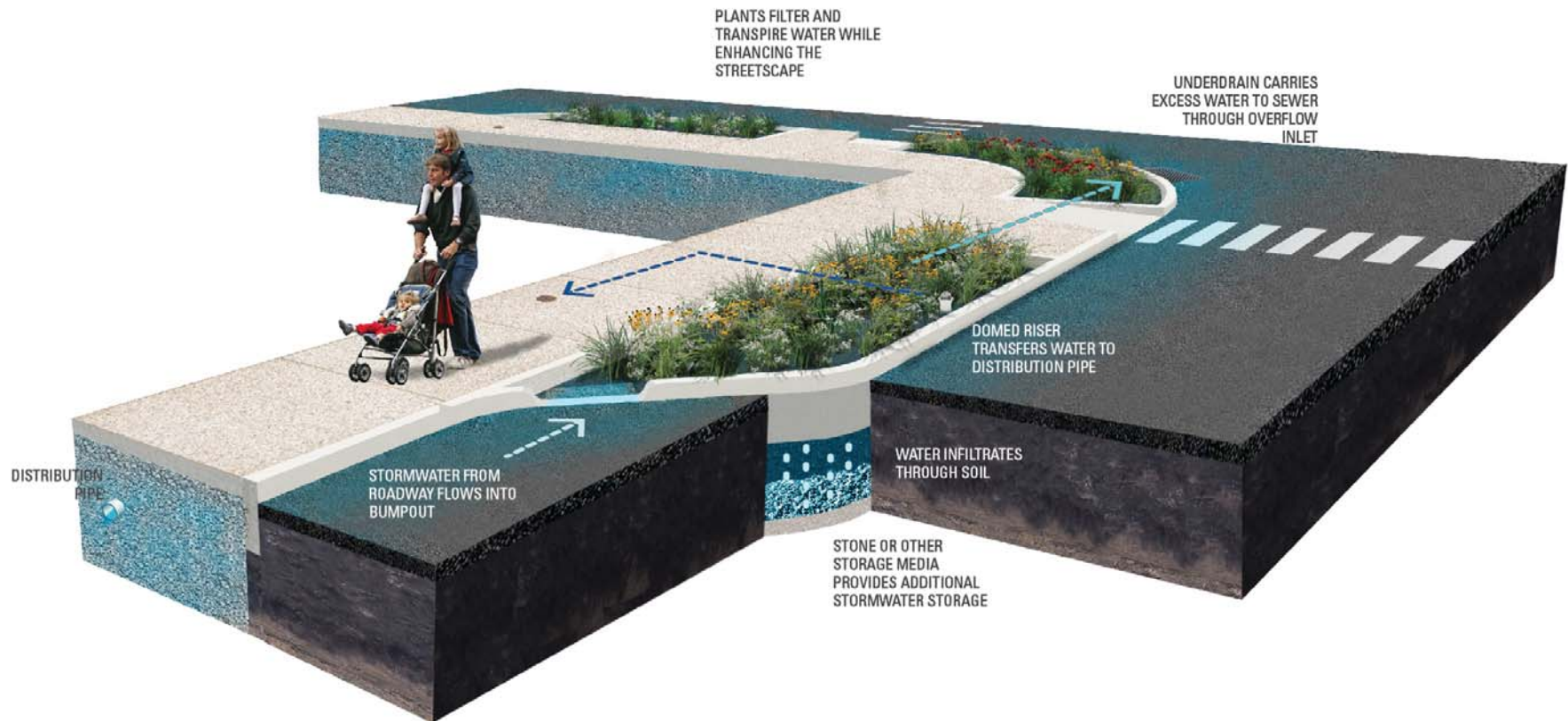


Figure 1-8 Stormwater Bump-out with Typical Features

1.2.4 STORMWATER PLANTER

Description

A stormwater planter is a specialized structure that is typically installed in the sidewalk area and designed to manage street and sidewalk runoff. A stormwater planter often contains curb edging and/or fencing as barrier protection. The stormwater planter is filled with stone, and topped off with soil and plants. The top of the soil in the stormwater planter is lower in elevation than the sidewalk, allowing for runoff to flow into the planter through an inlet or curb cut at street level. These planters manage stormwater by providing storage, infiltration, and evapotranspiration of runoff. Excess runoff is typically directed into an overflow pipe connected to the existing sewer system.

Stormwater planters are often integrated into sidewalks or plazas, and can also be found at building downspouts. They are commonly planted with a variety of native grasses, flowering perennials, and shrubs. Figure 1-9 provides examples of stormwater planter SMPs. Figure 1-10 shows typical stormwater planter features.



Figure 1-9. Examples of Stormwater Planters in Philadelphia

Stormwater Planter



Figure 1-10. Stormwater Planter with Typical Features

1.2.5 INFILTRATION/STORAGE TRENCH

Description

Infiltration/storage trenches are subsurface storage areas filled with stone, plastic crates, or pre-cast modular storage systems designed to either infiltrate stormwater or slow its flow into the sewer system. As water enters the trench (usually through a green inlet or pervious pavement), it fills the voids within the system, seeps to the bottom of the trench, and soaks into the soil beneath. Excess water that does not infiltrate into the soil can be slowly released into the sewer system at a controlled rate.

Infiltration/storage trenches can be located under sidewalks, parking lots, lawns, or other pervious and impervious recreational areas (e.g., basketball courts, athletic fields, etc.) and can be of varying sizes. They can be connected to other SMP types, such as stormwater bump-outs, to receive stormwater overflow from these systems. Some infiltration/storage trenches have very large drainage areas that collect runoff through an intricate series of inlets. Figure 1-11 provides examples of infiltration/storage trench SMPs. Figure 1-12 shows typical infiltration/storage trench features. Figures 1-13 and 1-14 show different varieties of storage systems for infiltration/storage trenches.



Figure 1-11. Examples of Infiltration/Storage Trenches in Philadelphia

Infiltration/Storage Trench

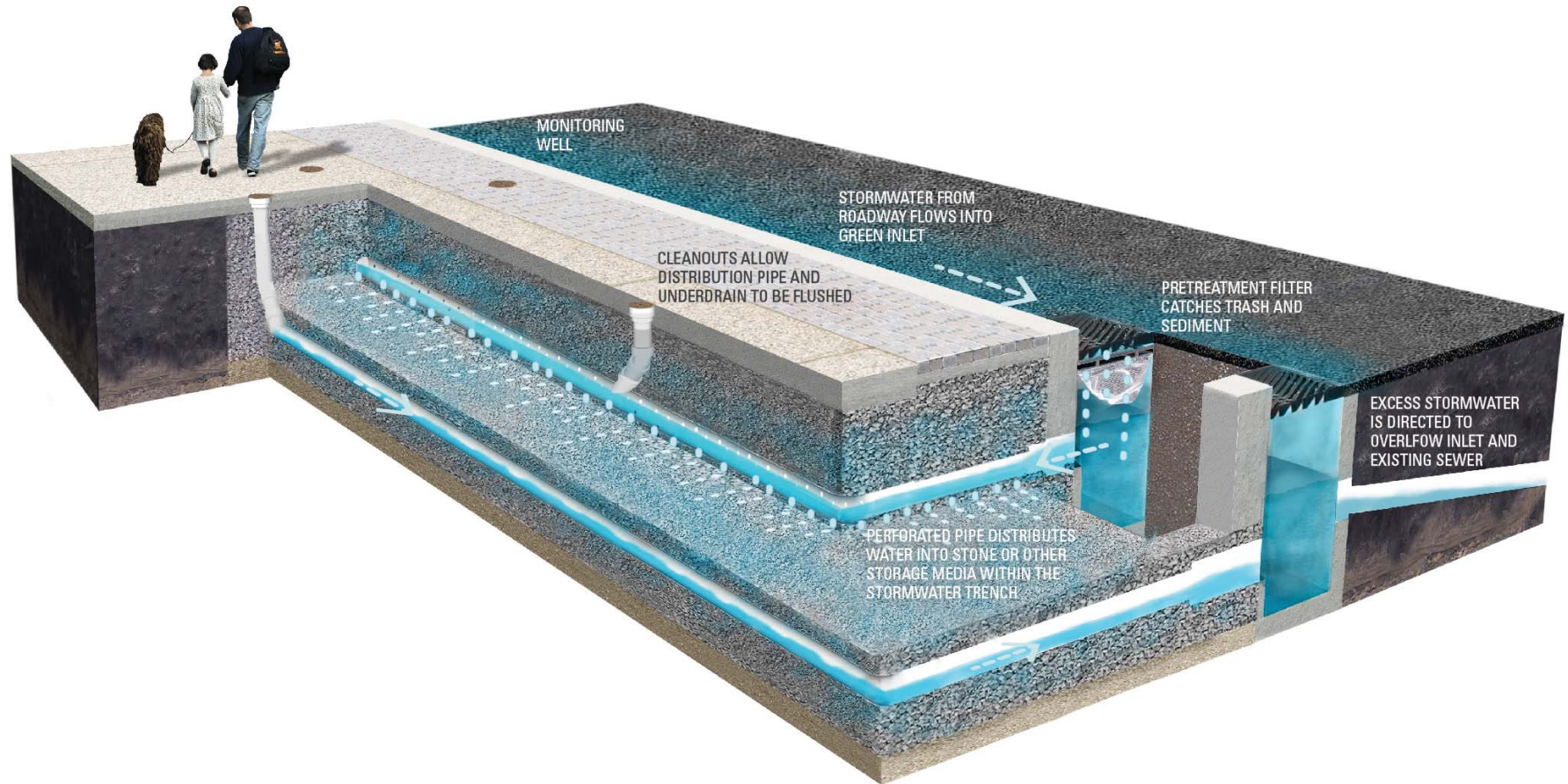


Figure 1-12. Infiltration/Storage Trench with Typical Features

Infiltration/Storage Trench Variety

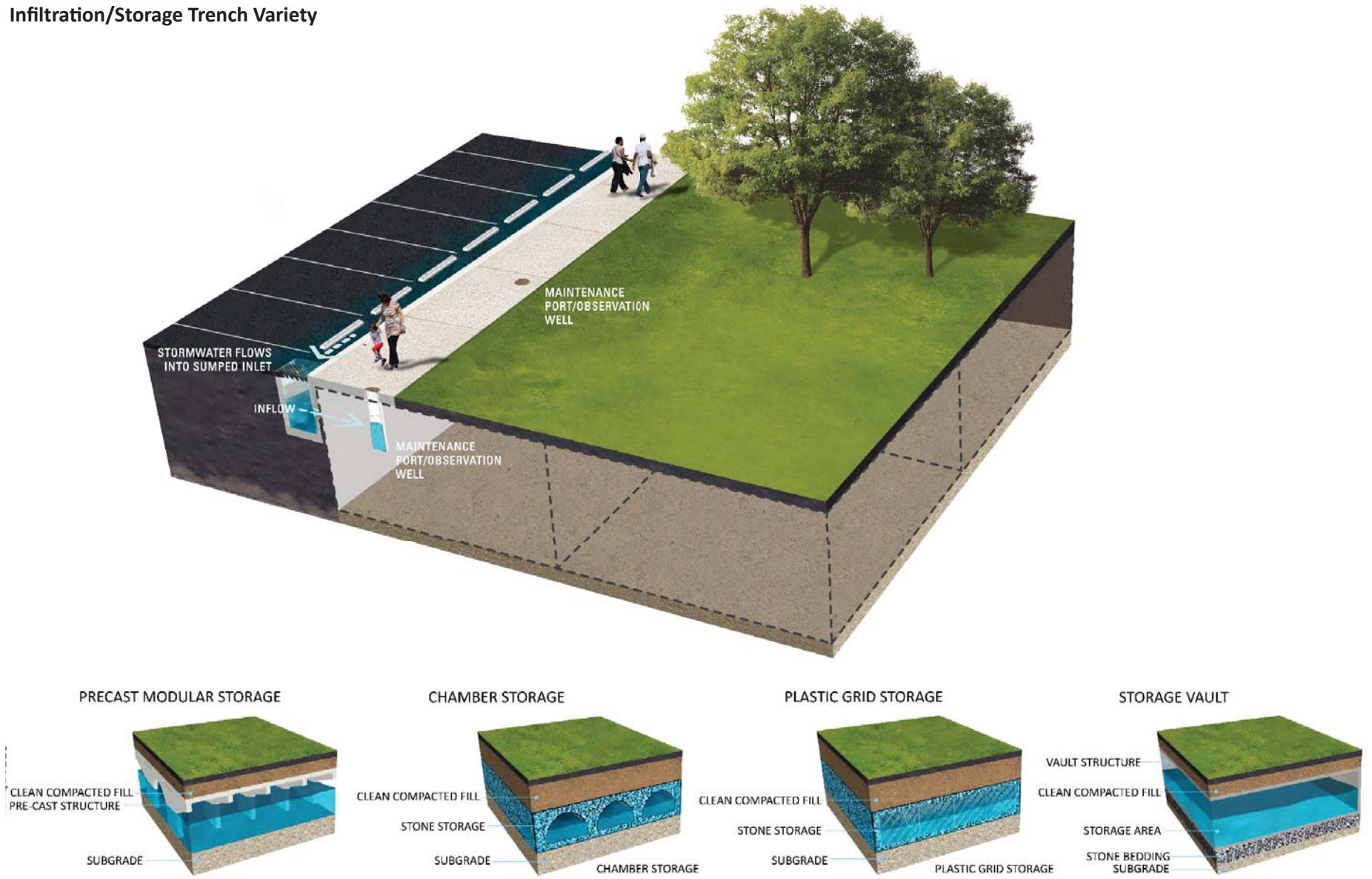


Figure 1-13. Infiltration/Storage Trench with Typical Features

Infiltration/Storage Trench Variety

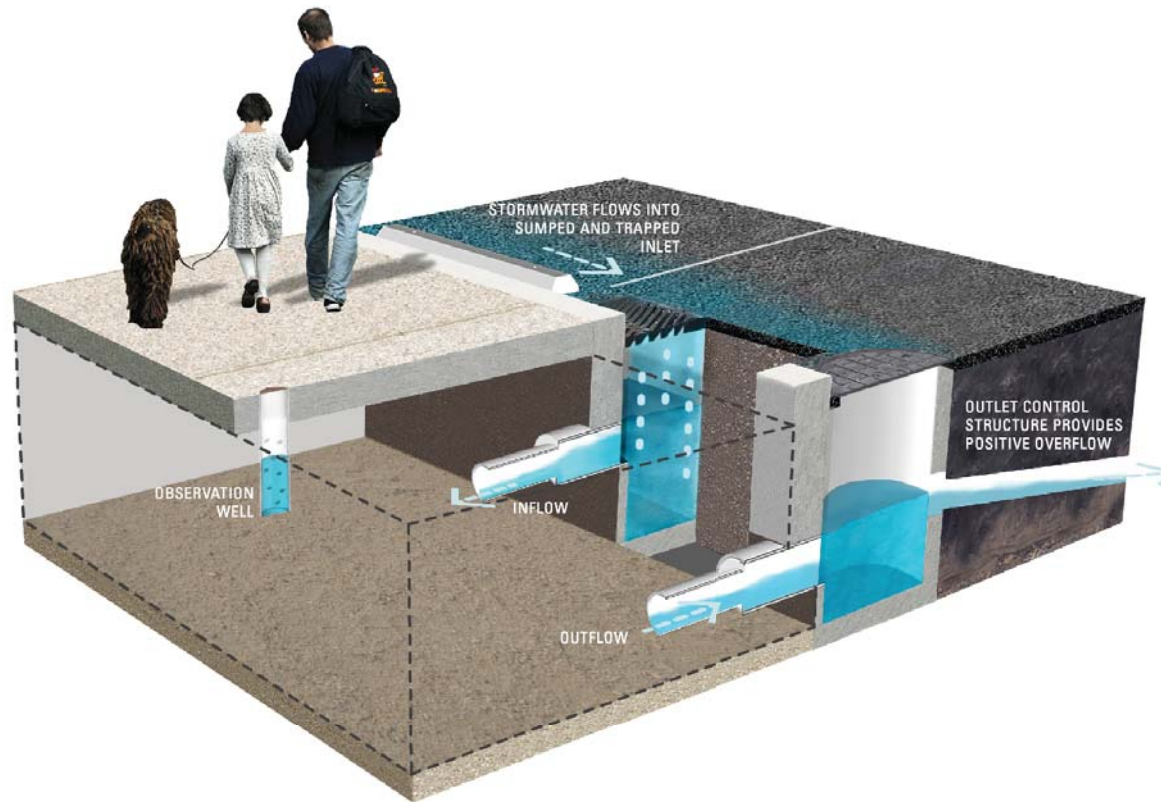


Figure 1-14. Infiltration/Storage Trench with Typical Features

1.2.6 STORMWATER WETLAND

Description

Stormwater wetlands are an effective tool for removing pollutants from stormwater runoff. Stormwater wetlands collect runoff and store it in a permanent, shallow pool and marshland vegetation helps treat the water and allows pollutants to settle to the bottom. Because stormwater wetlands seek to imitate the functions of natural wetlands, these systems can become aesthetic assets to the community and provide habitat for wildlife.

Stormwater wetlands are often constructed in regions originally designated as stormwater basins, within roadside right-of-ways, in areas where native soil conditions do not allow for infiltration, or where the groundwater table is exposed or close to the surface. Stormwater wetlands can also be created in low-lying areas through the use of impermeable liners to induce year-round inundated soil saturation. Wetland vegetation generally consists of a variety of open water, emergent, low/high marsh, and upland plants. Figure 1-15 provides examples of stormwater wetland SMPs. Figure 1-16 shows typical stormwater wetland features.



Figure 1-15. Examples of Stormwater Wetlands in Philadelphia

Stormwater Wetland



Figure 1-16. Stormwater Wetland with Typical Features

1.2.7 STORMWATER SWALE

Description

A stormwater swale is an open vegetated channel designed to convey stormwater runoff. Stormwater swales are typically designed to control stormwater runoff velocity and infiltrate stormwater runoff where feasible. Stormwater swales are often used as pretreatment or conveyance for another downstream SMP such as a rain garden or stormwater basin. Swales are most often planted with turf grass and maintained as lawn areas.

Stormwater swales may be located adjacent to roadways and parking lots, upstream of SMPs, or in areas subject to overland flooding. Figure 1-17 provides examples of stormwater swale SMPs. Figure 1-18 shows typical stormwater swale features.

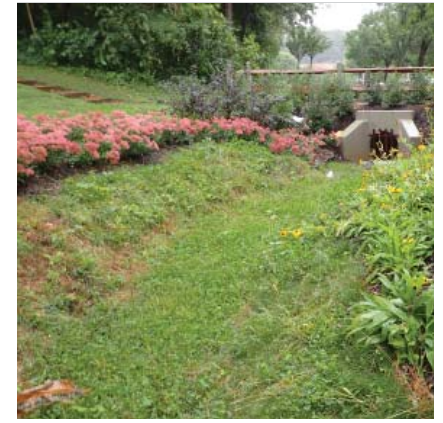


Figure 1-17. Examples of Stormwater Swales in Philadelphia

Swale

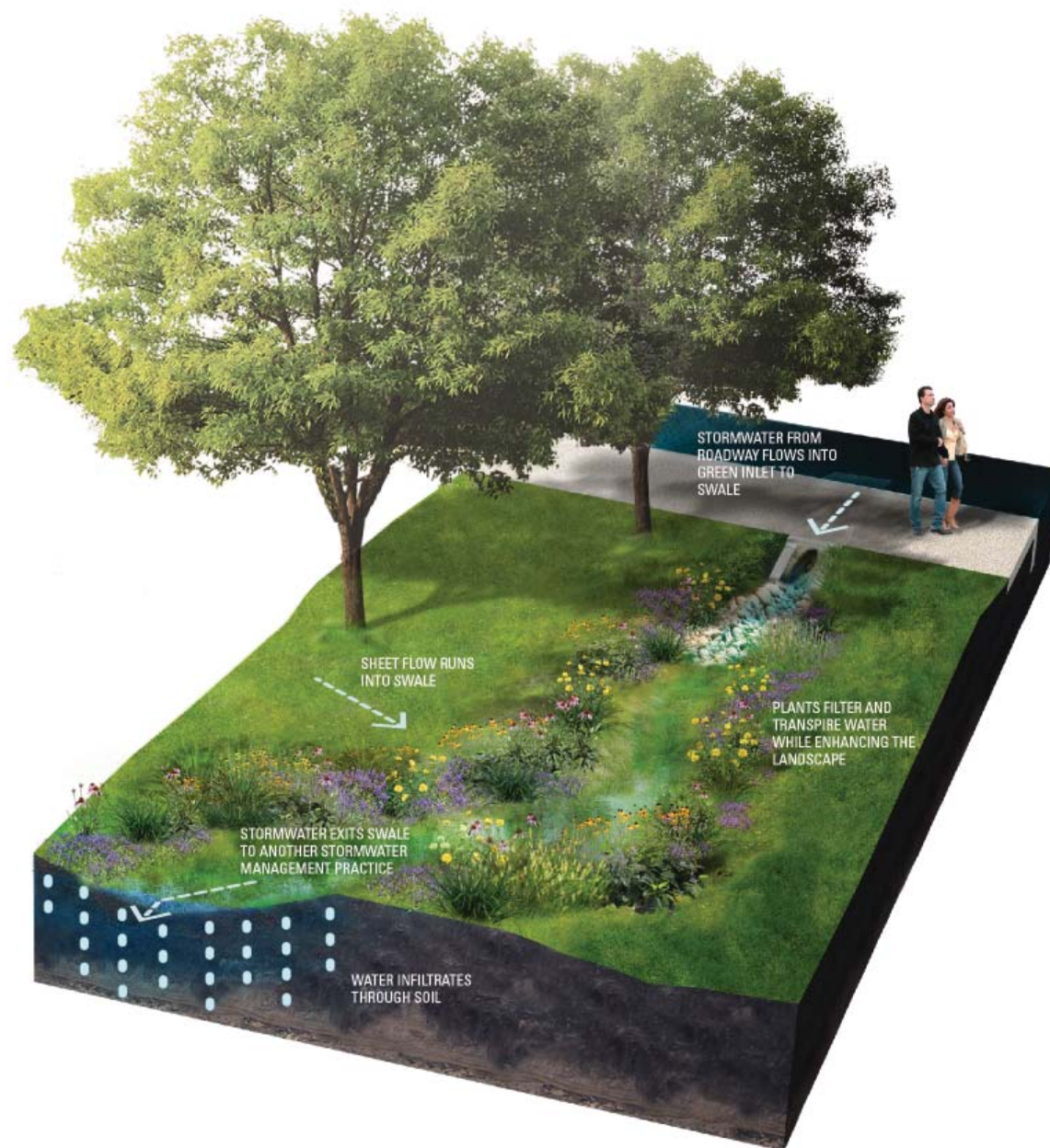


Figure 1-18. Stormwater Swale with Typical Features

1.2.8 STORMWATER TREE

Description

A stormwater tree is a tree planted in a specialized tree pit installed in the sidewalk area. Stormwater runoff is conveyed to a stormwater tree through sheet flow or a grate that is installed along the curb and connected to the tree pit. A stormwater tree design that has the planting media lower than the surrounding elevation requires a protective barrier. Multiple tree pits can be designed in series to maximize the potential for stormwater capture, treatment, and infiltration. Trees help reduce the volume of stormwater runoff through evapotranspiration.

Figure 1-19 provides examples of stormwater tree SMPs. Figure 1-20 shows typical stormwater tree features.



Figure 1-19. Examples of Stormwater Trees in Philadelphia

Stormwater Tree



Figure 1-20. Stormwater Tree with Typical Features

1.2.9 GREEN ROOF

Description

A green roof is a vegetated surface installed over a roof surface. A green roof system is constructed with multiple layers including waterproofing, a drainage layer, and a layer of engineered planting media. Green roofs are planted with specially selected plants that can grow in a thin layer of planting media. A green roof is effective in reducing the volume and velocity of stormwater runoff from roofs by temporarily storing stormwater, slowing excess stormwater release into the sewer system, and promoting evapotranspiration.

Figure 1-21 provides examples of green roofs. Figure 1-22 shows a green roof section with typical elements.



Figure 1-21. Examples of Green Roofs

Green Roof

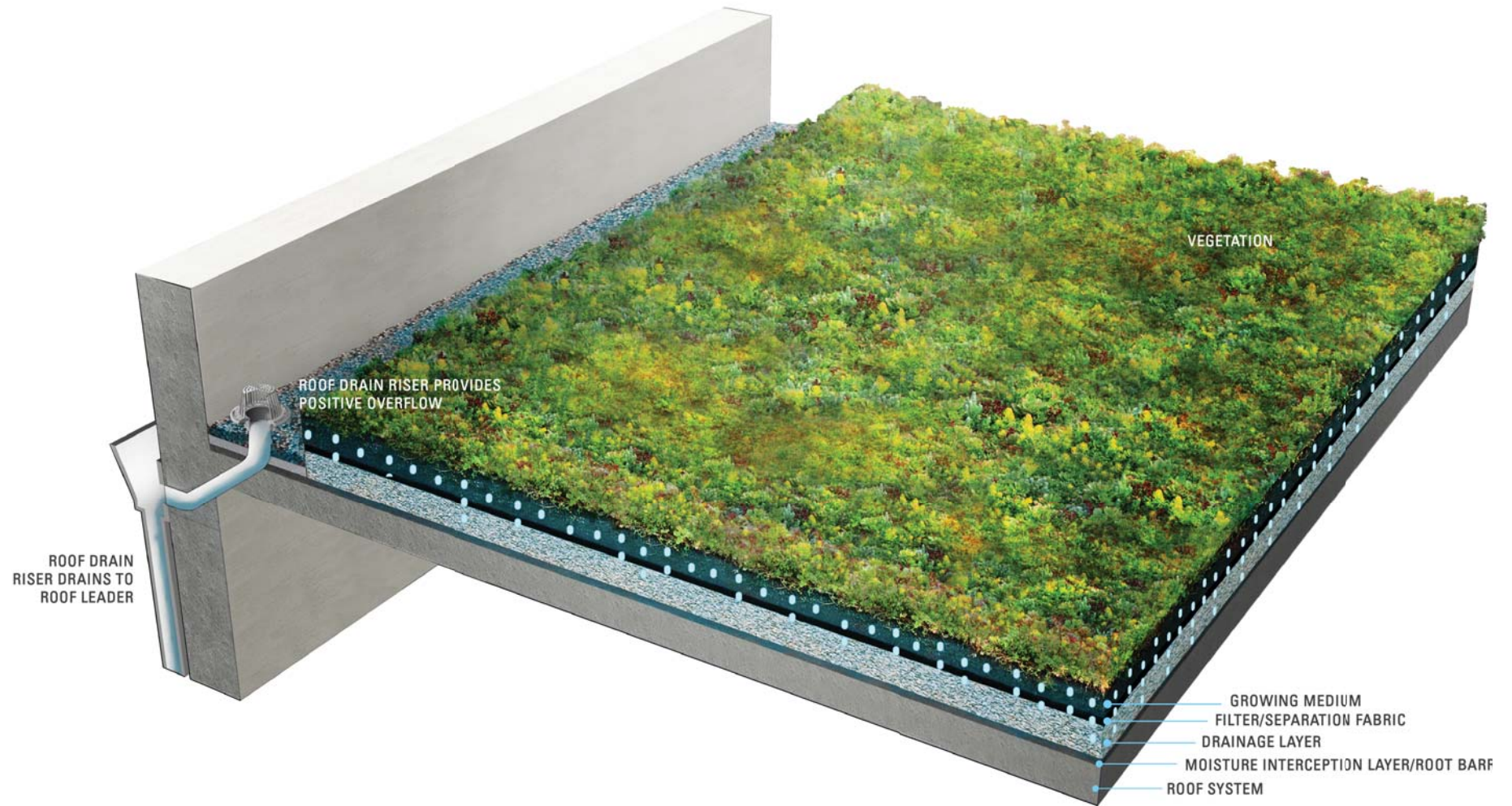


Figure 1-22. Green Roof with Typical Features

1.2.10 PERVIOUS PAVEMENT

Description

Pervious pavement is a permeable hardscape surface that allows water to pass through the surface. Pervious pavement materials can include concrete, asphalt, or pavers. Systems are typically underlain with a stone bed or infiltration/storage trench (see Section 1.2.5) to store stormwater until it is either infiltrated into the underlying soil and/or slowly released back to the existing sewer system via perforated underdrain pipe conveyance. Stormwater runoff is most often conveyed to the system via direct rainfall and/or sheet flow from surrounding impervious surfaces.

Pervious pavement can be found in hardscape areas designed for pedestrian traffic (e.g., sidewalks) and/or low levels of vehicular traffic (e.g., alleyways, parking stalls etc.) as well as in hardscape recreational areas such as basketball courts. Figure 1-23 provides examples of pervious pavement SMPs. Figure 1-24 shows typical pervious pavement features.

