

appendix 6.1

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Design Details

INTRODUCTION TO THE DESIGN DETAILS

The Design Details are intended to illustrate green street stormwater management practices currently being used or piloted by the City of Philadelphia. The Design Details do not reflect layouts, geometries, or extents that are fixed for each stormwater management practice under every street condition but instead provide designers with a combination of general rules, guidelines, requirements, and information to help them apply and modify the Design Details to their project and specific site conditions. The Design Details are also not intended to prescribe a required or the only allowable combination of design components for each stormwater management practice but instead reflect design components that have been typically used to date. None of the Design Details are for construction. Lastly, these Design Details do not supersede requirements and guidelines for symbology, notation, level of detail, or other drawing standards that PWD requires for design plan submissions.

The General Rules presented on Drawing G-03 provide information that applies to most or all of the stormwater management practices but may not necessarily be illustrated or cross referenced on all of the Design Details. It is very important for users of the Design Details to review and understand these rules in conjunction with using the Design Details.

In the case of the stormwater planter and stormwater bumpout, a Placement Diagram has been included that provides a block-scale view for these stormwater management practices to provide guidance and requirements focused on the placement of these stormwater management practices in the right-of-way. These Placement Diagrams do not necessarily cover every placement scenario but highlight a few important conditions that should be understood.

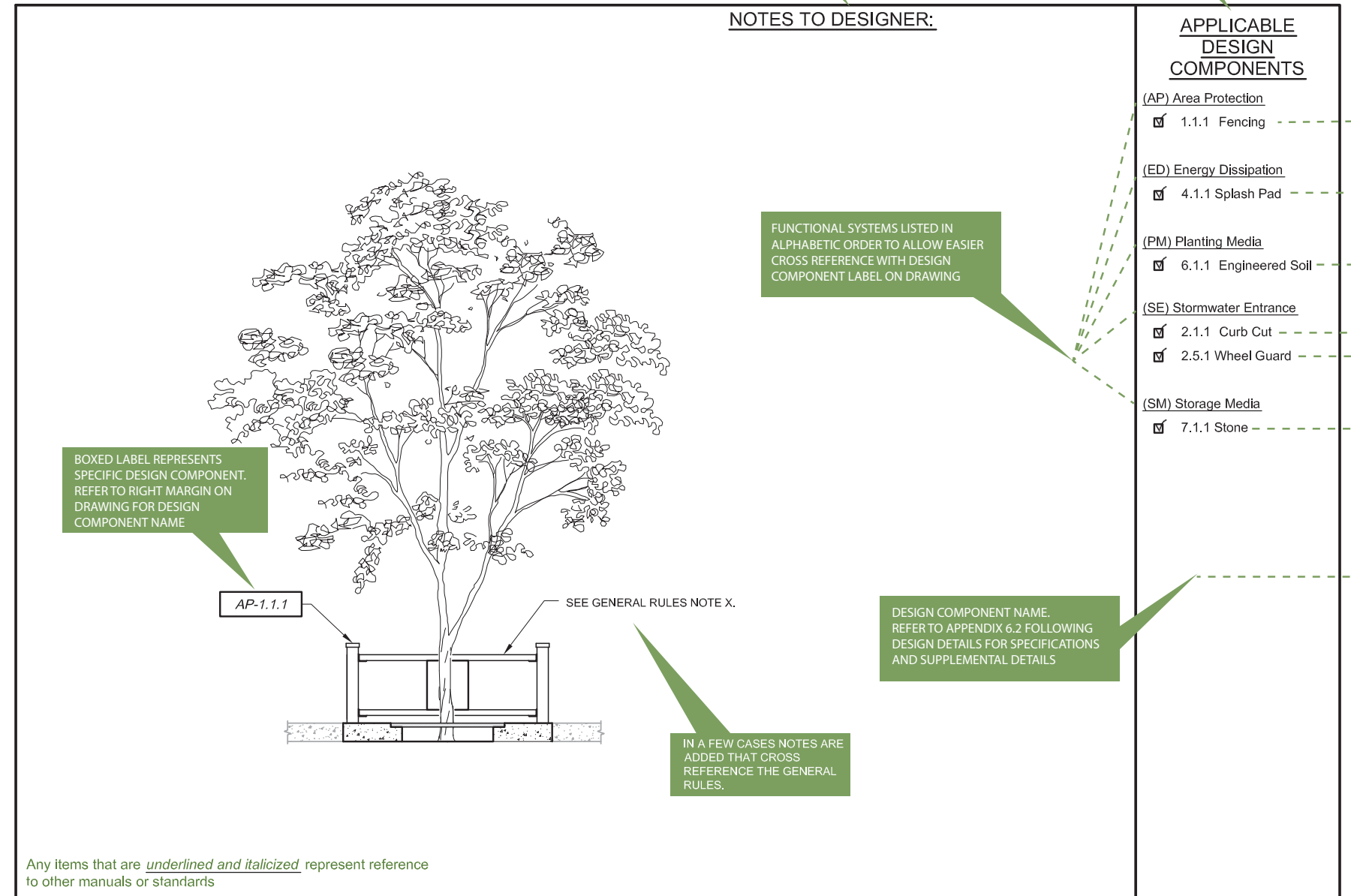
Finally, the "How to Use the Design Details" Diagram shown on this page provides instruction on the use of the Design Details.

FUNCTIONAL SYSTEMS	ABBREVIATION
FS-1 Area Protection	AP
FS-2 Stormwater Entrance	SE
FS-3 Pretreatment	PR
FS-4 Energy Dissipation	ED
FS-5 Landscaping	L
FS-6 Planting Media	PM
FS-7 Storage Media	SM
FS-8 Media Separation	MS
FS-9 Piping	P
FS-10 Impermeable Barriers	IB
FS-11 Subsurface Stabilization	SS
FS-12 Identification and Education	IE

ACRONYM LIST

ADA	Americans with Disabilities Act
GSI	Green Stormwater Infrastructure
PFD	Philadelphia Fire Department
PennDOT	Pennsylvania Department of Transportation
PP&R	Philadelphia Parks and Recreation
PWD	Philadelphia Water Department
SMP	Stormwater Management Practice

HOW TO USE THE DESIGN DETAILS



LEGEND



1. PLACEMENT, LOCATION, AND LAYOUT

- a. It is allowable and sometimes beneficial to interconnect multiple SMPs (either of the same type or of different types) or to interconnect SMPs with an adjacent or nearby subsurface storage system. While the term "SMP" refers to one of the specific Green Street practices (e.g. stormwater planter, stormwater bump-out, etc), a Green Street "system" refers to multiple SMPs that are hydraulically connected or to a single SMP that is hydraulically connected to another stormwater storage system.
- b. Green Street systems should be located directly upgrade of existing inlet locations whenever possible or located such that any bypass or overflow from a new Green Street system will be managed by the street's drainage facilities without negatively impacting existing drainage conditions under any circumstances. Appropriate offsets should be maintained from existing inlets if they will not be replaced. Refer to *PWD's Green Stormwater Infrastructure (GSI) Design Requirements and Guidelines* for information regarding replacement of existing inlets.
- c. While the Design Details themselves do not address their application in excessively steep street conditions, use of these details is not precluded by steep conditions. Instead, additional design features and configurations may be necessary to apply them in these conditions.
- d. In order to protect SMPs and Green Street systems from future construction on adjacent parcels, a minimum 3-foot buffer must be provided between the edge of the system and the right-of-way line.
- e. Infiltration systems should be placed at a distance to prevent damage to adjacent buildings. PWD recommends a minimum of 10-feet offset.
- f. Placement and siting of SMPs should consider the adequacy of existing street lighting as well as the interaction of lighting with trees and vegetation in order to improve night-time visibility of SMPs.

2. UTILITIES

- a. All impacts or potential impacts to surrounding utilities must be reviewed and approved by the utility. PWD generally follows and recommends the following clearances between utilities and SMPs/Green Street systems
 - Maintain a minimum of 3-feet horizontal and 6 to 18-inches vertical offset from existing utility lines. Consider the utility type, age, and condition.
 - Maintain an offset from sewers and sewer laterals such that the extents of the SMP/Green Street system are outside of the zone defined by a 1:1 slope line extending from the bottom of the sewer line to the ground surface. If within this zone, use an impermeable liner along the sides and bottom of the portion of the SMP/Green Street system that is within the zone.
 - Maintain a minimum of 5-feet horizontal offset from electric poles or other comparable existing infrastructure. Support and protect such poles during construction as needed.
 - Maintain a minimum of 3-feet horizontal offset from traffic lights.
- b. Utilities other than sewers and sewer laterals may pass under or through an SMP/Green Street system. Specific design requirements are subject to the requirements of each utility owner. At a minimum, anti-seep collars and utility sleeves must be included on service pipes that enter and exit an SMP/Green Street system. Consent from the utility owner should be obtained in writing prior to design.

3. GENERAL CONSTRUCTION GUIDELINES

- a. At a minimum, the following construction guidelines should be communicated for any Green Street project either in construction specifications or as notes on final design plans.
 - Erosion and sediment controls **must** be in place before work begins.
 - Clearly mark areas for SMPs/Green Street systems before any site work begins to avoid soil disturbance and compaction during construction.
 - Excavate SMPs/Green Street systems to proposed depth. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, remove the material and scarify the underlying soils to a minimum depth of 6-inches.
 - Do not compact existing subgrade or subject it to excessive construction equipment prior to placement of any materials into the SMP/Green Street system. It is essential that all construction equipment be operated from outside of the limits of the SMP/Green Street system. If that is not feasible, use low ground pressure equipment approved by the Engineer. Do not use equipment with narrow tracks or tires, rubber tires with large lugs, or high pressure tires, which will cause excessive compaction. Note the above does not apply to lined SMPs/Green Street systems, which may be compacted as needed. Also note that this rule applies only to the subgrade (i.e. existing soils below the SMP/Green Street system) and other materials within the area of an SMP/Green Street system may and often do require compaction such as the backfill material placed between the top of a tree trench's storage media and the underside of the sidewalk.
 - Obtain approval by the Engineer and hand-rake to scarify subgrades of infiltration systems prior to placing any materials into excavation.

4. OTHER

- a. Except for individual stormwater trees, all disturbed curb and sidewalk must, at a minimum, be replaced to the next joint beyond the limits of disturbance. Individual stormwater trees do not require restoration beyond the footprint of the tree pit disturbance. Additional restoration requirements may be required beyond this minimum as they relate to ADA compliance or specific site conditions. All sidewalk, curb, and pavement restoration is to be in accordance with *Streets Department Standards, Detail L-892*.
- b. The bottom surface (i.e. bottom of excavation) of all SMPs/ Green Street systems should be level.
- c. Designs should consider minimum and maximum depths of excavation due to surface elevation changes over length of systems. It is recommended to limit the total system depth to prevent the need for excavation support during construction or repair and potentially higher installation costs.
- d. Existing trees in good condition are to be preserved wherever possible. Additionally, designs should limit excavation around existing trees whenever possible. Excavation should not be performed within 6 feet of existing trees in good condition and, in general, excavation should be restricted to a distance of one foot for every diameter inch of any adjacent tree. Contact PP&R or a professional arborist for guidance on excavating around and preserving existing trees.
- e. All design shall comply with the *ADA Standards for Accessible Design* and *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way*.
- f. For PennDOT roads different requirements and criteria for Green Streets may apply and must be coordinated with PennDOT.

5. SMP DEPTHS AND AREA PROTECTION *[Pending confirmation with Risk Management, per meeting minutes from 9/19/2013 meeting]*

- a. Maximum surface depth of all SMPs shall be 15-inches below the sidewalk level unless otherwise approved by the City.
- b. SMPs within the sidewalk such as stormwater planters and stormwater trees must have an approved form of Area Protection (FS-1) around the SMP in all cases.
- c. For SMPs in the parking lane or street shoulder such as bumpouts, an Area Protection Barrier (AP-1.1) along the curb line between the sidewalk and the SMP is preferred over a flush curb. If an Area Protection barrier is not used and the curb is flush between the sidewalk and the SMP, some other visual/sensory cue must be provided along the curb line.
- d. Increasing visibility of SMPs during both day-time and night-time conditions is an important consideration. Area Protection barriers should use contrasting colors that differ from the color of adjacent surfaces as much as possible. Reflective surfaces or reflective features should be considered and incorporated into Area Protection barriers where practical.

6. FS-5 LANDSCAPING:

- a. When trees are planted, 2 1/2 inch caliper trees are recommended.

7. FS-6 PLANTING MEDIA:

- a. Length, width and depth of planting media can vary, but minimum dimensions should be appropriate for the vegetation planted.
- b. When trees are planted, the soil should provide adequate depths for root balls. Generally, this will be a minimum of 3 feet deep from the planting media's surface elevation. It is preferred that the planting media for trees extend directly to the subgrade without storage media below. Also, it is preferred that storage media not separate the planted trees from adjacent areas of native soil. Root paths should be provided whenever possible to allow roots to readily access native soil.

8. FS-7 STORAGE MEDIA:

- a. The extents of the storage media and the limits of the planting media are not required to coincide and, at times, do not. Often times, the extents of the storage media extend well beyond the planting media in order to provide the stormwater storage capacity required per the design requirements and guidelines (see Chapter 5).
- b. Extending subsurface storage media beneath curbing or using certain sectional geometries (particularly when using stone as the storage media) can create some complexities for construction that should be considered during design.
- c. The subsurface storage media should not extend downslope of the Green Street system lowest point of overflow. This is to prevent the water level in the system from encroaching into the subsurface or through the surface of the downgrade sidewalk.

9. FS-8 MEDIA SEPARATION:

- a. Geotextile fabric is used along the vertical side and top of storage media only. It should not be used along the bottom surface of SMPs/Green Street systems.

10. FS-9 PIPING:

- a. Every straight run of pipe should be accessible from at least 2 points.
- b. 90 degree pipe bends are not permitted. At maximum pipe bends should be at 45 degree angles, though 22 ½ degree bends are preferred.

- c. Pipe bends should be avoided whenever possible. Straight pipes with fewer cleanouts are easier and less time consuming to maintain than pipes with bends and more cleanouts.
- d. All pipes should have a box or sump to which they can be flushed. Typically, flushing can occur back to an inlet structure. However, if pipes do not connect to an inlet structure, then a sump or other flushing collection point should be provided. If the cleaning point will be a domed riser, then the domed riser should be at a minimum 12-inches in diameter, though a 15" diameter is preferred.
- e. Regardless of whether a system is designed for infiltration or for detention/slow-release or if they are shown on the Design Details, underdrains must be installed in all systems. This allows for conversion to a detention/slow-release system if infiltration capacity fails due to clogging in the future. Exception to this rule for stormwater trees has been typical.
- f. Though not necessarily shown on all design details included herein, at least one observation well must be installed per SMP/Green Street system, except for individual stormwater trees. However, additional observation wells should be installed as needed to adequately observe water levels in Green Street systems.
- g. All underdrain and distribution piping must maintain a minimum of 6" of stone on all sides or as required based on specific design application, conditions and pipe manufacturer. Minimum cover over all pipes must also be maintained as required based on specific design application, conditions, and pipe manufacturer. It is preferred to maintain as much clearance as feasible between tree pits and piping. If a material other than stone is used as a storage media (e.g. prefabricated modular materials), other requirements may apply.
- h. Although not typical, underdrains may be installed in a sumped trench that is below the bottom elevation of the system's surrounding storage media if feasible and appropriate.
- i. A perforated distribution pipe should generally run the length of any subsurface storage system. The distribution pipe should be sloped toward the stormwater entrance location at 0.5% so that trash and debris stay at one end of the pipe.
- j. Any pipe run for distribution and underdrain piping should at minimum, have cleanouts every 75' and at the end of all pipes. Additionally, cleanouts should be located upstream of complicated bends and evenly spaced during straight pipe runs.
- k. All intermediate cleanouts and domed riser connections must face upstream to allow for cleaning equipment to flush in the direction of the inlet.
- l. Cleanouts, observation wells, and/or piezometers should not be located in driveways unless necessary.
- m. Underdrains should extend inside the subsurface of the SMP/system for a minimum length of 20-feet where possible. All underdrains should be installed without any slope.
- n. Underdrains should typically connect to an inlet structure and terminate either in a solid cap (infiltration systems) or orifice (detention/slow-release systems). If it is not possible or advisable to connect the underdrain to an inlet structure for infiltration systems, the underdrain must extend for a minimum of 5-feet outside of the system and be capped. This will allow for future access to the underdrain without disruption of the system should the system need to be converted to detention/slow-release.
- o. All distribution and underdrain piping must have anti-seep collars where they enter and exit a Green Street system.
- p. Minimum allowable pipe size for distribution pipes and underdrains is 8-inches.

11. FS-10 IMPERMEABLE BARRIERS:

- a. Systems should be lined and slow-released if there are any geotechnical or contamination issues that would make infiltration inadvisable.



STORMWATER PLANTERS SHOULD BE LOCATED IN ACCORDANCE WITH THE CITY OF PHILADELPHIA COMPLETE STREETS DESIGN HANDBOOK. THIS REQUIRES THAT THEY MAINTAIN MINIMUM CLEAR WALKING ZONE WIDTHS BASED ON APPLICABLE STREET TYPE AND DO NOT CREATE PINCH POINTS OR TRIPPING HAZARDS. REFER TO THE CITY OF PHILADELPHIA COMPLETE STREETS DESIGN HANDBOOK FOR MINIMUM CLEAR WALKING ZONE WIDTHS AS WELL AS ALLOWABLE EXCEPTIONS.

WHILE ALLOWED WITHIN BUS STOP AREAS, STORMWATER PLANTERS MUST BE PLACED SO THAT MINIMUM REQUIREMENTS FOR LOADING PADS, WAITING AREAS, PEDESTRIAN PATHS, AND CLEAR AREAS ARE MET IN ACCORDANCE WITH SEPTA BUS STOP DESIGN GUIDELINES

PLANTERS MUST BE CLEAR OF HANDICAPPED STREET PARKING SPACES. OFFSET NOT REQUIRED BUT RECOMMENDED.

VEHICLE EXIT (BIKE/PARKING LANE)

VEHICLE APPROACH (NO PARKING LANE)

VEHICLE APPROACH (BIKE/PARKING LANE)

VEHICLE EXIT (NO PARKING LANE)

PLANTER (TYP)

DRIVEWAY

4'

4'

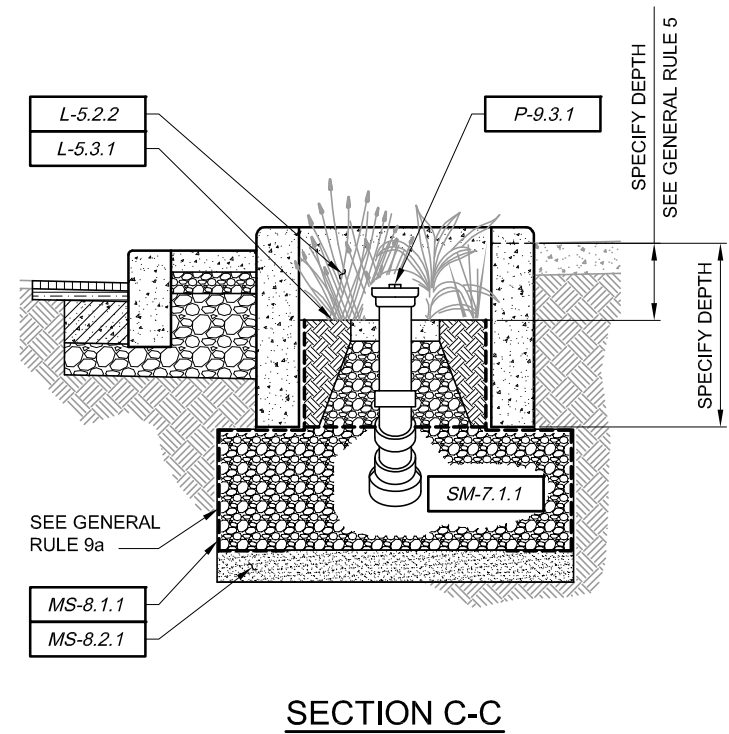
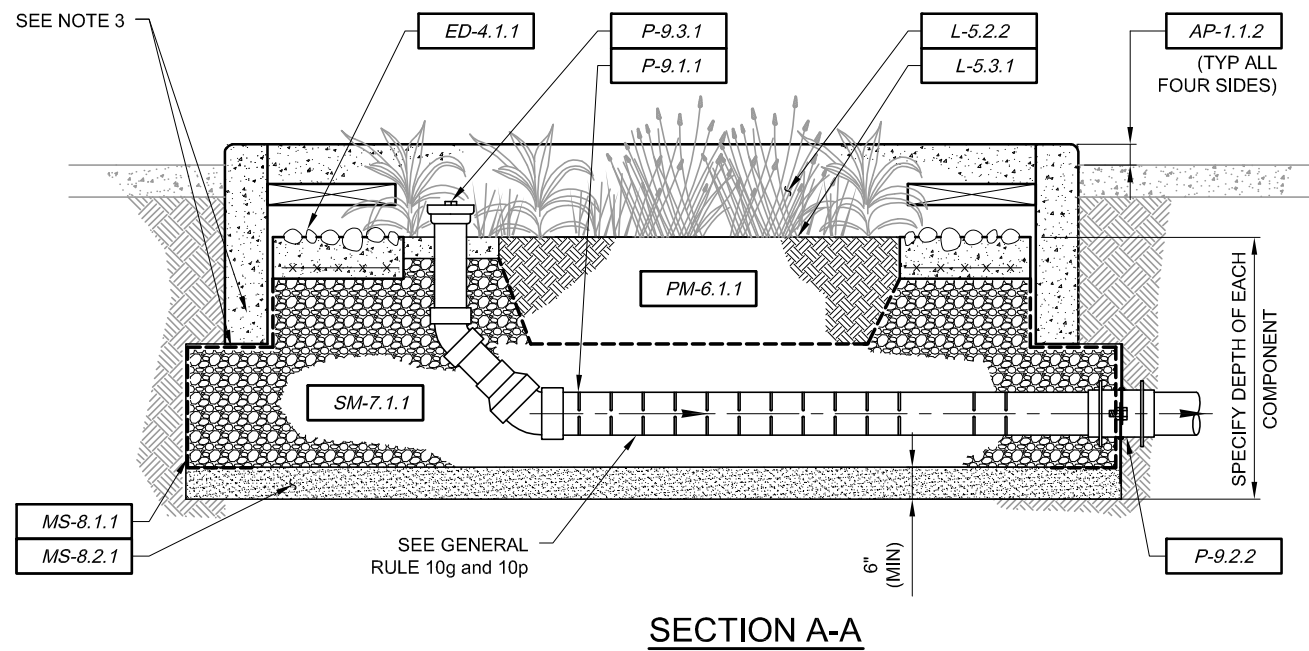
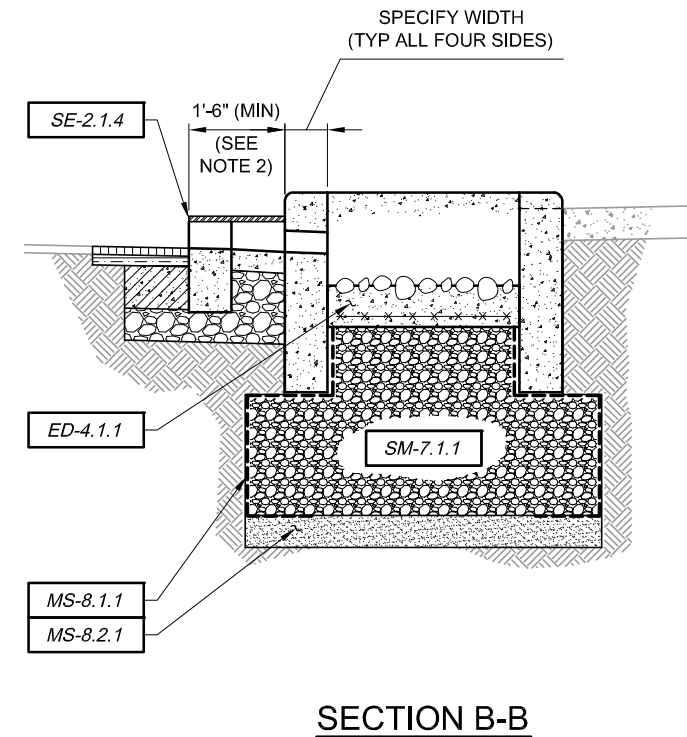
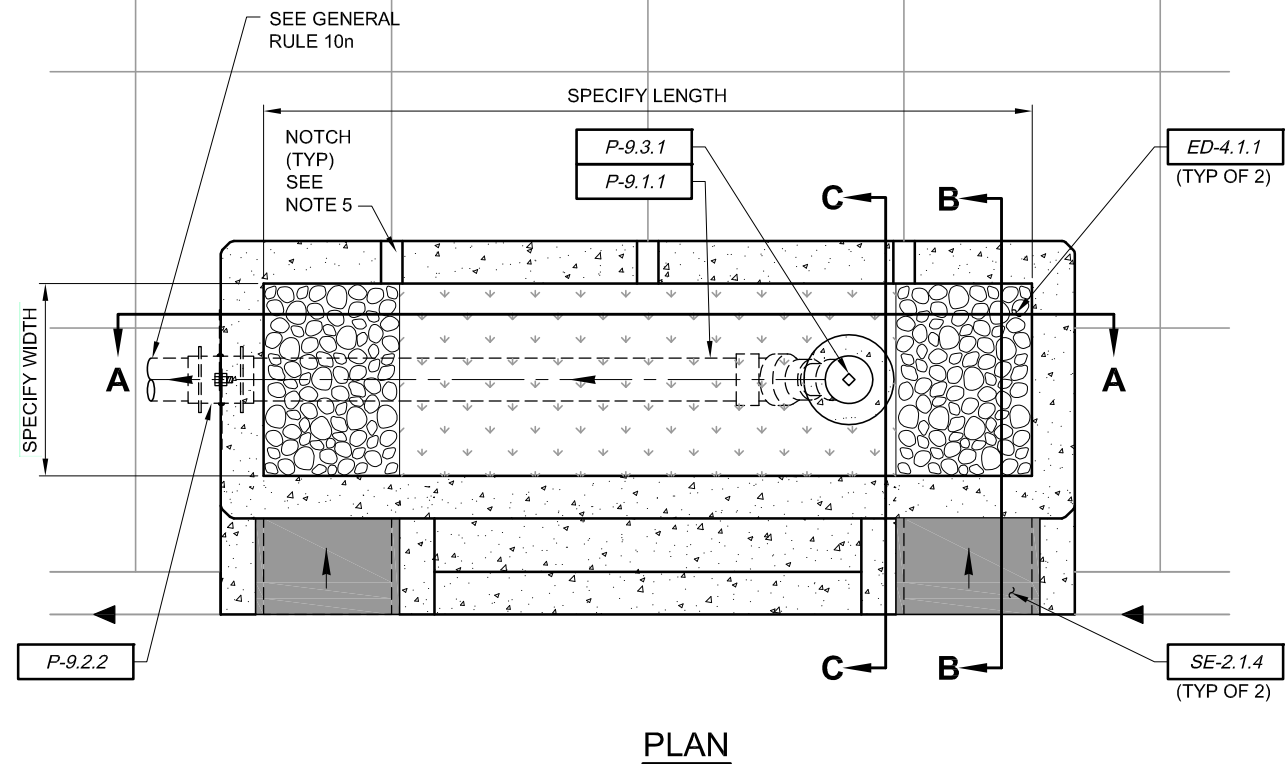
SUBSURFACE: 3'-0" FROM C-POLES (NO MAST ARMS - SIGNALS AND SCHOOL FLASHERS).
 SUBSURFACE: 5'-0" FROM D-POLES (MAST ARMS), UTILITY POLES AND STREET LIGHTS.
 SURFACE: 4'-0" (5'-0" PREFERRED) SPACING IN ALL CASES.
 INCREASED OFFSET MAY BE REQUIRED IF LIGHTS, SIGNS OR OTHER UTILITY POLES HAVE LARGE FOUNDATIONS.

5' (MIN)

PROVIDE OFFSET BETWEEN PLANTERS AND CURB RAMPS TO PROVIDE SUFFICIENT SPACE FOR PEDESTRIANS AT CORNERS

GENERAL NOTES

1. If stormwater planters contain trees, placement of planters will also depend on street tree placement requirements per the Street Tree Planting Diagram in the the city of Philadelphia Complete Streets Design Handbook.
2. Reducing the minimum offset from the face of the street curb to the stormwater planter may be appropriate in non-parking lane and non-loading zone conditions but must be reviewed and approved by the City on a case-by-case basis. Reduction of this offset will require additional design considerations regarding the street-side stormwater entrance and area protection design.



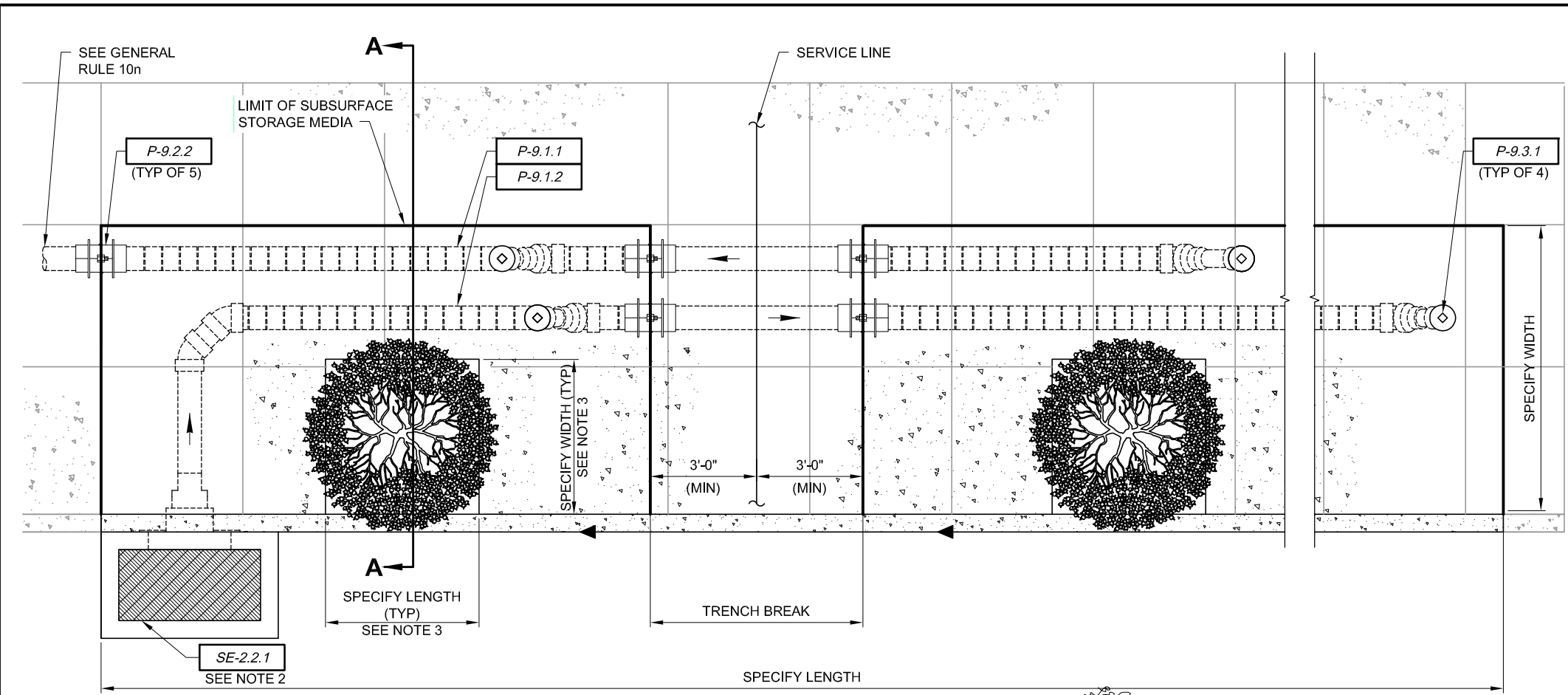
NOTES TO DESIGNER

1. This design detail should be adapted to the specific engineered design and its respective installation.
2. Reducing the minimum offset from the face of the street curb to the stormwater planter may be appropriate in non-parking lane and non-loading zone conditions but must be reviewed and approved by the City on a case-by-case basis. Reduction of this offset will require additional design considerations regarding the street-side stormwater entrance and area protection design.
3. Stormwater planter walls may be precast or cast-in-place concrete. For any structural components, including but not limited to planter walls, structural design must be prepared by the designer. At a minimum, designer should consider planter wall depth, footer/foundation for walls, concrete mix, concrete strength, reinforcing steel design (as required), joint placement and design, and design load condition.
4. Designer should be aware that properly aligning the invert of trench drain with opening through planter wall can be challenging when precast construction is used.
5. Notches in the planter wall should be sized and spaced as required to prevent ponding on the sidewalk adjacent to the planter. It is recommended that notches be cast-in-place rather than saw-cut.
6. All exposed concrete edges shall be beveled.
7. Designer should evaluate whether top of curb reveal should follow slope of surrounding grades or be level based on desired appearance and site conditions.
8. The lowest planting media surface in stormwater planters should be level along the alignment of the street. A mild slope no greater than 1 percent is acceptable but a level surface is recommended. If surrounding slopes are steep, impermeable barriers such as surface check dams can help maintain a level surface. Note this does not apply to the cross-grading, if used, from the perimeter of the planter down to the lowest planting media surface.
9. Designer should consider the height of vegetation both at installation and anticipated maturity. Both heights should be considered in the context of the stormwater planter's plan dimensions, depth, and surrounding area protection and vegetation selected accordingly. It has been found that if a planter is deep and/or has high area protection, very low vegetation at installation tends to give a stormwater planter an excessively deep appearance. Note that with the exception of trees, maximum vegetation height at maturity should be no greater than 36-inches above the surrounding sidewalk elevation. Also, plant selection and placement should be done to prevent encroachment of plants outside of the limits of the stormwater planter and in consideration of maintaining adequate sight lines based on the placement of the stormwater planter.
10. The ponding depth of water in the stormwater planter is correlated to a variety of site specific factors such as surrounding grades, offsets between stormwater entrance elevations and top of planting media, offsets between stormwater entrance and overflow elevations, desired freeboard, the vegetation selected for the stormwater planter, and the design depth of the stormwater planter. The designer should evaluate site specific conditions such as those mentioned in order to set the design ponding depth in the stormwater planter. As a point of reference, ponding depths for PWD's Green Street stormwater planters have typically been between 2-inches and 6-inches.

