

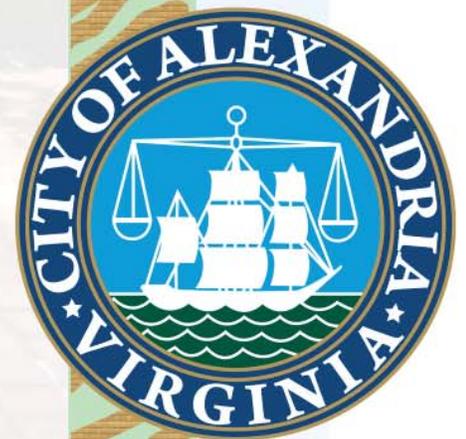


Green Sidewalks

BMP Design Guidelines

Eco-CITY  ALEXANDRIA

FINAL VERSION 1.1
ISSUE DATE 06/12/14



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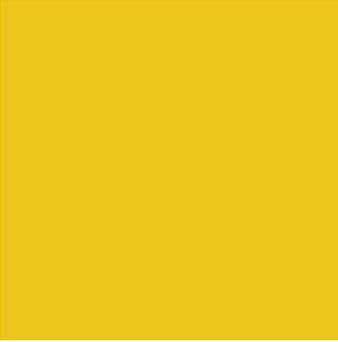
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EXECUTIVE SUMMARY

- In order to help meet the City's water quality responsibilities under the Chesapeake Bay Total Maximum Daily Load (TMDL) and to achieve municipal separate storm sewer system (MS4) permit compliance, facilities which can reduce non-point source pollution (keystone pollutant is phosphorus) in storm water run-off are required to the maximum extent practicable within the City's Public rights-of-way (ROW). The systems are termed sidewalk BMP's (Best Management Practice) within these guidelines.
- A BMP is a facility for controlling the pollutants found in runoff from precipitation which, although commonly referred to as storm water, includes all rainfall which is traditionally funneled directly into storm drains.
- The preferred BMP's for use in the public ROW are above-grade systems located within the sidewalk and which treat storm water runoff from adjacent roads and sidewalks
- In general, a portion of these systems are visible at street level as landscape features within the sidewalk. In appearance they are very similar to a tree well or continuously planted strip, although they are depressed below sidewalk grade to allow for shallow ponding of water.
- In areas with insufficient space, or other exceptional constraints, a below grade (ultra-urban) BMP system, or other BMP type shall be considered. In wider ROW settings, treatment within the median, or other locations may also be considered.

- The surface-installed BMP systems outlined in these guidelines are intended to be used in areas of new development or re-development. They are envisaged in areas where significant new construction will take place (e.g. large scale buildings or facilities, or areas of large scale master plan implementation), that include either the construction of new roads and sidewalks, or significant rehabilitation of the existing ROW facility.
- These guidelines are intended to direct designers, developers and stakeholders, whether working on private or public projects, towards design of BMP systems which are suitable both in terms of function and streetscape design to the City of Alexandria.
- In all cases, the maintenance responsibilities will form part of a BMP Maintenance Agreement between the Developer/Applicant and the City. The Memo to Industry No. 04-2014 shall be the basis for agreements, although agreements for specific projects shall be made on an individual basis, either as part of the master planning or development site plan process.
- BMP systems are to be sized to allow for both treatment of stormwater and to promote healthy, vigorous street planting. Apart from exceptional cases, the system shall include street tree planting and shall include a minimum of 450 cu. ft. of uncompacted soil volume per tree.



I INTRODUCTION

A. AIMS AND USE

These guidelines are being published to aid the development community during design and construction of best management practices (BMPs) for treatment of stormwater runoff from the public right-of-way and/or portions of private property. The primary focus is to provide a design that achieves maximum improvements in water quality and issue guidance for the placement and aesthetics of above-grade BMPs. The guidelines are also intended for projects being administered by the City itself as it upgrades the public right-of-way.

The guidelines are divided into sections which help to break down the various design issues that need to be addressed in designing sidewalk BMPs. The requirements for stormwater management and for streetscape have individual sections. In designing a BMP system, both the stormwater and streetscape requirements shall be met, and guidance is provided on how to achieve that, particularly with regards to the sizing and placement. It should also be noted that these guidelines supplement other, local guidelines and requirements published by the City. For example, the City's *Landscape Guidelines* include requirements for standard planting, i.e. non-BMP planting. The standards and requirements published here are specific to sidewalk BMPs.

The final sections provide both typical details and materials specifications which can be used by designers. These should be treated as standard details which set the functionality, finishes, specifications and aesthetics for design which may need to be modified to meet site specific conditions.

B. GOALS

Despite 25 years of clean-up efforts the Chesapeake Bay watershed remains a challenged ecosystem. The tidal waters of the Bay continue to be enriched with excess nitrogen, phosphorus and sediment. In response to this challenge and in accordance with the federal Clean Water Act, the EPA has directed the states contributing runoff to the Bay to develop and implement a "pollution diet", also known as a Total Daily Maximum Load (TMDL). The keystone regulated pollutant continues to be phosphorus with nitrogen and sediment added to the required load reductions. To meet the reduction goals, Virginia developed a Watershed Implementation Plan (WIP).

As part of the WIP, the City has been working with other municipalities and the State of Virginia to determine Alexandria's reduction requirements to meet the WIP goals. As one of the means to help achieve these reductions, a renewed emphasis on treating new roadways was promulgated with a Memo to Industry published on March 22, 2012 by the City's Department of Transportation and Environmental Services (T&ES). To help facilitate compliance with the new regulations the Memo specified that the first half inch of runoff from any new public roadways created during development or redevelopment shall receive treatment from a stormwater BMP facility.

Traditionally, treatment of impervious surfaces within the public right-of-way has been difficult to achieve due to their linear nature. Rights-of-way are, however, a significant portion of the impervious surface within the Chesapeake Bay watershed: particularly in highly urbanized areas such as Alexandria. Many of the recent Small Area Plans by the City have called for a 'Green Streets' approach which combines infrastructure and environmental improvements. The type of sidewalk BMPs advocated in these guidelines are one such example of this approach in helping the City achieve its environmental goals.

C. SURFACE-INSTALLED VERSUS BURIED BMPs

Surface-installed sidewalk BMPs are strongly preferred for linear projects because relative to other BMP choices they provide a high amount of pollutant reduction in a minimum amount of space. The City considers that the pollution reduction target is much better met through an above-grade BMP with vegetation and deep planting soil rather than a buried device.

The use of ultra-urban below ground BMPs are not as desirable due to the high maintenance requirement, lower efficiency pollutant removal and/or very large underground footprint in an area where many other public utilities must be located. The addition of soil space within the planter is also beneficial for improved tree growth and health, which serves to improve water as well as air quality. There may be situations where above grade BMP facilities prove to be impossible or impractical (presence of utilities which may not be moved, grade difficulties, etc.). In those situations a below grade (ultra-urban) BMP facility will be considered on a case by case basis.

D. APPLICABILITY AND LOCATION

The surface-installed BMP systems outlined in these guidelines are intended to be used in areas of new development or re-development. They are envisaged in areas where significant new construction will take place (e.g. large scale buildings or facilities, or areas of large scale master plan implementation), that include either the construction of new roads and sidewalks, or significant rehabilitation of the existing right-of-way facility. These guidelines lay out the framework for BMP facilities to be installed within the right-of-way. A determination as to the appropriateness of specific sites will occur during the small area plan, rezoning and design guideline process. Detailed design and application of these standards for specific sites will occur during the Development Special Use Permit (DSUP) process.

The following are typical examples where sidewalk BMPs shall be designed for at an early project stage

- A large-scale multi-use development which requires the reconstruction and widening of the existing sidewalk for multiple city blocks (e.g. improvements to Eisenhower Avenue between Mill Road and Holland Lane)
- The implementation of several blocks of a master-planned area which includes some new road and sidewalk connections in addition to buildings and communal facilities (e.g. the Beauregard Small Area Plan 2012 or, North Potomac Yard Small Area Plan 2010).

In general, these guidelines are suitable for areas where:

- Right-of-way facilities do not presently have stormwater treatment
- Sidewalk widths are 14' or more
- Proposed utilities and streetscape features (bus stops, light poles etc.) can be selectively located to avoid conflict with BMP facilities.
- Existing utility locations can be identified and recorded (including depth) early in the design process so the coordination between BMPs and utilities can be addressed to the extent that either:
 - Utilities are relocated, or
 - That the BMP functionality and streetscape appearance is not compromised by utilities or footings.

- BMP facilities can be incorporated for maximum water quality treatment and as a beneficial streetscape feature.
- Maintenance and access can be reasonably accommodated.

Retro-fitting of existing streets

Due to the anticipated size of surface-installed BMP facilities these guidelines are intended for the retro-fitting of existing streets only where technically feasible. Consideration should be given the following: sufficient sidewalk space, local character and conflict with existing features and utilities. BMPs of a more appropriate size and scale should be considered for these areas on a case by case basis.

Site constraints which preclude sidewalk BMPs

Although not specifically covered by these guidelines, site or project constraints may require that areas other than the sidewalk are considered for BMP locations which treat runoff from the ROW. These may include road medians, privately owned land or publicly owned land. In these cases, the stormwater treatment goals shall be considered on a case by case basis. Alternatively, below grade ultra-urban BMP facilities may be considered.

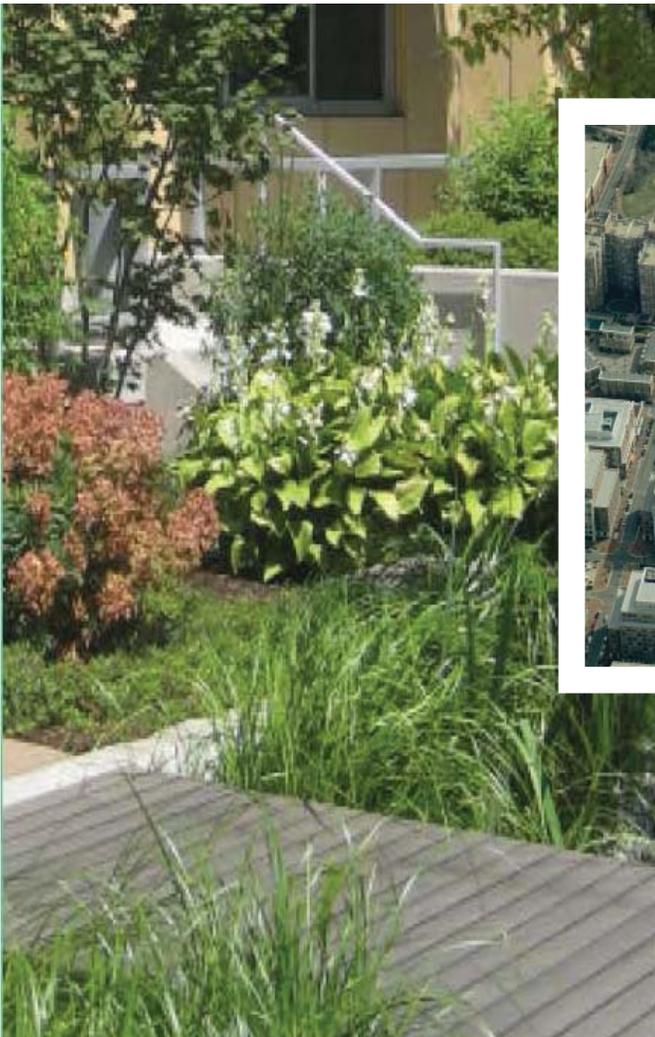


Image: Residential BMP Design



Image: Areas of Significant Redevelopment in the City.

E. CONCEPTS AND EXAMPLES



Image: BMP Installation, 1st St., Washington D.C.

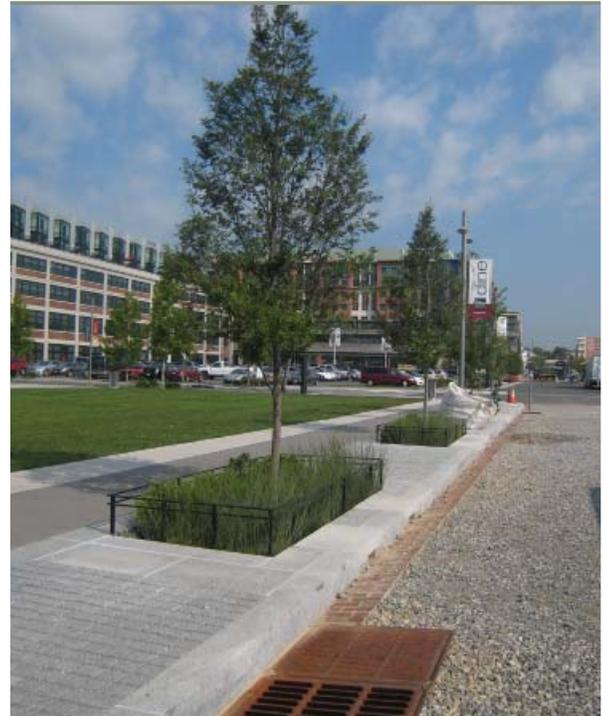


Image: BMP Installation, Yards Park, Washington D.C.



Image: BMP Installation, Yards Park, Washington D.C.



Image: BMP Installation, D St., S.W., Washington D.C.

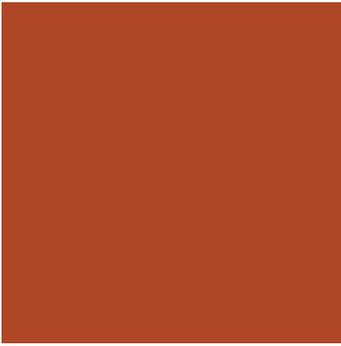


Image: BMP Installation, GWU Campus, Washington D.C.



II STANDARDS AND REQUIREMENTS





A. WATER QUALITY AND TREATMENT

1. General

As a result of the urban nature of a large portion of the City there will be limited areas within the public right-of-way where surface BMPs can be located. Even with this constraint, due to existing street tree requirements in the City, there is an opportunity to utilize this pre-designated space to treat storm water while simultaneously providing for a better growing environment for the trees.

Surface storm water treatment facilities are the preferred best management practice (BMP) for public right of ways. Alternative designs that incorporate individual project constraints will be considered on a case by case basis should surface BMPs prove impractical for certain projects. Installing underground BMPs should be provided in lieu of the surface BMPs. Having insufficient space to provide a surface BMP does not relieve the applicant from the requirement to provide a BMP for the treatment of the proposed right-of-way to the maximum extent practical.

2. Water Quality Standards and Sizing

The following standards shall be followed when designing for these systems.

- Treatment Volume
 - A minimum of the first half inch (also defined as the water quality volume – WQV) of storm water runoff from impervious surfaces within the right of way shall be treated to the maximum extent practicable
- Sizing
 - Maximum of 8 inches of ponding depth
 - The minimum surface area (footprint) of the bioretention facility shall be designed utilizing one of the following methods;
 - Dividing the WQV by the depth of ponding or;
 - Dividing the WQV by the depth of ponding plus the depth of water stored in the filter or $WQV / (h+x)$ where;
 - WQV = water quality volume; h = ponding depth; x = depth of water stored in filter, where;
 - $x = \text{fill time} * (\text{Infiltration rate}) * ((\text{depth of soil} + (\text{ponding depth} / 2)) / 4)$
 - Typical values: fill time estimated to be 1 hr; infiltration rate and depth of soil are project specific; ponding depth is six inches.

- BMP Phosphorus Removal Efficiencies*
 - Bioretention systems enhance the quality of storm water runoff through the processes of adsorption, filtration, volatilization, ion exchange, microbial activity, evapotranspiration, nutrient uptake and decomposition. The most critical design component that impacts these processes and the accompanying system efficiency is the specification and depth of the soil media. Soil specifications are provided in the Specification of Materials section. A minimum depth of thirty inches should be specified to ensure the system efficiency is maintained over time. Additional depth should be provided if needed based on the plantings proposed. Provided the above requirements are satisfied the efficiency listed below will be given.
 - Curbside Bioretention Facilities - 50%
 - *Unless superseded by Virginia stormwater management regulations
 - *For all other BMP efficiencies reference the Alexandria Supplement to the Northern Virginia BMP Handbook
- Design Parameters
 - a. Typical soil/filter media depth of 48 inches with trees. A typical number is specified as the depth of soil will range over the series of facilities which are installed as a linear run in the sidewalk. Site constraints and drainage falls over the run will necessitate that minimum depths of less than 48 inches are allowable as follows
 - i. Minimum soil/filter media depth of
 - 1. 30 inches if no trees or large shrubs,
 - 2. 36 inches if trees or large shrubs included
 - b. Bottom of soil layer must be 4 inches below root ball
 - c. The bioretention filter shall drain within 48 hours.
 - d. Underdrain shall be provided unless site specific infiltration testing is provided.
 - i. Acceptable in-situ soil infiltration rates are between 1.00 and 8.27 in/hr.
 - ii. If no underdrain is provided, facilities shall be located a minimum of 10 feet from the nearest building.
 - e. Observation well is required to allow for monitoring of drainage through filtering system.
 - f. The depth between the bottom of the bioretention cell and a high groundwater table should be a minimum of two feet.
 - g. Continuous or frequent flows unrelated to storm water runoff are not permitted to be directed to the BMP.
- Submission and Water Quality Requirements
 - All pertinent BMP information including, but not limited to, sizing, grading, water quality

calculations and associated details and cross sections shall be provided on the final plan in coordination with the items on the applicable site plan or grading plan checklist

- A pre and post development pollutant loading summary shall be provided for the right of way area(s) served by the BMP.
 - If a new street is being created and/or the right of way area receiving storm water quality treatment was previously located on private property, the water quality calculations completed for the private redevelopment project shall include the entire site including the new right of way.
 - If the project is intended to provide water quality treatment for a retrofit area (currently in the public right of way), a separate water quality calculation shall be provided.

- Construction

- The success of bioretention cells is heavily dependent on proper construction sequencing. Bioretention cells shall be constructed after the drainage area to the cell is completely stabilized. Erosion and sediment controls shall be provided as needed to protect the cell from accumulation of silts and fines that would accumulate within void spaces and negatively impact infiltration
- Soil media within the cell shall be placed to minimize compaction in lifts of 8 to 12 inches. The soil media should be overfilled by up to 20% to allow for natural settlement.

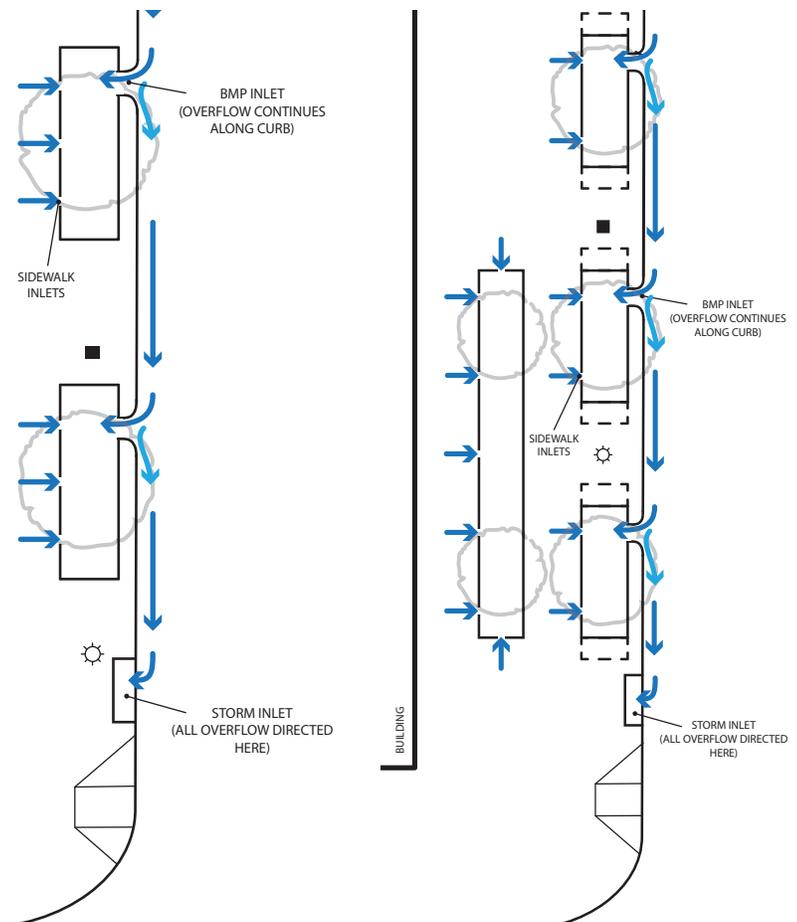
Hydrology Design

Sidewalk BMPs are designed to accommodate runoff from the public ROW, including both the road and sidewalk.

The general hydrologic principle is that a series of inlets allow water to flow into the BMP where it is retained and treated. The inlets are located at regular intervals along the road curb and within the coping curb which surrounds the BMP.

For road run off, water enters the BMP by a curb inlet until ponding capacity is reached. Overflow then follows the curblines to enter at the next inlet in the series. All overflow from the series is directed to a storm inlet which is located at the end of the series. The following flow diagrams illustrate the proposed hydrology design.

All overflow for the BMP series shall be directed to a storm inlet, whether sheet flow from the impervious surface or via the underdrain or over flow drain within the BMP.



FD-100: Tree Well Hydraulic Flow

FD-102: Mid-Sidewalk BMP Hydraulic Flow



STREETSCAPE DESIGN

B. STREETScape DESIGN

The BMP systems outlined in these guidelines are intended to form an integral part of the streetscape with a design that allows other street uses to continue. As an attractive and beneficial street feature, they are also intended to enhance the visual character and pedestrian environment of the street.

Siting the BMP system and choosing which type to install is an important consideration from a streetscape perspective. Key factors to consider include:

- the location of buried utilities (to ensure conflicts between utilities and BMPs are minimized)
- Whether frequent pedestrian access along the curbside is required, e.g. if the BMP area is adjacent to on-street parking then a tree well rather than continuous planting strip would be required.
- Accommodation of other streetscape features such as light poles and parking meters shall be considered from an early stage of design. The location of these features shall not compromise the visible portion of the BMP system.
- Where design guidelines for an area already exist (e.g. the Carlyle Design Guidelines), the type of BMP system should be chosen to reflect the overall intent of the design guidelines. For example, tree wells may be specified in local design guidelines, as may the spacing of street trees.

The BMP systems shall include appropriate urban planting (see the planting section III.C), and in particular the installation of large shade street trees. Not only are street trees a valued and recognized element of streetscape design, but trees offer a biological benefit to stormwater management by intercepting precipitation and filtering pollutants. Systems which include only groundcover and under-planting shall be considered only in exceptional circumstances, such as where space constraints limit the soil volume required for tree planting, or where other streetscape features such as utility wires would inhibit healthy tree establishment.

In considering the specific siting and type of BMP installation the following general principles shall be applied.

- All BMP systems shall be setback from the road curb by 2 feet. Exceptions to this shall be considered on a case by case basis, for example if systems are required within a narrow sidewalk area.
- All BMP systems shall allow at a minimum a six feet unobstructed sidewalk between the nearest building façade and their curblines.
- For all types of installation, appropriate vision clearance at intersections and pedestrian crossings shall be maintained.

For fuller details of placement, sizing and installation requirements, see the following illustrative sketches and sections, and the typical details and specifications at the end of these guidelines.

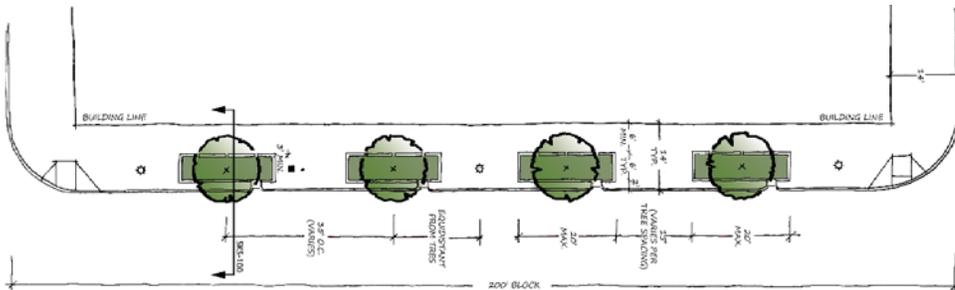
Types of BMP installation

Different urban locations and uses require different BMP solutions. As described above, consideration should

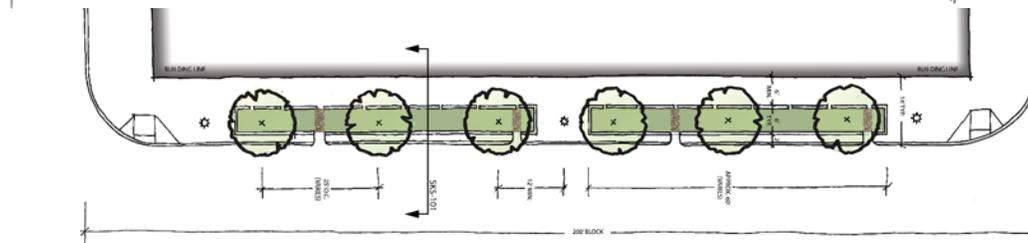
be given to the type of street (e.g. commercial, residential, mixed use etc.) and the uses that are intended for it. Whether curbside parking is to be accommodated on the street, is space for outdoor dining intended, and what pedestrian circulation is to be accommodated are all the type of issue that should be considered in choosing a type and placement of sidewalk BMPs.