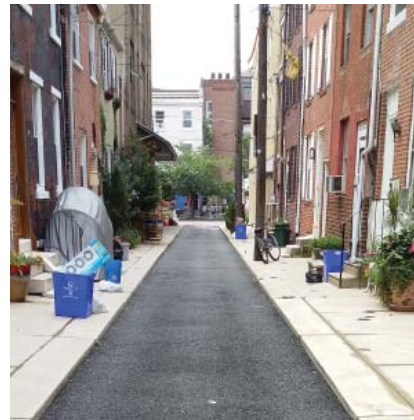


Figure 1-23. Examples of Pervious Pavement in Philadelphia

Pervious Pavement

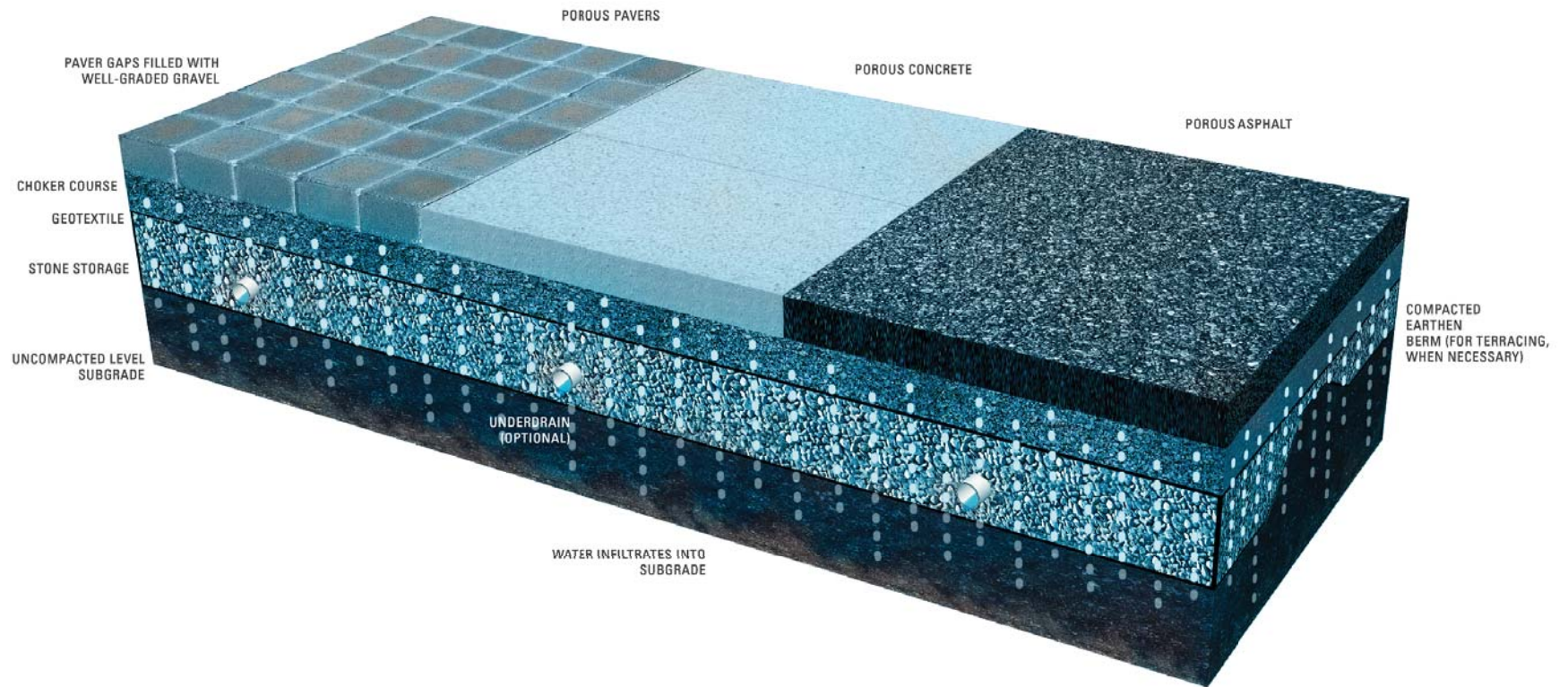


Figure 1-24. Pervious Pavement with Typical Features

1.2.11 GREEN WALL

Description

Green walls, also commonly known as “living walls”, are vertical vegetated systems that may be designed to capture stormwater via direct rainfall or via diversions from roof drainage systems. These systems are typically constructed using hanging containers affixed to a structural frame and may include a drip irrigation system. In some cases, green walls may be designed to utilize stormwater collected from roof areas via rainwater cisterns. Plantings may be hydroponic, or planted in a thin layer of media. Green walls typically do not provide significant stormwater storage, but can help to reduce stormwater volume through the evapotranspiration process.

Figure 1-25 provides an example of a green wall SMP and Figure 1-26 shows a green wall elevation with typical features.



Figure 1-25. Example of Green Wall

Green Wall

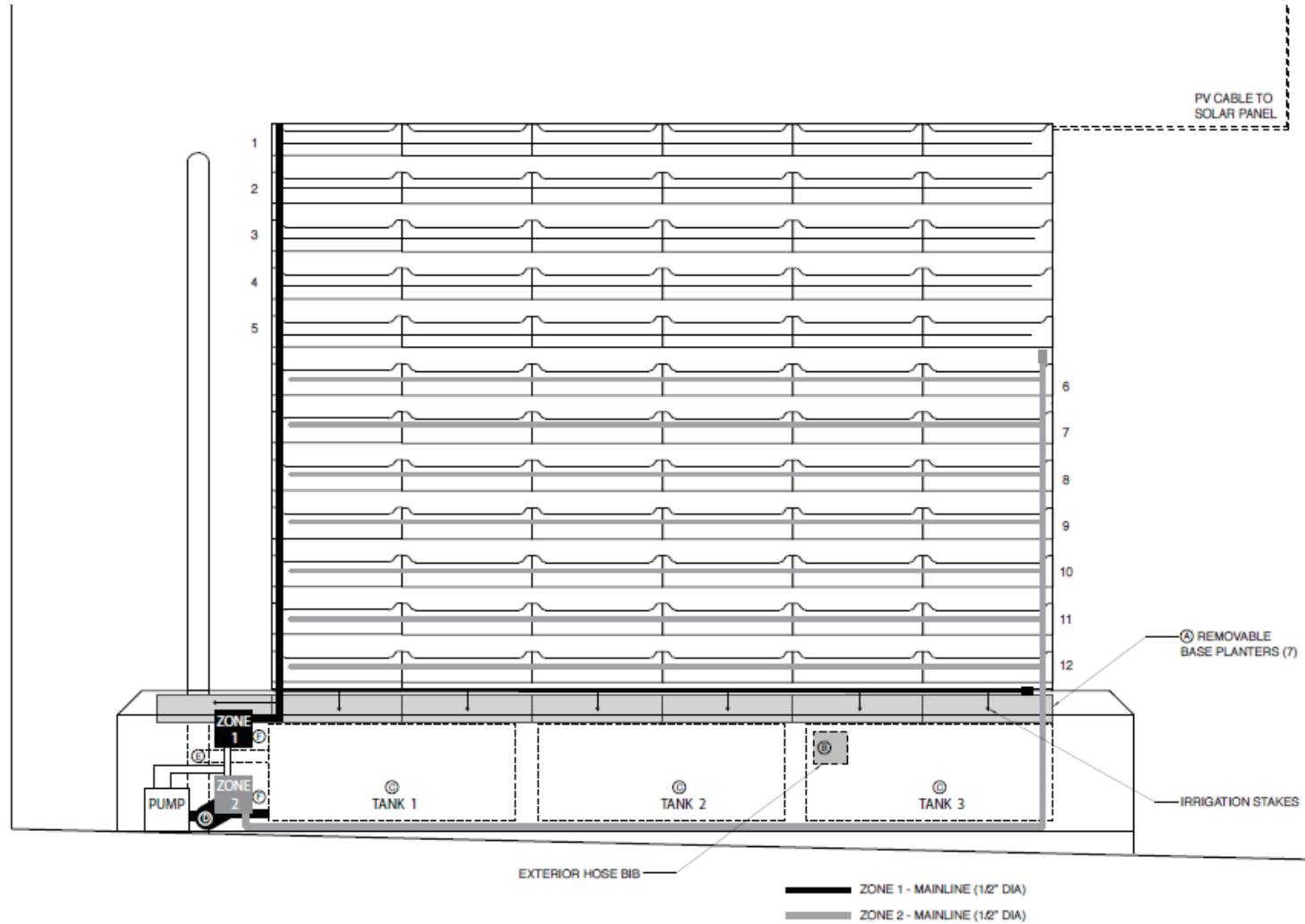


Figure 1-26. Green Wall Elevation with Typical Features

SMPS IN LIMITED PRACTICE OR NOT YET IN PRACTICE BY PWD

1.2.12 CISTERN/RAIN BARREL

Description

Cisterns and rain barrels are tanks or storage receptacles that capture and store stormwater for non-potable, beneficial reuse such as irrigation, toilet flushing, or industrial uses. Stormwater runoff is typically conveyed from roof areas to the rain barrels or cisterns via roof gutters, downspouts, drains, and/or pipes. Screens on gutters and downspouts filter large sediment and debris before it enters the rain barrel or cistern. First flush diverters are used in some systems to capture debris and pollutants within the first few gallons of stormwater runoff during a rain storm. Some systems may be designed to detain and slowly release water back to the existing sewer system via an orifice or valve.

Rain barrels are typically located adjacent to buildings at single downspout locations while cisterns may be located above or below ground and usually receive stormwater runoff from multiple downspouts or conveyance manifold systems. Figure 1-27 provides examples of rain barrel/cistern SMPs. Figure 1-28 shows typical cistern/rain barrel elements.



Figure 1-27. Examples of Cisterns and a Rain Barrel (Image Credits: DarcoInc.com, Septa.org)

Cistern



Figure 1-28. Subsurface Cistern with Typical Features

1.2.13 BLUE ROOF

Description

A blue roof is non-vegetated storage system designed into a roof structure such that the roof retains stormwater. It is installed over a sealed roof membrane and typically utilizes check dams, trays, or modified roof drains to capture and temporarily detain or slow stormwater before it reaches building downspouts. Stormwater detained by blue roofs is typically then slow released to the roof drains and/or removed through evaporation to the atmosphere, especially during warm, sunny weather.

Blue roofs are best suited for buildings with relatively flat roofs and other auxiliary structures. Figure 1-29 provides examples of blue roof configurations: retention trays (bottom) and check dams (top). Figure 1-30 shows a blue roof tray with typical elements.



*Figure 1-29. Examples of Blue Roofs in New York City
(Image credit: Gowanus Canal Watershed, Hazen and Sawyer)*

Blue Roof

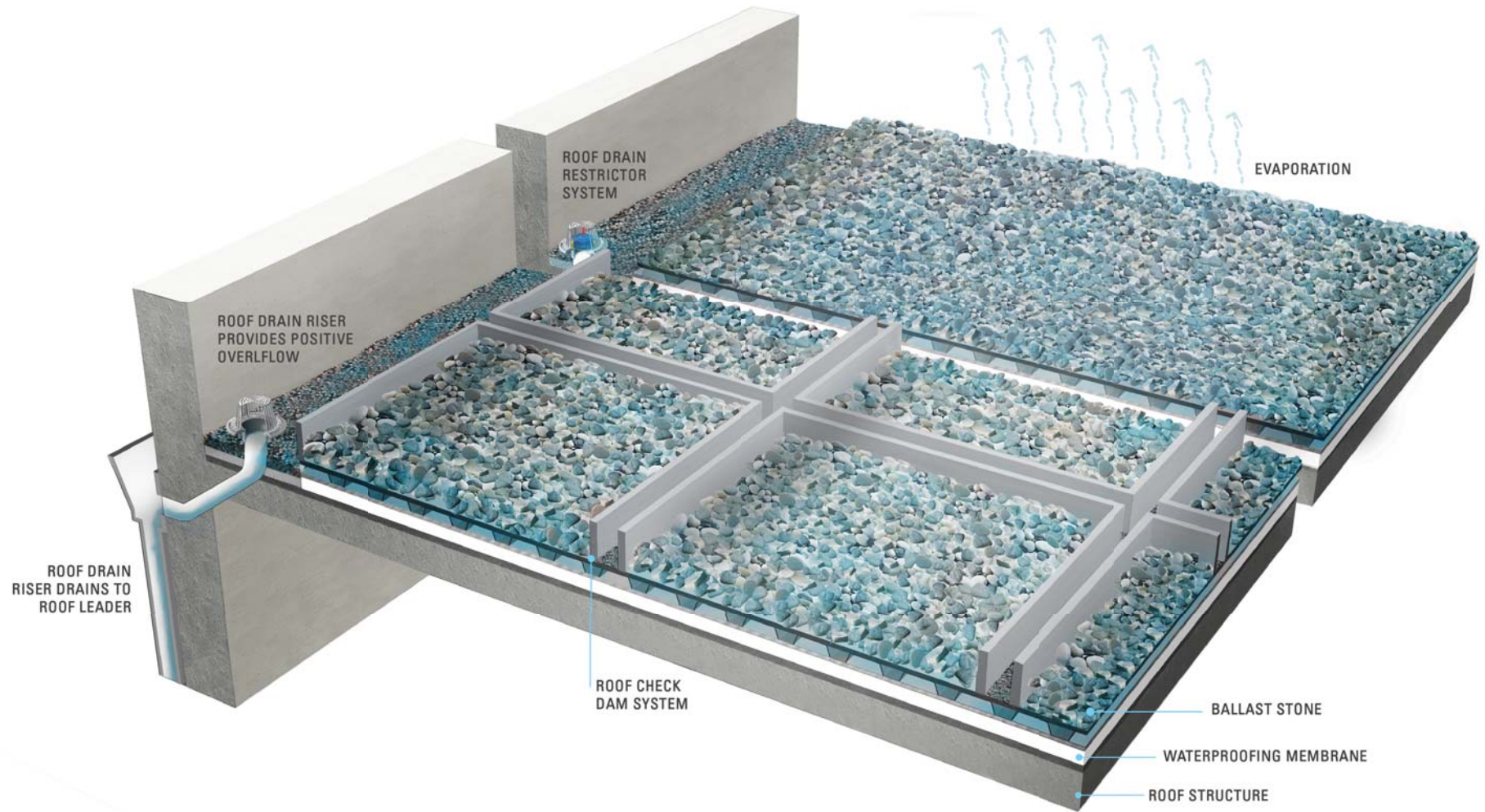


Figure 1-30. Blue Roof with Typical Features

1.2.14 GREEN GUTTER

Description

Green gutters are narrow and shallow landscaped strips along a street's curb line. The top of the planting media in the green gutter is lower than the street's gutter elevation, allowing stormwater runoff from both the street and sidewalk to flow directly into the system. Green gutters may be lined with geotextile (permeable or impermeable) and are commonly planted a variety of grasses and flowering perennials. Stormwater is infiltrated into the underlying soil and/or slowly released back to the existing sewer via a downstream curb cut or other overflow structure. Green gutter vegetation helps reduce the volume of stormwater runoff through evapotranspiration.

Green gutters are typically located within the public right-of-way either mid-block or at intersections. Figure 1-31 provides an example of a green gutter SMP. Figure 1-32 shows typical green gutter features.



*Figure 1-31. Example of a Green Gutter in Portland, Oregon
(Image credit: PWD Green Streets Design Manual, 2014)*

Green Gutter

Figure 1-32. Green Gutter with Typical Features

1.2.15 STORMWATER DRAINAGE WELL

Description

A stormwater drainage well is a manhole structure designed to manage stormwater runoff by receiving stormwater from upstream collection and pretreatment systems and then discharging the stormwater into the surrounding soils through perforations in the manhole. It is designed to infiltrate stormwater.

Stormwater drainage wells can be located under roads, sidewalks, parking lots, lawns, or other pervious and impervious areas. They can also be connected to other SMP types. Figure 1-33 provides an example of a drainage well installation and Figure 1-34 provides a conceptual rendering of a stormwater drainage well with typical features.



*Figure 1-33. Example of a Drainage Well Installation
(Image Credit: Lake George Association)*

Stormwater Drainage Well

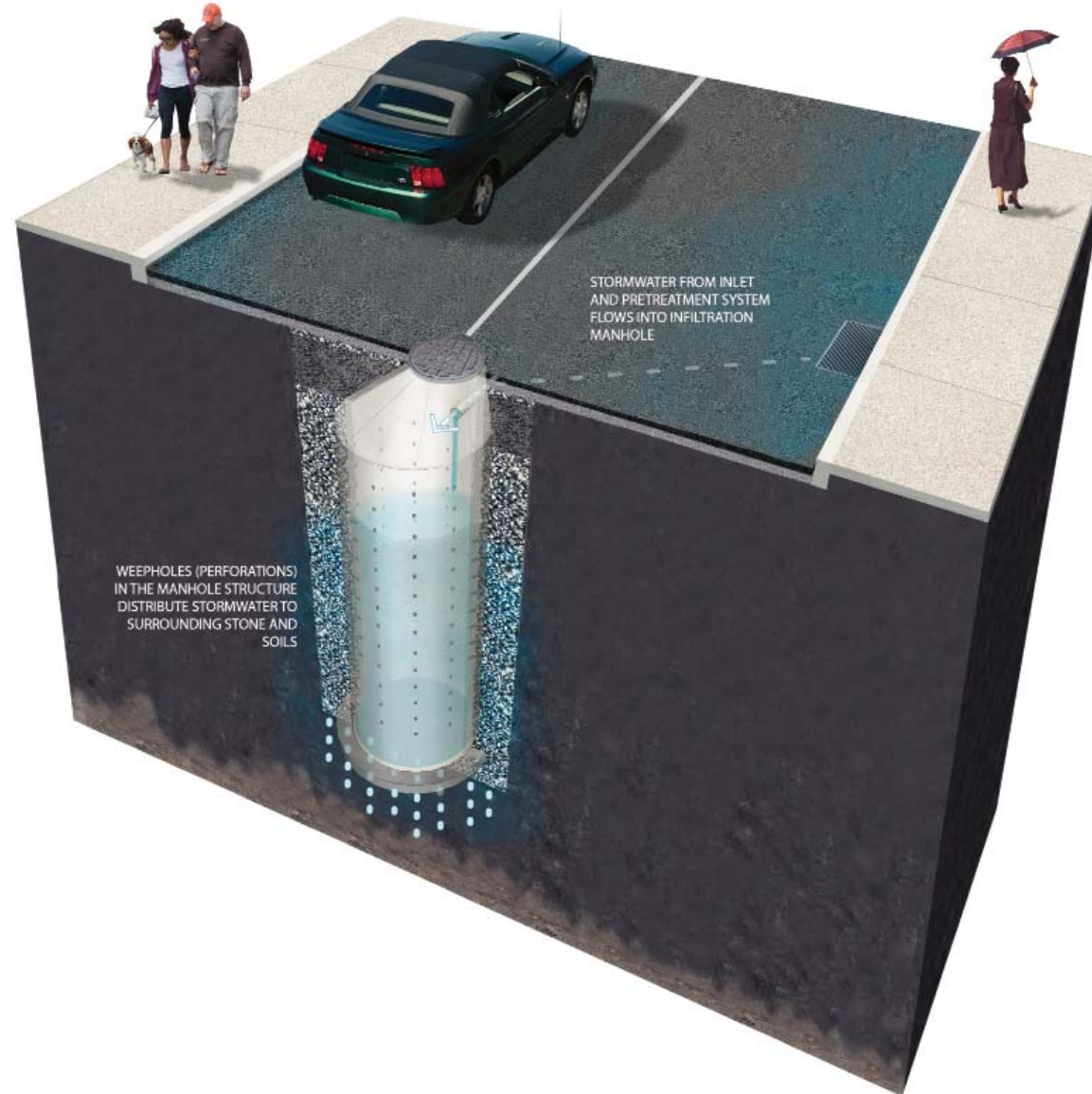


Figure 1-34. Stormwater Drainage Well with Typical Features

Routine Maintenance

division 1.3



1.3 ROUTINE MAINTENANCE TABLES

1.3.1 DESCRIPTION OF ROUTINE MAINTENANCE TABLES

1. Routine Maintenance tasks for the SMP types described in Section 1.2 are listed in Tables 1-1 through 1-7. Not all tasks are applicable to all SMP types.
2. Routine Maintenance tasks must be completed as needed at the frequencies prescribed in Tables 1-1 through 1-7.
3. Other tasks beyond those listed in these Routine Maintenance tables may be required in response to observed issues. These additional tasks are known as Reactive Maintenance, which is described in Section 1.4.

Table 1-1. Monthly Routine Surface Maintenance Tasks

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	APPLICABLE SMP TYPE(S)	PROTOCOL REFERENCE
General Care	Remove trash and/or sediment from SMP surfaces (e.g., sidewalks, gutterlines, tree pits, etc.)	If present within SMP	All SMPs	2.1.1
	Remove organic debris (e.g., leaves, feces, etc.) from SMP surfaces	If present within SMP		
	Remove sediment from basin and forebay areas	If sediment is visible	Rain garden/basin, Bump-out, wetland, swale	
	Remove tags, strings, and expired no-parking signage	Materials present within SMP	All SMPs	
	Wipe down signage	Dust, grime or residue on signs		
	Report dumping to Philly311	If present within SMP		
Pretreatment Device Maintenance	Empty and clean surface inlet pretreatment device	If trash, sediment, and/or organic debris present in pretreatment device	All SMPs	2.1.1
	Install pretreatment device (e.g., frame and bag)	Device not present in surface-accessible inlet		
	Replace ripped or clogged pretreatment device fabric	<i>Ripped pretreatment device fabric:</i> Fabric has rip or hole > 3 in. <i>Clogged pretreatment device fabric:</i> Fabric has standing water at time of maintenance and inlet is drained down to pipe invert		
Erosion Repair	Fill eroded areas, place erosion fabric, and, if necessary, seed	If minor (<20 ft ²), nonrecurring erosion is present within SMP	All SMPs	2.1.2

Table 1-1. Monthly Routine Surface Maintenance Tasks (cont'd.)

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	APPLICABLE SMP TYPE(S)	PROTOCOL REFERENCE
Concrete Repair	Repair hairline/cosmetic cracks	If present within SMP	All SMPs	2.1.3
	Replace loose, missing or displaced brick, stone or paver	If present within SMP		
Settling	Pack sinkholes or settling with stone, cover with soil and mulch if applicable	If sinkholes of 24 in. deep or less are present within SMP	All SMPs	2.1.4
Graffiti Removal	Remove graffiti from SMP signage, structures, or SMP surfaces	If present within SMP	All SMPs	2.1.5
Painting	Paint appropriate structures (planter box walls, half walls, etc.)	Existing paint on concrete/masonry surfaces is in poor condition	Planters, rain gardens, stormwater trees	2.1.6
Hardware Care	Clean and grease appurtenances; Replace if missing	Each time a component with bolts or locks is opened; As needed	All SMPs	2.1.7
	Install secure bars or grate	Outfall pipes or other openings > 8 in. diameter are not protected with secure bars		
Weeding	Remove weeds (e.g., within tree pits, sidewalk, gutterline, etc.) using approved mechanical or chemical methods	If present within SMP	All vegetated SMPs	2.2.1
Mowing	Mow turf grass	As directed by owner/operator	Rain garden/basin, wetland, swale	2.2.2
	Mow cool season grass meadows to a height of 3-4 in.	If height of vegetation is > 4 in. above ground surface elevation	Rain garden/basin, wetland, swale	2.2.2
Dead & Damaged Vegetation Removal	Remove dead herbaceous vegetation, trees or shrubs from SMP area	If present within SMP	All vegetated SMPs	2.2.3
	Prune trees	If damaged, diseased, and/or dead branches are present; suckers present within the SMP		

Table 1-1. Monthly Routine Surface Maintenance Tasks (cont'd.)

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	APPLICABLE SMP TYPE(S)	PROTOCOL REFERENCE
Cutting Back Vegetation	Cut back dense vegetation	If height of dense vegetation adjacent to walkways or street intersections is > 4 ft. measured from top of curb elevation	All vegetated SMPs	2.2.4
Pest & Disease Management	Treat vegetation to remove, destroy, or minimize pests and disease	If harmful insects (e.g., bag worms, wax scale, caterpillars, aphids, etc.); galls, mildew or fungus are present	All vegetated SMPs	2.2.5
	Remove small animal carcasses	If small animal (e.g., rat, bird, cat, etc.) carcasses are present within the SMP		
	Report large animal carcasses to Philly311	If large animal (e.g., deer, dog, raccoon, etc.) carcasses are present within the SMP		
	Fill animal burrows with stone and compact	If animal burrows are present within the SMP		
	Report animal infestations to SMP owner	If more than 2-3 animal burrows are present or more than 2-3 animals are observed (e.g., rats, mice, moles etc.)		
Mulching	Apply mulch to tree pits	If gap between top of sidewalk and top of mulch is > 1 in.	Tree trench, stormwater tree, green gutter	2.2.6
	Rake mulch away from base of tree trunk or woody-stemmed shrub	If mulch is within 3 in. of trunk	All vegetated SMPs	

Table 1-2. Annual and Semi-Annual Surface Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	FREQUENCY AND TIMING OF MAINTENANCE	APPLICABLE SMP TYPE(S)	PROTOCOL REFERENCE
Winterization	Clean and grease appurtenances	None	November and April	All SMPs	2.1.8
	Install traffic bollards	Requested by owner/operator	Annually in November	Bump-out, green gutter	
Pre-emergent Herbicide Application	Apply pre-emergent herbicide	Tree trenches and soft sites within first 2 years of establishment	Spring (April) and summer (June)	All vegetated SMPs	2.2.1
Structural Pruning	Complete selective pruning to improve tree architecture	None	Annually during the period from December to the end of February	All vegetated SMPs	2.2.4
Cutting Back of Vegetation	Cut back herbaceous vegetation from previous growing season	If the height of herbaceous vegetation exceeds 6 in.	Annually in March	All vegetated SMPs	2.2.4
Mulch Care	Remove existing mulch from tree pits and replace with fresh mulch	None	Annually in April	Tree trench, stormwater tree	2.2.6
	Apply mulch to the perimeter of landscaped beds > 2 years old and to entire bed for soft sites < 2 yrs. old	None	Annually in April	Rain garden/ basin, bump-out, green gutter	
Soil Amending	Tree/shrub appears unhealthy, unrelated to drought; soil issues observed	Consult owner/operator	Amend soil	All vegetated SMPs	2.2.7
Planting & Seeding	Bare areas in planted beds > 20 ft ² during the growing season	Consult landscape architect or horticulturist and owner/operator for plant selection	Replace plant(s)	All vegetated SMPs	2.2.8
	Bare areas in meadow areas or seeded areas (> 20 ft ²) during the growing season	Consult landscape architect or horticulturist and owner/operator for plant selection	Perform seeding in spring (March 1 - May 15) or fall (August 15 - October 15)	Rain garden/ basin, wetland, swale, green gutter	2.2.9

Table 1-3. Annual Subsurface Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	APPLICABLE SMP TYPE(S)	PROTOCOL REFERENCE
Vacuum Cleaning	Vacuum clean trash/sediment/organic debris from subsurface access and flow control/conveyance structures	If trash/sediment/organic debris present within structures	All SMPs with subsurface features	3.1
Pipe Jetting	Jet (i.e., hydro-clean) conveyance, distribution, and underdrain pipes	If 10% or more of the cross-sectional area of the pipe is blocked by sediment/debris, or as otherwise specified by the owner/operator		
Inlet Pretreatment Device Maintenance	Empty and clean surface pretreatment devices	If trash, sediment, and/or organic debris is present in pretreatment devices		
	Install permanent pretreatment devices	If pretreatment devices are not present		
	Replace ripped pretreatment device fabric	<i>Ripped pretreatment device fabric:</i> Pretreatment device fabric has a rip or hole > 3 in.		
Bolt & Lock Care	Clean and grease appurtenances	Each time a component with bolts or locks is opened		2.1.7

Table 1-4. Green Roof, Blue Roof, and Green Wall Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	FREQUENCY AND TIMING OF MAINTENANCE	PROTOCOL REFERENCE
General Care	Remove trash and/or sediment from all SMP surfaces (e.g., roof, planted areas, etc.)	If trash and/or sediment is present within the SMP area	3 times per year in April, July, and October	2.1.1
	Wipe down signage	If dust, grime or other residue is present on signage		2.1.1
Graffiti Removal	Remove graffiti from SMP signage, structures, or surfaces	If graffiti present within the SMP area	3 times per year in April, July, and October	2.1.5
Winterization	Clean and grease appurtenances	None	Annually in October	2.1.8
	Implement winterization tasks as defined by or required by manufacturer	As defined by the manufacturer		
	Drain and close internal irrigation pipes, reservoirs, and attachments	None		
Weeding	Remove weeds using one or more of the mechanical or chemical methods	If weeds are present within the SMP area	3 times per year in April, July, and October	2.2.1
Dead & Damaged Vegetation Removal	Remove dead herbaceous vegetation or shrubs from the SMP area	If dead vegetation is present within the SMP area	3 times per year in April, July, and October	2.2.3
Pest & Disease Management	Treat vegetation to remove, destroy, or minimize pests and disease	If harmful insects (e.g., bag worms, wax scale, caterpillars, aphids, etc.); galls, mildew or fungus are present within the SMP area	As Needed	2.2.5
	Remove animal carcasses	If small animal (e.g., rat, bird, cat, etc.) carcasses are present within the SMP area	As Needed	
Manage/ Amend Soil	Amend soil as needed following annual nutrient test performed by the owner/operator	Soil tests report the need for soil amendment; Consult the owner/operator	Depending on soil test results	2.2.7