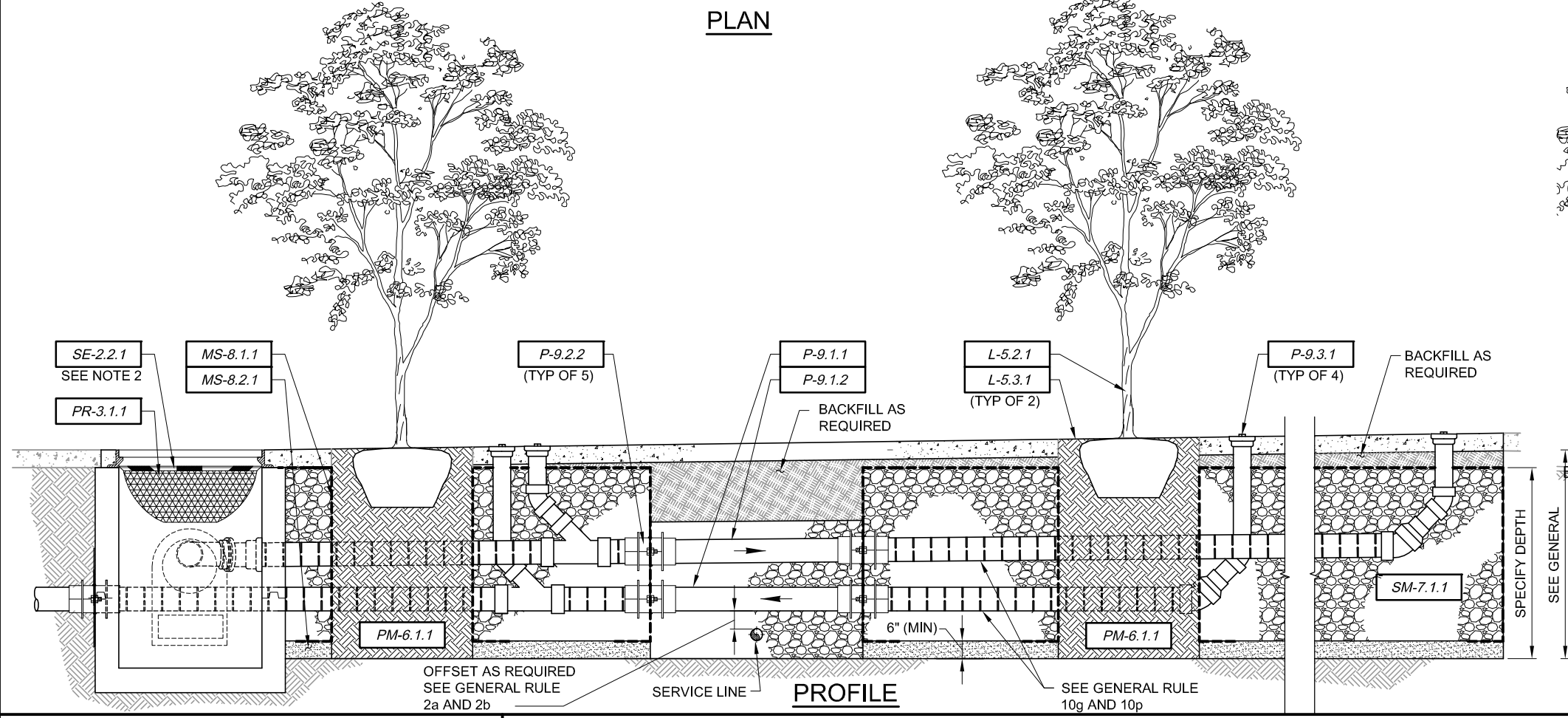
APPLICABLE DESIGN COMPONENTS

- (AP) Area Protection
 - 1.1.2 Curb Reveal
- (ED) Energy Dissipation
 - 4.1.1 Splash Pad
- (L) Landscaping
 - 5.2.2 Plants, Grasses, and Shrubs
 - 5.3.1 Mulch
- (MS) Media Separation
 - 8.1.1 Geotextile
 - 8.2.1 Sand Filter
- (P) Piping
 - 9.1.1 Underdrain
 - 9.2.2 Anti-seep Collar
 - 9.3.1 Cleanout
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (SE) Stormwater Entrance
 - 2.1.4 Trench Drain
- (SM) Storage Media
 - 7.1.1 Stone





PLAN



PROFILE

SECTION A-A

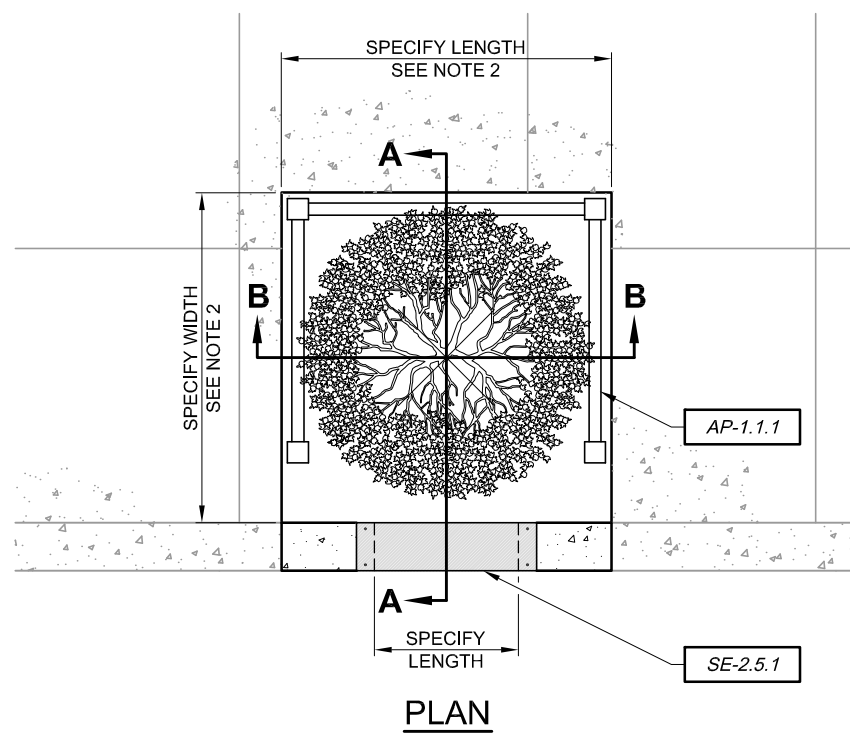
NOTES TO DESIGNER:

1. This design detail should be adapted to your specific engineered design and its respective installation.
2. Green inlets are the most typical inlet used for stormwater tree trenches. While a highway grate type green inlet is depicted and preferred, designers may use a PWD Standard city inlet type as the green inlet if there are utility conflicts or other constraints that preclude installation of a highway grate inlet type.
3. The minimum tree pit dimension is 3-feet by 3-feet. Larger tree pit areas are preferred for the health of the tree and should be used if space is available. Tree pit may also be rectangular in shape.
4. Design should include the number, spacing, and species selection of trees. The city of *Philadelphia Complete Streets Design Handbook* provides a Street Tree Planting Diagram that can be referenced for tree placement. Note that locations and species of all trees are reviewed and approved by PP&R. PP&R can also select tree species, if requested.
5. Although surface is shown as concrete sidewalk, tree trenches can be constructed in conjunction with various surfaces including grass strips, pavers, and other materials. Surface restoration will vary accordingly.

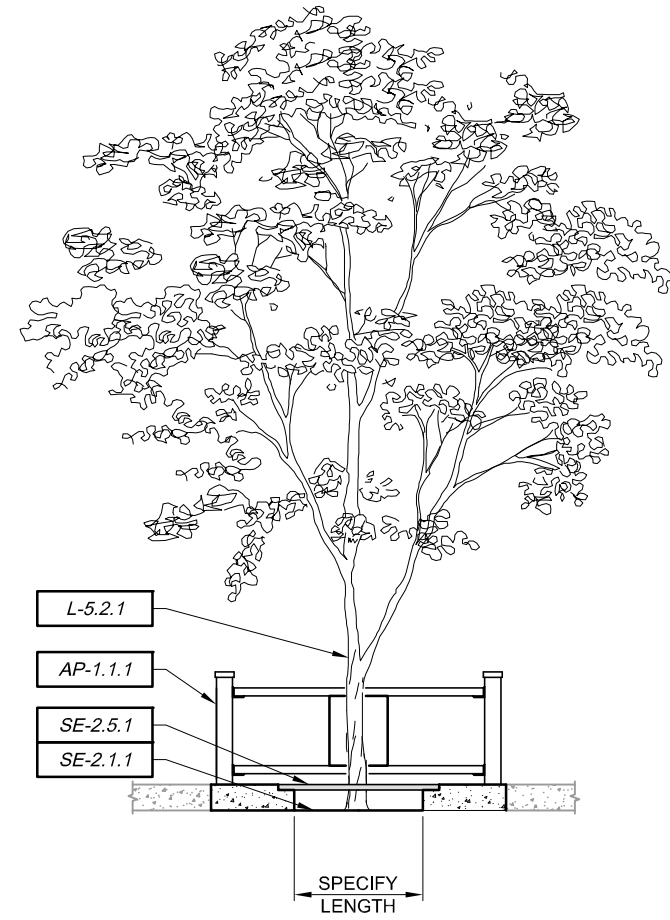
APPLICABLE DESIGN COMPONENTS

- (L) Landscaping
 - 5.2.1 Trees
 - 5.3.1 Mulch
- (MS) Media Separation
 - 8.1.1 Geotextile
 - 8.2.1 Sand Filter
- (P) Piping
 - 9.1.1 Underdrain
 - 9.1.2 Distribution Pipe
 - 9.2.2 Anti-seep Collar
 - 9.3.1 Cleanout
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (PR) Pretreatment
 - 3.1.1 Filter Insert
- (SE) Stormwater Entrance
 - 2.2.1 Green Inlet
- (SM) Storage Media
 - 7.1.1 Stone

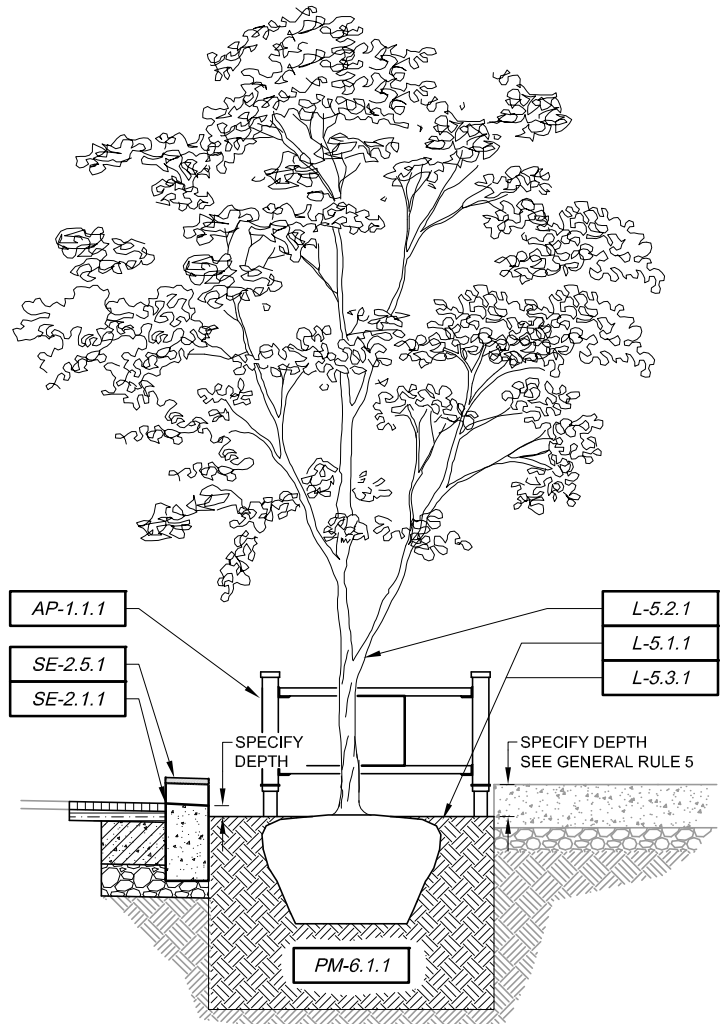




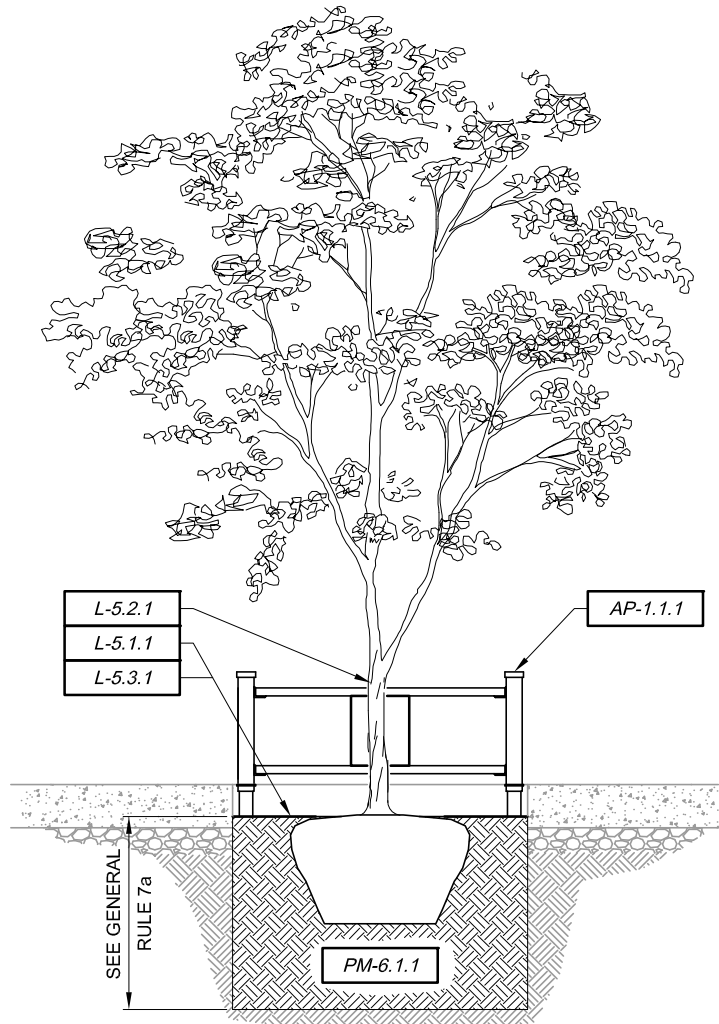
PLAN



FRONT ELEVATION



SECTION A-A



SECTION B-B

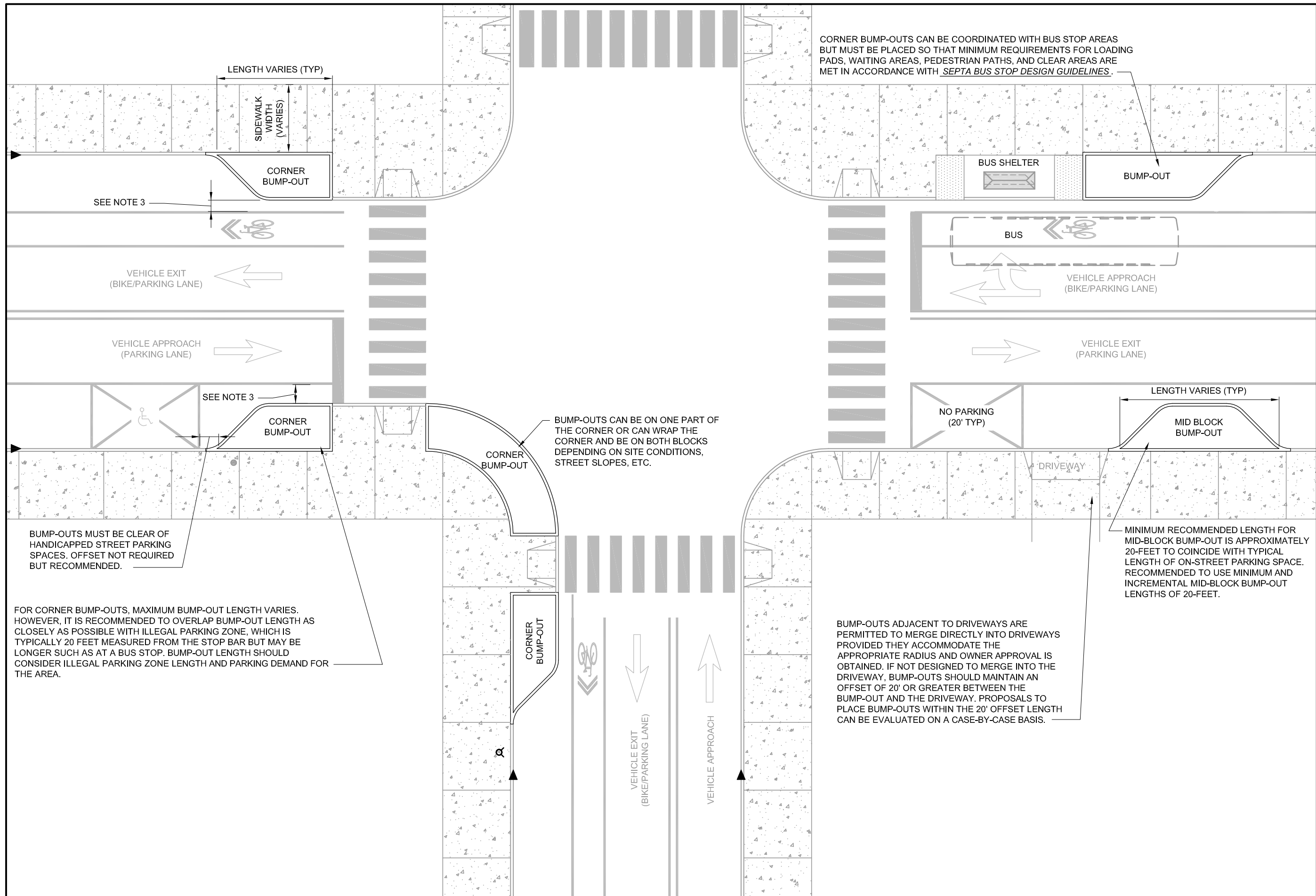
NOTES TO DESIGNER

1. This design detail should be adapted to your specific engineered design and its respective installation.
2. The minimum tree pit dimension for tree pits is 3-feet by 3-feet. Larger tree pit areas are preferred for the health of the tree and should be used if space is available. Also, tree pit may also be rectangular in shape.
3. Design should include location and species selection of tree. Note, however, that locations and species of all trees are reviewed and approved by PP&R. PP&R can also select tree species, if requested.
4. Although surface is shown as concrete sidewalk, stormwater trees can be constructed adjacent to various surfaces including grass strips, pavers, and other materials..
5. Designer must ensure the planting media surface is set at an elevation to prevent exposure of the sidewalk's aggregate subbase. If depth of the planting media surface will cause this material to be exposed, designer should design a system to prevent this material from sloughing into the tree pit.
6. The ponding depth of water in the stormwater tree is correlated to a variety of site specific factors such as surrounding grades, offsets between stormwater tree entrance elevations and top of planting media, offsets between stormwater tree entrance and overflow elevations, desired freeboard, and the design depth of the stormwater tree. The designer should evaluate site specific conditions such as those mentioned in order to set the design ponding depth in the stormwater tree. As a point of reference, ponding depths for PWD's Green Street stormwater trees have typically been between 2-inches and 6-inches.

APPLICABLE DESIGN COMPONENTS

- (AP) Area Protection
 - 1.1.1 Fencing
- (L) Landscaping
 - 5.1.1 Erosion Control Blanket
 - 5.2.1 Trees
 - 5.3.1 Mulch
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (SE) Stormwater Entrance
 - 2.1.1 Curb Cut
 - 2.5.1 Wheel Guard





CORNER BUMP-OUTS CAN BE COORDINATED WITH BUS STOP AREAS BUT MUST BE PLACED SO THAT MINIMUM REQUIREMENTS FOR LOADING PADS, WAITING AREAS, PEDESTRIAN PATHS, AND CLEAR AREAS ARE MET IN ACCORDANCE WITH SEPTA BUS STOP DESIGN GUIDELINES.

BUMP-OUTS CAN BE ON ONE PART OF THE CORNER OR CAN WRAP THE CORNER AND BE ON BOTH BLOCKS DEPENDING ON SITE CONDITIONS, STREET SLOPES, ETC.

BUMP-OUTS MUST BE CLEAR OF HANDICAPPED STREET PARKING SPACES. OFFSET NOT REQUIRED BUT RECOMMENDED.

FOR CORNER BUMP-OUTS, MAXIMUM BUMP-OUT LENGTH VARIES. HOWEVER, IT IS RECOMMENDED TO OVERLAP BUMP-OUT LENGTH AS CLOSELY AS POSSIBLE WITH ILLEGAL PARKING ZONE, WHICH IS TYPICALLY 20 FEET MEASURED FROM THE STOP BAR BUT MAY BE LONGER SUCH AS AT A BUS STOP. BUMP-OUT LENGTH SHOULD CONSIDER ILLEGAL PARKING ZONE LENGTH AND PARKING DEMAND FOR THE AREA.

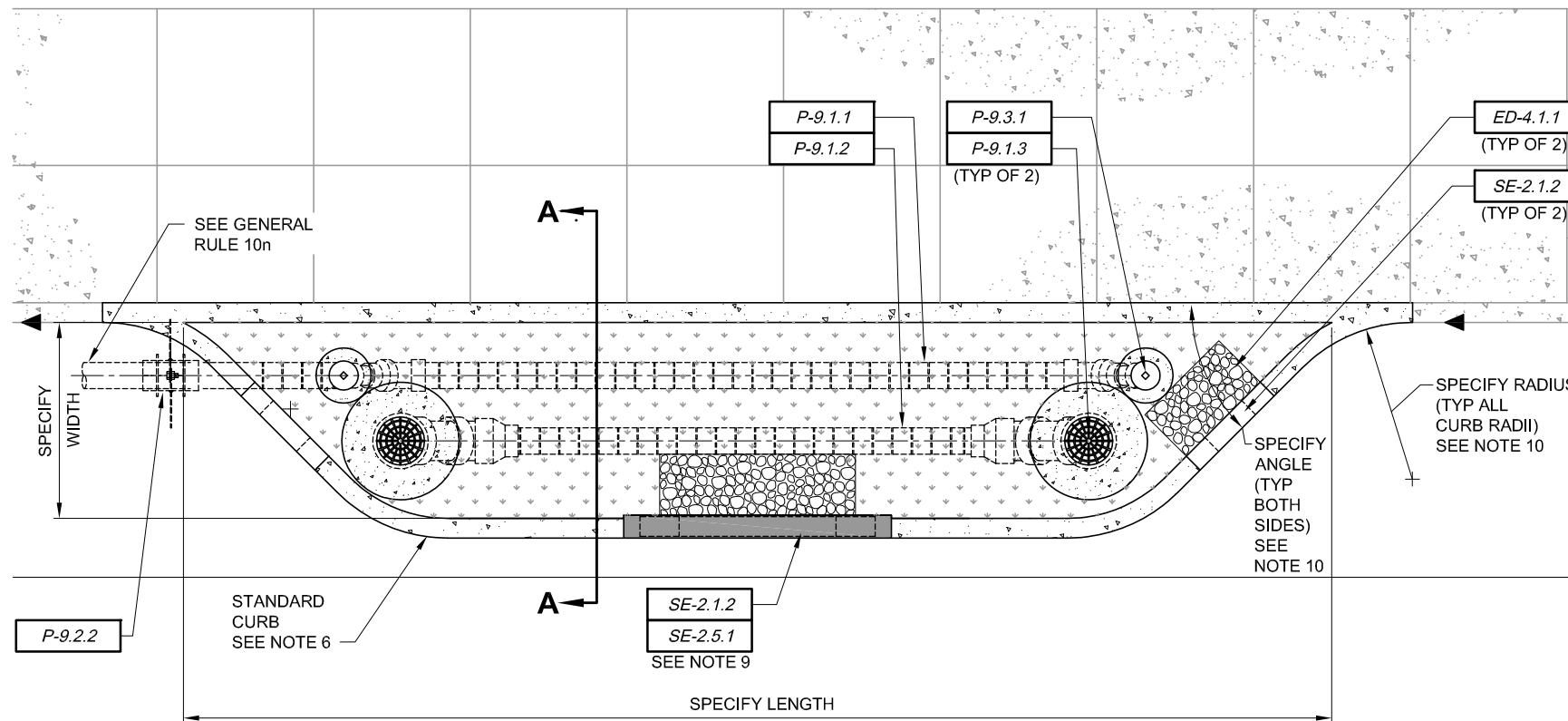
BUMP-OUTS ADJACENT TO DRIVEWAYS ARE PERMITTED TO MERGE DIRECTLY INTO DRIVEWAYS PROVIDED THEY ACCOMMODATE THE APPROPRIATE RADIUS AND OWNER APPROVAL IS OBTAINED. IF NOT DESIGNED TO MERGE INTO THE DRIVEWAY, BUMP-OUTS SHOULD MAINTAIN AN OFFSET OF 20' OR GREATER BETWEEN THE BUMP-OUT AND THE DRIVEWAY. PROPOSALS TO PLACE BUMP-OUTS WITHIN THE 20' OFFSET LENGTH CAN BE EVALUATED ON A CASE-BY-CASE BASIS.

MINIMUM RECOMMENDED LENGTH FOR MID-BLOCK BUMP-OUT IS APPROXIMATELY 20- FEET TO COINCIDE WITH TYPICAL LENGTH OF ON-STREET PARKING SPACE. RECOMMENDED TO USE MINIMUM AND INCREMENTAL MID-BLOCK BUMP-OUT LENGTHS OF 20- FEET.

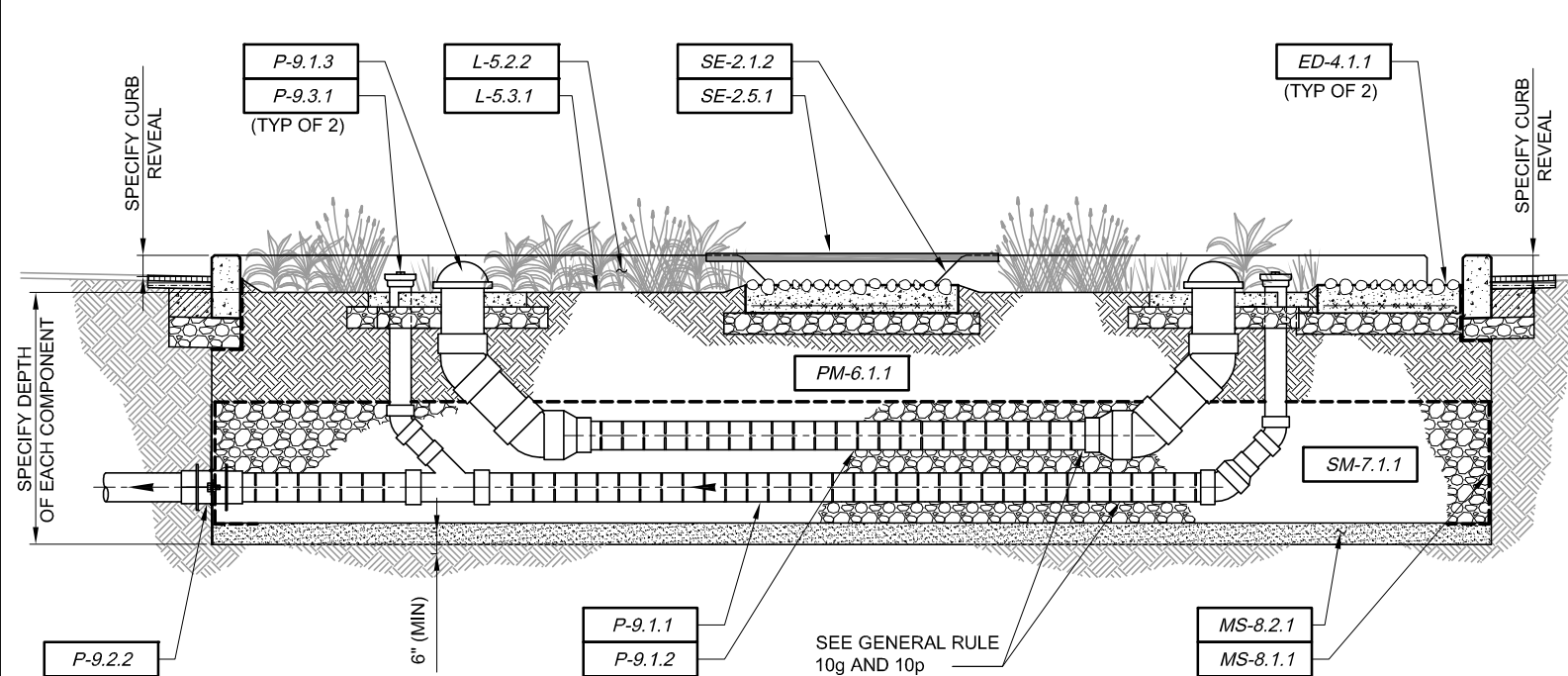
GENERAL NOTES:

1. Corner stormwater bump-outs should only be installed where at least one of the two streets meeting at the corner drain towards the corner.
2. Bump-outs in roadways with no parking lane can be considered on a case-by-case basis.
3. In all cases, bump-outs must maintain a minimum offset of 1' from travel lane. Travel lane includes both vehicle and bike lanes.
4. Bump-outs must never narrow street to less than 20' in order to not limit fire vehicles' access down the street.
5. Designers should determine the approved geometry for bump-outs based on good engineering practice and judgement of the site. This includes the angle of the curb that is cross to the travel lane and all curb radii. A typical bump-out geometry that is often used and approved in Philadelphia includes a curb at a 45 degree angle to the travel lane and 5' curb radii. For corner bump-outs that wrap the corner all curb radii around corners shall follow guidance on curb/corner radii included in the city of *Philadelphia Complete Streets Design Handbook*.
6. Fire hydrants must remain within 18-inches of the curb line unless otherwise approved by the Philadelphia Fire Department.