Four main types of sidewalk BMP are envisaged.

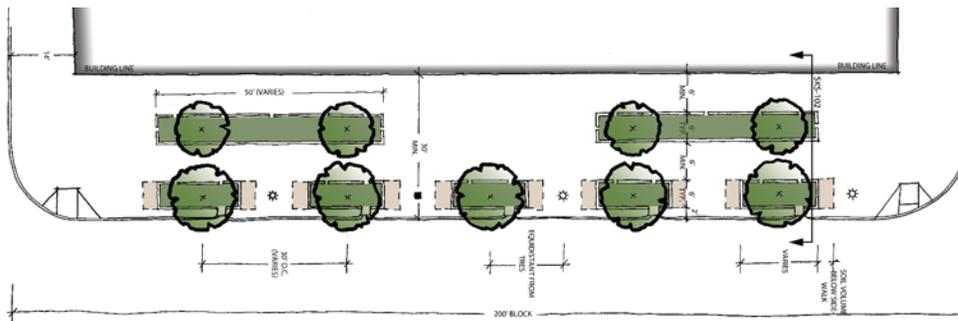
Each one is described separately below, with scenario criteria for each type's applicability. These scenarios are a guideline, and the designer should consider site specific conditions when electing a sidewalk BMP application.



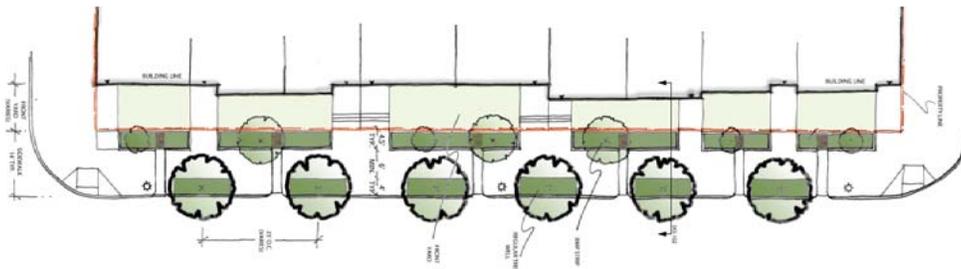
Type A: Tree Well BMP
(Type A2: Tree Well BMP with Soil Panels)



Type B: Continuous Planting Strip BMP



Type C: Mid-Sidewalk BMP



Type D: Back of Sidewalk BMP

For each type described below, a typical plan layout is provided based on a 200 ft city block. The standard items within the ROW such as meters, lighting and storm inlets are shown to illustrate how these features can be accommodated together with the BMP. A summary table of the sizing for types A and B is also included to give some idea of how the BMP sizing may be designed to fit within a sidewalk.

TYPE A: TREE WELL BMP

Sample sizing worksheet. See addendum for full worksheet

Row ID	Assumptions	Measurement	Unit
Contributing Drainage Area			
A	Area of roadway to be treated	200 LF of ROW x 24 ft wide (2 x 12 ft wide travel lanes)	4,800 SF
B	Area of sidewalk to be treated	approx 170 LF of ROW x 14 ft wide	2,300 SF
C	Total Contributing Drainage Area		7,100 SF
D	Total Water Quality Volume	First 0.5 in. required to be treated	296 CF

Water Quality Sizing Requirements			
E	Ponding Area Required (Gross)	8 in. ponding depth	444 SF
F	Ponding Area Required Line 1 (Net after infiltration)		0.180
G	Ponding Area Required Line 2 (Net after infiltration)	Total Water quality volume	349 SF

Project Specific Data	H	Fill Time	1 Hour (standard)	1 HOUR
	J	Infiltration Rate	Soil Spec range range	0.167 FT/HOUR
	K	Depth of Soil (Avg)	Project specific	4.25 FT
	L	Ponding Depth	Maximum ponding depth	0.667 FT

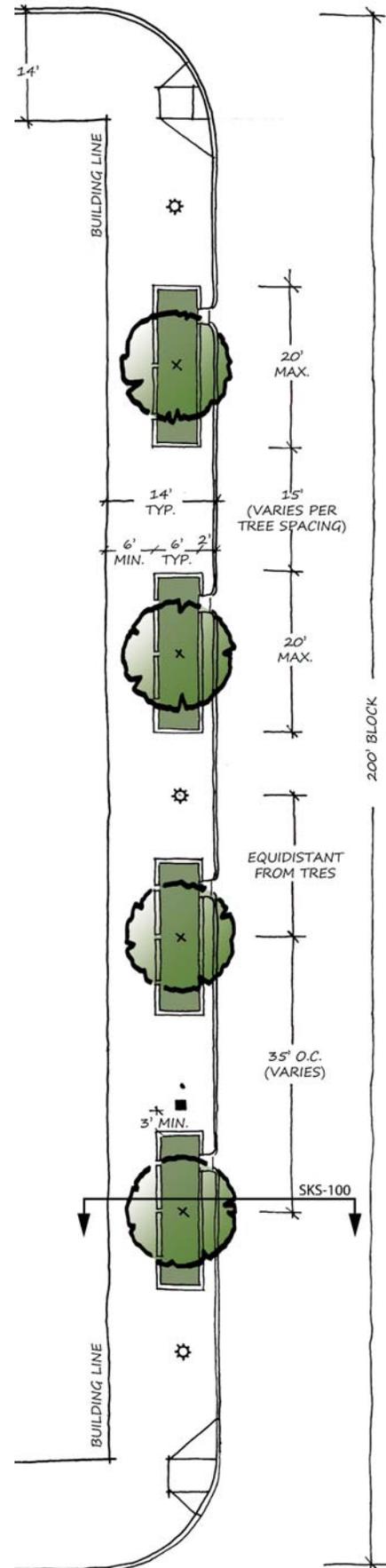
Landscape Sizing Requirements

Project Specific Data	M1	Type of Landscape Treatment Proposed	Tree wells	
	M2	Tree Spacing	30 - 35	FT O.C.
	N	Number of trees to be accommodated per block face	4 trees required	4

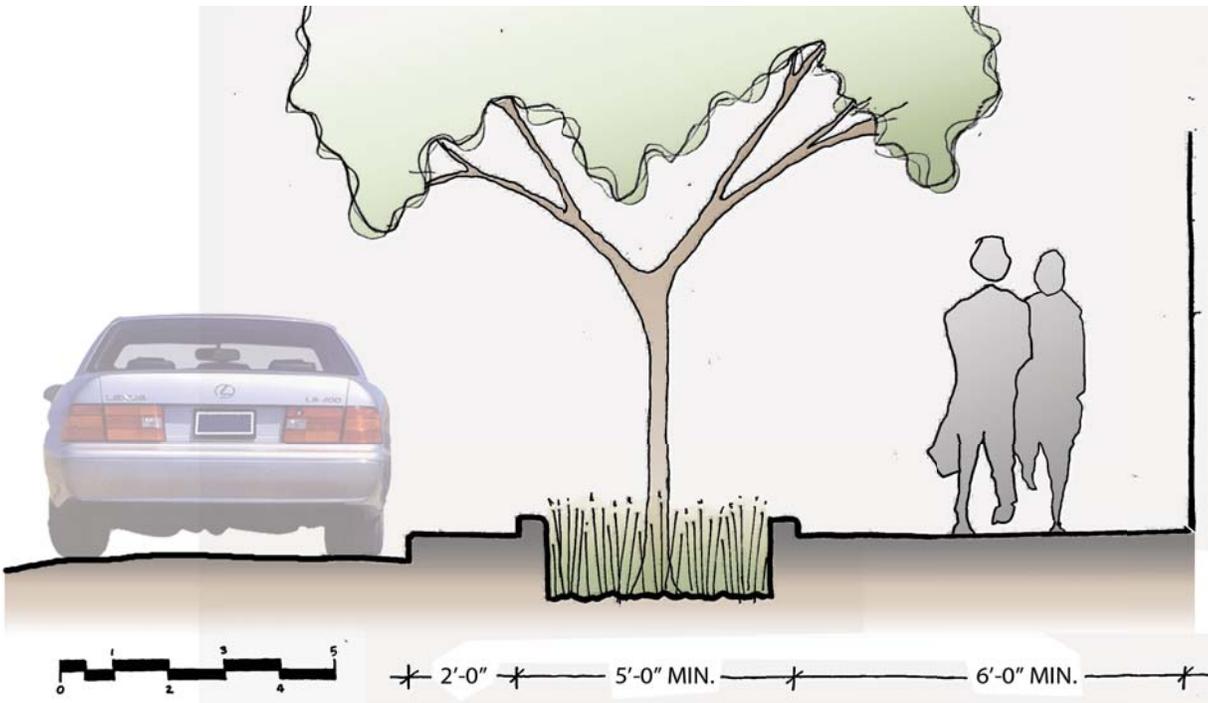
P	Open Area per Tree Well Required		87.3	SF
Q	Width		5.0	FT
R	Length (min. open length)		17.5	FT
S	Avg soil Depth		4.25	FT
T	Soil volume per tree provided		371.2	CF
U	Additional Soil Volume Required per tree		78.8	CF

Note: Figures in the electronic spreadsheet are frequently rounded and account for minor discrepancies.

Cell requires project specific data to be entered



SK-100: Tree Well Plan View



SKS-100: Tree Well Section (Type A & A2)

Type A: Tree Well BMP

i. Description

A landscape feature in the sidewalk which allows for tree planting and treatment of stormwater runoff. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be an individual feature with sidewalk separating each well.

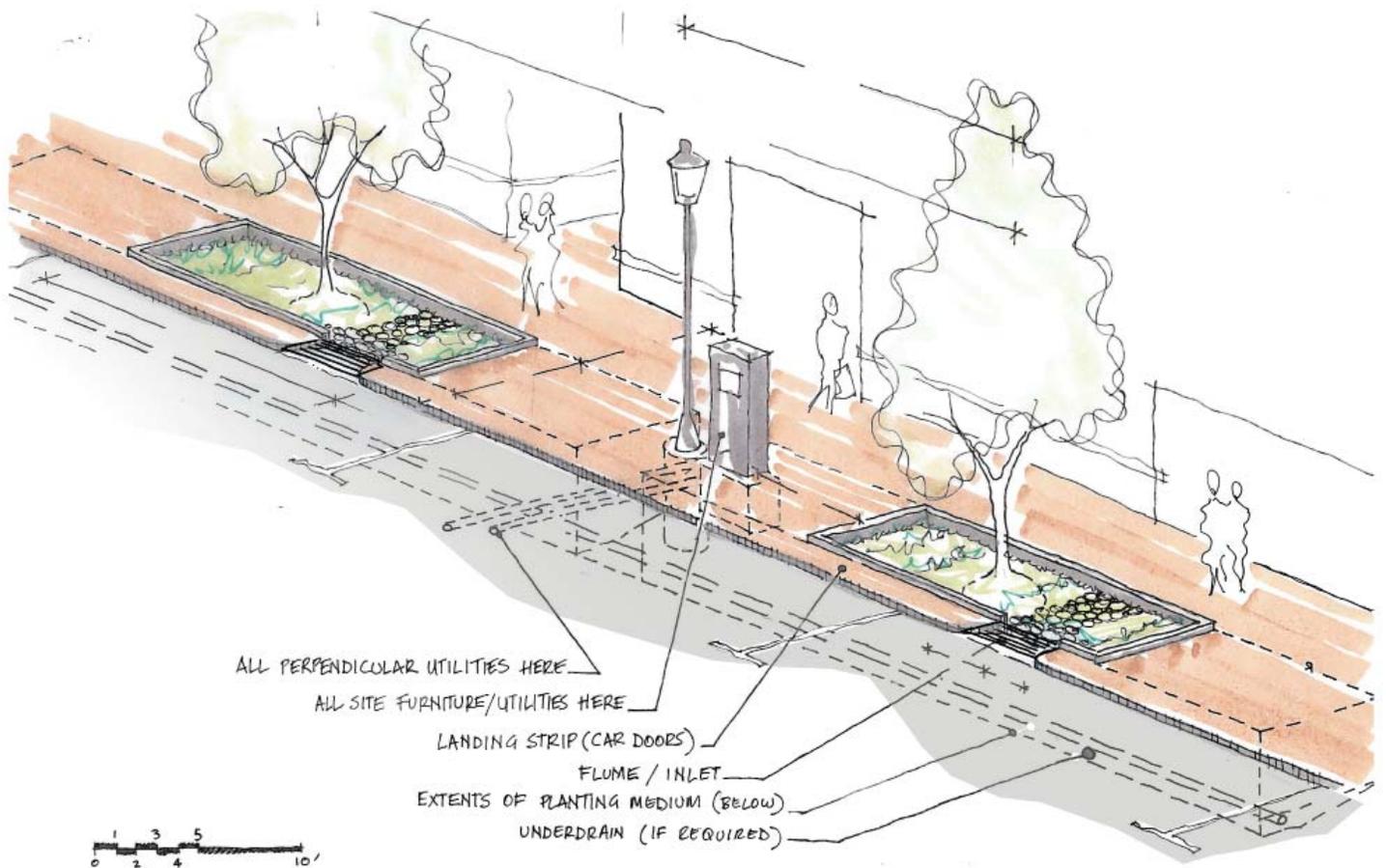
ii. Applicable locations

- Streets with a high degree of pedestrian activity and connectivity.
- Streets with adjacent curbside parking which requires access from the sidewalk to parked vehicles
- Streets accommodating furniture and infrastructure elements such as light poles, parking meters, hydrants and signs
- Streets accommodating buried utilities which run both parallel and perpendicular to the sidewalk, the latter of which can be grouped to run between individual wells.
- Streets with area design guidelines which specify that tree wells (rather than continuous planting strips) are specified.

TYPE A TREE WELL (CONTINUED)

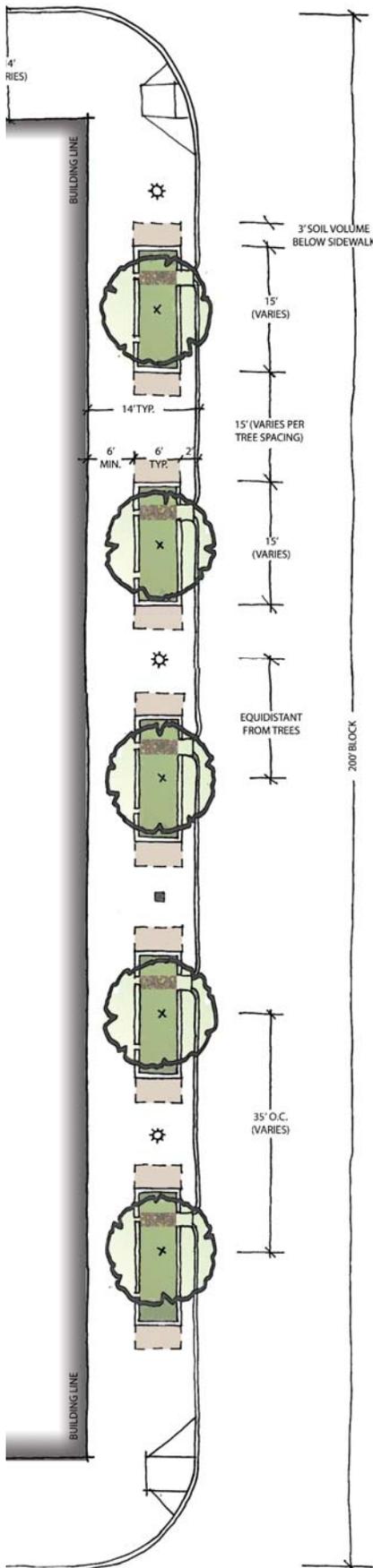
iii. Dimensions

- The open area of individual wells shall be a minimum of 10 feet in length and 4 feet in width
- The open area of individual wells shall be a maximum of 20 feet in length and 7 feet in width



SK-110: BMP Tree Well Diagrammatic Perspective. This version shows soil panels extending from the well.

TYPE A2: TREE WELL WITH SOIL PANELS



SK-100-A: Tree Well with Soil Panels Plan View

Type A-2: Tree Well BMP with soil panels

i. Description

A landscape feature in the sidewalk which allows for tree planting and treatment of stormwater runoff. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be an individual feature with sidewalk separating each well.

For scenarios where the sizing requirement for sidewalk BMPs would lead to overly-large systems which would be either out of character or in conflict with other street uses, soil panels shall be used to supplement the open portion of the well.

A soil panel is a structurally supported space under the sidewalk which allows for uncompacted growing medium which is suitable for tree root growth. See the typical details section of the guidelines for allowable soil panel designs. Soil panels are more commonly associated with tree wells, given their smaller size (as compared with continuous planting strips).

ii. Applicable locations

- Streets with a high degree of pedestrian activity and connectivity.
- Streets with adjacent curbside parking which requires access from the sidewalk to parked vehicles
- Streets where the character of large tree wells would be out of place or where spatial constraints necessitate smaller wells.
- Streets accommodating furniture and infrastructure elements such as light poles, parking meters, hydrants and signs
- Streets accommodating buried utilities which run both parallel and perpendicular to the sidewalk, the latter of which can be grouped to run between individual wells.
- Streets with area design guidelines which specify that tree wells (rather than continuous planting strips) are specified.

iii. Dimensions

- The minimum dimensions of Type A2 are the same as Type A.
- The open area of individual wells shall be a maximum of 15 feet in length and 5 feet in width

TYPE B: CONTINUOUS PLANTING STRIP

Sample sizing worksheet. See addendum for full worksheet

Row ID	Assumptions	Measurement	Unit
Contributing Drainage Area			
A	Area of roadway to be treated 200 LF of ROW x 24 ft wide (2 x 12 ft wide travel lanes)	4,800	SF
B	Area of sidewalk to be treated approx 170 LF of ROW x 14 ft wide	1,650	SF
C	Total Contributing Drainage Area	6,450	SF
D	Total Water Quality Volume First 0.5 in. required to be treated	269	CF

Water Quality Sizing Requirements			
E	Ponding area required (Gross)	8 in. ponding depth	403 SF
F	Ponding area required Line 1 (Net after infiltration)		0.217
G	Ponding area required Line 2 (Net after infiltration)	Total Water quality volume	304 SF

Project Specific Data			
H	Fill time	1 Hour (standard)	1 HOUR
J	Infiltration rate	Soil Spec range range	0.200 FT/HOUR
K	Depth of Soil (Avg)	Project specific	4.00 FT
L	Ponding depth	Maximum ponding depth	0.667 FT

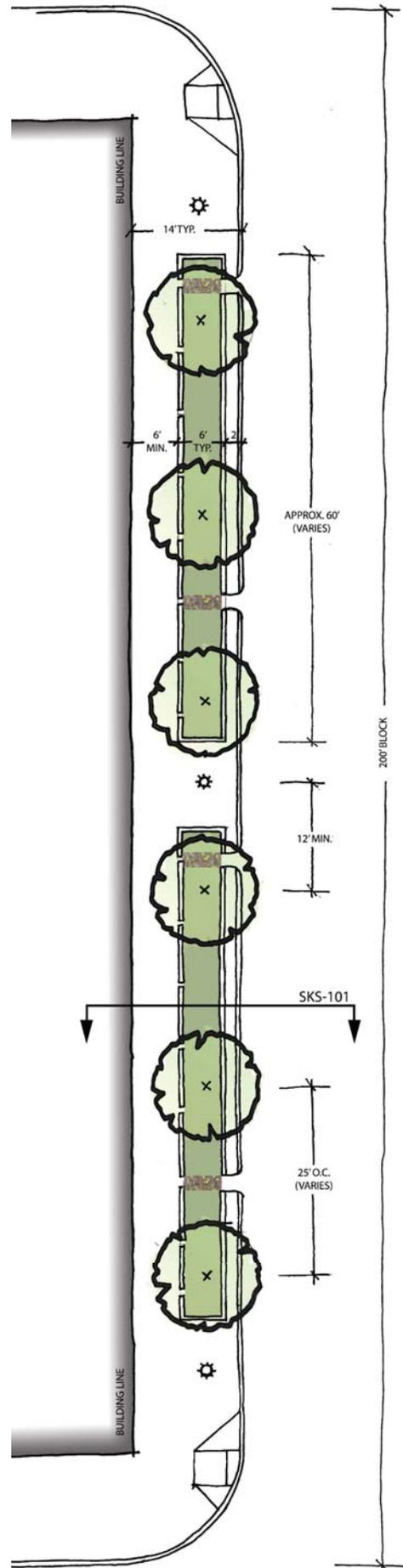
Landscape Sizing Requirements

Project Specific Data			
M1	Type of landscape treatment proposed		Continuous Strip
M2	Tree spacing		25 FT O.C.
N1	Number of trees to be accommodated per block face	6 trees required	6
N2	Number of strips to be accommodated per block face	Assumes 2 strips	2

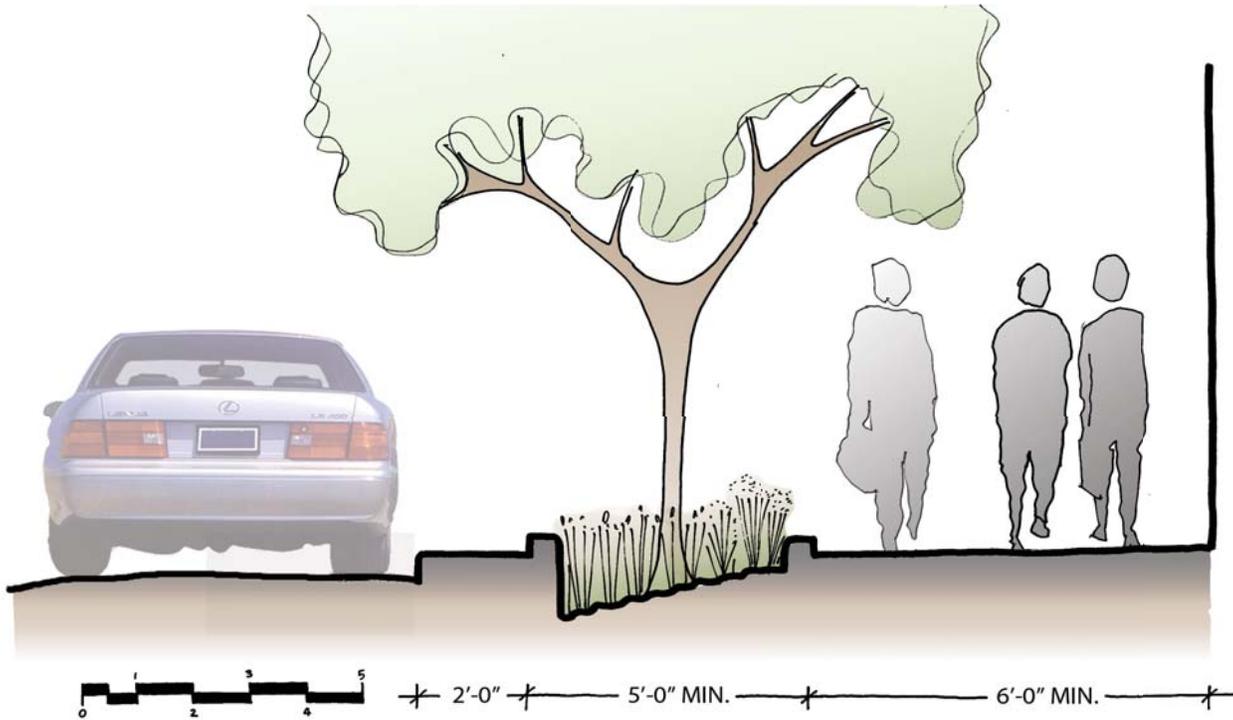
P	Open area per strip required	Assumes strips are same length	152.1 SF
Q	Width		5.0 FT
R	Length (min. open length)		65.0 FT
S	Avg soil depth		4.00 FT
T	Soil volume per tree provided		433.3 CF
U	Additional soil volume required per tree		16.7 CF

Note: Figures in the electronic spreadsheet are frequently rounded and account for minor discrepancies.

Cell requires project specific data to be entered



SK-101: Continuous Planting Strip Plan View



SKS-101: Continuous Planting Strip Section

Type B: Continuous Planting Strip BMP

i. Description

A landscape feature in the sidewalk which allows for tree planting and treatment of stormwater runoff. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be a continuous feature with a large area of visible landscape planting and occasionally separated by sections of sidewalk.