Table 1-5. Cistern/Rain Barrel Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	FREQUENCY AND TIMING OF MAINTENANCE	PROTOCOL REFERENCE
General Care	Remove trash and/or sediment from all SMP surfaces (e.g. gutterlines, screen, diverter etc.)	If trash or sediment is present within the SMP area	3 times per year in April, July, and October	2.1.1
	Wipe down signage	If dust, grime or other residue is present on signage	3 times per year in April, July, and October	
Graffiti Removal	Remove graffiti from SMP signage, structures, or SMP surfaces	If graffiti is present within SMP area	3 times per year in April, July, and October	2.1.5
Winterize	Disinfect cistern/rain barrel storage tank	None	Annually in October	2.1.8
	Close cistern/rain barrel storage tank	If cistern/rain barrel is located above ground or above the frost line for subsurface cisterns		
	Vacuum clean above ground cisterns (e.g., tanks, barrels, etc.)	If trash/sediment/ organic debris is present within the cistern/rain barrel		

Table 1-6. Pervious Pavement Surface Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	FREQUENCY AND TIMING OF MAINTENANCE	PROTOCOL REFERENCE
General Care	Remove trash and/or sediment from all SMP surfaces (sidewalks, gutter lines, tree pits, etc.)	If present within SMP area	3 times per year	2.1.1
	Wipe down signage	Dust, grime or residue present	3 times per year	2.1.1
	Report dumping to Philly311	If present within SMP area	As needed	2.1.1
	Vacuum pervious pavement surface	None	3 times per year	4.1
	Perform restorative vacuum cleaning	If infiltration testing performed by the owner/operator indicates decreased infiltration rates	As needed	4.2
	Remove organic debris (e.g., leaves, feces, etc.) from all SMP surfaces	If present within SMP area	3 times per year	2.1.1
Remove Graffiti	Remove graffiti from site signage, structures, or SMP surfaces	If present within SMP area	As needed	2.1.5
Winterize SMP	Clean and grease appurtenances	None	Semi-annually, November and April	2.1.8
Remove Animal Carcasses	Remove and dispose of small animal carcasses	Small animal (e.g., rat, bird, cat, etc.) carcasses present within SMP area	As needed	2.2.5
	Report large animal carcasses to Philly311	Large animal (e.g., deer, dog, raccoon, etc.) carcasses present within SMP area		
Winter Maintenance	Apply de-icer to pervious pavement surface	Snow events > 0.25 in., sleet and freezing rain events, and after any plowing event	Before and after every applicable storm, and after every plowing event	4.3
	Plow snow from surface	Snow event > 2 in.	Every 3 hrs. during storm	

Table 1-7. Establishment Watering Maintenance

TASK	DESCRIPTION	PRECONDITIONS FOR MAINTENANCE	FREQUENCY AND TIMING OF MAINTENANCE	PROTOCOL REFERENCE	APPLICABLE SMP TYPE(S)
Trees	Place water bag(s) on all newly planted tree(s)	If the tree has been planted within the last 24 months	Annually in April, or after planting	2.2.10	All SMPs with trees
	Place water bag(s) on unhealthy tree(s)	If tree leaves appear brown or wilted	Monthly from April to end of October		
	Fill water bag(s)	If there has been period of 7 or more days without rain or watering	Every 7 days from April to end of October		
	Remove water bag(s) from tree(s)	If water bag(s) are present	Annually in November		
Herbaceous Vegetation & Shrubs	Water herbaceous vegetation and shrubs	If there has been a period of 4 or more days without rain or watering and the site has been planted within the last 24 months	Every 4 days from April to end of October	2.2.10	All vegetated SMPs
	Water sedums	If there has been a period of 7 or more days without rain or watering and the site has been planted within the last 12 months	Every 7 days from April to end of October		Green roof, green wall

Reactive Maintenance

division 1.4



1.4 REACTIVE MAINTENANCE TABLES

1.4.1 DESCRIPTION OF REACTIVE MAINTENANCE TABLES

1. Reactive maintenance tasks in Table 1-8 are additional tasks beyond those routine tasks listed in Tables 1-1 through 1-7. Reactive maintenance tasks may be required in response to specific observations (related to site safety, SMP performance, and/or aesthetics) during Routine Maintenance, or made by the owner/operator. These tasks are typically broader in scope and complexity than routine tasks, and often require additional coordination, review, or investigation by the owner-operator. Reactive tasks may also require consultation with professionals such as engineers, scientists, landscape architects, horticulturalists, or others. **Reactive tasks require approval of the owner/operator before work can be performed.**

1.4.2 OBSERVATIONS

1. Some observations listed in Table 1-8 could present potential safety hazards to the public and to maintenance personnel (e.g., large sinkholes, widespread settling, etc.). When safety issues are observed, maintenance personnel must immediately secure the site and contact the owner/operator. The list of observations in Table 1-8 that require the site be immediately secured is not all inclusive, and maintenance personnel must be diligent in detecting issues.

1.4.3 POSSIBLE RESPONSES TO OBSERVATIONS

1. Table 1-8 lists possible responses. This list is not all-inclusive and other reactive maintenance tasks or investigations not listed in this table or manual may be required in response to observations.
2. Initiation of reactive maintenance tasks in response to observations requires approval from the owner/operator unless pre-approval to initiate response action(s) to specific observation(s) has been granted by the owner/operator.

Table 1-8. Reactive Maintenance

ISSUE CATEGORY	OBSERVATION	IMMEDIATELY SECURE SITE	POSSIBLE RESPONSE	PROTOCOL REFERENCE	POSSIBLE ADDITIONAL INVESTIGATION
Sedimentation	Sedimentation over an area > 250 ft ² in size		Perform sediment removal	2.1.1	Consult engineer to determine possible design solutions
Erosion	Recurring erosion located downslope of energy dissipater		Construct or extend energy dissipater	2.1.2	Consult engineer to correctly size energy dissipater for optimal performance
	Recurring erosion not associated with energy dissipaters		Perform erosion repair		Consult engineer to determine possible design solutions
Settling	Sinkholes > 24 in. depth	✓	Perform void/sinkhole repair	2.1.4	Assess area using dye testing or geotechnical investigation to determine root cause of soil loss
Clogging	Standing water within SMP infiltration/storage area more than 72 hrs. after a rain event (except stormwater wetlands)		Perform soil management; debris removal, and/or pipe jetting/vactoring/dewatering	2.2.7; 3.1	Consult engineer to determine possible design solutions that could affect the outcome of the repair. Geotechnical investigation may also be needed
	Standing water in inflow inlets above the height of the distribution pipe for more than 72 hrs. after a rain event		Perform emergency pipe cleaning	3.1	Perform pipe inspection to assess condition prior to cleaning
	Standing water on pervious pavement, or pavement pores that appear caked with fine sediment or debris		Perform restorative cleaning	4.1	Perform infiltration testing ; if infiltration rate is < 10 in./hr. pavement may require restorative maintenance

Table 1-8. Reactive Maintenance cont'd.

ISSUE CATEGORY	OBSERVATION	IMMEDIATELY SECURE SITE	POSSIBLE RESPONSE	PROTOCOL REFERENCE	POSSIBLE ADDITIONAL INVESTIGATION
Dead or Missing Vegetation	Large trees or trees in constrained urban areas are dead, have large broken limbs (> 6 in. diameter), or otherwise pose a safety risk	✓	Remove trees/shrubs or dead limbs	2.2.3	Consult arborist for tree removal
	Trees or shrubs that were present at previous maintenance event are missing		Replace trees/shrubs	2.2.8	N/A
Tree Limbs Interfering with Electric Lines	Tree limbs growing in the vicinity of overhead utility wires		Prune tree consistent with utility line clearance standards	N/A	Consult a certified line clearance arborist
Concrete, Pavement, or Masonry Damage	Structural failure or damage (e.g., broken or open structures, exposed subsurface elements, or failure of walls, walkways, or roadways)	✓	Repair/reconstruct structure	N/A	Consult an engineer for possible system re-design, and a construction contractor to perform repairs
	Loose, missing, or displaced brick, stone, or paver areas > 4 ft ² .	✓	Replace and/or reset the missing masonry parts	2.1.3	Perform additional investigate of root cause of missing components
	Pervious or conventional asphalt or concrete is severely degraded or shows significant dents or scars	✓	Replace the degraded area of pavement		Consult an engineer for possible system re-design, and a construction contractor to perform repairs
	Repair large/structural cracks		If large concrete cracks present within the SMP		

Table 1-8. Reactive Maintenance cont'd.

ISSUE CATEGORY	OBSERVATION	IMMEDIATELY SECURE SITE	POSSIBLE RESPONSE	PROTOCOL REFERENCE	POSSIBLE ADDITIONAL INVESTIGATION
Missing Components	Bypass of stormwater observed at inlet or curb cut during storm events; or inlet or curb cut is elevated or offset relative to the intended flow path		Perform inlet drainage modification	2.1.3	
	Missing cleanout covers	✓	Contact the owner/operator about replacements	N/A	
	Public access/safety risk is observed by the owner/operator		Install permanent fencing		Consult a construction contractor to perform repairs
	The owner/operator indicates that underdrain pipe is needed to address performance problems		Construct underdrain	3.1	Consult an engineer for possible system re-design, and a construction contractor to perform repairs
	The owner/operator indicates that pipe caps require an orifice or that pipes need to be plugged		Drill orifice (sized according to plan sets) or install plug		None
Pests	Mosquito infestation observed in inlets/structures; major mosquito or roach infestations, or wasps/hornets		Report and apply control measures	2.2.5	None
Soil Degradation	Significant salt has accumulated in tree pits, or tree pit soil has become compacted		Remediate salt accumulation and compaction	2.2.7	Investigate possible causes of salt accumulation and compaction; consult an engineer or landscape architect

Maintenance Event Procedures

division **1.5**



1.5 MAINTENANCE EVENT PROCEDURES

1.5.1 GENERAL

1. General inspection and maintenance event procedures noted herein shall be followed when executing any and all maintenance activities.
2. **Do not conduct any non-emergency work in saturated soil conditions.**

1.5.2 PRE-MAINTENANCE EVENT

1. Inspection or maintenance personnel shall perform the following general procedures, as applicable, in preparation for maintenance events:
 - Review all route and site access restrictions, site characteristics, and maintenance maps to determine the most appropriate personnel, materials, and equipment.
 - Prepare digital or print copies of all applicable documents (work orders, permits etc.)
 - **Prepare site for maintenance with all necessary warning devices, barricades, and ground personnel required to insure the safety, protection, and warning of persons and vehicular traffic within the area, especially when inlets are open.**
 - If there is a conflict between actual site conditions and the methods specified within protocols, personnel shall coordinate to change methods or to facilitate more effective installation. All modifications must be approved prior to the start of work.
 - Contact the owner/operator if site is inaccessible.

1.5.3 DURING MAINTENANCE EVENT

1. Inspection or maintenance personnel shall adhere to the following general procedures, as applicable, during maintenance events:
 - Personnel must follow any and all applicable PennDOT regulations for highway safety.
 - Minimize disturbance of soils and vegetation, especially that which is most prone to breakage (i.e. woody and broadleaf plants), by taking the following precautions:
 - As much as possible, select equipment that causes minimal disturbance of the ground surface.
 - Practice careful foot placement when working in vegetated areas and avoid stepping on plants.
 - Avoid dragging or driving equipment across vegetated areas.
 - Avoid compaction of SMP infiltration areas by equipment and personnel.
 - Restrict or limit vehicular access over finished grade soils in SMPs.
 - During work, all areas shall be kept neat, clean and free of all trash and debris.
 - Minimize disruption to vehicular traffic on adjacent roadways.
 - Minimize disruption to pedestrian traffic on adjacent sidewalks.
 - Limit use and minimize leaking of water during freezing conditions.

1.5.4 POST-MAINTENANCE EVENT

1. Inspection or maintenance personnel shall perform the following general procedures, as applicable, after maintenance events:
 - Complete all maintenance event documentation.
 - Remove any soil debris or organic debris from hardscape areas.
 - Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks or other hardscape areas.
 - It shall be the responsibility of maintenance personnel to remove and dispose of in a proper and acceptable manner and in accordance with applicable waste disposal requirements, all debris, trash, and materials resulting from maintenance operations.
 - Maintenance personnel may not dump wood chips or any debris, etc. at the Fairmount Park Recycling Center. Dumping of any debris at City dump sites must be authorized and coordinated with City staff.
 - All sites will be inspected by the owner/operator.

General Requirements

division 1.6



1.6 GENERAL REQUIREMENTS

1.6.1 DOCUMENTATION

1. Maintenance personnel may be required to complete work order forms with labor, materials, photographs, and other data fields as requested by the owner/operator.
2. Additional documentation requirements may be listed in Applicability and Requirements or Standard Operating Procedures.
3. All documentation shall be reviewed by the maintenance personnel prior to submission.

1.6.2 HEALTH AND SAFETY

1. Maintenance activities and equipment operation are to be performed in accordance with all applicable laws and regulations including, but not limited to, those of:
 - United States of America;
 - Commonwealth of Pennsylvania;
 - City of Philadelphia;
 - Occupational Safety and Health Administration (OSHA); and
 - The owner/operator's Health and Safety Plan (HASP).
2. In the event of a conflict between health and safety regulations, maintenance personnel shall follow the most stringent/protective requirements.
3. Personnel shall utilize personal protective equipment such as head, eye, and ear protection, as well as protective gloves, footwear, high-visibility clothing, and all other applicable protective equipment consistent with all OSHA standards.

Personnel are responsible for maintaining safe and healthy working conditions as part of their daily activities.

4. **Prior to maintenance events, maintenance personnel must assess sites for safety issues. If safety issues are identified maintenance personnel must report them to the owner/operator immediately. Personnel are responsible for temporarily securing the safety hazard using cones and safety tape.**
5. Combined sewer structures pose health hazards from the hydrogen sulfide gas that accumulates in sewers. No personnel shall for any reason enter a confined subsurface structure (such as a manhole or access port) without valid confined space entry certification. Maintenance personnel are to follow OSHA confined space entry protocols and utilize air quality monitors whenever entering a confined subsurface structure.
6. If any hazardous materials or wastes are encountered, work must be stopped and the owner/operator notified. Hazardous materials shall be handled only by trained personnel.
7. To reduce hazards associated with fire hydrant use, maintenance personnel operating fire hydrants shall adhere to the following conditions:
 - Maintenance personnel must exercise judgment to ensure fire hydrant use does not create a hazardous condition that may compromise public safety. It shall be the responsibility of the user to ensure that the fire hydrant is functioning properly at the conclusion of the workday. When the permit expires, a post use inspection will be performed by the owner/operator. The fire hydrant user shall be held responsible for a malfunctioning fire hydrant if the owner/operator was not notified of any defects.
 - Hoses shall not interfere with any public use of the area.
 - Traffic cones shall be placed surrounding the hose when running across a sidewalk.

- The fire hydrant operation equipment and fire hydrant shall be under close observation by maintenance personnel to prevent tampering or theft.
 - When operating a fire hydrant during a time where freezing is a risk, road salt shall be applied to all wet areas on the street or sidewalks surrounding the fire hydrant as well as any areas wet as a result of maintenance.
8. Green and blue roofs may have fall arrest systems and should be used according to manufacturer's instructions in conjunction with training.

1.6.3 ACCESS REQUIREMENTS

1. The owner/operator will provide maintenance personnel with appropriate access permissions to commencement of maintenance events.
2. Prior to commencement, maintenance personnel shall verify the following conditions are sufficient both at the site and along the proposed travel route for all maintenance equipment prior to transporting equipment to the SMP or site:
 - Overhead clearances (e.g., trees, overpasses, overhead utilities, etc.);
 - Weight restrictions (e.g., bridges, sidewalks, etc.);
 - Street and access road/path widths;
 - Physical site barriers (e.g., gates, fences, etc.);
 - Slopes;
 - Soil stability; and
 - Distances from vehicular access.
3. Maintenance personnel shall immediately notify the owner/operator if access to the site is blocked during a maintenance

event.

4. Maintenance personnel shall immediately notify the owner/operator if access to inflow inlets is obstructed by vehicles parked in the right-of-way during a maintenance event.
5. For sites where vehicle obstructions are commonplace, the owner/operator may choose to redirect parking using restrictive signage prior to a maintenance event.
6. Blocking of public streets shall not be permitted unless prior arrangements have been made with the City, and coordination with appropriate departments has been established. Traffic control is the responsibility of maintenance personnel and shall be in compliance with state, country, and local highway construction codes.
7. Street and lane closure permitting is described in Section 1.6.4.4.
8. Prior to any excavation using powered equipment, maintenance personnel or the owner/operator must place a PA1CALL (811).

1.6.4 PERMITS AND APPROVALS

1. The owner/operator and/or maintenance personnel shall obtain all required permits and approval prior to commencement of work and have hard copies of document on site during maintenance event.
2. A Philadelphia Parks and Recreation (PPR) requires an Access Permit for maintenance work with or within Philadelphia Parks.

The School District of Philadelphia requires the following clearances be obtained by maintenance personnel prior to executing maintenance on school district property:

- Criminal history check.
 - Website: www.epatch.state.pa.us/Home.jsp

- Child abuse clearance.
 - Website: www.webgui.phila.k12.pa.us/uploads/OT/CB/OTCBin1EYlLfH4ZP_DS1Q/dpwchildabuse.pdf
www.phila.k12.pa.us/forms/CY-113.pdf
 - FBI finger printing.
 - Website: www.pa.cogentid.com/index.htm
3. Philadelphia License and Inspections requires a fire hydrant Operation Permit prior to the use of a fire hydrant.
 - Applicant shall indicate to the owner/operator the location of requested fire hydrants, including street intersection and corner (NW, SW, NE, or SE) and show proof of purchase for a backflow preventer.
 - Applicant shall complete a Philadelphia Water Department Hydrant Operation Report (See Division 5 for sample document) each time a fire hydrant is accessed.
 4. Philadelphia Streets Department Right-of-Way Unit requires a Street, Lane and/or Sidewalk Closure Permit, if maintenance work requires that a street and/or sidewalk be closed to traffic.
 - Applicants must complete the Utility Work Application for Street Closure, available at http://philadelphiastreet.com/images/uploads/resource_library/Street_Closure_for_Utility_Work.pdf.
 - All applications for a street closure permit must be received by mail or fax by 12 noon at least ten (10) business days in advance of the start date.

1.6.5 PERSONNEL TRAINING, EXPERIENCE, AND IDENTIFICATION

1. All maintenance personnel shall possess the appropriate training and experience as defined by personnel classification listed in Division 5 and as applicable to specific maintenance tasks.

2. Personnel operating all equipment will possess all appropriate and applicable certifications and licenses.
3. Personnel handling regulated materials will possess all appropriate and applicable certifications and licenses.
4. Personnel performing work on public sites shall be clearly identified by clothing, equipment, and information as follows:
 - Personnel shall wear clothing clearly marked with their company or organization’s name and/or logo.
 - All vehicles driven in support of field activities shall be clearly marked with their company or organization’s name and/or logo. The owner/operator may choose to provide personnel with partner materials such as vehicle magnets and literature/handouts.
 - Personnel shall carry company business cards or program fact sheets as appropriate to provide contact and background information on the work being performed.

1.6.6 EQUIPMENT

1. Surface maintenance equipment is separated into two tables: one for general care (Table 2-1) and one for vegetation maintenance (Table 2-8).
2. Subsurface maintenance and inspection equipment is in Table 3-1.
3. Pervious pavement maintenance equipment is in Table 4-1.
4. Equipment lists are non-exhaustive, and additional or more specific equipment may be required to perform routine tasks as per the best professional judgment of maintenance personnel.

1.6.7 MATERIALS

1. Surface maintenance material for is separated into two

tables: one for general care (Table 2-2) and one for vegetation maintenance (Table 2-9).

2. Subsurface maintenance and inspection material for routine tasks is in Table 3-2.
3. Pervious pavement maintenance material is in Table 4-2.
4. Material lists are non-exhaustive, and additional or more specific materials may be required to perform routine tasks as per the best professional judgment of maintenance personnel.

1.6.8 REFERENCES

Surface Maintenance Content References:

1. American National Standards Institute. Undated document. ANSI A300. This document is available online for download at the following location: <http://tcia.org/business/ansi-a300-standards>. Accessed October, 2015.
2. American Society for Testing and Materials. 2015. C497 - 13 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile. This document is available online for download at the following location: <http://www.astm.org/Standards/C497.htm>.
3. Bragg, T. and Sutherland, D. 1989. Establishing Warm-Season Grasses and Forbs Using Herbicides and Mowing. University of Nebraska-Omaha, Publication Code 68182-0040.
4. Honu, Y.A.K., Gibson, D.J. and Middleton, B.A. 2006. Response of *Tridens Flavus* (L.) A. S. Hitchc. to Soil Nutrients and Disturbance in an Early Successional Old Field. *Journal of the Torrey Botanical Society*.
5. Pennsylvania State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension. 2002. Pennsylvania Wildlife (no. 12), Warm-Season Grasses and Wildlife. This document is available online for download at the following location: http://extension.psu.edu/natural-resources/wildlife/landscaping-for-wildlife/warm-season-grasses-and-wildlife/extension_publication_file.
6. Pennsylvania State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension. 2009. Turfgrass Species for Pennsylvania. Publication Code EC395. This document is available online for download at the following location: <http://extension.psu.edu/publications/ec395>.
7. Pennsylvania State University, College of Agricultural Sciences. Undated document. Soil Testing Methods. This document is available online for download at the following location: <http://agsci.psu.edu/aasl/soil-testing/soil-methods>. Accessed October, 2015.

Sources of Additional Information for Surface Maintenance:

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2. City of Philadelphia Mayor's Office of Transportation and Utilities. 2012. Philadelphia Complete Streets Design Handbook. This document is available online for download at the following location: http://www.philadelphiastreet.com/images/uploads/resource_library/cs-handbook.pdf
3. City of Philadelphia. Contractor Resources. Additional information can be found at the following location: <http://www.phila.gov/water/aboutus/buswithpwd/Pages/contractor.aspx>
4. Commonwealth of Pennsylvania, Department of Transportation. 2011. Publication 408 Specifications. This document is available online for download at the following location: http://www.dot.state.pa.us/public/PubsForms/Publications/Pub_408/PUB%20408.pdf
5. Commonwealth of Pennsylvania. 2015. The Pennsylvania Code Chapter 102: Erosion and Sediment Control. This document is

available online for download at the following location: <http://www.pacode.com/secure/data/025/chapter102/chap102toc.html>

6. National Association of State Departments of Agriculture - Association of Official Seed Analysts. Additional information can be found at the following location: <http://www.nasda.org>
7. Northeast Organic Farming Association. 2011. Standards for Organic Land Care: Practices for Design and Maintenance of Ecological Landscapes, 5th edition. This document is available online for download at the following location: <http://www.organiclandcare.net/sites/default/files/upload/standards2011.pdf>
8. Pennsylvania Department of Environmental Protection. 2008. Pennsylvania Stormwater Best Management Practices Manual. This document is available online for download at the following location: <http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305>
9. Pennsylvania Department of Environmental Protection. 2012. Erosion and Sediment Pollution Control Program Manual: Technical Guidance Number 363-2134-008. This document is available online for download at the following location: <http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-88925/363-2134-008.pdf>
10. Pennsylvania General Assembly. 2012. Pennsylvania Consolidated Statutes, Title 3, Chapter 21, §§7101-7122. This document is available online for download at the following location: <http://www.legis.state.pa.us/cfdocs/legis/LI/consCheck.cfm?txtType=HTM&ttl=3&div=00.&chpt=071.&sctn=001.&subctn=000>.
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12. Philadelphia Water Department. 2015. City of Philadelphia Stormwater Management Guidance Manual. This document is

available online for download at the following location: <http://www.pwdplanreview.org/manual/introduction>

13. Soil Science Society of America. 1983. Methods of Soil Analysis, Parts 1, 2, 3 & 4. Additional information can be found at the following location: <https://www.soils.org>
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15. US Composting Council. Seal of Testing Assurance. Additional information can be found at the following location: <http://compostingcouncil.org/seal-of-testing-assurance>

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3. Philadelphia Water Department. 2012. Green City, Clean Waters; Appendix IV: PWD Sewer Assessment Program Cleaning Training Manual. pp. i-v. This publication is available for download at the following location: <http://phillywatersheds.org/lcpcu/Green%20Infrastructure%20Maintenance%20Manual%20Development%20Process%20Plan.pdf>.

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1. American Society for Testing and Materials. 2014. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
2. American Society for Testing and Materials. 2009. ASTM C1701 Standard Test Method for Infiltration Rate of In Place Pervious Concrete.

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5. The University of New Hampshire Stormwater Center. Undated document. Winter Maintenance Guidelines for Porous Pavements. This document is available online for download at the following location: http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/winter_maintenance_fact_sheet.pdf. Accessed October, 2014.

Surface Maintenance

division **2**



2.1 GENERAL SITE CARE

2.1.1 TRASH, SEDIMENT, AND ORGANIC DEBRIS REMOVAL

1. Description

- This section sets forth procedures and requirements for trash, sediment, and organic debris removal from pretreatment devices and SMP surfaces.

2. Applicability and Requirements

- The efficiency of sediment, trash, and organic debris removal operations after winter weather events (e.g., snow or ice storms, etc.) may be significantly reduced to the point where removal requires an impractical level of effort. Based on the best professional judgment of the foreman, such material may be left in place until the next maintenance event where removal is to be attempted again.
- Removal of debris from the inlets, pipes, and culverts, or other structures that require confined space entry is covered in Division 3: Subsurface Maintenance.

3. Standard Operating Procedure

- **Remove trash, sediment, and organic debris from pretreatment devices in city inlets, highway inlets and/or domed risers (See Figures 2-1 and 2-2):**
 - If pretreatment device is not present in highway inlet and/or domed riser, install a new pretreatment device.
 - If the pretreatment device is not present in a city inlet, refer to subsurface maintenance installation of city pretreatment device per Section 3.1.
 - Remove the pretreatment device, if not permanently attached, from the structure by hand or with

specialized pretreatment device removal tools, if available.

- If removing device by hand, remove enough material from the device to achieve a liftable weight (based on surface maintenance personnel judgment) prior to lifting.
- If there is standing water, remove using a pump prior to lifting.
- Invert and shake or gently tap the device until all material has been removed.
- A tarp may be used to contain debris for bagging and removal.
- Clean the fabric using a scrub brush or pressure washer to remove fine sediment from fabric pores, taking care not to tear or damage the material.
- **When damage or tear/rip to pretreatment devices is greater than 3 in.:**
 - Remove filter fabric from pretreatment device frame.
 - Replace filter fabric.
 - Re-insert pretreatment device into structure and secure.
 - Stockpile damaged pretreatment device filter fabric offsite for repair.
- **Remove trash, sediment, and debris from SMP surfaces:**
 - Small quantities of trash/sediment/organic/debris can be removed using hand tools.
 - Remove trash, sediment, and organic debris from the

SMP, includes sidewalk/paved areas adjacent to any grates and curb openings with special attention to inflow/outflow areas:

- Remove pieces of trash such as plastic bags or bottles manually or using a trash claw.
- Remove fallen sticks, leaves, and organic material manually or using a leaf rake or blower.
- For trench drains use leaf blower or in some cases covers may have to be removed to fully access the inflow area.
- If trench drain grate is removed, clean and lubricate bolts before re-inserting, being careful not to cross-thread.
- If large quantities of sediment/debris, or sediment/debris are present in hard-to-access or permanently wet locations, then mechanized equipment such as a mini excavator or portable vacuum excavator may be used as needed at the discretion of the on-site foreman to promote safe and efficient sediment removal.
- Large deposits shall be removed from paved structures or turf-covered storage areas using a mini-excavator or portable vacuum excavator.
- Mechanized equipment such as skid-steers, mini loaders, etc. shall not traverse or otherwise be staged on the surface of the storage/infiltration areas to avoid soil compaction.
- Adjacent elements such as trees, slopes, and sidewalks shall be protected using fencing and stabilization materials.
- Any bare areas within vegetated SMPs that result from sediment/organic debris removal shall be immediately stabilized per Section 2.1.2.
- **Wipe down signage:**
 - Use an all-purpose cleaner and soft rag to remove any dust, grime or other residue.
- **Remove strings or tags from vegetation:**
 - Remove GSI Maintenance expired, temporary, no-parking signage along with string(s) used for attachment.
 - Do not remove intentional tree information labels.
- **Report illegal dumping:**
 - Report activity to the owner/operator.
 - Contact Philly311 for removal.



Figure 2-1. Cleaning of Pretreatment Device for a City Inlet



Figure 2-2. Cleaning of Pretreatment Device for a Highway Grate Inlet

2.1.2 EROSION CONTROL AND REPAIR

1. Description

- This section sets forth procedures and requirements for the control/repair of minor to moderate erosion. This section also provides guidance for energy dissipater repairs and extensions.

2. Applicability and Requirements

- Erosion Control Blanket shall be 100% jute fiber (hand-woven into one-inch by one-inch net). Jute netting shall be undyed and unbleached uniform single jute yarn and 100% biodegradable.
- New energy dissipaters must be sized by the owner/operator.

3. Standard Operating Procedure

- **To repair areas of erosion (See Figure 2-3):**
 - Fill eroded area, if necessary, with material matching that of the surrounding media profile.
 - Fine grade material with hoe, rake, or other hand tool to match the grade of the surrounding undamaged surface.
 - Install erosion blanket using method described below and consistent with manufacturer's specifications. If specifications below conflict with manufacturer's specifications, choose the specification that is most conservative.
 - Slopes, basins, and channels may each require different installation methods, including the direction of rolling the fabric. Refer to the manufacturer's guidelines prior to installation

to insure sufficient materials are provided to account for overlap, anchor trenches and staple pattern.