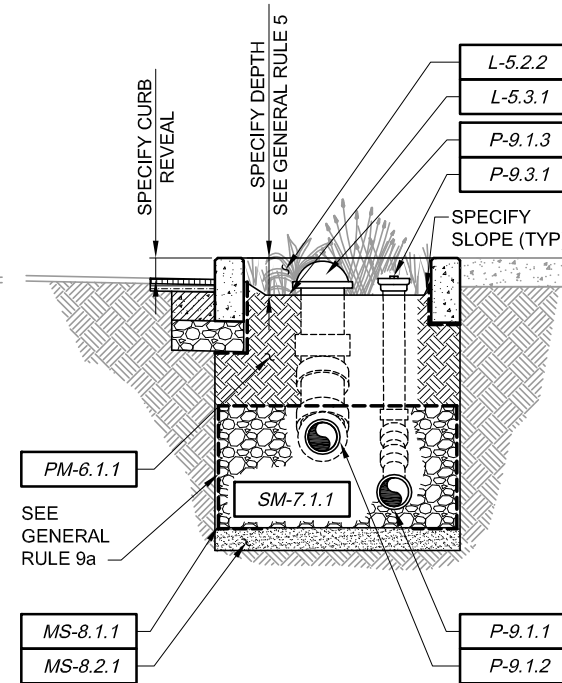




PLAN



PROFILE



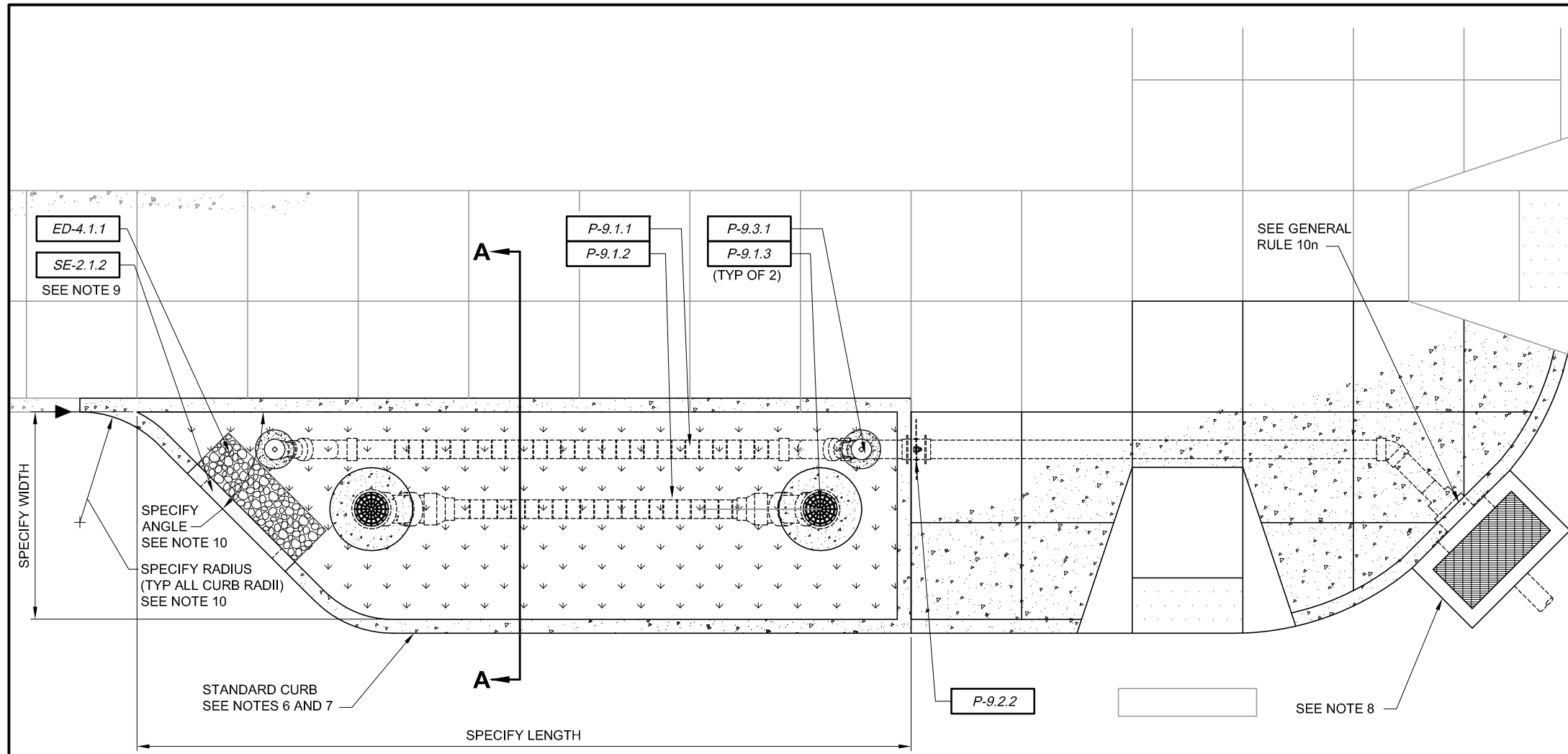
SECTION A-A

NOTES TO DESIGNER:

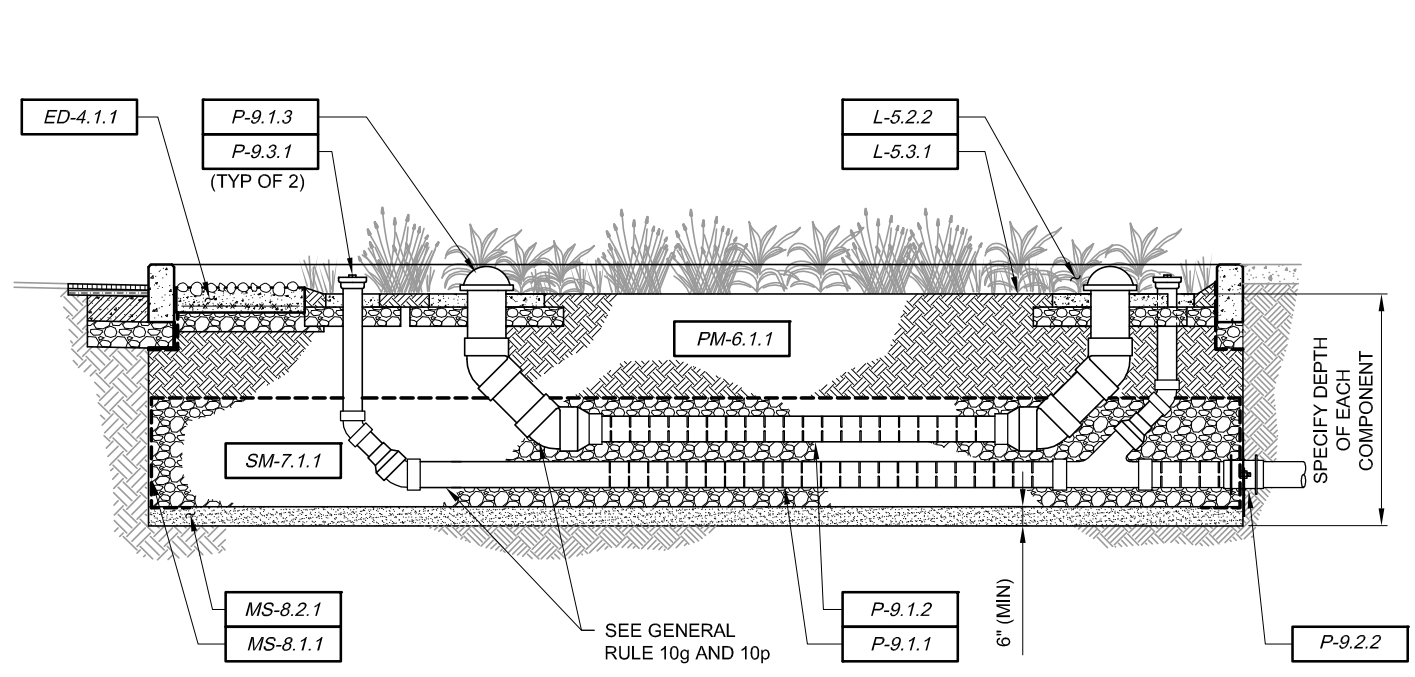
1. This design detail should be adapted to the specific engineered design of a respective installation.
2. The lowest planting media surface in stormwater bump-outs should be level along the alignment of the street. A mild slope no greater than 1 percent is acceptable but a level surface is recommended. If surrounding slopes are steep, impermeable barriers such as surface check dams can help maintain a level surface. Note this does not apply to the cross-grading, if used, from the perimeter of the bump-out down to the lowest planting media surface.
3. Designer should consider the height of vegetation both at installation and anticipated maturity. Both heights should be considered in the context of the stormwater bump-out's plan dimensions, depth, and surrounding area protection and vegetation selected accordingly. Note that with the exception of trees, maximum vegetation height at maturity should be no greater than 36-inches above the surrounding sidewalk elevation. Also, plant selection and placement should be done to prevent encroachment of plants outside of the limits of the stormwater bump-out and in consideration of maintaining adequate sight lines based on the placement of the stormwater bump-out.
4. The ponding depth of water in the stormwater bump-outs is correlated to a variety of site specific factors such as surrounding grades, offsets between stormwater entrance elevations and top of planting media, offsets between stormwater entrance and overflow elevations, desired freeboard, the vegetation selected for the stormwater bump-out, and the design depth of the stormwater bump-out. The designer should evaluate site specific conditions such as those mentioned in order to set the design ponding depth in the stormwater bump-out. As a point of reference, ponding depths for PWD's Green Street stormwater bump-outs have typically been between 2-inches to 6-inches.
5. Although not shown, extending the vegetated area into the limits of the sidewalk is permitted. However, any requirements/guidelines for other SMPs located in the sidewalk, such as stormwater planters, would apply.
6. Curbs around stormwater bump-outs on City Streets will follow the same requirements as normal curbs and shall be within a height range of 4" to 8". Designer will select a height within that range based on applicable site conditions and the curb height shall be consistent along the length of the bump-out.
7. Although it is typically replaced, note that mid-block stormwater bump-outs can sometimes be constructed without replacing the existing curb. Designer should evaluate this based on site or project specific conditions.
8. Although not shown here, delineators should be placed along the bump-out curb parallel to the travel lane on snow emergency routes.
9. Opening size and placement to be determined by designer. Openings along outside edge of bump-out, if used, must include a wheel guard.
10. Designer should determine the appropriate geometry for bump-outs based on good engineering practice and judgment of the site. This includes the angle of curb that is cross to the travel lane and all curb radii. A typical bump-out geometry that is often used and approved in Philadelphia includes a curb at a 45 degree angle to the travel lane and 5' curb radii.

APPLICABLE DESIGN COMPONENTS

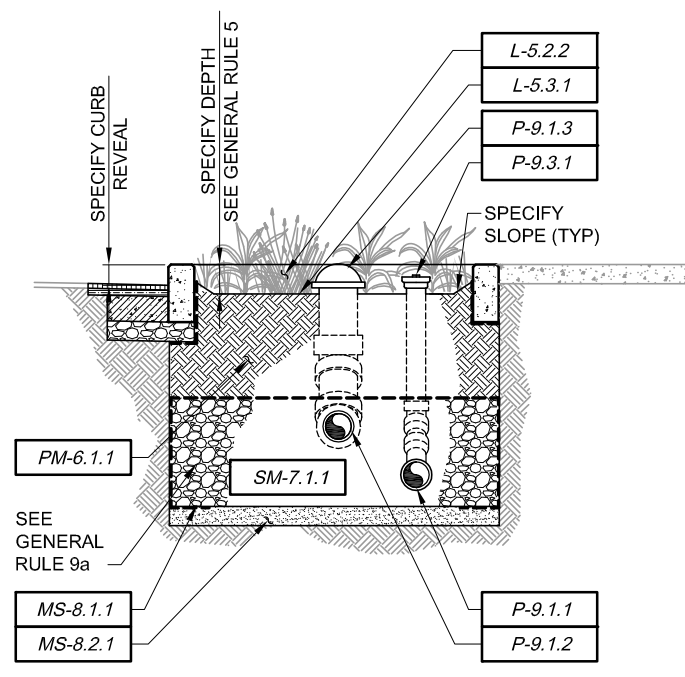
- (ED) Energy Dissipation
 - 4.1.1 Splash Pad
- (L) Landscaping
 - 5.2.2 Plants, Grasses, and Shrubs
 - 5.3.1 Mulch
- (MS) Media Separation
 - 8.1.1 Geotextile
 - 8.2.1 Sand Filter
- (P) Piping
 - 9.1.1 Underdrain
 - 9.1.2 Distribution Pipe
 - 9.1.3 Domed Riser
 - 9.2.2 Anti-seep Collar
 - 9.3.1 Cleanout
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (SE) Stormwater Entrance
 - 2.1.2 Depressed Curb
 - 2.5.1 Wheel Guard
- (SM) Storage Media
 - 7.1.1 Stone



PLAN



PROFILE



SECTION A-A

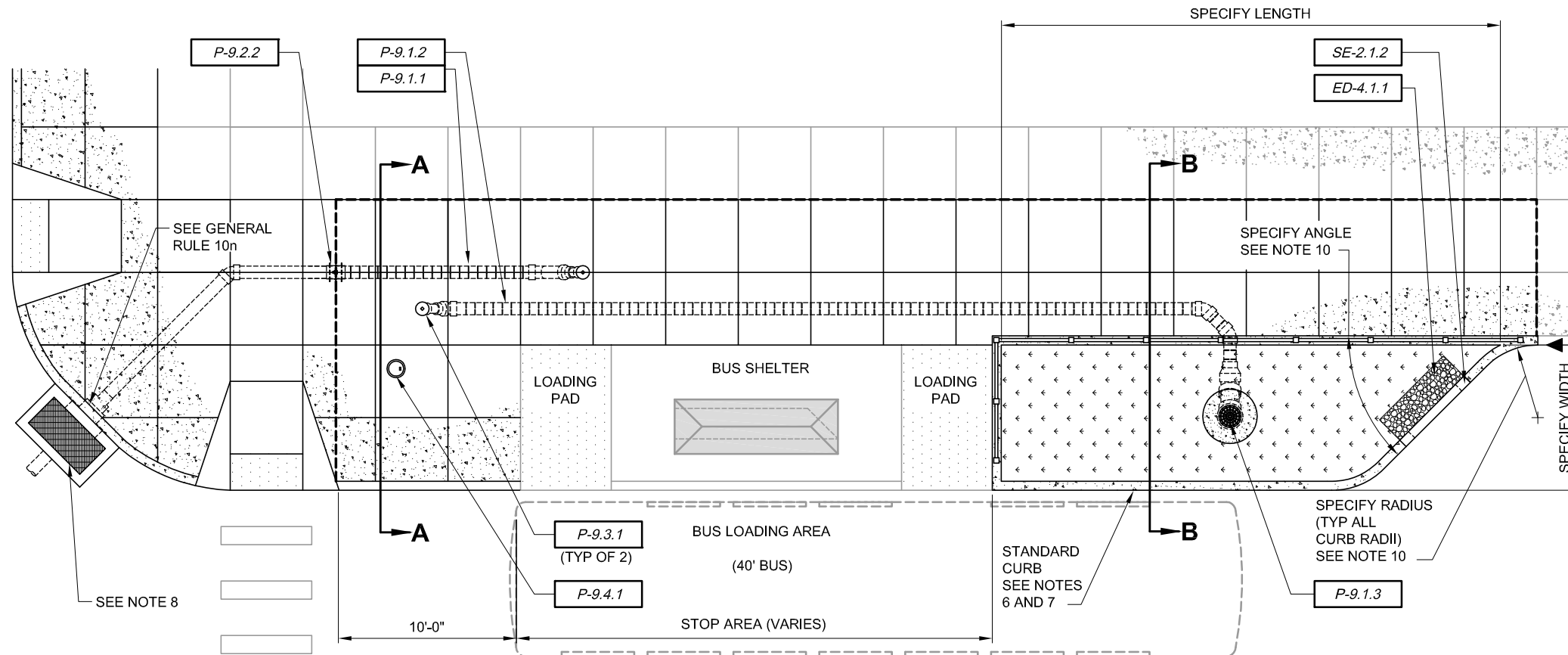
NOTES TO DESIGNER:

1. This design detail should be adapted to the specific engineered design of a respective installation.
2. The lowest planting media surface in stormwater bump-outs should be level along the alignment of the street. A mild slope no greater than 1 percent is acceptable but a level surface is recommended. If surrounding slopes are steep, impermeable barriers such as surface check dams can help maintain a level surface. Note this does not apply to the cross-grading, if used, from the perimeter of the bump-out down to the lowest planting media surface.
3. Designer should consider the height of vegetation both at installation and anticipated maturity. Both heights should be considered in the context of the stormwater bump-out's plan dimensions, depth, and surrounding area protection and vegetation selected accordingly. Note that with the exception of trees, maximum vegetation height at maturity should be no greater than 36-inches above the surrounding sidewalk elevation. Also, plant selection and placement should be done to prevent encroachment of plants outside of the limits of the stormwater bump-out and in consideration of maintaining adequate sight lines based on the placement of the stormwater bump-out.
4. The ponding depth of water in the stormwater bump-outs is correlated to a variety of site specific factors such as surrounding grades, offsets between stormwater entrance elevations and top of planting media, offsets between stormwater entrance and overflow elevations, desired freeboard, the vegetation selected for the stormwater bump-out, and the design depth of the stormwater bump-out. The designer should evaluate site specific conditions such as those mentioned in order to set the design ponding depth in the stormwater bump-out. As a point of reference, ponding depths for PWD's Green Street stormwater bump-outs have typically been between 2-inches to 6-inches.
5. Although not shown, extending the vegetated area into the limits of the sidewalk is permitted. However, any requirements/guidelines for other SMPs located in the sidewalk, such as stormwater planters, would apply.
6. Curbs around stormwater bump-outs on City Streets will follow the same requirements as normal curbs and shall be within a height range of 4" to 8". Designer will select a height within that range based on applicable site conditions and the curb height shall be consistent along the length of the bump-out.
7. Curb height around stormwater bump-outs shall be maximized at corner bump-outs as much as possible and be a consistent height between ADA ramps.
8. When installing corner stormwater bump-outs, gutter flow must be maintained to an existing downstream inlet or a new inlet must be installed along the new curb line as required. Location of new inlet shown can vary and must be evaluated on a case by case basis.
9. Opening size and placement to be determined by designer. Openings along outside edge of bump-out, if used, must include a wheel guard.
10. Designer should determine the appropriate geometry for bump-outs based on good engineering practice and judgment of the site. This includes the angle of curb that is cross to the travel lane and all curb radii. A typical bump-out geometry that is often used and approved in Philadelphia includes a curb at a 45 degree angle to the travel lane. All curb wrapping corners shall follow guidance on curb/corner radii included in the city of *Philadelphia Complete Streets Design Handbook*.
11. Although not shown here, delineators should be placed along the bump-out curb parallel to the travel lane on snow emergency routes.

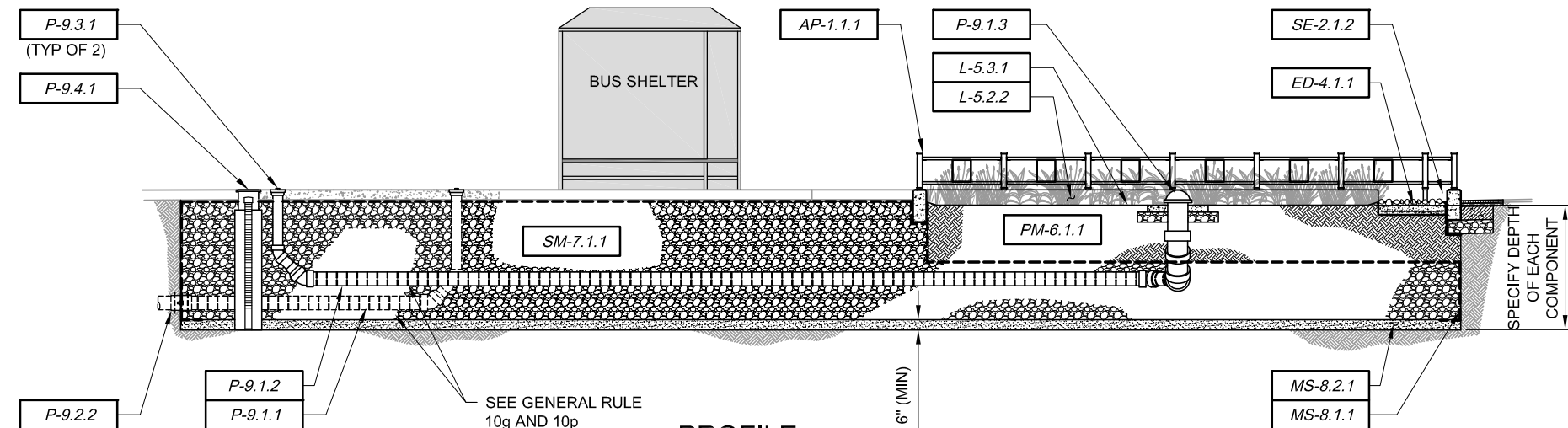
APPLICABLE DESIGN COMPONENTS

- (ED) Energy Dissipation
 - 4.1.1 Splash Pad
- (L) Landscaping
 - 5.2.2 Plants, Grasses, and Shrubs
 - 5.3.1 Mulch
- (MS) Media Separation
 - 8.1.1 Geotextile
 - 8.2.1 Sand Filter
- (P) Piping
 - 9.1.1 Underdrain
 - 9.1.2 Distribution Pipe
 - 9.1.3 Domed Riser
 - 9.2.2 Anti-seep Collar
 - 9.3.1 Cleanout
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (SE) Stormwater Entrance
 - 2.1.2 Depressed Curb
- (SM) Storage Media
 - 7.1.1 Stone

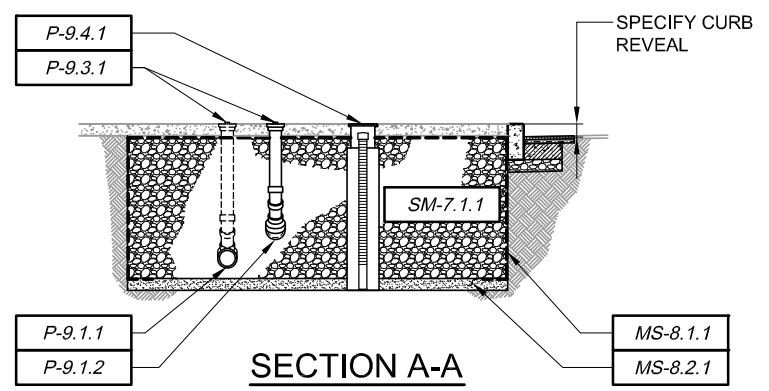




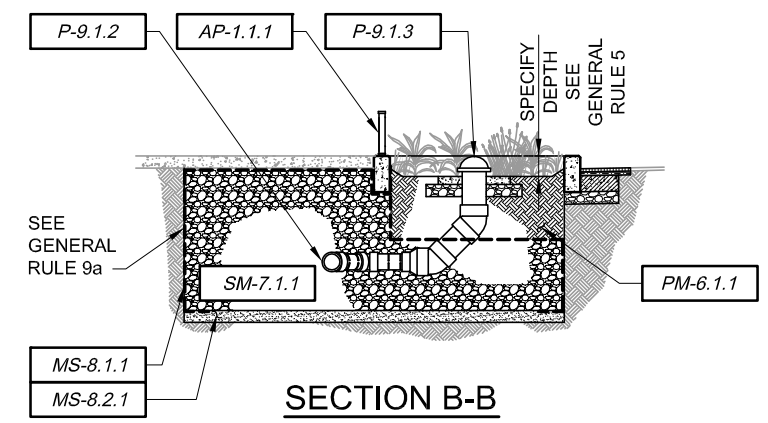
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PROFILE



SECTION A-A



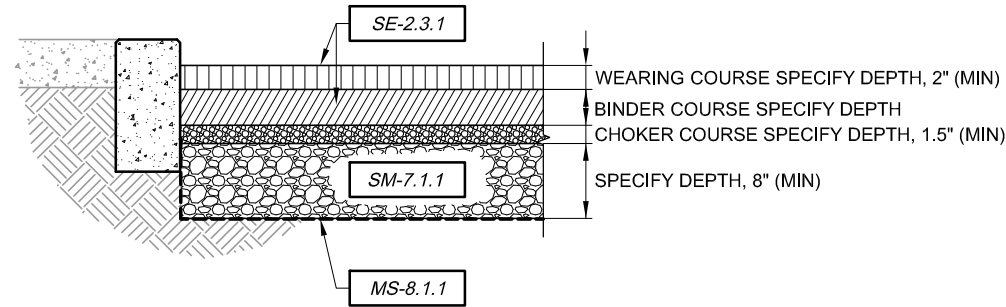
SECTION B-B

NOTES TO DESIGNER:

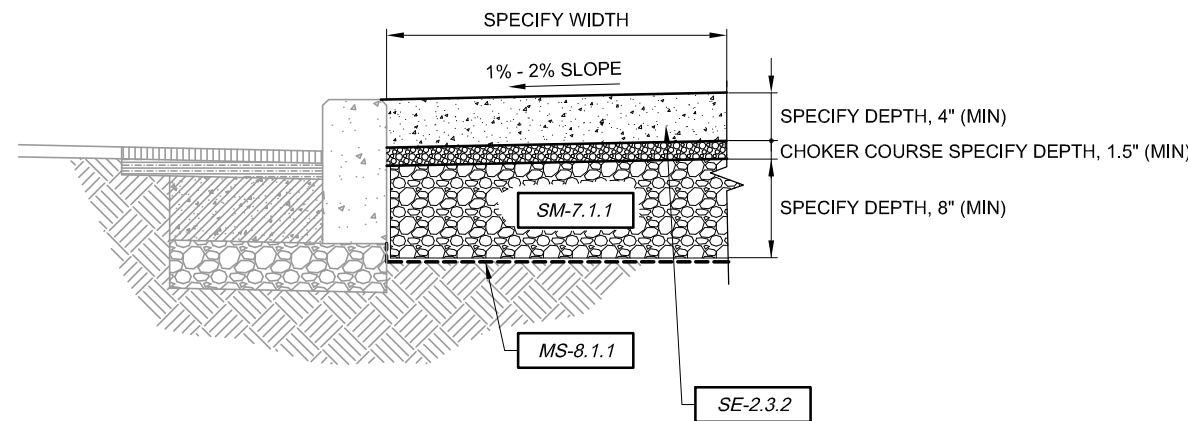
- This design detail should be adapted to the specific engineered design of a respective installation.
- The lowest planting media surface in stormwater bump-outs should be level along the alignment of the street. A mild slope no greater than 1 percent is acceptable but a level surface is recommended. If surrounding slopes are steep, impermeable barriers such as surface check dams can help maintain a level surface. Note this does not apply to the cross-grading, if used, from the perimeter of the bump-out down to the lowest planting media surface.
- Designer should consider the height of vegetation both at installation and anticipated maturity. Both heights should be considered in the context of the stormwater bump-out's plan dimensions, depth, and surrounding area protection and vegetation selected accordingly. Note that with the exception of trees, maximum vegetation height at maturity should be no greater than 36-inches above the surrounding sidewalk elevation. Also, plant selection and placement should be done to prevent encroachment of plants outside of the limits of the stormwater bump-out and in consideration of maintaining adequate sight lines based on the placement of the stormwater bump-out.
- The ponding depth of water in the stormwater bump-outs is correlated to a variety of site specific factors such as surrounding grades, offsets between stormwater entrance elevations and top of planting media, offsets between stormwater entrance and overflow elevations, desired freeboard, the vegetation selected for the stormwater bump-out, and the design depth of the stormwater bump-out. The designer should evaluate site specific conditions such as those mentioned in order to set the design ponding depth in the stormwater bump-out. As a point of reference, ponding depths for PWD's Green Street stormwater bump-outs have typically been between 2-inches to 6-inches.
- Although not shown, extending the vegetated area into the limits of the sidewalk is permitted. However, any requirements/guidelines for other SMPs located in the sidewalk, such as stormwater planters, would apply.
- Curbs around stormwater bump-outs on City Streets will follow the same requirements as normal curbs and shall be within a height range of 4" to 8". Designer will select a height within that range based on applicable site conditions and the curb height shall be consistent along the length of the bump-out.
- Curb height around stormwater bump-outs shall be maximized at corner bump-outs as much as possible and be a consistent height between ADA ramps.
- When installing corner stormwater bump-outs, gutter flow must be maintained to an existing downstream inlet or a new inlet must be installed along the new curb line as required. Location of new inlet shown can vary and must be evaluated on a case by case basis.
- Opening size and placement to be determined by designer. Openings along outside edge of bump-out, if used, must include a wheel guard.
- Designer should determine the appropriate geometry for bump-outs based on good engineering practice and judgment of the site. This includes the angle of curb that is cross to the travel lane and all curb radii. A typical bump-out geometry that is often used and approved in Philadelphia includes a curb at a 45 degree angle to the travel lane. All curb wrapping corners shall follow guidance on curb/corner radii included in the city of *Philadelphia Complete Streets Design Handbook*.
- Refer to *Septa Bus Stop Design Guidelines* for minimum requirements for loading pads, waiting areas, pedestrian paths, and clear areas.
- Although not shown here, delineators should be placed along the bump-out curb parallel to the travel lane on snow emergency routes.

APPLICABLE DESIGN COMPONENTS

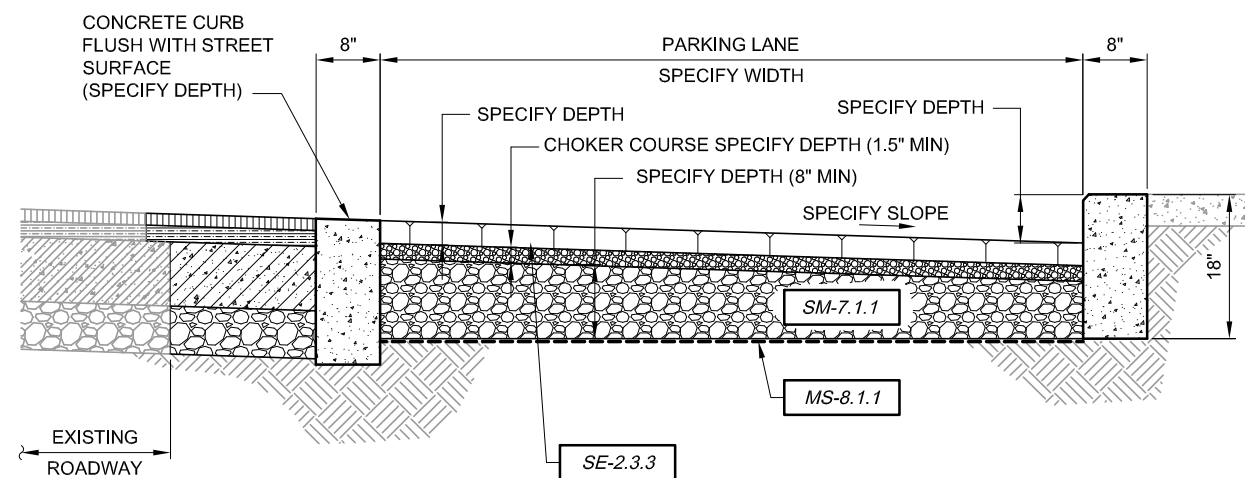
- (AP) Area Protection
 - 1.1.1 Fencing
- (ED) Energy Dissipation
 - 4.1.1 Splash Pad
- (L) Landscaping
 - 5.2.2 Plants, Grasses, and Shrubs
 - 5.3.1 Mulch
- (MS) Media Separation
 - 8.1.1 Geotextile
 - 8.2.1 Sand Filter
- (P) Piping
 - 9.1.1 Underdrain
 - 9.1.2 Distribution Pipe
 - 9.1.3 Domed Riser
 - 9.2.2 Anti-seep Collar
 - 9.3.1 Cleanout
 - 9.4.1 Observation Well
- (PM) Planting Media
 - 6.1.1 Engineered Soil
- (SE) Stormwater Entrance
 - 2.1.2 Depressed Curb
- (SM) Storage Media
 - 7.1.1 Stone



PERMEABLE ASPHALT (EXAMPLE STREET)



PERMEABLE CONCRETE (EXAMPLE SIDEWALK)



PERMEABLE PAVER (EXAMPLE PARKING LANE)

NOTES TO DESIGNER:

1. This design detail should be adapted to the specific engineered design of a respective installation.
2. The use of an impervious concrete base course is typical in Philadelphia streets and, when present, must be removed as part of the permeable pavement installation.
3. All edges between new and existing asphalt pavement shall be sealed with hot asphalt cement. Also, joints between utility frames for manholes and inlets or other utility owned structures and permeable asphalt wearing course shall be sealed with hot asphalt cement for a distance of 6-inches from the edge of the frame.
4. Pavement markings on permeable pavement surfaces shall be liquid epoxy pavement markings in accordance with PennDOT Publication 408, Section 964.
5. Permeable concrete pavement restoration shall cover the full area between original sidewalk joints of the slab disturbed, unless smaller pavement blocks to be sawcut from the slab are approved by the Streets Department.
6. Gaps at edges of permeable paver areas shall be filled with cut units. Cut pavers subject to tire traffic shall be no smaller than 1/3 of a whole unit.
7. The surface elevation of permeable pavers shall be 1/8-inch to 1/4-inch above drainage inlets.

APPLICABLE DESIGN COMPONENTS

(MS) Media Separation

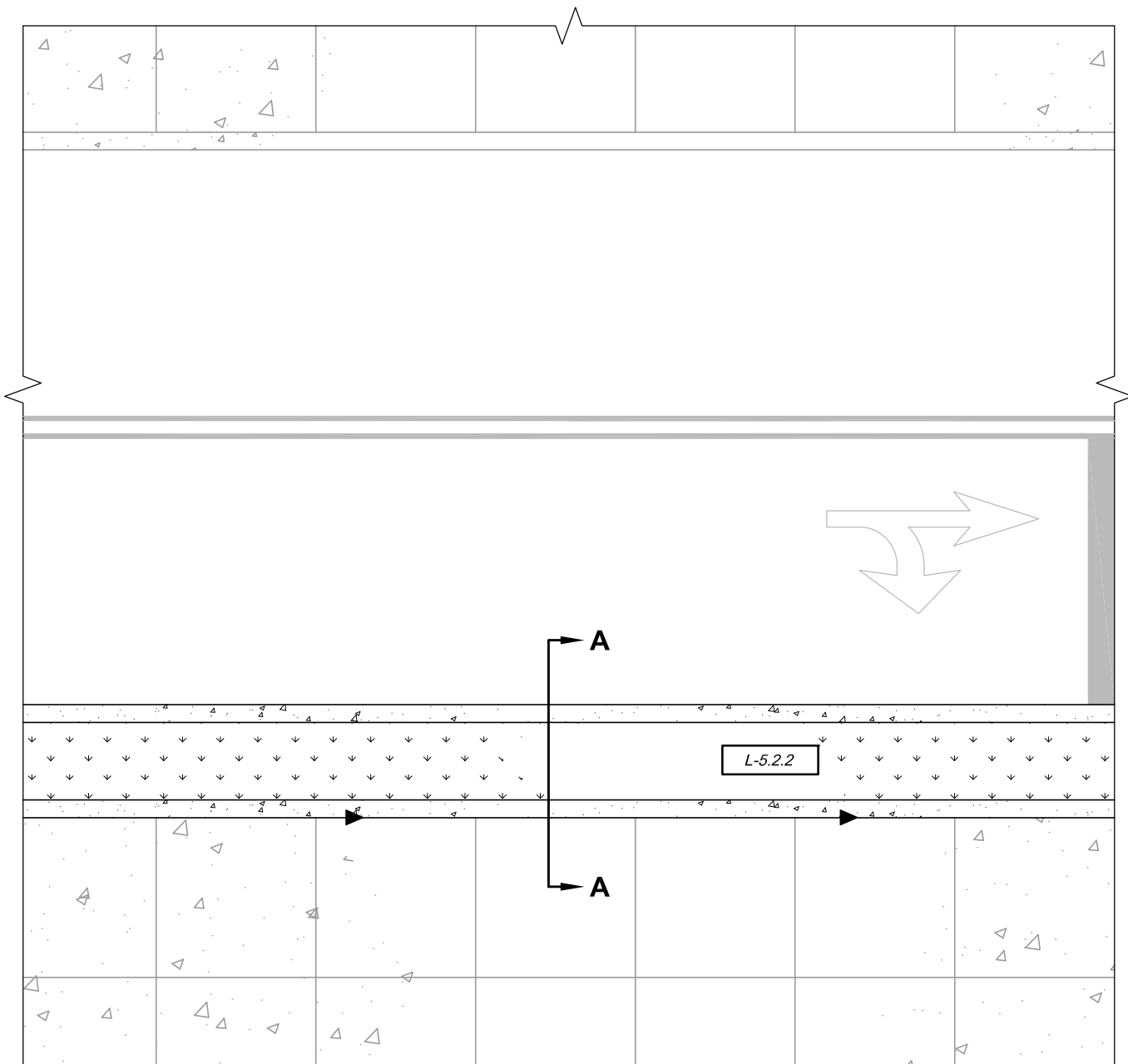
- 8.1.1 Geotextile

(SE) Stormwater Entrance

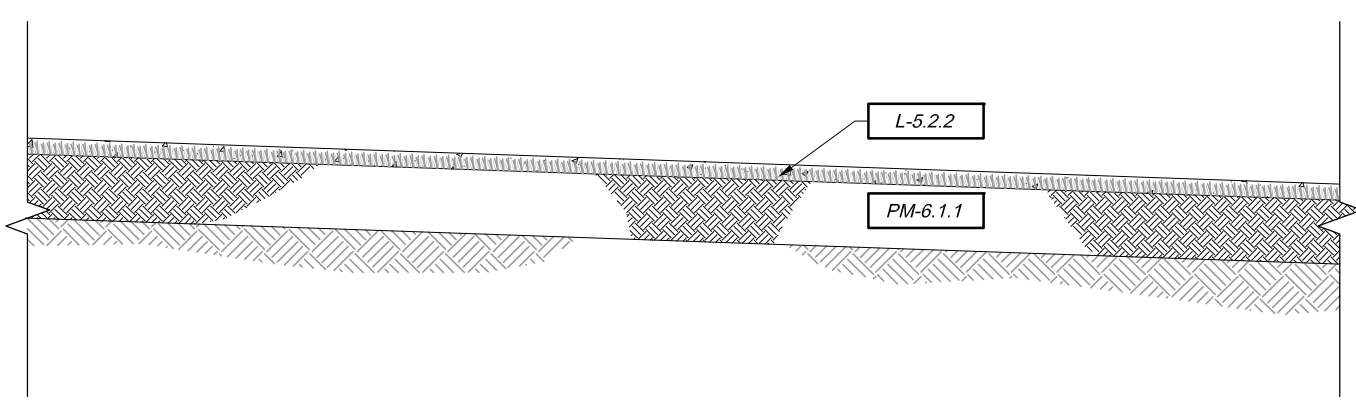
- 2.3.1 Permeable Asphalt
- 2.3.2 Permeable Concrete
- 2.3.3 Permeable Pavers