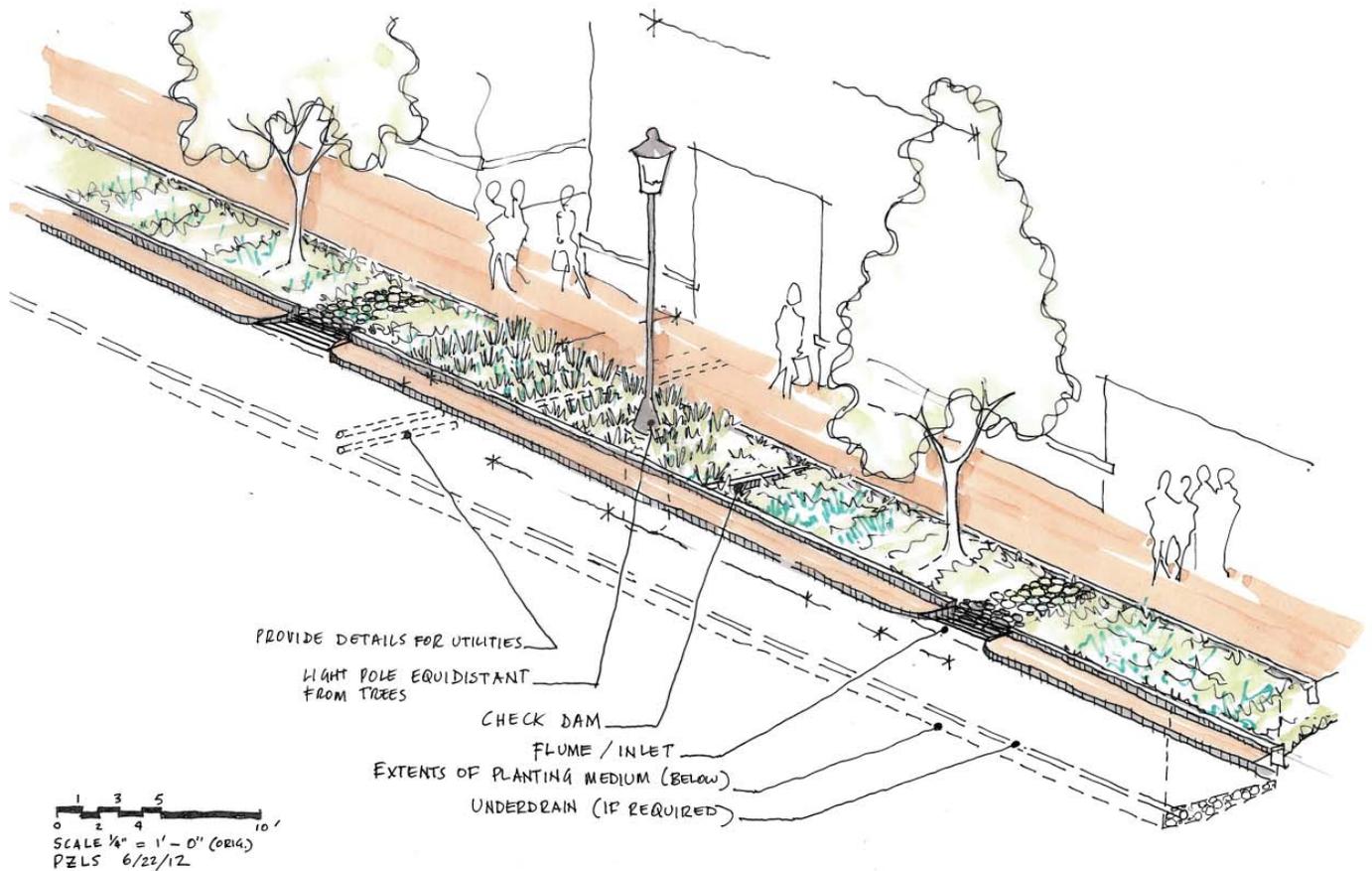
ii. Applicable locations

- Streets with a lower volume of pedestrian activity.
- Streets where the volume of vehicular traffic would benefit from a continuous planting area along the curb in order to provide a more comfortable pedestrian environment.
- Areas of the street without adjacent curbside parking.
- Streets with area design guidelines which specify that continuous planting strips (rather than tree wells) are specified.
- Streets where the close spacing of trees would leave very little linear space (typically less than 10 feet) between tree wells.
- Streets where drainage areas necessitate extended planting areas to accommodate the required volume of stormwater.

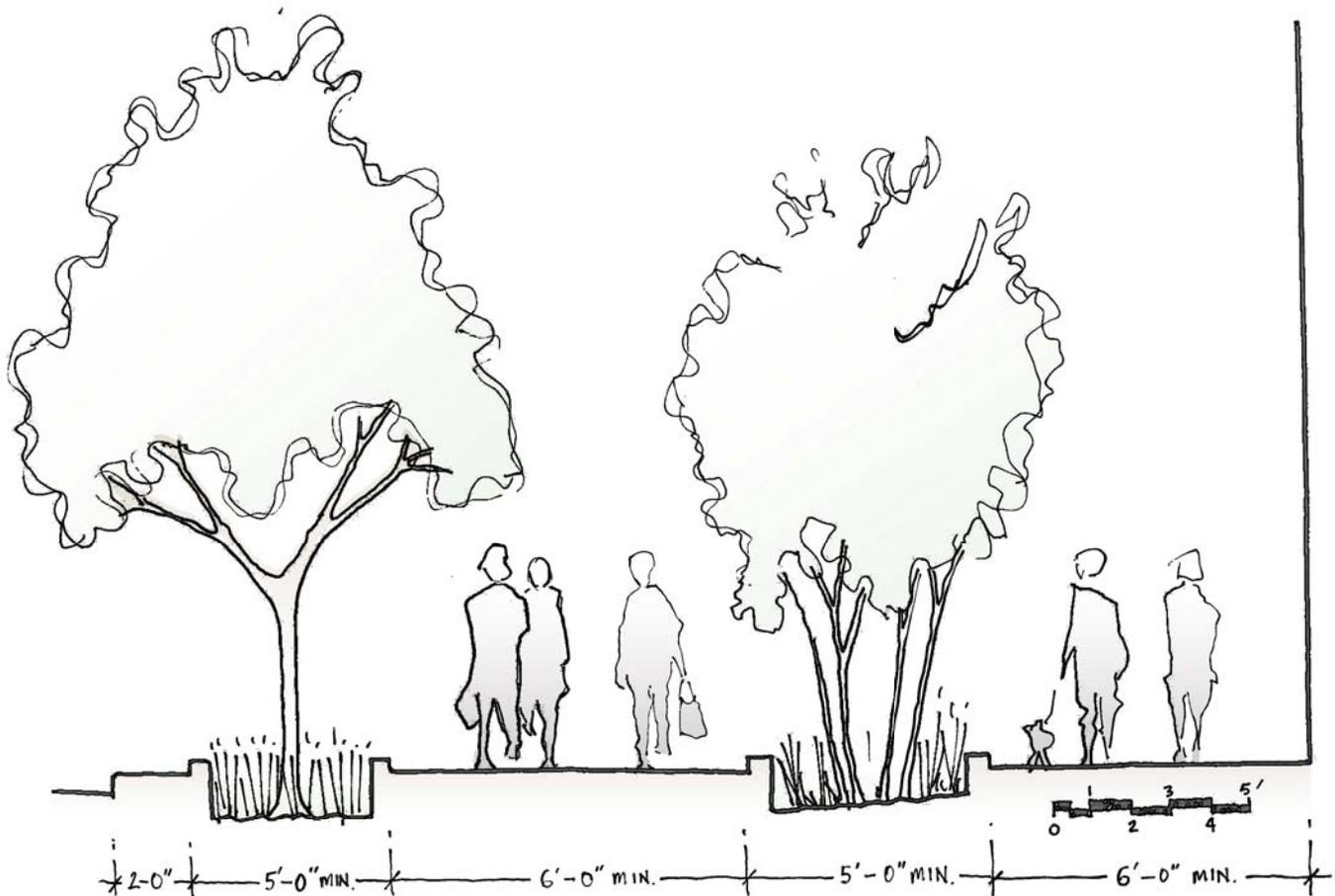
TYPE B: CONTINUOUS PLANTING STRIP (CONTINUED)

iii. Dimensions & Notes

- The open area of planting strips shall be a minimum of 4 feet in width.
- The open area of individual wells shall be a maximum of 7 feet in width.
- Due to their large size, a sloped soil profile is preferred which includes a shallower soil depth on the pedestrian side of the continuous strip (see section SKS-101).



SK-111: BMP Continuous Planting Strip Diagrammatic Perspective



SKS-102: Mid-sidewalk BMP Section

Type C: Mid-sidewalk BMP

i. Description

A landscape feature in the sidewalk which allows for tree planting and treatment of stormwater runoff. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be a continuous feature with a large area of visible landscape planting and occasionally separated by sections of sidewalk. They are set back, approximately mid-way between the curb and the building line.

Other landscape features may be present in the adjacent sidewalk, such as standard or BMP tree wells.

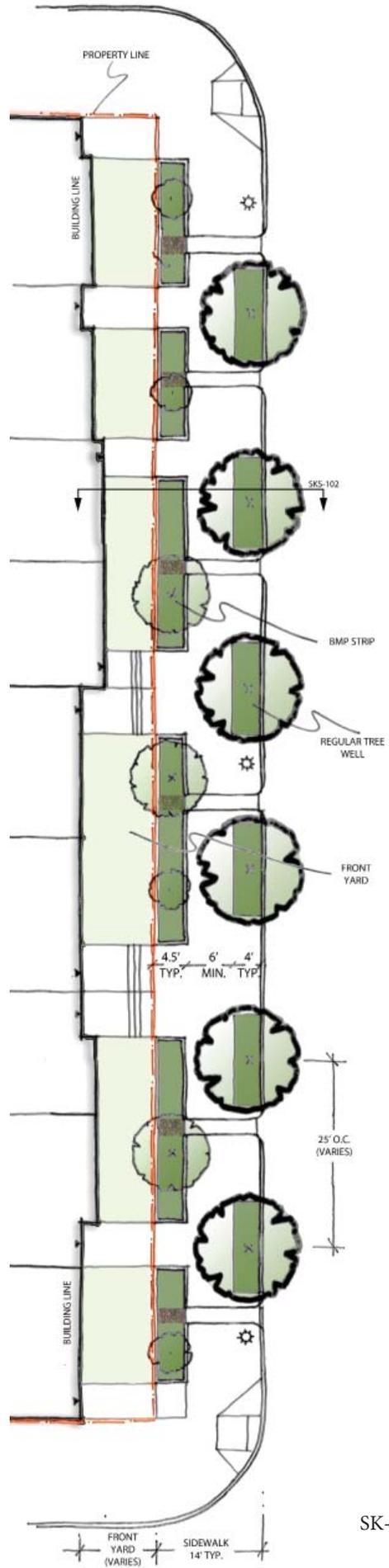
ii. Applicable locations

- Extremely wide sidewalks (e.g. 30 feet wide) which would allow both a standard curbside tree well / or planting strip to be installed in addition to a setback planted area. Pedestrian access shall be carefully considered and accommodated under this scenario.
- Sidewalks where seating or other streetscape elements may be accommodated adjacent to the setback planted area.

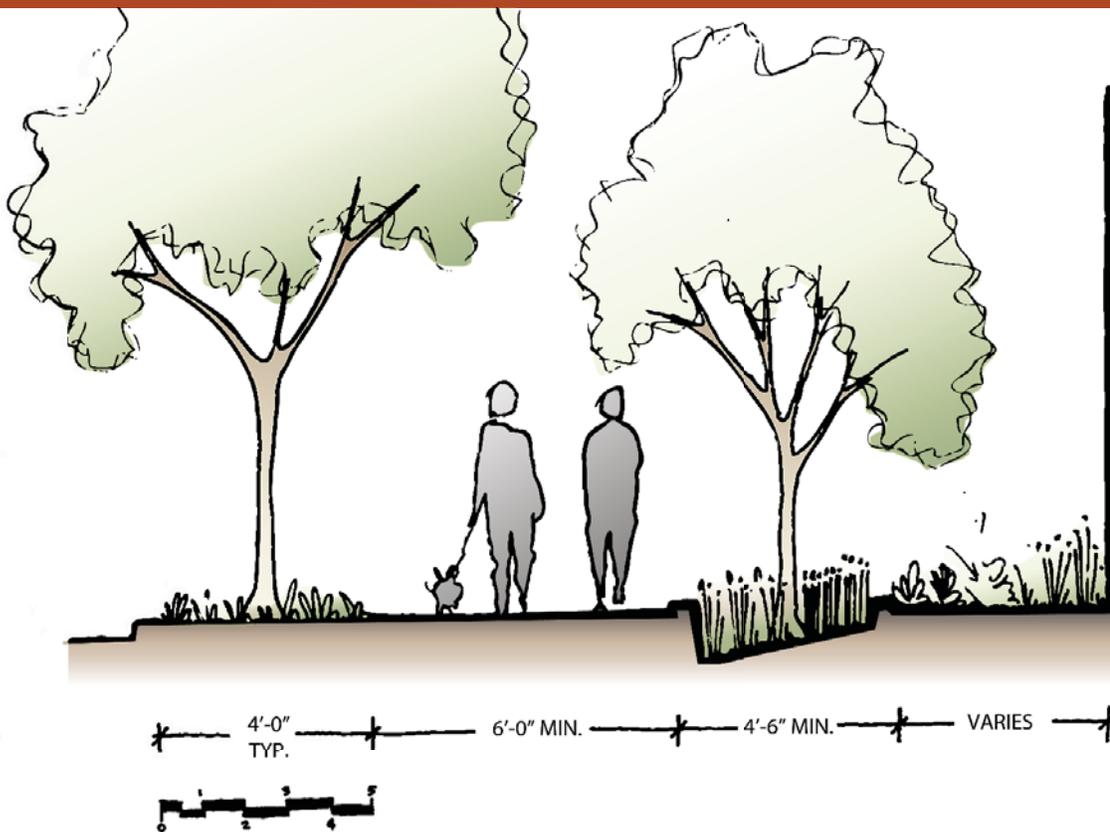
iii. Dimensions

- The dimension of setback planted areas shall be considered on a case by case basis.

TYPE D: BACK OF SIDEWALK BMP



SK-103: Back of Sidewalk BMP Plan View



SKS-103: Back of Sidewalk BMP Section

Type D: Back of sidewalk BMP

i. Description

A landscape feature in the sidewalk which allows for planting and treatment of stormwater runoff. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be either a continuous feature, or a series of smaller features with an area of visible landscape planting and occasionally separated by sections of sidewalk. They are set back, approximately at the back of the ROW, and can be adjacent to front yards.

Other landscape features may be present in the adjacent sidewalk, such as standard or BMP tree wells.

ii. Applicable locations

- Residential areas
- Narrower streets, especially streets with only one travel lane in each direction
- Areas which have front yards
- Streets with adjacent curbside parking which requires access from the sidewalk to parked vehicles

iii. Dimensions

- Where trees are envisaged within the BMP facility, a minimum sidewalk width of 14.5' is required.
- Smaller BMP facilities (with a slightly narrower width – 3' 6" where trees are planted), and alternatives without tree planting may be utilized. The sizing for the BMP facility is subject to the stormwater treatment requirements, regardless of the soil volume and tree planting requirement.

General layout and sizing requirements for all BMP types.

i. Utilities

Buried utilities

- The location of utilities shall be considered at a very early stage of design and shall be located to avoid conflict with BMP systems (both the above and below grade components).
- In general, this requires utilities which run parallel to the street to be located behind the BMP system.
- Early consideration shall be given to utilities which share a duct.
- Utilities which run perpendicular to the street shall be clustered together to minimize conflict with the BMP. Their location shall be under a sidewalk section (for BMP tree well installations). In all cases they shall be located and installed at the mid-point between street trees.
- Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.
- Significant buried utilities shall not be installed in the planting soil area and within a radius of five feet from the installed tree rootball

Overhead utilities: See the Planting section for applicable tree species where overhead utilities are present.

ii. Location of other streetscape features

Hydrants / parking meters / signs / light poles

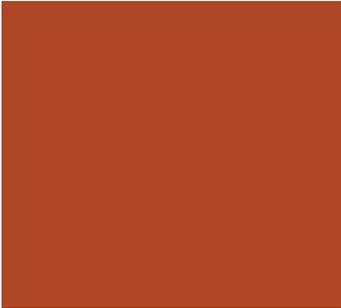
- In all cases they shall be located and installed at the mid-point between street trees, and no closer than 12 ft from the face of the tree trunk
- For BMP tree well installations, these streetscape features shall be located to maintain a minimum 3 ft clear of sidewalk between the feature and the nearest curb face of the BMP facility.
- All utilities and structural footings shall be coordinated with the placement of the tree wells/trenches, and in general shall not encroach upon the wells and strips. Separate details for these elements shall be provided should they be located within the wells/trenches.

iii. Streets with steeper gradients

Special design consideration shall be given to streets with steep gradients where the soil surface elevation for the series of BMPs makes the required ponding depth difficult to achieve. In these cases, designs with check dams and amended coping curb details shall be considered. In some instances coping curb heights may require to be increased on the downstream end of the facility.

iv. Areas of very high pedestrian activity

Special design consideration shall be given to sidewalks which have very high pedestrian activity and where conflicting uses may be compromised by the sizes of BMPs required. In these areas, Type A2 BMPs shall be considered to achieve the necessary soil volume requirements in soil panels. In exceptional circumstances, a tree grate system may be considered appropriate.



C. PLANTING

1. General

The purpose of this section is to provide information about plant selection, soil volume, and installation standards. The following requirements are generally appropriate for most installations. Where compliance with Coordinated Development District (CDD) Design Guidelines is required (for example when local design guidelines stipulate streetscape features such as tree species and spacing), deviation from the BMP Guidelines is subject to the approval of the Directors of Planning & Zoning and/or Recreation, Parks & Cultural Activities.

2. Soil

The soil volume requirements and specifications are intended to maximize the growing conditions for plants and to provide the dual functions needed for stormwater management systems.

- a. Volume: Minimum 450 cubic feet for street trees
- b. Volume: the volume for healthy trees shall be coordinated with the soil volume required for adequate water treatment (see the Water Quality and Treatment section).
- c. If an open well or continuous planting strip cannot accommodate the required soil volume, additional uncompacted soil volume shall be provided below the adjacent sidewalk by supported or suspended system (soil panels).
- d. See the Specification section for soil composition and additional planting specifications.
- e. In all cases, the soil volume requirement relates only to uncompacted soil suitable for root growth, and shall not include compacted subgrade adjacent to wells/trenches.

3. Species

The plant species selected here are intended to offer a variety of types, sizes and offering seasonal interest and are compatible with the species identified in many of the City’s design guidelines for specific areas. In addition, they have been carefully chosen as the best examples of plant species capable of providing vigorous performance both within a local urban context and in the specific conditions demanded by BMPs. The following was considered in selecting the plant palettes for the City’s sidewalk BMPs:

- persistent foliage
- canopy spread
- longevity
- growth rate
- drought tolerance
- tolerance to saturated soils
- resistance to urban pollutants (air and water)
- tolerance to poor soils
- bark texture
- foliage texture
- branching structure, and
- canopy density

Species by type & size:

- a. Mid to Full Sized Street Trees – See [Table 1](#)
 - i. Not to be installed under any existing or proposed overhead utility wires.
 - ii. Size: Minimum 3.5 to 4 inches in caliper.
 - iii. Spacing: Trees to be spaced 30-35 feet on center or as otherwise approved.
- b. Small to Mid-Sized (Ornamental) Street Trees – See [Table 2](#)
 - i. May be planted under existing or proposed overhead utility wires.
 - ii. Size: Minimum 2.5 to 3 inches in caliper.
 - iii. Spacing: Trees to be spaced 25-30 feet on center or as otherwise approved.
- c. Woody Shrubs and Groundcover – See [Table 3](#)
 - i. Installation size:
 1. Shrubs, minimum 18 to 24 inches (height) or as otherwise specified.
 2. Groundcover, depending on availability; sized by container or plug
 - ii. Maximum spacing:
 3. Shrubs, 24 inches on center or as otherwise approved.
 4. Groundcover, 6 to 8 inches on center or as otherwise approved.

d. Herbaceous and Grasses – See Table 4

- i. Installation size: Minimum: quart or tubeling
- ii. Maximum spacing: typically not more than 6 to 8 inches on center. To be spaced depending on ultimate size.

4. Installation

- a. In general, installation of plant material shall follow the procedures established in the City of Alexandria *Landscape Guidelines*, unless otherwise specified. If conflicting requirements and procedures with the *Landscape Guidelines* are in evidence, the procedures and requirements outlined in these guidelines shall be adhered to.

5. Planting Design & Layout

a. Street trees:

- i. Shall be installed at the center of tree wells, and along the longitudinal centerline of strips.

b. Shrubs, groundcovers and grasses shall be installed

- ii. To provide a continuous and vigorous cover for the planting ground plane. Two to three species maximum shall be used per 50 linear feet of planting strip, and two species maximum within a well. Supplemental herbaceous material may be inter-planted to provide additional seasonal interest.
- iii. In large swathes of the same species in order to provide a simple aesthetic and maintenance program.
- iv. To provide full seasonal interest
- v. The ultimate height of the planting material shall be carefully considered, especially in relation to the adjacent sidewalk level. As the BMP facility soil level is sunken below the sidewalk level, underplanting shall be chosen to ultimately grow above the adjacent sidewalk level. Planting selections for sloped soil profiles shall be cognizant of the plant sizes relative to the adjacent sidewalk.

c. Plants and water requirements

- i. Plants shall be located to maximize their vigor and health with regards to their water requirements. Careful consideration shall be given to the placement of plants and whether they can tolerate inundation or periods of drought. This is particularly pertinent to facilities which have a sloped soil profile, and to plants located in/around water inlets.

6. Maintenance

- a. Refer to the Maintenance and Operations Section for further maintenance information.
- b. During the establishment period and during prolonged spells of dry weather, regular planting will be required to maintain plant vigor. No permanent ground-set irrigation system shall be installed.

BMP PLANT LIST

TABLE 1: Mid to Full-Sized Street Trees

Botanical Name	Recommended Cultivars	Common Name	Height	Cultural *	Notes *
<i>Acer rubrum</i> - varieties	Autumn Flame, Franksred, October Glory, Northwood, Red Sunset	Red Maple	40-60 ft.	Slightly acidic, moist soils	not particularly urban tolerant
<i>Celtis occidentalis</i>		Common Hackberry	40-60 ft.	Prefers rich soil, very soil adaptable	tolerates urban conditions
<i>Ginkgo biloba</i>	Autumn Gold, Saratoga	Ginkgo	50-80 ft.	Sandy, deep, moderately moist soils	very tolerant, durable tree
<i>Liquidambar styraciflua</i>	Rotundiloba	American Sweetgum <small>(fruitless variety only)</small>	60-75 ft.	Moist slightly acidic soils	needs large area for root development
<i>Platanus acerifolia</i>	Bloodgood, Liberty	London Planetree	70-100 ft.	Moist well drained soils	tolerates urban conditions
<i>Quercus phellos</i>		Willow Oak	40-60 ft.	Moist well drained acidic soils	tolerates urban conditions
<i>Quercus shumardii</i>		Shumard Oak	60-80 ft.	Prefers moist, well-drained soil	tolerates urban conditions
<i>Quercus bicolor</i>		Swamp White Oak	50-60 ft.	Prefers moist, well-drained soil	tolerates urban conditions
<i>Ulmus parvifolia</i>	Accolade, Emer II	Chinese/Lacebark Elm	40-50 ft.	Moist well drained soils	tolerates urban conditions
<i>Zelkova serrata</i>	Green Vase, Village Green	Japanese Zelkova	50-80 ft.	Moist deep soil	tolerates urban conditions

TABLE 2: Small to Mid-Sized Street Trees

Botanical Name	Recommended Cultivars	Common Name	Height	Cultural *	Notes *
<i>Acer campestre</i>	Evelyn	Hedge Maple	25-35 ft.	Well-drained acid soils	adaptable to various soils; drought tolerant
<i>Prunus sargentii</i>		Sargent Cherry	40-50 ft.		
<i>Syringa reticulata</i>		Japanese Tree Lilac	20-30 ft.	Loose, well-drained slightly acidic soils	not drought tolerant

TABLE 3: Woody Shrubs and Groundcovers

Botanical Name	Recommended Cultivars	Common Name	Height	Cultural *	Notes *
<i>Abelia x grandiflora</i>		Glossy Abelia	18-30"	Full sun; acid, well drained soils	dwarf varieties
<i>Aronia melanocarpa</i>	Morton	black chokeberry	2-3 ft.	Full/part sun	tolerants dry and wet soils
<i>Ceanothus ovatus</i>		Inland Ceanothus	2-3 ft.	Full sun;	drought tolerant
<i>Clethra alnifolia</i>	Hummingbird	Summersweet Clethra	2-3 ft.	Full sun; moist, acidic soil	dwarf cultivars
<i>Cornus serica</i>	Arctic Fire, Kelsey	Red Twig Dogwood	3-4 ft.	Full/part sun; adaptable soils	drought tolerant
<i>Itea virginica</i>	Little Henry	Virginia Sweetspire	2-3 ft.	Full sun; adaptable soils	drought tolerant
<i>Potentilla fruticosa</i>		Cinquefoil	2-3 ft.	Full sun;	drought tolerant
<i>Rhus aromatica</i>	Gro Low	Gro Low Fragrant Sumac	2 ft.	Full sun;	drought tolerant
<i>Spiraea x bumalda</i>		Meadowsweet	2-3 ft.	Full sun; acid soil	dwarf varieties

TABLE 4: Herbaceous + Grasses

Botanical Name	Recommended Cultivars	Common Name	Height	Cultural *	Notes *
<i>Carex stricta</i>		Tussock Sedge	2-3 ft.	Full/part sun; moist, wet soils	
<i>Carex morrowii</i>	Aurea Variegata	Variegated Japanese Sedge	1 ft.	Full/part sun; moist, wet soils	
<i>Deschampsia caespitosa</i>	Northern Lights	Tufted Hair Grass	1 ft.	Filtered sun; moist, wet soils	
<i>Deschampsia flexuosa</i>		Wavy Hairgrass	12-18"	Shade/part sun; average to dry soil	
<i>Eragrostis spectabilis</i>		Purple Lovegrass	18-24"	Full sun; drought tolerant	
<i>Conoclinium coelestinum</i>		Blue Misflower	18-36"	Full/part sun; moist, wet soils	
<i>Hypericum calycinum</i>		St. John's Wort	12-18"	Full/part sun; drought tolerant	
<i>Juncus effusus</i>		Soft Rush	3 ft.	Full/part sun; well drained soils	
<i>Muhlenbergia capillaris</i>	Regal Mist	Pink Muhlygrass	2-3 ft.	Full/part sun; drought tolerant	
<i>Panicum virgatum</i>	Shenandoah	Switch Grass	3-4 ft.	Full/part sun; average well-drained soils	
<i>Pennisetum alopecuroides</i>	Hamel	Dwarf Fountain Grass	2 ft.	Full sun; drought tolerant	
<i>Rudbeckia hirta</i>		Blackeyed Susan	2-3 ft.	Full sun; drought tolerant	
<i>Schizachyrium scoparium</i>		Little Bluestem	2-3 ft.	Full sun; drought tolerant	
<i>Spartina patens</i>		Saltmeadow Cordgrass	1-3 ft.	Full sun; drought tolerant	



MAINTENANCE

D. MAINTENANCE RESPONSIBILITIES

For Memo to Industry No. 04-2014 please refer to addendum B.