- Ensure that the upslope edge of the erosion blanket is securely embedded and anchored into an anchor trench above the entry point of water into the SMP.
- If multiple pieces of erosion blankets are necessary to cover an eroded area, ensure that no bare soil is left exposed by overlapping the fabrics at the seams.
- At the downstream end, anchor the edge of the erosion fabric in an anchor trench at a minimum of 3 ft. downstream of the eroded area to provide sufficient coverage.
- At the discretion of the owner/operator, plant or seed the area as per Sections 2.2.8 and 2.2.9.
- If erosion repair/control is performed outside the normal seasonal seeding window for the desired species, seed a temporary cover crop.
- **To construct or extend exposed aggregate concrete energy dissipaters:**
 - Excavate area to accommodate design depth of sub-base.
 - Compact soil, add 2A Modified subbase to design depth and compact.
 - Construct forms to design dimensions and elevations.
 - Mix concrete and pour into form.
 - Immediately following pour, set stones/aggregate with the designed exposure.
 - Finish flat surfaces between aggregate.
 - Wash aggregate before concrete sets on stones.
 - Remove forms.
 - Backfill surrounding area to match existing grades.
- **To construct or extend river stone dissipaters (Example: Figure 2-4):**
 - Excavate area to accommodate design depth of sub-base.
 - Compact soil, add 2A Modified subbase to design depth and compact.
 - Mix screenings and Portland cement 50/50 and lay a 0.5-1 in. setting bed.
 - Install river stones with screenings/cement mix filling in voids between stones. Stones must be close but not touching to allow screening mix to surround each stone.
 - Backfill surrounding area to match existing grades.
 - Brush any soil or debris off stones and screenings.
 - Sprinkle with water to activate cement without washing material out from between stones.
- **To construct or extend energy dissipaters with cobblestones/Belgian blocks set in mortar:**
 - Remove any loose or broken pieces and clean surrounding area.



Figure 2-3. Example of Erosion Control



Figure 2-4. Extension of a Velocity Dissipator

- Confirm that a stable base is in place.
- Place materials loosely in the area to be repaired to confirm the fit and arrangement before setting in mortar.
- Adjust material sizes and/or shapes as necessary to achieve the desired aesthetic of the dissipater.
- Mix mortar and set the stones in place with uniform spacing for joints.
- Strike joints and clean off loose mortar before it hardens.
- Backfill surrounding area to match existing grades.

2.1.3 CONCRETE, PAVEMENT, AND MASONRY REPAIR AND MODIFICATION

1. Description

- This section sets forth procedures and requirements for concrete, pavement, and masonry repair and modification, including regrading of asphalt to modify drainage to inlets.

2. Applicability and Requirements

- If practicable, schedule concrete work early in the day for final setting to occur during the work day. Protect the newly poured concrete from pedestrian and vehicular traffic using barricades, caution tape or signage. Ensure that personnel are present during the final setting period to prevent vandalism and damage.
- Maintain protective measures during the 5 to 7 days curing period of concrete.
- Concrete, pavement, and masonry repairs shall be limited to

days with a temperature range between 40° and 80° F.

- Concrete, pavement, and masonry repairs shall be avoided within a 48 hr. period of forecasted rain.
- Crew shall consist of at minimum one Mason for technical or advanced concrete, pavement, and masonry repair and modification.

3. Standard Operating Procedure

- Guidance from the owner/operator is required if the damaged pavement is greater than 50 ft² and more than 10% of the total pavement surface. Block off any areas that are unsafe for pedestrians or vehicular traffic and notify the owner/operator.
- **To repair broken, loose, or compromised concrete or masonry structures:**
 - Place tarp over adjacent areas to protect surfaces, soil, and vegetation from spilled materials.
 - Remove loose debris or material from the repair area.
 - To repair hairline/cosmetic crack in concrete, apply a concrete crack repair product (Sikadur® or approved equal) to the surface per the manufacturer's recommendations.
 - To repair a large/structural crack in concrete, clean out loose debris, fill the cracked area.
 - If the damage is too large to support mortar, saw cut concrete and install concrete forms, as needed.
 - Mix mortar.
 - Fill repair area and smooth joints.

- Remove excess mortar.

- **To replace and/or reset missing masonry parts such as stones, bricks, or pavers:**

- Remove stone/brick from an area larger than required repair to provide space to tie in newly constructed masonry work.
- Place and fine grade subbase according to design documents, if available.
- If design documents are not available, match depth of the surrounding subbase.
- If there is existing geotextile in the area of the repair, install geotextile fabric at appropriate depth to match existing elements by excavating soil and keying geotextile into edges of excavated area.
- Mix mortar or prepare masonry adhesive and plan placement of selected stones/bricks prior to installation.
- Apply mortar or adhesive according to the designed aesthetic and required structural strength according to manufacturer's specifications.
- Place stone, brick, or paver material to match existing surfaces.
- Remove excess mortar or adhesive.

- **To repair small divots in pervious or conventional asphalt, where damage is smaller than 50 ft². and comprising less than 10% of the total pavement surface:**

- Cut the damaged areas with an asphalt cutting blade on a masonry saw, and remove material down to the

base stone course.

- Fill cut hole with conventional asphalt cold patch and pack with a hand tamper.
- Seal patched seams with acrylic sealant consistent with manufacturer’s specifications.
- Block repaired area from pedestrian or vehicular traffic.
- **To construct drainage modifications to redirect gutter flow into green inlets offset from curb edges:**
 - Clean the surface where the between the inlet and the curb and allow to dry.
 - Apply cold patch on a downward angle from the curb toward the edge of inlet without interfering with grate approximately 2-2.5 in. thick to direct runoff into the drain.
 - Tamp very firmly with hand tamper and club hammer.
 - Allow cold patch to set per manufacturer’s recommendation for current conditions.
 - Seal edges of cold patch with asphalt sealer consistent with manufacturer’s specifications.

2.1.4 SETTLING REPAIR

1. Description

- This section sets forth procedures and requirements for the repair of minor to moderately settled areas.

2. Applicability and Requirements

- If area is unstable, STOP maintenance and immediately contact the owner/operator.

3. Standard Operating Procedure

- **If settling has created a visible depression or a sinkhole in the SMP surface:**
 - Remove material over the settled area to access any subsurface voids.
 - Saw cut and jackhammer any settled asphalt or concrete and dispose of this material at an approved off-site location.
 - Remove pavers or stone by hand and set aside.
 - Dig herbaceous plants, shrubs, and small trees less than 3 in. diameter-breast-height (DBH) and set aside, avoiding root damage.
 - Remove turf and associated top soil.
 - Clear around settled area and excavate using hand tools to the bottom of the depression/void space.
 - Fill excavated area with clean fill material (2A Modified subbase or as specified by the owner/operator) and compact with a hand tamper.
 - For softscape areas, cover excavation with top soil or planting soil mix to match existing planting medium and grade.
 - Replace mulching (see Section 2.2.6).
 - Replant or reseed bare areas of soil (see Section 2.2.8 and 2.2.9).
 - For hardscaped areas, replace hardscape subbase and surface over repaired area to match existing grade.
 - Replace any damaged or disturbed pavers, asphalt,

concrete, or stone (see Section 2.1.3).

- **If minor settling extends beneath hardscape areas but has not created a visible depression or sinkhole in the hardscape (e.g., voids beneath sidewalks or walkways) (See Figure 2-5):**
 - Pack void area with 2A Modified subbase using a shovel, pry bar, or hand tamp as needed.
 - Replace soil using topsoil as needed at the interface of the repair.



Figure 2-5. Example of Settling in a Tree Pit

2.1.5 GRAFFITI REMOVAL

1. Description
 - This section sets forth procedures and requirements for graffiti removal.
2. Standard Operating Procedure
 - **Remove spray paint and similar materials (e.g., permanent makers, polishes, etc.) from concrete and masonry materials and metal surfaces:**
 - Protect all surrounding areas (including plants and soil/mulch) with tarp.
 - Pressure wash surface.
 - Apply chemical graffiti removal solvent as per manufacturer specifications.
 - Scrub surface with metal or plastic brush.
 - Wipe away graffiti removal solvent with rags.
 - Pressure wash or rinse surface clean.
 - Repeat as needed until graffiti is removed.
 - If applicable, repaint surface as per the owner/operator's specifications (see Section 2.1.6).
 - **Remove sticker-based graffiti from metal or other smooth surfaces:**
 - Remove sticker from surface by holding utility knife at a low angle relative to the surface to prevent scratching of the surface.

2.1.6 PAINTING

1. Description
 - This section sets forth procedures and requirements for painting.
2. Applicability and Requirements
 - Follow product manufacturers' instructions and recommendations for paint application. Most paint requires temperatures to be above 50° F.
 - Do not paint if precipitation is forecasted for within 48 hr. of effort.
3. Standard Operating Procedure
 - Drape all surrounding areas (including plants and soil/mulch) with tarp or paint cloth.
 - Remove existing loose paint, corrosion, and/or deposits from painting surface.
 - Tape all non-soil edges.
 - Without disturbing vegetation, dig soil away from painting surface to maximize paintable area and minimize visible non-painted areas.
 - Apply primer per manufacturing recommendations.
 - Apply paint, paint color should match existing color unless otherwise specified by the owner/operator.
 - Install wet paint signs and temporary barriers.
 - Remove wet paint signs and temporary barriers after manufacturer-specified drying time.

2.1.7 HARDWARE CARE

1. Description
 - This section sets forth procedures and requirements for general care of hardware:
 - Clean and lubricate bolts.
 - Extract and replace broken bolts.
 - Replace missing or damaged appurtenances.
 - Replace missing or damaged safety bars for concrete end walls and outfalls larger than 8 in. diameter.
2. Standard Operating Procedure
 - **Cleaning and lubricating of nuts and bolts:**
 - Remove nuts and bolts from the associated structure.
 - Wipe any grit or other debris and clean threading.
 - Carefully and accurately spray nuts and bolts with material-appropriate lubricant.
 - Replace nuts and bolts, careful to not cross thread, within the associated structure.
 - See broken or seized bolt extraction.
 - **Cleaning and lubricating of locks:**
 - Wipe any grit or other debris and clean shackle.
 - Carefully and accurately spray locking mechanism.
 - **Broken or seized bolt extraction:**
 - Drill out bolt completely with a hardened alloy bit (same diameter as bolt shaft).

- Rethread bolt hole with tap and die set.
- Grease new bolt and insert, careful to not cross-thread.
- Avoid mixing metals (e.g., stainless steel, iron, or aluminum) as this can lead to corrosion and binding.
- **Replace missing or damaged appurtenances:**
 - Replace rods, washers, bolts, caps and gaskets with equivalent hardware.
- **Replace missing or damaged safety bars:**
 - Remove debris from unsecured endwall and outfall openings consistent with procedures set forth in Section 2.1.1.
- **To install hinged metal grate over headwall and endwall openings where pipe diameter is greater than 8 in.:**
 - Measure and mark off hinge fastener locations on concrete headwalls or endwalls. Hinge fasteners must be located on one side of the grate to allow the structure to open outward away from the structure. Lock attachment fittings must be located opposite the hinges or according to manufacturer's specifications.
 - Using a hammer drill and concrete drill bit of appropriate size, pre-drill holes for fasteners in the concrete.
 - Use the shop vacuum with small crevice tool to blow the dust out of holes.
 - If necessary, paint the grate and allow to dry.
- Fasten the grate hinges and lock attachment fittings to the wall using the concrete bolts and pre-drilled holes or threaded stock and adhesive with washers and nuts.
- Close and lock grate.
- **To install unhinged metal grate using steel flat stock to endwall openings where pipe diameter is greater than 8 in.:**
 - Measure, mark and cut steel bars to appropriate lengths.
 - Drill holes in steel bars at ends and at points of intersection to match the diameters of fasteners to be used.
 - Mark locations of end holes onto the concrete endwall.
 - Use appropriate size masonry bits and hammer drill to create holes in endwall.
 - Use the shop vacuum with small crevice tool to blow the dust out of holes.
 - Insert adhesive and threaded stock into holes and allow to set.
 - Install bolts and nuts as required to secure bars at points of intersection.
 - Use washers as needed to close gaps under outer bars at points of attachment to threaded stock.
 - Use washers, thread locker and nuts to secure assembled grate to the concrete endwall.

2.1.8 WINTERIZATION

1. Description

- This section sets forth procedures and requirements for winterization, including:
 - Clean and lubricate bolts and locks.
 - Drain, clean, and close cisterns and irrigation systems.
 - Place traffic bollards.
 - Drain irrigation system.

2. Standard Operating Procedure

- **Clean and lubricate bolts consistent with procedures in Section 2.1.7.**
- **Drain, clean, and seal any surface cisterns, tanks, and rain barrels or any subsurface storage systems that are located above the frost line in the fall:**
 - Remove standing water using approved vacuum cleaning (see Section 3.1) and decanting and waste disposal protocols (see Section 3.2 and 3.3).
 - Disinfect and rinse storage areas using approved non-toxic disinfectant, and dispose of waste material using approved decanting and waste disposal protocols (see Section 3.2 and 3.3).
 - Close inflow valves as needed to maintain dry conditions within the cistern or rain barrel.
- **For stormwater bump-outs and other structures that include detachable traffic delineators, install bollard elements in the fall:**

- Wipe any grit or other debris and clean threading in bollard base.
 - Spray base carefully and accurately with material-appropriate lubricant.
 - Place bollard within the associated base.
- **Drain and seal any irrigation systems that are located above the frost line:**
 - Remove any attachments, stakes, and removable watering heads and store in a dry place.
 - Close inflow valves, including surface-accessible downspout attachments, and drain standing water from inflow pipes as applicable.
 - Clean any filters and screens.
 - Using an air compressor, force any remaining water from the irrigation pipes for approximately 5 minutes.

Table 2-1. Recommended Equipment for Surface General Maintenance

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Angle grinder with cutting wheels and grinding wheels			•				•	
Axe	•							
Backflow preventer(s) and associated appurtenances		•	•		•	•		
Backhoe	•							
Bolt cutters			•				•	•
Buckets or tub		•	•		•	•		
Chainsaw	•							
Chipper trailer type, either disc or drum. Minimum 12 knives.	•							
Chisel		•	•				•	•
Club hammer			•					
Concrete cut-off saw			•	•				
Concrete mixing tray		•	•					
Cordless drills and batteries							•	
Crowbar			•	•			•	•
Digging bar	•							

Table 2-1. Recommended Equipment for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Drill bits (assorted concrete)							•	
Dust pan and brush	•							
Electric jackhammer				•				
Extension cord(s)				•				
Fire hydrant center compression lock		•	•		•	•		
Fire hydrant wrench		•	•		•	•		
Float		•	•					
Generator				•			•	
Graffiti remover applicator					•			
Hammer		•						
Hand tamper		•	•	•				
High-pressure sprayer/hose	•				•			
Hoe		•						
Hose spray nozzles and appurtenances		•	•		•	•		
Ladder					•	•		

Table 2-1. Recommended Equipment for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Laser level, standard level(s) (Torpedo, 2 foot, 4 foot);				•				
Leaf blower	•	•						
Line level		•	•					
Mallet		•					•	•
Manhole hooks	•						•	•
Mason line			•					
Masonry chisel set and stone hammer		•	•					
Masonry tools for mixing and finishing concrete and mortar		•	•					
Masonry trowel			•					
Metal or plastic brush	•				•		•	•
Mini excavator	•							
Paint brushes and/or paint roller						•		
Paint scraper, sander, or stripper			•		•	•		
Pick mattock	•							
Pliers, adjustable wrenches, vice grips, and pipe wrenches	•						•	•

Table 2-1. Recommended Equipment for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Pump (handheld)	•							
Push broom with firm bristles	•							
Rakes (assorted)	•	•		•			•	
Rotary/hammer drill (high speed)							•	
Saw to cut lumber for forms		•						
Screwdrivers, phillips and standard	•						•	•
Scrub brush with fine bristles	•							
Shovels (assorted)	•	•		•			•	
Socket wrenches, sets of metric and standard	•						•	•
Spade	•	•		•				
Stakes		•	•					
Tap and die set with clamp							•	
Tarp or other receptacle	•	•	•	•	•			
Trash claw	•						•	
Utility blade		•	•	•	•	•	•	

Table 2-1. Recommended Equipment for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Water hose of sufficient strength to withstand kinking and abrasion		•	•		•	•		
Water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank		•	•		•	•		
Wheelbarrow or push cart	•	•	•	•				

Table 2-2. Recommended Materials for Surface General Maintenance

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
1,000 lb. test rope	•							
50 gal. plastic contractor bags	•	•	•	•	•	•	•	•
Acrylic crack sealant			•					
All-purpose cleaner	•		•		•	•	•	
All-purpose rags	•		•		•	•	•	•
Appropriate replacement appurtenances (e.g., bolts, screws, caps, etc.). Ask Owner/Operator or manufacturer specifications							•	
Asphalt cold patch			•					
Assorted concrete anchors/bolts or threaded studs							•	
Assorted washers and nuts to fit threaded stock							•	
Bagged concrete mix		•	•					
Bagged Portland cement		•	•					
Biodegradable degreasing agent							•	
Biodegradable erosion blanket (North American Green® NAG-C125BN or SC-150BN or equivalent)		•						

Table 2-2. Recommended Materials for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Clean sand with a high clay content				•				
Concrete cold patch			•					
Disinfectant (e.g., bleach, pine oil, or other household disinfectant liquids).								•
Flat black exterior spray paint for steel							•	
Graffiti remover solvent for different surface types					•			
High strength masonry adhesive (epoxy)		•	•				•	
Hinged metal grate or rack with openings between 6-8 in.							•	
KBI Flexi®-Pave			•					
Landscape edging or edge barrier with a subsurface depth of 1-2 ft. made of rust-resistant metal or plastic				•				
Large paper bags, 30 gal.								•
Lock attachment fittings							•	
Lumber, stakes and nails to make concrete forms		•	•					

Table 2-2. Recommended Materials for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Maintenance Map	•	•	•	•	•	•	•	•
Material Safety Data Sheets (MSDS) as applicable	•		•		•	•	•	•
Mulch material; Licorice bark mulch if available, shredded hardwood bark mulch (see Section 2.2.4)	•			•				
Nonwoven geotextile fabric and staples		•	•					
Paint and primer as per owner/operator specifications					•	•		
Painting tape					•	•		
Permits and access permissions	•	•	•	•	•	•	•	•
Porous asphalt			•					
Porous concrete			•					
Potable municipal or well water and/or harvested rainwater sufficient for watering and cleaning activities, as required			•		•			
Re-sealable plastic bags – 1 or 2 gal.								•
Sand		•	•					

Table 2-2. Recommended Materials for Surface General Maintenance (cont'd)

	TRASH, SEDIMENT, & ORGANIC DEBRIS REMOVAL	EROSION CONTROL/ REPAIR	CONCRETE PAVEMENT, MASONRY REPAIR & MODIFICATION	SETTLING REPAIR	GRAFFITI REMOVAL	PAINTING	HARDWARE CARE	WINTERIZATION
	2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	2.1.7	2.1.8
Sandpaper, various grades			•					
Sikadur® hairline crack sealant or equivalent			•					
Stone dust/screenings		•						
Stone, various sizes (including clean fill 2A modified)		•	•	•				
Thread locker							•	
Top soil	•	•		•				
Various pavers		•	•	•				
Water (potable or non-potable)	•	•	•					
Waterproof lock							•	
White lithium grease or equivalent metal-to-metal lubricant and rust protector							•	•
Woven geotextile		•	•	•				

Vegetation Maintenance

division **2.2**



2.2 VEGETATION MAINTENANCE TASKS

2.2.1 WEED CONTROL

1. Description

- This section describes the procedures and requirements of weed control using mechanical and chemical methods:
 - Mechanical:
 - Hand pulling herbaceous and woody weeds
 - Chemical including:
 - Cut stem treatments
 - Foliar treatments
 - Basal bark treatments
 - Pre-emergent treatments
- For the purpose of this section weeds are defined as:
 - Plants listed on the Pennsylvania Department of Conservation and Natural Resources Invasive Plant List
 - Plants listed by the United States Department of Agriculture as a Federal Noxious Weed
 - Volunteer species that do not fit within the aesthetic of the SMP, as defined by the owner/operator

2. Applicability and Requirements

- Chemical vegetation control shall be performed during periods of dry weather (not within 24 hrs. of a prior or expected rain event) with little or no wind.
- Foliar treatments shall not be performed in temperatures below 60°F and periods of high wind.

- Cut stem and basal bark treatments shall not be performed in temperatures below freezing (32°F).
- For herbicide application, submit the following information to the owner/operator within 24 hrs.:
 - Date of application, and for herbicides specifying a reentry period, the hour of completion
 - Name and address of the application site (commercial applicators must also record the name and address of the customer if it differs from the application site)
 - The brand name, Environmental Protection Agency (EPA) registration number, amount, and rate or dosage of each herbicide used
 - Size and identification of the area treated
 - Names and certification numbers of all persons involved with the application
 - Application records must also include restricted reentry interval and vegetation treated
- All herbicides shall be applied per label-specific safety instructions and manufacturer's directions.
- Personnel shall comply with directions on all herbicide label sheets, Material Safety Data Sheets (MSDS) sheets, other applicable sources, and all applicable codes and regulations.
- Notify anyone listed on the Pennsylvania Pesticide Hypersensitivity Registry whose location is within 500 ft. of an herbicide application site not more than 12 hrs. in advance, but less than 72 hrs. prior to application. Notification must be made via email, a telephone answering device, or by contact with an adult by dialing any of the listed telephone numbers.
- Include the following in the hypersensitivity notification

information: date, time, location of application, EPA registration number, brand name, common name of active ingredients of herbicide(s) that may be used, business name, business phone number, and a copy of the label if requested.

- Personnel performing chemical weed control shall include at a minimum:
 - A Pennsylvania Certified Pesticide Applicator or Registered Technician who is under the supervision of a Pennsylvania Certified Pesticide Applicator that can be on site within 5 hrs. if necessary.
 - A Noncertified Applicator under the direct supervision of a Pennsylvania Certified Pesticide Applicator who is physically present and within sight of the application.
- Chemical control in aquatic environments must be conducted with a permit from the PA Fish and Boat commission.

3. Standard Operating Procedure

- **Select appropriate method weed control (See Table 2-3 for species-specific best practices for weed control).**
- **Hand pulling of mature annual and tap-rooted herbaceous plants and tree seedlings:**
 - If necessary, use a shovel or spade to loosen the soil surrounding plant root mass.
 - Remove entire plant including root mass to prevent re-sprouting.
 - Shake soil of plant roots.
 - Using a shovel or rake, smooth the surrounding soil to fill in the remaining hole and cover with shredded hardwood or root mulch consistent with procedures in Section 2.2.6.

- Properly bag and dispose of the plant material in approved location off site. Ensure that no plant pieces remain on site.

- **Hand pulling of aquatic weeds:**

- In areas of intentional continuous ponding, remove aquatic weeds using an aquatic weed rake.
- Properly bag dispose of the plant material in an approved location off site. Ensure that no plant pieces remain on site.

- **General chemical control procedure:**

- Provide the necessary notifications, as applicable (See Applicability and Requirements):
- Prepare herbicide solution as per manufacturer's specifications prior to arriving on site.
- Apply the herbicide according to manufacturer's instructions and recommended safety procedures:
 - To minimize risk of herbicide spillage, open containers are not to be used on the site during the application process.
 - In the event that herbicide is spilled, follow appropriate safety protocols for cleanup and notification of appropriate parties (See Pesticide Safety Fact Sheet: How to Handle Chemical Spills, Penn State College of Agricultural Sciences Document UO229).
 - Use caution to keep herbicide agents from spreading to other areas.
 - Follow manufacturer and safety specifications for pesticide clean-up and disposal.

- **Procedures for specific chemical treatments:**
 - **Cut stem treatments:**
 - Horizontally cut stems at or near ground level.
 - All cuts shall be level, smooth, and free of debris.
 - Immediately apply appropriate translocated herbicide (see Table 2-4) to the outer 20% (cambial area) of the stump.
 - **Foliar treatments:**
 - Apply appropriate translocated or contact herbicide (see Table 2-4) using a low pressure (20-50 psi) backpack sprayer at rates of one gallon or less per minute, equipped with a flat spray tip or adjustable cone nozzle.
 - Apply herbicide to leaves and stems of target plants using a consistent back and forth motion to ensure that herbicide has fully covered foliage, but not to the point of run-off.
 - Allow herbicide treatments to dry for at least 3 hrs. at an air temperature above 60° F to ensure adequate absorption and translocation.
 - In areas that receive significant public use, it may be necessary to close off the treatment area until the herbicide has completely dried. Need for area closures shall be determined prior to application and reviewed/approved by the owner/operator.
 - **Basal bark treatments:**
 - Apply herbicide with a backpack sprayer using low pressure (20-40 psi) with a straight stream or flat fan tip.
 - To control vegetation with a basal stem diameter of less than 3 in. apply a translocated herbicide-oil mixture on one side of the basal stem to a height of 6 in. from the base; within an hour the mixture must almost encircle the stem.
 - For stems greater than 3 in. basal diameter or with thick bark, treat both sides of the stem to a basal height of 12-24 in.
 - **Pre-emergent treatments:**
 - Apply pre-emergent herbicide early spring, late summer or early fall; or immediately following cultivation.
 - Thoroughly remove weed residues, prunings and debris prior to treatment.
 - Apply pre-emergent herbicide in granular form using a small handheld spreader, or in liquid form using a hand-held or backpack sprayer.
 - Apply evenly to bare soil, avoiding any areas seeded with non-weed species.
 - Following application of granular herbicide, apply approximately 1/4 in. or more of water evenly across treatment area (manual watering or rainfall is acceptable).
 - Do not apply more than 600 lbs. per acre within a 12-month period.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Norway maple	<i>Acer platanoides</i>	Tree	Hand pulling of seedlings;	Monthly	Saplings can be cut multiple times to weaken and kill plant.
			Cutting of saplings		
Tree of Heaven	<i>Ailanthus altissima</i>	Tree	Hand pulling of seedlings;	Monthly	Control with glyphosate or triclopyr for larger trees or major invasions. (Foliar, basal bark or cut stump applications, depending on time of year).
			Digging & removal of saplings		
Akebia	<i>Akebia quinata</i>	Vine	Hand pulling of seedlings;	Monthly	
			Cutting & herbicide application to stumps		
Mimosa	<i>Albizia julibrissin</i>	Tree	Hand pulling of seedlings;	Monthly	Remove before flowering for optimal effectiveness.
			Cutting & herbicide application to sapling stumps		
Garlic mustard	<i>Alliaria petiolata</i>	Herbaceous	Hand pulling	Monthly	Biannual; conduct manual and mechanical removal over 5 years effective for eradication. Removal more effective before flowering.
Foxtail (meadow)	<i>Alopecurus pratensis</i>	Grass	Hand pulling	Monthly	Hand pull in early spring to prevent seed set.
Porcelainberry	<i>Ampelopsis brevipedunculata</i>	Vine	Hand pulling	Monthly	Hand pull before flower and fruit set.
			Cutting and herbicide application to stumps	Monthly, Sept- Oct.	Glyphosate can be applied to cut stumps in the fall for eradication
Japanese barberry	<i>Berberis thunbergii</i>	Shrub	Hand pulling of seedlings	Monthly	Pull before flower and fruit set

