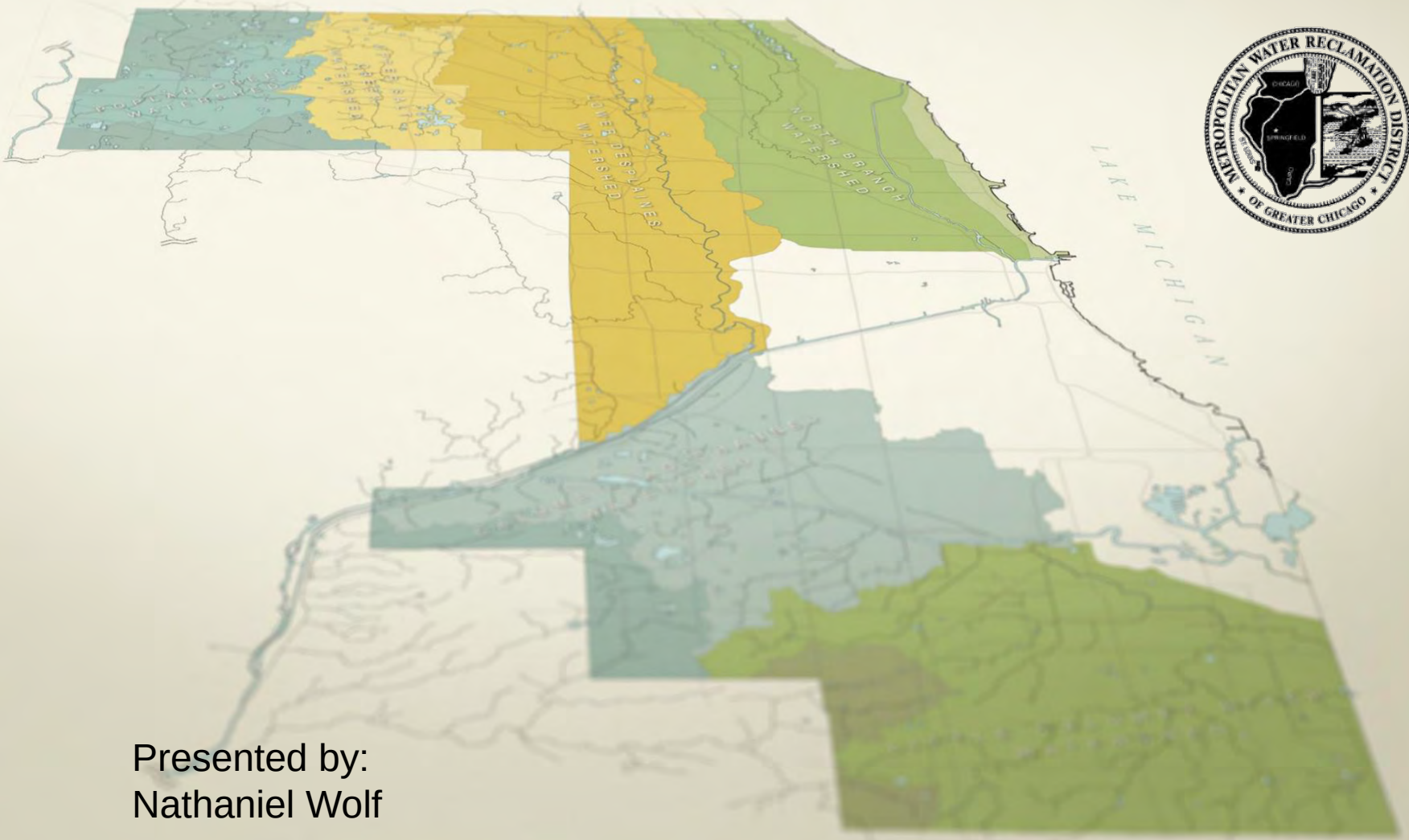
# Watershed Management Ordinance (WMO)

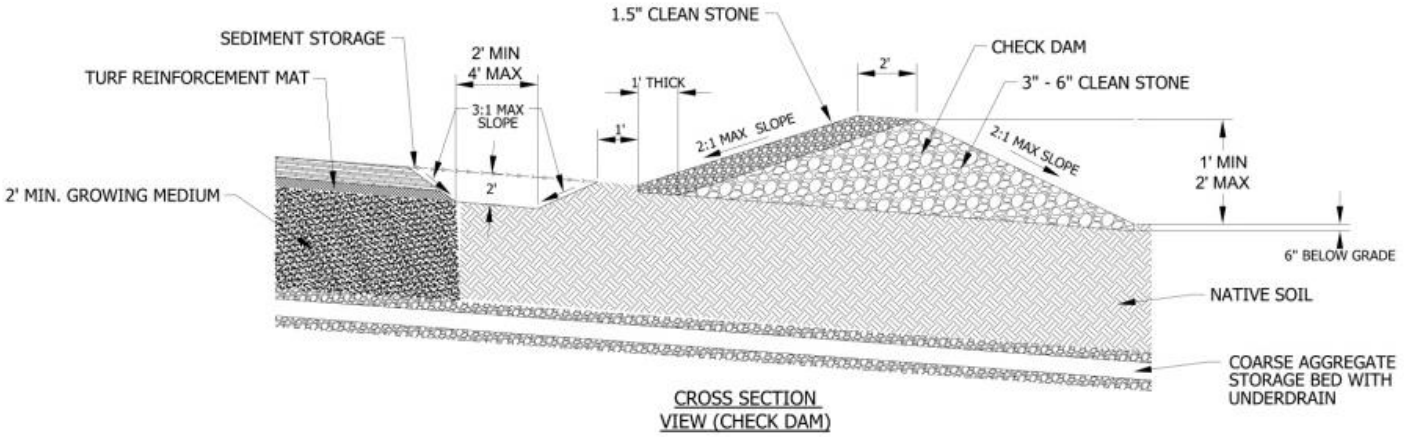
## Appendix C Detail Updates

## Green Infrastructure Details




Presented by:
Nathaniel Wolf

# Bioswale



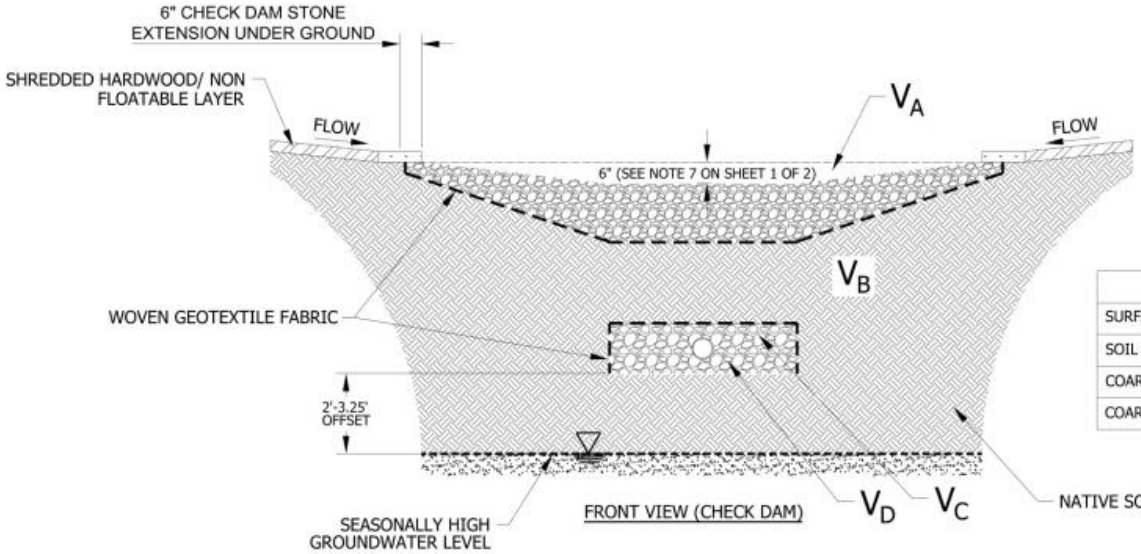
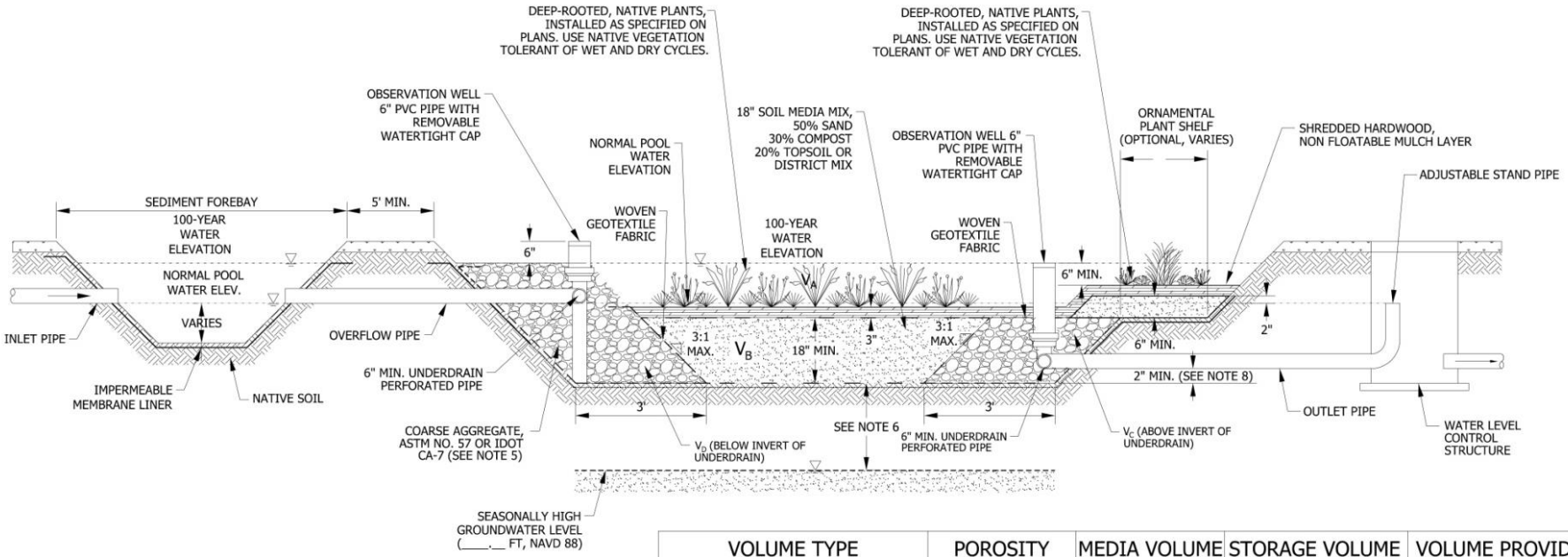