E. BONDING AND AS-BUILTS

Bonding:

Per Section 11-413 of the Zoning Ordinance, the developer/applicant must post a Performance Bond for all work in the right of way, as well as all landscaping (public and private). The current bond estimate form (as of 12/2012) can be located at: <http://alexandriava.gov/uploadedfiles/tes/info/Performance%20Bond%20for%20Public%20Improvements%20for%20Site%20Plans.pdf>

The current bond estimate form has a per-Acre cost for BMPs, but the actual cost of construction for the facilities shall be used. For underground facilities, a lump sum cost is acceptable. For facilities that include plantings, a lump sum cost for the structural items is acceptable, but the landscaping must be called out separately as shown on the estimate form.

Any landscaping installed as part of a BMP in the right of way is subject to the requirements of Section 11-413 (6) (b) of the Zoning Ordinance which requires a 100 percent bond or escrow for all landscaping until such time as a minimum of 90 percent of the planting, including any replanting, have survived for a period of three years.

As-builts:

Per Section 11-414 of the Zoning Ordinance and the City's Landscape Guidelines, as-built documents are required to be approved prior to Performance Bond release.

A number of certifications are required to be submitted with the as-builts which are directly impacted by construction of BMPs in the right of way, and include, but may not be limited to:

- BMP Certification (per conditions of approval)
- Tree wells, tree trenches, and plantings above structure (per Landscape Guidelines)

Inspection logs/reports of the certifying professional shall be included with the certification of BMPs installed in the right of way which will be maintained by the City.

Structural components of BMPs in the right of way shall be certified by a Professional Engineer and Landscaping components shall be certified by a Registered Landscape Architect. All professionals preparing and certifying plans shall be licensed to practice in the Commonwealth of Virginia.



F. MAINTENANCE AND OPERATIONS

General

This section is a summary of BMP maintenance responsibilities, agreements, considerations and inspections that are necessary after installation. It also features first year and subsequent routine and some non-routine maintenance activities that shall be considered anytime BMPs and natural drainage system (NDS) projects are designed and installed.

In terms of maintenance responsibility, two outline scenarios are likely:

1. Developer/Applicant is responsible for maintenance during the bond period (Performance and/or Maintenance), after which the City assumes maintenance responsibilities (see the Level of Service section for further information). Prior to approval of the as-builts and release of the Performance and Maintenance Bonds, the stormwater facilities, to include any plantings, shall be maintained by the Developer/Applicant to the levels of service noted herein. Planting shall remain healthy and showing signs of vigor and growth. For any underground systems that do not include any planting component, when the Performance Bond is released, the City will accept the facilities for maintenance. However, if any plantings are installed as part of the BMP system, the requirements of Section 11-413 (6) (b) of the Zoning Ordinance apply, and the plantings must be maintained for three years. See chapter II.E of these Guidelines for more information on the bonding and as-built process.
2. Developer/Applicant is responsible for maintenance during the bond period (Performance and/or Maintenance) and in perpetuity. Facilities that accept private drainage which, per Memo to Industry 04-2014, *Treatment of Roadway Runoff Associated with Development Projects*, will be maintained by the developer/applicant in perpetuity, will follow the same general schedule as above for bond release purposes, but will be maintained in perpetuity by the developer/applicant per the BMP Maintenance Agreement recorded prior to release of the project's Final Site Plan.

In all cases, the maintenance responsibilities will form part of a BMP Maintenance Agreement between the Developer/Applicant and the City. The Memo to Industry No. 04-2014 (or subsequent revisions) shall be the basis for agreements, although agreements for specific projects shall be made on an individual basis, either as part of the master planning or development site plan process.

Maintenance Responsibilities & Requirements

The primary purpose of this section is to address issues that arise when BMPs are constructed in the public ROW. Per the terms of Memo to Industry No. 04-2014, in many of these cases the City will maintain the BMP, after the bond period (Performance and/or Maintenance, as applicable). In these situations, the Department of Transportation & Environmental Services (T&ES) maintains the hardscape and drainage elements of each installation. The Department of Recreation, Parks and Cultural Activities (RPCA) maintains all associated plantings and landscape elements. Consequently, City maintenance and operations crew supervisors and superintendents will need to use the relevant maintenance categories for a given project per the NDS Service Agreement. Chapters II.E and F of the guidelines specifies the circumstances under which a maintenance or bonding agreement must be executed between private BMP owners and the City.

For BMPs, maintenance agreements must contain recommended maintenance tasks and a copy of an annual inspection checklist. For any element of a BMP on private property, a deed restriction, drainage easement or other mechanism enforceable by the City must be in place to help ensure that BMP facilities are maintained and not converted or disturbed, as well as to pass the knowledge along to any subsequent owners. The mechanism shall grant authority for the City to access the property for inspection or corrective action.

Regular Maintenance

First Year Maintenance Operations

Successful establishment of BMP facilities requires that the following tasks be undertaken in the first year following installation:

- **Initial inspections:** For the first 6 months following construction, the site should be inspected at least twice after storm events that exceed 1/2 inch of rainfall.
- **Spot re-planting:** Identify bare or eroding areas in the BMP area, and make sure they are immediately stabilized with plant cover.
- **Fertilization:** One-time, spot fertilization may be needed for initial plantings.
- **Watering:** Watering is needed once a week during the first 3 months, and then as needed during first growing season (April-October), depending on rainfall.
- **Remove and replace dead plants:** Since up to 10% of the plant stock may die off in the first year, construction contracts should include a care and replacement warranty to ensure that vegetation is properly established and survives during the first growing season following construction. Planting shall remain healthy and showing signs of vigor and growth. The typical thresholds below which replacement is required are 85% survival of plant material and 100% survival of trees.
- **Weeding:** remove by hand weed species.

Maintenance Inspections

It is highly recommended that a spring maintenance inspection and cleanup be conducted at each BMP area. The following is a list of some of the key maintenance problems to look for:

- Check to see if 90% cover (mulch plus vegetative cover) has been achieved in the bed, and measure the depth of the remaining mulch.
- Check for sediment buildup at curb cuts, gravel diaphragms or pavement edges that prevents flow from getting into the bed, and check for other signs of bypassing.
- Check for any winter- or salt-killed vegetation, and replace it with recommended species.
- Note presence of accumulated sand, sediment and trash in the pre-treatment cell or filter beds, and remove it.
- Inspect bioretention side slopes and filter strips for evidence of any rill or gully erosion, and repair it.
- Check the bioretention bed for evidence of mulch flotation, excessive ponding, dead plants or concentrated flows, and take appropriate remedial action.
- Check inflow points for clogging, and remove any sediment.
- Check for and remove litter.
- Check for clogged or slow-draining soil media, a crust formed on the top layer, inappropriate soil media, or other causes of insufficient filtering time, and restore proper filtration characteristics.

The Level of Service (LOS) charts for the vegetation section as well as the hardscape and infrastructure sections include many of these concerns.

Routine and Non-Routine Maintenance Tasks

Maintenance of BMPs requires integration into the routine operations for both landscaping and more traditional stormwater facilities (i.e. catch basin maintenance). If contractors will be expected to perform maintenance, these contracts should contain specifics on unique BMP landscaping needs, such as maintaining elevation differences needed for ponding, proper mulching, sediment and trash removal, and limited use of fertilizers and pesticides. A customized maintenance schedule and work order tracking system must be in place for each BMP facility, since the maintenance tasks will differ depending on the scale of BMP, the landscaping template chosen, and the type of surface cover. A generalized summary of common maintenance tasks and their frequency is provided herein.

The most common non-routine maintenance problem involves standing water. If water remains on the surface for more than 48 hours after a storm, adjustments to the grading may be needed or under drain repairs may be needed. The surface of the filter bed should also be checked for accumulated sediment or a fine crust that builds up after the first several storm events. There are several methods that can be used to rehabilitate the filter (try the easiest things first, as listed below):

- Open the under drain observation well or cleanout and pour in water to verify that the under drains are functioning and not clogged or otherwise in need of repair. The purpose of this check is to see if there is standing water all the way down through the soil. If there is standing water on top, but not in the under drain, then there is a clogged soil layer. If the under drain and stand pipe indicates standing water, then the under drain must be clogged and will need to be snaked.
- Remove accumulated sediment
- By hand, add 2 to 3 inches of sand into the upper 8 to 12 inches of soil at very selective locations only and without damaging the root system of the tree planting. Shrub and grass under-planting may require to be replaced to allow for soil amendments. A careful assessment of the location of the tree roots shall be performed prior to selecting the locations for sand amendment.
- Install sand wicks from 3 inches below the surface to the underdrain layer. This reduces the average concentration of fines in the media bed and promotes quicker drawdown times. Sand wicks can be installed by excavating or augering (using a tree auger or similar tool) down to the gravel storage zone to create vertical columns which are then filled with a clean open-graded coarse sand material (ASTM C-33 concrete sand or similar approved sand mix for bioretention media). A sufficient number of wick drains of sufficient dimension should be installed to meet the design dewatering time for the facility without damaging the root system of the planting. A careful assessment of the location of the tree roots shall be performed prior to selecting the locations for sand wicks.

Maintenance Agreements: Levels of Service

The maintenance aspect of BMP's is subject to varying levels of service (LOS) which define specific requirements and activities for the vegetation, hardscape, and infrastructure maintenance. For some design elements, the service levels are very similar. LOS considerations for future maintenance are critical components of the selection process since the desired BMP installation will be maintained by City maintenance staff to the agreed upon level where applicable.

The table below features images and descriptions for vegetation, hardscape, infrastructure, and infiltration rates. It includes photos of BMPs systems referenced in this guide and which are currently used in other municipalities. It is important to realize that no single project includes every design element.

The table below summarizes the varying levels of maintenance service which shall be agreed between the developer/applicant and the City.

Service Category	Service Level 1	Service Level 2	Service Level 3
Hardscape and BMP Infrastructure	<ul style="list-style-type: none"> Minimal Sediment 	<ul style="list-style-type: none"> Sediment present but not heavy 	<ul style="list-style-type: none"> Heavy sediment present
	<ul style="list-style-type: none"> Infrastructure is always accessible 	<ul style="list-style-type: none"> Infrastructure access limited but not impeded 	<ul style="list-style-type: none"> Infrastructure access impeded
	<ul style="list-style-type: none"> No competition between roots and pipes 	<ul style="list-style-type: none"> Some competition between roots and pipes 	<ul style="list-style-type: none"> Heavy competition between roots and pipes
	<ul style="list-style-type: none"> No trash present 	<ul style="list-style-type: none"> Small amount of trash present 	<ul style="list-style-type: none"> Significant trash present
	<ul style="list-style-type: none"> Minor debris accumulation on grate 	<ul style="list-style-type: none"> Moderate debris accumulation on grate 	<ul style="list-style-type: none"> Heavy debris accumulation on grate
	<ul style="list-style-type: none"> No erosion around weir walls 	<ul style="list-style-type: none"> Minor erosion around weir walls 	<ul style="list-style-type: none"> Erosion around weir walls evident
	<ul style="list-style-type: none"> Sedimentation structure less than 1/2 full 	<ul style="list-style-type: none"> Sedimentation structure less than 1/2 full 	<ul style="list-style-type: none"> Sedimentation structure less than 1/2 full
<p>Grates and Debris Screens on Catch Basins</p>			
<p>Flow Control Structures and Overflow Structures/Pipes</p>			

Table: Maintenance Levels of Service

Service Category	Service Level 1	Service Level 2	Service Level 3
Vegetation	<ul style="list-style-type: none"> • Healthy and attractive 	<ul style="list-style-type: none"> • Healthy but less attractive 	<ul style="list-style-type: none"> • Unhealthy, unattractive
	<ul style="list-style-type: none"> • No bare spots 	<ul style="list-style-type: none"> • Occasional bare spots 	<ul style="list-style-type: none"> • Bare spots common
	<ul style="list-style-type: none"> • Plants match existing landscape 	<ul style="list-style-type: none"> • Plants mostly match existing landscape 	<ul style="list-style-type: none"> • Plants seem out of place
	<ul style="list-style-type: none"> • 95% survival of plants 	<ul style="list-style-type: none"> • 75% survival of plants 	<ul style="list-style-type: none"> • Less than 50% survival of plants
			
Weeds	<ul style="list-style-type: none"> • Little or no weeds present 	<ul style="list-style-type: none"> • Moderate weeds present 	<ul style="list-style-type: none"> • Weeds dominant
			

Service Category	Service Level 1	Service Level 2	Service Level 3
Aesthetics	<ul style="list-style-type: none"> • Clean, distinct edges 	<ul style="list-style-type: none"> • Loose edges, grass/mulch encroaching outside BMP 	<ul style="list-style-type: none"> • No edges, encroaching outside BMP present
	<ul style="list-style-type: none"> • Vegetation confined to planted areas 	<ul style="list-style-type: none"> • Minor vegetation growing into pedestrian area 	<ul style="list-style-type: none"> • Significant vegetation growing into pedestrian area
	<ul style="list-style-type: none"> • No overgrown appearance 	<ul style="list-style-type: none"> • Isolated overgrowth, some dead material 	<ul style="list-style-type: none"> • Overgrowth prevalent
			
Mulch	<ul style="list-style-type: none"> • Evenly distributed, roughly 4" of good quality mulch 	<ul style="list-style-type: none"> • 2-4" mulch present, with erosion likely 	<ul style="list-style-type: none"> • Mulch is absent, substantial erosion
	<ul style="list-style-type: none"> • Limited mulch compaction 	<ul style="list-style-type: none"> • Moderate mulch compaction 	<ul style="list-style-type: none"> • Significant mulch compaction
			



G. SPECIFICATION OF MATERIALS

1. General

The material specifications listed below shall be used in the design and installation of Sidewalk BMP systems. A separate list of preferred suppliers and products is available from the Departments of Planning and Zoning or Transport and Environmental Services.

2. Paving Materials

a. Paving materials installed above suspended or supported sidewalks

- i. See Typical Details SW300 to 307 for the location, type and dimensions of paving materials installed above suspended or supported sidewalks.
- ii. Option 1: Brick units (City Standard) on;
 - 1. 1” sand setting bed on;
 - 2. Concrete with rebar (refer to table below for slab thickness and rebar specification), or

Summary for Suspended Sidewalk

Clear Span Length	Design Load	Slab Thickness	Main Reinforcing Steel	Distribution Steel
6 ft	H 20	6 inches	# 8 @ 6”	# 4 @ 12”
6 ft	H 20	8 inches	# 5 @ 6”	# 4 @ 12”
6 ft*	85 psf Pedestrian LL	6 inches	# 4 @ 6”	# 4 @ 12”
8 ft	H 20	7 inches	# 7 @ 6”	# 4 @ 12”
8 ft	H 20	8 inches	# 6 @ 6”	# 4 @ 12”
8 ft*	85 psf Pedestrian LL	6 inches	# 4 @ 6”	# 4 @ 12”

*Pedestrian loading shall be used only in cases where sidewalk is not accessible to any form of vehicular traffic.

- iii. Option 2: Concrete with rebar (refer to table above for slab thickness and rebar specification). The finished appearance of the concrete shall be approved to the satisfaction of the Directors of Planning and Zoning and Transportation and Environmental Services.

b. Paving materials in other areas

- i. For all other sidewalk installation, including the areas adjacent to the BMP and any suspended/supported sidewalks, use SW-336 and 337 and the appropriate City standards:
 1. See Memo to Industry 05-08 for brick sidewalks: <http://alexandriava.gov/uploadedFiles/tes/info/StandardsforBrickSidewalks%20.pdf>
 2. Paving materials for areas of Mt. Vernon Ave (see streetscape section): <http://alexandriava.gov/uploadedFiles/planning/info/MtVernonAvenueurbanDesignGuidelinescomplete1993.pdf>
 3. Paving for Park and Plaza areas, Memo to Industry 10-11. <http://alexandriava.gov/uploadedfiles/tes/info/PavingForParksAndPlazaAreas2.pdf>
- ii. The City's brick sidewalk map is attached for reference at addendum A.
- iii. Option 1: Brick units (City Standard) on;
 1. 1" sand setting bed on;
 2. 4" deep concrete on; 4" deep 21A-sized aggregate; on 90% compacted subgrade, or
 3. 4" deep intermediate grade asphalt on; 4" deep 21A-sized aggregate; on 90% compacted subgrade.
- iv. Option 2: 4" deep Concrete on; 4" deep 21A-sized aggregate; on 90% compacted subgrade. The finished appearance of the concrete shall be approved to the satisfaction of the Directors of Planning and Zoning and Transportation and Environmental Services.

3. Curbs, walls and edge materials

a. Coping curb

- i. See Typical Details SW-300 to 321 and SW-333 to 335 for the location and dimension of coping curbs. For the dimensions of individual coping units see SW-334.
- ii. Curb material shall be granite with thermal finish on all exposed faces, mid-grey color.

b. Grate and frame

- i. See Typical Detail SW-300, 303, 310, 320, 321, 330 & 332 for the location, type and size of grate and frame.
- ii. Material & Finish:
 1. Frame, mild steel ASTM A36 angle iron. All welds ground smooth on outside edges. Finish: Natural patina of raw steel
 2. Grate, high quality ductile iron, ASTM A536 class 65-45-12. Finish: Natural weathered finish of ductile iron.
- iii. Gap between grate and frame: 1/8 inch.
- iv. Openings at top of grate: 3/8 inch to 1/2 inch.

- v. Grate and frame system to be rated for H20 loading with a non-slip surface having a static coefficient of friction between 0.6 – 1.0 per ASTM C1020. Grates on inclines shall have a coefficient of 0.8-10
- vi. ADA compliant. Frames will be true to square. Top of grate flush with grade of adjacent paving.

4. Concrete Curb Inlet

- a. See details SW-303, 321 & 330 for dimensions and location of curb inlets.
- b. Constructed of 4 inch thick Class A3 Concrete; open flume to be 22 in length (parallel to the street) and shall be constructed from the back of the gutter pan at a slope of generally 25 to 30%.

5. Forebay

- a. See details SW-300 to 321 for location and dimensions of forebays.
- b. Material: Natural rounded river stone, 6-8” average size, on
- c. Filter fabric pinned securely in place

6. Planting/ Filter Medium (Soil)

- a. See the design parameters for soil depths in the Water Quality and Treatment section for these guidelines.
- b. Planting/filter Mix: In order to reduce contractor costs and provide a mix which is uniformly appropriate for nutrient reduction, the following specifications indicate the mix that the soil matrix must meet, rather than guidance based on percentages of the component mix.
- c. The contractor shall either:
 - i. provide soil from the mix specified in the preferred suppliers list (attached as an appendix to these guidelines). Certification from the supplier shall be provided to the City verifying the mix, or
 - ii. Provide soil which meets the specifications below. Soil testing reports shall be provided to the City which demonstrates that the mix specifically meets the approved specification.
- d. Specifications which shall be met are:
 - i. pH between 5.5-6.5
 - ii. Particle size analysis showing between 2-4% fines in the sand mixture
 - iii. P Index between 10-30%
 - iv. Soil drainage rate between 2-3.5 inches per hour
 - v. Organic content of the entire mix between 3-5%. A Higher organic content may be approved by the satisfaction of the Directors of Planning and Zoning and Transportation

and Environmental Services.

- e. Soil media shall be placed to minimize compaction in lifts of 8 to 12 inches. The soil media should be overfilled by up to 20% to allow for natural settlement.
- f. Soil compaction shall be 75 – 80% by Proctor.

7. Mulch

- a. Depth: 3”
- b. Material: Well aged (12 month min.) shredded hardwood.

8. Guying and Staking

- a. Materials and installation per the City’s *Landscape Guidelines*.

9. Underdrain, drainage materials and root cells.

a. Underdrains and drainage materials

- i. See Typical Details SW-300 to 321 and SW-350 for the location, type and dimension of underdrains and drainage layers.
- ii. A 4-inch minimum slotted pipe (perforations on top only) PVC SCH 40 or SDR 26 with threaded end cap placed in a layer of VDOT #57 stone.
- iii. Min. 2” of choker layer, VDOT #8 stone above,
- iv. Min. 2” of VDOT #57 stone above and below pipe. The aggregate layer within which the drain pipe runs shall be generally 12” deep. Where the depth of planting soil varies due to root cell depths or other physical considerations, the drainage layer depth may vary.
- v. Minimum 0.50% slope for all under drain piping
- vi. Shall be connected to the City’s storm sewer system. The connection pipes shall be solid, minimum 12 inches in diameter RCP CLIII or CL IV if exposed to vehicular traffic with a minimum slope of 0.50%.

b. Root cells

- i. Silva Cell or equal approved
- ii. Installed per manufacturer’s guidelines.

10. Planting material

- a. For all planting specifications, refer to the Planting section.

11. Concrete

- a. Concrete shall be Class “A3 Paving” in accordance with current VDOT Road and Bridge

Specifications

12. Reinforcing Steel

- a. All reinforcing steel shall conform to ASTM A615, Grade 60

13. Structural Steel

- a. All structural shapes and plates shall be ASTM A 36.
- b. Structural steel shall be galvanized in accordance with ASTM 123. Hardware shall be galvanized in accordance with ASTM A153.



H. TYPICAL DETAILS

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SW-300 BMP TREE WELL

DESIGNER INFORMATION

Adapt this example to your engineered design.

- | | | |
|---|--|--|
| <p>I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.</p> <p>II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission.</p> <p>III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam.</p> <p>IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.</p> <p>V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.</p> <p>VI. Soil slopes shall be 1:4 max.</p> <p>VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.</p> | <p>VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.</p> <p>IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements</p> <p>X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements</p> <p>XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications</p> <p>XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements</p> <p>XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications</p> <p>XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.</p> <p>XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration</p> | <p>A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout.</p> <p>B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs.</p> <p>C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer.</p> <p>D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.</p> |
|---|--|--|

STANDARD NOTES

- | | |
|---|------------------------|
| 1. ROAD CURB AND GUTTER | 11. COMPACTED SUBGRADE |
| 2. COPING CURB (SW-333-A or B) | 12. (NOT USED) |
| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
| 4. FORE BAY | 14. ROOT CELLS |
| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-301 to 307; SW-330 to 338; SW-350 to 351

SW-301 SECTION ELEVATION 'A'

DESIGNER INFORMATION

Adapt this example to your engineered design.

- | | | |
|---|--|--|
| <p>I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.</p> <p>II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission.</p> <p>III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam.</p> <p>IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.</p> <p>V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.</p> <p>VI. Soil slopes shall be 1:4 max.</p> <p>VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.</p> | <p>VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.</p> <p>IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements</p> <p>X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements</p> <p>XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications</p> <p>XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements</p> <p>XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications</p> <p>XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.</p> <p>XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration</p> | <p>A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout.</p> <p>B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs.</p> <p>C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer.</p> <p>D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.</p> |
|---|--|--|

STANDARD NOTES

- | | |
|---|------------------------|
| 1. ROAD CURB AND GUTTER | 11. COMPACTED SUBGRADE |
| 2. COPING CURB (SW-333-A or B) | 12. (NOT USED) |
| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
| 4. FORE BAY | 14. ROOT CELLS |
| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307

SW-302 SECTION ELEVATION 'B'

DESIGNER INFORMATION

Adapt this example to your engineered design.