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Paper mulberry	<i>Broussonetia papyrifera</i>	Tree	Hand pulling of seedlings	Monthly	Glyphosate or triclopyr can be used on cut stumps for complete eradication.
			Cutting and herbicide application to stumps		
Fanwort	<i>Cabomba caroliniana</i>	Submerged aquatic	Chemical control with approved aquatic herbicide	Monthly	
Marijuana**	<i>Cannabis sativa</i>	Herbaceous	Hand pulling for light infestation	Monthly, May –Sept.	Glyphosate can be use in nonselective locations.
			Foliar herbicide application for larger infestation		2,4-D can be used when target grassy species are present.
Musk thistle**	<i>Cardus nutans</i>	Herbaceous	Hand pulling for light infestation	Monthly	Bag and dispose of plants, especially flower sand seed heads.
			Foliar herbicide application for severe infestation	Monthly, Apr - Oct	Apply foliar treatment at rosette stage prior to flowering. Glyphosate can be used. Large infestations of musk thistle require selective herbicides, but 2,4-D is only minimally effective by itself. Clopyralid or a blend of clopyralid and 2,4-D is typically more effective.
Oriental bittersweet	<i>Celastrus orbiculata</i>	Vine	Hand pulling of seedlings	Monthly	Glyphosate or triclopyr can be used on cut stumps for complete eradication.
			Cutting and herbicide application to stumps		
Chara	<i>Chara spp.</i>	Algae	Hand pulling and raking	Monthly	Remove and dispose all parts of plant off-site to prevent re-establishment.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Canadian thistle**	<i>Cirsium arvense</i>	Herbaceous	Mechanical removal for light infestation	Monthly, May - June	Mow down before flowering.
			Foliar herbicide application for severe infestation	June and Sept.	2, 4-D can be used as post emergent herbicide application after basal rosette stage in spring; glyphosate or aminopyralid can be used in fall to kill plant.
Bull thistle**	<i>Cirsium vulgare</i>	Herbaceous	Mechanical removal for light infestation	Monthly	Sever root below the crown with a shovel or spade because plant is a tapped rooted species
			Foliar application for severe infestation	Monthly, June-Sept.	Apply foliar treatment at rosette stage prior to flowering. Glyphosate can be used.
Blue green algae	<i>Cyanobacteria</i>	Algae	Manual removal by surface skimming	Monthly	Physical control can be implemented by increasing aeration by the owner/operator. Chemical control must be conducted with care as massive algae kill can release large quantities of toxins into water.
Nutsedge	<i>Cyperus spp.</i>	Grass	Hand pulling or mowing	Monthly	Pro Sedge® specifically targets nutsedge.
			Foliar herbicide application for severe infestation		
Jimsonweed**	<i>Datura stramonium</i>	Herbaceous	Hand pulling	Monthly, June-Sept.	Wear protective clothing; sap is toxic.
			Foliar herbicide spot application for larger plants		Glyphosate can be used in non-selective situations. 2,4-D can be used where desirable target grasses are present.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Diymo	<i>Didymosphenia geminata</i>	Algae	Manual removal with net	Monthly	Check equipment for contamination; bag refuse and dispose in approved location. Clean non-absorbent items with a 2% solution of bleach and let soak for 20 min. Clean absorbent items by soaking in 113°F plus hot water for 40 min. or freeze solid.
Crabgrass	<i>Digitaria sanguinalis</i>	Grass	Hand pulling or mowing	Monthly	Remove before seed set.
			Pre-emergent herbicide	Monthly, Mar. Apr.	Timing and correct rate of pre-emergent chemical are important for effectiveness; refer to manufacturer's instructions.
Russian olive	<i>Elaeagnus angustifolia</i>	Shrub	Hand pulling of seedlings	Monthly	
Autumn olive	<i>Elaeagnus umbellata</i>	Shrub	Hand pulling of seedlings	Monthly	
Burning bush	<i>Euonymous alatus</i>	Shrub	Hand pulling of seedlings	Monthly	
Goatsrue**	<i>Galega officinalis</i>	Herbaceous	Hand pulling of seedlings	Monthly	Hand pulling is only effective for seedlings.
			Foliar herbicide application	June - Oct.	Apply glyphosate at non-selective situations. 2,4-D can be used where desirable grasses are present. Chemical control must be conducted over 2 successive years for complete eradication.
English ivy	<i>Hedera helix</i>	Vine	Hand pulling of seedlings	Monthly	

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Giant hogweed**	<i>Heracleum mantegazzianum</i>	Herbaceous	Mechanical removal by digging out entire plant	Monthly	Wear protective clothing when handling as plant exudes sap which sensitizes skin to UV radiation.
			Foliar herbicide application for severe infestation	Monthly, June - July	Glyphosate or a combination of triclopyr and clopyralid can be used as a post emergent herbicide.
Water stargrass	<i>Heteranthera dubia</i>	Submerged aquatic	Mechanical control by raking or seining	Monthly	Remove all plant fragments and dispose off-site to prevent re-establishment.
Japanese hops	<i>Humulus japonicus</i>	Vine	Hand pulling	Monthly	
Hydrilla	<i>Hydrilla verticillata</i>	Submerged aquatic	Seasonal water drawdown and manual removal of tubers in the fall prior to regrowth in the spring for limited application.	Sept- Oct.	Chemical treatment is preferred for long-term management. Fluridone is used for large scale control.
Morning glory	<i>Ipomoea spp.</i>	Vine	Hand pulling	Monthly	
Privet (Chinese, Common, Japanese)	<i>Ligustrum spp.</i>	Shrub	Hand pulling of seedlings	Monthly	
Honeysuckle (Amur, Bell's, Japanese)	<i>Lonicera spp.</i>	Shrub	Hand pulling of seedlings	Monthly	
Floating primrose –willow	<i>Ludwigia peploides</i>	Emergent aquatic	Manual removal	Monthly	Remove and dispose of all plant parts at approved offsite location to prevent reintroduction by vegetative reproduction of remaining plant parts.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Purple loosestrife**	<i>Lythrum salicaria</i>	Herbaceous	Hand pulling	Monthly	Remove entire plant at seedling stage; dispose off site at approved location.
			Spot foliar application with aquatic approved herbicide	Monthly, June – Sept.	Triclopyr is preferred in situations where desirable target grassy species are present.
White mulberry	<i>Morus alba</i>	Tree	Hand pulling of seedlings	Monthly	
Parrot feather*	<i>Myriophyllum aquaticum</i>	Submerged aquatic	Aquatic Herbicide	Monthly	Species spread vegetatively. Do not use manual or mechanical removal as it may spread plant parts. Consult a licensed aquatic herbicide applicator.
Eurasian watermilfoil*	<i>Myriophyllum spicatum</i>	Submerged aquatic	Manual control by raking in small scale infestations; all plant fragments must be removed.	Monthly, Apr –Sept.	Monitoring and prevention of are important because it is difficult to control once established. Fluridone is an effective chemical treatment.
Yellow floating heart	<i>Nymphoides peltata</i>	Floating aquatic	Hand raking	Monthly	Rake and remove of all plant parts because plant can reproduce from stem and root parts.
Princess tree	<i>Paulownia tomentosa</i>	Tree	Hand pulling of seedling	Monthly	
Bristled knotweed	<i>Persicaria longiset</i>	Herbaceous	Cut down	Monthly	Do not pull as it can lead to erosion.
Common reed	<i>Phragmites australis</i>	Grass	Hand pulling or mowing	Late July	
			Foliar herbicide application for severe infestations	Sept.	Use glyphosate herbicide to eradicate large areas of infestation.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Mile-a-minute**	<i>Polygonum perfoliatum</i>	Vine	Hand pulling	Monthly, Apr- Sept.	Wear protective clothing to guard against spines.
			Pre and post emergence herbicide application	Feb.-Mar; Jun-July	Pendimethalin can be used for effective for pre-emergent application; Glyphosate or triclopyr can be used for post-emergent application.
Curly-leaf pondweed*	<i>Potamogeton crispus</i>	Submerged aquatic	Mechanical removal	Monthly	Cut, rake and remove all plant parts.
Kudzu**	<i>Pueraria montana</i>	Vine	Foliar herbicide application for severe infestations	Monthly, June –Oct.	Clopyralid can be used for effective post emergent control.
Lesser celandine	<i>Ranunculus ficaria</i>	Herbaceous	Hand pulling or mechanical removal by digging with a trowel for small infestation.	Monthly	Take care to prevent leaving large bare spots if removing mechanically near riparian areas to prevent soil erosion. Remove all tubers to prevent re-establishment.
			Foliar herbicide application	Monthly, March-May	Use aquatic safe herbicide near riparian areas.
Poison ivy	<i>Rhus toxicodendron</i>	Vine	Hand pulling of seedlings	Monthly	Wear protective clothing to guard against toxic urisols. Never burn plants.
			Cutting of large plants		
Multiflora rose**	<i>Rosa multiflora</i>	Shrub	Hand pulling of seedlings	Monthly	Use triclopyr for selective removal where desirable grass species are present.
			Foliar herbicide application		
Foxtail	<i>Setaria spp.</i>	Grass	Hand pulling	Monthly	Conduct manual removal in early spring to prevent seed set.

Table 2-3. Weed Management for Noxious and Invasive Plants of Pennsylvania (cont'd)

COMMON NAME	SCIENTIFIC NAME	PLANT TYPE	PREFERRED TREATMENT	SCHEDULE	COMMENTS
Shattercane**	<i>Sorghum bicolor</i>	Grass	Hand pulling for light infestation	June	Glyphosate is effective chemical control, may require several years of application to completely eradicate.
			Foliar herbicide application for severe infestation	Monthly	
Johnsongrass**	<i>Sorghum halepense</i>	Grass	Hand pulling for light infestation	June	Glyphosate is effective chemical control, may require several years of application to completely eradicate.
			Foliar herbicide application for severe infestation	Monthly	
Water chestnut*	<i>Trapa natans</i>	Floating aquatic	For small scale infestation, manual removal is preferred before plants go into flower and set seed.	Monthly, June – Sept.	Chemical control is no longer widely used but the herbicide 2,4- D has been shown to be effective.
Cattail	<i>Typha spp.</i>	Grass	Mechanical removal by cutting	Monthly	Cut below water line.
Filamentous algae	<i>Various filamentous spp.</i>	Algae	Manual removal	Monthly	Rake or sein with aquatic rake.
			Organic chemical control		Barley straw effective as organic control if added prior to growing season to prevent establishment.
Wild grape	<i>Vitis spp.</i>	Vine	Hand pull seedling	Monthly	

* Aggressive, invasive species

** Pennsylvania Noxious Weed

Table 2-4. Selection of Applicable Chemical Vegetation Control Methods

TREATMENT METHOD	COMMONLY USED HERBICIDE	SPECIES TREATED	TIMING
Basal bark treatment	Systemic chemical herbicides such as glyphosate (e.g., brand name Round-up PRODry®)	Small stands of woody species, including vines, with main stem diameter < 6-8 in. (e.g., Norway Maple [<i>Acer platanoides</i>] and Tree of Heaven [<i>Ailanthus altissima</i>])	Year round, when temperatures are between 32-80° F
Foliar treatment, non-selective	Systemic chemical herbicides such as glyphosate (e.g., brand name Round-up PRODry®)	Perennial, biennial, and annual herbaceous species, and woody species < 8 ft. tall (e.g., Japanese Knotweed [<i>Polygonum cuspidatum</i>], Common Reed [<i>Phragmites australis</i>])	After full leaf-out and before fall colors appear
	Contact herbicides such as perlargonic acid (e.g., brand name Scythe®), acetic acid, or clove oil (e.g., brand name Matran II®)	Biennial and annual herbaceous species, or perennial seedlings during the first year of growth (e.g., Ragweed [<i>Ambrosia artemisiifolia</i>], Lambsquarters [<i>Chenopodium album</i>], Chickweed [<i>Stellariamedia</i>])	After full leaf-out and before fall colors appear
Foliar treatment, selective	2,4-D dicamba, mecoprop, carfentrazone, sulfentrazone	Broadleaf herbaceous species (e.g., Mugwort [<i>Artemisia</i> sp.], Plantain [<i>Plantago</i> sp.], Thistle [<i>Cirsium</i> sp and <i>Carduus</i> sp.]	Spring or fall, when air temperature is between 65 and 85° F
Cut stem treatment	Systemic chemical herbicides such as glyphosate (e.g., brand name Round-up PRODry®)	Large woody species with main stem diameter > 6-8 in. (e.g., Norway Maple [<i>Acer platanoides</i>] and Tree of Heaven [<i>Ailanthus altissima</i>])	Late summer or fall
Pre-emergent treatment	Isoxaben, trifluralin, dinitroaniline (e.g., brand name Snapshot®)	Annual broadleaf and grass species, and perennials spread by seed (e.g., Foxtail [<i>Alopecurus</i> sp.], Japanese Stilt Grass [<i>Microstegium vimineum</i>])	Early spring prior to seed germination; late summer or early fall; or immediately following cultivation

2.2.2 MOWING AND STRING TRIMMING

1. Description

- This section describes the procedures and requirements for mowing and string trimming including: warm season/wildflower meadows, cool season meadows, and turf.

2. Applicability and Requirements

- Where mowing cannot be performed due to slope or terrain issues use a string-trimmer instead.
- If mowing or string trimming of vegetation occurs during the spring and summer, special care should be taken to reduce potential impact to ground-nesting birds where applicable (in other words, prior to or after nesting season: April 15 – July 31).

3. Standard Operating Procedure

- Refer to Tables 2.5-2.6 for species-specific mowing protocols for warm season and cool season grasses. For all other warm and cool weather species refer to the following protocols:
- **Mowing warm season grasses:**
 - Mow established warm season/wildflower meadows to a height of 6-8 in. to discourage the establishment of woody species and to encourage the new growth of target grasses and forbs.
 - Use a flail-type mower or equivalent if possible to prevent burying of seedlings with mowed material.
 - When using a flail mower, mow perpendicular to the slope (up and down) and never parallel (along the contours) to any slope that is greater than 15 degrees.

- Clippings are very finely chopped by a flail-type mower and so can be left in place without damaging plants.
- If a flail-type mower cannot be used, a conventional tractor, hand held, or walk-behind mower may be used.
- Walk-behind mowers, riding mowers, or tractors with brush hogs shall not be used on any slope greater than 15 degrees.
- Rake and remove excess clippings and properly dispose of the plant material in an approved location off-site.
- To avoid accidental damage, do not mow within 1 ft. of any tree or shrub. Instead, cut or remove plants by hand within the 1 ft. offset zone.

- **Mowing cool season grass meadows:**

- Mow cool season meadows to a height of 3-4 in. to discourage the growth of woody species and maintain height/aesthetic conditions as preferred by the owner/operator.
- Use a handheld, tractor, or walk-behind mower.
- Mow uniformly to the prescribed height without scalping or tearing the grasses.
- To avoid accidental damage, do not mow within 1 ft. of any tree or shrub. Instead, cut or remove plants by hand within the 1 ft. offset zone.
- Rake and remove excess clippings and dispose of the plant material in an approved location off-site.

- **String trimming:**
 - String trim herbaceous vegetation to approximately 4-6 in. above the ground surface.
 - To avoid accidental damage, do not string-trim within 1 ft. of any tree or shrub. Instead, cut vegetation with garden scissors or remove plants by hand within the 1 ft. offset zone.
 - Maintain an even level of string-trimmed vegetation to create a neat and tidy appearance.
 - Rake and properly dispose of the plant material in an approved location off site.

Table 2-5. Mowing Protocols for Cool Season Grasses

COMMON NAME	SCIENTIFIC NAME	MOWING REGIME	MOWING SCHEDULE	COMMENTS
Kentucky Bluegrass	<i>Poa pratensis</i>	Mow to 1 ½ to 2 ½ in. height. Mow to above 2 in. in warmer weather above 85°F.	Monthly from May to October	Sensitive to low mowing height. Perform best when grown in well-drained soils, in an open, sunny condition.
Rough Bentgrass	<i>Poa trivialis</i>	Mow to height of 1 ½ to 2 ½ in.	Monthly from May to October	Shade-tolerant, prefers moist soils.
Perennial Ryegrass	<i>Lolium perenne</i>	Mow to height of 1 ½ to 2 ½ in.	Monthly from May to October	Wear and heat tolerant.
Fine Fescues spp.	<i>Festuca spp.</i>	Mow to height of 2 ½ in. or higher.	Bimonthly from May to October	Tolerates low soil fertility, low pH, drought and shady.
Tall Fescue	<i>Festuca arundinacea</i>	Mow to height of 2-3 in.	Monthly from May to October	Drought and heat tolerant.
Bentgrasses	<i>Argrostis spp.</i>	Mow to 3/16 to ¼ in.	Monthly from May to October	Cold and heat tolerant, but moderately wear and drought tolerant.

Table 2-6. Mowing Protocols for Warm Season Grasses

COMMON NAME	SCIENTIFIC NAME	MOWING REGIME	MOWING SCHEDULE	COMMENTS
Big Bluestem	<i>Andropogon gerardii</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Tolerates hot weather and drought; grows best in moist, well-drained soils.
Little Bluestem	<i>Schizachyrium scoparium</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Drought tolerant, prefers soil pH of 5.5 to 6.5.
Indiangrass	<i>Sorghastrum nutans</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Moderately drought tolerant.
Sideoats Grama	<i>Bouteloua curtipendula</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Moderately drought tolerant.
Purple Lovegrass	<i>Eragrostis spectabilis</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Highly drought tolerant. Can be left unmown in extremely dry situations.
Purpletop	<i>Tridens flavus</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Does not tolerate accumulation of old leaf litter. Moderately shade tolerant. Adaptable to moist and dry-mesic conditions.
Prairie Dropseed	<i>Sporobolus heterolepis</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Drought and heat tolerant.
Switchgrass	<i>Panicum virgatum</i>	Remove no more than the top 1/3 of growth	Annually in early spring	Drought and heat tolerant; adaptable to a wide variety of soil conditions.

2.2.3 DEAD AND DAMAGED VEGETATION REMOVAL

1. Description

- Procedures and requirements for the following types of vegetation removal are described in this section:
 - Removal of shrubs measuring over 5 ft. to the top of the crown
 - Removal of trees in unconstrained settings
 - Removal of herbaceous vegetation or shrubs

2. Applicability and Requirements

- If site constraints are such that the tree cannot be safely removed by maintenance personnel, a specialty tree removal service may be needed. Inform the owner/operator. Specialty tree removal is not included in this manual.
- Work must be performed consistent with the following standards:
 - International Society of Arboriculture (ISA)—All applicable standards
 - ANSI A300 (Part 9) – 2011 Tree Risk Assessment
 - OSHA Standard 1901.266: Logging Operations

3. Standard Operating Procedure

- **Large shrub removal:**
 - Use a handsaw or small chainsaw to cut through thick branches.
 - Using a digging spade and a digging fork, dig around the perimeter of the root zone to loosen and cut roots.

- Cut through roots at the base of the stump with a garden mattock.
- Use a digging spade and digging fork to dislodge the stump from ground. If a stump puller is available, securely clamp the stump in the puller's vice. Rock the stump puller back and forth until the stump loosens and can be pulled away from the earth completely.
- Backfill excavated hole with surrounding soil and finish with mulch per Section 2.2.6.

- **Tree removal:**

- Identify the expected fall line by observing the natural growth pattern and angle of the tree, check for and remove, if possible, obstacles within the escape routes and erect temporary barriers to warn pedestrians and vehicular traffic.
- Remove all dead snags prior to felling, if practicable.
- Select appropriate saw. Typically a hand saw may be used for cutting trees less than 4 in. DBH, but a small chain saw may be used in some cases to increase efficiency.
- Select appropriate 1-cut or 2-cut (undercut) method to fell the tree, depending on size of crown and constraints in the surrounding area. The 2-cut method allows greater control of where the tree falls, but is difficult to implement on small trunks.

- **One-cut method:**

- Cut directly through the trunk with a single horizontal cut.

- **Two-cut method (undercut) method:**

- First, establish an undercut: Cut a 90-degree V-shaped notch into the side of the tree in the direction of intended fall. The undercut must be approximately one-third of the branch diameter in depth. The face of the notch must be equal to the depth of the notch. A rope may be used to secure the upper trunk to ensure that the tree falls in the right direction.
- Second, establish a backcut: Cut approximately 2 in. higher than the deepest part of undercut and on the opposite side of the trunk. Never make the backcut lower than the undercut. Never cut through the undercut.
- Cut the trunk and branches into pieces that can be easily carried, and remove and dispose of material at an approved off-site location.
- Roots may be removed or left in the ground at the discretion of the owner/operator.
 - If roots are to be left in the ground:
 - Cut stump to an elevation flush with the ground surface.
 - If roots are to be removed:
 - Use a shovel, pick mattock and digging bar to reveal the roots around the stump. Cut roots with an axe or loppers.
 - Push the trunk to expose more roots; continue cutting and pushing until the trunk is uprooted.
- Remove roots from the site.
- Backfill with soil and cover with mulch and replant as needed (see Section 2.2.8 and 2.2.9).
- **Herbaceous Vegetation and Small Shrub Removal:**
 - Cut base of vegetation using a hand saw or pruners.
 - Dig out roots using a shovel, taking care not to disturb nearby plants.
 - Backfill area with top soil.
 - Apply mulch to match existing condition, consistent with Section 2.2.6.

2.2.4 PRUNING, THINNING, AND CUTTING BACK VEGETATION

1. Description

- This section sets forth procedures and requirements for trimming, pruning, and thinning woody and herbaceous plants to maintain health, including the following:
 - Non-structural pruning of trees and shrubs
 - Structural pruning of trees and shrubs
 - Cutting back of herbaceous species

2. Applicability and Requirements

- Trimming, pruning, and thinning shall be performed consistent with the latest revision of the ANSI A300 (Part 1)-2008, “Tree, Shrub and other Woody Plant Maintenance-Standard Practices,” and ANSI Z-133.1-2006.
- All equipment to be used and all work to be performed must be in full compliance with the most current revision of the ANSI A-300 [Part 1] – 2008 and ANSI Z-133.1-2006 standards for tree care operations.
- Structural tree pruning work must be performed under the direction and on-site supervision of a Certified Arborist.
- The owner/operator shall make arrangements with the utility company for removal of any limbs or branches in conflict with of electrical distribution lines. Tree pruning near or within electrical wires shall only be conducted by a qualified line-clearance arborist. **Electric Utilities warn to keep 10 ft. from all Primary/Distribution Power Lines.** (See Figure 2-6).
- All pruning efforts should intend to protect clear sight lines, insure that branches and limbs are not impeding with street traffic, pedestrian traffic, or structures. Ideal clearances may not be practical in all cases, particularly for young trees.

3. Standard Operating Procedure

- **Pruning of shrubs and trees:**

- **Non-structural pruning:**

- Remove all dead, damaged, diseased, or dying branches.
- Remove broken or cut branches back to the branch collar.
- Remove low limbs as needed to maintain safe overhead and line of sight clearances for pedestrians and vehicles (Figures 2-7 and 2-8).
- Use sharp, sterilized pruning tools.
- Make clean even cut using proper tool for size of branch.
- Carefully cut as close to the branch collar without cutting the branch collar. Preserve the branch collar for proper healing.

- **Structural pruning:**

- Structural pruning promotes proper growth habit and train the growth of young trees to achieve target clearances.
- Do not remove more than 25% annually of total tree foliage or foliage of any single branch or limb when it is cut back to a lateral.
- Elevate lower limbs:
 - The extent of elevation depends on the size, species, and location of tree.
 - Laterally prune (to a lateral large enough

to assume terminal role) only those limbs that are directly interfering with objects such as street lights, wires, buildings, utility poles, etc. or lines of sight.

- Remove all rubbing and crossing limbs.
 - Perform structural pruning not more than once per year during winter dormancy if needed.
 - Remove competing leaders, if tree is single-stemmed species.
 - Use sharp sterilized pruning tools
 - Make clean even cut using proper tool for size of branch.
 - Carefully cut as close to the branch collar without cutting the branch collar. Preserve the branch collar for proper healing.
 - For branches larger than 1.5 inches in diameter use the 3-cut method (Figure 2-9) or method approved of by Certified Arborist on site.
 - Cut branches into pieces than can be easily carried, and remove and dispose of material at an approved off-site location.
- **Cutting back of herbaceous species:**
 - Trim plants, as needed, to maintain safe lines of sight for pedestrians, especially at intersections. A general rule at traffic triangles or other SMPs located at intersections is to keep the height of herbaceous vegetation no more than 4 ft from top of curb to top

of vegetation.

- Cut back dormant herbaceous species annually.
- Use sharp sterilized pruning tools
- Make clean even cut using the proper tool.
- Cut back herbaceous to a height of 3-5" above ground once in the spring.
- Remove and dispose of material at an approved off-site location.

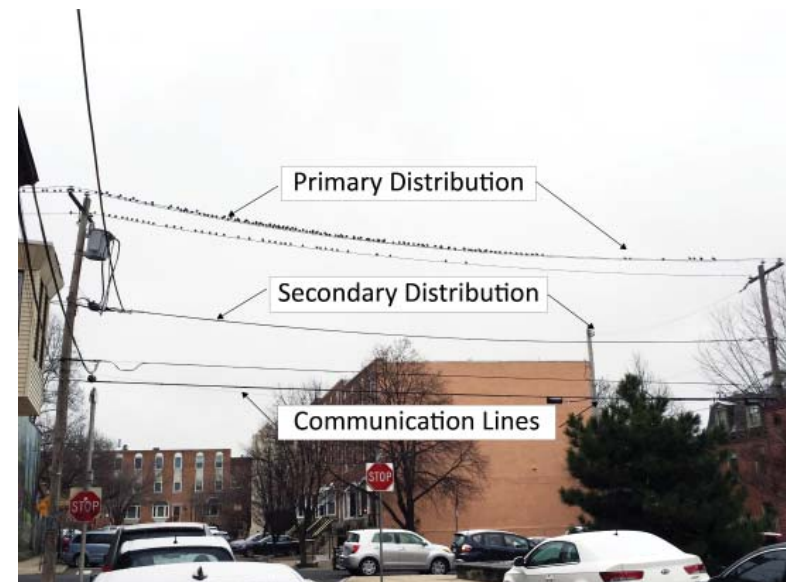


Figure 2-6. Common Electric Distribution Lines



Figure 2-7. Shrubs Pruned to Preserve Sight Lines.



Figure 2-8. Tree with Elevated Lower Limbs to Preserve Sight Lines.

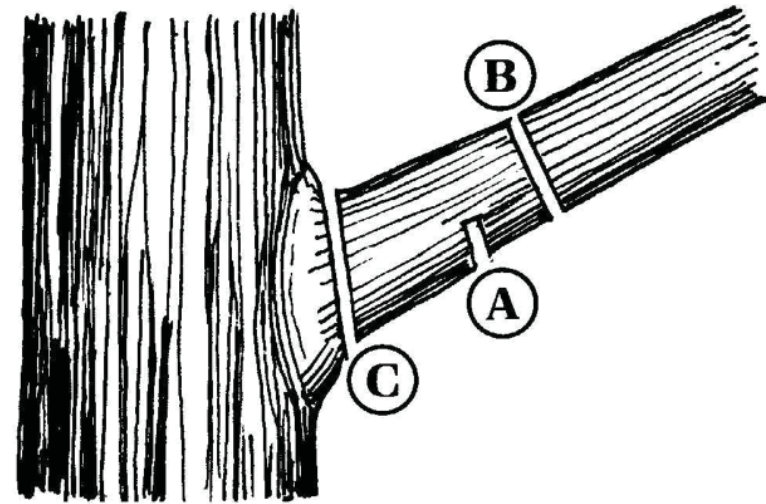


Figure 2-9. 3-Cut Method for Pruning.

Image Credit: Roswell Arborist.

2.2.5 PEST AND DISEASE MANAGEMENT

1. Description

- This section sets forth procedures and requirements for cultural, mechanical, biological, and/or natural chemical controls to manage pests and diseases, including:
 - Pest mammals
 - Pest insects and fungi

2. Applicability and Requirements

- Chemical pest control shall be performed during periods of dry weather (not more than 24 hrs. before or after a rain event) with little or no wind.
- Temperature restrictions may apply but vary by pesticide type (see Table 2-7).
- For pesticide application, submit the following information to the owner/operator within 24 hrs.:
 - Date of application, and for herbicides specifying a reentry period, the hour of completion;
 - Name and address of the application site (commercial applicators must also record the name and address of the customer if it differs from the application site);
 - The brand name, EPA registration number, amount, and rate or dosage of each pesticide used;
 - Size and identification of the area treated;
 - Names and certification numbers of all persons involved with the application; and
 - Application records must also include restricted

reentry interval.

- All pesticides shall be applied per label-specific safety instructions and manufacturer's directions.
- Personnel shall comply with directions on all pesticide label sheets, Material Safety Data Sheets (MSDS) sheets, and other applicable sources, as well as all applicable codes and regulations.
- Notify anyone listed on the Pennsylvania Pesticide Hypersensitivity Registry whose location is within 500 ft. of a pesticide application site not less than 12 hrs. in advance, but not more than 72 hrs. prior to application. Notification must be made via e-mail, a telephone answering device, or by giving information to an adult contacted by dialing any of the listed telephone numbers.
- Include the following in the hypersensitivity notification information: date, time, location of application, EPA registration number, brand name, common name of active ingredients of the pesticide(s) that may be used, business name, BU number, business phone number, and a copy of the label if requested.
- Personnel performing pest and disease management shall include at a minimum:
 - A Pennsylvania Certified Pesticide Applicator or Registered Technician who is under the supervision of a Pennsylvania Certified Pesticide Applicator that can be on site within 5 hrs. if necessary; and
 - A Noncertified Applicator under the direct supervision of a Pennsylvania Certified Pesticide Applicator who is physically present and within sight of the application being made.

3. Standard Operating Procedure

- Determine the extent of infestation and damage, and select the most specific control for the pest to avoid harming beneficial organisms. Start with the least-toxic measures. See Table 2-7 for common pest and disease control methods.
 - **Large animal carcass removal:**
 - Report the presence of large animal carcass to the owner/ operator.
 - Report large animal carcass to Philly311 or to the Philadelphia Streets Department (if located in a public street) for prompt removal.
 - **Small animal carcass removal:**
 - Wear disposable gloves.
 - Use shovel(s) and rake(s) to collect and place the animal carcass in the trash bag.
 - Seal and dispose of the bag Clean tools with disinfectant solution (bleach, pine oil, or other household disinfectant liquids).
 - If potable water is available, apply disinfectant solution to the tools and hose down.
 - **Repair of animal burrows:**
 - Fill animal burrows with 2A modified stone, pack with hand tamp
 - Replace mulch as applicable(see Section 2.2.6);
 - **Pest insects or fungi:**
 - Remove infected leaves, twigs, branches, needles, and cones around the base of trees and shrubs to remove disease reservoirs (see Section 2.2.4).
- Apply appropriate pesticide (see Table 2-5):
 - Prepare pesticide solution as per manufacturer’s specifications prior to arriving on site.
 - Apply the pesticide according to manufacturer’s instructions and recommended safety procedures.
 - To minimize risk of pesticide spillage, do not use open containers on the site during the application process. In the event that the pesticide is spilled, follow appropriate safety protocols for cleanup and notification of appropriate parties.
 - Avoid introducing pesticide onto unaffected vegetation or areas of the plant that will not respond to treatment.
 - Follow manufacturer and safety specifications for pesticide clean-up and disposal.
 - For mosquito issues within inlets or catch basins, use Mosquito Dunks[®] or the equivalent to treat areas of standing water.
 - Report wasp/hornet nests, roach, or animal infestations to the owner/operator and Philadelphia Health Department’s Vector Control Services (See Appendix) Table 2-5. Common Pest and Disease Control Methods.