**TABLE 2**

| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

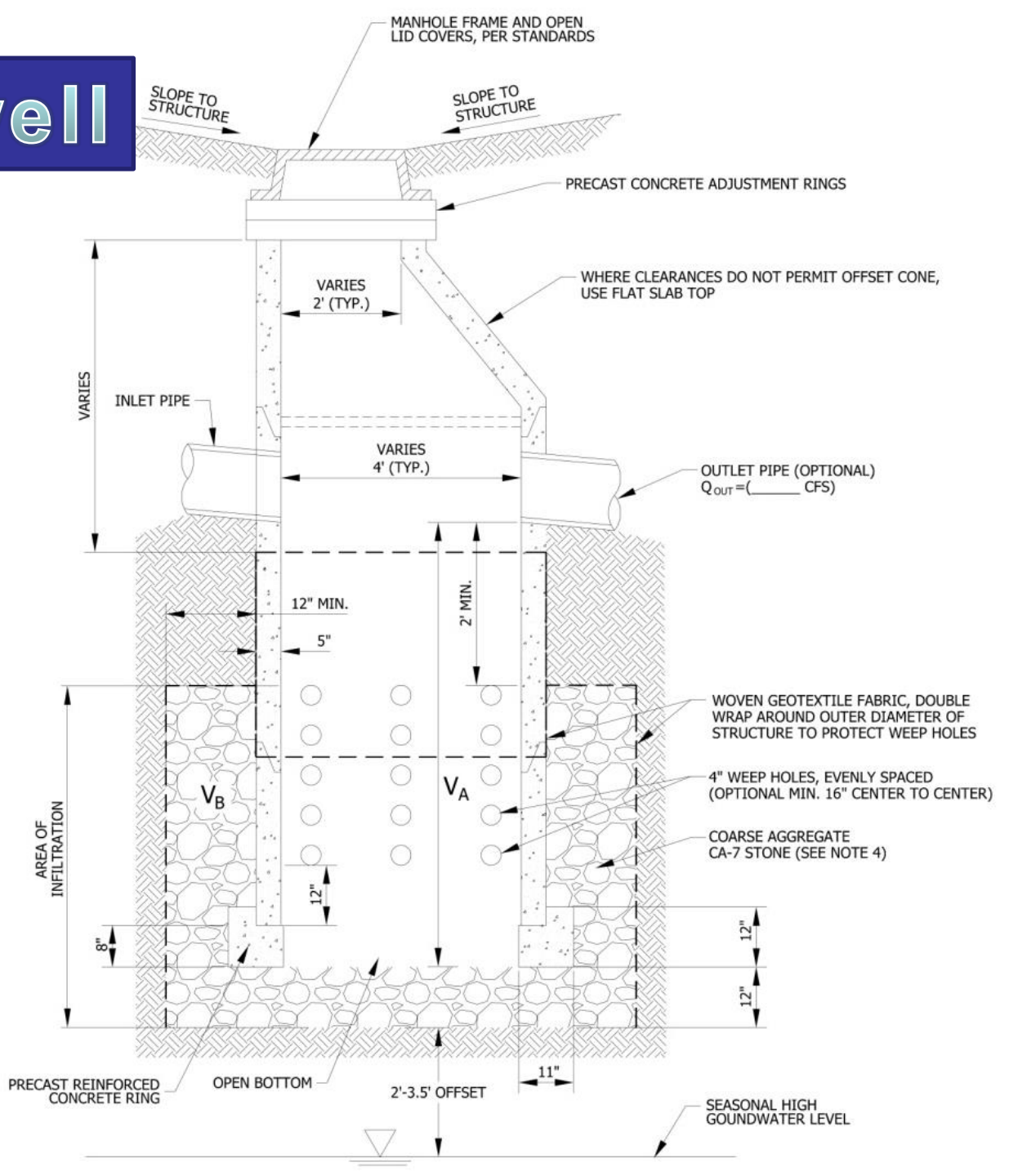
# Constructed Wetland



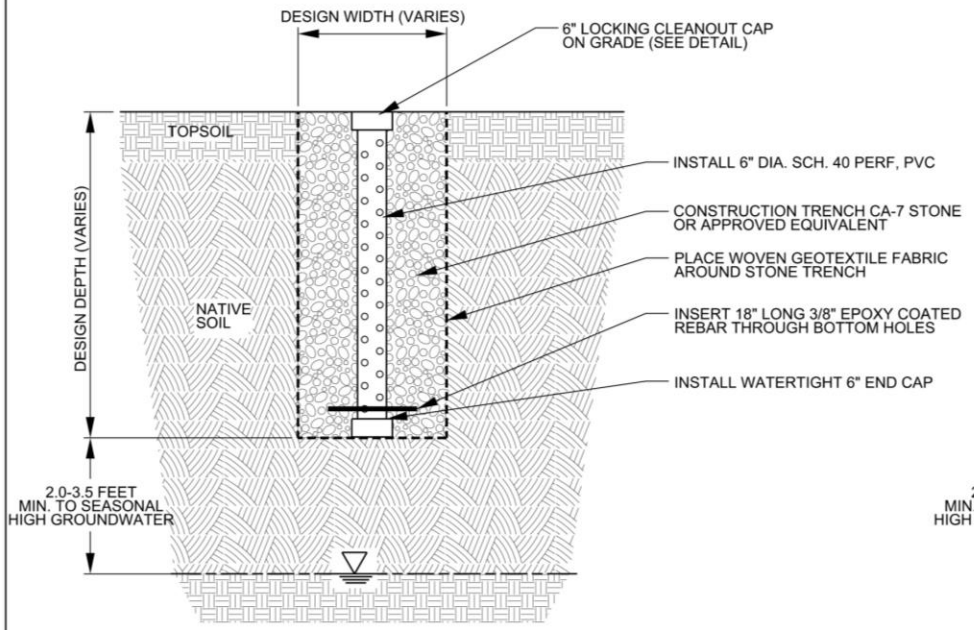

| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. WETLAND LENGTH TO WIDTH RATIO SHOULD RANGE FROM 2 TO 3.
4. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
5. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
6. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
7. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. MAXIMUM OF 1 UNDERDRAIN PER 30 FEET. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS.
8. MINIMUM UNDERDRAIN BEDDING OF TWO INCHES, MAXIMUM OF 12 INCHES.
9. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

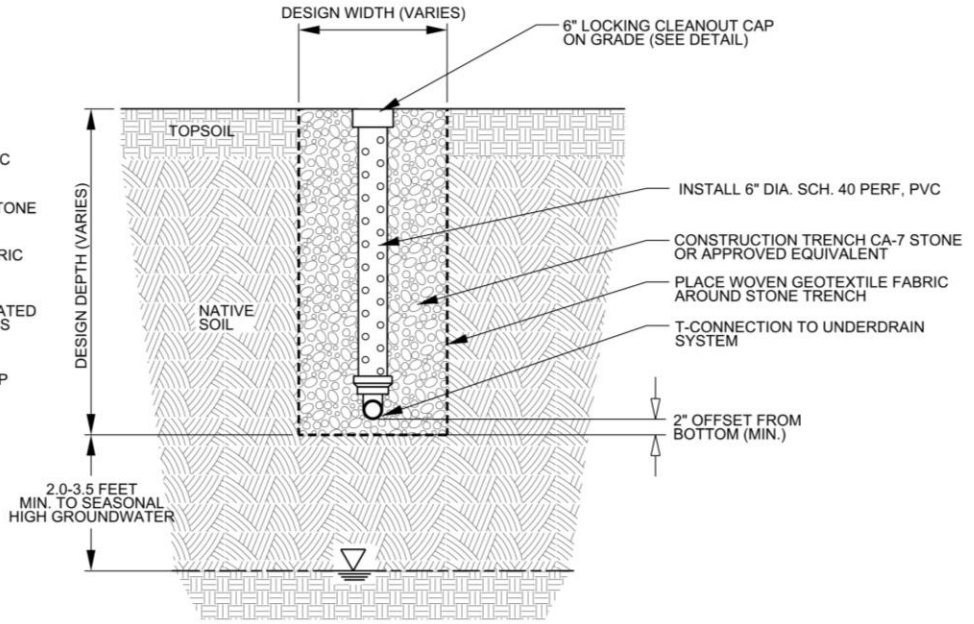
# Drywell


MANHOLE FRAME AND OPEN LID COVERS, PER STANDARDS
SLOPE TO STRUCTURE
SLOPE TO STRUCTURE
PRECAST CONCRETE ADJUSTMENT RINGS
WHERE CLEARANCES DO NOT PERMIT OFFSET CONE, USE FLAT SLAB TOP
VARIES 2' (TYP.)
VARIES
INLET PIPE
VARIES 4' (TYP.)
OUTLET PIPE (OPTIONAL) $Q_{OUT}$ =(_____ CFS)
12" MIN.
5"
2' MIN.
WOVEN GEOTEXTILE FABRIC, DOUBLE WRAP AROUND OUTER DIAMETER OF STRUCTURE TO PROTECT WEEP HOLES
4" WEEP HOLES, EVENLY SPACED (OPTIONAL MIN. 16" CENTER TO CENTER)
COARSE AGGREGATE CA-7 STONE (SEE NOTE 4)
$V_B$
$V_A$
AREA OF INFILTRATION
12"
8"
12"
12"
11"
PRECAST REINFORCED CONCRETE RING
OPEN BOTTOM
2'-3.5' OFFSET
SEASONAL HIGH GOUNDWATER LEVEL

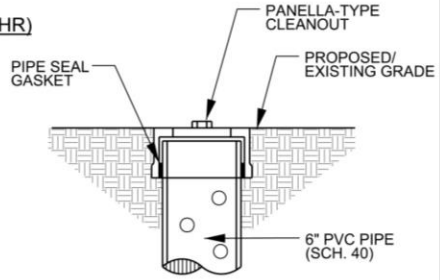
# Observation Well




WITHOUT UNDERDRAIN
(SOIL INFILTRATION CAPACITY ≥0.5 IN/HR)



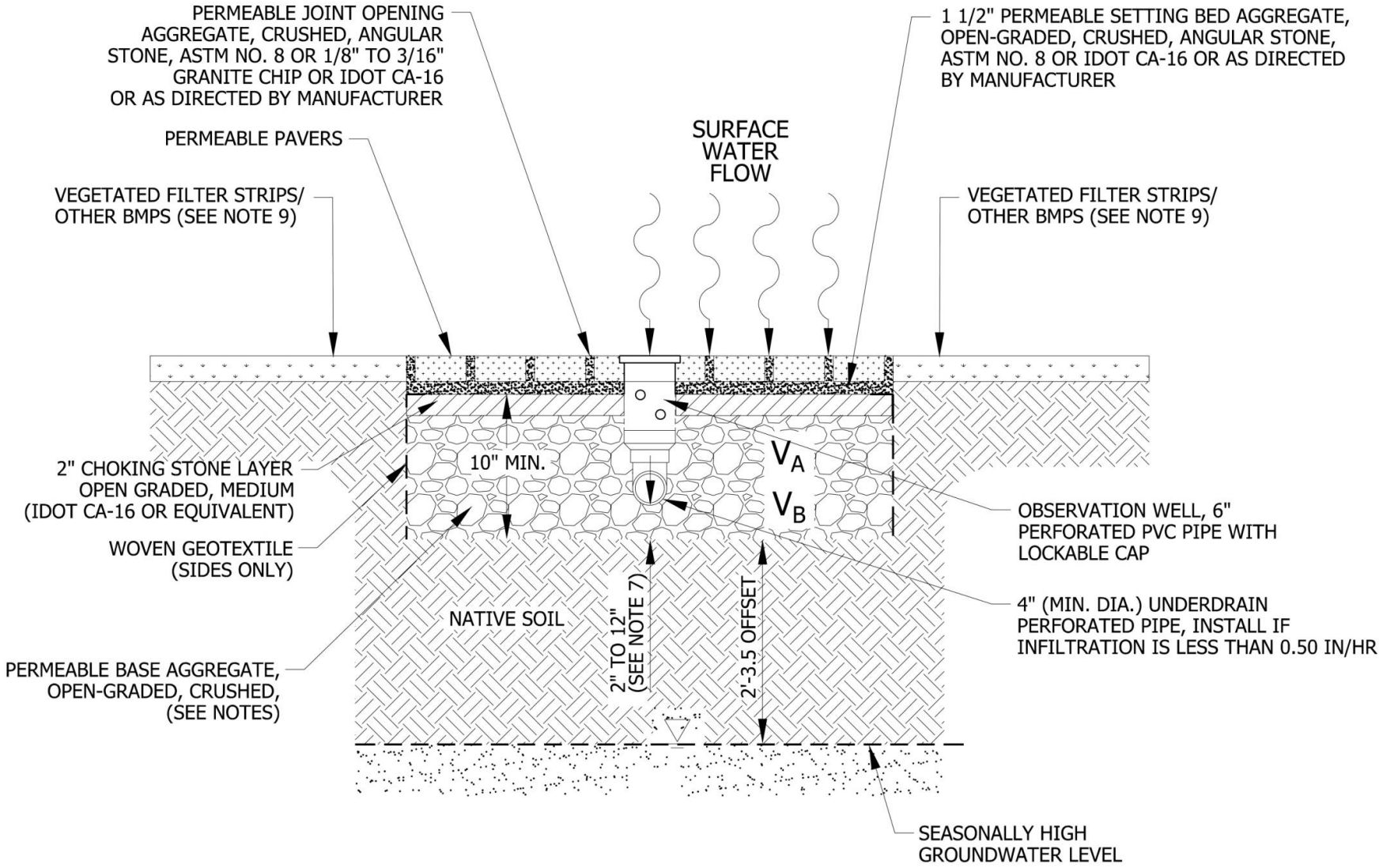

WITH UNDERDRAIN
(SOIL INFILTRATION CAPACITY <0.5 IN/HR)