(SM) Storage Media

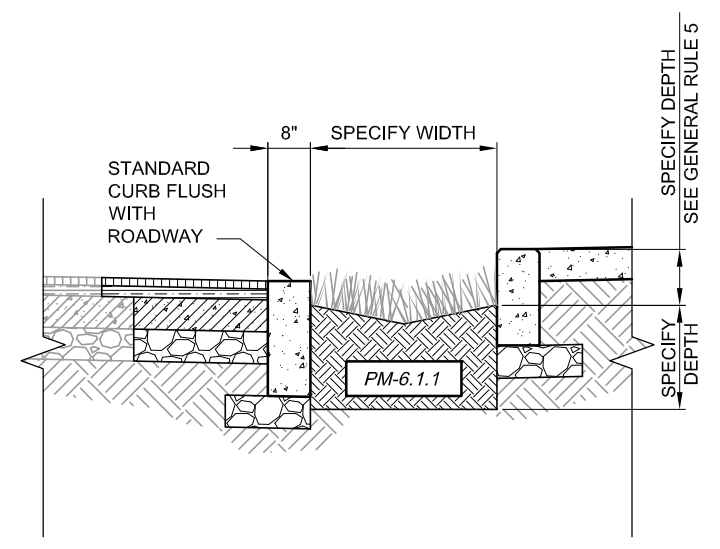
- 7.1.1 Stone



PLAN



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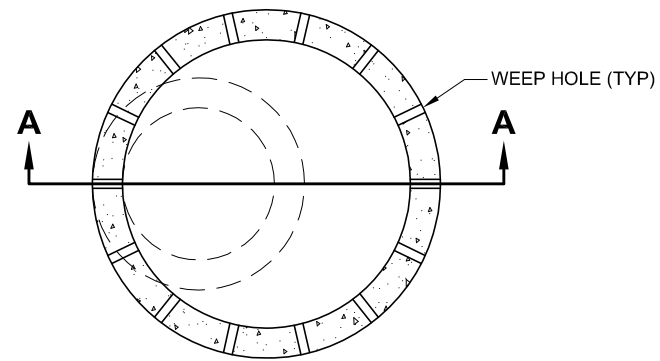
SECTION A-A

NOTES TO DESIGNER

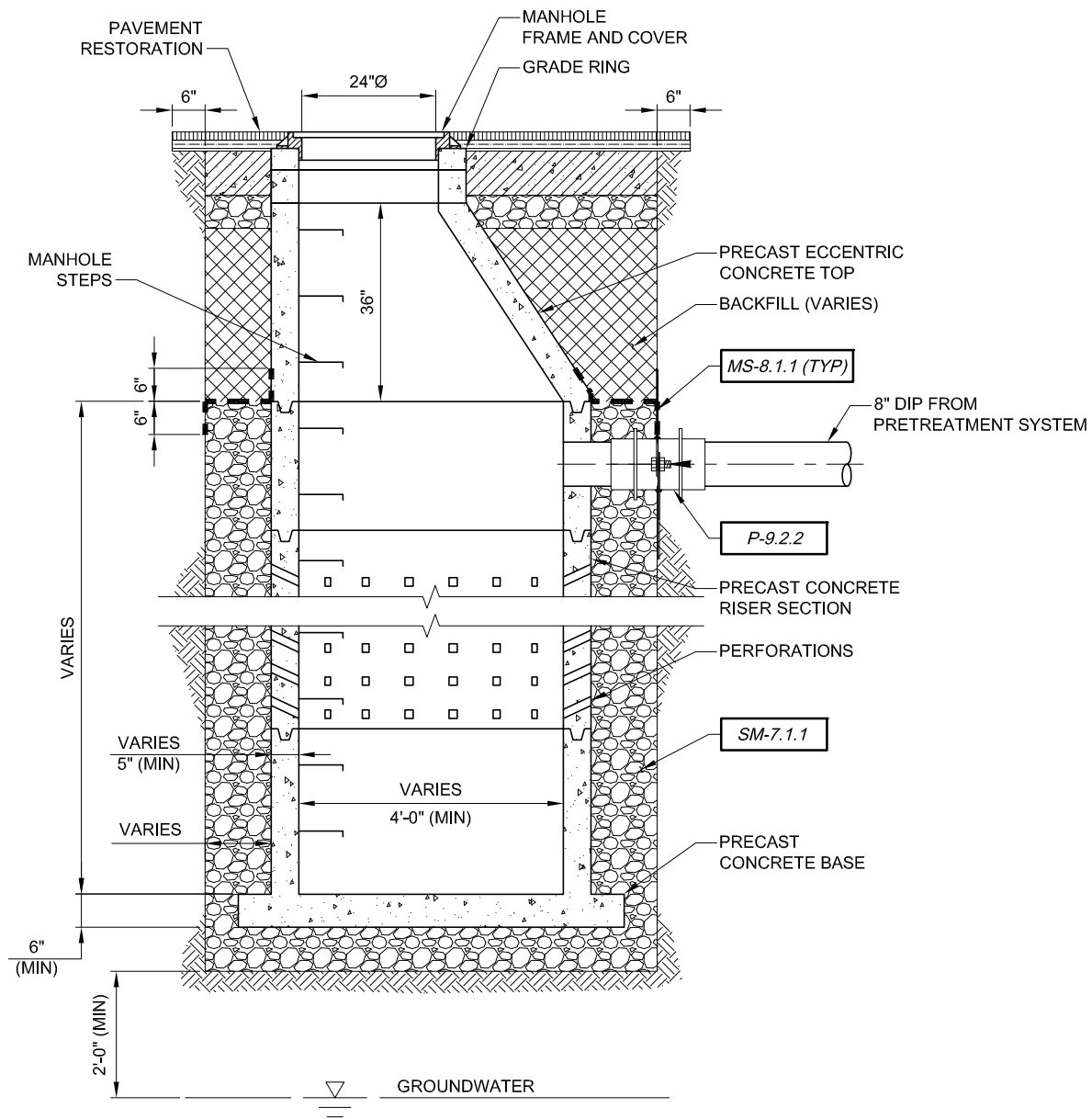
1. This design detail should be adapted to the specific engineered design and its respective installation.
2. Consider adding rumble strips or cobble to the curb adjacent to and flush with the street to give an additional cue about change in gutter surface. A raised curb with openings may be used and may be more appropriate for certain conditions in lieu of flush curb.

APPLICABLE DESIGN COMPONENTS

- (L) Landscaping
- ☑ 5.2.2 Plants, Grasses, and Shrubs
- (PM) Planting Media
- ☑ 6.1.1 Engineered Soil



PLAN



SECTION A-A

NOTES TO DESIGNER

1. Precast eccentric top, manhole frame, manhole cover, and steps must be in accordance with PWD's standard precast concrete manhole per PWD's Standard Details and Standard Specifications for Sewers.
2. Manhole wall and base thickness will vary depending on manhole depth and structural design and must be specified by designer.
3. Use appropriate precast adapter sections to join precast concrete riser section with PWD standard precast eccentric top as needed if riser sections vary from standard diameter and wall thickness of eccentric top.
4. Specify size and spacing of perforations as well as depth of manhole and surrounding stone as required based on system sizing and infiltration rate of surrounding soils.
5. Pretreatment systems vary but must always be provided before directing any stormwater into the stormwater drainage well.
6. Backfill shall be appropriate for the surface restoration surrounding the stormwater drainage well.
7. PWD will provide direction on minimum required separation between bottom of stormwater drainage well and groundwater.

APPLICABLE DESIGN COMPONENTS

(MS) Media Separation

- 8.1.1 Geotextile

(SM) Storage Media

- 7.1.1 Stone

(P) Piping

- 9.2.2 Anti-seep Collar



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appendix **6.2**

Design Components Specifications

Table of Contents

18	Area Protection
23	Stormwater Entrance
40	Pretreatment
42	Energy Dissipation
47	Landscaping
59	Planting Media
61	Storage Media
63	Media Separation
65	Piping
80	Impermeable Barriers

Area Protection

AP

Summary

The Area Protection (AP) Functional System includes design components that provide some level of protection between a stormwater management practice (SMP) and the pedestrian environment.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Area Protection design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-1 Area Protection

1.1 Barriers

- 1.1.1 Fencing
- 1.1.2 Curb
- 1.1.3 Wall
- 1.1.4 Edging
- 1.1.5 Delineators
- 1.1.6 Multipurpose Barrier

1.2 Buffers

- 1.2.1 Landscaping Buffer

1.3 At-grade Transitions

- 1.3.1 Sidewalk Grates

1.1.1 Fencing

Description

Fencing used for area protection includes short, rigid fencing that can be placed around a stormwater management practice (SMP) to provide a visual and tactile alert for pedestrians.

Specifications

- Top of fencing must be a minimum of 18-inches above the surrounding grade.
- Fencing must include vertical pickets with a maximum spacing of 4-inches.

Additional Considerations/Options

There are a variety of materials that can be used for fencing such as wrought iron, aluminum, or other materials. It can also be of a variety of colors, shapes, and patterns and can add a decorative appearance to an SMP.

Additional Considerations

Not applicable.

Applicability

May use where area protection is required around an SMP in the sidewalk area including stormwater planters and stormwater trees or on sidewalk side of stormwater bump-outs.

Submittal Requirements

In all cases, submit details of proposed fencing including manufacturer, product number, materials, painting specifications, fastener details, and proposed post anchoring for review and approval.

References

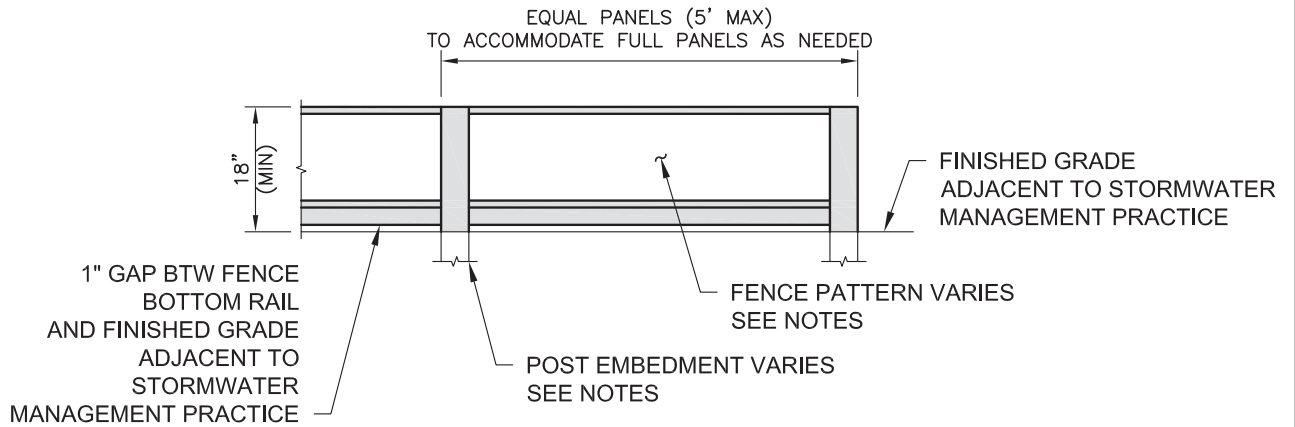
Not applicable.

Attachments

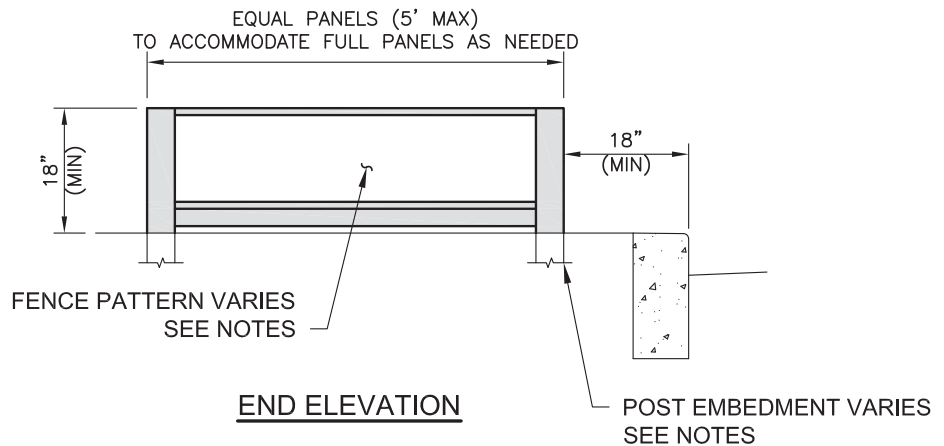
- Fencing detail



AP



FRONT ELEVATION



END ELEVATION

NOTES:

1. SPECIFIC FENCE PATTERN, POST/RAIL DIMENSIONS, MATERIALS, COLOR, JOINTS, AND OTHER FENCE DETAILS SHALL BE SPECIFIED BY DESIGNER FOR REVIEW AND APPROVAL BY PWD.
2. POSTS MAY BE EMBEDDED IN SIDEWALK SURROUNDING STORMWATER MANAGEMENT PRACTICE (SMP) OR WITHIN THE PLANTING MEDIA OF THE SMP. SPECIFIC EMBEDMENT OF POST SHALL BE DESIGNED FOR SPECIFIC SITE CONDITIONS.



2014

FENCING

1.1.2 Curb

Description

Curb used for area protection includes any curb like barrier that rises above the footway and can be placed around a stormwater management practice (SMP) to provide a visual and tactile alert for pedestrians. It is generally no taller than 8-inches, distinguishing it from a wall. Also, it is not to be confused with standard roadway curbing constructed for sidewalks or the curbing in the street that surrounds stormwater bump-outs, although its design and construction may be the same or similar. In the case of stormwater planters, the curb around the planter may simply be the reveal of the stormwater planter wall above the grade of the sidewalk.

Specifications

- All edges of the curb shall have beveled or softened edges.
- Curbing must be secure and unmovable without the use of mechanized power equipment.

Additional Considerations/Options

There are a variety of materials that can be used for area protection curb such as concrete, granite, or other materials. Curb constructed from poured materials such as concrete can be pigmented with color which adds visual interest but also helps make them more detectable. Curb can also be decorated through painting or tiling. Although not required, using a curb that has a different color than the surrounding surfaces is a recommended practice for making the curb more visually detectable.

Applicability

May use where area protection is required around an SMP in the sidewalk area including stormwater planters and stormwater trees or on sidewalk side of stormwater bump-outs.

Submittal Requirements

Not applicable.

References

Not applicable.

Attachments

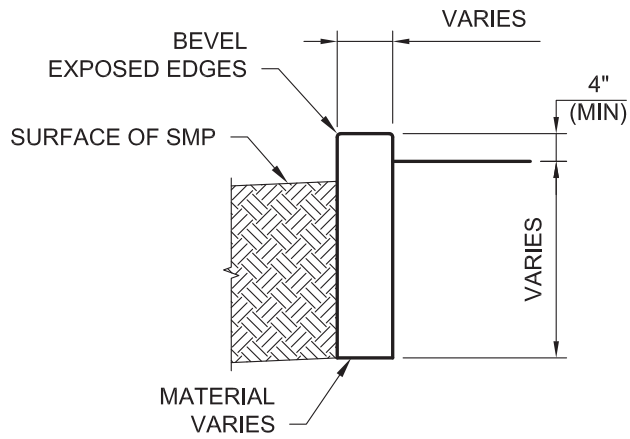
- Curb detail



AP



AP



2014

CURB

Stormwater Entrance

SE

Summary

The Stormwater Entrance (SE) Functional System includes design components that allow stormwater to enter a stormwater management practice (SMP) or Green Street system. This generally includes different inlet types but also includes a few related items that are supplementary to and support the function of stormwater entrances.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Stormwater Entrance design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-2 Stormwater Entrance and Entrance Related

2.1 At-Grade Inlets

- 2.1.1 Curb Cut
- 2.1.2 Depressed Curb
- 2.1.3 Lay-by Inlet
- 2.1.4 Trench Drain

2.2 Inlet Structures

- 2.2.1 Green Inlet
- 2.2.2 Shallow Inlet
- 2.2.3 Dual Connection Inlet
- 2.2.4 Upflow through Domed Riser

2.3 Permeable Surfaces

- 2.3.1 Permeable Asphalt
- 2.3.2 Permeable Concrete
- 2.3.3 Permeable Pavers

2.4 Other Inlet Types

- 2.4.1 Curb Insert (e.g. scupper, curb-o-let)
- 2.4.2 Formed Opening Through Curb
- 2.4.3 Hollow Curb
- 2.4.4 Curb Core

2.5 Entrance Related

- 2.5.1 Wheel Guard
- 2.5.2 Gutter Apron

SE

2.1.1 Curb Cut

Description

A curb cut is simply a cut in an curb that allows stormwater runoff from the street to enter a stormwater management practice (SMP) located directly behind the back edge of the curb cut. Note the curb cut is made in an existing curb and is not to be confused with a curb that is poured with an opening.

Specifications

- Curb cuts must be saw-cut such that all edges are cut square and clean.
- All exposed edges must be beveled.

Additional Considerations / Options

A wheel guard can be added to curb cuts where needed. Also, concentrated flow needs to be managed to prevent erosion directly behind the curb cut

Applicability

May use where it is necessary to convey stormwater runoff from the street to the surface of an SMP directly behind the back edge of the curb. Typically applied on stormwater trees.

Submittal Requirements

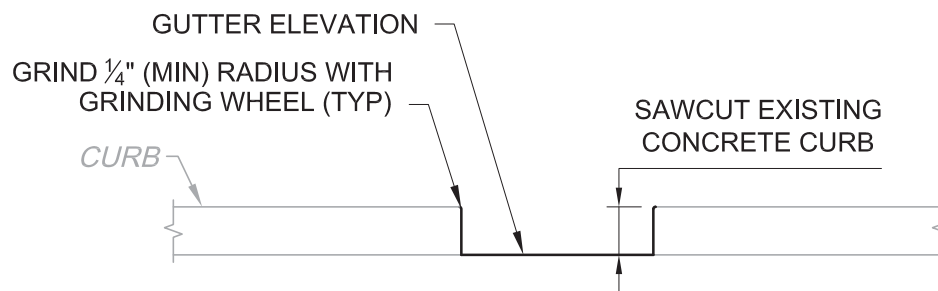
Not applicable.

References

Not applicable.

Attachments

Curb cut detail



FRONT ELEVATION

NOTE:

1. SIZE OPENING BASED ON STORMWATER CAPTURE REQUIREMENTS.
2. A WHEEL GUARD CAN BE ADDED TO CURB CUTS WHERE NEEDED OR REQUIRED. WHERE PENNDOT REQUIRES A WHEEL GUARD, IT MUST BE RATED FOR H-20 LOADING.



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CURB CUT

SE

2.1.2 Depressed Curb

Description

A depressed curb is a curb that is poured with one or more sides tapered down to an opening that allows stormwater runoff from the street to enter a stormwater management practice (SMP) directly behind the back edge of the depressed curb. Note that a curb poured with one or more vertical sides on either side of the opening rather than tapered also constitutes a depressed curb and is not to be confused with a curb cut.

Specifications

- All specifications that apply to standard curb per Streets Department Detail L-892 apply to depressed curbs.

Additional Considerations/Options

A wheel guard may be required for depressed curbs.

Applicability

Not applicable.

Submittal Requirements

Not applicable.

References

Not applicable.

Attachments

Curb cut detail





FRONT ELEVATION

NOTES:

1. THE DIMENSIONS OF DEPRESSED CURBS VARY DEPENDING ON THEIR LOCATION AND PLACEMENT.
2. SIZE OPENING BASED ON STORMWATER CAPTURE REQUIREMENTS.



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DEPRESSED CURB

2.1.4 Trench Drain

Description

A trench drain is a shallow concrete trench with a grate or solid cover over the top of the trench that allows stormwater runoff from the street to enter a stormwater management practice (SMP). The trench drain allows the stormwater to be conveyed across a distance while maintaining the grades of the surrounding surfaces through the use of the grate or solid cover.

Specifications

- Trench drains shall be heavy duty with bolted grate or solid cover. All bolts shall be stainless steel or as recommended by manufacturer.
- All grates or covers used shall be ADA compliant.
- All concrete used for trench drains shall have a minimum specified compressive strength of 3500 pounds per square inch (psi) per ACI 318 / ASTM C39 unless otherwise specified.
- Trench drain assembly shall be in accordance with the attached PWD Trench Drain Assembly detail.
- PWD currently approves Neenah R-4999 with "Riverwalk" pattern or approved equal.
- Trench Draining rates must comply with AASHTO H-20 loading requirements.

Additional Considerations/Options

Trench drains are manufactured and sized for many different site conditions and should be selected accordingly. In addition, some trench drain grates and covers offer decorative features or can add design interest based on their patterns or color. Lastly, because metal grates or covers can become slippery when wet, additional considerations should be given to addressing this issue such as the use of slip resistant materials, textured surfaces, or other measures.

Applicability

May use where it is necessary to convey stormwater runoff from the street to the surface of an SMP while traversing a path of travel such as a sidewalk. Typically applied on stormwater planters.

Submittal Requirements

If a trench drain or trench drain assembly other than that specified above is proposed, submit a detail of proposed trench drain including configuration and details of all proposed sizes, materials, manufacturer, and product number of all items used for the trench drain.

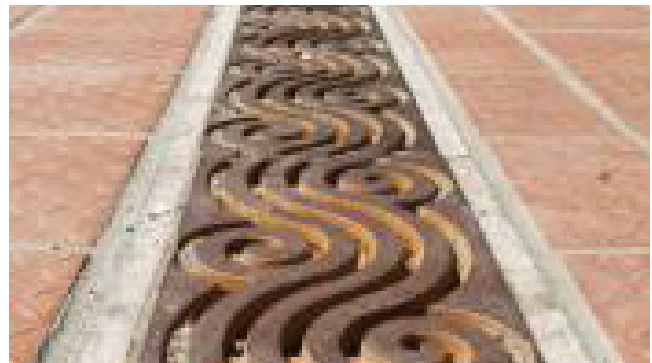
References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

Attachments

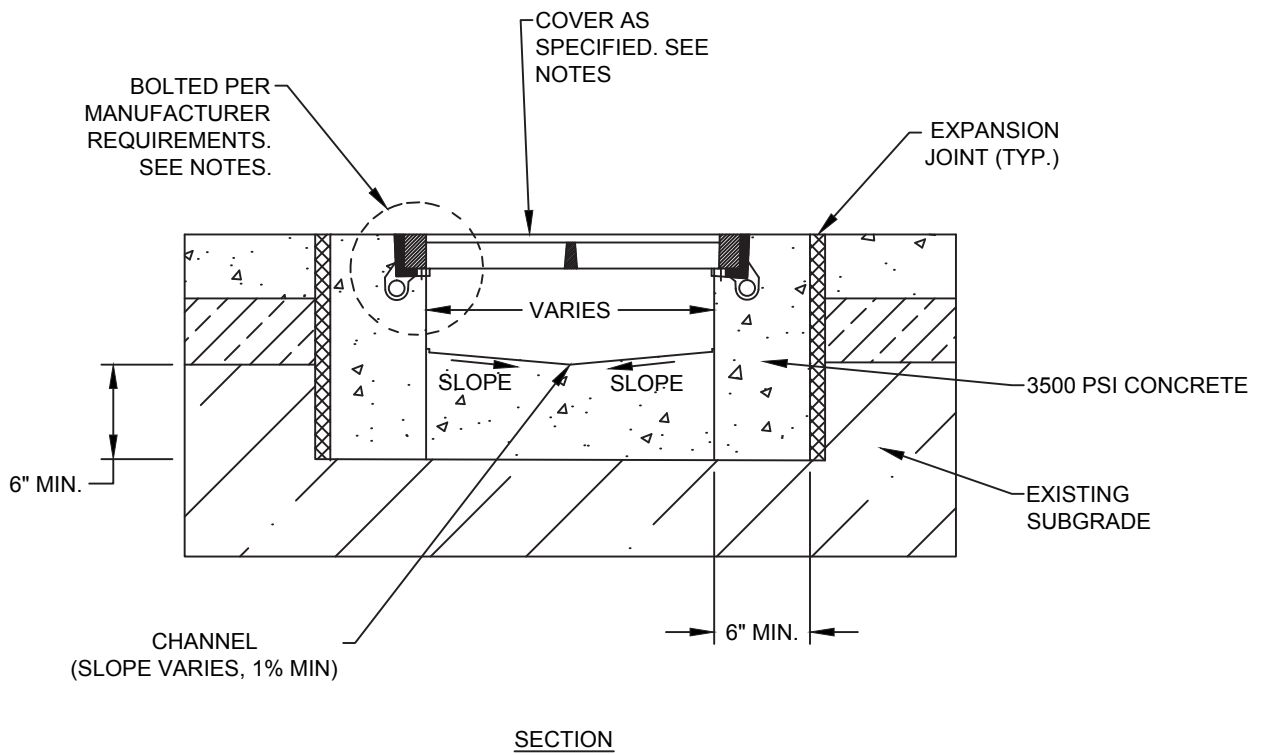
- PWD Trench Drain Assembly detail

Trench Drain Examples



NOTES:

1. MUST BE HEEL SAFE AND ADA COMPLIANT
2. MUST BE H-20 LOADING
3. MUST BE BOLTABLE



2014

TRENCH DRAIN ASSEMBLY

2.2.1 Green Inlet

Description

A green inlet is a standard PWD inlet structure except that it does not have a connection to the sewer. Instead, it only includes a pipe connected to a stormwater management practice (SMP) or Green Street system and some form of water quality protection installed in it, such as a filter insert (see PR-3.1.1), for pretreatment purposes.

Specifications

- Green Inlet shall be in accordance with the attached PWD Green Inlet with Protection detail.

Additional Considerations/Options

Not applicable.

Applicability

Must use where it is necessary to convey stormwater runoff from the street to the subsurface of an SMP. Typically applied on stormwater tree trenches.

Submittal Requirements

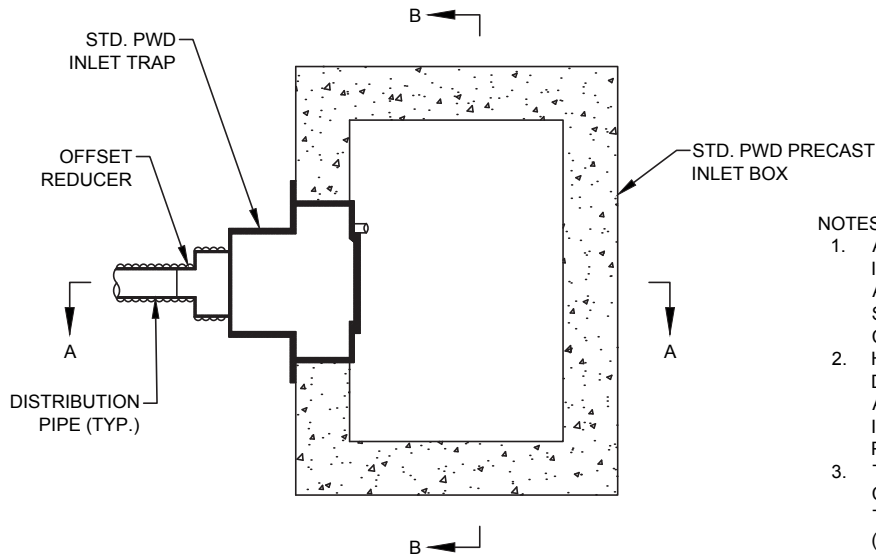
Not applicable.

References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)

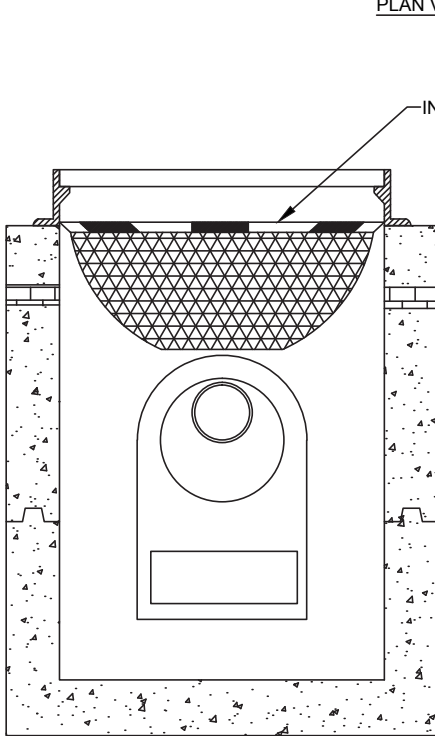
Attachments

- PWD Green Inlet with Protection detail

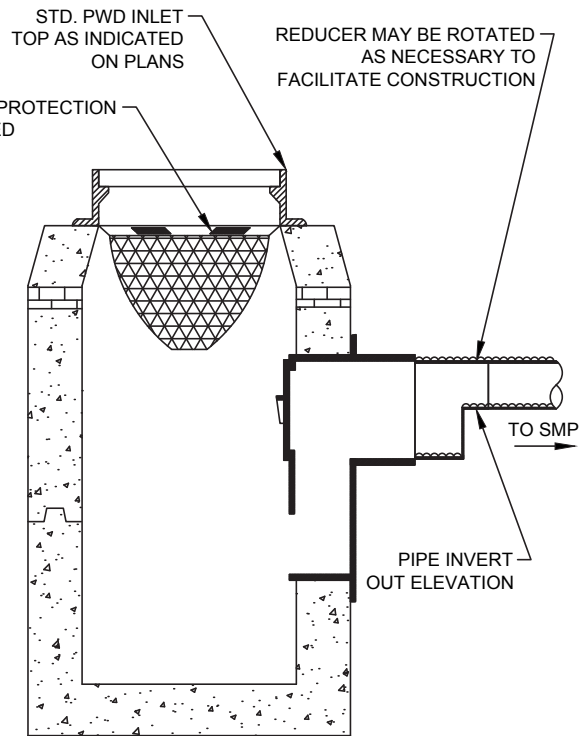


- NOTES:
1. ALL CONCRETE COMPONENTS, INLET GRATE AND FRAME, AND INLET TRAP SHALL BE STANDARD PWD CONSTRUCTION.
 2. HIGHWAY INLET DEPICTED; DESIGN IS GENERALLY APPLICABLE TO ALL PWD INLETS, WITH APPROPRIATE PROTECTION DEVICE.
 3. THIS INLET HAS NO SEWER CONNECTION. CONNECTION TO STORMWATER SYSTEMS (SMP) ONLY.

PLAN VIEW



SECTION VIEW B-B



SECTION VIEW A-A



2014

GREEN INLET WITH PROTECTION

SE

2.3.1 Permeable Asphalt

Description

Permeable asphalt is standard bituminous asphalt which limits the fine aggregate in comparison to impervious asphalt, making the pavement permeable and allowing stormwater to pass through the surface. While permeable asphalt and any storage media below the asphalt comprise the stormwater management practice (SMP), the permeable asphalt surface has been isolated as a stormwater entrance design component because the permeable surface functions as the stormwater entrance to the SMP.

Specifications

- Specifications for permeable asphalt wearing course are as follows:
 1. Air Void Content > 18%
 2. Bituminous Asphalt Content (by weight) 5-7%
 3. Bituminous Asphalt shall be Grade PG 76-22. Additives to be employed shall be approved prior to placement.
 5. Aggregate Material to be clean, open graded, and a minimum of 75% fractured with at least one fractured face by mechanical means of each individual particle larger than 1/4". Aggregate gradation to meet the following particle size limitations:

Sieve Size	Percent Passing By Weight
5/8"	100%
1/2"	95-100%
3/8"	70-95%
No. 4	20-40%
No. 8	10-20%
No. 40	0-8%
No. 200	0-3%

- Specifications for permeable asphalt binder course are as follows:
 1. Air Void Content > 22%
 2. Bituminous Asphalt Content (by weight) > 3-4%
 3. Bituminous Asphalt shall be Grade PG 64-22 or higher. Additives to be employed shall be approved prior to placement.
 4. Aggregate Material to be clean, open graded, and a minimum of 75% fractured with at least one fractured face by mechanical means of each individual particle larger than 1/4". Aggregate gradation to

meet the following particle size limitations:

Sieve Size	Percent Passing By Weight
1"	100%
3/4"	90-100%
1/2"	80-100%
3/8"	50-80%
No. 4	10-20%
No. 8	5-10%
No. 40	3-8%
No. 200	0-3%

- Choker course shall be AASHTO No. 8 as defined in Standard Sizes of Course Aggregate, Table 4, AASHTO Specifications, Part I, latest edition and meet the following specifications:
 1. Maximum wash loss of 1% (ASTM C117)
 2. Minimum Durability Index of 35 (ASTM D3744)
 3. Maximum abrasion of 10% for 100 revolutions and maximum of 40% for 500 revolutions
 4. Shall be clean and thoroughly washed.
 5. Aggregate gradation to meet the following particle size limitations:

U.S. Standard Sieve Size	Percent Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

- Pavement (including stone bed and all paving layers) shall be designed for a 25-year service life using the standard AASHTO flexible paving design method as described in PennDOT Publication 242 - Pavement Policy Manual.

Additional Considerations/Options

Not applicable.

Applicability

May be used in either full or partial width repaving projects within the street. Typically applied on streets.

Permeable asphalt is not currently permitted for installation within State Routes.

Submittal Requirements

If a permeable asphalt mix other than that specified above is proposed, submit complete specification of proposed permeable asphalt.

References

- PWD Green Master Specification (dated September 25, 2012)
- Philadelphia Streets Department, Standard Specifications for Paving and Repaving.
- Philadelphia Streets Department, Standard Construction Items.
- PennDOT Publication 408 – Specifications
- PennDOT Publication 242 – Pavement Policy Manual.
- Pennsylvania Department of Environmental Protection (PaDEP) Stormwater Best Management Practice Manual, Section 6.4.1 – Pervious Pavement with Infiltration Bed.
- National Asphalt Pavers Association (NAPA) Information Series 131 – Porous Asphalt Pavements.
- American Association of State and Highway Transportation Officials (AASHTO) Guide for Design of Pavement Structures with 1998 Supplement (GDPS -4-M).
- Pavement Structures with 1998 Supplement (GDPS-4-M)

Attachments

Not applicable.

Permeable Asphalt Examples



2.3.2 Permeable Concrete

Description

Permeable concrete is a specifically formulated mixture of Portland cement, open graded course aggregate, and water which creates enough void space to allow stormwater to pass through the surface. While permeable concrete and any storage media below the concrete comprise the stormwater management practice (SMP), the permeable concrete surface has been isolated as a stormwater entrance design component because the permeable surface functions as the stormwater entrance to the SMP.

Specifications

- Permeable concrete shall comply with ASTM C94/C94M and ACI 522.1-08.
- Nominal aggregate size shall not exceed one-third (1/3) of the specified pavement thickness.
- Admixtures, fibers, and pigments shall be permitted only when approved by mix designer.
- Density and void content shall be measured on test samples using ASTM C 1688/C 1688M – 08 or equivalent. Unit weight shall be within +/- five (5) pounds per cubic foot of design. Voids shall be 15% minimum and 21% maximum.
- Mix design shall be substantially similar to design specified below.