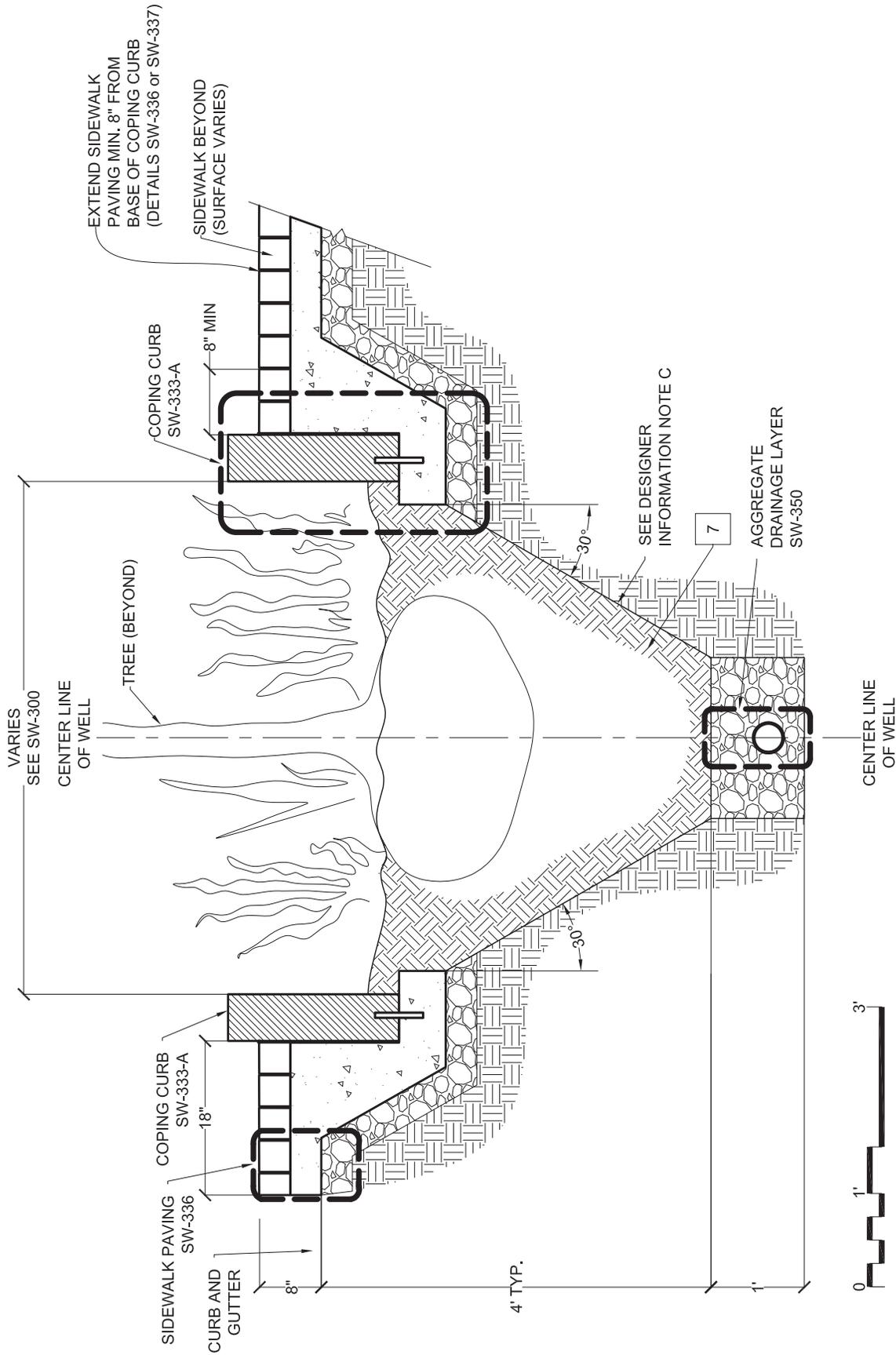
- I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.
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- III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam.
- IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.
- V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.
- VI. Soil slopes shall be 1:4 max.
- VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.
- VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.
- IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements
- X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements
- XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications
- XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements
- XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications
- XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.
- XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration
- A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout.
- B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs.
- C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer.
- D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.

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| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307; SW-330 to 338



SW-302 SECTION ELEVATION 'B'

SW-303 TREE WELL: INLET SECTION ELEVATION

DESIGNER INFORMATION

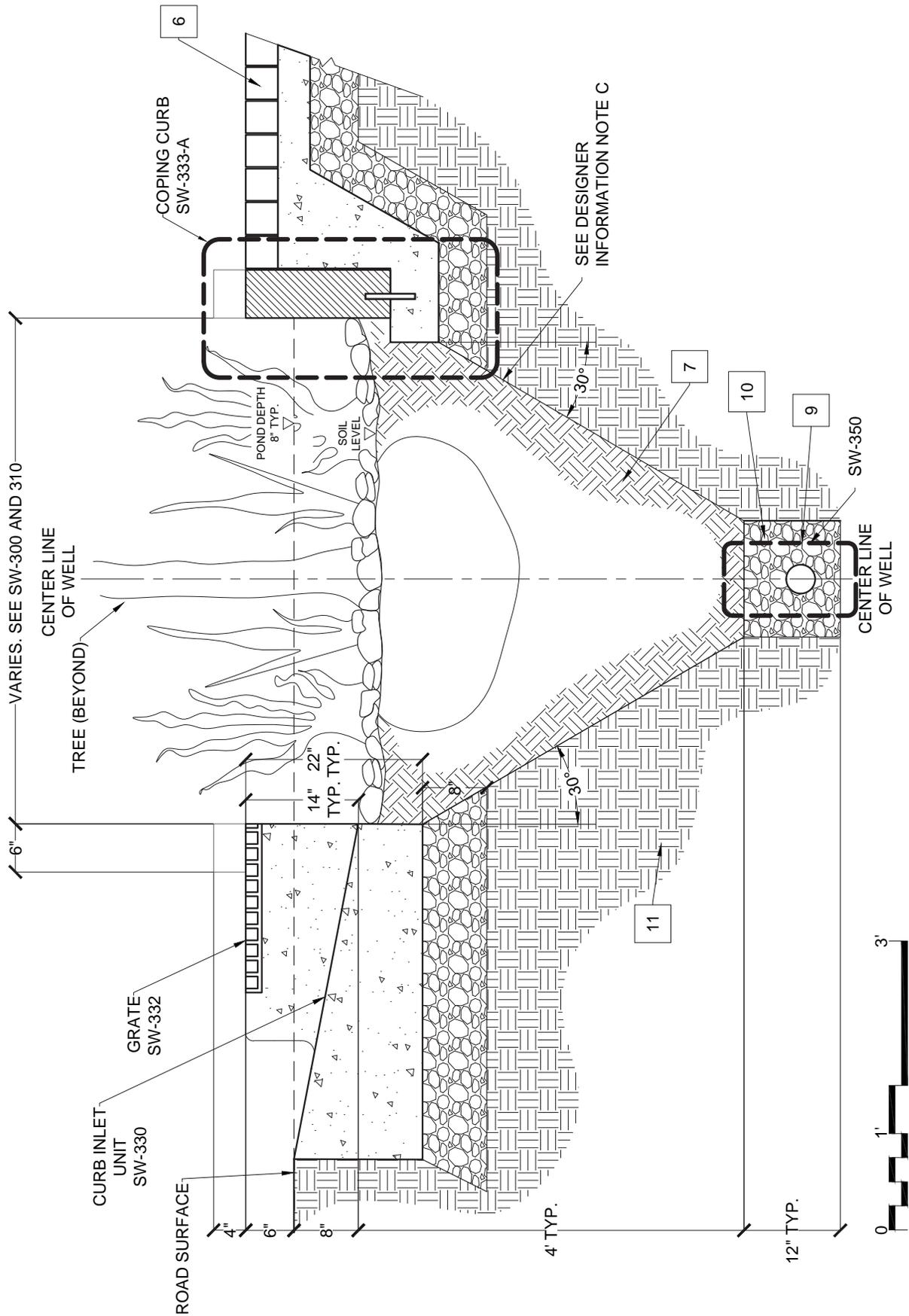
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 - V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.
 - VI. Soil slopes shall be 1:4 max.
 - VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.
 - VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.
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| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307; SW-330 to 338



SW-303 INLET SECTION

SW-304 SOIL PANEL: SUSPENDED SIDEWALK

DESIGNER INFORMATION

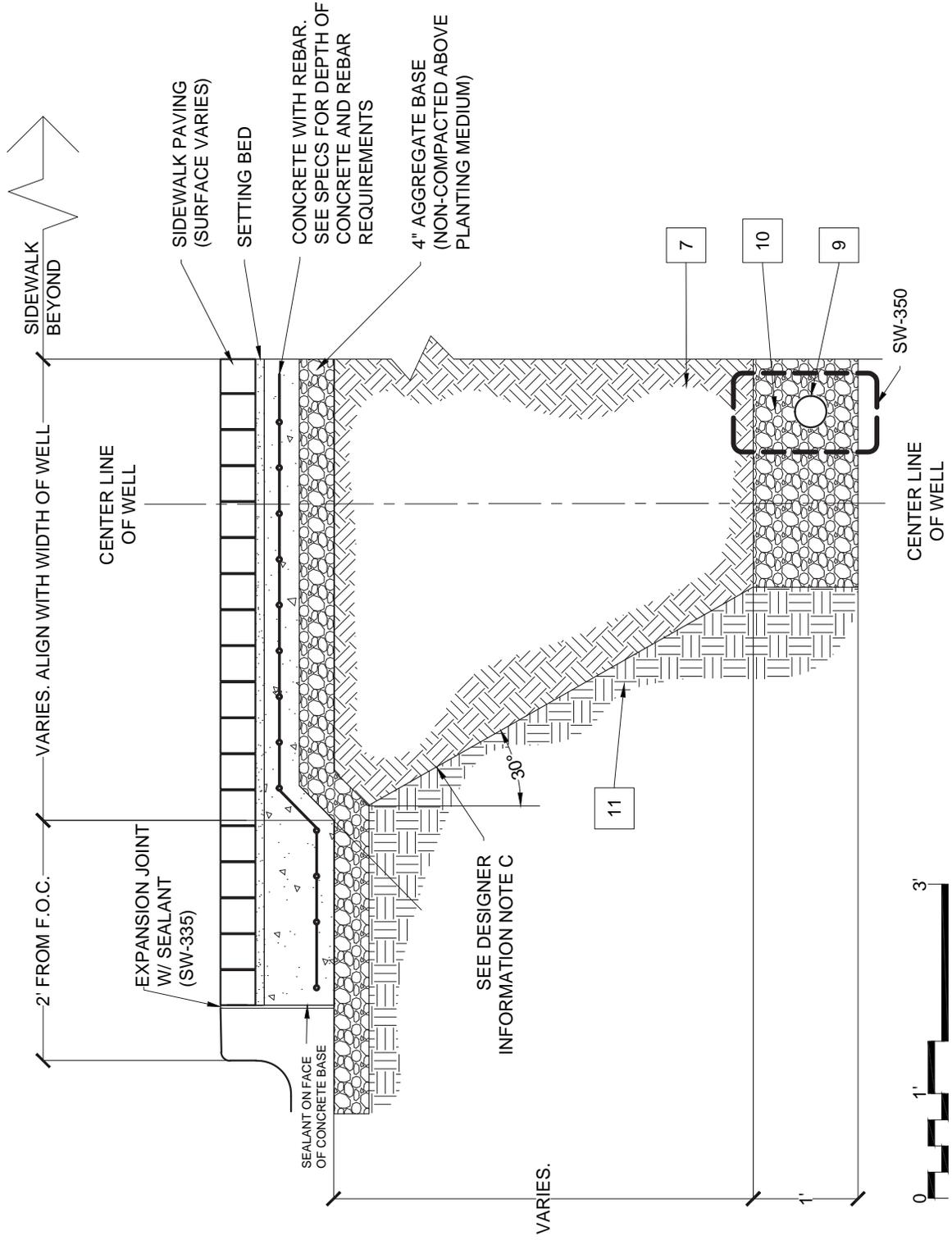
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| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
| 4. FORE BAY | 14. ROOT CELLS |
| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307, 310, 320; SW-336 to 338



SW-304 SOIL PANEL SUSPENDED SIDEWALK

SW-305 SOIL PANEL: SUPPORTED SIDEWALK

DESIGNER INFORMATION

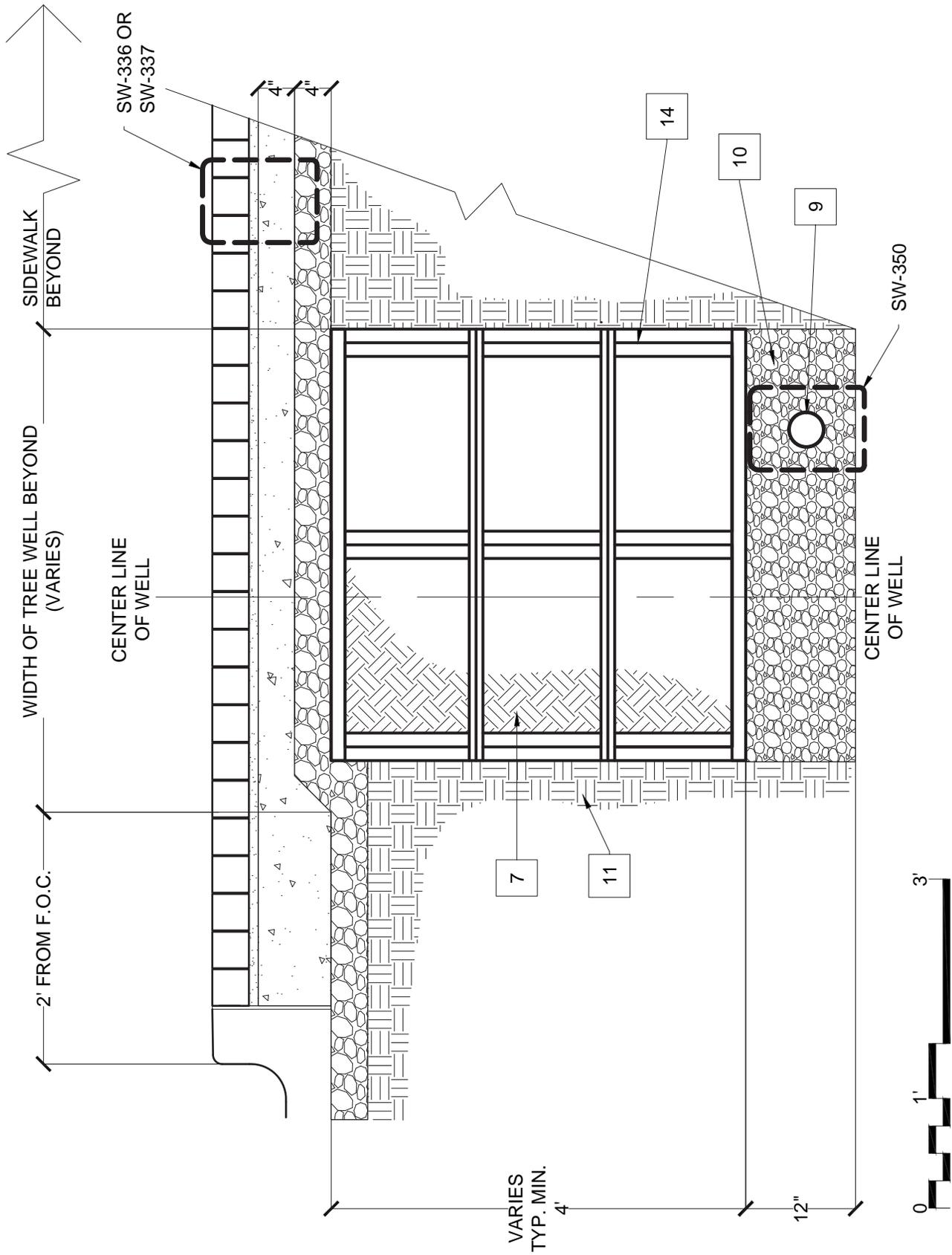
- Adapt this example to your engineered design.
- I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.
 - II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission.
 - III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam.
 - IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.
 - V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.
 - VI. Soil slopes shall be 1:4 max.
 - VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.
 - VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.
 - IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements
 - X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements
 - XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications
 - XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements
 - XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications
 - XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.
 - XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration
 - A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout.
 - B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs.
 - C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer.
 - D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.

STANDARD NOTES

- | | |
|---|------------------------|
| 1. ROAD CURB AND GUTTER | 11. COMPACTED SUBGRADE |
| 2. COPING CURB (SW-333-A or B) | 12. (NOT USED) |
| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
| 4. FORE BAY | 14. ROOT CELLS |
| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307, 310, 320; SW-336 to 338



SW-305 SOIL PANEL SUPPORTED SIDEWALK

SW-307 TREE WELL: END SECTION W/ SUPPORTED SIDEWALK

DESIGNER INFORMATION

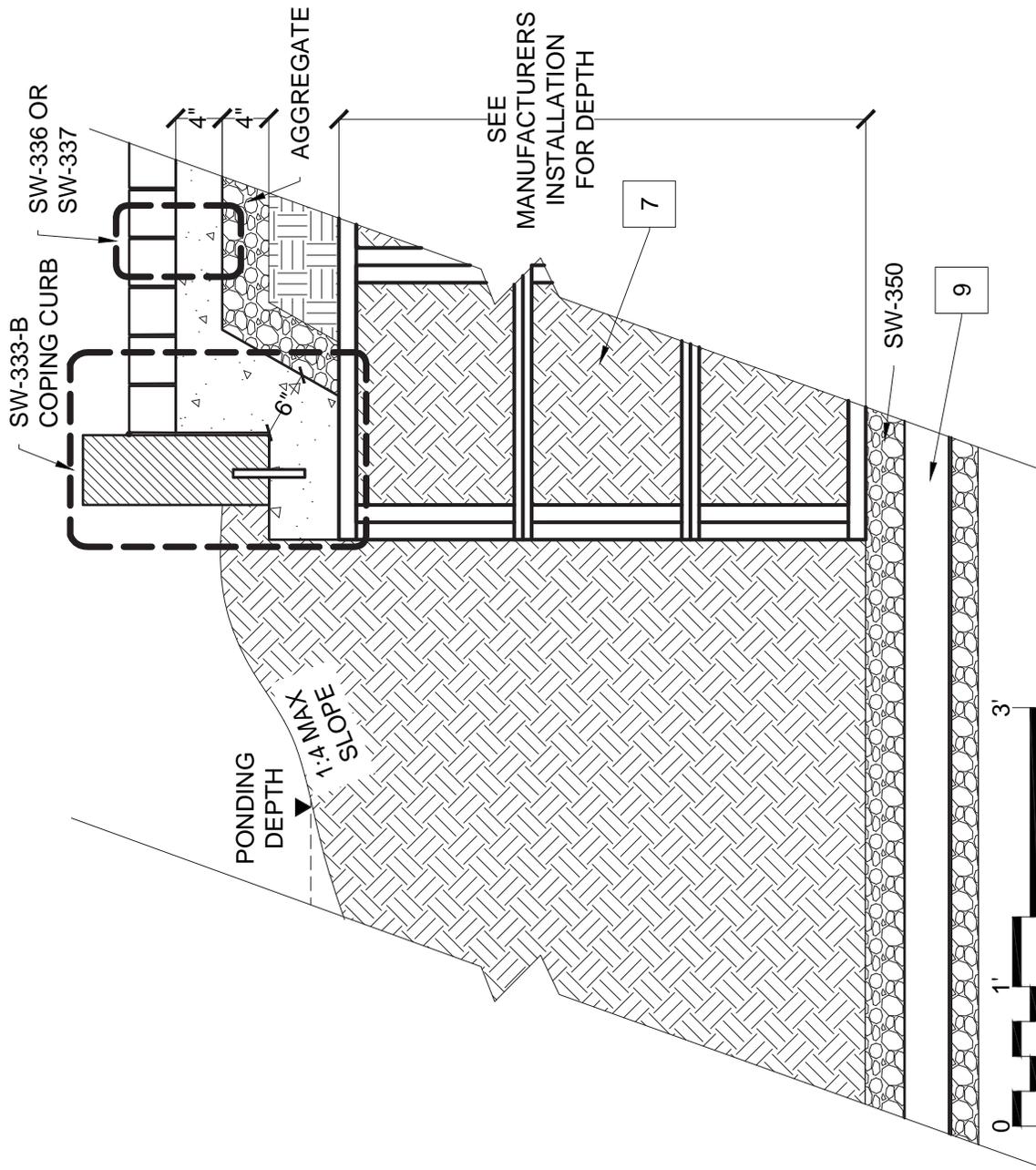
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 - IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.
 - V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.
 - VI. Soil slopes shall be 1:4 max.
 - VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.
 - VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.
 - IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements
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 - XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration
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STANDARD NOTES

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| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300 to 307, 310, 320; SW-333 to 338



SW-307 TREE WELL END SECTION W/ SUPPORTED SIDEWALK

SW-310 BMP PLANTING STRIP

DESIGNER INFORMATION

Adapt this example to your engineered design.

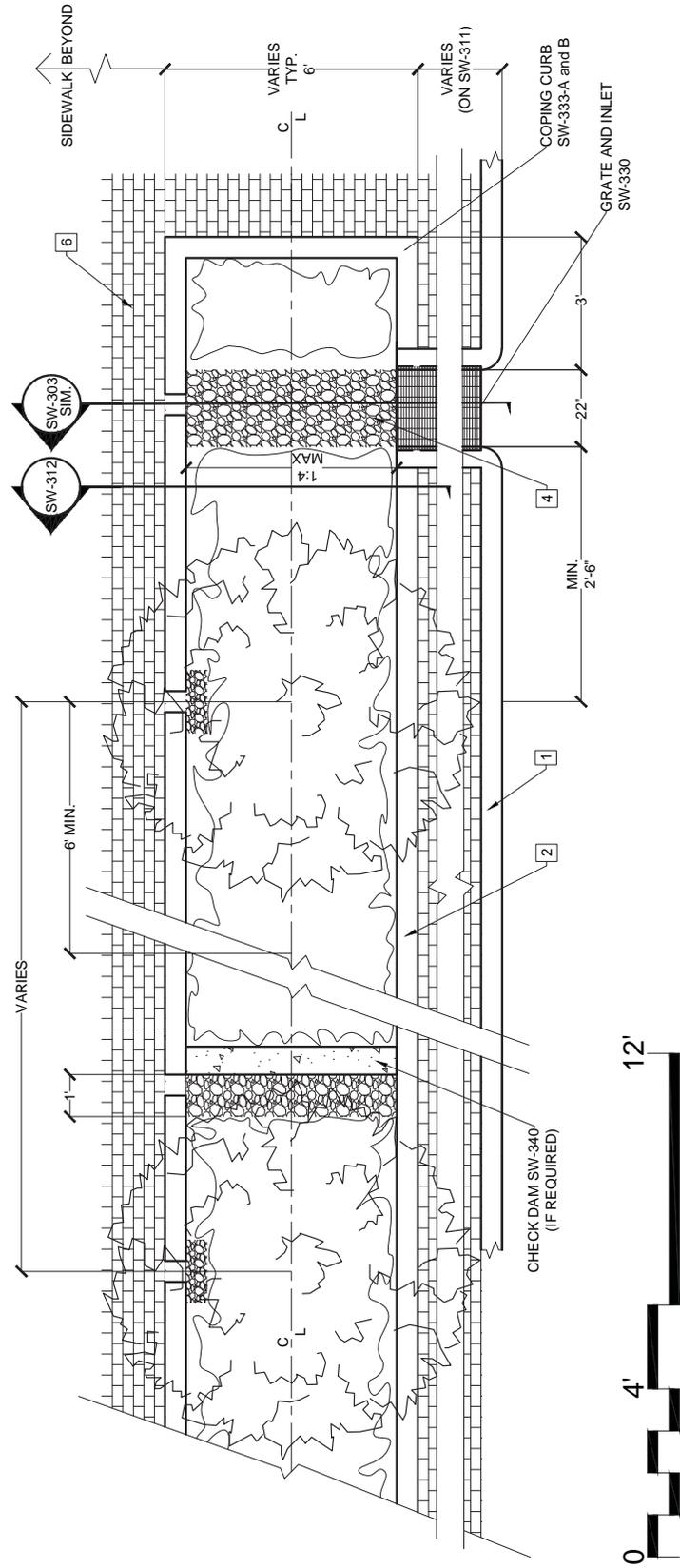
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STANDARD NOTES

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| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-312; SW-330 to 351



SW-310 BMP PLANTING STRIP

SW-312 BMP PLANTING STRIP: SECTION (CROSS)

DESIGNER INFORMATION

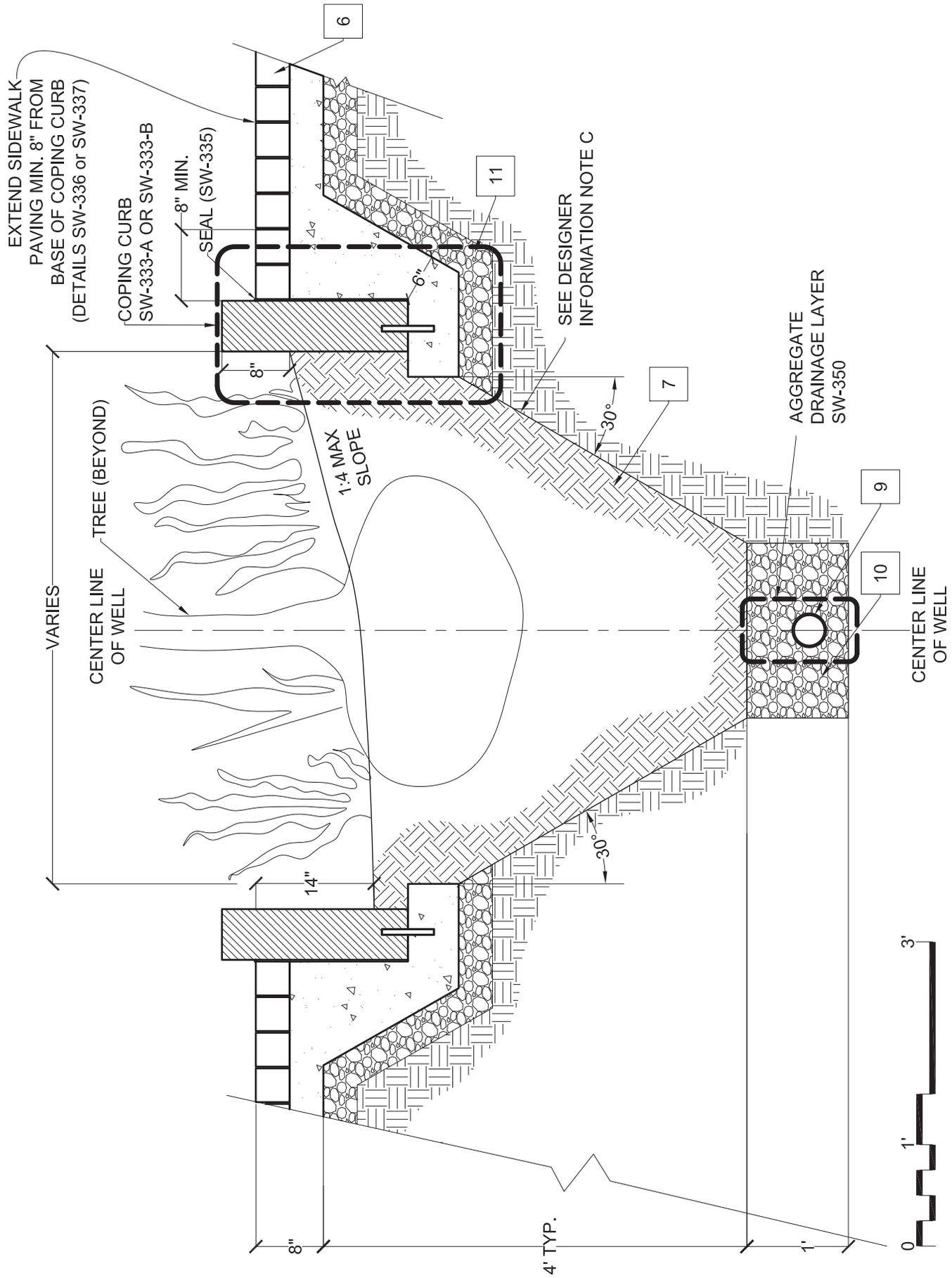
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STANDARD NOTES

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| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-310 and 320; SW-330 to 338



SW-312 BMP PLANTING STRIP

SW-320 BACK-OF-SIDEWALK BMP: PLAN

DESIGNER INFORMATION

- Adapt this example to your engineered design.
- I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.
 - II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission.
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 - XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.
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STANDARD NOTES

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| 6. SIDEWALK PAVING | 16. GRATE |
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| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-321; SW-330 to 351

SW-321 BACK-OF-SIDEWALK BMP: SECTION

DESIGNER INFORMATION

Adapt this example to your engineered design.