Table 2-7. Common Pest and Disease Control Methods

PEST/DISEASE	TREATMENT	APPLICATION NOTES
Mites, aphids, whiteflies, and other soft-bodied insects as well as the softer nymph stages of some hard-bodied insects.	Insecticidal soap	Spray only on pests. Avoid hitting beneficial insects with the spray. Insecticidal soap must come in contact with the insects while it's still liquid. It has no effect after it dries on the plants. Caution: Insecticidal soap can burn some plant leaves. Test each type of plant before spraying entire plant.
	Narrow-range, or superior, horticultural spray oils (petroleum derivative), e.g., JMS Stylet Oil, Saf-T-Side Spray Oil, Sunspray Ultra-Fine Spray Oil; Plant-based oils, including those derived from garlic, neem, jojoba, cottonseed, and thyme.	Use "dormant" oils to kill insect pest eggs and disease spores on bare branches of trees and shrubs during the dormant season. To treat growing plants, use a lighter-weight horticultural oil. Lighter oils evaporate more quickly than dormant oils and are less likely to damage plants. Avoid use of oils at temperatures below freezing or above 90°F.
	Beneficial organisms	Application methods and timing vary by species and intended target.
Slugs	Slug baits with ferric (iron) phosphate as the active ingredient; Diatomaceous earth	Caution: Protection is needed against breathing diatomaceous dust.
Wasp/hornet nests; severe mosquito/roach infestations	Report to owner/operator and to Philadelphia Vector Control Services: 215-685-9000	N/A
Minor mosquito infestations in inlets/structures	Mosquito Dunks® or equivalent	N/A
Powdery mildew	Horticultural oil, e.g. JMS Stylet Oil, Saf-T-Side Spray Oil, Sunspray Ultra-Fine Spray Oil; Plant-based oils, e.g. neem oil (Powdery Mildew Killer), jojoba oil (E-rase).	Do not apply an oil spray within 2 weeks of a sulfur spray, or it may injure plants. Do not apply oils when temperatures are above 90°F or to water-stressed plants.
	Wettable sulfurs that are specially formulated with surfactants , e.g., Safer Garden Fungicide	Do not apply within 2 weeks of an oil spray.
	Biological fungicides, e.g., Serenade	Helps prevent the powdery mildew from infecting the plant.
Mammals	Liquid repellent, e.g. Critter Ridder	Groundhogs will eat all parts of a plant, especially woody parts. Spray directly on plants susceptible to damage.
	Granular repellent, e.g., fox urine granules	Sprinkle granular repellent on the ground around problem areas (burrows, areas of herbivory).
	Removal of borrows	Fill burrows with crushed stone.

2.2.6 MULCHING

1. Description
 - This section sets forth procedures and requirements for mulch application and maintenance.
2. Standard Operating Procedure
 - **Mulch removal:**
 - Remove mulch from tree pit or SMP using rakes and shovels, taking care not to disturb vegetation. Mulch shall be disposed of at an off-site location.
 - **Mulch application:**
 - For established landscaped beds aged 2 years or older, apply mulch to perimeter of landscaped beds.
 - Apply a 3 in. thick layer of mulch extending from the edge of the tree pit or other SMP to a radius of 3 in. from the woody stem of each plant.
 - Add mulch until the mulched area is flush with the edge of pavement unless tree pit is covered by a grate or has fencing around the pit.
 - **Mulch maintenance:**
 - Rake mulch away from trunks and woody stems of shrubs to a distance of 3 in. using a rake taking care not to disturb vegetation.

2.2.7 SOIL MANAGEMENT

1. Description
 - This section sets forth procedures and requirements to maintain soil health and function, including:
 - Soil amendment
 - Decompaction of tree pit soil
 - Remediation of accumulated salt
2. Applicability and Requirements
 - Inorganic fertilizer is intentionally excluded from this section and shall not be used, unless specifically approved by the owner/operator for special circumstances.
 - Soil must meet the owner/operator's requirements – fertile, natural soil, free from large stones, roots, sticks, clods, plants, peat, sod, pockets of coarse sand, pavement and building debris, glass, noxious weeds, invasive species, undesirable organisms and disease causing pathogens.
 - Soil shall be amended as required according to soil analysis, which may be completed or requested by the owner/operator.
3. Standard Operating Procedure
 - **Application of soil amendments:**
 - Remove weeds and complete tree and shrub pruning before spreading soil amendments.
 - Spread soil amendments evenly over the target area, avoiding clumping or piling of material, and taking care not to injure target vegetation.
 - When applying amendments to vegetated areas,

spread by hand.

- For turf areas, till soil amendments into existing soil with a mechanical tiller to a depth of 4 in.
- Reseed disturbed area as needed (see Section 2.2.9).
- **Decompaction of tree pit soil:**
 - Use the proper hand tools or an air spade to break up soil compaction in tree pits. Do not use a conventional rototiller, which will damage roots near the surface.
 - Top dress with 3 in. of compost over roots.
- **Remediation of accumulated salt:**
 - Flush or leach excess salt from the soil by irrigating with water. After flushing, the owner/operator may request a follow-up soil analysis.
 - Apply amendments. Typical amendments for correcting saline soil include gypsum, calcium chloride, sulfur, and iron sulfate.

2.2.8 PLANTING AND TRANSPLANTING

1. Description

- This section sets forth procedures and requirements for planting and transplanting of trees, shrubs, containerized herbaceous plants, and herbaceous plugs within SMPs. Work includes, but is not limited to the following:
 - Delivery, storage, and handling of plants;
 - Appropriate planting seasons, site preparation and planting list;
 - Installation of trees, plants, and shrubs (containers and seedlings); and
 - Protection of new plantings.

2. Applicability and Restrictions

- **Plant delivery, storage and handling:**
 - Plants and trees must meet the owner/operator's requirements for genus, species, variety, size, and quality. Plants must be clearly labeled with scientific and common names when delivered to site.
 - Substandard plants or trees for caliper size and condition of root ball and root systems, insects, injuries and latent defects or defective material may be rejected by the owner/operator at any time during progress of work.
 - Do not store vegetation in direct sunlight and roots should be kept moist.
 - Protect bark, roots and branches from handling; do not use trunk as lever; do not lift or carry a plant by the trunk or branches.

- **Appropriate planting seasons:**

- Deciduous trees and shrubs: Early spring and late fall when plants are dormant (typically March 15 to May 30 and September 15 to October 31).
- Tree selection and digging operations shall be scheduled so as to comply with nursery industry standards for ‘Spring Dig Only’ or ‘Fall Hazard’ plant materials. If Red maple (*Acer rubrum*), American hornbeam (*Carpinus caroliniana*), Tulip poplar (*Liriodendron tulipifera*), hickories (*Carya* sp.), Sassafras (*Sassafras* sp.) or Black gum (*Nyssa sylvatica*) are to be planted, they must be planted in early spring when trees are dormant (have not leafed out yet).
- Evergreen trees and shrubs: Early spring and late summer/early fall (typically April 15 to May 30 and September 15 to October 31). Fall-planted conifers must have enough time to establish fine root systems and be well watered so as not to be at risk of desiccation during winter months. Soil temperatures for fall planting must not be less than 60°F.
- Ground cover, herbaceous perennials and plugs: In spring after danger of frost is past (typically April 15-May 30) or late summer/early fall at least 30 days before first frost (typically September 15 to October 31).
- Bulbs: September 15 to October 31 planting (soil temperature less than 55°F, but before soil freezes).

- **Site preparation and plant lists:**

- No planting pits shall be left open at the end of day.
- The owner/operator will inform where to install

plants.

- Installed plant list – A complete list of installed plants shall be submitted to the owner/operator after completion of the plantings.
 - The list shall include botanical and common names, variety, size (container or caliper), quantity, location within SMP, and source of plant materials.

3. Standard Operating Procedure

- **Installation in erosion control blanket:**

- An incision shall be cut in the erosion blank and a hole shall be dug for each plug or plant that is the same depth as the soil of the plug or potted plant.
- For plugs, a ‘dibble bar’ with the same diameter as the plug can be used to create the hole, when punched through the erosion blanket.
- For container plants, the stapled erosion control blanket shall be cut in a circular shape to match the diameter of the container.
- No erosion control blanket is to rest directly against any tree or plant stem.

- **Installation of trees and shrubs (See Figures 2-10 and 2-11):**

- All planting pits shall be dug so the walls of pits are vertical or angled outward from the bottom up. Scarify the walls of the pit after digging.
- Excavate the planting pit to at least 1-½ times the width of the root mass of the plant to be installed.
- The planting pit shall be deep enough to allow the

- bottom of the root flare to be flush with the final grade.
- Remove all debris from the pit and tamp loose soil in the bottom of the pit by foot.
- Do not handle plant by the branches, leaves or stem (or trunk).
- Remove plant from container and place straight in the center of the planting pit, carrying the plant by the root mass. Do not lift or carry a plant by the trunk or branches.
- If a tree or shrub is balled and burlapped, carefully remove root ball packing (½ of cage and as much burlap as possible) while disturbing the tree as little as possible after tree is set in pit.
- Cut and remove all ropes around the burlapped ball.
- Remove as much burlap from the ball as possible.
- Remove at least ½ of the wire basket.
- Remove all nails.
- Remove bamboo staking adjacent to root ball and trunk prior to planting, if present.
- Backfill planting pit with soil and tamp firmly to fill all voids and air pockets. Do not over compact soil. Make sure the plant remains straight during backfilling/tamping procedure.
- The top of the root mass of the trees/shrubs shall be flush with, or slightly elevated (no more than ¼ in. height) above the final grade. Root flare must be visible. Do not cover woody stem with soil.
- Water plants thoroughly immediately after planting to saturate backfill. See Section 2.2.10.
- Install mulch as specified in Section 2.2.6.
- Install stakes on all trees. Use Hardwood stakes and ArborTie®, or equivalent approved by owner/operator.
- If space allows place stake at curb side and the second stake opposite.
- Remove all strings and wire from the plant materials with the exception of plant name tags which must be left until owner/operator inspection.
- **Installation of herbaceous containers and plugs:**
 - Dig the planting pit to at least 1 ½ times the width of the root ball.
 - Remove the plants and soil from the pots or plug trays and position in the holes so that the soil level of each plant is flush with the surrounding finished grade soil surface.
 - After planting, fill soil in around the plant completely, firming the soil and ensuring there are no air pockets as plants are installed.
 - Water plants thoroughly immediately after planting to saturate backfill. See Section 2.2.10.
- **Protection of new plantings:**
 - Install silt socks over trench drain and curb cut openings to minimize scour, inundation, and sediment delivery impacts of stormwater during early establishment of new plants (silt socks must be removed after a full growing season has elapsed).



Figure 2-10. A Tree After Planting, Before Mulching



Figure 2-11. A Tree Being Planted

2.2.9 SEEDING

4. Description

- This Section sets forth procedures and requirements for seeding. Work includes, but is not limited to the following:
 - Seeding seasons and seeding plan
 - Seedbed preparation
 - Seeding - manual and hydroseeding
 - Protecting newly seeded areas

5. Applicability and Requirements

- Appropriate seeding seasons:
 - Spring (March 1 - May 15)
 - Fall (August 15 - November 15)
- Seed plan:
 - Owner/operator will inform where to install seed mix.
 - Seed species list – a complete composition list for each area that was seeded.
 - Include scientific and common names and percentages of each species within the mix.
 - Label each list by the site and corresponding feature ID.
 - Any change from the originally specified mix must be fully documented.

6. Standard Operating Procedure

- **Seedbed preparation:**

- No seeding shall be performed on frozen ground or when the temperature is 32 °F/0 °C or lower, unless specifically instructed by owner/operator.
- If herbicide is necessary, apply well in advance (several days to weeks) of site preparation.
 - Apply all approved herbicides under supervision of a Certified Pesticide Applicator licensed for commercial application by the Commonwealth of Pennsylvania (see Section 2.2.1).
- All areas to be seeded shall be well-graded and free of all weeds, trash, debris, brush, clods, loose stones, construction debris, and other foreign materials that would interfere with seeding.
- Scarify seedbed prior to seeding using a harrow/rake.
- If area to be seeded is in within the vicinity of trees and shrubs or a woodland opening, take care to avoid damage to existing trunks and roots by using a hand rake or small rototiller to prepare the site.
- Avoid critical root zone areas.
- **Seeding – general:**
 - Seeding is to be performed only after all other work in an area is complete.
 - No fertilizer or lime shall be applied to any seeded areas, unless explicitly approved.
- **Seeding – hand broadcast:**
 - Uniformly distribute seed throughout the target area.
 - Applied seed in two different directions.
- Harrow or rake site following seeding.
- Maximize the seed/soil contact by firming soil around the seed with a Cultipacker, other similar equipment. Do not cover seed with more than ¼ in. of soil.
- Immediately after initial seeding, water seeded areas evenly and thoroughly – see Section 2.2.10.
- Straw mulch all seeded areas within 12 hrs. Place straw uniformly, in a continuous blanket, in approximately ¾ in. loose layers, anchor straw mulch with tackifier, if necessary.
- **Seeding – hydroseeding:**
 - All seeding equipment shall be calibrated before application so that the materials are applied accurately and evenly to avoid misses and overlaps.
 - Seed shall be installed by equipment capable of placing seed at a specified rate.
 - Apply seed uniformly and evenly across the entire disturbed area.
 - Apply seed-water mixture within the hydroseeder tank no later than 1 hr. after the seed is added to the tank.
 - Comply with equipment manufacturer’s installation instructions and recommendations. Use approved spraying equipment with fan-type nozzle.
 - Hydroseed shall be applied using a two-step process to ensure good seed to soil contact:
 - Step 1: Apply the first coat evenly and uniformly from opposing directions to the soil surface to cover the entire area. The mix

shall contain only the specified seed mixtures at specified rates, hydroseed mixture at 500 lb. per acre (for visual metering only) and tackifier at manufacturer recommended rates.

- Step 2: Apply the second coat evenly and uniformly on top of the first coat, covering the entire seeded area with an erosion resistant coating of mulch. This mix shall contain water, hydro-seed mixture at 1,500 lb. per acre and tackifier at manufacturer recommended rates.
 - After hydro-seed application, thoroughly flush the tank, pumps and hoses to remove all material. Wash all material from the exterior of the machine and remove any slurry spills.
- **Protecting newly seeded areas:**
 - Do not allow seeded areas to be trafficked. A temporary fence may be necessary.

2.2.10 WATERING

1. Description

- This task outlines the procedures and requirements for watering vegetation.

2. Applicability and Requirements

- Do not perform overhead watering during sunny days to prevent leaf scorch.

3. Standard Operating Procedure

- **Fire hydrant operation:**

- Operate permitted fire hydrants using-approved center compression lock keys or a hydrant wrench if the center compression lock bonnet has been removed.
- Follow fire hydrant operation procedure guidelines to open, operate, and close all permitted fire hydrants, using approved backflow preventer assemblies.

- **Watering tank operation:**

- If direct onsite access to a rain-harvested or fire hydrant is not available, personnel shall use a watering tank as the source of water.

- **Watering of herbaceous plants, shrubs, and seeded areas:**

- Direct water towards base of plants.
- Allow the water to soak into the ground within each area of vegetation, moving slowly through each section.
- Each 100 ft² section of the vegetated SMP shall be evenly and thoroughly watered for 5 min. before

moving on to the next section.

- Use appropriate hose sprinkler attachments, taking care to avoid directing concentrated flows at planted or seeded areas.
- **Watering of trees:**
 - Water bag installation, filling, and removal:
 - Install and fill 15-20 gal. watering bags such as TreeGator® or equivalent (See Figure 2-12), per the manufacturer’s recommendations, on any trees that:
 - Have been in the ground for less than 24 months, during April through October
 - Between April and October, have more than 25% dead, wilted, or discolored foliage
 - Allow the first 15-20 gal. to seep into the ground, then refill the watering bag
 - In October, remove watering bags from trees, wash, and store in a dry environment
 - Watering using manual methods:
 - Water each tree for a 5 min. or until the soil is thoroughly saturated.
 - Using a hose and gentle stream of water, apply water to the base of the tree.
 - Allow the water to soak into the ground. Replace any mulch that has been disturbed during the watering process.



Figure 2-12 Gator bags installed on trees

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Aerial lift truck with dump box				•						
Air spade to decompact and aerate soil							•			
Air tiller	•									
Aquatic weed cutter	•									
Aquatic weed rake	•									
Axe	•	•	•							
Backflow preventer(s) and associated appurtenances										•
Chainsaw	•			•						
Chipper trailer type, either disc or drum. Minimum 12 knives.				•						
Club hammer	•									
Cultipacker	•								•	
Dibble bar								•		•
Digging bar		•								

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Dust pan and brush			•							
Fire hydrant center compression lock										•
Fire hydrant wrench										•
Flail mower – adjustable cutting height with sharpened blades, minimum cutting width of 4 ft., with offset for mowing around trees and shrubs	•									
Garden scissors	•									
Hammer								•		
Hand held power mower unit with sharpened blades										
Hand trowel								•		
Harrow									•	
Hoe	•									
Hose with spray nozzle								•		•

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Hydroseed tank, hoses, nozzles and related appurtenances									•	
Ladder of appropriate height				•						
Landscape edger (manual) – corrosion resistant, step on model						•				
Landscape edger (mechanical) – gas-powered, caster steering, pneumatic tires, carbide-tipped cutting blades, adjustable cutting depth, curb hop option and appropriate safety guards						•				
Leaf blower				•						
Mallet	•							•		
Manual tiller	•									
Pesticide applicators and injectors					•					

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Pick mattock		•	•							
Pruning shears, clippers, and loppers – sharpened and sterilized	•	•	•	•	•					
Push broom with firm bristles				•						
Rake	•			•	•	•	•		•	
Rototiller	•			•					•	
Safety lines/ropes, saddles, lowering lines				•						
Shovel	•	•	•	•	•	•	•	•		
Soil test kit							•			
Spade	•	•	•							
Spreader									•	
Stakes								•		
Staple gun								•		
Sterilized hand saw, pruning pole saws, and pole clips		•	•	•	•					

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Storage containers for herbicides, as specified in manufacturer's instructions	•									
Storage containers for pesticides, as specified in manufacturer's instructions					•					
String trimmer	•			•		•				
Stump puller		•	•							
Tarp						•	•			
Tractor and brush hog or finish mower—3-point hitch, sharpened rotary blades, minimum cutting width of 4 ft	•									
Trash bags (various sizes)										
Trash claw										

Table 2-8. Recommended Equipment for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Walk-behind mower –commercial-grade, with sharpened blades with minimum cutting width of 30 in.	•					•				
Water hose of sufficient strength to withstand kinking and abrasion									•	•
Water tank (250 gal. minimum), hose with appropriate nozzles, and truck of sufficient capacity to support a water tank										•
Watering bags such as TreeGator										•
Weed-pulling tool, e.g., Root Talon, Weed Wrench	•									
Wheelbarrow or push cart							•			

Table 2-9. Recommended Materials for Surface Vegetation Maintenance

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK VEG.	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
50 gal. plastic contractor bags	•	•	•	•	•	•	•	•	•	•
Biostimulants (various)							•			
Bonded fiber matrix (BFM), wood cellulose, or equivalent approved by owner/operator (for hydroseeding applications)									•	
Burlap								•		
Clean straw mulch free of noxious weeds with tackifier added									•	
Compost							•			
Deer repellent (e.g., Repellex)					•					
Disinfectant (e.g., bleach, pine oil, or other household disinfectant liquids)				•						
Erosion blanket (biodegradable NAG-C125BN or SC-150BN or equivalent)								•	•	

Table 2-9. Recommended Materials for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK VEG.	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Grass clippings							•			
Hardwood stakes shall be 2 in. x 2 in. square wood, 6 ft. length, and chiseled on one end	•							•		
Herbaceous containers and plugs								•		
Herbicide (various)	•								•	
Horticultural spray oils (petroleum derivatives)	•				•					
Insecticidal soap					•					
Maintenance map	•	•	•	•	•	•	•	•	•	•
Material Safety Data Sheets (MSDS) as applicable	•				•					
Mosquito dunks					•					
Mulch material; Licorice bark mulch if available, shredded hardwood bark mulch	•		•		•	•			•	
Mycorrhizal fungal inoculant							•			

Table 2-9. Recommended Materials for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK VEG.	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Organic fertilizers							•			
Paper bags, 30 gal.	•									
Permits and access permissions	•				•					
Pesticides (various)					•					
Pine straw mulch							•			
Potable municipal or well water and/or harvested rainwater sufficient for watering and cleaning activities, as required	•				•		•	•	•	•
Sand							•			
Seed and establishment dressings									•	
Shredded leaf mold							•			
Shredded leaves							•			
Silt sock filled with straw or hay								•		
Staking ribbon shall be ArborTie®, or equivalent								•		

Table 2-9. Recommended Materials for Surface Vegetation Maintenance (cont'd)

	WEED CONTROL	MOWING, STRING TRIMMING	DEAD VEG. REMOVAL	PRUNING, CUTTING BACK VEG.	PEST & DISEASE MGMT	MULCHING	SOIL MGMT	PLANTING	SEEDING	WATERING
	2.2.1	2.2.2	2.2.3	2.2.4	2.2.5	2.2.6	2.2.7	2.2.8	2.2.9	2.2.10
Stone, various sizes					•					
Top soil			•				•			
Trees and container shrubs								•		

Subsurface Maintenance

division **3**



3.1 JETTING/VACTORING/INSPECTION

1. Description

- This section describes the protocols for subsurface inspection, jet-rodding, and vacuum cleaning. The task includes:
 - Subsurface inspection and maintenance of SMPs with a stone bed and distribution and/or underdrain piping
 - Inspection and maintenance of proprietary subsurface storage chambers with maintenance port(s)
 - Inspection and maintenance of proprietary subsurface storage chambers with an access manifold
 - Pretreatment device installation
 - Troubleshooting

2. Applicability and Requirements

- Subsurface inspection, jet-rodding, and vacuum cleaning shall not be performed within 48 hrs. of a significant (greater than 1.0 in.) rainfall event unless approved by the owner/operator.
- Determination of appropriate equipment for inspection and maintenance shall be made prior to inspection and maintenance of each structure (e.g. cleanout, domed riser, inlet. See Figures 3-9 through 3-11.) so that appropriate equipment is transported to the site.
- Structural loading constraints must be considered for each site. Staging area for vactor truck must support weights in excess of 35,000 lb.
- For maintenance occurring in SMPs directly connected to the Municipal Separate Storm Sewer System (MS4) or to a water body, the following conditions must be met:

- Water used in all subsurface maintenance activities must be dechlorinated prior to use (75 mL of calcium thiosulfate dechlorination liquid must be added to every 1,500 gal. of water) to avoid discharge of chlorinated water into the MS4 or water body. Approval by the owner/operator must be given prior to use of alternative dechlorination liquids.
- Prior to performing any maintenance, all downstream pipes connecting to the MS4 or discharging directly into a nearby water body must be plugged.
- In access structures that have more than one pipe connection, pipes (other than the one being maintained) must be plugged if there is concern of debris migrating to another portion of the system.
- For SMPs where backflow conditions may allow non-treated surface water or sewage to enter SMP piping, the installation of an inline check valve (or other backflow assembly) may be requested by the owner-operator.
- Confirm that the vacuum/jetter equipment waste storage tank is free of debris from another site or project. If required by owner/operator, take a time stamped photograph of empty storage tanks.
- When hydraulically-propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the pipe line are used, precautions shall be taken to ensure that the water head pressure does not damage or cause flooding to nearby public or private property.
- When hydraulically-propelled cleaning tools are used, all access structures that are not used as entry points shall be closed, secured by screws, screw caps, or weighted bags

(minimum 40 lbs.).

3. Standard Operating Procedure

- **Subsurface inspection and maintenance of SMPs with a stonebed and distribution and/or underdrain piping:**

- Position jet/vactor truck so that the reel is adjacent to the structure (e.g., inlet, manhole, control structure, riser, or cleanout, etc.). Utilize an inlet, manhole, or control structure as the primary maintenance access point, if possible.
- If SMPs include extensive sewer networks such as “daisy-chained” inlets, junction boxes, manholes, or other access structures, then maintenance must be performed first on upstream components before continuing to downstream components.
- If the structure has a grate, sweep or vacuum the grate. If the structure has a grate and is in the right-of-way, sweep or vacuum the surrounding area, collecting trash/sediment/organic debris at least 4 ft. from the structure on all sides.
- Open structure.
- If pretreatment device(s) is present:
 - Perform a visual condition inspection and report tears, clogged fabric or missing components to the owner/operator.
 - Remove trash, sediment, and organic debris from the pretreatment device(s).
 - If not permanently attached to the structure, remove the pretreatment device.
- If removing by hand, remove enough material from the device to achieve a liftable weight (based on subsurface maintenance personnel judgment). Once removed, invert and shake or gently tap the device and pressure-wash device with water or hand-clean using wire brush or stiff nylon brush until clean.
- If performed prior to vacuum cleaning structure, trash/sediment/organic debris from the pretreatment device may be emptied into the structure.
- If pretreatment device is permanently attached (e.g., pretreatment screen), clean using wire brush or stiff nylon brush.
- Perform a visual condition inspection of the structure. Look for underdrain end cap and any plugs.
 - If distribution plugs are present:
 - PVC or wingnut/plumber’s plugs are installed in distribution components during construction or to keep a site offline. These plugs must should generally be removed during maintenance, but confirm with the owner/operator.
 - Underdrain end cap:
 - Most underdrain pipes are designed and constructed to include a PVC end cap at the connection to an access structure. If a cap is missing or was not properly installed, contact the owner/operator.
 - If owner/operator determines a solid end

- cap is required, install the end cap without drilling an orifice.
 - If owner/operator determines that an orifice is required, orifice must be drilled into center of the underdrain end cap using a cordless drill and the appropriate drill bit based on the orifice size listed in the design plans.
 - If the underdrain is exposed, a PVC adapter sleeve may be required for the installation of the end cap. Concrete patching of the inlet wall may be required to create a seal around the pipe.
- Loosen compacted sediment on structure with high-velocity water gun or air lance while vacuuming, removing all trash/sediment/organic debris down to the sump.
- During maintenance of structure but prior to maintenance of pipes, complete a pre-maintenance inspection of any pipes connected to the structure.
 - The type of closed-circuit television (CCTV) camera required will depend on pipe size, length, and presence of bends in the pipe network. Refer to Figure 3-1 for guidance on camera selection and Figures 3-2 and 3-3 for photographs of camera types.
 - Position CCTV camera in center of pipe at access point. If possible, attempt access through a cleanout or riser before attempting access through other structures such as an inlet, control structure, or manhole.
- Ensure the lighting is adequate enough to illuminate the pipe. Avoid excessive lighting as it can result in the flaring of the image or misrepresent defects.
- Ensure color and video display correctly reflects the true colors of the pipe. Camera settings must follow manufacturer's recommendations to ensure proper identification and documentation.
- Move camera at a steady pace not to exceed 30 ft. per minute from entry point to the intended end point by pushing manually or remotely steering.
- Stop the camera if structural or construction defects are observed. Re-position camera to better view the defect(s) and capture still shots if possible.
- At the completion of the inspection, retract the camera to the entry point, recording the CCTV data.
- Remove the camera from the pipe.
- Close and secure any access points that were used for pre-maintenance inspection that will not be used for jetting. Clean and grease the bolts.
- Code defects observed in CCTV camera inspections using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program Manual (PACP) (Version 7.0 or later) and PACP partner software.