OBSERVATION WELL
CLEANOUT CAP DETAIL

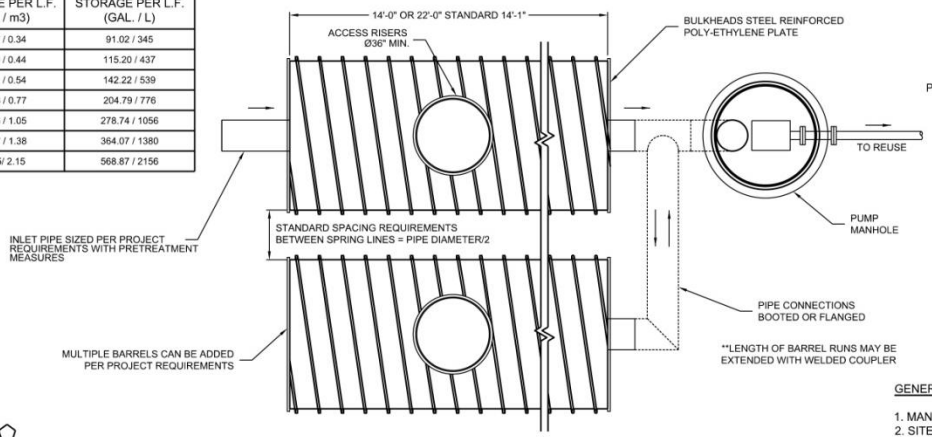
NOTES:
1) ONE OBSERVATION WELL SHALL BE INSTALLED PER 40,000 SQ. FT. OF SURFACE AREA.
2) PERFORATIONS SHALL BE 3/8" CIRCULAR HOLES, 4" ON CENTER, 90° AROUND PIPE.
3) OBSERVATION WELL FOR BIORETENTION FACILITIES SHALL EXTEND 6"-12" ABOVE GRADE AND CONTAIN AN OVERFLOW GRATE INSTEAD OF LOCKING CAP.
4) PIPES/FITTINGS SHALL BE SCHEDULE 40 PVC OR HIGHER QUALITY, 6" DIAMETER MINIMUM.

# Permeable Pavers

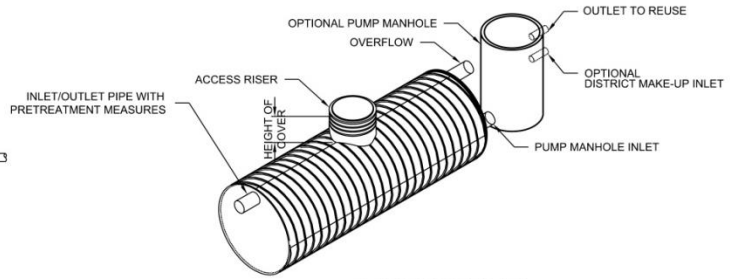


# Stormwater Reuse

| STORAGE AVAILABILITY PER DIAMETER | | |
|---|---|---|
| DIAMETER (IN / mm) | AVAILABLE STORAGE PER L.F. (C.F. / m3) | AVAILABLE STORAGE PER L.F. (GAL. / L) |
| 48 / 1200 | 12.17 / 0.34 | 91.02 / 345 |
| 54 / 1350 | 15.40 / 0.44 | 115.20 / 437 |
| 60 / 1500 | 19.01 / 0.54 | 142.22 / 539 |
| 72 / 1800 | 27.38 / 0.77 | 204.79 / 776 |
| 84 / 2100 | 37.26 / 1.05 | 278.74 / 1056 |
| 96 / 2400 | 48.67 / 1.38 | 364.07 / 1380 |
| 120 / 3000 | 76.05/ 2.15 | 568.87 / 2156 |

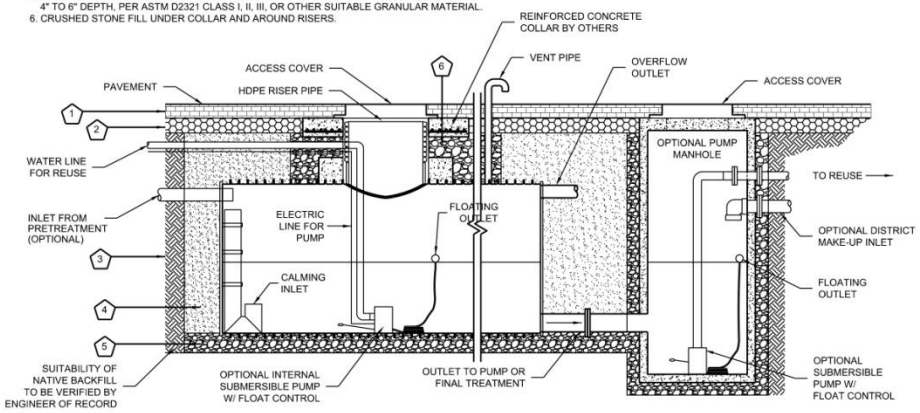



PLAN VIEW




ISOMETRIC VIEW

KEY
1. RIGID OR FLEXIBLE PAVEMENT.
2. GRANULAR COMPACTED ROAD BASE.
3. ANY SUITABLE NATIVE OR GENERAL BACKFILL, SEE ENGINEER PLANS.
4. WELL GRADED GRANULAR FILL. ASTM D2321 CLASS I, II, III, OR EQUIVALENT. COMPACT TO MIN. 90% STANDARD DENSITY PER AASHTO T99. MAY INCLUDE ROAD BASE.
5. RELATIVELY LOOSE GRANULAR BEDDING, ROUGHLY SHAPED TO FIT BOTTOM OF BARREL, 4" TO 6" DEPTH, PER ASTM D2321 CLASS I, II, III, OR OTHER SUITABLE GRANULAR MATERIAL.
6. CRUSHED STONE FILL UNDER COLLAR AND AROUND RISERS.




ELEVATION VIEW

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE, CAPACITY AND BACKFILL DETAILS, TO BE PROVIDED BY MANUFACTURER.
3. ALL ELEVATIONS, DIMENSIONS AND LOCATIONS OF RISERS AND INLETS SHALL BE VERIFIED BY THE ENGINEER OF RECORD.
4. PRIOR TO INSTALLATION OF THE SYSTEM A PRE-CONSTRUCTION MEETING SHALL BE CONDUCTED. THOSE REQUIRED TO ATTEND ARE THE SUPPLIER OF THE SYSTEM, THE GENERAL CONTRACTOR, SUB-CONTRACTORS AND THE ENGINEER.
5. THE CISTERN IS MANUFACTURED FROM STEEL REINFORCED POLYETHYLENE PLASTIC.
6. SYSTEM TO MEET AASHTO HS20/HS25 LIVE LOADING, PER AASHTO LRFD SECTION 12.
7. ACCESS COVERS TO MEET AASHTO M306 LOAD RATING.
8. MINIMUM COVER IS EQUAL TO PIPE DIAMETER/5 AND NO LESS THAN 12-INCHES FROM TOP OF PIPE TO BOTTOM OF PAVEMENT. Ø72" AND Ø84" PIPE MINIMUM COVER IS 18-INCHES, Ø96" PIPE MINIMUM COVER IS 24-INCHES, Ø120" PIPE MINIMUM COVER IS 36-INCHES.
9. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

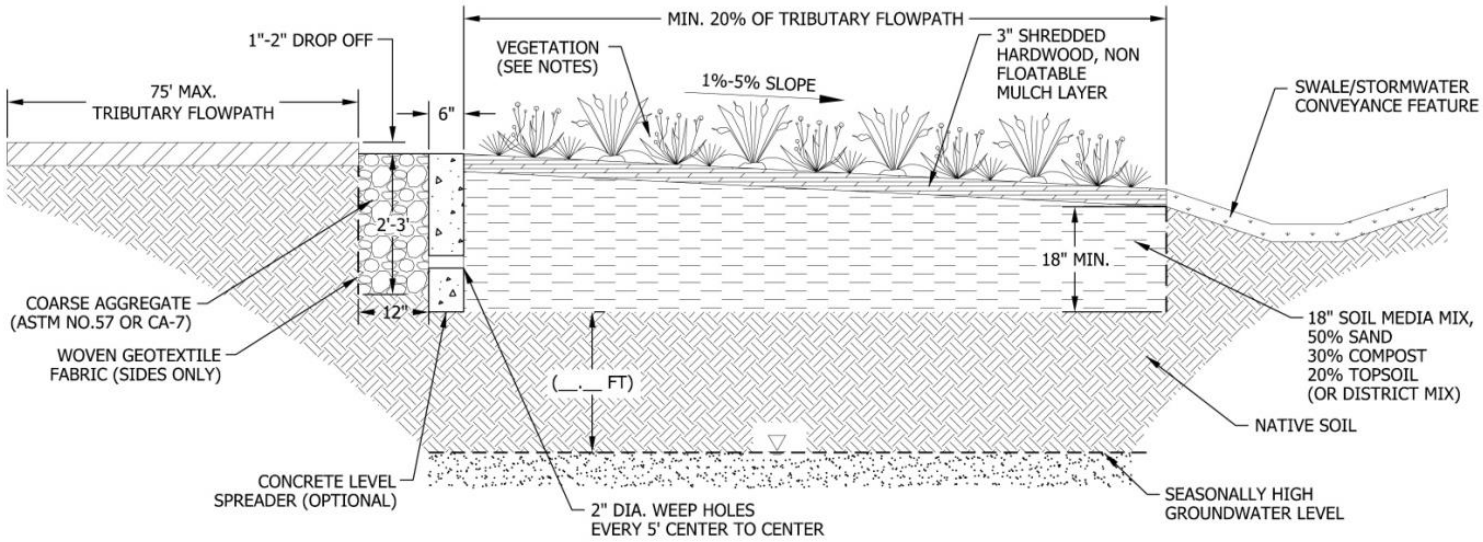
INSTALLATION NOTES

A. INSTALLATION GUIDE TO BE REVIEWED BY CONTRACTOR PRIOR TO INSTALLATION.
B. CONTRACTOR TO PROVIDE, INSTALL AND GROUT ALL INLET AND OUTLET PIPES.
C. CONTRACTOR TO PROVIDE AND INSTALL ALL BEDDING AND BACKFILL MATERIAL.
D. PRIOR TO PLACING BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, A GEOGRID SHALL BE UTILIZED OR UNSUITABLE MATERIAL SHALL BE REMOVED AND BROUGHT BACK TO GRADE WITH FILL MATERIAL AS APPROVED BY THE ENGINEER OF RECORD. ONCE THE FOUNDATION PREPARATION IS COMPLETE, THE BEDDING MATERIAL CAN BE PLACED.
E. STONE EMBEDMENT MATERIAL SHALL BE INSTALLED TO 95% STANDARD PROCTOR DENSITY AND PLACED IN 6-INCH TO 8-INCH LIFTS SUCH THAT THERE IS NO MORE THAN A TWO LIFT DIFFERENTIAL BETWEEN ANY OF THE BARRELS AT ANY TIME. GRANULAR BACKFILL MATERIAL SHALL BE COMPACTED TO 90% SPD. BACKFILLING SHALL BE ADVANCED ALONG THE LENGTH OF THE BARRELS AT THE SAME RATE TO AVOID DIFFERENTIAL LOADING AND DISPLACEMENT OF THE BARRELS. THE MINIMUM PIPE SPACING MUST BE MAINTAINED.
F. REFER TO INSTALLATION GUIDE FOR TEMPORARY CONSTRUCTION LOADING GUIDELINES.
G. IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.
H. GENERAL INSTALLATION METHODS AND MATERIALS TO BE IN ACCORDANCE WITH ASTM D2321.