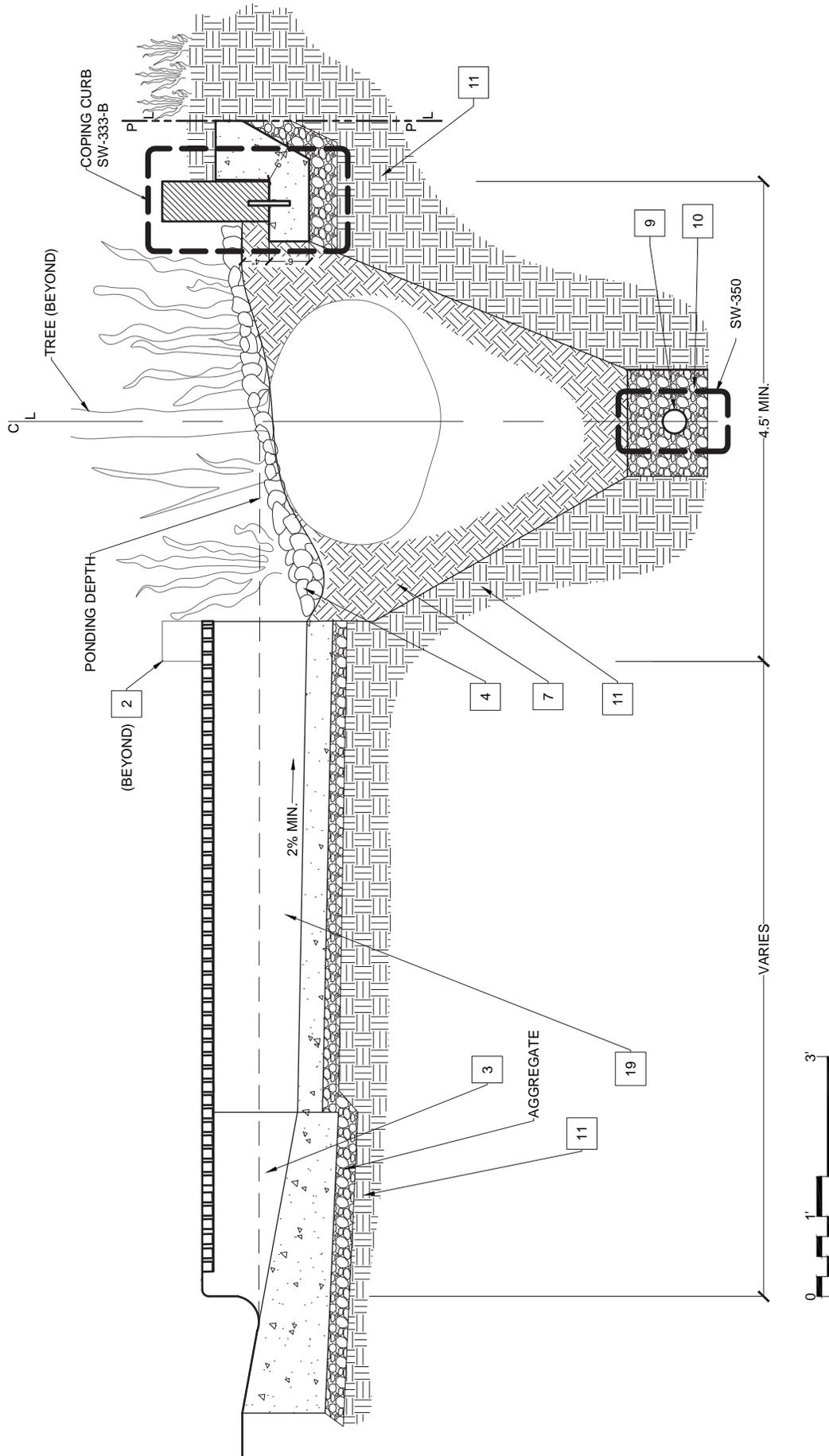
- | | | |
|--|---|---|
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STANDARD NOTES

- | | |
|--|---|
| <ul style="list-style-type: none"> 1. ROAD CURB AND GUTTER 2. COPING CURB (SW-333-A or B) 3. CURB INLET AND GRATE (SW-330, 331 or 321) 4. FORE BAY 5. CLEAN-OUT / OBSERVATION WELL 6. SIDEWALK PAVING 7. UNCOMPACTED PLANTING / FILTER MEDIA 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED 9. UNDERDRAIN 10. AGGREGATE | <ul style="list-style-type: none"> 11. COMPACTED SUBGRADE 12. (NOT USED) 13. (NOT USED) 14. ROOT CELLS 15. CURB INLET 16. GRATE 17. (NOT USED) 18. BMP PLANTING 19. GRATED CHANNEL |
|--|---|

RELATED DETAILS

SW-320; SW-330 to 351



SW-321 BACK-OF-SIDEWALK BMP SECTION

SW-330 CONCRETE INLET AND WINGWALLS

DESIGNER INFORMATION

Adapt this example to your engineered design.

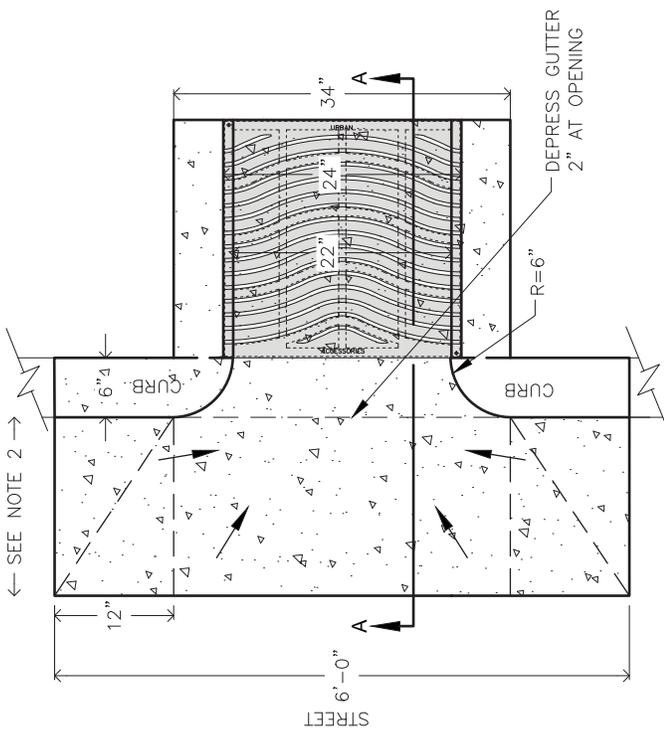
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STANDARD NOTES

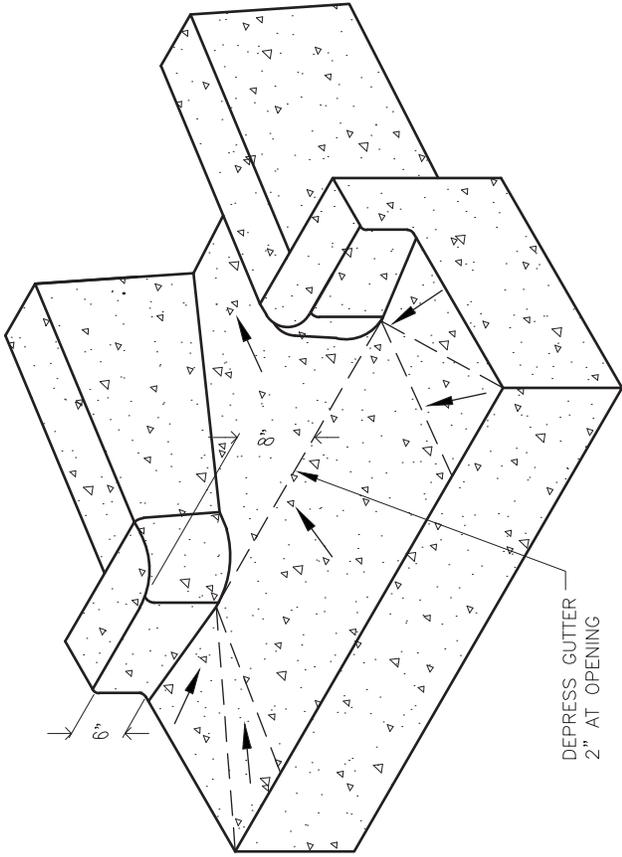
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RELATED DETAILS

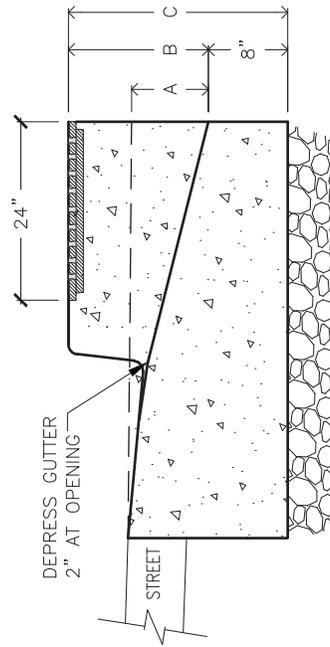
SW-332



PLAN VIEW



PERSPECTIVE VIEW



SECTION A-A

- (A) VARIES TO MEET PONDING DEPTH. 8" TYP.
- (B) VARIES TO MEET PONDING DEPTH. DIMENSIONS (A) + 6".
- (C) VARIES TO MEET PONDING DEPTH. DIMENSIONS (B) + 8".

SW-330 CONCRETE INLET WITH WINGWALLS

SW-332 GRATE AND FRAME DETAILS

DESIGNER INFORMATION

Adapt this example to your engineered design.

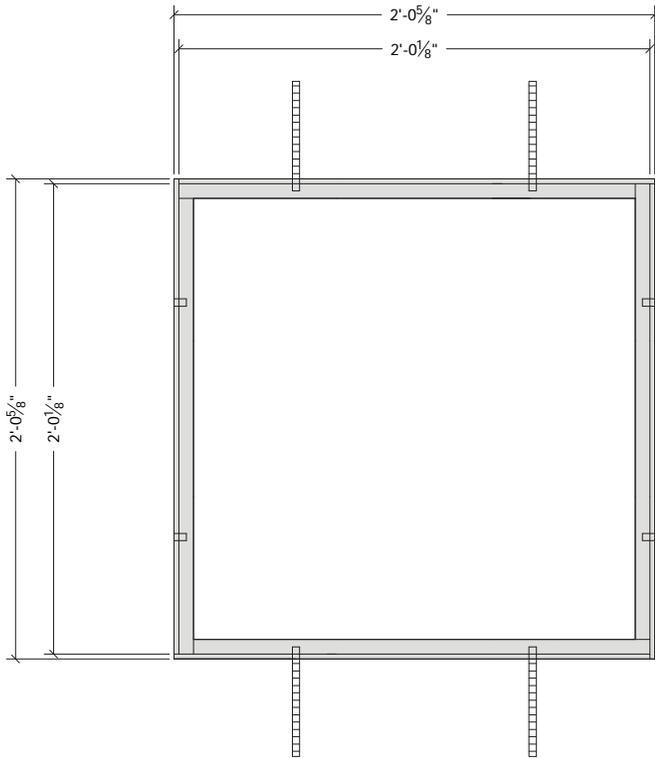
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- D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.

STANDARD NOTES

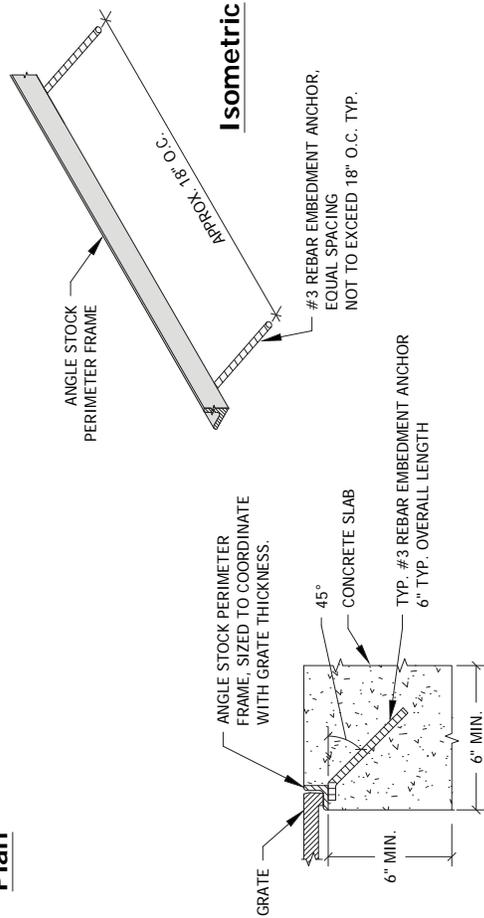
- | | |
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| 2. COPING CURB (SW-333-A or B) | 12. (NOT USED) |
| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
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RELATED DETAILS

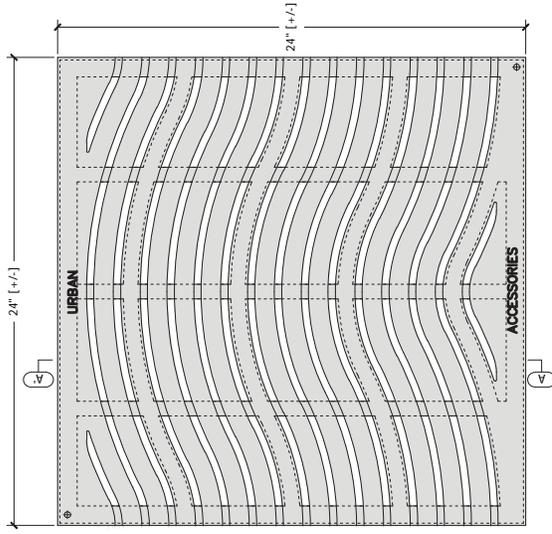
SW-330



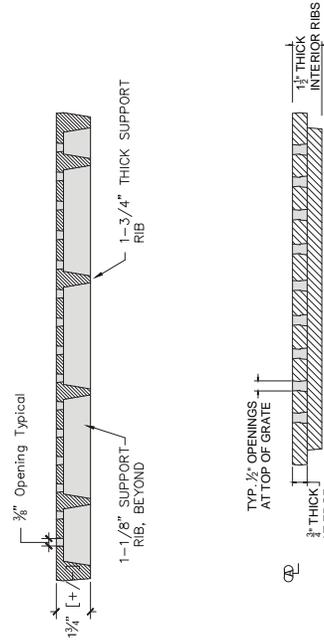
Plan



Elevation



Plan



Section A-A'

SW-332 GRATE AND FRAME DETAIL

SW-333-A COPING CURB: TYPICAL DETAIL

DESIGNER INFORMATION

Adapt this example to your engineered design.

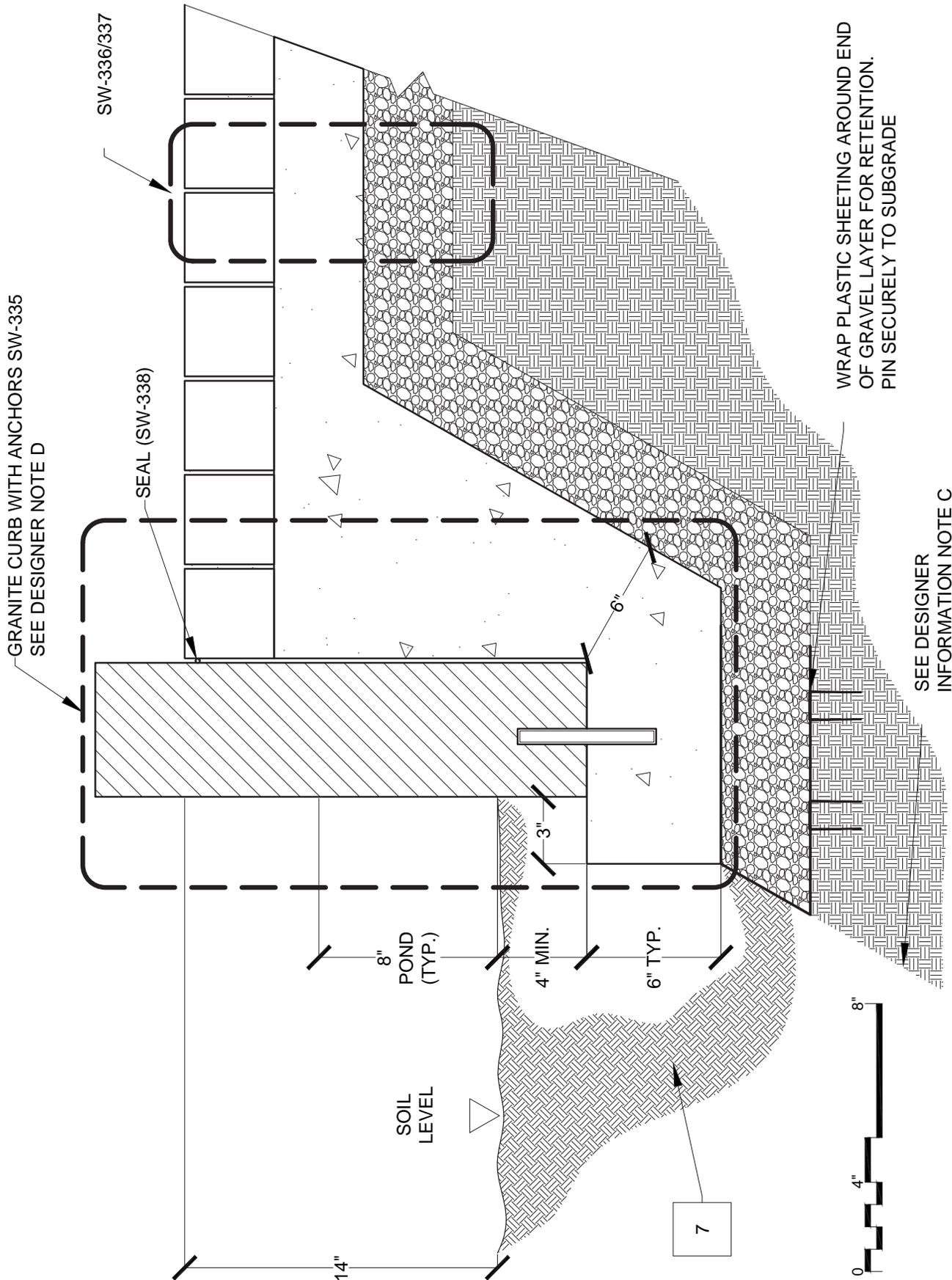
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RELATED DETAILS

SW-333-B to 338



GRANITE CURB WITH ANCHORS SW-335
SEE DESIGNER NOTE D

SEAL (SW-338)

SW-336/337

SOIL
LEVEL

8"
POND
(TYP.)

4" MIN.

6" TYP.

6"

3"

WRAP PLASTIC SHEETING AROUND END
OF GRAVEL LAYER FOR RETENTION.
PIN SECURELY TO SUBGRADE

SEE DESIGNER
INFORMATION NOTE C

SW-333-A COPING CURB @ LONG WALLS, FULL DEPTH

SW-333-B COPING CURB: SHALLOW ALTERNATIVE DETAIL

DESIGNER INFORMATION

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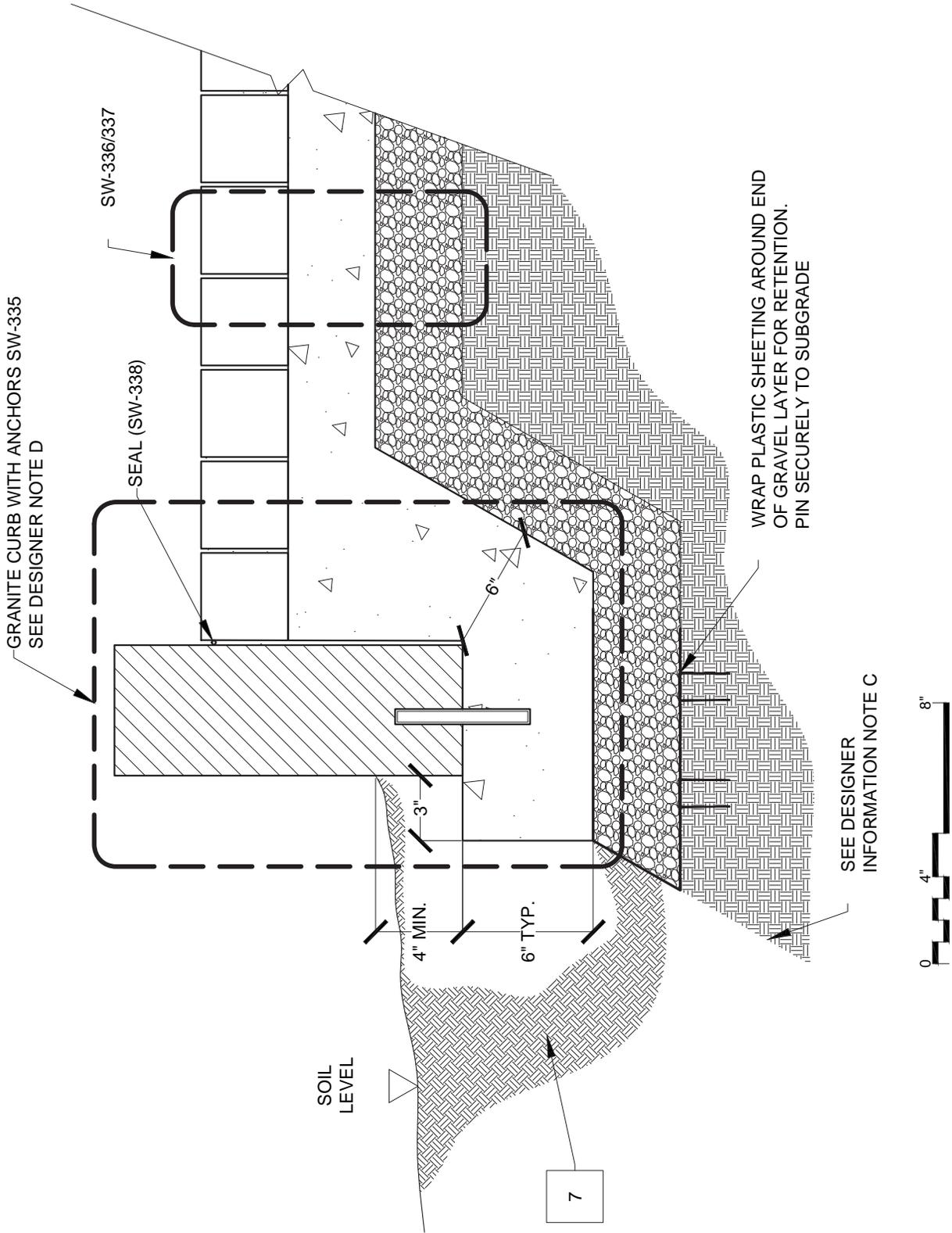
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- VI. Soil slopes shall be 1:4 max.
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RELATED DETAILS