Mixture Component	Weight (lbs)	Percent by Volume (%)
Portland Cement	611	11.5
Coarse Aggregate CA – ½" cover	2290	50.5
Fine Aggregate	310	7.0
Polypropylene Fibers	2.0	0.1
Water	183 (22.0 Gallons)	10.9
Volumetric Design Unit Weight – 125.8 pcf		
Volumetric Design Void Content – 20.0 %		
Fine / Coarse Aggregate Ratio – 12.0 %		

SE

- Course aggregate for concrete mixes shall meet the following grading requirements:

Sieve Size	Percent Passing By Weight
1½"	100
3.4"	100
1/2"	94
3/8"	30
#4	2
#8	1
#16	1
#30	1
#50	1
#100	1
Pan	0

- Fine aggregate for concrete mixes shall meet the following grading requirements:

Sieve Size	Percent Passing By Weight
1½"	100
3.4"	100
1/2"	100
3/8"	100
#4	97
#8	88
#16	74
#30	45
#50	10
#100	1
Pan	0

- Choker course shall be AASHTO No. 8 as defined in Standard Sizes of Course Aggregate, Table 4, AASHTO Specifications, Part I, latest edition and meet the following specifications:
 - Maximum wash loss of 1% (ASTM C117)
 - Minimum Durability Index of 35 (ASTM D3744)
 - Maximum abrasion of 10% for 100 revolutions and maximum of 40% for 500 revolutions
 - Shall be clean and thoroughly washed.
 - Aggregate gradation to meet the following particle size limitations:

U.S. Standard Sieve Size	Percent Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

- Minimum acceptable designed 28-day compressive strengths for permeable concrete are 3500 psi for roadway paving and 3000 psi for footway paving.

Additional Considerations/Options

Color pigmented concrete is an option that can be considered for permeable concrete surfaces.

Applicability

May be used in either full or partial width repaving projects within the street or sidewalk. Typically applied on sidewalks.

Permeable concrete is not currently permitted for installation within State Routes.

Submittal Requirements

If a permeable concrete mix other than that specified above is proposed, submit complete specification of proposed pervious concrete.

References

- PWD Green Master Specification (dated September 25, 2012)
- American Concrete Institute (ACI) Standard 522.1-08 – Specification for Pervious Concrete Pavement.

Attachments

Not applicable.

2.3.3 Permeable Pavers

Description

Permeable pavers are interlocking units that either have aggregate joints that allow stormwater to pass in between the pavers and through the joints or the pavers themselves are permeable and allow stormwater to pass through their surface. While permeable pavers and any storage media below the pavers comprise the stormwater management practice (SMP), the permeable paver surface has been isolated as a stormwater entrance design component because the permeable surface functions as the stormwater entrance to the SMP.

Specifications

- All pavers shall comply with ASTM C936 as a minimum for materials, ASTM C140 for compressive strength, and ASTM C979 for coloring and pigmentation.
- Choker course and joint filler aggregate shall be as recommended by the paver manufacturer or AASHTO No. 8 as defined in Standard Sizes of Course Aggregate, Table 4, AASHTO Specifications, Part I, latest edition and meet the following specifications:
 1. Maximum wash loss of 1% (ASTM C117)
 2. Minimum Durability Index of 35 (ASTM D3744)
 3. Maximum abrasion of 10% for 100 revolutions and maximum of 40% for 500 revolutions
 4. Shall be clean and thoroughly washed.
 5. Aggregate gradation to meet the following particle size limitations:

U.S. Standard Sieve Size	Percent Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

- All pavers shall be certified for H-20 loading or greater for all traffic applications (including sidewalk installation within the City right-of-way). Add required edge restraints as required. Concrete curbing is an acceptable edge restraint in all applications where the curb extends below the paver bedding layer.

Additional Considerations/Options

Pavers come in a variety of colors and materials. Also, there are multiple options for paver laying pattern that can be considered.

Applicability

May be used in either full or partial width repaving projects within the street's parking lane or shoulder, or within sidewalk. Typically applied on sidewalks.

Permeable pavers are not currently permitted for installation within State Routes.

Submittal Requirements

If permeable pavers other than that specified above is proposed, submit complete specification of proposed permeable pavers.

References

- PWD Green Master Specification (dated September 25, 2012)
- Interlocking Concrete Pavement Institute (ICPI) – Permeable Interlocking Concrete Pavement Manual and related documents.

Attachments

Not applicable.

SE 2.5.1 Wheel Guard

Description

A wheel guard is a plate that is placed across a curb opening to cover the opening and to maintain a constant surface along the top of the curb. By maintaining the top of curb, wheel guards help prevent car wheels from entering the curb opening. Wheel guards are also sometimes referred to as wheel stops.

Specifications

- Wheel guards shall be steel plate with a minimum tensile strength of 35,000 pounds per square inch (psi) and in conformance with PWD Standards Specifications for Gray and Ductile Iron.
- Bolts and attachments shall be stainless steel (Grade 304 or 316).

Additional Considerations/Options

Other materials may be applicable and beneficial to use as wheel guards such as strong composite plastics. Also, wheel guards of different materials, patterns, and colors can offer decorative features or can add design interest.

Applicability

Must use on openings that are parallel to traffic. Typically applied on stormwater bump-outs.

Submittal Requirements

If a wheel guard material other than that specified above is proposed, submit a detail of proposed wheel guard including configuration and details of all proposed sizes, materials, manufacturer, and product number of all items used for the wheel guard.

References

- PWD Standards Specifications for Gray and Ductile Iron
- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.



2.5.2 Gutter Apron

Description

A gutter apron is a section of concrete that is placed along the gutter line in front of curb openings that have a restriction along the top of the opening, such as City Inlets and trench drains. The concrete for gutter aprons is cast-in-place and provides an increased cross slope as well as tapered sides that slope toward the curb opening. Gutter aprons help form and maintain inlet openings, particularly in cases where there is limited curb reveal to begin with or after milling/repaving operations where the new pavement could potentially block the original curb opening. Gutter aprons also help to increase the inlet capacity by directing water towards the curb openings.

Specifications

- Concrete used for gutter aprons shall have a minimum specified compressive strength of 3500 pounds per square inch (psi) per ACI 318/ASTM C39. All concrete shall conform to PWD's Standard Specifications for Masonry Concrete.

Additional Considerations/Options

Limit slopes of aprons to prevent creating a tripping hazard. In addition, aprons that create a drop of more than 8-inches at the face of the curb could prohibit car doors from opening.

Applicability

May use on curb opening type inlets such as City Inlets and trench drains or other curb openings where there is a restriction along the top of the opening such as a curb cut or depressed curb with a wheel guard installed. The size and location of gutter aprons must be approved on a case-by-case basis by the Highway Division of the Streets Department. However, gutter aprons proposed in parking lanes that are not likely to be cleared for traffic have the best likelihood of being approved. Typically applied on stormwater bump-outs and stormwater planters.

Submittal Requirements

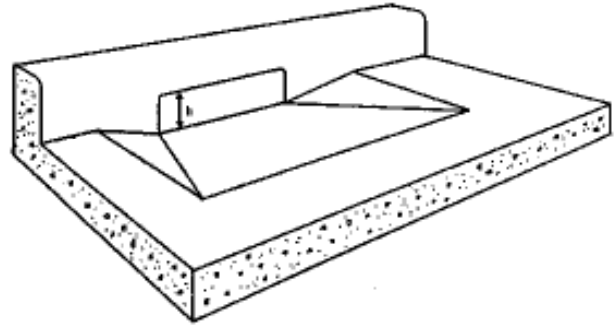
Submit a detail of proposed gutter apron including proposed location as well as configuration and details of proposed dimensions and slopes.

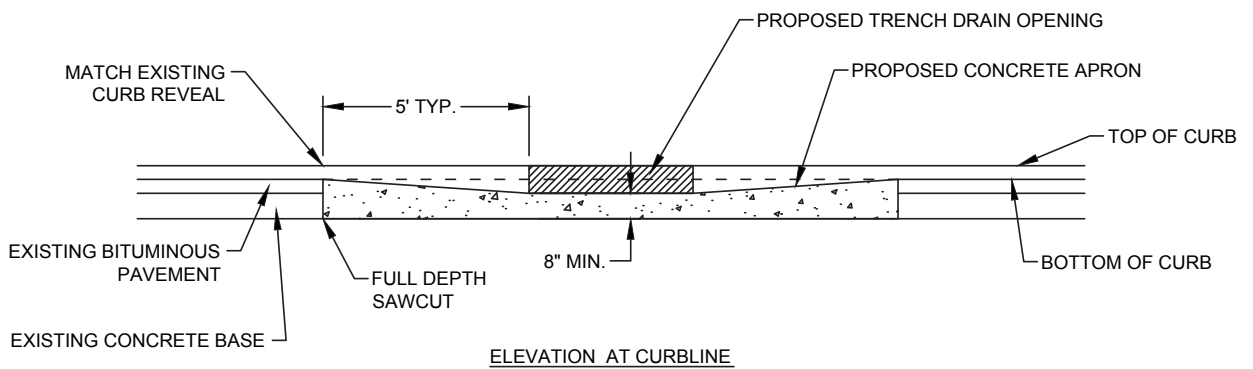
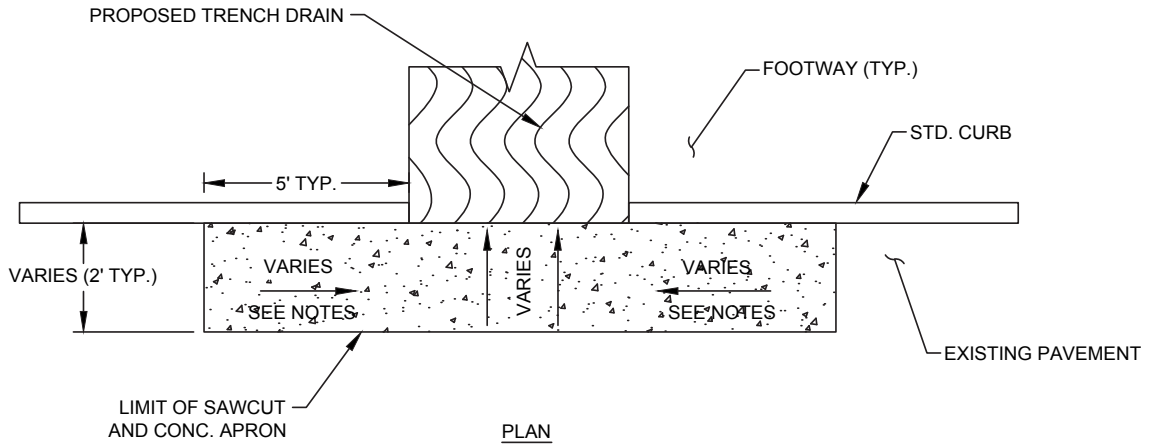
References

- PWD's Standard Specifications for Masonry Concrete
- PWD Green Master Specification (dated September 25, 2012)
- PWD Green Infrastructure Standard Details (dated December 6, 2012)

Attachments

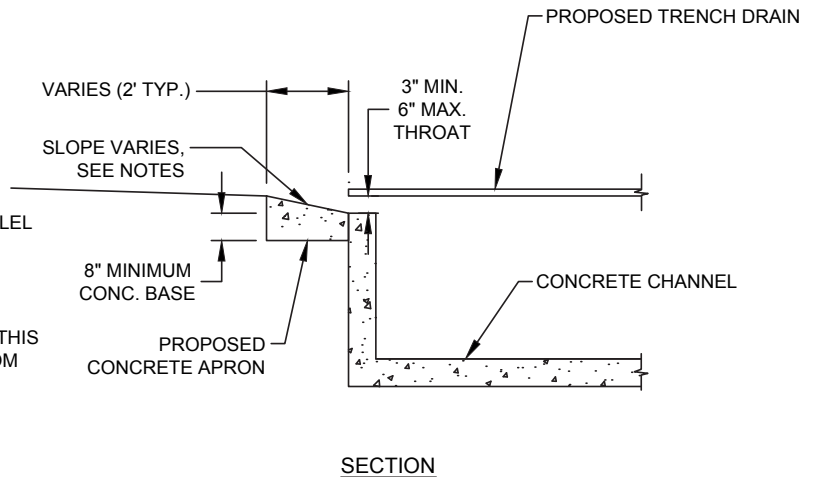
- PWD Concrete Apron at City Inlets detail
- PWD Concrete Apron at Trench Drain detail





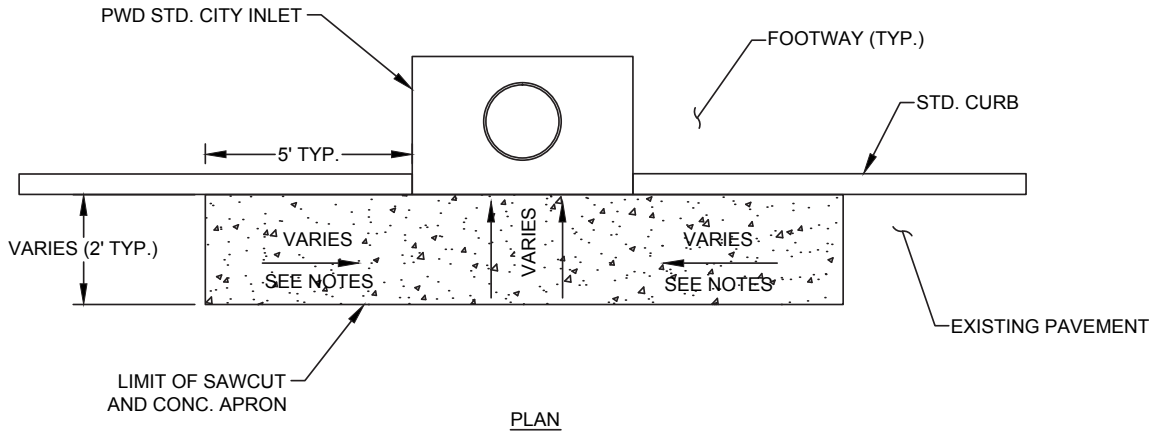
NOTES:

1. MAXIMUM SLOPE OF APRON PARALLEL TO CURB IS 2%. THIS VALUE IS SUBJECT TO REVIEW FROM THE STREETS DEPARTMENT.
2. MAXIMUM SLOPE OF APRON PERPENDICULAR TO CURB IS 15%. THIS VALUE IS SUBJECT TO REVIEW FROM THE STREETS DEPARTMENT.

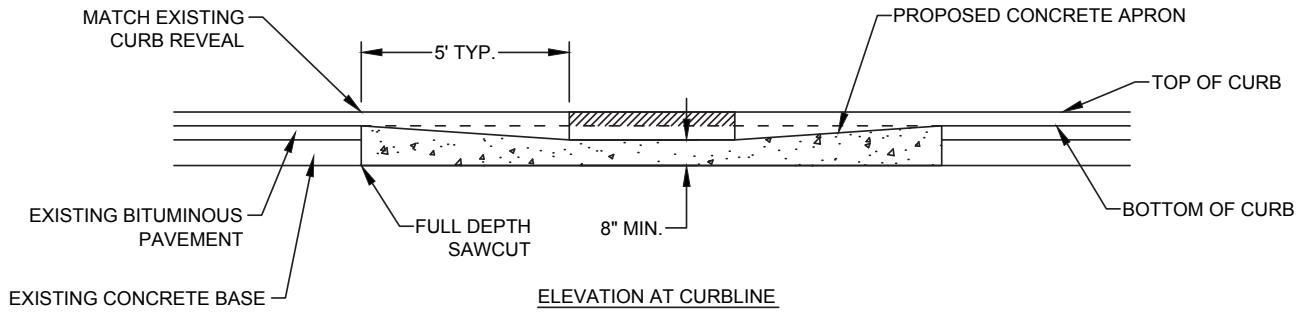


2014

CONCRETE APRON AT TRENCH DRAIN

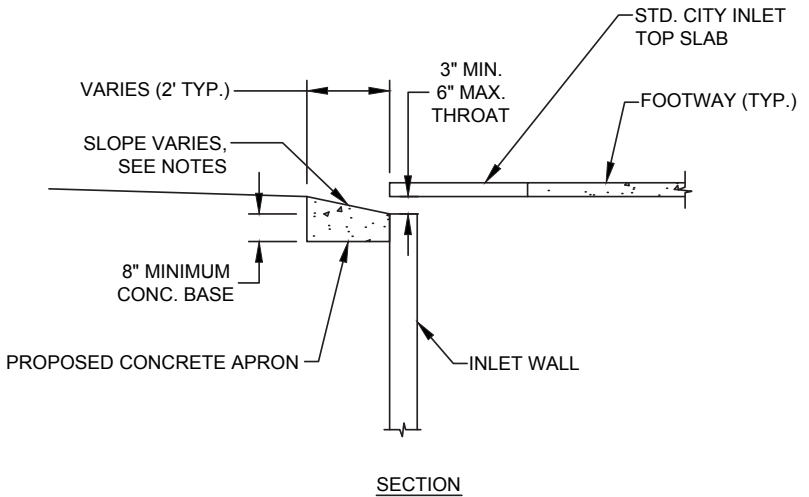


PLAN



ELEVATION AT CURBLINE

- NOTES:
1. MAXIMUM SLOPE OF APRON PARALLEL TO CURB IS 2%.
 2. MAXIMUM SLOPE OF APRON PERPENDICULAR TO CURB IS 15%.



SECTION



2014

CONCRETE APRON AT CITY INLETS

Pretreatment

PR

Summary

The Pretreatment (PR) Functional System includes design components that reduce or prevent sediment and trash in stormwater runoff from entering a stormwater management practice (SMP) or Green Street system and help prevent clogging, reduce maintenance needs, and increase SMP/system longevity. Pretreatment is recommended for all SMPs or Green Street systems but is always required where stormwater enters directly into the subsurface of an SMP or Green Street system.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Pretreatment design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-3 Pretreatment

3.1 Inlet Inserts

- 3.1.1 Filter Insert

3.2 Inlet Barriers

- 3.2.1 Opening Covers (e.g. grate plate)

3.1.1 Filter Insert

Description

A filter insert is a manufactured filter unit that is inset into stormwater inlet structures and domed risers. Filter inserts screen stormwater and remove particles before they enter a distribution pipe or the subsurface of a stormwater management practice (SMP) or Green Street system.

Specifications

- Filter inserts for inlet structures shall have the following minimum properties:
 - a. Sediment bag
 - i. Flow rate: 200 gallons per minute per square foot (gpm/sqft)
 - ii. AOS: 20 (sieve size)
 - iii. Puncture Strength: 135 pounds
 - iv. Filtration Efficiency: 82%
 - b. Frame
 - i. Stainless steel construction
 - ii. Integral lifting points
- Filter inserts for domed risers shall have the following minimum properties:
 - a. Sediment bag
 - i. Flow rate: 137 gallons per minute per square foot (gpm/sqft)
 - ii. AOS: 140 (US Sieve)
 - iii. Filtration Efficiency: 82%
 - b. Frame
 - i. Stainless steel construction
 - ii. Integral lifting points
- PWD currently approves of the Flexstorm 62XLHDFX System for grate inlets, the Flexstorm 62HDWM2 System for City inlets, and the Flexstorm 62SRDPCP System for domed risers as manufactured by Inlet and Pipe Protection Inc. (a division of ADS, Inc.) or approved equals.

Additional Considerations/Options

Filter inserts are manufactured and sized for many inlet sizes and types and should be selected accordingly. Some manufacturers provide filter material options that offer special pretreatment such as targeting specific pollutants. Also, the hydraulic capacity of the filter insert must be adequate to avoid causing any flow restriction to the required hydraulic capacity of the inlet structure or domed riser into which it is installed.

Applicability

Must use in green inlets (see SE-2.2.1) and domed risers (see P-9.1.3) unless another approved pretreatment design component or method is used.

Submittal Requirements

If a filter insert other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacture, and product number of all items used for the filter insert.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

Energy Dissipation

ED

Summary

The Energy Dissipation (ED) Functional System includes design components that dissipate the energy of stormwater entering a stormwater management practice (SMP) in order to prevent and reduce erosion and potential damage caused by the incoming stormwater.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Energy Dissipation design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-4 Energy Dissipation

4.1 Formed Materials

- 4.1.1 Splash Pad

4.2 Loosely Placed Materials

- 4.2.1 Level Spreader

4.3 Grade Changes

- 4.3.1 Surface Sump

4.4 Vertical Obstacles

- 4.4.1 Baffles

4.1.1 Splash Pad

Description

A splash pad is a combination of hardscape materials placed in the form of a physical pad that provides a hard surface for stormwater entering a stormwater management practice (SMP) to run across, or “splash” against, before flowing over the surface of the SMP, thereby dissipating energy of the incoming stormwater.

Specifications

- Any concrete used for splash pads shall have a minimum specified compressive strength of 3500 pounds per square inch (psi) per ACI 318 / ASTM C39 and shall conform to PWD’s Standard Specifications for Masonry Concrete.
- Loose materials (e.g. stone, brick, cobbles, etc) should be placed and secured such that it is not removable by hand.

Additional Considerations/Options

There are various options for splash pad materials, colors, and geometry that can provide decorative features or design interest while being designed to adequately reduce the velocity, energy, and turbulence of the flow entering an SMP to prevent erosive potential of the surface material in the SMP.

Applicability

Must use on the surface of an SMP whenever stormwater is concentrated and the energy of the water needs to be dissipated unless another approved energy dissipation design component or method is used. Typically applied on stormwater planters and stormwater bump-outs.

Submittal Requirements

If a splash pad other than one of the attached PWD example splash pad details is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, and colors used for the splash pad.

References

- PWD Green Infrastructure Standard Details (dated December 6 2012)
- PWD Green Master Specification (dated September 25, 2012)

Attachments

PWD Example Splash Pad details:

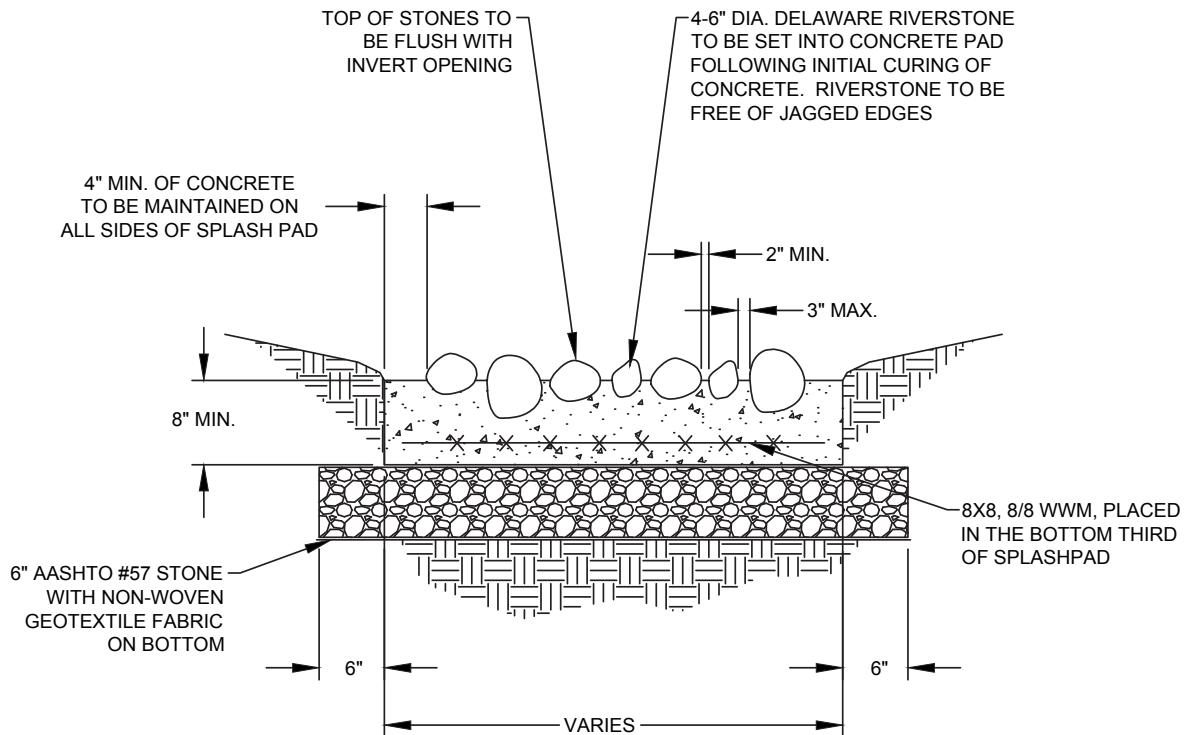
- Rock Splash Pad
- Brick Splash Pad



ED

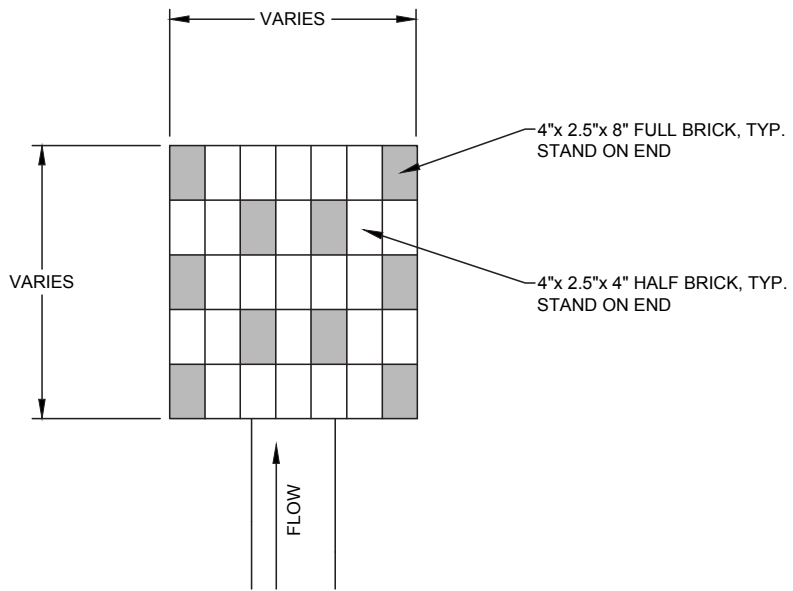


ED

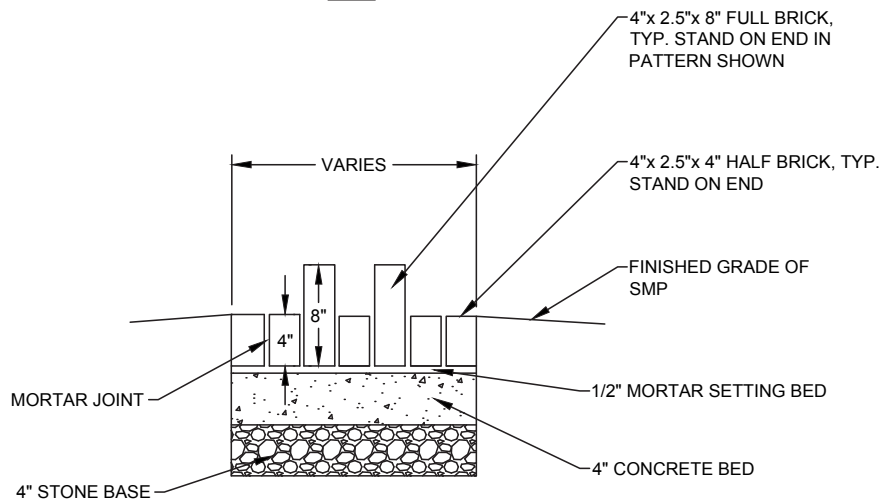


2014

ROCK SPLASH PAD



PLAN



SECTION



2014

BRICK SPLASH PAD

4.3.1 Surface Sump

Description

A surface sump is a small depression located at the entrance to a stormwater management practice (SMP) that creates a pooling area where the stormwater must drop into before flowing out into the SMP, thereby dissipating energy of the incoming stormwater.

Specifications

Not applicable.

Additional Considerations/Options

There are various shapes and materials that can be used for surface sumps that can provide decorative features or design interest while being designed to adequately reduce the velocity, energy, and turbulence of the flow entering an SMP to prevent erosive potential of the surface material in the SMP.

Applicability

Must use on the surface of an SMP whenever stormwater is concentrated and the energy of the water needs to be dissipated unless another approved energy dissipation design component or method is used. Typically applied on stormwater planters and stormwater bump-outs.

Submittal Requirements

Not applicable.

References

Not applicable.

Attachments

Not applicable.

Landscaping



Summary

The Landscaping (L) Functional System includes landscaping materials used in a stormwater management practice (SMP).

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Landscaping design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-5 Landscaping

5.1 E&S / Final Stabilization

- 5.1.1 Erosion Control Blanket
- 5.1.2 Temporary Seeding

5.2 Vegetation

- 5.2.1 Trees
- 5.2.2 Plants, Grasses and Shrubs
- 5.2.3 Seeding
- 5.2.4 Vines and Trellises

5.3 Top Dressings

- 5.3.1 Mulch
- 5.3.2 Stone

L 5.1.1 Erosion Control Blanket

Description

Erosion control blanket is a material that is placed on top of planting media in order to prevent erosion of the soil while vegetation is becoming established.

Specifications

- Erosion Control Blanket shall meet the following requirements:
 1. Shall be a 100% jute fiber hand-woven into a one-inch by one-inch (1" x 1") net. Jute netting shall be of a uniform, open, plain weave, undyed and unbleached single jute yarn. Yarn shall be of loosely-twisted construction, and shall not vary in thickness by more than one-half its normal diameter.
 2. Blanket shall be 100% biodegradable.
 3. Minimum width shall be forty-eight inches (48") or plus/minus one inch (+/- 1") from manufacturer rated width. Weight shall average a minimum of 0.9 pounds per square yard.
 4. Netting shall at minimum consist of seventy-eight (78) warp ends per forty-eight-inch (48") width, and forty-one (41) weft ends per linear yard.
- Furnish attachment devices as recommended by blanket manufacturer.
- PWD currently approves ACF Environmental Woven Jute Mesh Erosion Control Blanket or approved equal.

Additional Considerations/Options

Over time, erosion control blankets degrade naturally in place. In addition, like mulch, erosion control blankets also help retain soil moisture and buffer soil temperature.

Applicability

May use on the surface of the planting media where extra protection from erosion or flotation of mulch is likely. Typically applied on stormwater bump-outs and stormwater trees.

Submittal Requirements

If erosion control blanket other than that specified above is proposed, submit complete specification for proposed erosion control blanket.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

5.2.1 Trees

Description

Trees are used both within and outside of vegetated stormwater management practices (SMP) and are an important element of green streets. They create shade, make SMPs more attractive and visible, help to reduce heat island effects, improve air quality, help maintain and improve soil permeability, and provide evapotranspiration of the stormwater being managed.

Specifications

- Native species are preferred.

Additional Considerations/Options

Selected tree species for street applications must be able to withstand a wide range of conditions. Consider stressors such as wind, exposure, salt tolerance, insects, drought and inundation tolerance, and disease as well as micro-climates and sunlight conditions.

Applicability

Typically used in stormwater tree trenches and stormwater trees but may be used in stormwater planters and stormwater bump-outs or outside of SMPs altogether.

Submittal Requirements

Submit location and species of all trees to Philadelphia Parks and Recreation (PP&R) for review and approval.

References

- PWD Green Stormwater Infrastructure Design Requirements and Guidelines Packet, GSI Recommended Plant List (dated March 26, 2013)

Attachments

- Tree Pit detail
- GSI Recommended Plant List (Trees Only)

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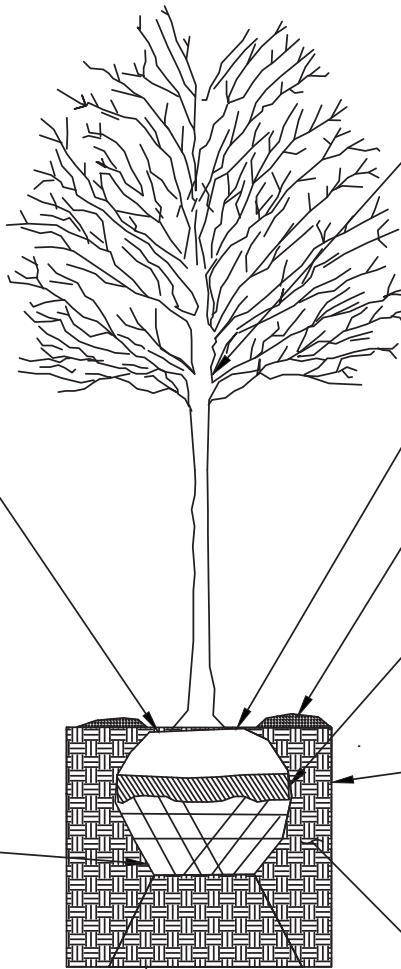
NOTES:

1. THE TRUNK OF THE TREE SHALL NOT BE USED AS A LEVER IN POSITIONING OR MOVING THE TREE. CONTRACTOR SHALL LEAVE NURSERY/CONTRACTOR SEAL IN PLACE.

CONTRACTOR SHALL EXPOSE THE TREE ROOT FLARE PRIOR TO PLANTING TO ENSURE THAT THE BASE OF THE TRUNK FLARE IS LEVEL WITH FINISHED GRADE AND THE TREE IS PLUMB IN ALL DIRECTIONS. TREES WITH ROOT FLARES SET BELOW GRADE WILL BE REJECTED.

PLACE ROOT BALL ON FIRMLY PACKED SOIL PEDESTAL TO PREVENT SETTLING AND PROVIDE TREE STABILITY

SCARIFY SOIL HORIZON WHERE PLANTING SOIL MEETS UNDISTURBED SOIL TO DEPTH OF ROOT BALL



DO NOT HEAVILY PRUNE THE TREE AT PLANTING. PRUNE ONLY CO-DOMINANT LEADERS, BROKEN, DEAD OR DAMAGED BRANCHES. PRUNE WITH A CLEAN CUT PER ANSI A300 & ISA (2008) STANDARDS. DO NOT CUT TREE'S CENTRAL LEADER.

KEEP MULCH 6" AWAY FROM TRUNK FLARE

2" DOUBLE SHREDDED HARDWOOD MULCH DRESSING AROUND ALL SIDES TO THE EDGE OF THE SIDEWALK OPENING.

CUT AND REMOVE 2/3 OF WIRE BASKET OR BURLAP; REMOVE TREE WRAP OR CARDBOARD TUBING FROM ALL TREE TRUNKS. DO NOT LEAVE MATERIALS IN THE TREE PIT.

PLACE GEOTEXTILE ON SIDES OF TREE PIT WHEN IN CONTACT WITH AN SMP'S STORAGE MEDIA, IF APPLICABLE.

PLANTING MEDIA BACKFILL IN 6" LIFTS, FIRMLY TAMPING EACH LIFT TO PREVENT SETTLEMENT.