OPERATION NOTES

1. PROPERTY OWNER MUST INSPECT AND EXERCISE ANNUALLY.
2. THE STORAGE MUST DEWATER IN 72 HOURS OR 12 HOURS BEFORE STORM EVENT.
3. CISTERN MUST BE PROTECTED FROM FREEZING EFFECTS.

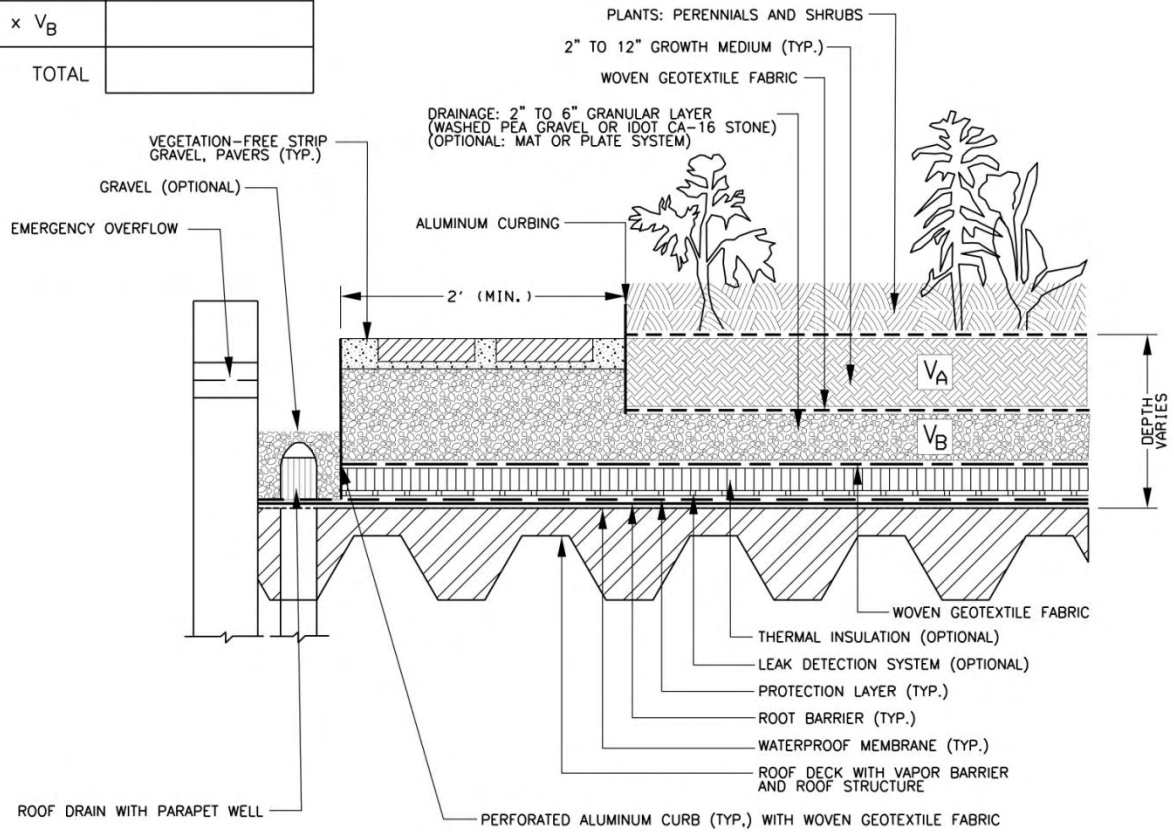
# Vegetated Filter Strip




NOTES:
1. MULCH LAYER SHALL BE HARDWOOD MULCH OR OTHER NON-FLOATING GROUND COVER.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. LONGEST FLOW PATH OF CONTRIBUTING DRAINAGE AREA MUST NOT EXCEED 75 FEET.
4. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50.
5. COARSE AGGREGATE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS ARE ALLOWED.
6. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL.

| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| GROWTH MEDIUM | 0.25 | $V_A$ | 0.25 x $V_A$ | |
| DRAINAGE LAYER | 0.25 | $V_B$ | 0.25 x $V_B$ | |
| | | | TOTAL | |

# Green Roof




NOTES:
1) WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF SPECIFICATION IUM 592 GEOTEXTILE, TABLE 1, CLASS I, WITH AN APPARENT OPENING SIZE OF 50.
2) PLANTINGS SHALL BE SELECTED ACCORDING TO ASTM E2400-06, *GUIDE FOR SELECTION, INSTALLATION AND MAINTENANCE OF PLANTS FOR GREEN (VEGETATED) ROOF SYSTEMS.*
3) GROWTH MEDIA SHALL CONSIST OF 80% LIGHTWEIGHT INORGANIC MATERIALS AND 20% ORGANIC MATTER.
4) THERE SHALL BE A MINIMUM SETBACK OF 2-FEET FROM ROOF PERIMETER AND ROOF PENETRATIONS.

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | GREEN ROOF TYPICAL DETAIL | STD. DWG. NO.5 |
| | | PAGE NO. 6 |

# Thank You
# Questions?

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Wolfn@mwrd.org

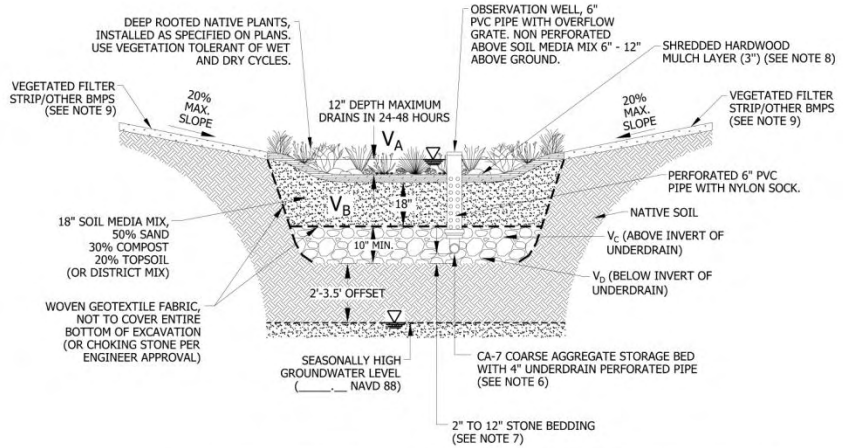
Metropolitan Water Reclamation District of Greater Chicago
100 E. Erie Street
Chicago, Illinois

# All Details/Reference

# Agenda

- New Green Infrastructure Details
  - Volume Control Design basics
  - How volume control storage is credited
  - Assorted Green Infrastructure Details
  - Green Roofs

## APPENDIX C. STANDARD DETAILS AND NOTES

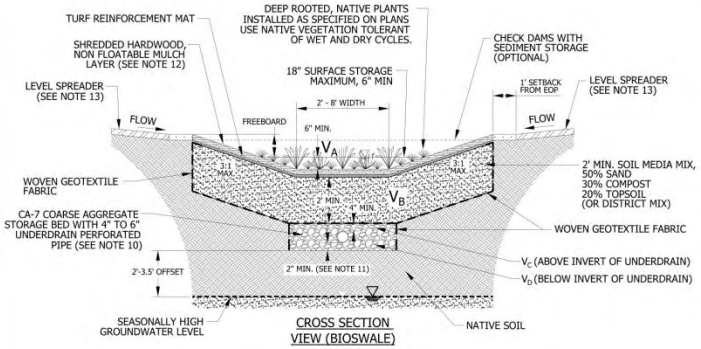



| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

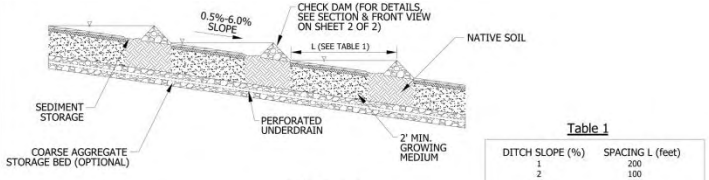
NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
4. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
5. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
6. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. NO MORE THAN 1 UNDERDRAIN EVERY 30 FEET ON CENTER. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS. NO FILTER FABRIC COVER/SOCK.
7. MINIMUM UNDERDRAIN BEDDING OF 2 INCHES, MAXIMUM OF 12 INCHES.
8. MULCH LAYER SHALL BE HARDWOOD MULCH OR OTHER NON-FLOATING GROUND COVER.
9. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL, PAGE 17.

NOT TO SCALE

| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
|---|---|---|
| | BIORETENTION FACILITY DETAIL | STD. DWG. NO.1 |
| | | PAGE NO.1 |




CROSS SECTION VIEW (BIOSWALE)




PROFILE VIEW

Table 1

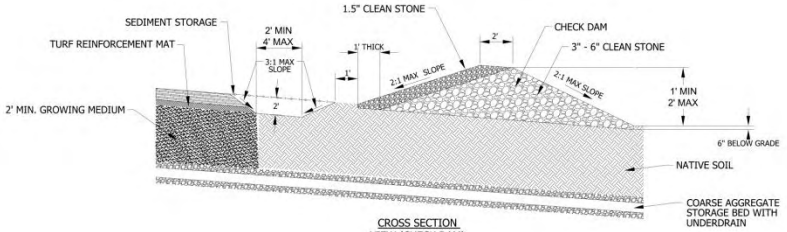
| DITCH SLOPE (%) | SPACING L (feet) |
|---|---|
| 1 | 200 |
| 2 | 100 |
| 4 | 50 |
| 6 | 33 |

SLOPES ABOVE 6% ARE NOT RECOMMENDED

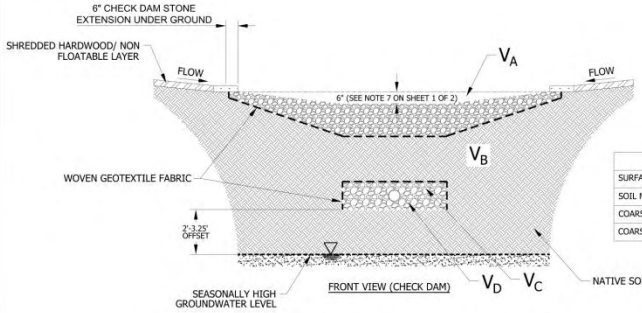
NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. GROWING MEDIUM SHALL BE 4 INCHES DEEPER THAN LARGEST PLANTED ROOT BALL.
4. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
5. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
6. CHECK DAMS MUST BE INSTALLED FOR VELOCITIES GREATER THAN 1 FT/S FOR THE 2-YEAR, 24-HOUR STORM EVENT. CHECK DAM SPACING PER TABLE 1.
7. CENTER OF CHECK DAM MUST BE A MINIMUM OF 6 INCHES LOWER THAN OUTSIDE EDGES TO PASS HIGH FLOWS.
8. BOTTOM OF UPSTREAM CHECK DAM SHALL BE SAME ELEVATION AS TOP OF DOWNSTREAM CHECK DAM.
9. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
10. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. MAXIMUM OF 1 UNDERDRAIN PER 30 FEET. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS.
11. MINIMUM UNDERDRAIN BEDDING OF TWO INCHES, MAXIMUM OF 12 INCHES.
12. MULCH LAYER SHALL BE HARDWOOD MULCH OR OTHER NON-FLOATING GROUND COVER.
13. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

NOT TO SCALE

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | BIOSWALE DETAIL (SHEET 1 OF 2) | STD. DWG. NO.2 |
| | | PAGE NO.2 |




CROSS SECTION VIEW (CHECK DAM)