SW-333-A to 338



SW-333-B COPING CURB SHALLOW ALTERNATIVE

SW-334 COPING CURB ELEVATION

DESIGNER INFORMATION

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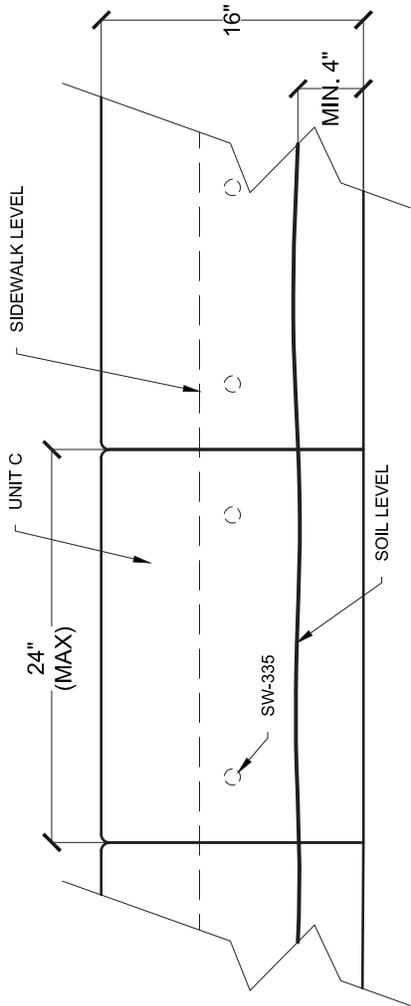
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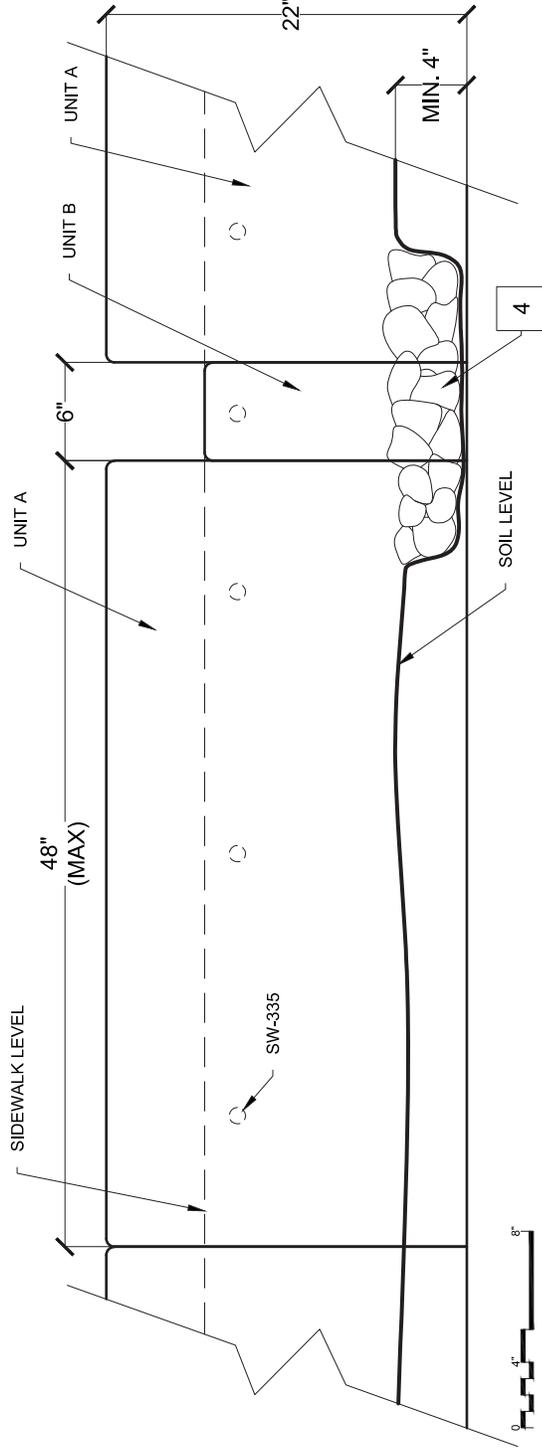
RELATED DETAILS

SW-333-A and B to 338

UNIT	DIMENSION (Inches)		
	Depth	Height	Length
A	6	22	48 (max), 24 (Min)
B	6	18	6
C	6	16	24 (max), 12 (Min)



1 ELEVATION AT SHALLOW ALTERNATIVE DETAIL (SW-333-B)



2 ELEVATION AT TYPICAL CURB DETAIL (SW-333-A)

SW-334 COPPING CURB ELEVATION

SW-335 COPING CURB AND ANCHOR DETAIL

DESIGNER INFORMATION

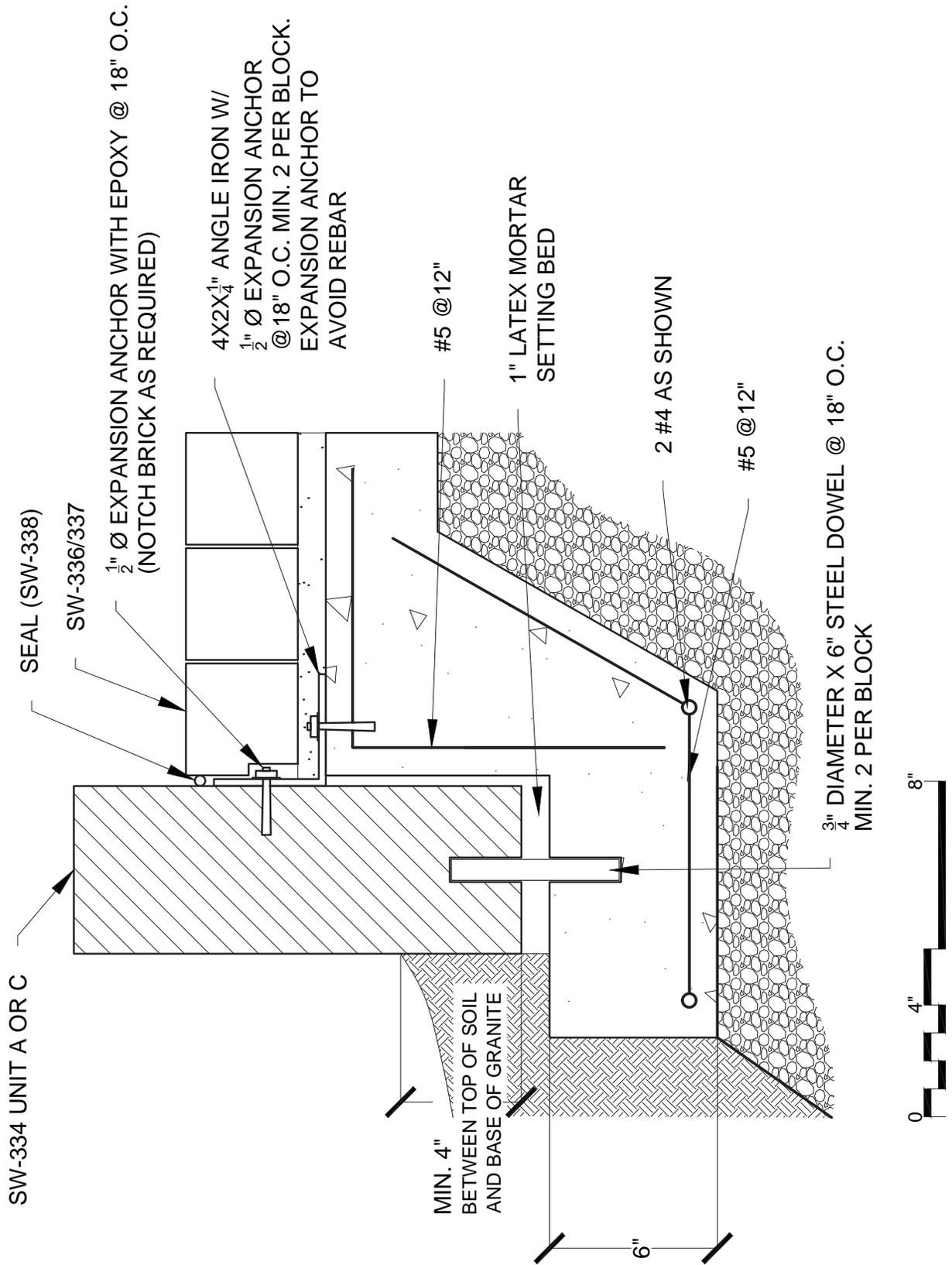
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RELATED DETAILS

SW-333-A and B to 338



SW-335 COPING CURB ANCHOR DETAIL

SW-336 AND SW-337 STANDARD PAVING DETAILS

DESIGNER INFORMATION

Adapt this example to your engineered design.

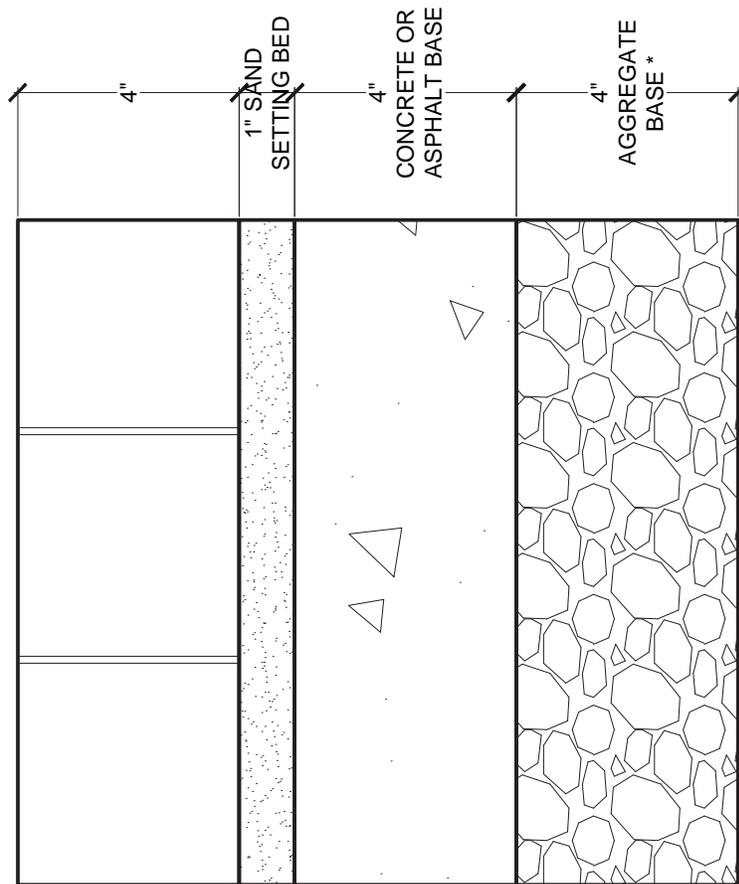
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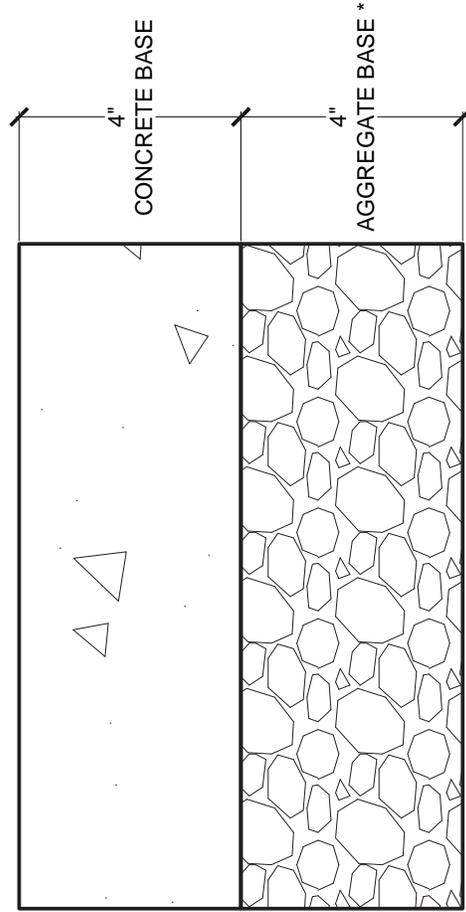
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RELATED DETAILS

SW-300 to 307, SW-310 and 320



SW-336 BRICK PAVING



SW-337 CONCRETE PAVING

SW-338 JOINT SEALANT

DESIGNER INFORMATION

Adapt this example to your engineered design.

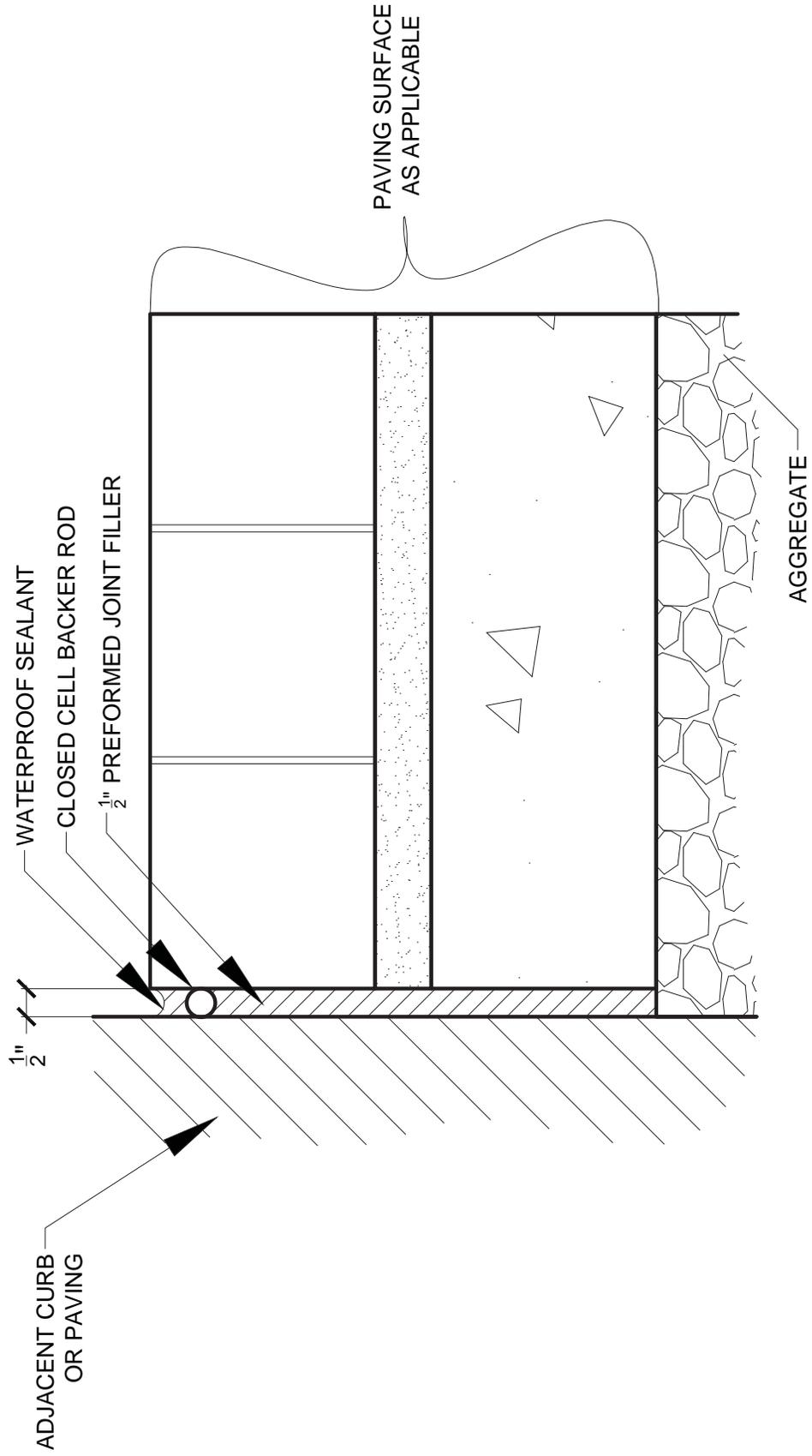
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RELATED DETAILS

SW-300, 310 and 320



SW-338 JOINT SEALANT

SW-340 CONCRETE CHECK DAM FOR BMP TREE WELLS AND PLANTING STRIPS

DESIGNER INFORMATION

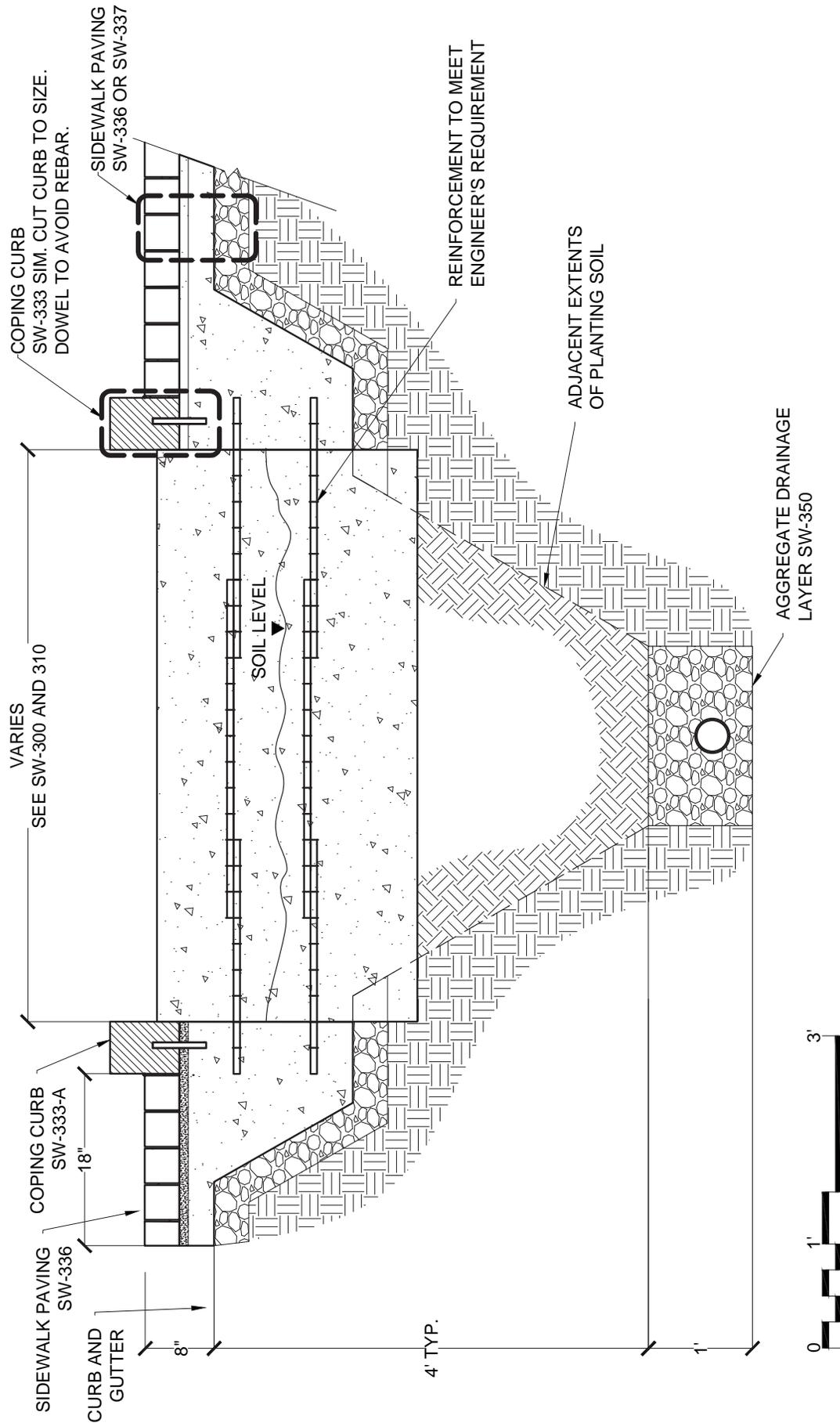
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| 4. FORE BAY | 14. ROOT CELLS |
| 5. CLEAN-OUT / OBSERVATION WELL | 15. CURB INLET |
| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
| 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED | 18. BMP PLANTING |
| 9. UNDERDRAIN | 19. GRATED CHANNEL |
| 10. AGGREGATE | |

RELATED DETAILS

SW-300, 310 and 320



SW-340 CONCRETE CHECK DAM

SW-350 AGGREGATE DRAINAGE LAYER

DESIGNER INFORMATION

Adapt this example to your engineered design.

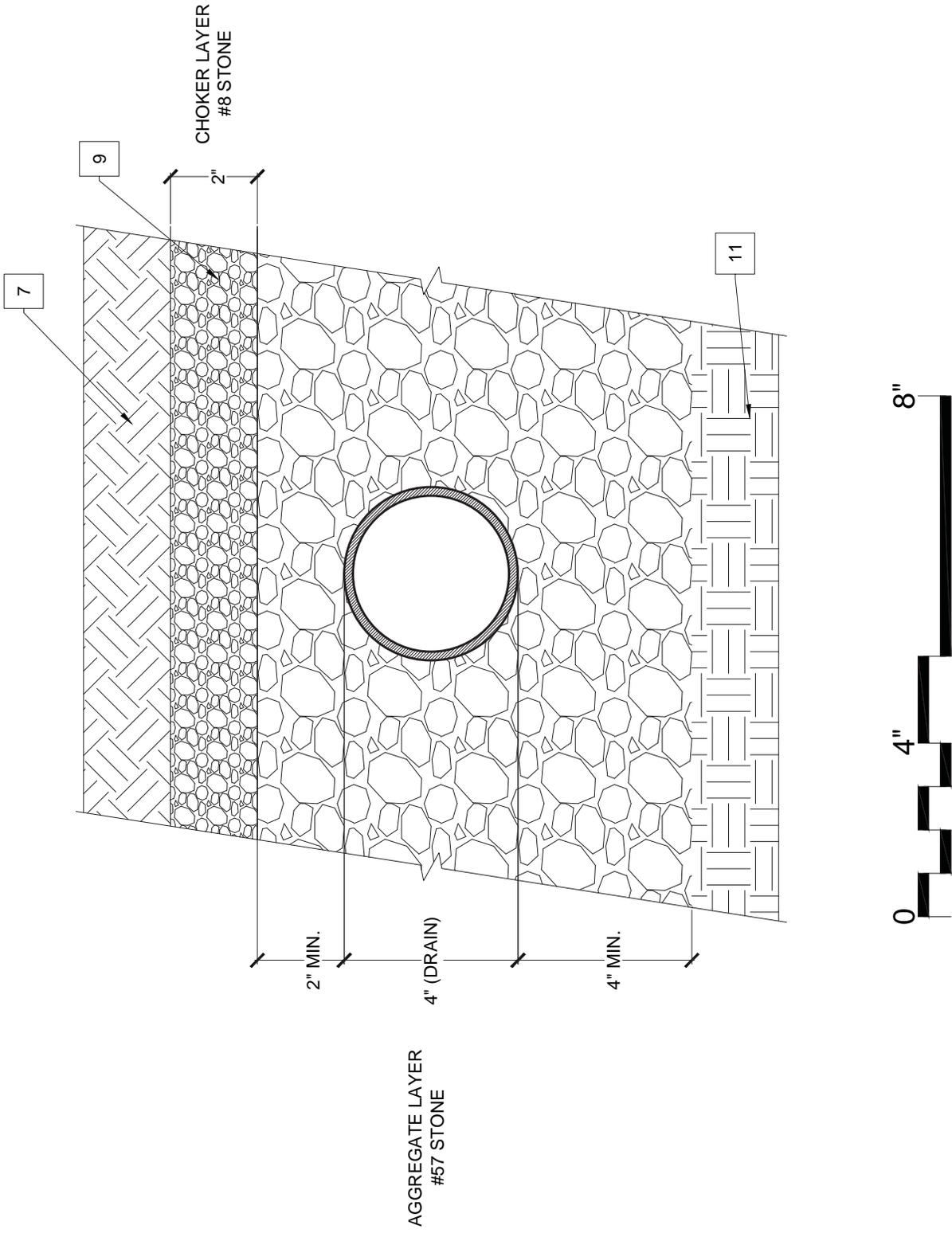
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|--|---|---|
| <ul style="list-style-type: none"> I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility. II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission. III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam. IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains. V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk. VI. Soil slopes shall be 1:4 max. VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams. | <ul style="list-style-type: none"> VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth. IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended. XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration | <ul style="list-style-type: none"> A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout. B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs. C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer. D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows. |
|--|---|---|

STANDARD NOTES

- | | |
|--|---|
| <ul style="list-style-type: none"> 1. ROAD CURB AND GUTTER 2. COPING CURB (SW-333-A or B) 3. CURB INLET AND GRATE (SW-330, 331 or 321) 4. FORE BAY 5. CLEAN-OUT / OBSERVATION WELL 6. SIDEWALK PAVING 7. UNCOMPACTED PLANTING / FILTER MEDIA 8. SIDEWALK OVER SOIL PANEL: SUSPENDED OR SUPPORTED 9. UNDERDRAIN 10. AGGREGATE | <ul style="list-style-type: none"> 11. COMPACTED SUBGRADE 12. (NOT USED) 13. (NOT USED) 14. ROOT CELLS 15. CURB INLET 16. GRATE 17. (NOT USED) 18. BMP PLANTING 19. GRATED CHANNEL |
|--|---|

RELATED DETAILS

SW-300, 310 and 320



SW-350 AGGREGATE DRAINAGE LAYER

SW-351 OVERFLOW DRAIN

DESIGNER INFORMATION

Adapt this example to your engineered design.