2014

TREE PIT

PWD GSI Recommended Plant List (Trees Only)

Species	Common Name	Native to US	Height	Bloom Time	Bloom Color	Wetland Indicator Status	Inundation Tolerance	Drought Tolerance	Hydrologic Zone	Sun/Shade	Salinity Tolerance	Winter Interest	Recommended SMP Type		
													Tree Trench	Bump-out	Planter
SMALL TREES (UNDER 30')															
<i>Acer campestre</i>	Hedge Maple	No	25-35'	Apr - June	yellow	N/A	seasonal	H	[4],5,6	Full Sun	Low		*		
<i>Amelanchier canadensis</i>	Canadian Service Berry	Yes	20-30'	Apr - June	white	FAC	seasonal	L	[4],5,6	Full Sun - Part Shade	Low	*			
<i>Cercis canadensis</i>	Eastern Redbud	Yes	20-30'	March - June	purple	FACU	seasonal	H	[4],5,6	Full Sun - Part Shade	Low			*	
<i>Chionanthus virginicus</i>	Fringetree	Yes	20-25'	Apr - June	white	FAC+	seasonal	M	4,5,6	Full Sun - Part Shade	Low		*	*	
<i>Cornus florida</i>	Flowering Dogwood	Yes	20-25'	Apr - May	white	FACU	seasonal	L	[4],5,6	Full Sun - Part Shade	Low		*	*	
<i>Crataegus crus-galli var. inermis</i>	Thornless Cockspur Hawthorne	Yes	20-25'	Apr - June	white	FAC	seasonal	H	[4],5,6	Full Sun	High			*	
<i>Crataegus viridis 'Winter King'</i>	Winter King Hawthorne	Yes	20-25'	Apr - June	white	N/A	seasonal	H	[4],5,6	Full Sun	Low		*	*	
<i>Magnolia virginiana</i>	Sweetbay Magnolia	Yes	10-30'	May - Aug	white	FACW+	seasonal	N	4,5,6	Full Sun	Low	*	*	*	
<i>Syringa reticulata</i>	Japanese Tree Lilac	No	20-25'	June - Sept	white	N/A	seasonal	H	4,5,6	Full Sun - Part Shade	High		*	*	
MEDIUM TREES (30-40')															
<i>Koelreuteria paniculata</i>	Goldenrain Tree	No	20-40'	July - Aug	yellow	N/A	seasonal	H	[4],5,6	Full Sun	Low		*	*	
<i>Ilex opaca</i>	American Holly	Yes	20-40'	May - June	white	FAC-	seasonal	M	5,6	Full Sun - Part Shade	High	*		*	
<i>Juniperus virginiana</i>	Eastern Redcedar	Yes	30-40'	N/A	N/A	FACU	seasonal	H	5,6	Full Sun	Low	*			
LARGE TREES (OVER 40')															
<i>Chamaecyparis thyoides</i>	Atlantic White Cedar	Yes	40 - 50'	N/A	N/A	OBL	seasonal	N	4,5,[6]	Full Sun	Low	*			
<i>Nyssa sylvatica</i>	Blackgum	Yes	30-60'	N/A	N/A	FAC	seasonal	M	4,5,6	Full Sun	High		*		
<i>Quercus bicolor</i>	Swamp White Oak	Yes	50-60'	Apr - June	yellow	FACW+	seasonal	M	4,5,6	Full Sun	Low		*		
<i>Quercus imbricaria</i>	Shingle Oak	Yes	40-60'	Apr - June	yellow	FAC	seasonal	M	[4],5,6	Full Sun	Low		*		
<i>Taxodium distichum</i>	Bald Cypress	Yes	45-70'	N/A	N/A	OBL	seasonal	M	3,4,5,[6]	Full Sun	High	*	*		
<i>Zelkova serrata 'Green Vase'</i>	Japanese Zelkova	No	40-60'	Apr - June	N/A	N/A	seasonal	M	4,5[6]	Full Sun	High		*		



L 5.2.2 Plants, Grasses, and Shrubs

Description

Plants, grasses, and shrubs are landscape materials that make up the majority of vegetation used in a vegetated stormwater management practice (SMP) and make SMPs more attractive, help reduce heat island effects, improve air quality, help maintain and improve soil permeability, and provide evapotranspiration of the stormwater being managed.

Specifications

- Noxious weeds and invasive species shall not be used.
- Native species are preferred.

Additional Considerations/Options

Selected plant species for streets must be able to withstand a wide range of conditions. Consider stressors such as wind, exposure, salt tolerance, insects, drought and inundation tolerance, and disease as well as micro-climates and sunlight conditions. Also consider plant massing, form, color, bloom time and other visual characteristics for the site conditions. Lastly, consider using taller plants along the perimeter of an SMP that offer visual cues and may help discourage entry into the SMP.

Applicability

May use in any vegetated SMP including stormwater planters and stormwater bump-outs.

Submittal Requirements

Not applicable.

References

- PWD Green Stormwater Infrastructure Design Requirements and Guidelines Packet, GSI Recommended Plant List (dated March 26, 2013)

Attachments

- GSI Recommended Plant List
- PWD Container Planting detail
- PWD Shrub Planting detail

This section provides landscaping criteria and plant selection guidance for effective SMPs.

Recommended Plants

The following list of plant species represents herbaceous, tree, and shrub plants suitable for planting in stormwater management facilities within street rights-of-way in Philadelphia. This list is intended as a guide for general planting purposes and planning considerations. Knowledgeable landscape designers and nursery suppliers may provide additional information for considering specific conditions for successful plant establishment and accounting for the variable nature of stormwater hydrology. Because individual plants often have unique growing requirements difficult to convey in a general listing, it will be necessary to research specific information on the plant species proposed in order to ensure successful plant establishment.

Plant Selection and Arrangement

Species selection should be influenced by a variety of factors.

Aesthetics and visual characteristics should be a prime consideration. Plant form, texture, color, bloom time and fragrance are important to the overall feel of the site. The designer should carefully consider the long-term vegetation management strategy for the SMP.

Microclimates and stressors (e.g. wind, exposure, exposure to deicing salt, salt tolerance, insects, drought and inundation tolerance, and disease) should be considered when laying out the planting plan.

The proper selection and installation of plant materials is key to a successful system. There are essentially three zones within a bioretention system. The lowest elevation supports plant species adapted to standing and fluctuating water levels. The middle elevation supports a slightly drier group of plants, but still tolerates fluctuating water levels. The outer edge is the highest elevation and generally supports plants adapted to drier conditions. However, plants in all the zones should be drought tolerant. Plants should also have high salt tolerance if bioretention area receives runoff from ground level impervious surfaces.

Hydrologic Zone: Hydrologic zones describe the degree to which an area is inundated by water. Plants have differing tolerances to inundation. As an aid to landscape designers, these tolerance levels have been divided into six zones and corresponding plant species have been identified.

Hydrologic zones 2-4 are the lowest zones in an SMP, and should be planted with species adapted to standing and fluctuating water levels. Hydrologic zones 4-5 are middle zones, which are slightly drier than the lowest zones. Selected plants should be able to tolerate fluctuating water levels. Hydrologic zones 5-6 generally support plants adapted to drier conditions.

Plant Height: Plant heights (both at planting and at maturity) should be appropriate to the SMP. For example, planters that are set below grade in an urban environment may require larger plants, such as shrubs, to fill the void space. Heights need also be considered where sight lines are to be preserved, especially relevant for GSI within the right-of-way. Overhead utilities and soil volumes are also important considerations, especially when determining tree species. In urban conditions, tree heights may vary somewhat from heights described in the list in this manual.

Wetland Indicator Status: The wetland indicator status is from the National List of Plant Species that Occur in Wetlands: Northeast (Region 1) compiled by the U.S. Fish and Wildlife Service. The list indicates the likelihood that a plant will be found in a wetland. Because wetland indicator status is very generalized and does not contain information about depth or frequency of inundation, the "Hydrologic Zone," "Inundation Tolerance," and "Drought Tolerance" fields are also included.

Inundation Tolerance: Wetland Indicator Status alone does not provide an indication of the depth or duration of flooding that a plant will tolerate. The term "inundation tolerance" is designed to provide further guidance. If a plant is capable of withstanding permanent saturation, the depth of this saturation is listed in the Inundation Tolerance column in the PWD GSI Recommended Plant List. For example, "sat, 0-6" indicates that the species can survive in constantly moist soil conditions with up to 6 inches of standing water. Conversely, a plant may only tolerate seasonal inundation, such as after a storm event, or may not tolerate inundation at all.

Drought Tolerance: Drought tolerance is defined as the relative tolerance of the plant to drought conditions compared to other plants in the same region. The Drought Tolerance column in the PWD GSI Recommended Plant List is meant to provide a way for SMP designers to select appropriate native plants that can survive in hot summer conditions with minimal irrigation.

Salinity Tolerance: The use of deicing salts in winter to maintain safe roadways, sidewalks, driveways, and other areas is a common practice in Philadelphia. In particular, schools and snow emergency routes experience a higher application. These salts may have an adverse impact on plant material and GSI located in the right-of-way and/or receiving stormwater runoff from the right-of-way. A variety of sources were used to assess salinity tolerance, but research is still limited at this time. Plants with a high tolerance may be most appropriate to use in right-of-way.

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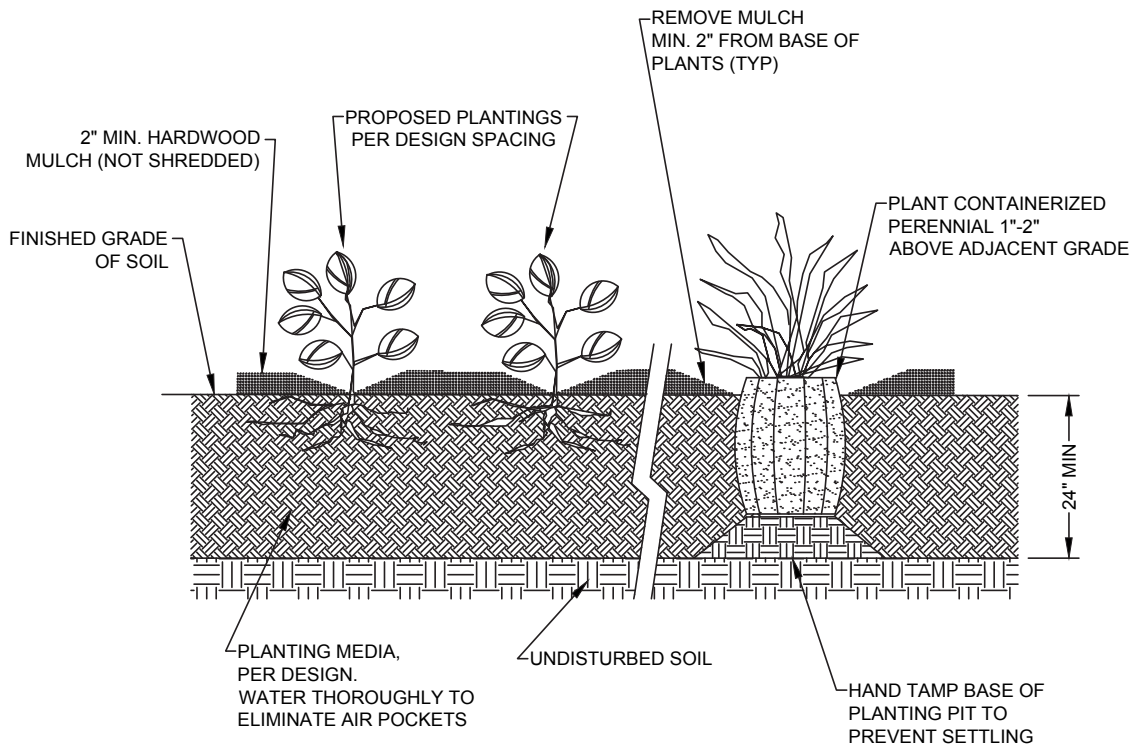
PWD GSI Recommended Plant List

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Species	Common Name	Native to US	Height	Bloom Time	Bloom Color	Wetland Indicator	Inundation Tolerance	Drought Tolerance	Hydrologic Zone	Sun/Shade	Salinity Tolerance	Winter Interest	Recommended SMP Type		
													Tree Trench	Bump-out	Planter
FORBS															
<i>Agastache rupestris</i>	Threadleaf Giant Hyssop	Yes	1-2'	July - Sept	Orange	FACU	no	M	N/A	Full Sun-Part Shade	Low		*		
<i>Allium cernuum</i>	Nodding Onion	Yes	1-2'	June - Aug	Pink	FACU	no	H	N/A	Full Sun-Part Shade	High		*		
<i>Aquilegia canadensis</i>	Red Columbine	Yes	2'	March - July	Red	FACU	no	L	4,5,[6]	Part Shade-Shade	High		*		
<i>Baptisia australis</i>	Blue Wild Indigo	Yes	3-5'	April - Aug	Blue	FACU	seasonal	H	4,5,6	Full Sun	High		*	*	
<i>Boltonia asteroides</i>	White Doll's Daisy	Yes	2-6'	July - Sept	White, Purple, P	FACW	no	H	5	Full Sun	Low		*		
<i>Coreopsis grandiflora</i>	Large-Flowered Tickseed	Yes	2-3'	July - Aug	Yellow	N/A	no	H	N/A	Full Sun	High		*		
<i>Echinacea purpurea</i>	Eastern Purple Coneflower	Yes	2-4'	July - Aug	Purple	N/A	seasonal	L	5	Full Sun-Part Shade	Low		*		
<i>Eupatorium hyssopifolium</i>	Hyssop-leaved Thoroughwort	Yes	2-3'	Aug - Oct	White	N/A	no	M	5,6	Full Sun-Part Shade	Low		*		
<i>Gaillardia aristata</i>	Blanketflower	Yes	1-2'	July - Sept	Red, Yellow	N/A	no	M	N/A	Full Sun	High		*		
<i>Geranium maculatum</i>	Wild Geranium	Yes	1-2'	April - June	Purple, Pink	N/A	no	H	N/A	Full Sun-Part Shade	High		*		
<i>Liatris spicata</i>	Dense Blazing Star	Yes	2-4'	July - Aug	Purple	FAC	seasonal	L	4,5	Full Sun	High		*		
<i>Oenothera fruticosa</i>	Narrowleaf Evening Primrose	Yes	1-2'	June	Yellow	FACU	no	L	5,6	Full Sun	High		*		
<i>Penstemon digitalis</i>	Foxglove Beardtongue	Yes	2-4'	June	White or Pink	FAC	seasonal	H	5,6	Full Sun-Part Shade	Low		*		
<i>Perovskia atriplicifolia</i>	Russian Sage	No	3-5'	July - Sept	Purple	N/A	no	H	N/A	Full Sun	High		*		
<i>Phlox subulata</i>	Moss Phlox	Yes	0-1'	April - May	Pink, White, F	N/A	seasonal	M	6	Full Sun-Part Shade	High		*		
<i>Physostegia virginiana</i>	Obedient Plant	Yes	1-5'	Summer-Fall	White, Purple, W	FAC+	seasonal	L	4,5	Full Sun-Part Shade	High		*		
<i>Pycnanthemum virginianum</i>	Virginia Mountainmint	Yes	2-3'	July - August	White	FAC	seasonal	M	3	Full Sun	Low		*		
<i>Rudbeckia fulgida</i>	Orange Coneflower	Yes	2-3'	July - Sept	Yellow	FAC	no	M	5,6	Full Sun-Part Shade	Low		*		
<i>Rudbeckia hirta</i>	Black-Eye Susan	Yes	2-3'	July - Sept	Yellow	FACU-	no	M	4,[5,6]	Full Sun-Part Shade	Low		*		
<i>Rudbeckia laciniata</i>	Cutleaf Coneflower	Yes	4-6'	July - Sept	Yellow	FACW	seasonal	H	4,5	Full Sun-Part Shade	Low		*	*	
<i>Rudbeckia triloba</i>	Brown Eyed Susan	Yes	1-3'	July - Oct	Yellow	FACU	no	M	5,6	Full Sun-Part Shade	Low		*		
<i>Ruellia humilis</i>	Fringeleaf Wild Petunia	Yes	1-2'	July - Oct	Purple	FACU	no	H	N/A	Full Sun-Part Shade	Low		*		
<i>Salvia nemorosa</i>	May Night Sage	No	2-3'	July - Sept	Purple	N/A	no	H	N/A	Full Sun	Low		*		
<i>Symphotrichum novae-angliae</i>	New England Aster	Yes	2-6'	Aug - Oct	Purple	FACW	seasonal	M	3,[4,5]	Full Sun-Part Shade	Low		*	*	
<i>Symphotrichum novi-belgii</i>	Newfoundland Aster	Yes	1'-3'	Aug - Oct	Purple	FACW-	seasonal	L	3,[4,5]	Full Sun	Low		*		
<i>Tradescantia virginiana</i>	Virginia spiderwort	Yes	2-3'	Jun - Sept	Blue, Purple	FAC	no	M	5,6	Full Sun-Part Shade	Low		*		
<i>Vernonia noveboracensis</i>	New York Ironweed	Yes	6-8'	Aug - Oct	Purple	FACW	seasonal	M	3,4	Full Sun	Low		*		
<i>Zizia aurea</i>	Golden Zizia	Yes	1-2'	May - June	Yellow	FAC	no	L	5,6	Full Sun-Part Shade	High		*		
GRASSES OR GRASS-LIKE															
<i>Andropogon virginicus</i>	Broomsedge Bluestem	Yes	2-4'	Jun - Sept	Gold	FACU	no	H	5,6	Full Sun-Part Shade	Low	*			
<i>Carex pennsylvanica</i>	Pennsylvania Sedge	Yes	8-10"	N/A	conspicuous/n	N/A	seasonal	M	5,6	Part-Full Shade	High		*		
<i>Carex vulpinoidea</i>	Fox Sedge	Yes	1-3'	N/A	conspicuous/n	OBL	sat,0-6"	M	1,2,[3],4	Full Sun-Part Shade	High		*		
<i>Helictotrichon sempervirens</i>	Blue Oat Grass	No	1-2'	May - June	conspicuous/n	N/A	no	L	N/A	Full Sun	Low		*		
<i>Juncus effusus</i>	Common Rush	Yes	3'	N/A	conspicuous/n	OBL	seasonal	M	[2,3],4	Full Sun	Low		*	*	
<i>Liriope muscari</i>	Lily Turf	No	1-1.5'	Aug - Sept	Purple	N/A	seasonal	H	N/A	Full Sun-Part Shade	Low		*		
<i>Muhlenbergia capillaris</i>	Pink Muhly Grass	Yes	3-4'	Aug - Oct	Pink	FAC	seasonal	H	[4,5],6	Full Sun	High		*	*	
<i>Panicum virgatum</i>	Switchgrass	Yes	4-8'	Jul - Aug	Pink	FAC	seasonal	M	[4,5],6	Full Sun-Part Shade	Low		*		
<i>Pennisetum alopecuroides</i>	Dwarf Fountain Grass	No	2-3'	Aug - Oct	Gold	N/A	no	H	N/A	Full Sun-Part Shade	Low		*		
<i>Pennisetum orientale</i>	Fountain Grass	No	3-4'	Aug - Oct	Pink	N/A	no	H	N/A	Full Sun-Part Shade	Low		*		
<i>Schizachyrium scoparium</i>	Little Bluestem	Yes	2-3'	Aug	Gold	FACU-	no	H	6	Full Sun	Low		*		
<i>Sporobolus heterolepis</i>	Prairie Dropseed	Yes	2-4'	Aug - Oct	Gold	UPL	seasonal	L	N/A	Full Sun	Low		*	*	
SHRUBS															
<i>Aronia melanocarpa</i>	Black Chokeberry	Yes	3-5'	Apr - June	White, Pink	FACW	seasonal	M	3,[4,5]	Full Sun-Part Shade	Low		*	*	
<i>Cornus sericea</i>	Red Twig Dogwood	Yes	2-8'	May - July	White	FACW+	seasonal	M	3,[4,5]	Full Sun	Low	*	*	*	
<i>Diervilla lonicera</i>	Northern Bush Honeysuckle	Yes	1-4'	June - Aug	Yellow	N/A	no	H	N/A	Full Sun-Part Shade	Low		*		
<i>Hydrangea quercifolia</i>	Oakleaf Hydrangea	Yes	6-8'	Apr - June	White, Pink	N/A	seasonal	L	N/A	Full Sun-Part Shade	High		*		
<i>Hypericum densiflorum</i>	Bushy St. John's Wort	Yes	4-6'	July - Aug	Yellow	FACW	seasonal	L	N/A	Full Sun	High		*	*	
<i>Hypericum prolificum</i>	Shrubby St. John's Wort	Yes	1-4'	Jun - Aug	Yellow	FAC	no	M	N/A	Full Sun-Part Shade	High		*		
<i>Ilex glabra</i>	Inkberry	Yes	6-8'	Apr - June	White	FACW-	seasonal	M	3,[4,5]	Full Sun-Part Shade	High	*	*	*	
<i>Ilex verticillata</i>	Common Winterberry	Yes	5-15'	Apr - June	White	FACW+	seasonal	L	[3,4],5	Full Sun-Part Shade	Low	*	*	*	
<i>Itea virginica</i>	Sweetspire	Yes	3-5'	Apr - June	White	OBL	seasonal	L	3,4,5	Sun-Shade	Low		*	*	
<i>Myrica pensylvanica</i>	Northern Bayberry	Yes	3-12'	Apr - June	Yellow	FAC	seasonal	H	[3,4],5	Full Sun	High	*	*	*	
<i>Rhus aromatica</i>	Fragrant Sumac	Yes	6-8'	Apr - June	Yellow	UPL	seasonal	M	5,6	Full Sun-Part Shade	High		*	*	
<i>Rosa carolina</i>	Carolina Rose	Yes	4'-6'	June - Aug	Pink	FACU	no	H	5,6	Full Sun	High		*		
<i>Spiraea alba var. latifolia</i>	White Meadowsweet	Yes	3-5'	Apr - June	White	FAC+	seasonal	H	4,5,6	Full Sun	Low		*	*	
<i>Viburnum dentatum</i>	Southern Arrowwood	Yes	4-5'	May - June	White, Blue	FAC	seasonal	M	3,[4,5]	Full Sun-Part Shade	High		*	*	

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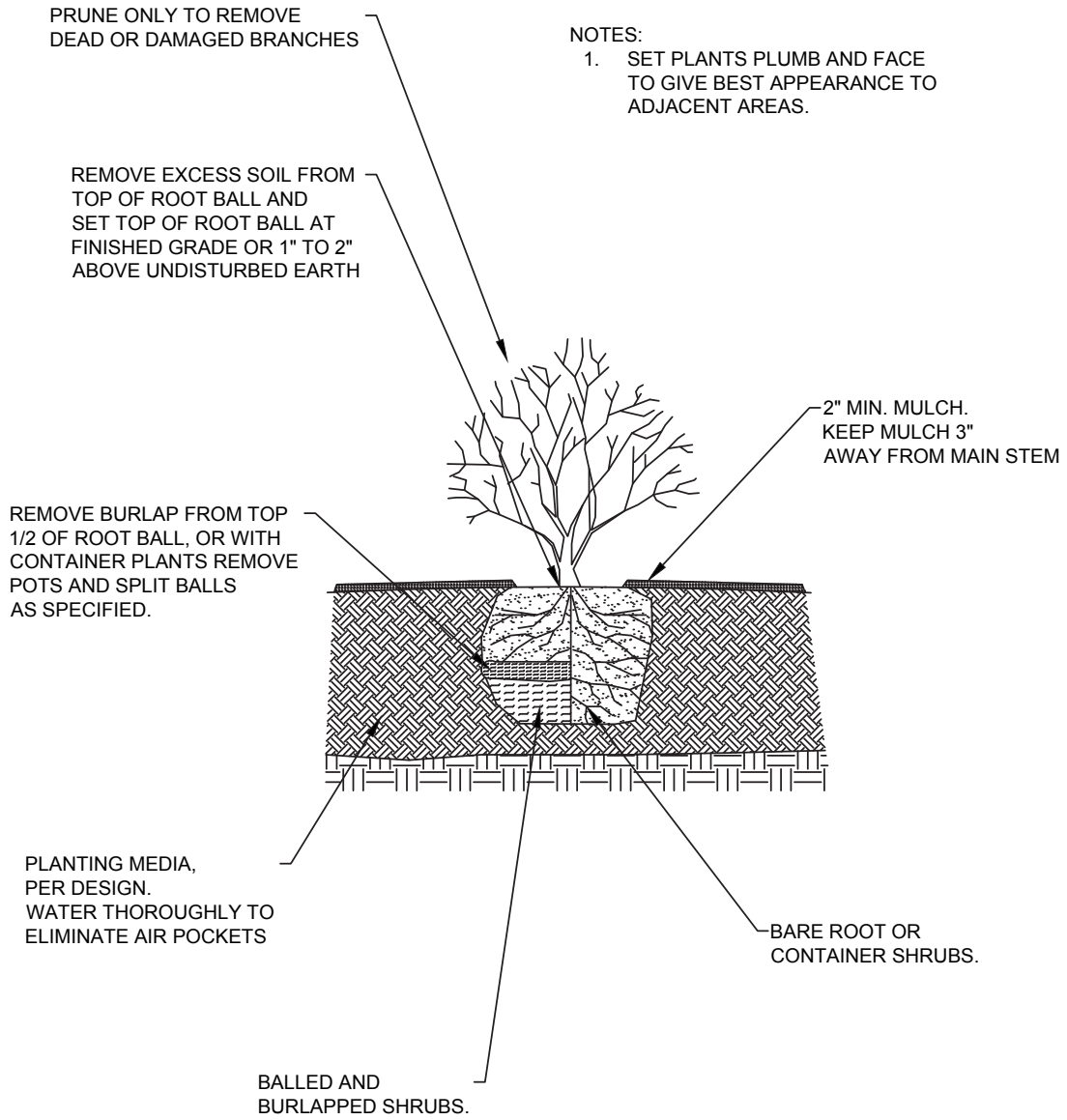
NOTES:

1. MINIMIZE SOIL COMPACTION TO PRESERVE INFILTRATION CAPACITY OF SOIL.
2. SET PLANTS PLUMB AND FACE TO GIVE BEST APPEARANCE TO ADJACENT AREAS.



2014

CONTAINER PLANTING



2014

SHRUB PLANTING

L 5.3.1 Mulch

Description

Mulch is a landscape material that covers the surface of planting soil in order to retain soil moisture, suppress weeds, and help buffer the soil temperature.

Specifications

- Organic mulch shall be double-shredded well-composted, hardwood bark, aged six (6) months to one year.
- Mulch shall be free of wood chips, stones or other undesirable matter. Mulch shall be dark brown in color. Post consumer materials and dyes shall not be permitted.
- Mulch shall be installed 2-inches thick.

Additional Considerations/Options

Mulch also provides organic content to the soil as it decomposes when made from an organic material.

Applicability

Must use on the surface of all vegetated SMPs including stormwater planters, stormwater bump-outs, stormwater trees, and in the tree pits of stormwater tree trenches.

Submittal Requirements

If mulch other than that specified above is proposed, submit complete specification for proposed mulch.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

Planting Media

PM

Summary

The Planting Media (PM) Functional System includes different types of planting soil. While planting media in some cases can provide stormwater storage capacity, its primary function is as a planting media rather than a storage media.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Planting Media design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-6 Planting Media

6.1 Soils

- 6.1.1 Engineered Soil
- 6.1.2 Amended Soil
- 6.1.3 Native Soil
- 6.1.4 Structural Soil

6.1.1 Engineered Soil

Description

Engineered soil is a mixture of different soil types that are combined together to produce a specified planting soil that is a fertile growing medium for vegetation in a stormwater management practice (SMP) while providing infiltration characteristics suitable for stormwater management purposes.

Specifications

- Engineered soil shall be a fertile, natural soil, free from large stones, roots, sticks, clods, plants, peat, sod, pockets of coarse sand, pavement and building debris, glass, noxious weeds including invasive species, infestations of undesirable organisms and disease causing pathogens, and other extraneous materials harmful to plant growth.
- Texture of engineered soil shall conform to the classification within the USDA triangle for Sandy Loam or Loamy Sand. Engineered soil shall be a mixture of sand, silt and clay particles as required to meet the desired soil classification. Planting soil shall be screened and free of stones larger than ½-inch in any dimension. Ranges of particle size distribution, as determined by the pipette method in compliance with ASTM F-1632 shall be as follows:

Particle Size	Percent
Sand (0.05 to 2 mm)	50% - 85%
Silt (0.002 to 0.05 mm)	40% maximum
Clay (less than 0.002 mm)	10% maximum
Gravel (2.0 to 12.7 mm)	15% maximum

- Organic content of planting soil shall have a range of two to ten percent by weight (2.0 - 10.0%) as determined by the appropriate testing method. To adjust organic content, planting soil may be amended, prior to placing and final grading, with the addition of organic amendments as defined below. The pH of the planting soil shall have a range of 6.0 to 7.0. Extremes shall be avoided.
- Soil shall be amended as required according to soil analysis performed during construction with organic compost incorporated into the surface of the soil. Organic compost shall conform to the following minimum characteristics:
 - Organic compost shall be a commercially manufactured humus product that is dark, crumbly, fine textured decayed organic matter specifically manufactured for use as a soil amendment to promote vegetative growth. Organic amendments shall be well aged, and contain no visible admixture of refuse or other physical contaminants nor any material toxic to plant growth.
 - Carbon/ Nitrogen ratio shall be between 12:1 and 25:1.

- Degree of maturity: Composted organic matter shall be considered stable as determined by the Solvita compost maturity index. Compost must achieve a maturity index of 6 or better, indicating a curing active compost.
- Organic content shall be 40% minimum on a dry weight basis as determined by loss on ignition.
- Particle size: 100% shall pass the ½" or smaller screen.
- pH of the finished composted organic matter shall be near 7.0, and be within the range of 6.0 to 8.0.
- Salinity: Soluble salts shall be <4.0 mmhos/cm (dS/m)
- Ammonium content: Ammonium shall be less than 400 ppm on a dry weight basis.

- Fertilizer shall be a complete slow-release commercial fertilizer, complying with all Federal and State fertilizer laws. Fifty percent of the fertilizer components shall be derived from natural organic sources. Fertilizer chemical make-up shall be based on the soil test recommendations by the soil testing laboratory.
- Lime shall be an approved agricultural pelletized limestone containing not less than 85 percent calcium and magnesium carbonates, and shall be applied at the rate as recommended by the soil tests. Lime shall be applied mechanically at least 2 weeks prior to planting and fertilizer application and incorporated into full depth of planting soil prior to fine grading.

Additional Considerations/Options

Not applicable.

Applicability

Must use in all vegetated SMPs including stormwater planters, stormwater bump-outs, stormwater trees, and the tree pits of stormwater tree trenches unless another approved planting media design component is used.

Submittal Requirements

If an engineered soil other than that specified above is proposed, submit complete specification for proposed engineered soil.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

Storage Media

SM

Summary

The Storage Media (SM) Functional System includes media that detains or “stores” stormwater underground to help achieve the storage volume design requirement discussed in Chapter 5. Storage media is comprised of two main categories: aggregate materials and prefabricated materials. For both, stormwater is stored in the void space within the aggregate or prefabricated materials.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Storage Media design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-7 Storage Media

7.1 Aggregate Materials

- 7.1.1 Stone

7.2 Prefabricated Materials

- 7.2.1 Modular Storage Systems
- 7.2.2 Arch Systems
- 7.2.3 Pipe Systems

SM

7.1.1 Stone

Description

Stone is aggregate material that can be placed in the subsurface of a stormwater management practice (SMP) or Green Street system to provide stormwater storage capacity by holding the water within the open space between stones.

Specifications

- Stone shall be coarse aggregate meeting the following requirements:
 1. Maximum wash loss of 1% (ASTM C117)
 2. Minimum Durability Index of 35 (ASTM D3744)
 3. Maximum abrasion of 10% for 100 revolutions and maximum of 50% for 500 revolutions
 4. All aggregate shall be clean and thoroughly washed.
 5. Aggregate shall be 100% crushed material.
- Stone shall be AASHTO No. 57 coarse aggregate and uniformly graded as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, latest edition and meet the following requirements:

U.S. Standard Sieve Size	Percent Passing
1½" (37.5 mm)	100
1" (25 mm)	95-100
½" (12.5 mm)	25-60
No. 4 (4.75 mm)	0-10
No. 8 (2.36 mm)	0-5

Additional Considerations/Options

Not applicable.

Applicability

May use in all SMPs unless another approved storage media is used or stormwater storage capacity is not required.

Submittal Requirements

If stone other than that specified above is proposed, submit complete specification for proposed stone.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

7.2.1 Modular Stormwater Storage Systems

Description

Modular stormwater storage systems are individual units/modules that can be placed in the subsurface of a stormwater management practice (SMP) or Green Street system to provide stormwater storage capacity by holding the water within the open space of the modules. They are typically plastic, lightweight, rectangular in shape, and offer greater than 90% void space.

Specifications

- All modules installed beneath vehicular traffic must be rated for and installed to ensure a minimum loading capacity in accordance with H-20 loading.
- Follow all specifications, requirements and guidelines from product manufacturer.
- Modular Stormwater Storage Systems installed along State Routes must be listed in PennDOT Publication 35, Bulletin 15: PennDOT approved Construction Materials, or must seek additional PennDOT approvals for their installation.

Additional Considerations/Options

There is a wide variety of modular stormwater storage system products available that offer different available void space, materials, dimensions, interconnectivity, load ratings, depth of cover required, maximum stack height, and other characteristics.

Applicability

May use in all SMPs unless another approved storage media is used or stormwater storage capacity is not required.

Submittal Requirements

Submit details of proposed modular stormwater storage system including dimensions, materials, manufacturer, and product number.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

Media Separation

MS

Summary

The Media Separation (MS) Functional System includes design components that isolate different media such as stone and soil and prevent transport of one media into the zone of the other media. Media separation is generally achieved through the use of fabric or aggregate materials.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Media Separation design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-8 Media Separation

8.1 Fabric Materials

- 8.1.1 Geotextile

8.2 Aggregate Materials

- 8.2.1 Sand Filter
- 8.2.2 Pea Gravel Filter

MS

8.1.1 Geotextile

Description

A geotextile is a fabric based filter material often referred to as geotextile filter fabric that provides a barrier to separate different types of media such as soil and stone.

Specifications

- Geotextile shall be non-woven and meet the following requirements:
 1. Minimum flow rate 95 gal/min/ft² (ASTM D-4491)
 2. Minimum grab tensile strength 120 lbs (ASTM D-4632)
 3. Minimum CBR puncture strength 300 psi (ASTM D-6241)
 4. Minimum tear resistance 50 lbs (ASTM D-4533)
 5. Minimum UV resistance 70% retained strength (ASTM D-4355)
- Geotextile shall be placed in accordance with manufacturer's standards and recommendations. Adjacent strips of geotextile shall overlap a minimum of 18-inches or per manufacturer specifications, whichever is greater.
- Geotextile for prefabricated modular storage media (see SM-7.2.1) shall be in accordance with manufacturer's instructions.
- PWD currently approves Mirafi 140N geotextile or approved equal.

Additional Considerations/Options

Not applicable.

Applicability

Must use on the sides and top of all storage media unless another approved media separation design component or method is used. Typically applied on stormwater planters, stormwater bump-outs, stormwater tree trenches, and permeable paving.

Submittal Requirements

If a geotextile other than that specified above is proposed, submit complete specification for proposed geotextile.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

8.2.1 Sand Filter

Description

A sand filter is a layer of sand that provides a barrier to separate different types of media such as soil and stone.