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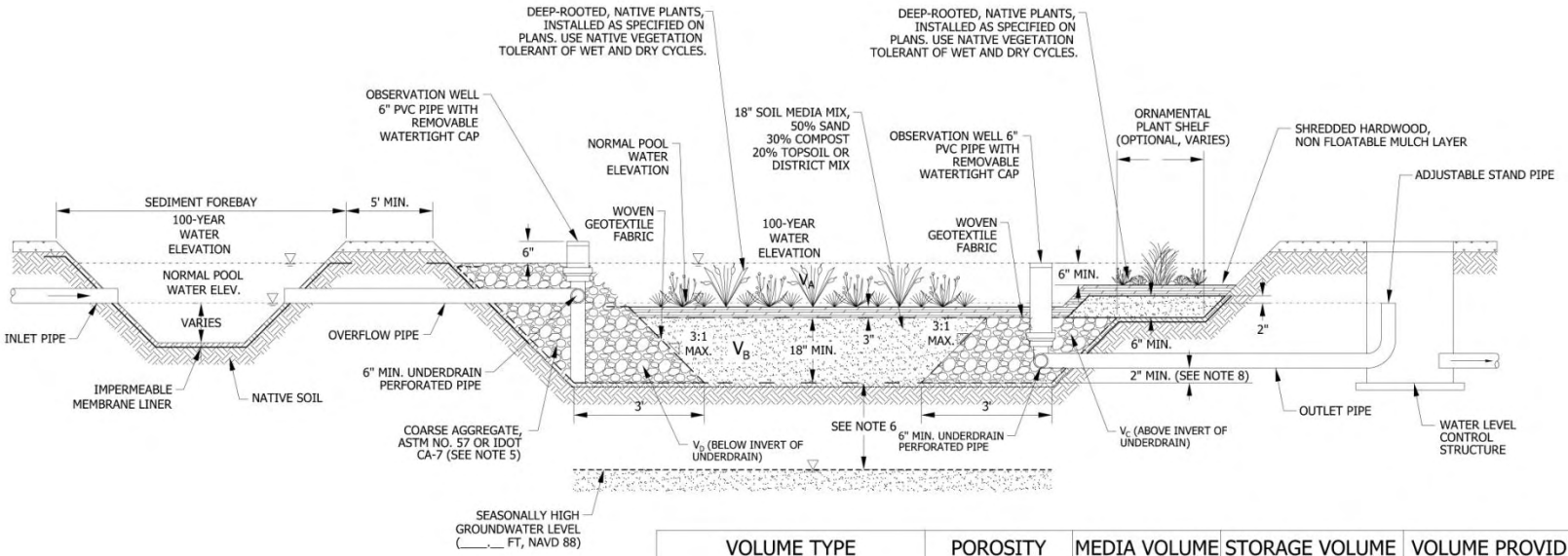
| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | BIOSWALE DETAIL (SHEET 2 OF 2) | STD. DWG. NO.2 |
| | | PAGE NO.3 |

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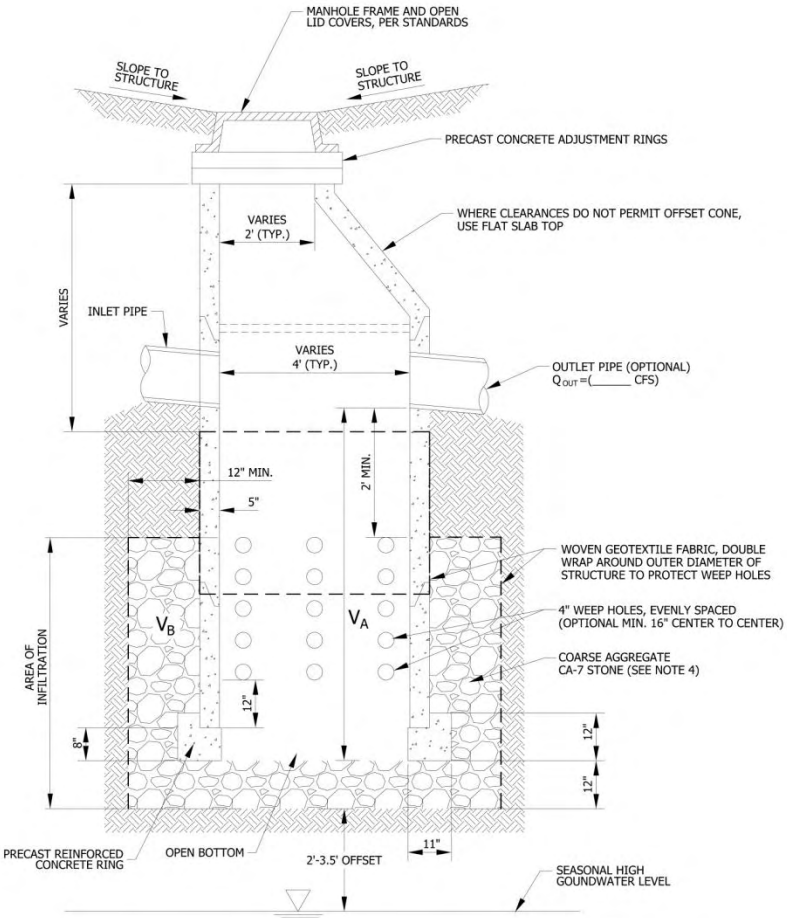
NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. WETLAND LENGTH TO WIDTH RATIO SHOULD RANGE FROM 2 TO 3.
4. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
5. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
6. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
7. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. MAXIMUM OF 1 UNDERDRAIN PER 30 FEET. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS.
8. MINIMUM UNDERDRAIN BEDDING OF TWO INCHES, MAXIMUM OF 12 INCHES.
9. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

NOT TO SCALE

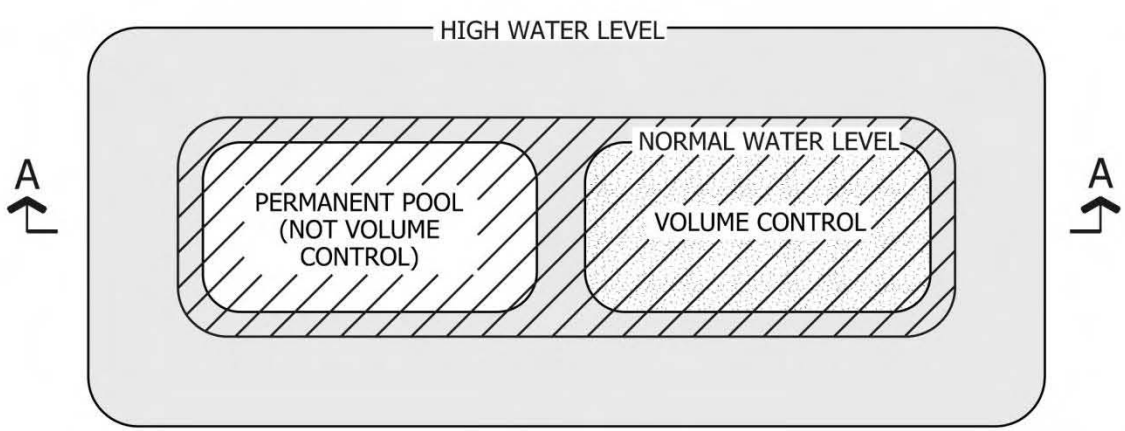



| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| MANHOLE VOL. BELOW SEWER | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| COARSE AGGREGATE | 0.36 | $V_B$ | 0.36 x $V_B$ | |
| | | | TOTAL | |

NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION AREAS OF COMPACTED FILL.
3. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
4. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
5. AGGREGATE BASE OF ONE FOOT (MINIMUM) BELOW PRECAST REINFORCED RING AND SHALL PROVIDE ADEQUATE STRUCTURAL STABILITY PER SOIL CONDITIONS.
6. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
7. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).
8. PROVIDE $Q_{OUT}$ INTO AREA OF INFILTRATION.

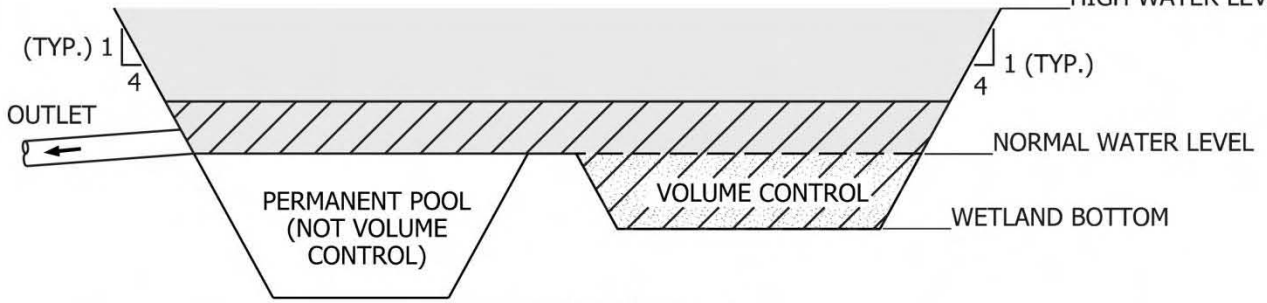
NOT TO SCALE

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | DRYWELL DETAIL | STD. DWG. NO.4 |
| | | PAGE NO.5 |




PLAN VIEW

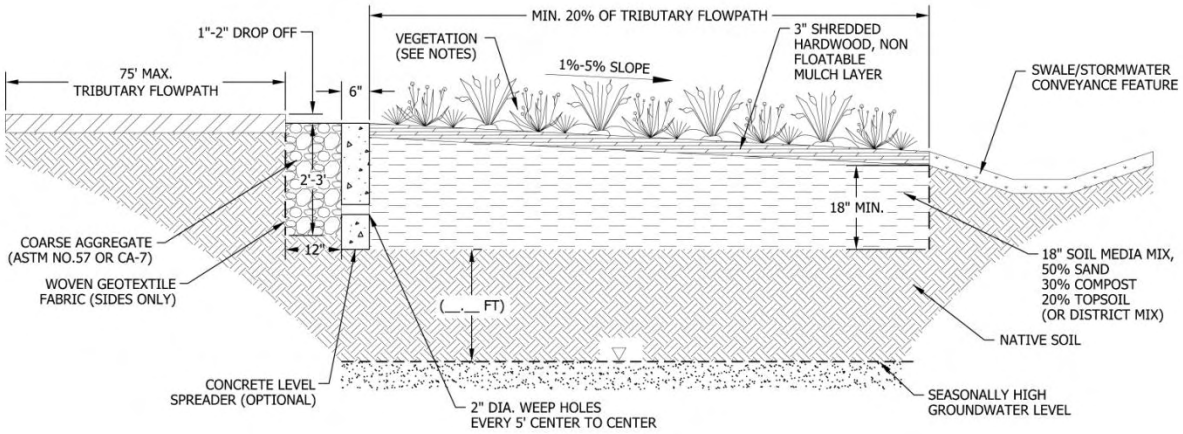
| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| | | | TOTAL | |




SECTION A - A

NOTES:
1) BOTTOM OF VOLUME CONTROL FACILITY SHALL BE AS FLAT AS POSSIBLE. BOTTOM SLOPES SHALL NOT EXCEED 20:1.
2) DEPTH BELOW OUTLET SHALL NOT EXCEED 12 INCHES.
3) DETENTION BASIN SIDE SLOPES SHALL BE 3:1 MINIMUM.
4) FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