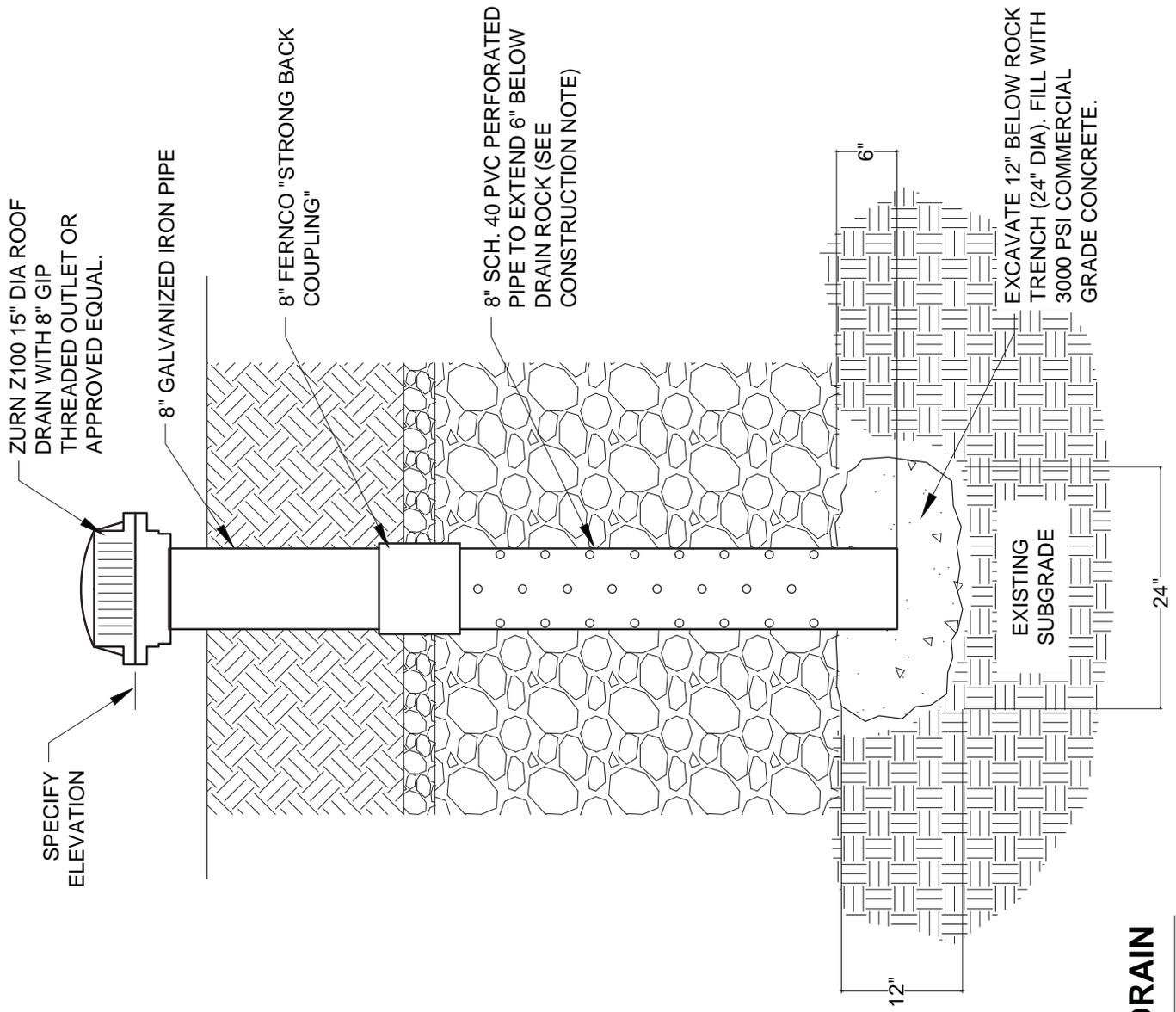
- I. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the BMP facility.
- II. Existing conditions and utility conflicts can create major design variables. Survey existing conditions and utilities prior to design and include information within the design submission.
- III. Provide beginning and end stations for each facility. Provide stations and/or dimensions and elevations at each inlet, outlet and check dam.
- IV. Provide a dimensioned longitudinal section for each run of BMP facilities which includes sidewalk, road, inlet /outlet elevations and depth and elevation of underdrains.
- V. Sidewalk elevation must be set above check dam and inlet / outlet elevations to allow overflow to drain to street before sidewalk.
- VI. Soil slopes shall be 1:4 max.
- VII. Longitudinal slope of the BMP surface shall either match the road slope, or be stepped with check dams.
- VIII. Size of the facility shall meet both the requirements for stormwater treatment and soil volume for tree growth.
- IX. Refer to Sidewalk BMP Design Guidelines Chapter II.A for stormwater treatment requirements
- X. Refer to Sidewalk BMP Design Guidelines Chapter II.B for streetscape and layout requirements
- XI. Refer to Sidewalk BMP Design Guidelines Chapter II.C for planting materials specifications
- XII. Refer to Sidewalk BMP Design Guidelines Chapter II.D, E & F for maintenance requirements
- XIII. Refer to Sidewalk BMP Design Guidelines Chapter II.G for materials specifications
- XIV. For tree wells measuring less than 15 ft. in length (open surface dimension), the minimum dimension between the tree and the forebay and between the forebay and the coping curb may be amended.
- XV. If infiltration rates are acceptable, underdrains are not required and compacted subgrade at the base of the facility shall be amended to allow infiltration
- A. Use the sizing worksheets to determine soil volume and ponding areas. In some cases additional soil panels beneath the sidewalk paving will be needed to meet the soil volume requirement. Several of the typical plan details indicate how soil panels shall be accommodated, and chapter II.B provides guidance on streetscape layout.
- B. Min /Max & Typical plan dimensions for BMP facilities include the coping curbs.
- C. The side walls of BMP facilities shall be designed to support the edge of the well/trench, structurally support the coping curb and in many cases to provide a root barrier. The design of side walls may include alternatives which meet these requirements, and may include full depth concrete walls, benched walls and battered walls. All structured elements shall be certified by a structural engineer.
- D. Shallow alternative detail may be used where either a sloped profile or a shallow ponding depth allows.

STANDARD NOTES

- | | |
|---|------------------------|
| 1. ROAD CURB AND GUTTER | 11. COMPACTED SUBGRADE |
| 2. COPING CURB (SW-333-A or B) | 12. (NOT USED) |
| 3. CURB INLET AND GRATE (SW-330, 331 or 321) | 13. (NOT USED) |
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| 6. SIDEWALK PAVING | 16. GRATE |
| 7. UNCOMPACTED PLANTING / FILTER MEDIA | 17. (NOT USED) |
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| 10. AGGREGATE | |

RELATED DETAILS

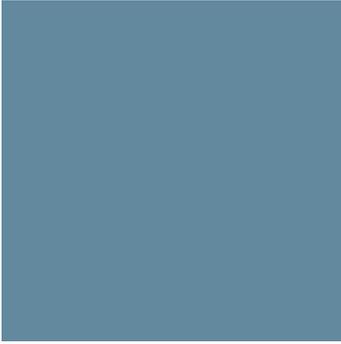
SW-300, 310 and 320



SW-351 OVERFLOW DRAIN



III REFERENCE STANDARDS



A. CITY STANDARDS, MEMO'S TO INDUSTRY, INDUSTRY STANDARDS,
LANDSCAPE GUIDELINES

Plant material, materials and methods of horticultural standardization and maintenance operations shall be in accordance with the Specifications, Planting and Maintenance sections of these Guidelines, and with the most current edition of the following. In the event that standards conflict, the most restrictive standard shall apply.

- American Standard for Nursery Stock, ANSI-Z60.1 American Association of Nurserymen; Washington DC.
- Pruning Standards, ANSI-A300, International Society of Arboriculture, Savoy Illinois.
- City of Alexandria Code
- City of Alexandria Zoning Ordinance
- City of Alexandria, Landscape Guidelines
- Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance, ANSI-A300, International Society of Arboriculture, Savoy Illinois.

B. NOMENCLATURE

<u>Term</u>	<u>Definition</u>
Best Management Practice (BMP)	A practice that is an effective and practicable means of controlling stormwater point or nonpoint source pollutants at levels compatible with environmental quality goals.
BMP Planting strip	A landscape feature in the street which allows for tree planting and treatment of stormwater run-off. These systems are installed in a series, with drains connecting the series. At the street level, they appear to be a continuous feature with a large area of visible landscape planting and occasionally separated by sections of sidewalk.
Check dam	An obstruction placed across the width of a swale or continuous bioretention area to reduce velocity, limit erosion and promote infiltration into the underlying media.
Curb inlet	A stormwater structure designed to capture stormwater runoff in the roadway and/or gutter pan and deliver it to the BMP underground stormwater piping system.
Edge Restraint	A manufactured unit (usually composed of stainless steel) installed at the edge of a field of paving or at a curb face to prevent horizontal movement of paving, curbs or aggregate base courses.
Infiltration	The downward movement of water from the land surface into the soil.
Liner / membrane	A thin pliable sheet or geotechnical fabric to provide separation between filter media and/or to prevent water seepage.
Right-of-way (ROW)	The public Right of Way unless otherwise identified. Generally considered of as a publicly owned street, alley, lane, etc.

Root cell	Manufactured unit which is designed to allow maximum root growth under a sidewalk. The unit is installed as a system and provides structural support for the sidewalk and void space for uncompacted planting medium.
Runoff	The portion of precipitation on land that ultimately reaches streams often with dissolved or suspended material
Soil Matrix/Planting Medium	Uncompacted soil of specific physical, chemical and biological characteristics designed to support maximum phosphorus removal at the same time enhancing plant health and growth.
Suspended sidewalk	Sidewalk installation which is designed to allow maximum root growth. The sidewalk is structurally supported to span a void beneath, with the void filled by uncompacted growing medium (soil) for the street trees.
Total Maximum Daily Load (TMDL)	A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.
Watershed Implementation Plan (WIP)	The State of Virginia plan that documents how the jurisdiction will partner with federal and local governments to achieve and maintain water quality standards as outlined in the Chesapeake Bay TMDL.
Water Quality Volume (WQV)	Water Quality Volume, for the purposes of this design, is the first half inch of runoff from an impervious surface.
Weir	A dam in a swale or bioretention area to raise water levels or divert flow.



IV CITATIONS AND REFERENCES

Casey Trees: Tree Space Design, 2009, <http://caseytrees.org/resources/design/tree-space-design/>

City of New York: Tree Planting Standards, 2009, http://www.nycgovparks.org/sub_permits_and_applications/images_and_pdfs/tree_planting_standards_2009.pdf

City of Portland (Oregon): Stormwater Management Manual, 2008, <http://www.portlandoregon.gov/bes/47952>

CRWA: Stormwater, Trees and the Urban Environment, 2009, <http://www.crwa.org/pubs/StormwaterTreesUrbanEnvMar09.pdf>

Dirr, Michael: *Manual of Woody Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses*, 2009

DDOT: *Anacostia Waterfront Transportation Architecture Design Standards*, <http://www.scribd.com/ddotdc/d/83991242-Anacostia-Waterfront-Transportation-Architecture-Design-Guidelines>

DDOT: *Noma Public Space and Water Management Study*, 2011, <http://planning.dc.gov/DC/Planning/Across+the+City/Other+Citywide+Initiatives/Sustainability/Local+Initiatives/NoMa+Public+Space+and+Water+Management+Study>

Schuler, Jim (USGBC): *Multivariate study of stormwater BMPs*, 2008,

Urban, James: *Up by the Roots*, 2008

Virginia DCR: *Stormwater Design Specification No. 9, Bioretention*, 2011, http://vwrrc.vt.edu/swc/april_22_2010_update/DCR_BMP_Spec_No_9_BIORETENTION_FinalDraft_v1-8_04132010.htm

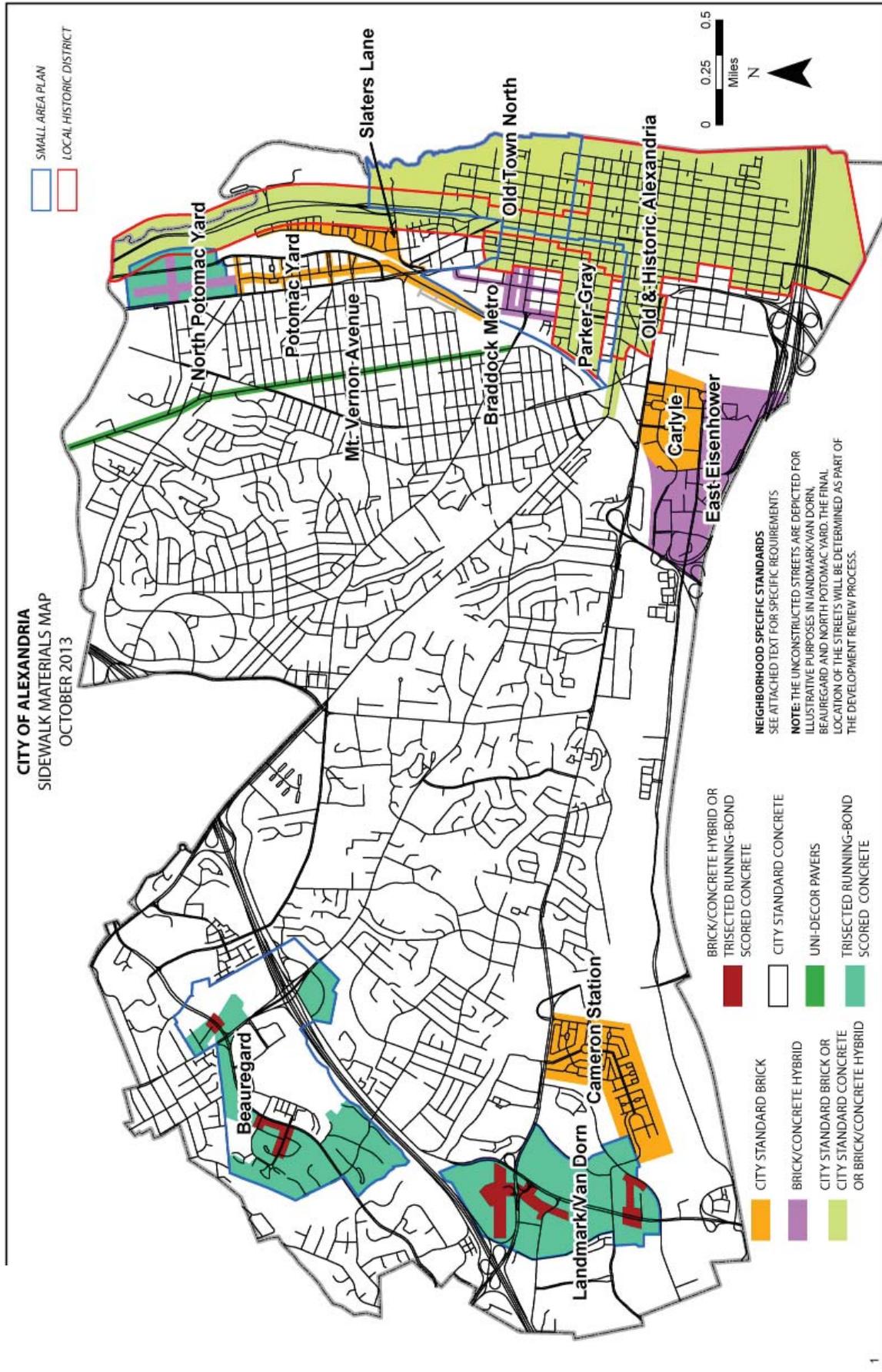
Soil Volume Research

Arnold (1980), Cervelli (1986), Kopinga (1985), Lindsey/Bassuk (1992), Moll & Urban (1989), Perry (1985), Urban (2008)



V ADDENDA

A. BRICK SIDEWALKS MAP



B. MEMO TO INDUSTRY

MEMORANDUM**MEMORANDUM TO INDUSTRY NO. 04-2014***

DATE: JUNE 1, 2014

TO: DEVELOPERS, ARCHITECTS, ENGINEERS & SURVEYORS

FROM: WILLIAM SKRABAK, DEPUTY DIRECTOR, INFRASTRUCTURE AND ENVIRONMENTAL QUALITY, DEPARTMENT OF TRANSPORTATION AND ENVIRONMENTAL SERVICES 

SUBJECT: TREATMENT OF ROADWAY RUNOFF ASSOCIATED WITH DEVELOPMENT PROJECTS

Article XIII, the Environmental Management Ordinance, requires water quality treatment of impervious areas for all land disturbances over 2,500 square feet. To date this existing requirement has been particularly difficult to achieve with linear projects such as sidewalks and roadways. To facilitate compliance and provide guidance in meeting requirements of the Ordinance for linear projects, the following policy is being promulgated.

In order to improve water quality within the City of Alexandria and the Chesapeake Bay the runoff from any NEW public roadways created as a consequence of development or redevelopment shall be treated by the developer. All Best Management Practices (BMPs) that treat right-of-way runoff shall be installed by the developer. Under certain circumstances the BMPs that treat right-of-way water quality volume may be placed in the right-of-way. Any BMP in the right-of-way shall follow design guidelines established by the City of Alexandria and be subject to approval by the Director of T&ES. Conditions under which BMPs can be placed in the right-of-way are as follows:

1. If all water flowing to the BMP is derived from impervious area on public property/right-of-way then a BMP in the right-of-way is acceptable. The property owner will cover infrastructure and installation costs of the BMP and the City will maintain the BMP. The type of BMP will be as designated and approved by the Director of T&ES.
2. Directing the water quality volume generated on private property to a BMP designed to treat right of way runoff is discouraged as the purpose of the BMP is to treat runoff from the public right of way, not that from a privately developed parcel. However, if adjacent impervious surfaces (plazas, sidewalks, etc.) can be

treated along with roadway runoff (and cannot be treated within a BMP on the property) their use is not precluded. If there is a nominal portion of privately generated water quality volume flowing to the BMP due to proven grading constraints, then the City may accept responsibility for maintenance. The type of BMP will be as designated and approved by the Director of T&ES.

The developer or owner shall remove trash and be responsible for the long-term health and vigor of vegetation beyond the 3-year maintenance bond period. All maintenance concerns, especially long-term health and vigor of vegetation and litter removal, shall be negotiated at site plan stage.

Any questions pertaining to this policy can be directed toward the City's Stormwater Division at 703 746-4065.

***This Memo to Industry replaces Memo to Industry 01-2012.**

C. SAMPLE SIZING WORKSHEET INCLUDING INSTRUCTIONS: TYPE A

Row ID	Assumptions	Measurement	Unit	Notes & Instructions
Contributing Drainage Area				
A	Area of roadway to be treated	200 LF of ROW x 24 ft wide (2 x 12 ft wide travel lanes)	SF	Measure area of the roadway required to be treated
B	Area of sidewalk to be treated	approx 170 LF of ROW x 14 ft wide	SF	Measure area of the sidewalk required to be treated. The landscape treatment areas (tree wells, continuous planting strips etc. can be deducted from this measurement)
C	Total Contributing Drainage Area		SF	Combine Row A with Row B
D	Total Water Quality Volume	First 0.5 in. required to be treated	CF	Multiply Row C by 0.5 in (0.041667 ft)
Water Quality Sizing Requirements				
E	Ponding Area Required (Gross)	8 in. ponding depth	SF	Divide Row D by the average ponding depth to be provided. See the sections at 2.A for further information on ponding design. The minimum depth is 6 in. (0.5 ft) and the maximum is 8 in (0.67 ft)
F	Ponding Area Required Line 1 (Net after infiltration)			Row F = 1hr fill time * Infiltration rate * (Depth of soil * (ponding depth/2)) / Depth of soil
G	Ponding Area Required Line 2 (Net after infiltration)	Total Water quality volume	SF	Row D divided by (Ponding depth ft + Row F)
Project Specific Data	H	Fill Time	1 Hour (standard)	Use standard 1 hour fill time
	J	Infiltration Rate	Soil Spec range range	Use a value from within the Soil Specification range = 2 to 3.5 (in/hr), 0.167 to .292 (ft./hr)
	K	Depth of Soil (Avg)	Project specific	Refer to section 2.A for water quality soil depth requirements (where the soil acts as filter media), and to section 2.C for horticultural soil depth requirements (where soil acts as growing media)
	L	Ponding Depth	Maximum ponding depth	Refer to section 2.A for ponding depth requirements
Landscape Sizing Requirements				
Project Specific Data	M1	Type of Landscape Treatment Proposed		Refer to the local masterpan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate landscape treatment, e.g tree wells, continuous planting strip etc.
	M2	Tree Spacing		Refer to the local masterpan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate tree spacing
	N	Number of trees to be accommodated per block face	4 trees required	Refer to the local masterpan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate tree spacing
P	Open Area per Tree Well Required		SF	Divide Row G by Row N
Q	Width		FT	Refer to section 2.B for sizing criteria.
R	Length (min. open length)		FT	Either divide Row P by Row Q to determine the minimum length required given the width, or use a length suitable for the site. Refer to section 2.B for sizing criteria.
S	Avg soil Depth		FT	Equals Row K
T	Soil volume per tree provided		CF	Row Q * Row R * Row S. See Soil volume requirement section 2.C
U	Additional Soil Volume Required per tree		CF	Equals 450 CF minus Row T. A negative value indicates that the soil volume requirement has been met. A positive number means additional soil volume is required to meet the landscape requirements for planting establishment. This can be provided as either open, or below sidewalk volume (see section 2.C for requirements)

Note: Figures in the electronic spreadsheet are frequently rounded and account for minor discrepancies.

Cell requires project specific data to be entered
 Cell requires project specific data and area measurements to be entered (Electronic version)

D. SAMPLE SIZING WORKSHEET INCLUDING INSTRUCTIONS: TYPE B

Row ID	Assumptions	Measurement	Unit	Notes & Instructions
Contributing Drainage Area				
A	Area of roadway to be treated	200 LF of ROW x 24 ft wide (2 x 12 ft wide travel lanes)	SF	Measure area of the roadway required to be treated
B	Area of sidewalk to be treated	approx 170 LF of ROW x 14 ft wide	SF	Measure area of the sidewalk required to be treated. The landscape treatment areas (tree wells, continuous planting strips etc. can be deducted from this measurement)
C	Total Contributing Drainage Area		SF	Combine Row A with Row B
D	Total Water Quality Volume	First 0.5 in. required to be treated	CF	Multiply Row C by 0.5 in (0.041667 ft)
Water Quality Sizing Requirements				
E	Ponding area required (Gross)	8 in. ponding depth	SF	Divide Row D by the average ponding depth to be provided. See the sections at 2.A for further information on ponding design. The minimum depth is 6 in. (0.5 ft) and the maximum is 8 in (0.67 ft)
F	Ponding area required Line 1 (Net after infiltration)			Row F = 1hr fill time * Infiltration rate * (Depth of soil * (ponding depth/2)) / Depth of soil)
G	Ponding area required Line 2 (Net after infiltration)	Total Water quality volume	SF	Row D divided by (Ponding depth ft + Row F)
Project Specific Data	H	Fill time	1 Hour (standard)	Use standard 1 hour fill time
	J	Infiltration rate	Soil Spec range range	Use a value from within the Soil Specification range = 2 to 3.5 (in/hr), 0.167 to .292 (ft./hr)
	K	Depth of Soil (Avg)	Project specific	Refer to section 2.A for water quality soil depth requirements (where the soil acts as filter media), and to section 2.C for horticultural soil depth requirements (where soil acts as growing media)
	L	Ponding depth	Maximum ponding depth	Refer to section 2.A for ponding depth requirements
Landscape Sizing Requirements				
Project Specific Data	M1	Type of landscape treatment proposed		Refer to the local masterplan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate landscape treatment, e.g tree wells, continuous planting strip etc.
	M2	Tree spacing		Refer to the local masterplan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate tree spacing
	N1	Number of trees to be accommodated per block face	6 trees required	Refer to the local masterplan and design guidelines, and to the 2.B section within these BMP design guidelines to determine the appropriate tree spacing
	N2	Number of strips to be accommodated per block face	Assumes 2 strips	Applies only to planting strips, not tree well applications. Input the number of strips to be accommodated on the block
P	Open area per strip required	Assumes strips are same length	SF	Divide Row G by Row N2
Q	Width		FT	Refer to section 2.B for sizing criteria.
R	Length (min. open length)		FT	Either divide Row P by Row Q to determine the minimum length to meet the water quality requirement given the width, or use a length suitable for the site. Refer to section 2.B for sizing criteria.
S	Avg soil depth		FT	Equals Row K
T	Soil volume per tree provided		CF	Row Q * Row R * Row S / number of trees per strip. See Soil volume requirement section 2.C
U	Additional soil volume required per tree		CF	Equals 450 CF minus Row T. A negative value indicates that the soil volume requirement has been met. A positive number means additional soil volume is required to meet the landscape requirements for planting establishment. This can be provided as either open, or below sidewalk volume (see section 2.C for requirements)
<p>Note: Figures in the electronic spreadsheet are frequently rounded and account for minor discrepancies.</p> <p>Cell requires project specific data to be entered</p> <p>Cell requires project specific data and area measurements to be entered (Electronic version)</p>				