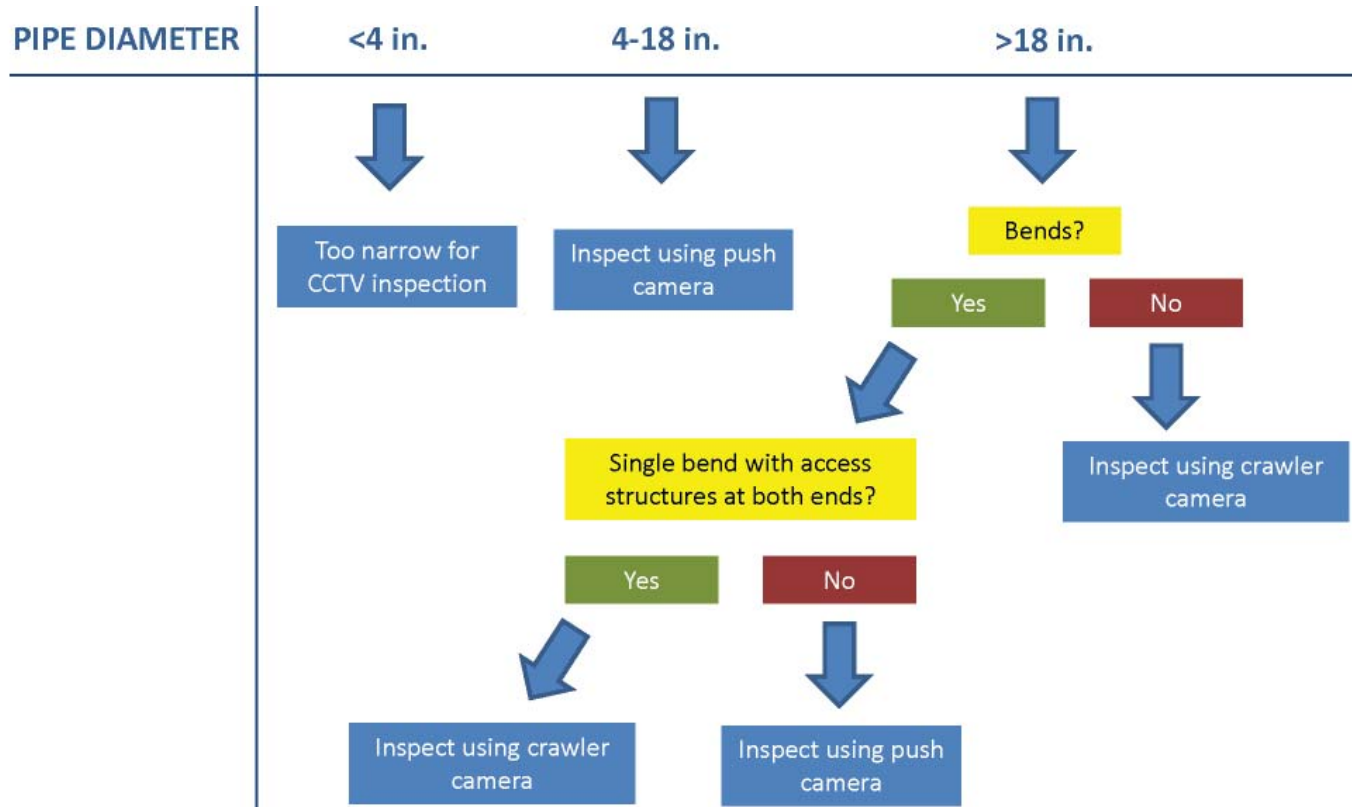


Figure 3-1. CCTV Camera Selection Flow Chart

CCTV CAMERAS



Figure 3-2. Crawler Camera



Figure 3-3. Push Camera

- Refer to Figures 3-12 to 3-25 for examples of commonly observed pipe defects.
- If any pipes connected to the structure require maintenance, select appropriate nozzle. (See Figures 3-4 to 3-8 for examples of jetting nozzles).
 - There are 3 types of nozzles that can be used:
 - Rotating nozzles can have forward- and/or rear-facing jets. A component of these nozzles rotates, providing lateral cleaning. These nozzles are effective at removing roots as well as debris from pipe walls.
 - Penetrating nozzles have both forward and rear-facing jets. The forward-facing jets help loosen large blockages.
 - Flushing nozzles have rear-facing jets and are used to clean lines that do not have large blockages.
 - Before installing nozzle, always run water through the hose for a short period of time until the water runs clear.
 - If material to be cleaned is known, select appropriate nozzle; if not, initially use a penetrating type nozzle until material is determined.
- Jet-rod pipe(s) requiring maintenance through primary access structure:

- Insert vacuum tube into the structure from which conveyance pipe will be accessed, and vacuum waste material throughout jet-rodding procedure.
 - Insert jetter hose into the pipe through the flexible hose guard.
 - Insert flexible hose guard in the pipe to guide the jetter hose and prevent wear from friction.
- Start high-pressure pump after ensuring the nozzle is fully inserted in the pipe.
- Jet-rod conveyance pipe structures moving trash/sediment/organic debris toward the access point for vacuuming and performing as many passes as necessary to clean the structure.
 - During cleaning, keep the nozzle moving and the water pump operating to prevent damage to pipe.
 - Stop maintenance immediately if indications of structural damage or failure are observed (e.g., infiltration bed stone, soil, or pieces of pipe are removed during jet-rodding, etc.) Report observation to owner/operator immediately.
- Jet-rod conveyance pipe until jet-rodding water is clear.
 - If pipe cannot be cleaned successfully using initial equipment and techniques, attempt cleaning with different equipment set ups (e.g., other combinations of jetter hose diameter, nozzles, and/or pressure, etc.) or from alternative access points.
- Complete post-maintenance inspection of pipe(s) using pre-maintenance inspection protocol.
- If water remains in the pipe, obstructing the post-maintenance inspection, reference “Troubleshooting.”
- For structures that connect to the combined sewer, fill inlet with water up to the top of the trap opening after all pipes have been cleaned as needed.
- Inspect structure to ensure all traps are closed and pretreatment devices/screens are latched and/or correctly installed prior to closing access points.
- Follow guidelines for Decanting and Waste Disposal (Section 3.2 and 3.3) when removing sediment/trash/organic debris from the vector truck.

JETTING NOZZLES



Figure 3-4. Large Penetrating Nozzle with 1 Front-Facing and 5-Rear Facing Jets



Figure 3-5. Most Commonly Used Nozzle. Rotating Nozzle with 3 Rear-facing Jets and Rotating Center



Figure 3-6: Small Rotating, Root Cutting Nozzle



Figure 3-7. Small Penetrating Nozzle with 1 Front-facing and 6 Rear-facing Jets

JETTING NOZZLES (CONT'D)



Figure 3-8. Various Types of Penetrating, Rotating, and Flushing Nozzles

TYPICAL PROCEDURES FOR JETTING AND VACUUMING

Cleanout

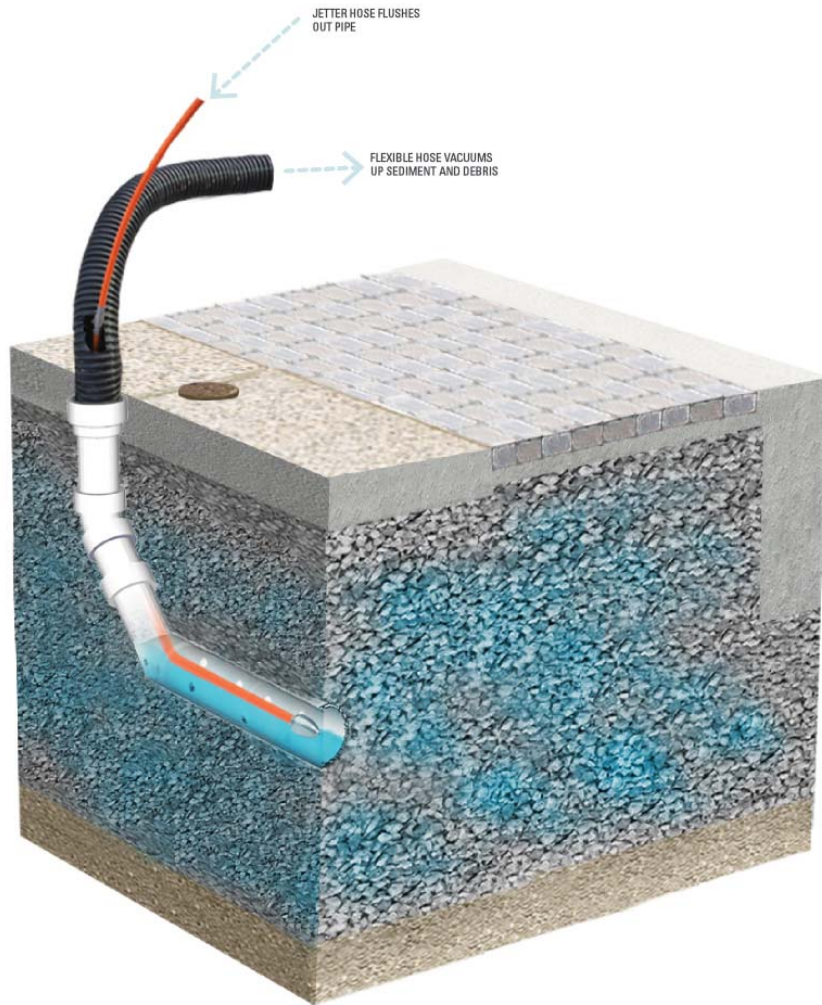


Figure 3-9. Typical Procedure for Vacuuming and Jetting from a Cleanout Access Structure

Domed Riser

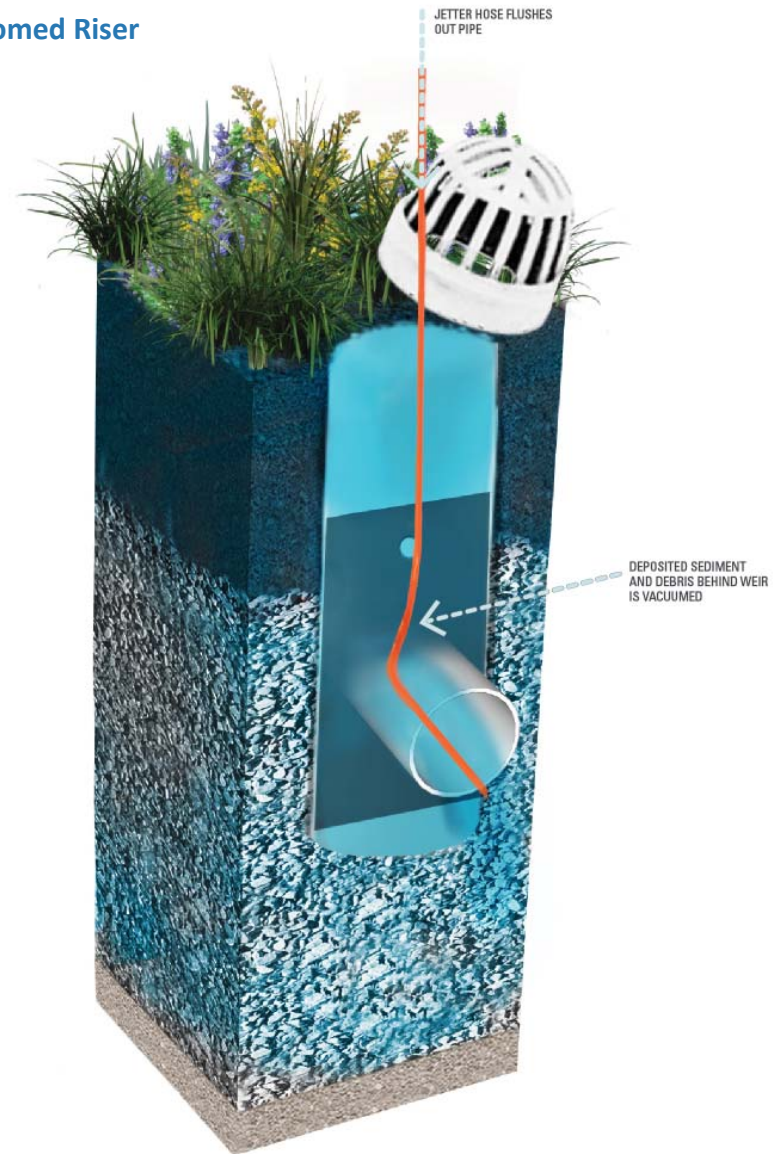


Figure 3-10. Typical Procedure for Jetting from a Domed Riser with a Weir

Inlet

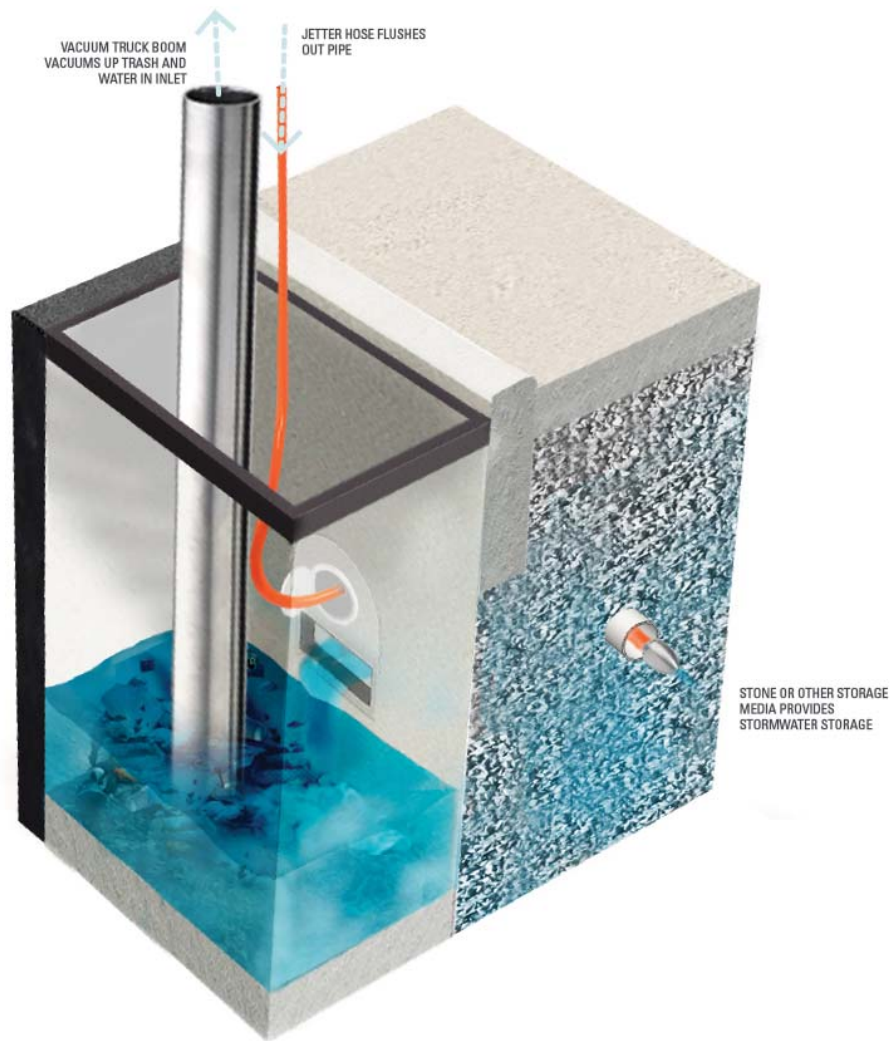


Figure 3-11. Typical Procedure for Jetting and Vacuuming from an Inlet

- **Inspection and maintenance of proprietary subsurface storage chambers with maintenance port(s):**

- Subsurface storage chambers with maintenance port(s) may also include distribution and underdrain piping, inlets, control structures, weirs, sumps, and similar components, which must be inspected and maintained.
- Open maintenance port or manhole.
- Use flashlight to detect sediment deposits.
- If sediment is present, measure depth to sediment with a tape measure.
- Close all maintenance ports or manholes.
- Repeat steps above for all available maintenance ports or manholes.
- See manufacturer’s guidelines to determine if maintenance is required. If maintenance is required:
 - Plug the outlet control structure to contain waste water within storage chamber.
 - Insert vacuum tube into the outlet control structure, if applicable, or the most downstream access point.
 - Open maintenance port.
 - To suspend any sediment or debris, pump water (at a high flow rate using a fire hydrant or jetter hose) through maintenance port until water level in the system is at least 1 in., or as specified by manufacturer’s guidelines.
 - Close maintenance port.

- Repeat for all available maintenance ports.
- Remove plug from outlet control structure.
- Vacuum all waste water from outlet control structure or most downstream maintenance port.
- Re-inspect the area to verify that subsurface storage unit is free of trash/sediment/organic debris.
- If subsurface storage unit is not free of trash/sediment/organic debris, then repeat flushing procedures.
- Inspect structure to ensure all traps are closed and pretreatment/screens are latched and/or correctly installed prior to closing access points.
- Follow guidelines for Decanting and Waste Disposal (Sections 3.2 and 3.3) when removing sediment/trash/organic debris from the site.

- **Inspection and maintenance of proprietary subsurface storage chambers with an access manifold:**

- Subsurface storage chambers with an access manifold utilizing pre-cast modular arches or chambers (typically concrete) may also include distribution and underdrain piping, inlets, control structures, weirs, sumps, and similar components which must be inspected and maintained.
- Open and visually inspect chamber manifold and arch rows.
- Measure sediment depth of manifold and/or arch rows. Refer to the manufacturer’s guidelines to

determine if maintenance is required.

- Maintenance of subsurface storage chambers allowing full access for a maintenance worker can be maintained as follows:
 - Any non-porous surface can be maintained using standard vacuum cleaning techniques.
 - Any porous surface or surface with loose material must be maintained as specified by the manufacturer.
- Inspect structure to ensure all traps are closed and pretreatment/screens are latched and/or correctly installed prior to closing access points.
- Follow guidelines for Decanting and Waste Disposal (Sections 3.2 and 3.3) when removing sediment/trash/organic debris from the site.
- **Pretreatment device installation:**
 - For 4 ft. distribution city inlets, installation of pretreatment filter bags also requires installation of brackets. Since personnel must enter flow control/conveyance structure to install brackets, confined space equipment protocols must be followed (see Section 1.6.2.5 and Table 3-1).
 - For 4 ft. distribution highway grate inlets, installation of pretreatment device does not require personnel to enter flow control/conveyance structure.
 - Green-grey inlets (those with underdrain connections that receive surface runoff bypassing distribution inlets) do not require pretreatment devices.
 - For non-standard or irregular inlets (e.g., 6 ft. city inlets, dual trap inlets, etc.) contact owner/operator as customized pretreatment device may be required.
- **Troubleshooting:**
 - **If the jetter hose gets stuck or cannot maneuver pipe bends:**
 - Decrease pressure and/or reduce jetter hose diameter to maneuver jetter through sharp bends or bends in close proximity (i.e., less than 5 ft. apart).
 - If the nozzle becomes trapped in the pipe, shut off water supply and attempt to pull it back with the hose reel. If this does not work, turn on the water supply, send the nozzle to the upstream manhole for removal, and then pull back the jetter hose with the hose reel.
 - **If pipes cannot be accessed via larger structures, cleanouts may be used to access pipes. The following steps and considerations may be necessary:**
 - Attempt to jet the pipe through the cleanout.
 - Insert a flexible vacuum hose, with a diameter only slightly smaller than access structure, into cleanout, sealing the area around the hose to maximize suction power.
 - Cut a small window into the side of the vacuum hose and insert the jetter hose into the opening.
 - Jet and vacuum the pipe.
 - **If jet-rodding through the cleanout does not successfully clean the pipe, flush the pipe.**

- Flush conveyance pipe using a jetter hose and no nozzle to loosen and push deposits and large debris to the downstream access point.
- **Large quantities of debris:**
 - If pipe has large quantities of debris, is long (e.g., over 200 ft.) and/or must be jetted from an upstream access point, perform multiple short passes that remove trash/sediment/organic debris in sections starting closest to the access point.
- **Significant blockages:**
 - Select an appropriate penetrating nozzle.
 - If nozzle will not move forward, pull back a few feet and let go to sling-shot against the blockage. This pulsating action on nozzle must be used only for extremely heavy blockages.
 - Once the blockage has been removed, shut down the pressure, wait until flow subsides, and then make a couple of passes to ensure the pipe is free of blockages.
 - Change the nozzle as needed, and re-clean the pipe where blockage was first identified.
 - Verify that conveyance pipe is free of trash/sediment/organic debris by repeating inspection procedures.
 - If conveyance pipe is not free of trash/sediment/organic debris, then repeat jet-rodging procedures.
- **Roots:**
 - If significant roots are present within the pipe, utilize a rotating nozzle.
 - Exercise caution to avoid entangling the nozzle in roots. When removing the nozzle, pull slowly and gently on the hose. Do not yank or jerk the hose if nozzle does become entangled, as this could compromise the structural integrity of the pipe.
 - Attempt to move the nozzle slowly and carefully through the section of pipe that has roots.
- **If a significant amount of water remains in the pipe after maintenance:**
 - Insert the vacuum hose at the most downstream access point, if possible.
 - Seal other access points to maximize suction.
 - Vacuum conveyance pipe until it is dewatered.
- **Illegal Dumping:**
 - Report activity to owner/operator.
 - Contact Philly311 for removal.

3.2 DECANTING

1. Description
 - This section describes the protocol for the disposal of water generated or collected during the performance of subsurface maintenance activities.
2. Applicability and Restrictions
 - Sediment-laden and/or chlorinated water must not be discharged into the MS4 or to a structure directly connected to a water body. Decanting can only occur in Combined Sewer areas.
3. Standard Operating Procedures
 - Collect the material removed during the maintenance operation in the truck holding tank, and allow it to settle.
 - Check the collected water for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
 - Transport the water to the approved decanting inlet or manhole.
 - Decant or filter the water prior to discharging it into an inlet or as directed by the owner/operator. This may require the insertion of inlet filters. Ensure that no sediments are discharged to the inlet. The solids, in slurry form, must be transported to an approved disposal site.

3.3 WASTE DISPOSAL

1. Description
 - This section describes the protocol for the disposal of non-hazardous waste materials generated or collected during the performance of subsurface maintenance activities. The task includes proper containment, transport and disposal of waste material.
2. Applicability and Restrictions
 - Waste disposal location must be pre-approved by owner/operator.
3. Standard Operating Procedures
 - Collect the material removed during the maintenance operation in applicable waste storage container (e.g., traps, bins, vacuum/jetter truck storage, etc.).
 - If necessary, decant or filter wet material prior to disposal as discussed in Section 3.2.
 - Check the waste material for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
 - Transport the waste material to the approved disposal site or beneficial end use location, as directed by the owner/operator.
 - Dispose of the waste material as directed by disposal site.

EXAMPLES OF COMMON PIPE DEFECTS

STRUCTURAL

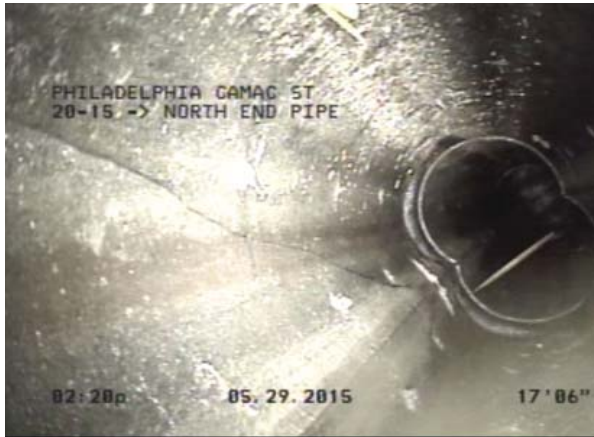


Figure 3-12. Longitudinal Crack, a Break Line that is Visible on the Surface But is Not Visibly Open.



Figure 3-13. Circumferential Fracture, a Break Line that is Visibly Open and a Gap Can be Seen. The Sections of Pipe Wall are Still in Place and Cannot Move.



Figure 3-14. Break, a Defect Where Pieces are Noticeably Displaced and Have Moved from Original Position at Least $\frac{1}{2}$ the Thickness of the Pipe.



Figure 3-15. Hole, a Defect Where Pipe Material is Completely Dislodged from Pipe Wall and the Surrounding Media is Exposed.

EXAMPLES OF COMMON PIPE DEFECTS

STRUCTURAL CONT'D



Figure 3-16. Deformation, Pipe Damage Where the Original Cross-section or Geometry of the Pipe has Noticeably Changed.



Figure 3-18. Offset Joint, a Defective Displacement of at Least One Pipe Thickness at a Joint.



Figure 3-17. Collapse, Deformation so Great that there has been a Complete Loss of the Structural Integrity of the Pipe with More than 40% of Cross-sectional Area Lost.

EXAMPLES OF COMMON PIPE DEFECTS: OPERATIONAL AND MAINTENANCE



Figure 3-19. Deposited Material in the Invert of the Pipe.



Figure 3-21. Tap Roots: Individual Roots that are Greater than $\frac{1}{2}$ in. (10mm) Thick.



Figure 3-20. Roots - Fine: Small Diameter and Small Quantities of Roots that are Insufficient to Cause a Quantifiable Reduction of Pipe Cross-sectional Area (<5% loss).



Figure 3-22. Roots - Medium: Roots that have Formed a Mass and Restrict the Flow of Water. Cross-sectional Area Lost is Greater than or Equal to 5% up to or Less than or Equal to 50% (5-50%).

EXAMPLES OF COMMON PIPE DEFECTS:

OPERATIONAL AND MAINTENANCE CONT'D



Figure 3-23. Root - Ball: Roots that have Formed a Mass, Typically in the Form of a Ball, and have the Potential to Severely Restrict the Flow. The Cross-sectional Area is Greater than 50%.



Figure 3-24. Construction Debris

MISCELLEOUS FEATURES



Figure 3-25. Water Level: the Depth of Water at the Observed Point in the Pipe (Includes Flowing and Stagnant Water). Water Level Sag Occurs when the Grade of the Pipe is Poor.

Table 3-1. Recommended Equipment for Subsurface General Maintenance

	INSPECTION 3.1	MAINTENANCE 3.1
1 in. – 1.5 in. square key	•	•
10+ megapixel digital camera with spare batteries	•	•
200 ft. of vacuum tubes ranging from 4 in. to 8 in.		•
25 ft. tape measure and/or measuring tape	•	
300 ft. of 3/8 in. jetter hose		•
300 ft. of 1/2 in. jetter hose		•
600 ft. of 1 in. jetter hose		•
Assorted Phillips and standard screwdrivers	•	•
Assorted standard and metric socket wrenches and Allen wrenches	•	•
Assortment of wingnut or plumber’s plugs for plugging distribution pipes and underdrains (sizes to include, at a minimum: 6 in., 8 in., 12 in., 15 in., 18 in., and 21 in.)		•
Backflow preventer(s) and associated appurtenances in accordance with PWD’s approved list of backflow assemblies (http://www.phila.gov/water/wu/Documents/CCC_Manual.pdf)		•
Battery charging device for CCTV camera	•	
Bryce Fastener #50 Penta-Plus security bit	•	•
CCTV crawler camera with ability to rotate the camera head, zoom, and capture still images (see Figure 2.3 for camera selection guidance)	•	
CCTV push camera housing units (skids)	•	

Table 3-1. Recommended Equipment for Subsurface General Maintenance (cont'd)

	INSPECTION 3.1	MAINTENANCE 3.1
Chisel and mallet	•	•
Confined space entry harness, tripod, and air monitor as per OSHA standard 29 CR 1910.146	•	•
Cordless drill with assortment of bits (sizes to include, at a minimum: ½ in., ⅝ in., ¾ in., ⅞ in., and 1 in.) for drilling underdrain orifices		•
Crowbar	•	•
Extension ladder (minimum 16 ft. length)		•
Fire hydrant center compression lock		•
Fire hydrant wrench		•
Flexible hose guard to protect jetter hose from abrasion		•
Flexstorm pre-treatment device fabric (FX/FX+/FXO models) with frames and brackets (as necessary) for city and highway grate inlets		•
Flushing nozzle		•
Hand tools as necessary for assembling and disassembling tubes and hoses		•
High-velocity water gun or air lance and associated hose and appurtenances for power cleaning structure walls and floor		•
Holding tank equipped with filters or baffles to facilitate removal of sediments		•
Hydraulic lift and dolly to move contained material from vehicle to disposal location, if necessary		•
Impact wrench with assorted sockets	•	•

Table 3-1. Recommended Equipment for Subsurface General Maintenance (cont'd)

	INSPECTION 3.1	MAINTENANCE 3.1
Jet-rodding/vacuuming (jet/vac) truck with hose reel with 600 ft. of 1 in. jetter hose capacity, Water pump with flow of 80 gal. per minute (gpm) @ 2000 lbs. per square in. (psi), Vacuum flow of 2600 cf per minute (cfm), Vacuum lift of 22 in. of mercury (HG), 8 cy. debris tank with strainer and decanting valve, and 1,500 gal. integrated water tank		•
Manhole hooks	•	•
Measuring wheel to determine distances between structures	•	
Penetrating nozzle		•
Pliers, adjustable wrenches, vice grips, and pipe wrenches	•	•
Portland cement (Type I or Type II) mix for formwork around PVC adapter sleeves		•
PVC reducers, adapter sleeves and PVC caps for 8 in. underdrains		•
Rotating nozzle		•
Round-mouth shovel, spades and/or push broom to remove trash/sediment/ organic debris generated from maintenance tasks		•
Self-leveling CCTV push camera with 200+ ft. reel and ability to zoom and capture still images (see Figure 2.3 for camera selection guidance)	•	
Silt sock to contain waste at disposal site		•
Sledge hammer (minimum 16 lbs. head weight)	•	•
Water hose of sufficient strength to withstand kinking and abrasion from concrete surfaces or other hoses as appropriate		•

Table 3-2. Recommended Materials for Subsurface General Maintenance

	INSPECTION 3.1	MAINTENANCE 3.1
50 gal. plastic contractor bags		•
All-purpose rags	•	•
Calcium thiosulfate (30% w/v) dechlorination liquid, or approved alternative		•
Duct tape		•
Electrical tape		•
Fire hydrant operation report form		•
Hard copies of permits and access permissions	•	•
Maintenance maps	•	•
Potable municipal or well water sufficient for cleaning activities		•
Rock salt (winter only)		•

Pervious Pavement Maintenance

division **4**



4.1 ROUTINE MAINTENANCE

1. Description

- This section sets forth procedures and requirements for pervious pavement routine maintenance.