NOT TO SCALE



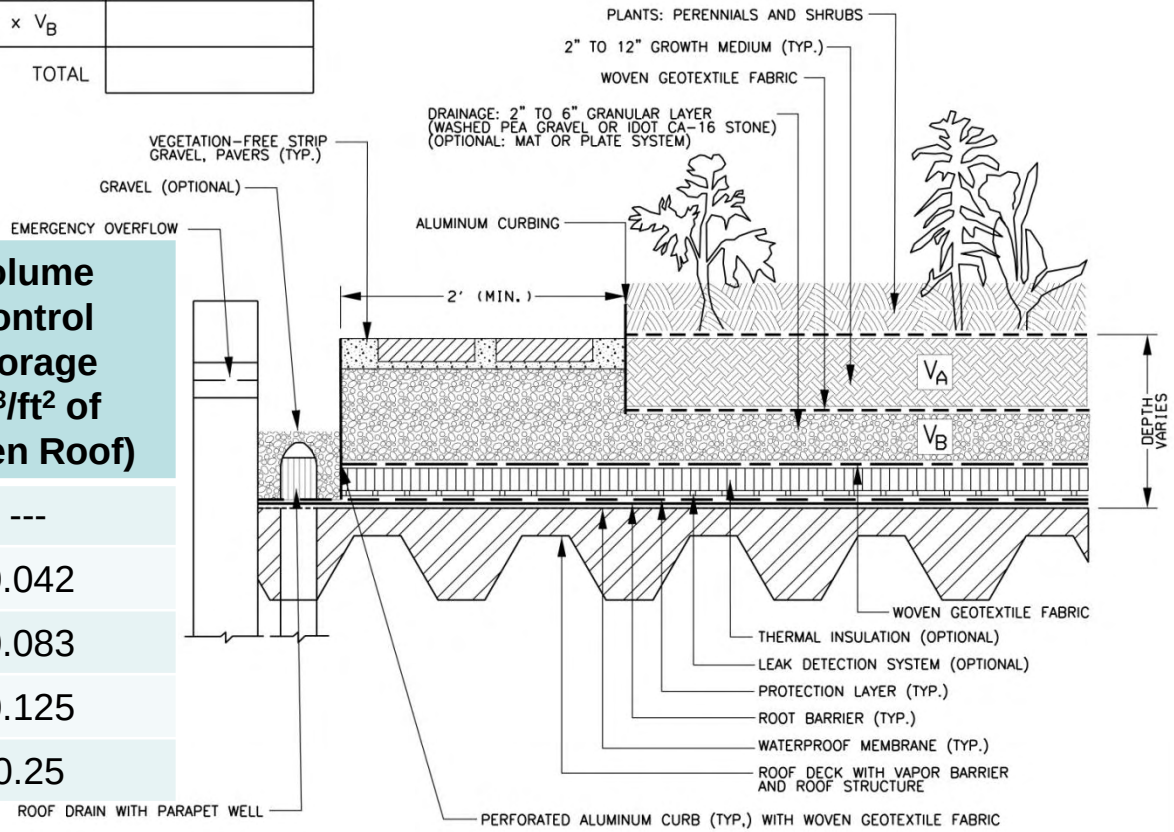

NOTES:
1. MULCH LAYER SHALL BE HARDWOOD MULCH OR OTHER NON-FLOATING GROUND COVER.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. LONGEST FLOW PATH OF CONTRIBUTING DRAINAGE AREA MUST NOT EXCEED 75 FEET.
4. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50.
5. COARSE AGGREGATE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS ARE ALLOWED.
6. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL.

NOT TO SCALE

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | VEGETATED FILTER STRIP (FLOW-THROUGH) DETAIL | STD. DWG. NO.15 |
| | | PAGE NO. 16 |

| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| GROWTH MEDIUM | 0.25 | $V_A$ | 0.25 x $V_A$ | |
| DRAINAGE LAYER | 0.25 | $V_B$ | 0.25 x $V_B$ | |
| | | | TOTAL | |

| Media Depth (inches) | Void Ratio | Reduced CN | Volume Control Storage ($ft^3/ft^2$ of Green Roof) |
|---|---|---|---|
| 0 | N/A | 98 | --- |
| 2 | 0.25 | 94 | 0.042 |
| 4 | 0.25 | 90 | 0.083 |
| 6 | 0.25 | 85 | 0.125 |
| 12 | 0.25 | 72 | 0.25 |




NOTES:
1) WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF SPECIFICATION IUM 592 GEOTEXTILE, TABLE 1, CLASS I, WITH AN APPARENT OPENING SIZE OF 50.
2) PLANTINGS SHALL BE SELECTED ACCORDING TO ASTM E2400-06, *GUIDE FOR SELECTION, INSTALLATION AND MAINTENANCE OF PLANTS FOR GREEN (VEGETATED) ROOF SYSTEMS.*
3) GROWTH MEDIA SHALL CONSIST OF 80% LIGHTWEIGHT INORGANIC MATERIALS AND 20% ORGANIC MATTER.
4) THERE SHALL BE A MINIMUM SETBACK OF 2-FEET FROM ROOF PERIMETER AND ROOF PENETRATIONS.

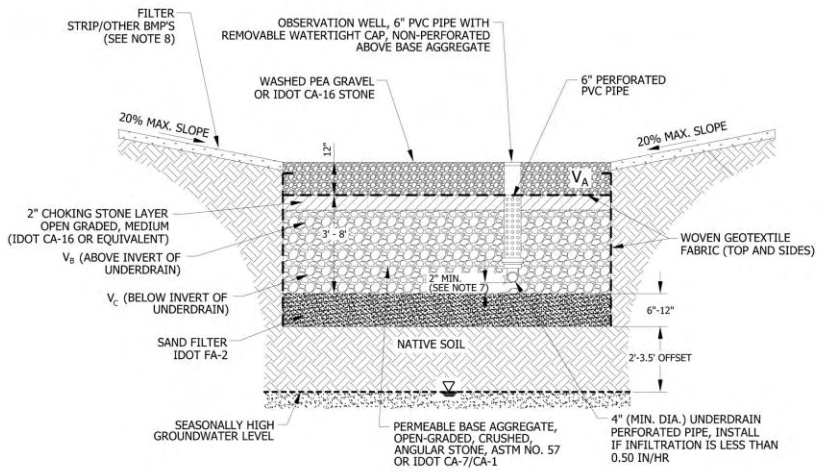
TECHNICAL GUIDANCE MANUAL

7/1/15

GREEN ROOF TYPICAL DETAIL

STD. DWG. NO.5

PAGE NO. 6

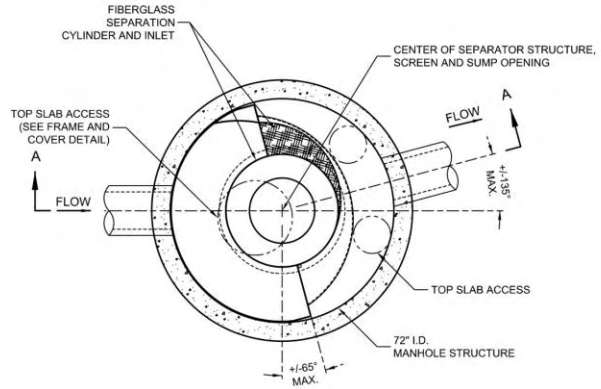



| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| PEA GRAVEL | 0.25 | $V_A$ | 0.5 x 0.25 x $V_A$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_B$ | 0.5 x 0.36 x $V_B$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_C$ | 0.36 x $V_C$ | |
| | | | TOTAL | |

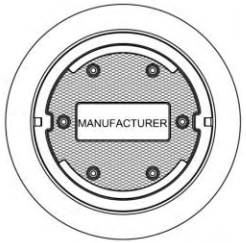
NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
4. STONE STORAGE OPTIONS FOR BASE AGGREGATE ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
5. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
6. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. MAXIMUM OF 1 UNDERDRAIN PER 30 FEET. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS.
7. MINIMUM UNDERDRAIN BEDDING OF TWO INCHES, MAXIMUM OF 12 INCHES.
8. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).

NOT TO SCALE

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | INFILTRATION TRENCH DETAIL | STD. DWG. NO.6 |
| | | PAGE NO. 7 |




**PLAN VIEW B-B**
N.T.S.




**FRAME AND COVER**
(DIAMETER VARIES)
N.T.S.

## SITE SPECIFIC DATA REQUIREMENTS

| | |
|---|---|
| STRUCTURE ID | |
| WATER QUALITY FLOW RATE (CFS) | |
| PEAK FLOW RATE (CFS) | |
| RETURN PERIOD OF PEAK FLOW (YRS) | |
| SCREEN APERTURE (2400 OR 4700) | |

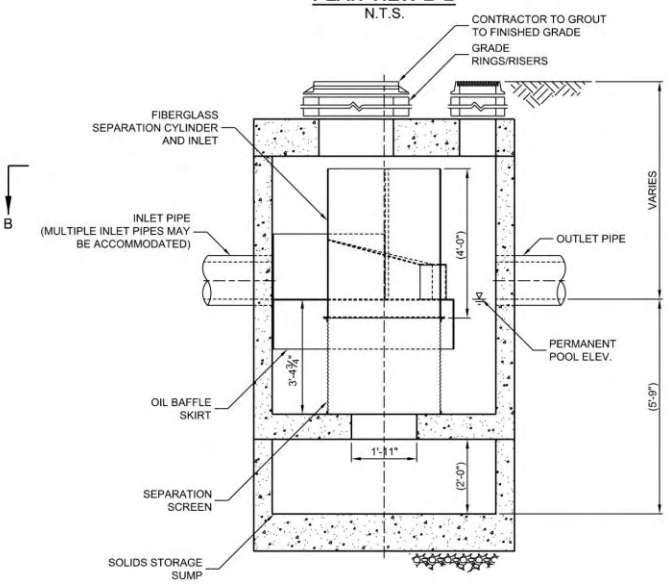
| PIPE DATA: | I.E. | MATERIAL | DIAMETER |
|---|---|---|---|
| INLET PIPE 1 | | | |
| INLET PIPE 2 | | | |
| OUTLET PIPE | | | |

| | |
|---|---|
| RIM ELEVATION | |

| ANTI-FLOTATION BALLAST | WIDTH | HEIGHT |
|---|---|---|
| | | |

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD




**ELEVATION A-A**
N.T.S.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR MANUFACTURER.
4. WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

DESIGN NOTES

1. RATED TREATMENT CAPACITY TO BE DETERMINED BY DESIGN ENGINEER AND WILL VARY BASED ON SITE.
2. RATED TREATMENT CAPACITY IS XX CFS, MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS YY CFS. IF THE SITE CONDITIONS EXCEED YY CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