Specifications

- Sand shall be AASHTO M-43 No. 9 or 10 and meet the following requirements:

AASHTO No. 9

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	95-100
No. 8 (2.36 mm)	25-60
No. 16 (1.18 mm)	0-10
No. 50 (300 μm)	0-5

AASHTO No. 10

U.S. Standard Sieve Size	Percent Passing
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	85-100
No. 100 (150 μm)	10-30

Additional Considerations/Options

Not applicable.

Applicability

Must use as a layer along the entire bottom surface of every SMP or Green Street system except stormwater trees, green gutters, and permeable paving.

Submittal Requirements

If sand other than that specified above is proposed, submit complete specification for proposed sand.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

Piping

P

Summary

The Piping (P) Functional System includes design components that generally involve piping in one form or another such as for stormwater conveyance, protection of piping, protection around pipes, access to piping, or for monitoring using systems made up of piping.

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Piping design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-9 Piping

9.1 Conveyance

- 9.1.1 Underdrain
- 9.1.2 Distribution Pipe
- 9.1.3 Domed Riser
- 9.1.4 Consolidation Pipe / Fittings

9.2 Protection on / around Piping

- 9.2.1 Utility Sleeve
- 9.2.2 Anti-seep Collar

9.3 Access to Piping

- 9.3.1 Cleanout

9.4 Monitoring

- 9.4.1 Observation Well
- 9.4.2 Piezometer Well

9.5 Unpiped / Other Conveyance Items

- 9.5.1 Runnels
- 9.5.2 Swales
- 9.5.3 End Walls

P 9.1.1 Underdrain

Description

An underdrain is a pipe used to collect and convey stormwater from the subsurface of a stormwater management practice (SMP) or Green Street system and drain it to a point of discharge. Underdrains are perforated when passing through the extents of the SMP or Green Street system in order to collect stormwater from the subsurface and are solid when passing through areas where stormwater needs to be conveyed from one point to another but should not be allowed to exfiltrate from the pipe, such as outside the extents or at breaks in the system.

Specifications

- Underdrains shall be a minimum of 8-inch diameter.
- Underdrains shall be corrugated high density polyethylene (HDPE), high density polypropylene (PP), polyvinyl chloride (PVC), or ductile iron (DI). HDPE pipe is the most typically used material for underdrains but PP or DI are also used. HDPE and PVC may only be used beneath the footway. PP may be used beneath the footway and also may be used beneath the cartway when parallel to the curb. DI may be used beneath the footway and also may be used beneath the cartway when both parallel and perpendicular to the curb.
- Corrugated HDPE or PP pipe shall have an annular corrugated exterior and smooth inner wall.
- Corrugated pipe shall meet or exceed the following specifications as applicable: AASHTO M-252, AASHTO M-294, ASTM F2306, or ASTM F2881.
- PVC for underdrains shall be SDR -35 or ASTM D 3034, Type PSM.
- Joints shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
- Perforated pipe shall have AASHTO Class II perforations. Class II perforations shall be located in the outside valleys of the corrugations, be circular and/or slotted, and evenly spaced around the circumference and length of the pipe. The opening area shall be no less than 0.945 square inches per linear foot (pipe diameters 8 through 10-inches).
- All underdrains installed beneath vehicular traffic shall be installed to ensure a minimum loading capacity in accordance with H-20 loading. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.
- DI shall meet PWD Standard Specifications for ductile iron pipe and fittings.

- PWD currently approves ADS ST IB N-12 for HDPE pipe or approved equal and ADS N-12 HP for PP pipe or approved equal.
- Underdrains installed beneath the cartway along State Routes must comply with PennDOT Publications 72 and 408.

Additional Considerations/Options

Not applicable.

Applicability

Must use in all SMPs and Green Street systems regardless of whether the SMP or system is designed for infiltration or for detention/slow-release. This allows for conversion of infiltration systems to a detention/slow-release system if infiltration capacity fails due to clogging or failure in the future. Exception to this rule for stormwater trees has been typical. Underdrains typically connect to an inlet structure as shown in the attached detail (Standard Inlet with Underdrain Connection detail). When installed in infiltration systems, underdrains have a solid cap on the end to prevent discharge. When installed in detention/slow-release systems, a device such as a cap with a drilled hole as shown in the attached detail (Slow Release Orifice detail) is installed to allow the underdrain to discharge at a controlled rate. For infiltration systems, if it is not possible or advisable to connect the underdrain to an inlet structure, the underdrain must extend for a minimum of 5-feet outside of the system and be capped.

Submittal Requirements

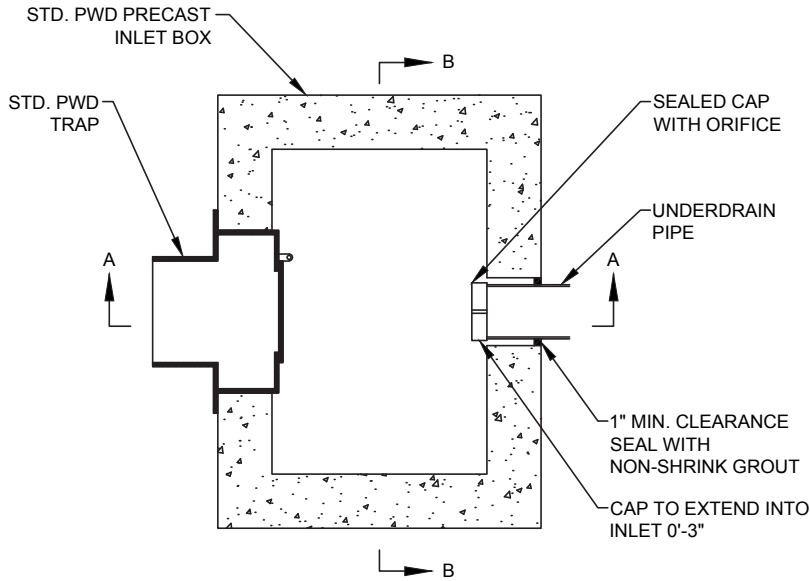
If underdrain piping other than that specified above is proposed, submit details of the proposed piping including dimensions, materials, manufacturer, and product number.

References

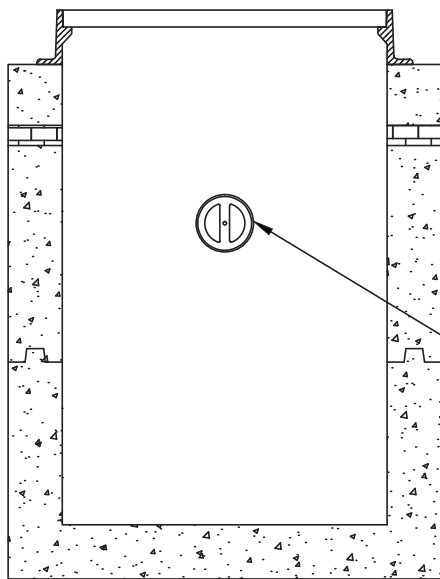
- PWD Green Master Specification (dated September 25, 2012)
- PWD Green Infrastructure Standard Details (dated December 6 2012)
- PWD Standard Details and Standard Specifications for Sewers (dated 1985)

Attachments

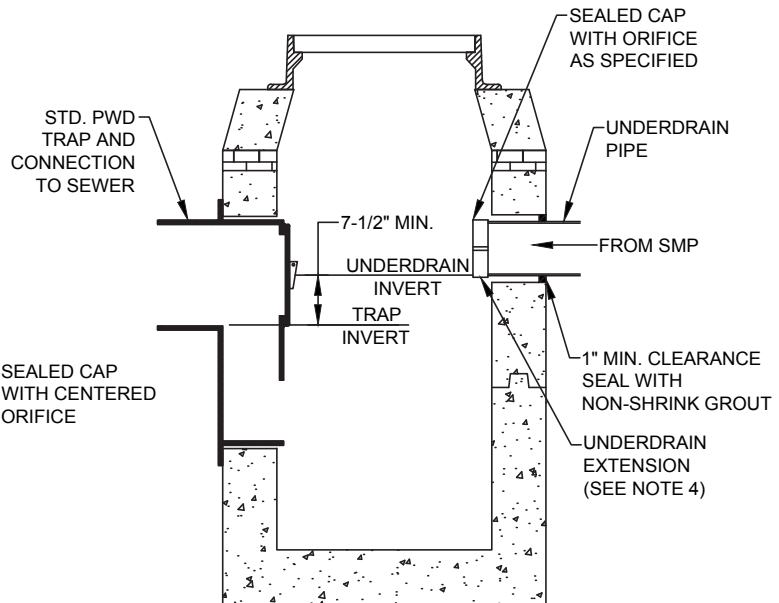
- PWD Standard Inlet with Underdrain Connection detail
- PWD Slow Release Orifice detail



- NOTES:
1. ALL CONCRETE COMPONENTS, INLET GRATE AND FRAME, INLET TRAP, AND CONNECTION TO SEWER SHALL BE PWD STANDARD CONSTRUCTION.
 2. HIGHWAY INLET DEPICTED; DESIGN IS GENERALLY APPLICABLE TO ALL PWD STANDARD INLETS.
 3. THIS INLET HAS A SEWER CONNECTION AND AN UNDERDRAIN ONLY FROM A STORMWATER SYSTEM (SMP).
 4. TOTAL EXTENSION OF UNDERDRAIN AND CAP ASSEMBLY INTO INLET TO BE 0'-3" FROM INLET WALL TO END OF CAP



SECTION B-B



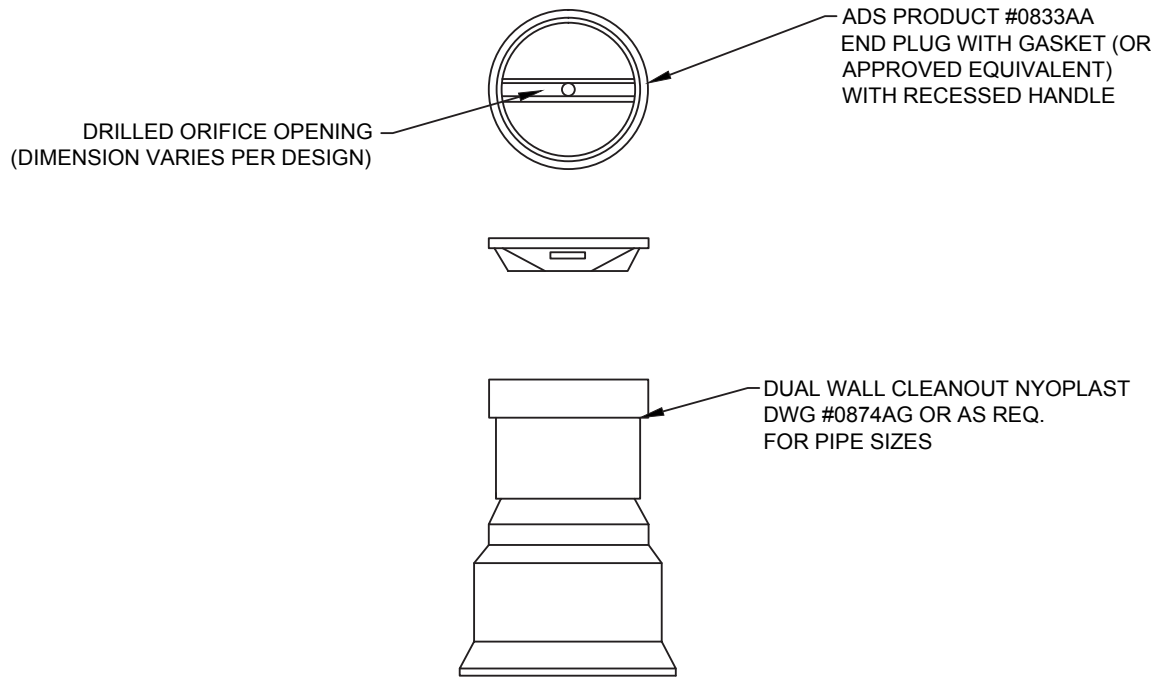
SECTION A-A



2014

STANDARD INLET WITH UNDERDRAIN CONNECTION

P



NOTES:

1. TO BE SET IN PWD INLET WITH RECESSED CONTROL STRUCTURE.



2014

SLOW RELEASE ORIFICE

9.1.2 Distribution Pipe

Description

A distribution pipe is a pipe used to convey and distribute stormwater into the subsurface of a stormwater management practice (SMP) or Green Street system. Distribution pipes are perforated when passing through the extents of the SMP or Green Street system in order to distribute stormwater into the subsurface and are solid when passing through areas where stormwater needs to be conveyed from one point to another but should not be allowed to exfiltrate from the pipe, such as outside the extents or at breaks in the system.

Specifications

- Distribution pipes shall be a minimum of 8-inch diameter.
- Distribution pipes shall be corrugated high density polyethylene (HDPE), high density polypropylene (PP), polyvinyl chloride (PVC), or ductile iron (DI). HDPE pipe is the most typically used material for distribution pipes but PP or DI are also used. HDPE and PVC may only be used beneath the footway. PP may be used beneath the footway and also may be used beneath the cartway when parallel to the curb. DI may be used beneath the footway and also may be used beneath the cartway when both parallel and perpendicular to the curb.
- Corrugated HDPE or PP pipe shall have an annular corrugated exterior and smooth inner wall.
- Corrugated pipe shall meet or exceed the following specifications as applicable: AASHTO M-252, AASHTO M-294, ASTM F2306, or ASTM F2881. PVC for distribution or drainage piping shall be SDR -35 or ASTM D 3034, Type PSM.
- Joints shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
- Perforated pipe shall have AASHTO Class II perforations. Class II perforations shall be located in the outside valleys of the corrugations, be circular and/or slotted, and evenly spaced around the circumference and length of the pipe. The opening area shall be no less than 0.945 square inches per linear foot (pipe diameters 8 through 10-inches).
- All distribution pipe installed beneath vehicular traffic shall be installed to ensure a minimum loading capacity in accordance with H-20 loading. Any deviation from manufacturer's specifications for product installation (without approval by manufacturer or signed and sealed statement of adequacy by Professional Engineer) is prohibited.
- DI shall meet PWD Standard Specifications for ductile iron pipe and fittings.

- PWD currently approves ADS ST IB N-12 for HDPE pipe or approved equal and ADS N-12 HP for PP pipe or approved equal.
- Distribution pipes installed beneath the cartway along State Routes must comply with PennDOT Publications 72 and 408.

Additional Considerations/Options

Not applicable.

Applicability

May use where it is necessary to convey stormwater runoff into and distribute it within the subsurface of an SMP or Green Street system. Typically applied on stormwater tree trenches.

Submittal Requirements

If distribution piping other than that specified above is proposed, submit details of the proposed piping including dimensions, materials, manufacturer, and product number.

References

- PWD Green Master Specification (dated September 25, 2012)
- PWD Standard Details and Standard Specifications for Sewers (dated 1985)

Attachments

Not applicable.

P 9.1.3 Domed Riser

Description

A domed riser is a domed shape grate on top of a vertical pipe within the footprint of a stormwater management practice (SMP) used to convey stormwater ponded above a certain elevation from the surface of the SMP into the subsurface.

Specifications

- Domed riser grates shall be locking type.
- Domed riser grates shall be a minimum of 12-inch diameter. Riser piping of domed risers shall be pipe with soil-tight seals and fittings.
- Domed risers shall be in accordance with the attached PWD Domed Riser detail.

Additional Considerations/Options

Grates for domed risers are manufactured and sized for many different site conditions and should be selected accordingly while ensuring that the grate has adequate hydraulic capacity. Domed risers must be set at an elevation to control the elevation of stormwater ponding in the SMP consistent with the site specific design.

Applicability

Must use where stormwater ponding elevation within SMP planting areas needs to be controlled and/or where conveyance of stormwater from the SMP planting area into subsurface storage media is required unless another approved piping design component or method is used. Typically applied on stormwater planters, and stormwater bump-outs.

Submittal Requirements

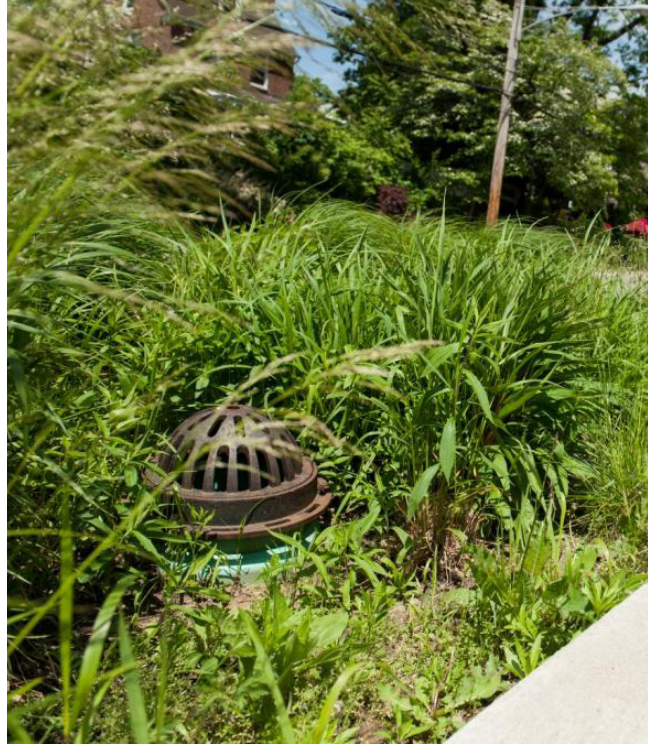
If a domed riser other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacture, and product number of all items used for the domed riser.

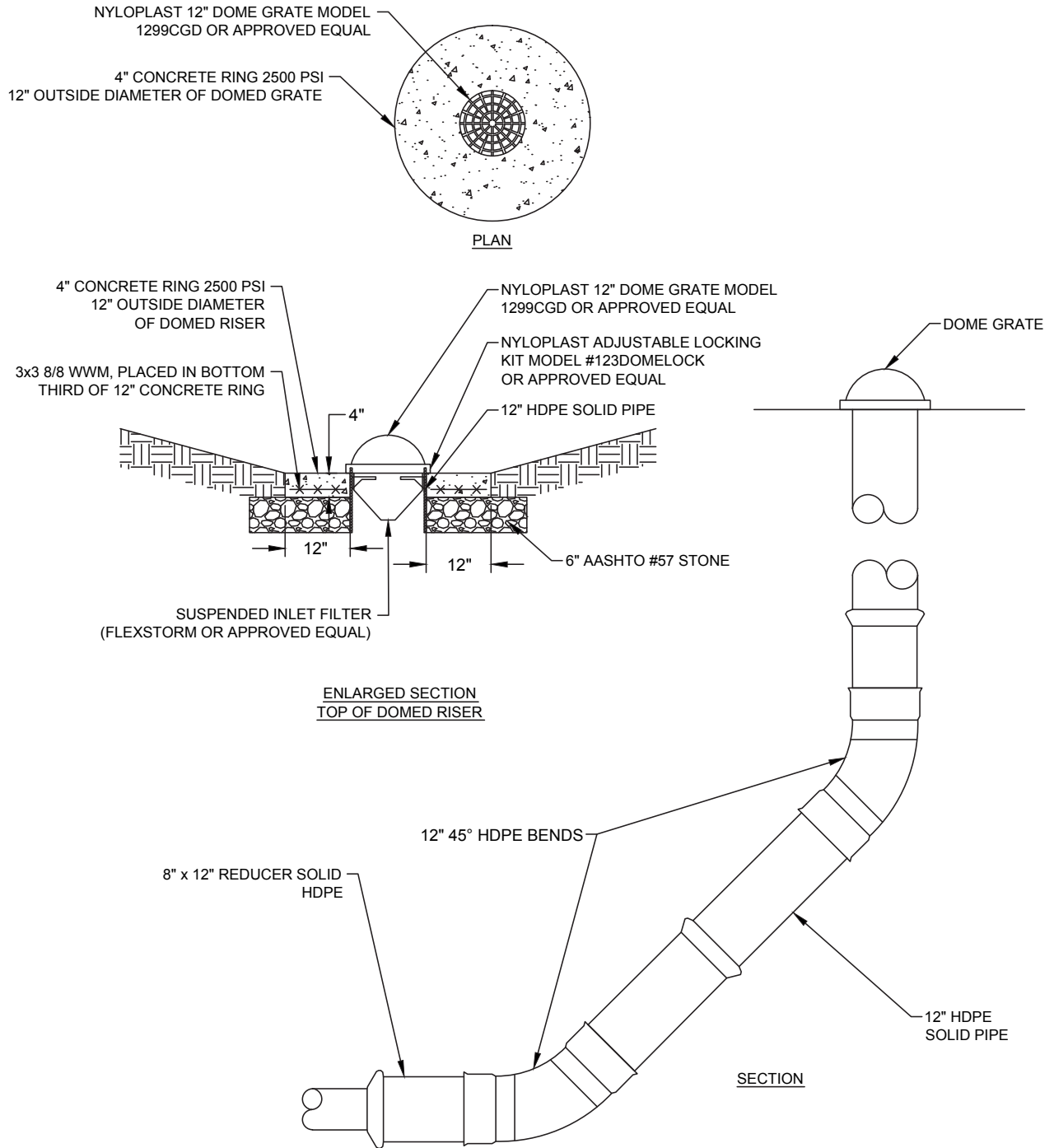
References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

Attachments

PWD Domed Riser detail





DOMED RISER



2014

P 9.2.1 Utility Sleeve

Description

A utility sleeve is a protective encasement sleeve that surrounds a service line as it passes through a stormwater management practice (SMP) or Green Street system in order to prevent water from damaging the service line and to allow access/replacement of the service line in the future without excavating into the SMP or Green Street system.

Specifications

- Utility sleeves shall include anti-seep collars installed at either end and outside the geotextile around the subsurface storage media.
- The utility sleeve shall be of watertight construction and sealed at either end around the existing pipe with non-shrink grout or sealant.
- Utility sleeves for prefabricated modular storage media (see SM-7.2.1) shall be in accordance with manufacturer's instructions.
- Utility sleeves shall be in accordance with the attached PWD Utility Sleeve detail.

Additional Considerations/Options

Not applicable.

Applicability

Must use on any utility service lines that pass through the subsurface of an SMP or Green Street system.

Submittal Requirements

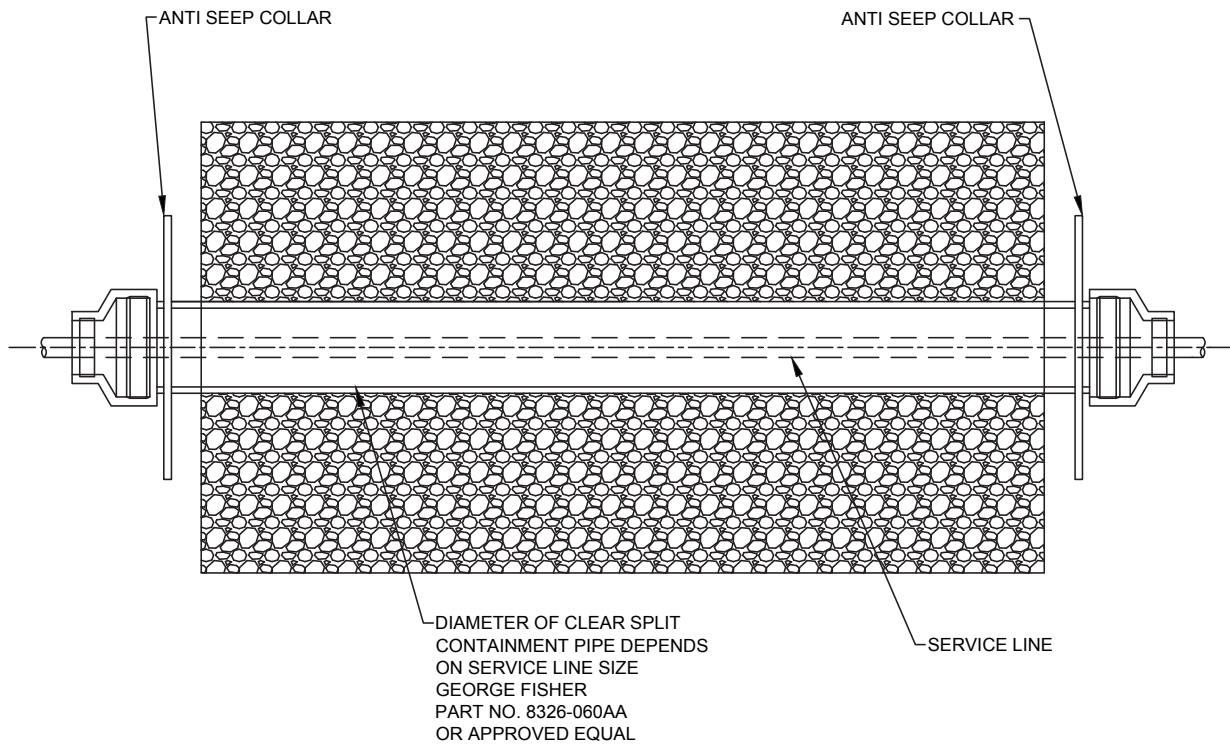
If a utility sleeve other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacture, and product number of all items used for the utility sleeve.

References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

Attachments

PWD Utility Sleeve detail



2014

UTILITY SLEEVE

P 9.2.2 Anti-Seep Collar

Description

An anti-seep collar is a combination of clamps, bands, and collars attached to and surrounding a pipe in order to prevent stormwater stored in a stormwater management practice (SMP) or Green Street system from traveling around a pipe as it enters or exits the SMP or system.

Specifications

- All anti-seep collars shall be placed continuously to form a watertight joint. All bends, corners, and splicing shall be made by standard rubber waterstop fittings or by vulcanizing. All collars projecting from the side of the joint shall be protected from damage during construction and be free from defects. All waterstops shall be placed in the center of the joint, with 1/2 of the waterstop on each side of the joint.
- Geotextile or impermeable liners in place at the interface with anti-seep collars shall be minimally cut to allow for the pass-through section and then sealed within the solid external sheets of the anti-seep collar. All fittings and seals shall be installed to manufacturer's specifications for a watertight seal. Anti-seep collars shall be in accordance with the attached PWD Anti-Seep Collar.

Additional Considerations/Options

Not applicable.

Applicability

Use on all pipes that enter and exit an SMP or Green Street system.

Submittal Requirements

If an anti-seep collar other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacture, and product number of all items used for the anti-seep collar.

References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

Attachments

PWD Anti-Seep Collar detail.

P 9.3.1 Cleanout

Description

A cleanout is a vertical pipe connected to underground piping including distribution pipes and underdrains that comes to the surface and provides access by equipment to the underground piping for maintenance purposes such as cleaning.

Specifications

- Cleanout frame and cover shall be ductile iron and lockable.
- Frame and/or cover to be stamped "CLEANOUT".
- Cleanouts shall be PVC structures in all vertical sections with adapters to connect to distribution and underdrain piping materials as required.
- Cleanouts shall be in accordance with the attached PWD Cleanout detail.

Additional Considerations/Options

Not applicable.

Applicability

Must use on all distribution piping and underdrains as discussed in the General Rules of the Design Details, Appendix 6.1.

Submittal Requirements

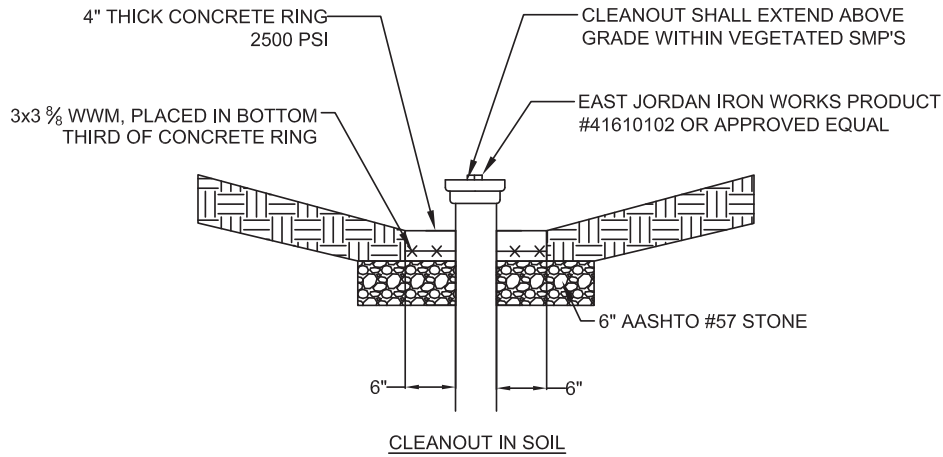
If a cleanout other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacture, and product number of all items used for the cleanout.

References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

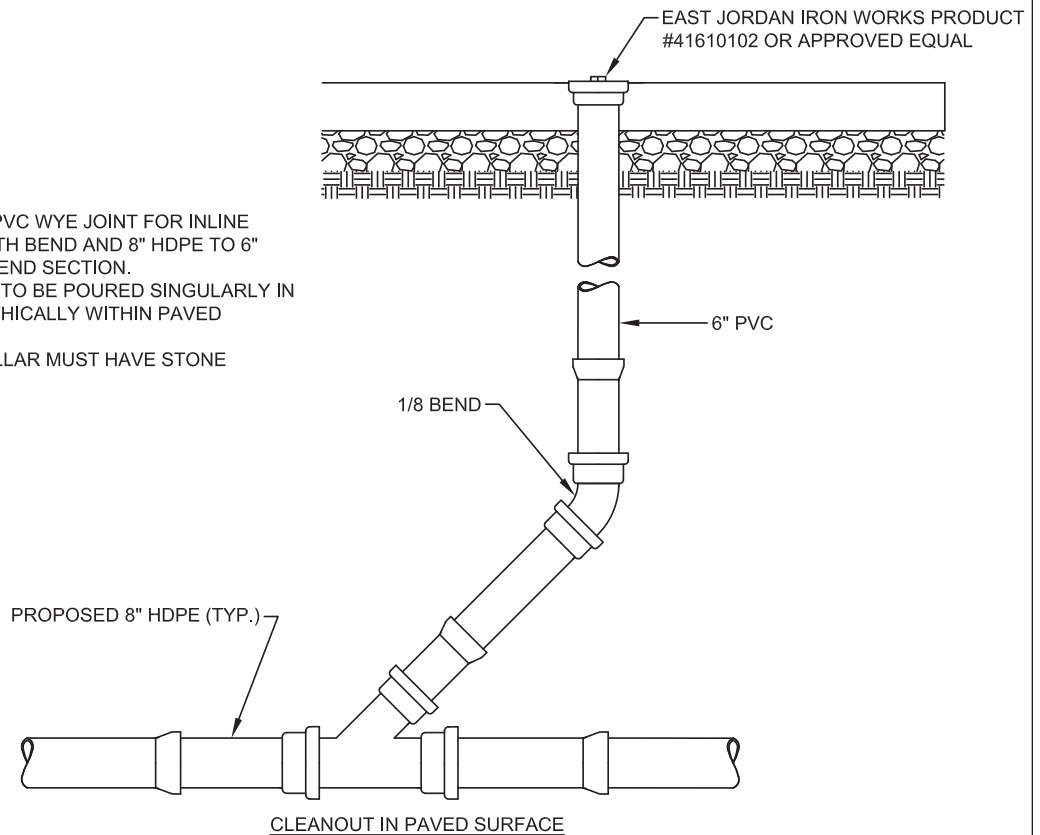
Attachments

PWD Cleanout detail



NOTES:

1. 8" HDPE (TYP.) X 6" PVC WYE JOINT FOR INLINE SECTION -OR- 8"-1/8TH BEND AND 8" HDPE TO 6" PVC REDUCER FOR END SECTION.
2. CONCRETE COLLAR TO BE POURED SINGULARLY IN GRASS OR MONOLITHICALLY WITHIN PAVED SURFACE.
3. THE CONCRETE COLLAR MUST HAVE STONE FOOTING.



2014

CLEANOUT

P 9.4.1 Observation Well

Description

An observation well is a vertical pipe that extends through the depth of a stormwater management practice (SMP) or Green Street system and allows “observation” of the water level stored in the subsurface of a Green Street system.

Specifications

- Covers for observation wells shall be lockable ductile iron with gray iron frames. Cover and/or frame shall be stamped “OBS WELL”. Also, the well cover shall be stamped with a unique identification number, to be provided by PWD.
- The area surrounding the solid well section shall be restored in kind with the adjoining area. Any geotextile filter fabric that the observation well must penetrate shall be cut and wrapped six inches (6”) up the solid well section.
- The solid well section shall extend into the cover frame enough such that a bentonite/cement seal can be placed around the well within the frame, and a solid slip-on cap can be fitted onto the pipe end.
- Aggregate fill around observation wells shall be consistent with surrounding aggregate.
- Observation wells shall be installed prior to placement of aggregates in the trenches. Care shall be taken to avoid compacting the bottom of the bed during the excavation necessary for observation well installation.
- Observation wells for prefabricated modular storage media (see SM-7.2.1) shall be in accordance with manufacturer’s instructions. Observation wells shall be in accordance with the attached PWD Observation Well detail.

Additional Considerations/Options

In some cases, data recording equipment will be used in the observation well to record water levels and the sizing and depth of installation should be considered to accommodate this equipment.

Applicability

Must use at least one observation well per Green Street system, except for stormwater trees.

Submittal Requirements

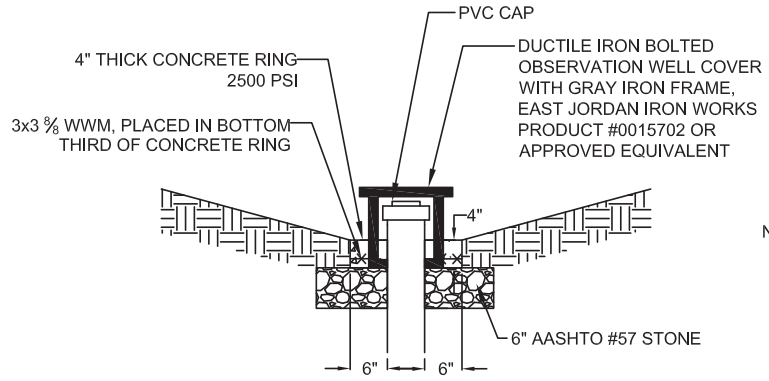
If an observation well other than that specified above is proposed, submit a detail of proposed configuration and details of all proposed sizes, materials, manufacturer, and product number of all items used for the observation well.