2. Applicability and Requirements

- Implement routine maintenance as directed by owner/operator if infiltration rates at test locations are greater than 10 in./hr.
- The protocol for routine pervious pavement maintenance is applicable to SMPs constructed of the following materials: porous asphalt, pervious concrete, permeable interlocking pavers, or permeable pavers with rigid joint material. Permeable pavers set in loose joint material such as sand or gravel should not be maintained with regenerative air equipment and may require full replacement if they become clogged, at the discretion of the owner/operator.

3. Standard Operating Procedures

- Manually remove large trash/sediment/organic debris (See Section 2.1.1).
- Clean pervious pavement using approved regenerative air sweeper listed in Table 4-1 (See Figure 4-1).
 - Sweep the entire surface of the pervious pavement moving at a controlled speed. Use water as needed for dust control.
 - Re-sweep the surface until all visible material is removed from the surface of the pervious pavement.
 - Use a vacuum attachment as needed for any corners or difficult to access sections.
 - Refer to Decanting and Waste Disposal (see Section 4.4) to remove sediment/trash/organic debris.

4.2 RESTORATIVE MAINTENANCE

1. Description

- This section sets forth procedures and requirements for pervious pavement restorative maintenance.

2. Applicability and Requirements

- Implement restorative maintenance as directed by owner/operator if infiltration rates at selected test locations are less than 10 in./hr.
- The protocol for pervious pavement restorative maintenance is applicable to SMPs constructed of the following materials: porous asphalt, pervious concrete, permeable interlocking pavers, permeable pavers with solid joints, or permeable pavers set in loose joint material such as sand or gravel.
- The pressure washer shall not compromise the structural integrity of the pavement.
- The vacuum pressure shall be sufficient to prevent sediment-laden water from re-entering the system.

3. Standard Operating Procedure

- Manually remove large trash/sediment/organic debris (See Section 2.1.1).
- Divide the site into 18 in. sections, which is based on the width of the vacuum attachment. Mark the divisions on a map of the site.
- Identify areas with very low infiltration rates by spraying water using a hose gun over the entire SMP area until the surface is saturated. If water ponds for more than a few seconds, mark these areas for more intensive maintenance.
- Follow a standard cleaning procedure to maintain the entire pervious pavement area using an approved pressure washer

with a vacuum attachment (see Table 4-1 and Figure 4-2).

- Set up equipment at the upstream end of the system.
- Maintain the entire site with a steady pace with two passes for each 18 in. wide section.
- Follow an intensive cleaning procedure to maintain the pervious pavement identified as having low infiltration rates using an approved pressure washer with vacuum attachment (see Table 4-1).
 - Set up equipment at the identified areas with very low infiltration rates.
 - Maintain the identified areas at a steady pace with at least two passes in at most 12 in.-wide sections.
- Spray water over the entire SMP area until the surface is saturated to confirm maintenance was performed to an adequate level. If water ponds, repeat the process.
- Follow guidelines for Decanting and Waste Disposal (see Section 4.4) when removing sediment/trash/organic debris from the vector truck.



Figure 4-1. Regenerative Air Truck



Figure 4-2. Pressure Washer with Vacuum Attachment

4.3 WINTER MAINTENANCE

1. Description

- This section sets forth procedures and requirements for pervious pavement winter maintenance.

2. Applicability and Requirements

- Snow piles containing sand shall not be stored on pervious pavement.
- All de-icers used in the right-of-way must be approved by owner/operator and must be a PennDOT-approved product.

3. Standard Operating Procedure

- Apply de-icer as pre- and post-treatment for every snow event greater than 0.25 in., for sleet and freezing rain events, and after every plowing event.
 - Apply sodium formate at a rate of 10 lbs./1000 ft² for the following:
 - All non-right-of-way (ROW) pervious pavement
 - All non-ROW pervious concrete constructed in the past two years
 - Apply calcium chloride in flake form at a rate of 21 lbs./1000 ft². for the following:
 - All pervious pavement in the ROW
 - **For ROW pervious concrete SMP constructed in the past two years, contact owner/operator for a PennDOT-approved product.**
 - Repeat as requested by owner/operator for the duration of the storm.

- Plow pervious pavement for snow events with snow accumulation of more than 2 in. as directed by the owner/operator.
 - Raise rubber plow blade to ½ in. above the surface. Repeat as requested by owner/operator for the duration of the storm.
 - Follow guidelines for Decanting and Waste Disposal (see Section 4.4) when removing sediment/trash/organic debris from the site.

4.4 DECANTING

1. Description
 - This section describes the protocol for the disposal of water generated or collected during the performance of pervious pavement routine and restorative maintenance activities.
2. Applicability and Restrictions
 - Sediment-laden and/or chlorinated water must not be discharged into the MS4 or to a structure directly connected to a water body. Decanting can only occur in Combined Sewer areas.
3. Standard Operating Procedures
 - Collect the material removed during the maintenance operation in the truck holding tank, and allow it to settle.
 - Check the collected water for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
 - Transport the water to the approved decanting inlet or manhole.
 - Decant or filter the water prior to discharging it into an inlet or as directed by the owner/operator. This may require the insertion of inlet filters. Ensure that no sediments are discharged to the inlet. The solids, in slurry form, must be transported to an approved disposal site (See Section 4.4.1).

4.5 WASTE DISPOSAL

1. Description
 - This section describes the protocol for:
 - Disposal of non-hazardous waste materials generated or collected during the performance of pervious pavement routine and restorative maintenance activities
 - Proper containment, transport and disposal of waste material
2. Applicability and Restrictions
 - Waste disposal location must be pre-approved by owner/operator.
3. Standard Operating Procedures
 - Collect the material removed during the maintenance operation in applicable waste storage container (e.g., traps, bins, vacuum/jetter truck storage, etc.).
 - If necessary, decant or filter wet material prior to disposal as discussed in Section 4.4.2.
 - Check the waste material for any unusual color or odor that might indicate the presence of oil or other chemicals. If any unusual color or odor is found, notify the owner/operator immediately.
 - Transport the waste material to the approved disposal site or beneficial end use location, as directed by the owner/operator.
 - Dispose of the waste material as directed by disposal site or beneficial end use personnel.

Table 4-1. Recommended Equipment for Pervious Pavement Maintenance

	ROUTINE MAINTENANCE 4.1	RESTORATIVE MAINTENANCE 4.2	WINTER MAINTENANCE 4.3	WASTE DISPOSAL 4.4	DECANTING 4.5
10+ megapixel digital camera with spare batteries	•	•	•	•	•
Adjustable wrenches	•	•			•
Crowbar					•
Hand tools as necessary for assembling and disassembling hoses	•	•			•
Holding tank equipped with filters or baffles for removal of sediments		•		•	•
Hydraulic lift and dolly				•	
Manhole hooks					•
Measuring wheel to determine distances between structures	•	•			
Pipe wrenches					•
Pliers					•
Regenerative air sweeper with a min. sweeping width of 78 in., storage hopper capacity of 2 cy, dust separator, system pressure of 3500 psi, and hydraulic system capacity of 5 gpm.	•				
Shovel, spades and/or push broom to remove trash/sediment/debris	•	•		•	
Truck with plow blade & salt distributor			•		

Table 4-2. Recommended Equipment for Pervious Pavement Maintenance (cont'd)

	ROUTINE MAINTENANCE 4.1	RESTORATIVE MAINTENANCE 4.2	WINTER MAINTENANCE 4.3	WASTE DISPOSAL 4.4	DECANTING 4.5
Vacuum sweeper equipment with water hose connection & downward facing jets and min. sweeping width of 144 in., storage hopper capacity of 8 cy, hydraulic system capacity of 16 gpm, and 10 micron dust filter		•			
Vice grips	•	•			•
50 gal. plastic contractor bags	•	•		•	•
All-purpose rags	•	•	•	•	•
Calcium chloride in flake form			•		
Duct Tape	•	•		•	•
Hard copies of permits and access permissions	•	•	•	•	•
Maintenance maps	•	•	•	•	•
Material Safety Data Sheets (MSDS) as applicable	•	•	•		
Potable water	•	•			
Rubber plow blade attachment			•		
Silt sock				•	
Sodium formate in flake or granular form			•		

Appendices

division 5



5.1 PERSONNEL CLASSIFICATIONS

5.1.1 REQUIREMENTS

Various aspects of SMP maintenance require the use of specialized personnel. The following personnel classifications are required to carry out one or more tasks described herein:

Certified arborist: Tree care professional recognized by the International Society of Arboriculture (ISA) as an ISA Certified Arborist®.

Certified utility specialist arborist: Tree care professional recognized by the ISA as a Utility Specialist ISA Certified Arborist®.

CCTV camera operator: Professional with a minimum of two (2) years experience in the operation of CCTV equipment for inspection of urban storm sewer systems and/or SMPs with NASSCO PACP certification, traffic control in urban areas, and confined space entry as per OSHA standards.

CCTV camera technician: Professional experienced in the operation of CCTV equipment for inspection of urban storm sewer systems and/or SMPs with NASSCO PACP certification, traffic control in urban areas, and confined space entry as per OSHA standards.

Engineer or engineering technician: Professional with an accredited degree in the field of engineering with experience working on a minimum of two (2) projects involving SMPs.

Environmental scientist or environment technician: Professional with an accredited degree in the field of environmental science with experience working on a minimum of two (2) projects involving vegetation identification and health assessment in an urban environment and/or within SMPs.

Facility/landscape manager or facility/landscape maintenance crew foreman: Professional with a minimum of 5 (5) years experience leading facility/landscape operation and maintenance programs and/or

maintenance crews and with a minimum of one (1) year experience in the operation and maintenance of SMPs.

Facility/landscape professional: Professional with a minimum of one (1) year experience performing skilled tasks related to facility/landscape maintenance under the direction of a foreman.

Laborer: Paid worker with experience performing unskilled manual tasks related to facility/landscape maintenance under direction of a foreman.

Landscape architect or landscape designer: Professional educated in the field of landscape architecture with experience working on a minimum of two (2) projects involving vegetation identification and health assessment in an urban environment and/or within SMPs.

Mason: Professional with a minimum of two (2) years experience working with concrete and masonry materials.

Vacuum/jetter operator: Professional with a minimum of two (2) years experience with the maintenance of urban storm sewer systems and/or SMPs using vacuuming and jetting equipment, traffic control in urban areas, and confined space entry as per OSHA standards.

Vacuum/jetter technician: Professional experienced with the maintenance of urban storm sewer systems and/or SMPs using vacuuming and jetting equipment, traffic control in urban areas, and confined space entry as per OSHA standards.

Street Regenerative air sweeper operator: Professional with a minimum of two (2) years experience with the operation of regenerative air sweepers.

Snow plow operator: Professional with a minimum of two (2) years experience with the operation of snow plow and de-icer spreader equipment.

Snow plow technician: Professional experienced with the use of snow plow and de-icer spreader equipment.

5.1.2 SURFACE MAINTENANCE PERSONNEL

Surface maintenance events shall be executed by a standard surface maintenance crew comprised of the following minimum personnel classifications:

- One (1) facility/landscape manager or facility/landscape crew foreman; and
- One (1) facility/landscape professional or laborer.

5.1.3 SUBSURFACE INSPECTION AND MAINTENANCE PERSONNEL

Subsurface inspection events shall be executed by a standard subsurface inspection crew comprised of the following personnel classifications:

- One (1) CCTV camera operator
- CCTV camera technicians shall be added to the inspection crew as required for site inspection, traffic control, and/or confined space entry.

Subsurface maintenance events shall be executed by a standard subsurface maintenance crew comprised of the following personnel classifications:

- One (1) vacuum/jetter operator.
- Vacuum/jetter technicians shall be added to the maintenance crew as required for site maintenance, traffic control, and/or confined space entry.

5.1.4 PERVIOUS PAVEMENT MAINTENANCE PERSONNEL

Pervious pavement routine maintenance events shall be executed by a standard pervious pavement routine maintenance crew comprised of the following personnel classifications:

- One (1) regenerative air sweeper operator.

Pervious pavement restorative maintenance events shall be executed by a standard pervious pavement restorative maintenance crew comprised of the following personnel classifications:

- One (1) vacuum/jetter operator; and
- One (1) vacuum/jetter technician.
- Vacuum/jetter technicians shall be added to the maintenance crew as required.

Pervious pavement winter maintenance events shall be executed by a standard pervious pavement winter maintenance crew comprised of the following personnel classifications:

- One (1) snow plow operator.
- Snow plow technicians shall be added to the maintenance crew as required.

5.2 POINTS OF CONTACT

NAME	CONTACT INFORMATION
Animal Care and Control Team of Philadelphia	111 W. Hunting Park Ave Philadelphia, PA 267-385-3800 www.acctphilly.org/programs/ac
Emergency Police and Fire Services	9-1-1
Pennsylvania 811 / PA One Call	925 Irwin Run Rd. West Mifflin, PA 15122 8-1-1 (800-242-1776) www.pa1call.org
Philadelphia Water - Water Emergency and General Information	215-685-6300
Philadelphia Water - Industrial Waste Unit	215-685-6236
Philadelphia Licenses and Inspections	Philadelphia L&I Municipal Services Building, Concourse Level 1401 J.F.K. Blvd. Philadelphia, PA 19102 Permits: 215-686-2567 Certifications: 215-686-2448 www.phila.gov/li/Pages/default.aspx

NAME	CONTACT INFORMATION
Philadelphia Streets Department	Philadelphia Department of Streets Municipal Services Building 1401 J.F.K. Blvd. Philadelphia, PA 19102 215-686-5560
	Street Closure Permits: www.philadelphiastreet.com/transportation-highways-street_closure-intro.aspx ; and www.philadelphiastreet.com/highways/street-closure-permits
	Illegal Dumping Report: www.potholes.phila.gov/tap.nsf/2cf8da9cb0da9bb9852573c9006b7d99?OpenForm
	Dead Animal Report: www.potholes.phila.gov/tap.nsf/85e1a10ac026ffe58525743600760694?OpenForm
Philadelphia Parks and Recreation	One Parkway Building 10th Floor, 1515 Arch Street Philadelphia, PA 19102 215-686-1776 www.phila.gov/parksandrecreation/Pages/default.aspx
Philly 311	3-1-1 (215-686-8686) www.phila.gov/311

5.3 SAMPLE HYDRANT OPERATION REPORT

HYDRANT OPERATION REPORT

(READ BOTTOM OF FORM PRIOR TO COMPLETING)

NAME (Last, First)	SECTION/COMPANY	PHONE
--------------------	-----------------	-------

PERMIT NUMBER	201503710
---------------	-----------

DATE	CCL KEY SERIAL#	HYDRANT LOCATION	SIZE OF CONNECTION TO HYDRANT	TIME ON	TIME OFF

WATER USAGE		
METERED	ESTIMATED VOLUME	
ENTER DIFFERENCE OF METER READINGS (indicate unit)	APPROX. DURATION OF HYDRANT USAGE (in minutes)	ENTER VOLUME OF TANK (gallons)

WATER USAGE may be determined by ONE of the following methods:

- A. *Metered* - Enter a meter reading if a meter is used
- B. *Estimated* - Indicate the size of the connection to the hydrant and the approx. duration of hydrant usage in minutes
- C. *Volume* - Enter size of tank

RETURN COMPLETED FORMS BY THE END OF EACH MONTH TO:

George Stokes, Water Conveyance, 4th fl.
 11th & Market Sts., ARAMARK TWR
 Phila., PA 19107 (or fax to 685-6207)

PROCEDURE

Each time a hydrant is operated, a record on the Hydrant Operation Report sheet must be made.

- 1) Enter name of responsible party. City employees, enter name of first line supervisor. Permit holders, enter name of permit holder.
- 2) Enter Department/Section if City Employee, if permit holder enter name of Company or Group name.
- 3) Enter Phone number for the responsible party.
- 4) Enter Permit number, or "City" if City employee
- 5) Enter Date of Hydrant use.
- 6) Enter CCL key number, if CCL key is not required, enter N/A.
- 7) Enter Location of the Hydrant. Enter street name which hydrant faces, followed by nearest cross street. If located at a corner, enter geographic location (eg. For a hydrant on 11th above market, at the north west corner, enter NWC 11th and Market Sts.) If located midblock, enter

nearest property address (eg. IFO 3939 Main St.)

- 8) Enter size of connection to hydrant. This is the size of the hose. A garden hose is considered 3/4". If there is no connection, enter NC, and estimate flow from pictures on reverse side of form.
- 9) Enter time hydrant turned on.
- 10) Enter time hydrant turned off.
- 11) If a meter is used, enter the difference in finish and start readings (note the unit of measurement).
- 12) If no meter is used, calculate number of minutes the hydrant was turned on (difference between time on and time off).
- 13) If a tank is filled, enter the known size of the tank (in gallons). Repeat steps 5 to 13 as often as necessary
- 14) When operation is complete, replace cap on hydrant to protect nozzle threads, prevent trash from being deposited in barrel, and help insulate hydrant in cold weather.

Glossary

division 6



6. GLOSSARY

The following terms are defined as they apply to this document:

2A Modified subbase: 2A Modified refers to PennDOT approved graded mixture of finer and larger stone, which gives the material excellent compaction.

Access permissions: Documents granting access to and/or use of a given site (e.g., agreements to enter and maintain SMPs on School District of Philadelphia property, PPR Access Permits, etc.).

Access structure: A portal to subsurface structures within a rain garden. Access structures may also serve additional functions, such as joining subsurface pipes.

Anchor trench: A narrow channel used with staples to secure erosion blanket to the ground surface.

Arborist: An individual engaged in the profession of arboriculture who, through experience, education, and related training, possesses the competence to provide for or supervise the management of trees and other woody plants.

Balled and burlapped stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with the ball size not less than the diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

Choker/filter course: Permeable layer, typically 1 to 2 in. thick, placed underneath pervious pavement to provide a level and stable surface.

Closed-circuit television (CCTV): The use of one or more video cameras to transmit a video signal to one or more monitors and/or to video recording equipment. In the context of this protocol, CCTV refers to the use of remotely controlled camera to view and record the condition of subsurface structures.

Cleanout: A solid vertical pipe capped at the surface that provides access to subsurface pipes for pipe jetting, flushing, vacuum cleaning, and inspection.

Container grown stock: Well-rooted plants grown in a container with root system reaching the sides of the container and maintaining a firm ball when removed from the container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plants required.

Conveyance pipes: Pipes that carry stormwater runoff to, from, or within a SMP.

Crown: The leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree.

Multipacker: A tool that helps to create a firm seedbed, by pressing down small debris and stones and smoothing the surface.

Decanting: The process by which a mixture or suspension is separated through filtering and/or settling.

Diameter-Breast-Height (DBH): A width measurement of a tree trunk at 4.5 ft. above the ground; a means to measure the size of the trunk above the root flares.

Distribution pipes: Pipes, including perforated and solid pipes that deliver stormwater runoff to an SMP. Distribution pipes are typically located below ground surface within soil media or drainage gravel, but can also be located at the ground surface.

Dredging: The process of excavating and removing sediment from the bottom of a body of water.

Establishment: The point after planting when a tree's root system has grown sufficiently into the surrounding soil to support shoot growth and anchor the tree.

Establishment watering: A series of watering events that aid in long-term survivorship of newly installed plants.

Failure: Complete loss of function.

Filtering: The process by which a mixture or suspension is separated, by passing the mixture through a filtration medium such as a bed of sand or filter cloth; the fluid phase passes through the medium, while solid materials are trapped.

First flush diverter: An element of a stormwater management practice used to capture debris and pollutants from runoff generated during the initial phase of a rain storm.

Flow control structure: Structural components of stormwater drainage system that detain stormwater and allow its controlled release, e.g., weirs, weir walls, orifices, spillways).

Forebay (or sediment forebay): A pool or basin located immediately down-gradient of a stormwater runoff inflow point. Forebays are storage areas designed to trap and settle sediment or other pollutants. Forebays can either be dry (inundated with water during storm events) or wet (inundated with water continuously).

Geotextile: A permeable synthetic fabric that may surround the media and/or drainage stone in an SMP to prevent stormwater from eroding the underlying subbase.

Green inlet: An inlet placed within an existing gutter or other surface flow path that diverts runoff from paved areas and redirects into a green stormwater infrastructure system.

Green stormwater infrastructure (GSI): Engineered systems that use hydrologic processes of infiltration and evaporation to manage stormwater runoff and provide environmental and community benefits.

Hand removal (weeding): The removal of an entire plant (leaves and root system) by pulling with the hands.

Hardscape: A surface or wall composed of traditional or pervious asphalt or concrete or masonry that is located above ground.

Hazardous waste: The regulatory definition of solid waste is contained in 40 CFR Part 261. Generally, a hazardous waste is waste that is dangerous or potentially harmful to health or the environment.

Herbaceous container: A herbaceous plant (annual or perennial flower, grass, sedge or rush) that is approximately 8 in. to 24 in. tall that is available from nurseries in quart, #1, #2, #3, and #5 sized containers. Roots must be healthy, vigorous and established, reaching the sides of the container, but not encircling the sides of the container.

High-pressure vacuum washing: A method used to remove fine soil and sediment from pervious pavement. Water at a high pressure is used to dislodge soil particles/sediment, contaminants and debris from the pores of pervious pavement. A vacuum must be used in conjunction with the washer to remove the debris.

Herbaceous plug: A herbaceous plant (annual or perennial flower, grass, sedge or rush) that is approximately 2 in. to 8 in. tall and grown in soil within a cylindrical container cell of a tray. The roots must be healthy, vigorous and established, reaching the sides of the container, but not encircling the sides of the container.

Hydroseeding: A seeding process that uses a slurry comprised of seed, water, and mulch using a tank and hose.

Infiltration: A hydrologic process where water drains downward through SMPs and soil subbase to groundwater.

Inlet: A point of entry into the storm water drainage system (storm sewer). Common types of inlets may include grate inlets, curb opening inlets and combination grate and curb opening inlets. Inlets may be constructed with pretreatment structures such as inlet inserts, sumps, inlet traps, and screens. Inlets are connected to SMPs and/or storm sewer networks by lateral pipes.

Inlet or catch basin sump: The area within an inlet or catch basin that

is below the deepest conveyance pipe outlet of the structure and which provides capacity for sediment accumulation. Sumps within combined sewer inlets are designed to remain filled with water at all times to prevent the release of sewer gas. Sumps within inlets that are not connected to a combined sewer typically drain through weep holes (a series of small diameter drill holes) located in the bottom of the structure.

Inlet trap and hood: A structure installed within an inlet over the connection of an inlet lateral or distribution pipe to provide protection from floatable trash and debris. In inlets directly connected to a combined sewer system, inlet traps define the standing water level of the inlet sump to prevent the escape of sewer gas from the system. Inlet hoods are typically installed in inlets not connected to a combined sewer.

Inorganic fertilizers: Soil additives that are manufactured from minerals or synthetic chemicals.

Invasive vegetation: A plant species that has the tendency to colonize rapidly and outcompete target species. For the purposes of this manual, invasive plants are those species listed as such by the Pennsylvania Department of Conservation and Natural Resources: (www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20026634.pdf)

Jetting: The process of cleaning stormwater drainage systems using a truck- or trailer-mounted cleaning system which pumps high-pressure water through nozzles placed inside the drainage system. The high-pressure water jet-cleaning device operates on the principle of high-volume, high-speed water movement to wash away accumulated soil particles/sediment, dirt, contaminants or debris, dissolve blockages, and clean interior surfaces. The nozzles are connected to the water supply by up to 500 ft. of hose coiled on a reel. The thrust generated by the jets of water propels the nozzle assembly through the structure. The process is also referred to as High-Velocity Jet Cleaning, Hydrocleaning, Hydraulic Cleaning, or High Pressure Cleaning.

Lateral pipes: Pipes that connect inlets to SMPs and/or storm sewer networks.

Maintenance event: Any on-site event devoted to continued functionality of a SMP, where a crew of trained personnel executes a series of prescribed or reactive tasks.

Manhole: A concrete chamber within sewer networks or connected to inlets that provides surface access, via cast iron manhole lids, to subsurface pipe networks for inspection, pipe jetting, pipe flushing, vacuum cleaning, and entry of trained personnel.

Mechanical removal: The removal of the leaves or stems of a plant through cutting and the use of a sharpened tool or equipment.

Municipal Separate Storm Sewer System (MS4): A municipal storm sewer system that is not combined with the sanitary sewer system; usually discharges stormwater directly to surface water bodies.

Native vegetation: A plant species that is native to the mid-Atlantic region.

Non-native vegetation: A plant species that is not native to the mid-Atlantic region.

Non-target vegetation: A plant species that was not specifically planted/seeded within the SMP and is not desired by the owner/operator. Non-target species may include both native and non-native species.

Organic amendments: Various forms of plant debris that are broken down by natural processes and used to ameliorate soil.

Organic debris: Unwanted living, dead, or decomposing plant or animal matter including leaf litter, branches, fruit, flowers, bark, feces, animal carcasses, etc.

Owner/operator: Organization or individual legally responsible for the operation and maintenance of a SMP.

Pervious area: Surfaces which have the ability to infiltrate water into the soil or subbase.

Pesticides: Substances that control, eradicate, or mitigate pest organisms.

As defined by the State of Pennsylvania and for the purposes of this manual they include, but are not limited to, herbicides, fungicides, insecticides, and rodenticides.

Plant transpiration: A biological process in which plants absorb water through their roots and ultimately evaporate this water to the atmosphere through their leaves or stems.

Planting/seeding event watering: A watering event that occurs directly following the new installation of plants or seeding of an area.

Pretreatment devices: Structures that capture trash, sediment, and/or other pollutants from stormwater runoff before delivery to a surface detention area or media.

Reactive maintenance: A non-routine maintenance task or event that is performed in response to an observed, often unexpected condition or problem.

Regenerative air sweeping: A method used to remove fine soil and sediment from pervious pavement. Air at a high pressure and at an angle is used to dislodge soil particles/sediment, contaminants and debris from the surface of pervious pavement. The air moves along the width of the sweeping head and the vacuum tube transports the material into the storage hopper. With all the material removed, the clean air is reused.

Risers and outlet control structures: Structures that establish a high water level and regulate the overflow of stormwater SMPs. These structures typically consist of catch basins or vertical pipes set within a detention area.

Routine maintenance: A maintenance event or task that is performed on a prescribed schedule, usually to address common, predictable conditions or problems.

Secure container: A container that prevents spilling, leaking or blowing of contained material.

Sediment: Non-organic debris that includes fines, sand, gravel, or soil.

The latter may contain some organic components but is still considered sediment.

Settling: A reduction in ground elevation due to compaction or soil voids.

Softscape: Refers to the elements of a landscape that comprise live, horticultural elements. A softscape can include, flowers, plants, shrubs, trees, flower beds, etc.

Soil loss: A reduction in elevation and/or development of void space below surface elevation due to soil migration from its original location.

Soil testing: Laboratory tests to characterize soil properties such as mineral, nutrient, or pollutant content or to measure the range of particle sizes.

Solid waste: The regulatory definition of solid waste is contained in 40 CFR Part 261.2. Generally, a solid waste is a discarded or abandoned material. In this case, solid wastes would be materials such as trash or wastes encountered during GSI maintenance activities.

Storage/media: Storage within a rain garden is provided by an earthen depression storage area and underlying media that accepts, filters, and/or infiltrates stormwater runoff.

Stormwater management practices (SMPs): Individual GSI systems.

Stormwater management practice (SMP) component: A related group of SMP elements (e.g., an underdrain comprised of individual pipe sections, fittings, collars, etc.) associated with a specific SMP.

Stormwater management practice (SMP) element: An individual unit (e.g., a pipe section, pretreatment device, tree, etc.) associated with a specific SMP.

Stormwater management practice (SMP) feature: Any SMP element or SMP component associated with a specific SMP.

Stormwater management practice (SMP) maintenance area: All SMP elements and components designated for routine maintenance by the

owner/operator.

Structure: When used to describe a component of a SMP, the term “structure” refers to a structural component, commonly a flow control structure such as an inlet, riser, or trench drain, but also may refer to a wall, weir, or other constructed or hardscaped area.

Subbase: the material beneath an engineered or designed surface.

Subsurface chamber storage: Subsurface chambers, typically made of a modular framework of multiple crate-like or arch-like structures used to store and sometimes infiltrate.

Subsurface maintenance: Any maintenance events and associated tasks that apply to SMP elements that are located below ground and can only be maintained with specialized equipment.

Surface maintenance: Any maintenance events and associated tasks that apply to SMP elements that are located above ground and can be maintained from the surface.

Target vegetation: A plant species that was planted/seeded within the SMP or desired by owner/operator. Target species may be native or non-native.

Trench drains: Narrow channels with solid or grated covers that can convey stormwater runoff. They are typically used to convey stormwater runoff under areas of pedestrian traffic such as sidewalks and are typically constructed of concrete or plastic with cast iron or plastic covers.

Underdrain pipes: Perforated pipes that collect water, often from an infiltration bed, and deliver it to a flow control structure. Underdrain pipes are always located beneath the ground surface and are typically plastic (e.g., HDPE, PVC, etc.).

Vacuum cleaning: The use of a truck-mounted stormwater drainage system cleaning device. The cleaning device operates on the principle of large volume, high-speed air movement to lift water, soil particles/ sediment, contaminants and debris. A large tube conveys the collected

materials into a tank mounted on the truck. The cleaning device also includes a freshwater supply and high-pressure pump system to flush and clean pipes and structures. Collected material is transported in the truck to approved disposal sites. This process is sometimes called vactoring.

Weed: See “Non-target vegetation.”

Green Stormwater Infrastructure
Maintenance Manual



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