# Appendix C. Standard Details & Notes (29 MB) (Updated July 2015)

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| 4 | Drywell | 5 |
| 5 | Green Roof | 6 |
| 6 | Infiltration Trench | 7 |
| 7 | Lake Michigan Outfall Water Quality Device | 8 |
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| 27 | Signage for Parking Lot Detention | 28 |
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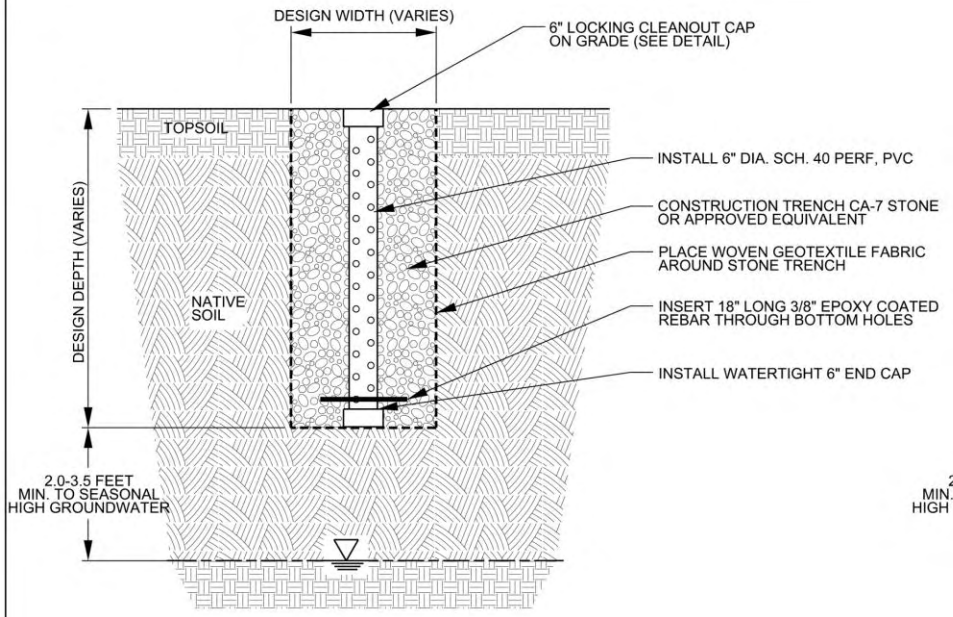
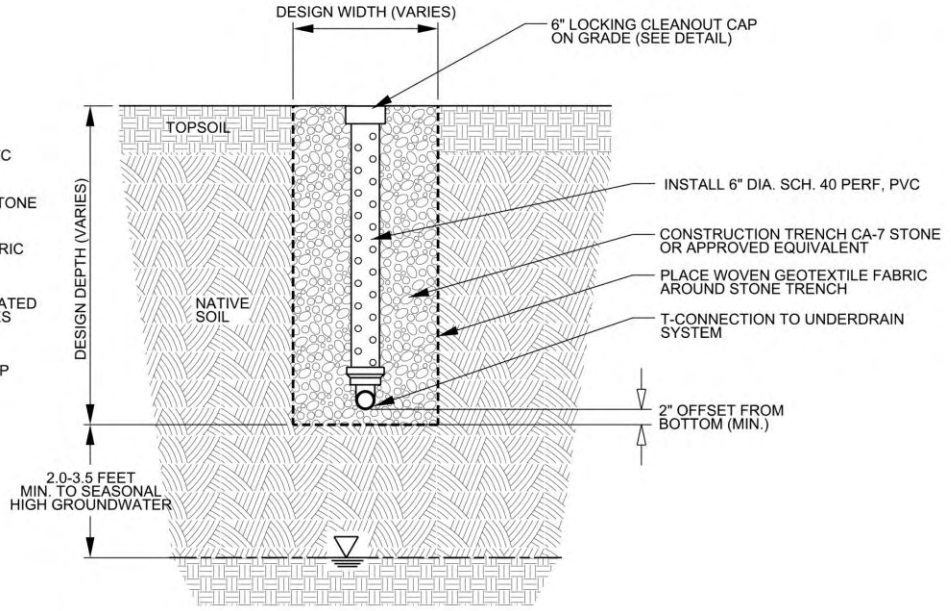
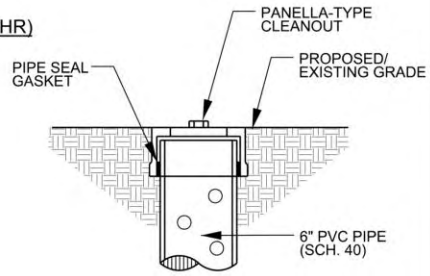



WITHOUT UNDERDRAIN
(SOIL INFILTRATION CAPACITY ≥0.5 IN/HR)




WITH UNDERDRAIN
(SOIL INFILTRATION CAPACITY <0.5 IN/HR)

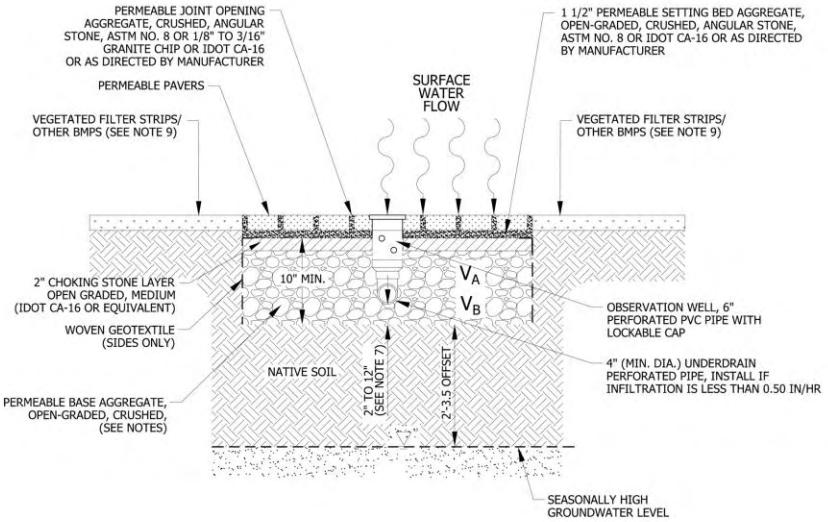
NOTES:
1) ONE OBSERVATION WELL SHALL BE INSTALLED PER 40,000 SQ. FT. OF SURFACE AREA.
2) PERFORATIONS SHALL BE 3/8" CIRCULAR HOLES, 4" ON CENTER, 90° AROUND PIPE.
3) OBSERVATION WELL FOR BIORETENTION FACILITIES SHALL EXTEND 6"-12" ABOVE GRADE AND CONTAIN AN OVERFLOW GRATE INSTEAD OF LOCKING CAP.
4) PIPES/FITTINGS SHALL BE SCHEDULE 40 PVC OR HIGHER QUALITY, 6" DIAMETER MINIMUM.




OBSERVATION WELL
CLEANOUT CAP DETAIL

NOT TO SCALE

| | | |
|---|---|---|
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
| | TYPICAL DETAIL OBSERVATION WELL | STD. DWG. NO.8 |
| | | PAGE NO. 9 |




| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| COARSE AGGREGATE (ABOVE INVERT) | 0.36 | $V_A$ | 0.50 X 0.36 x $V_A$ | |
| COARSE AGGREGATE (BELOW INVERT) | 0.36 | $V_B$ | 0.36 x $V_B$ | |
| | | | TOTAL | |

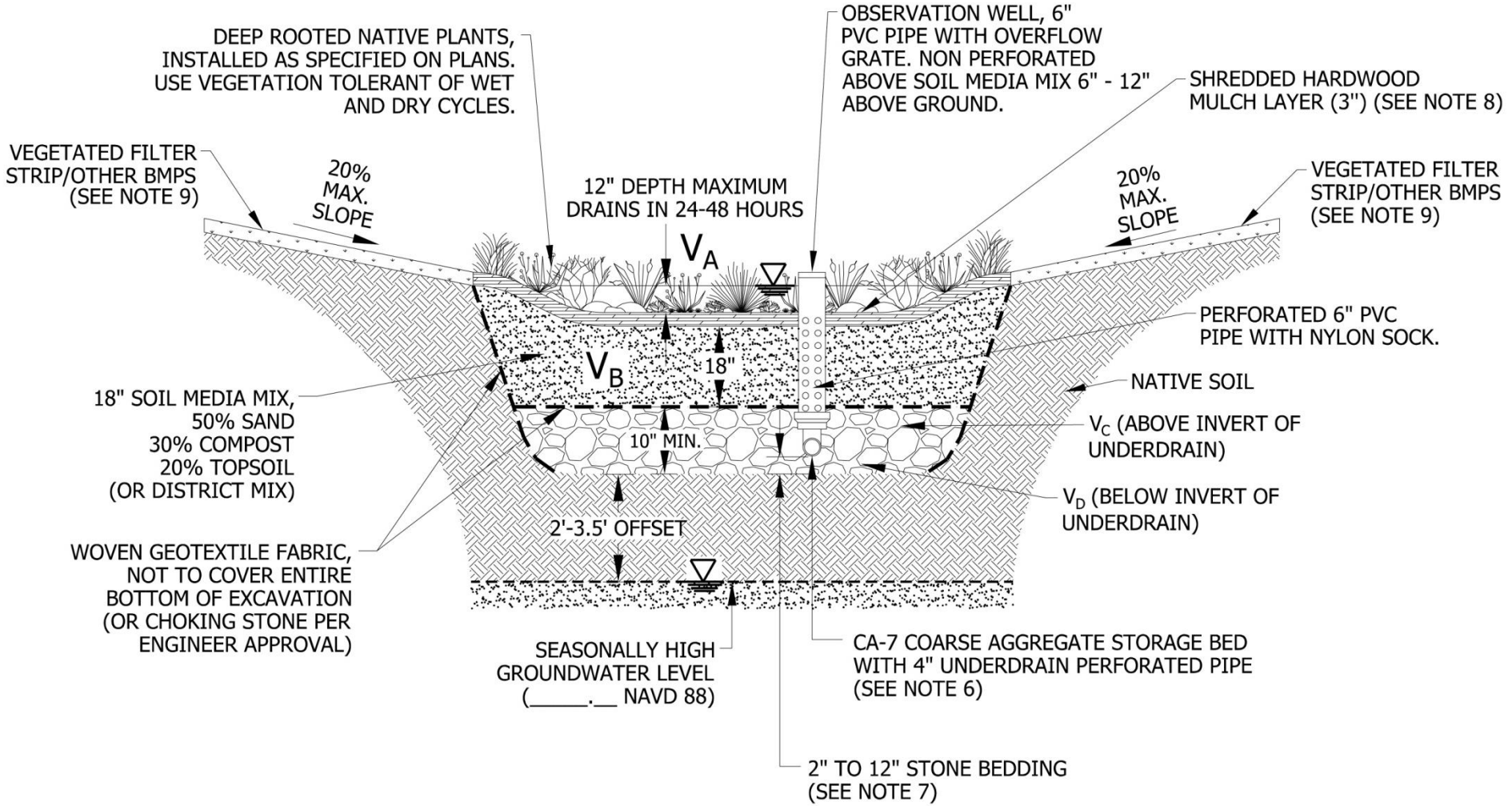
NOTES:
1. OFFSET A MINIMUM OF 10 FEET FROM FOUNDATIONS UNLESS WATERPROOFED, 20 FEET FROM SANITARY SEWERS, 20 FEET FROM ROADWAY GRAVEL SHOULDER AND 100 FEET FROM POTABLE WATER WELLS OR SEPTIC TANKS.
2. AVOID INSTALLATION ON SLOPES GREATER THAN 15 TO 1 AND ABOVE COMPACTED FILL.
3. WOVEN GEOTEXTILE FABRIC SHALL MEET REQUIREMENTS OF IUM MATERIAL SPECIFICATION 592 GEOTEXTILE, TABLE 1, CLASS 1, WITH AN APPARENT OPENING SIZE OF 50 MM.
4. STONE STORAGE OPTIONS ARE CA-7, DISTRICT VULCAN MIX, OR APPROVED ALTERNATE. NO RECYCLED MATERIALS.
5. MINIMUM DISTANCE OF 2 FEET (3.5 FEET IN COMBINED SEWER AREAS) BETWEEN BOTTOM OF BMP AND SEASONALLY HIGH GROUNDWATER LEVEL.
6. UNDERDRAINS ARE REQUIRED IN TYPICAL CLAYEY SOILS WHERE INFILTRATION RATES ARE LESS THAN 0.5 INCH/HOUR. MAXIMUM OF 1 UNDERDRAIN PER 30 FEET. PROVIDE A SOIL REPORT DOCUMENTING NATIVE INFILTRATION RATE TO FOREGO UNDERDRAINS.
7. MINIMUM UNDERDRAIN BEDDING OF TWO INCHES, MAXIMUM OF 12 INCHES.
8. ONE OBSERVATION WELL REQUIRED PER 40,000 SQUARE FEET OF SURFACE AREA.
9. FOLLOW THE REQUIRED PRETREATMENT MEASURES LISTED ON THE VOLUME CONTROL PRETREATMENT MEASURES DETAIL (PAGE 17).
10. MAINTENANCE REQUIREMENTS INCLUDE ANNUAL VACUUMING AND LOW-PRESSURE POWER WASHING OF PAVEMENT SURFACE. ADJACENT VEGETATED AREAS SHALL BE WELL-MAINTAINED. BARE SPOTS AND ERODED AREAS SHALL BE REPLANTED AND STABILIZED IMMEDIATELY. DO NOT SEALCOAT.
11. APPROPRIATE SIGNAGE REQUIRED FOR FACILITY, REFER TO THE SIGNAGE FOR PERMEABLE PAVEMENT DETAIL (PAGE 17).