References

- PWD Green Infrastructure Standard Details (dated December 6, 2012)
- PWD Green Master Specification (dated September 25, 2012)

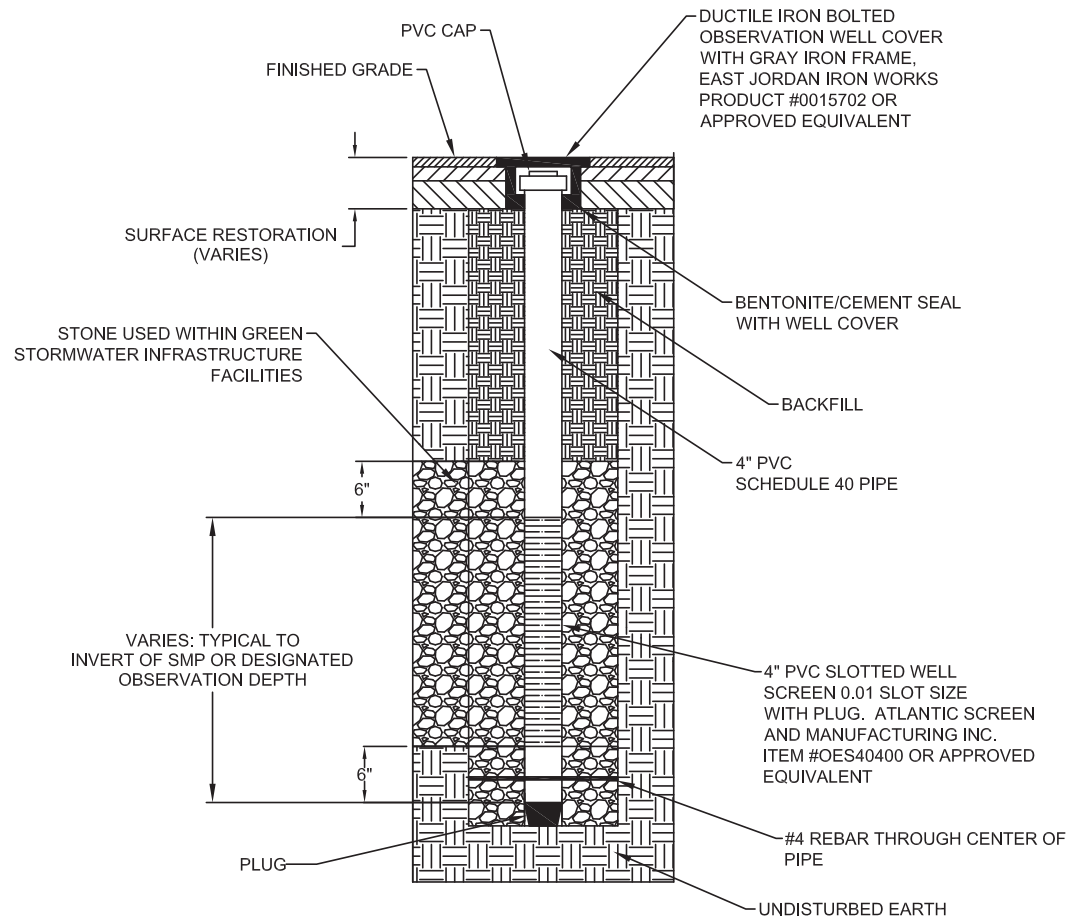
Attachments

PWD Observation Well detail.



OBSERVATION WELL IN SOIL

- NOTES:
1. WELL COVER SHALL BE SECURED IN CONCRETE SURROUND (1'-4" TOTAL DIAMETER) IF WELL IS NOT OTHERWISE SECURED BY SURFACE RESTORATION.
 2. THE UNSLOTTED DEPTH IS LOCATED ENTIRELY IN THE SUMP.
 3. THE #4 REBAR SHOULD BE 16" IN LENGTH.
 4. WELL CASING IS TO EXTEND 6" ABOVE COVER'S FRAME.



OBSERVATION WELL IN PAVED SURFACE



2014

OBSERVATION WELL

Impermeable Barriers

IB

Summary

The Impermeable Barrier (IB) Functional System includes design components that limit or prevent stormwater from infiltrating or migrating to an area beyond the impermeable barrier. Impermeable barriers can be used on either the surface or subsurface portion of a stormwater management practice (SMP).

Design Components

Further detail including standards, requirements, and other information such as supplemental details for Impermeable Barrier design components are found in the section that follows. Design components shown in gray below are intended for potential future development and further description and ideas on some of those design components are included in Appendix 6.3.

FS-10 Impermeable Barriers

10.1 Liners

- 10.1.1 Geomembrane Sheets

10.2 Check Dams

- 10.2.1 Surface Check Dams
- 10.2.2 Subsurface Check Dams

10.3 Coatings

- 10.3.1 Epoxy / Tar

10.1.1 Geomembrane Sheets

Description

A geomembrane sheet is a synthetic material with a very low permeability that acts as a barrier to prevent the migration of stormwater through the sheet. Geomembrane sheets are often referred to as impermeable liners.

Specifications

- Geomembrane sheets shall be 40 mil thick high density polyethylene designed specifically for flexible geomembrane applications and meet the following requirements:
 1. Minimum average thickness 40 mil (mm) (ASTM D 5199)
 2. Density 0.94 g/cm³ (ASTM D 1505)
 3. Strength at break 152 lb/in-width
 4. Strength at yield 84 lb/in-width
 5. Elongation at break 700%
 6. Elongation at yield 12%
 7. Tear resistance 28 lb (ASTM D 1004)
 8. Puncture resistance 72 lb (ASTM D 4833)
 9. Carbon black content 2% (ASTM D 5596)
 10. Notched constant tensile load 300 hr (ASTM D 5397, Appendix)
- Geomembrane sheets shall be placed in accordance with manufacturer's standards and recommendations. All seams and openings in the liner shall be sealed according to manufacturer's recommendations and specifications. Adjacent strips of impermeable liner shall overlap a minimum of 18-inches or per manufacturer specifications, whichever is greater.
- Geomembrane sheets for prefabricated modular storage media (see SM-7.2) shall be in accordance with manufacturer's instructions.
- PWD currently approves GSE Lining Technology product # HDE 040A000 or approved equal.

Additional Considerations/Options

Geomembrane sheets can come in a variety of materials including thin polymeric sheets made of materials like polyvinyl chloride (PVC), high density polyethylene (HDPE), or other polymeric materials but can also consist of geotextile sheets impregnated with asphalt, elastomers, clays, or other low permeability materials.

Applicability

Must use on the sides and bottom of green street systems if there are any geotechnical or contamination issues that would make infiltration inadvisable.

Submittal Requirements

If a geomembrane sheet other than that specified above is proposed, submit complete specification for proposed geomembrane sheet.

References

- PWD Green Master Specification (dated September 25, 2012)

Attachments

Not applicable.

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appendix **6.3**

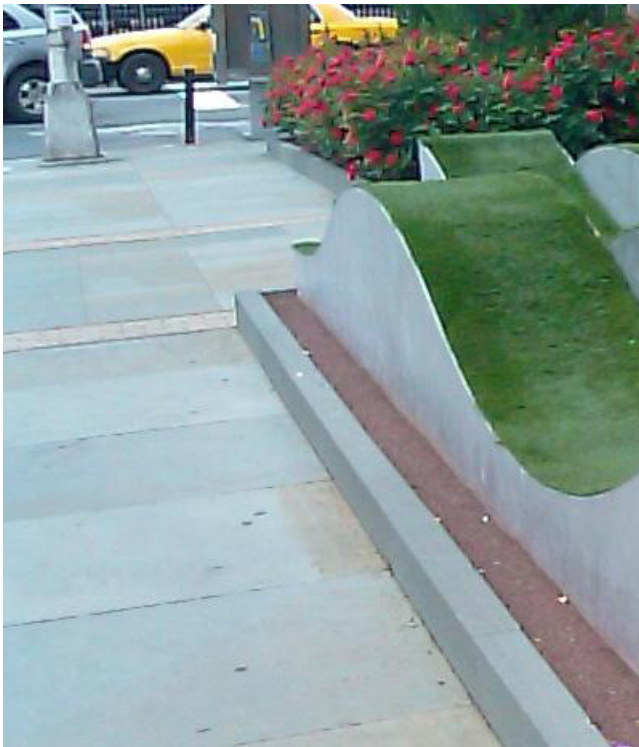
**Design Components
Ideas and Potential Future
Development**

AP

1.1.3 Walls

Description

Walls are barriers that are taller than the curb reveal design component (AP-1.1.2) and can be placed around a stormwater management practice (SMP) and because of their height and size can act as a more robust form of area protection. They can also be constructed from a variety of materials such as concrete, masonry, wood, and others, be designed with varying geometries, and even add design interest by integrating a planted surface, color, or muraling.



1.1.4 Edging

Description

Edging is a barrier that is about the same height as the curb reveal design component (AP-1.1.2) but is thinner and of a prefabricated material. Edging comes in a variety of materials and colors. A popular material often used for edging is Corten steel, which is a material that is strong and provides a rustic look as it naturally weathers over time. Because edging is thinner than curb reveal and walls, the top edge should be softened in order to reduce the sharpness of the edge. Rounding the edge in the form of a bullnose edge is an acceptable method to accomplish this.



1.1.6 Multi-Purpose Barriers

Description

There are several barriers that could serve multiple purposes in addition to providing a barrier and area protection for a stormwater management practice (SMP). Some examples include walls constructed as planters, walls and fences with integrated seating, or even street furniture such as benches, bike racks, and others can all provide a barrier around SMPs while serving other uses.



1.2.1 Landscaping Buffer

SE

Description

A landscaping buffer is a planted area of sufficient width that surrounds a stormwater management practice and provides a buffer between pedestrians and the SMP, providing a visual and tactile alert that there is a change in sidewalk conditions. Landscaping buffers can add aesthetic value to the SMP, provide increased vegetation in the right-of-way, and further reduce the amount of impervious area.



SE

2.1.3 Lay-by Inlet

Description

A lay-by inlet is a surface inlet that routes gutter flow into an SMP using rounded or perpendicular wing walls that is uncovered between the gutter and the final entrance to the SMP.



L

2.4.1 Curb Insert

Description

A curb insert is a fabricated single unit that is self-supporting and replaces a removed section of curb while providing an opening to allow water into the SMP. The unit can be custom fabricated or there are a few products that serve this purpose.

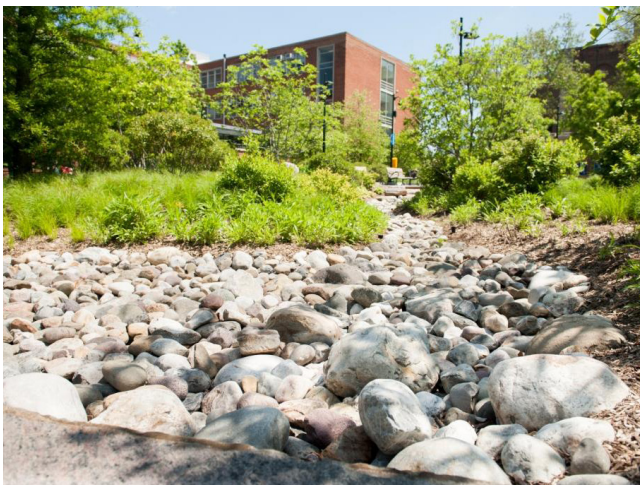


5.3.2 Stone Top Dressing

IB

Description

Stone used as a top dressing is not a replacement for mulch but a possible consideration in addition to mulch. Different colors and placement patterns with stone can create design interest or even provide a functional path for access through an SMP. Use should be limited to locations with low incidence of vandalism.



10.2.1 Surface Check Dams

Description

Surface check dams help to hold back water within the planted area of SMPs. They can be constructed from a variety of materials such as concrete, masonry, wood, stone, steel, and others and offer both a functional and aesthetic opportunity for SMPs.



Checkdams made from packed earth and river rock are used in each curb extension to slow and retain stormwater runoff. NE Siskiyou Green Street, Portland, Oregon.

Photo by Kevin Robert Perry



<http://landscapeandurbanism.blogspot.com/2010/10/feral-green-streets-tamed.html>

appendix 7.1

**PWD Green Street
Project Proposal**

APPENDIX 7.1:

PWD Green Street Project Proposal Section A: Project Proposal Form

The purpose of this document is to initiate the green street design review and approval process. It will be used by PWD to evaluate the eligibility of the proposed project.




PWD Green Street Project Proposal

PWD’s Green Streets program provides technical assistance to third parties undertaking improvement projects within the right-of-way in order to encourage the inclusion of green stormwater infrastructure elements.

This proposal form will be used to evaluate the eligibility of a green street project proposed within the right-of-way. Please refer to PWD Green Streets Design Manual as guidance throughout the development process of this project. Please be advised that once the final design process is completed, the green stormwater infrastructure project will be adopted as a PWD asset.

NOTE: Please ensure you have read Chapter 7 of the Green Streets Design Manual before completing this Project Proposal form. Complete all sections of the form as fully and accurately as possible.

SECTION (A)	
<p>APPLICATION FOR GREEN STREET PROJECT</p> <p>APPLICATION #: _____ <i>(PWD use only)</i></p> <p>PROJECT NAME: _____</p>	 <p>CITY OF PHILADELPHIA WATER DEPARTMENT OFFICE OF WATERSHEDS 1101 MARKET STREET PHILADELPHIA, PA 19107 <i>For more information visit us at</i> www.phillywatersheds.com</p>
<p>ADDRESS OF PROPOSED PROJECT/CONSTRUCTION:</p> <p>_____</p>	
<p>APPLICANT NAME:</p> <p>_____</p> <p>COMPANY NAME:</p> <p>_____</p> <p>PHONE # _____ FAX # _____</p>	<p>APPLICANT’S ADDRESS:</p> <p>_____</p> <p>_____</p> <p>LICENSE # _____ E-MAIL: _____</p>
<p>ARCHITECTURE/ENGINEERING FIRM:</p> <p>_____</p> <p>PROJECT MANAGER:</p> <p>_____</p> <p>PHONE # _____ FAX # _____</p>	<p>ARCHITECTURE/ENGINEERING FIRM ADDRESS:</p> <p>_____</p> <p>_____</p> <p>LICENSE # _____ E-MAIL: _____</p>
<p>CONTRACTING COMPANY:</p> <p>_____</p> <p>CONTRACTOR:</p> <p>_____</p> <p>PHONE # _____ FAX # _____</p>	<p>CONTRACTING COMPANY ADDRESS:</p> <p>_____</p> <p>_____</p> <p>LICENSE # _____ E-MAIL: _____</p>
<p>PROJECT AREA (PRECISE STREET LIMITS):</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>PROPOSED SMP TYPE:</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>PROJECT LOCATION:</p> <p>I. NEIGHBORHOOD: _____</p> <p>II. CITY COUNCIL DISTRICT: _____</p> <p>III. SPECIAL DISTRICT: <i>(e.g. Planned development, TIF, University, BID)</i> _____</p> <p>IV. PENNDOT HIGHWAY DESIGNATION: _____</p>	<p>ANTICIPATED DESIGN AND CONSTRUCTION SCHEDULE:</p> <p>I. CONCEPTUAL PLANNING: ___/___/___</p> <p>II. PRELIMINARY DESIGN: ___/___/___</p> <p>III. FINAL DESIGN: ___/___/___</p> <p>IV. CONSTRUCTION: ___/___/___</p>

	PARTNER AGENCIES/ORGANIZATIONS: <i>(If any)</i> _____
DESIGN COMPLETION (%): _____	
INTENDED GOAL(S) FOR THE PROJECT: _____ _____	
PROJECT SCOPE (DESCRIPTION OF WORK, ATTACH ADDITIONAL SHEETS IF NECESSARY): _____ _____ _____ _____	
TOTAL AREA OF PROJECT: _____ SQUARE FEET	
ADDITIONAL PROJECT CONSIDERATIONS: ARE THERE OPPORTUNITIES TO ADD TREE CANOPY OR PROTECT EXISTING TREES WITHIN THIS PROJECT? ARE YOU WILLING TO PARTNER WITH PWD ON PROMOTING ENVIRONMENTAL EDUCATION THROUGH THIS PROJECT? IS THIS PROJECT A PART OF AN EXISTING OR PROPOSED CITY, DISTRICT, OR NEIGHBORHOOD PLAN? DOES THIS PROJECT HAVE ANY COMMUNITY GROUP OR NON-PROFIT ORGANIZATION AFFILIATIONS? ARE THERE ANY OTHER SPECIAL CONSIDERATIONS OR COLLABORATION OPPORTUNITIES UNIQUE TO THIS PROJECT?	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> YES <input type="checkbox"/> NO <i>(If yes, please state each plan below)</i> <hr/> <input type="checkbox"/> YES <input type="checkbox"/> NO <i>(If yes, please state each plan below)</i> <hr/> <input type="checkbox"/> YES <input type="checkbox"/> NO <i>(If yes, please explain)</i> <hr/> <hr/> <hr/>
ESTIMATED TOTAL COST OF PROPOSED PROJECT: \$ _____	
<p>Plans approved by the Water Department may be considered a part of this application. I hereby certify that the statements contained herein are true and correct to the best of my knowledge and belief. I further certify that I am authorized by the owner to make the application, and that, before I accept project approval, the owner shall be made aware of all conditions of the approval. I understand that if I knowingly make any false statement herein I am subject to such penalties as may be prescribed by law or ordinance.</p> <p>APPLICANT'S SIGNATURE: _____ DATE: ___ / ___ / ___</p> <p>TITLE <i>(If applicable):</i> _____</p>	

PWD Green Street Project Proposal

Section B: Review and Approval Checklist

The purpose of this document is to assist partners in the implementation of green streets projects by providing a checklist to track their submittals throughout the design review and approval process.

SECTION (B)

REVIEW AND APPROVAL CHECKLIST

APPLICATION #: _____
 (PWD use only)
 PROJECT NAME: _____
 PWD WORK NUMBER : _____



**CITY OF PHILADELPHIA
 WATER DEPARTMENT
 OFFICE OF WATERSHEDS**
 1101 MARKET STREET
 PHILADELPHIA, PA 19102
 For more information visit us at
www.phillywatersheds.com

COMPLETED <input type="checkbox"/>	Phase 1: Proposal and Location Approval
COMPLETED <input type="checkbox"/>	Phase 2: Concept Design and Approval
COMPLETED <input type="checkbox"/>	Phase 3: Preliminary Design Meeting(Optional)
COMPLETED <input type="checkbox"/>	Phase 4: Final Design
COMPLETED <input type="checkbox"/>	Phase 5: Permitting Process

PRE-CONSTRUCTION CHECKLIST

COMPLETED	AGENCY	DATE REVIEWED	REQUIRED SUBMITTALS
<input type="checkbox"/> 1. Concept Design Review <input type="checkbox"/> 2. Pre-Design Meeting <input type="checkbox"/> 3. Preliminary Design Meeting (Optional) <input type="checkbox"/> 4. Final Approval Letter <input type="checkbox"/> 5. Developers Agreement (if needed) <input type="checkbox"/> 6. Pre-construction Meeting	PHILADELPHIA WATER DEPARTMENT Office of Watersheds 1101 Market Street, 4 th Floor Philadelphia, PA 19107	1. ___/___/___ 2. ___/___/___ 3. ___/___/___ 4. ___/___/___ 5. ___/___/___ 6. ___/___/___	
<input type="checkbox"/> 1. Concept Design Review <input type="checkbox"/> 2. Developer Services Meeting (if requested by Streets) <input type="checkbox"/> 4. Final Approval Letter <input type="checkbox"/> 5. Street Opening/ Closing Permit	STREETS DEPARTMENT Municipal Services Building Room 940 1401 J.F. Kennedy Boulevard Philadelphia, PA 19102	1. ___/___/___ 2. ___/___/___ 3. ___/___/___ 4. ___/___/___	
<input type="checkbox"/> 1. Technical Review	PENNDOT 7000 Geerdes Blvd. King of Prussia, PA 19406	1. ___/___/___	
<input type="checkbox"/> 1. Tree Layout Plan Review (if needed)	PARKS AND RECREATION STREET TREE MANAGEMENT DIVISION 1515 Arch Street, 10th Floor Philadelphia, PA 19102	1. ___/___/___	
<input type="checkbox"/> 1. Utility Review	SEPTA	1. ___/___/___	
<input type="checkbox"/> 1. Utility Review	PECO ENERGY	1. ___/___/___	

<input type="checkbox"/> 1. Utility Review	PGW	1. __/__/__	
<input type="checkbox"/> 1. Utility Review	COMCAST	1. __/__/__	
<input type="checkbox"/> 1. Utility Review	VERIZON	1. __/__/__	
PWD PROJECT COMPLETION APPROVAL (PWD USE ONLY)			
APPROVED FINAL DESIGN PLAN: <input type="checkbox"/> YES <input type="checkbox"/> CONDITIONAL <i>(Please see below if approval is conditional)</i>			
CONDITIONAL APPROVAL: _____ _____ _____ _____			
This is to certify that I have examined the within detailed statement, together with a copy of the plans relating thereto, and find the same to be in accordance with the provisions of the law relating to buildings in the City of Philadelphia, that the same has been approved and entered into the records of this Department.			
PROJECT MANAGER: _____ DATE APPROVED: __/__/__			

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appendix **7.2**

**Green Stormwater Infrastructure
Review Contacts**

APPENDIX 7.2:

Green Stormwater Infrastructure Review Contacts

All GSI designs should be submitted to the following agencies and groups for review. The PWD project manager should be copied on all review submittals. All conflicts arising from reviews should be resolved by the design consultant prior to final design.

Reviewer	Contact
<p>Philadelphia Water Department Office of Watersheds Green Stormwater Infrastructure Implementation Program (GSIIP)</p>	<p>Jessica K. Brooks Philadelphia Water Department GSIIP Manager 1101 Market St., 4th Floor Philadelphia, PA 19107 215-685-6213 Jessica.K.Brooks@phila.gov</p>
<p>Philadelphia Water Department Construction Branch</p>	<p>Robert Britt Philadelphia Water Department Construction Branch 1101 Market St., 2nd floor Philadelphia, PA 19107 215-685-6341 Robert.Britt@phila.gov</p> <p>Copy Robert Rotermund on all correspondence Robert.Rotermund@phila.gov</p>
<p>Philadelphia Water Department Public Affairs</p>	<p>John DiGiulio Philadelphia Water Department Public Affairs 1101 Market St., 3rd Floor Philadelphia, PA 19107 215-685-6019 John.DiGiulio@phila.gov</p>
<p>Philadelphia Streets Department</p>	<p>Philadelphia Streets Department Attn: Project Design Engineer 1401 J.F.K. Boulevard Municipal Services Building, Room 940 Philadelphia, PA 19102 215-686-5578</p>

<p>Philadelphia Streets Department City Plans Unit</p>	<p>Frank Morelli, PLS Philadelphia Streets Department Survey Bureau Manager 1401 J.F.K. Boulevard Municipal Services Building Philadelphia, PA 19102 215-686-5540 Frank.Morelli@phila.gov</p>
<p>Pennsylvania Department of Transportation (PennDOT) Engineering District 6-0</p>	<p>PA Department of Transportation Engineering District 6-0 Attn: District Traffic Services Manager 7000 Geerdes Blvd. King of Prussia, PA 19406-1525 610-205-6560</p>
<p>Philadelphia Parks and Recreation Street Tree Management Division</p>	<p>Philadelphia Parks & Recreation Street Tree Management Division Attn: Park District Manager 1515 Arch St., 10th Floor Philadelphia, PA 19102 215-685-4363</p>
<p>Southeast Pennsylvania Transit Authority (SEPTA)</p>	<p>Contact the Philadelphia Streets Department to obtain the current <i>Committee of Highway Supervisors Contact List (Utilities)</i></p>
<p>PECO Energy</p>	<p>Contact the Philadelphia Streets Department to obtain the current <i>Committee of Highway Supervisors Contact List (Utilities)</i></p>
<p>Philadelphia Gas Works</p>	<p>Contact the Philadelphia Streets Department to obtain the current <i>Committee of Highway Supervisors Contact List (Utilities)</i></p>
<p>Comcast</p>	<p>Contact the Philadelphia Streets Department to obtain the current <i>Committee of Highway Supervisors Contact List (Utilities)</i></p>
<p>Verizon Communications</p>	<p>Contact the Philadelphia Streets Department to obtain the current <i>Committee of Highway Supervisors Contact List (Utilities)</i></p>

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appendix **7.3**

**Photographic Documentation
Specifications**

APPENDIX 7.3:

Photographic Documentation Specifications

Applicants must maintain construction records and photographic progress for all components of the projects. This specification includes administrative and procedural requirements for photography, prior to and during construction.

Section 01110 Photographic Documentation

1.01 Photo-Documentation

Part 1 Summary

- A. Retain a competent individual knowledgeable in construction practices and experienced in the implementation of established inspection procedures to perform the services specified.
- B. Contractor will assume the responsibility for the management of the photographer
- C. The photo-document is considered a product without artistic value. Photograph copyrights are equally shared and unrestricted between the photographer, PWD and/or contractor.

Part 2 Photo-Documentation

- A. Prior to start of construction, photo-document pre-construction conditions of all areas to be disturbed or accessed by contractor. Take sufficient number of photographs of each residence including but not limited to cartway, curb, footway, steps, front wall, curb stop box, fresh air inlet, and gas shut off, and other areas where work will occur to document pre-construction conditions.
- B. All photographs shall be taken with a full frame digital camera equipped with geotagging.
- C. Electronically date & time stamp each photograph.
- D. A brief descriptive note will be recorded for each photograph. It must include date taken, photograph number assigned by the camera, directional and other reference points that help identify the photograph location in the project.
- E. Notes are to be transcribed into a typewritten searchable format such as a table or spreadsheet.
- F. All damage or claims not indicated on pre-construction photographs may be considered the result of construction. All costs to correct damages or settle claims shall be borne by the contractor.
- G. Notify the project engineer at least two days before taking any photographs.
- H. The project engineer may communicate any special requests or instructions for photo-documentation prior to each visit.
- I. Upon completion of construction photo-document post construction conditions and document as described above.
- J. No photographs shall be taken during periods of inclement weather or when more than 10 percent of the ground area is covered with obstructions, cars, snow, leaves or debris unless otherwise authorized by the project engineer.

Part 3 Submittals

- A. Furnish JPEG file for viewing and printing of each photograph w/notes to the project engineer and to: Department of Records, City Hall - Room 156, Philadelphia, PA 19107, Attn: Mark Brooks. Provide in a digital media format (flash drive or DVD) prior to start of construction. Work may not start until photographs are reviewed and accepted by project engineer.
- B. Furnish a 5" x 7" color photographic print of each photograph to the project engineer prior to start of construction.
- C. Post-construction photo-documentation must be received before final contract payment is processed.
- D. Photographic files are to be saved unaltered.

Part 4 Payment

- A. There will be no separate payment for photo-documentation. This item shall be considered a distributed cost.

Revised: 11/1/12

appendix **7.4**

Glossary

Appendix 7.4: Glossary

As-Built Plan

An As-Built Plan is a plan that is prepared after construction to document the actual constructed conditions of the project

Base plan

A Base Plan is a plan that depicts pertinent site information that exists before a project is constructed. A base plan may show property lines, rights-of-way, utility locations, topographical contours, or any other pertinent information.

City Plan

The City Plan is the legal description of the streets, on which the curb lines are regulated.

City Plan Action

A City Plan Action is a change to the official City Plan and is managed by the Streets Department. The application for City Plan changes is available through the Streets Department. Actions that incur a change to the City plan are as follows:

- Placing a new street on the city plan;
- Striking an existing street from the city plan;
- Revising the lines and/or grades of an existing street;
- Relocating curb lines and change roadway widths;
- Placing or strike a city utility right of way on/from the city plan; or
- Any combination of the above

Combined Sewer Overflow (CSO)

Combined Sewer Overflow is discharge from a combined sewer that contains untreated or partially treated sanitary sewage.

Conditional Approval Letter

A Conditional Approval Letter (sometimes referred to as Final Approval Letter) is issued from the Streets Department following completion of the Department's review of final design plans. This letter is required to obtain a final design review from PWD.

Construction Approval Letter

A Construction Approval Letter (also known as a Notice to Proceed) is issued by PWD once all of the final design submissions have been received by PWD. This letter serves as the final approval from PWD for a developer to initiate the construction of a project.

Developers Agreement

The Developers Agreement is an agreement between the Water Department and a Developer that outlines the Developers requirements throughout construction and the Water Department's future ownership rights. The Developers agreement is prepared by PWD and attached to a copy of signed final mylars. If a bond is required, it will be detailed within the agreement.

Developer Services Meeting

Developer services meetings are offered by the Streets Department to provide guidance to developers in the earlier stages of the design of projects that will incur significant work in the right-of-way. If a meeting is requested by the Streets Department, an applicant must attend and submit concept designs at least one week prior to the meeting.

Final Design Report

The final design report is a PDF form that the design engineer (consultant or PWD engineer) fills out with project metrics as part of the final design submission. It records final design information for a project, each system within a project, and each SMP within a system.

Functional system

Functional system is a group of design components that serve the function corresponding to the functional system name.

Greened Acre

A Greened Acre is an acre of land in a combined sewer drainage area that was formerly impervious area connected directly to a sewer, but has been reconfigured to utilize GSI to manage one inch of stormwater runoff. A Greened Acre is an expression of the volume of stormwater managed by GSI in acre-inches, using the following equation:

$$GA = IC * Wd$$

Where:

IC is the impervious cover utilizing green stormwater infrastructure (acres). This quantity can include the area of the stormwater management feature itself, as well as the area that drains to it.

Wd is the depth of water over the impervious surface that can be physically managed in the facility (inches). Green stormwater infrastructure designs will be aimed at controlling at least 1 inch of runoff, and up to 1.5 inches of runoff, unless otherwise deemed feasible by engineering design.

Green Gutter

A Green Gutter is a narrow and shallow landscaped strip along a street's curb line. It is designed to manage stormwater runoff by placing the top of the planting media in the green gutter lower than the street's gutter elevation allowing stormwater runoff from both the street and sidewalk to flow directly into the green gutter.

Green Stormwater Infrastructure (GSI)

Green stormwater infrastructure (GSI) comprises a range of soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases, release a portion of the captured stormwater slowly back into the sewer system.

Guaranteed Pavement Information System (GPIS)

GPIS is a Streets Department-developed application that allows for the coordination of street opening activities and utility work in the right-of-way. Through GPIS, information can be exchanged between facility owners and the City relating to construction, projects and events which may affect City Rights-Of-Way. GPIS offsets are a set of specified dimensions that are completed for each segment to provide its detailed location.

Highway Occupancy Permit

A Highway Occupancy Permit (HOP) must be acquired from PennDOT prior to the start of construction if a project impacts a state-owned street. HOPs are issued for occupancy of State highway right-of-ways, opening of the street surface, placing of a facility or structure, or opening an access way. HOPs are filed through PennDOT's permitting System (<https://www.dot14.state.pa.us/EPS/home/home.jsp>).

Impervious Area

Impervious Area is a surface, which is compacted or is covered with material that restricts infiltration of water, including semi-pervious surfaces such as compacted clay, most conventionally hard-scaped surfaces such as streets, driveways, roofs, sidewalks, parking lots, attached and detached structures, and other similar surfaces.

Permeable Pavement

Permeable Pavement is a hard pavement surface consisting of materials that allow water to pass freely through the surface, thereby eliminating or reducing runoff compared to impervious paving.

Pre-Construction Conference

A Pre-Construction conference must be scheduled between an applicant and PWD's construction unit prior to receiving a PWD Construction approval letter. Applicants are expected to provide a written notice to all parties involved (e.g. contractor, construction administration) at least 7 days in advance of the meeting. The pre-construction conference will address construction details such as project requirements, inspection procedures, and city code compliance. Documentation of this meeting by the applicant is recommended to record any instructions or agreements designated by the city and as a reference for any unresolved questions or concerns.

Pre-Planning Conference

A Pre-Planning Conference is an option conference with PWD that must be requested by an applicant. This meeting will provide the applicant with the opportunity to review concept designs, project schedule, project construction and the list of required documents and approvals.

Punch List

A Punch List is a list of tasks, in response to unaddressed issues in the projects construction, which are required to be completed to comply with the terms of a construction contract. Generally, punch lists are generated during the final inspection phases of construction.

Right-of-way

A Right-of-way is an easement reserved over land for transportation purposes.

Sewer Collection System

A Sewer Collection System is a system that collects and transports sewage to a sewage treatment plant.

Storage Volume

The Storage Volume is the volume of runoff storage created by the system. For infiltration systems, the entire depth of the system is counted. In detention/slow-release systems, only the depth above the orifice elevation is counted.

Storm Size Managed

The Storm Size Managed is the depth in inches of runoff managed by the system (not based on storage depths). This value is calculated from storage volume and drainage area.

Stormwater Management Practice (SMP)

A Stormwater Management Practice is any man-made structure that is designed and constructed to detain, infiltrate, or otherwise control stormwater runoff quality, rate, or quantity.

Stormwater Management System

A Stormwater Management System consists of multiple stormwater management practices that are hydraulically and/or hydrologically connected through a single control structure.

Stormwater Bump-out

A Stormwater Bump-out is a vegetated curb extension that intercepts street and sidewalk flow along the curb-line. It is designed to infiltrate and/or detain and release stormwater runoff where necessary.

Stormwater Drainage Well

A Stormwater Drainage Well is a defined subtype of Class V underground injection controls (UIC) as defined by the USEPA's UIC Program. It is 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.

Stormwater Planter

A Stormwater Planter is a structure filled with soil media and planted with vegetation or trees. It is designed to infiltrate and/or detain and release Stormwater runoff where necessary. Planters can be designed below street grade or above grade and often contain curb edging as the structure surrounding the planter.

Stormwater Tree

A Stormwater Tree is a tree that has stormwater runoff directed to its pit. It is designed to infiltrate and/or detain and release stormwater runoff where necessary.

Stormwater Tree Trench

A Stormwater Tree Trench is a system of trees connected by a subsurface infiltration/storage trench. It is designed to infiltrate and/or detain and release stormwater runoff where necessary.

Street Opening/Street Closure Permit

A street opening permit is required by the Streets Department for all projects that propose opening or excavating within the City Right-of-Way. This permit ensures compliance with all current state, city and federal government regulations for ROW construction. Most street opening permits will also need a Street Closure Permit from the Streets Department, in order to close off the right-of-way to proceed with work and for equipment storage.

Underdrain

An Underdrain is the perforated pipe placed within a system for the purpose of slow-releasing or draining stormwater back to the sewer.

Glossary of Acronyms

BMP	Best Management Practice
CCTV	Closed circuit television
CSO	Combined Sewer Overflow
DVRPC	Delaware Valley Regional Planning Commission
E&S	Erosion and Sediment Control
GA	Greened Acres
GPIIS	Guaranteed Pavement Information System
GSI	Green Stormwater Infrastructure
LTCPU	Long Term Control Plan Update
NOAA	National Oceanographic and Atmospheric Agency
PADCNR	PA Department of Conservation and Natural Resources
PADEP	Pennsylvania Department of Environmental Protection
PCPC	Philadelphia City Planning Commission
PennDOT	Pennsylvania Department of Transportation
PGW	Pennsylvania Gas Works
PPR	Philadelphia Department of Parks & Recreation
SEPTA	Southeastern Pennsylvania Transportation Authority
SMIP	Stormwater Management Incentives Program
SMP	Stormwater Management Practices
USEPA	United States Environmental Protection Agency