NOT TO SCALE

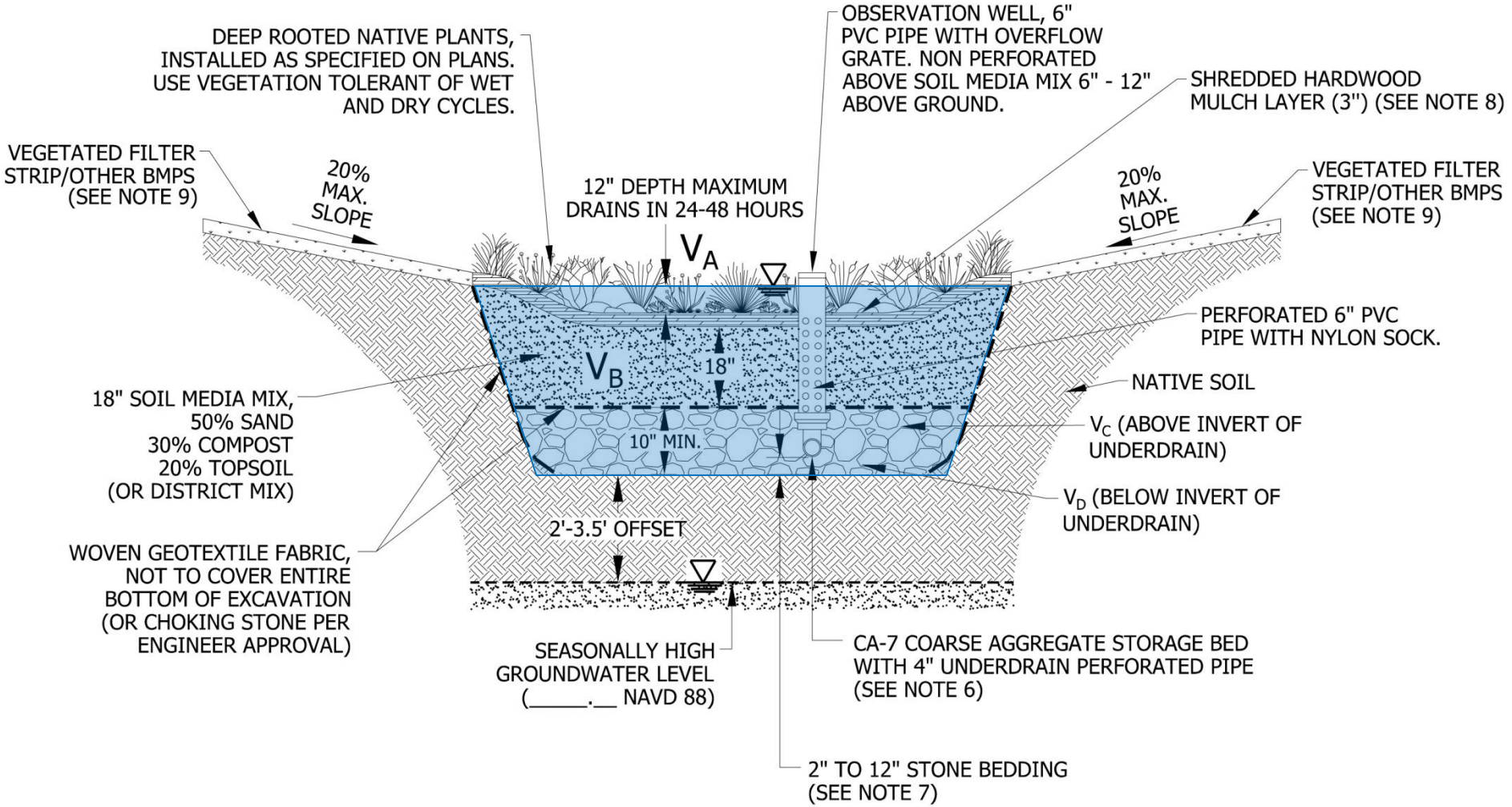
| | TECHNICAL GUIDANCE MANUAL | 7/1/15 |
|---|---|---|
| | PERMEABLE PAVERS DETAIL | STD. DWG. NO.9 |
| | | PAGE NO. 18 |

# Green Infrastructure Details

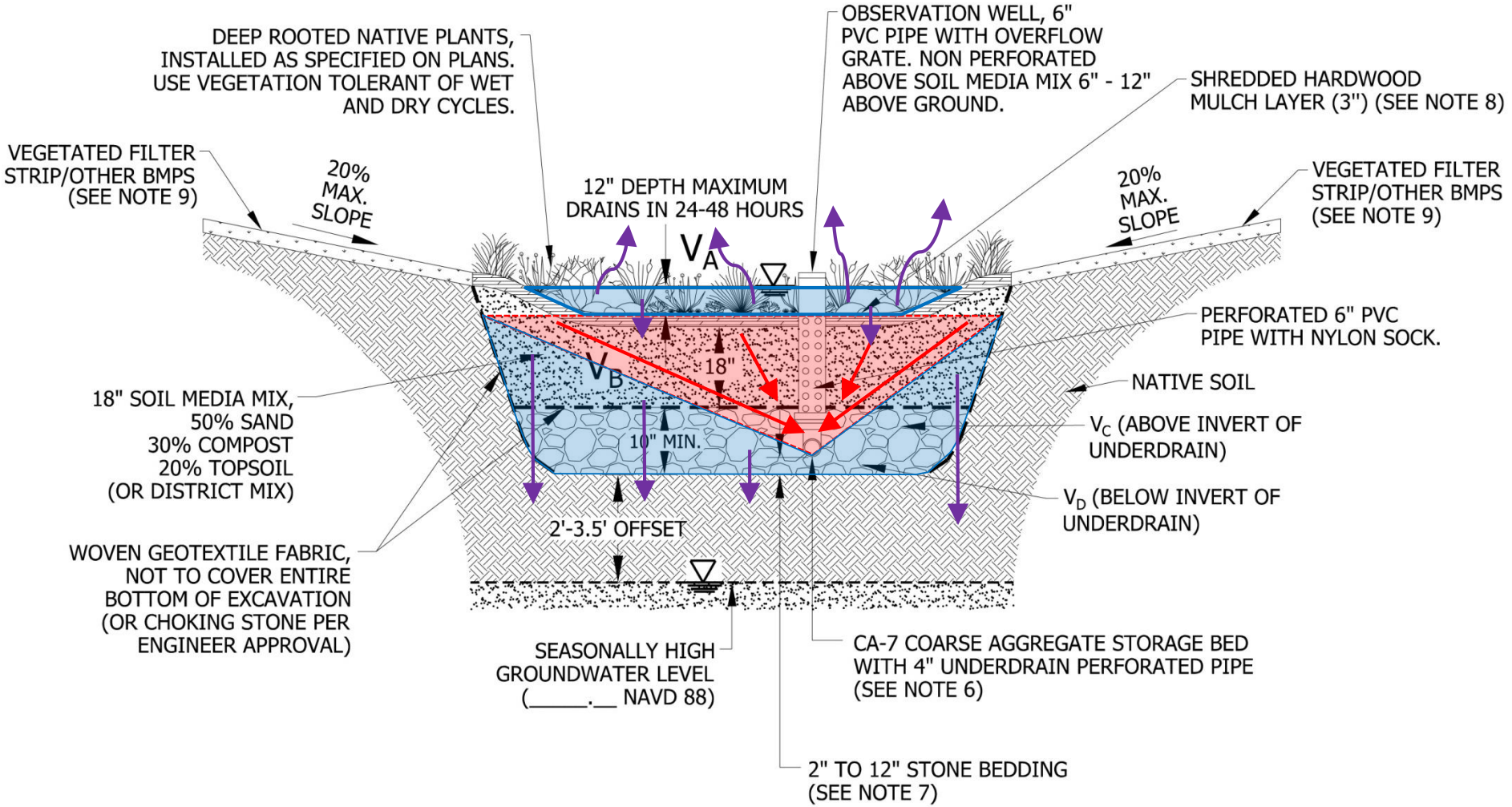
- Bioretention
- Bioswale 1 and 2
- Constructed Wetlands
- Drywell
- Observation Well
- Permeable Pavers
- Rain Cistern/Water Reuse
- Vegetated Filter Strip (Flow-Through)
- Green Roof



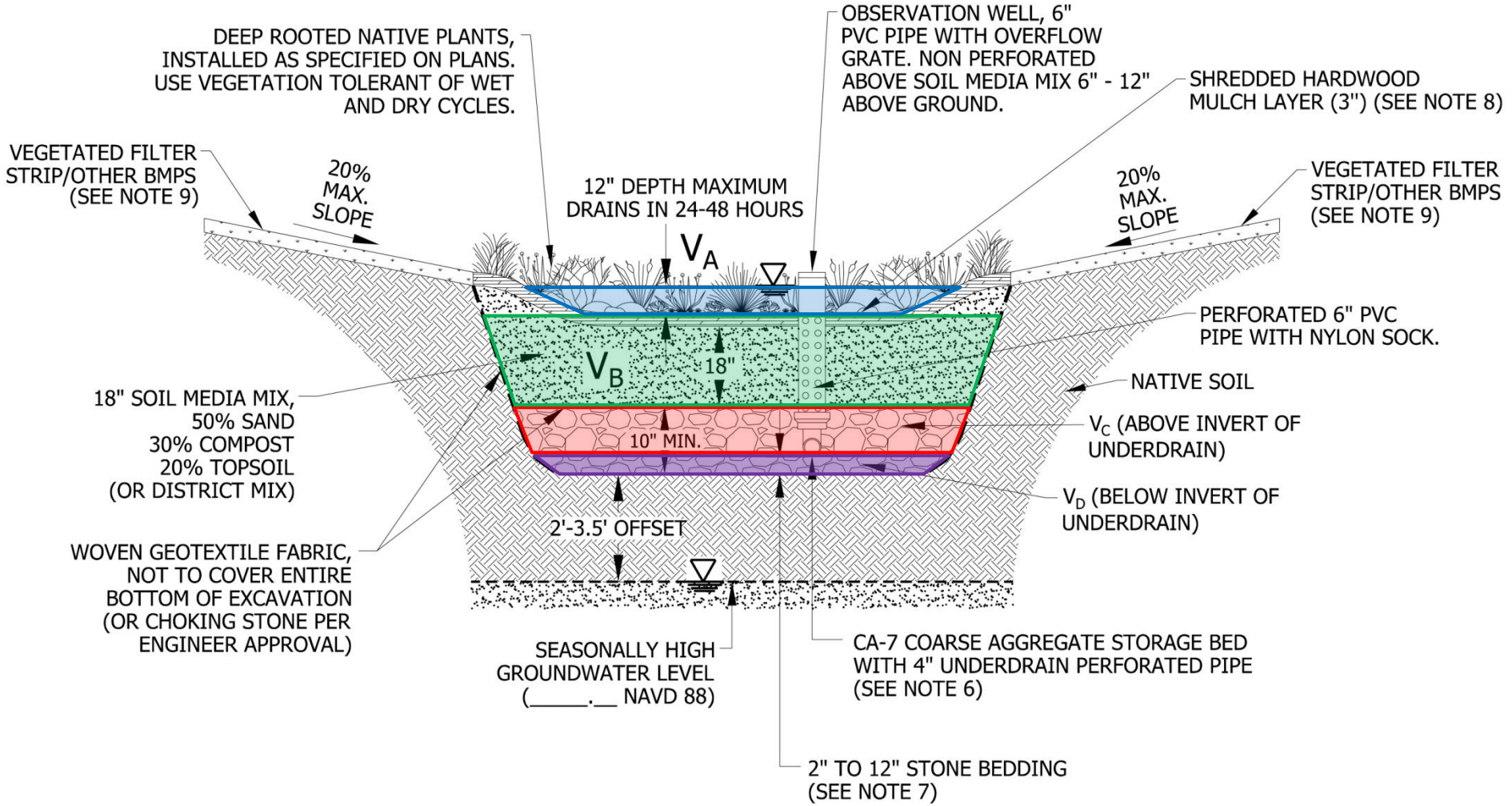

| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |




| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

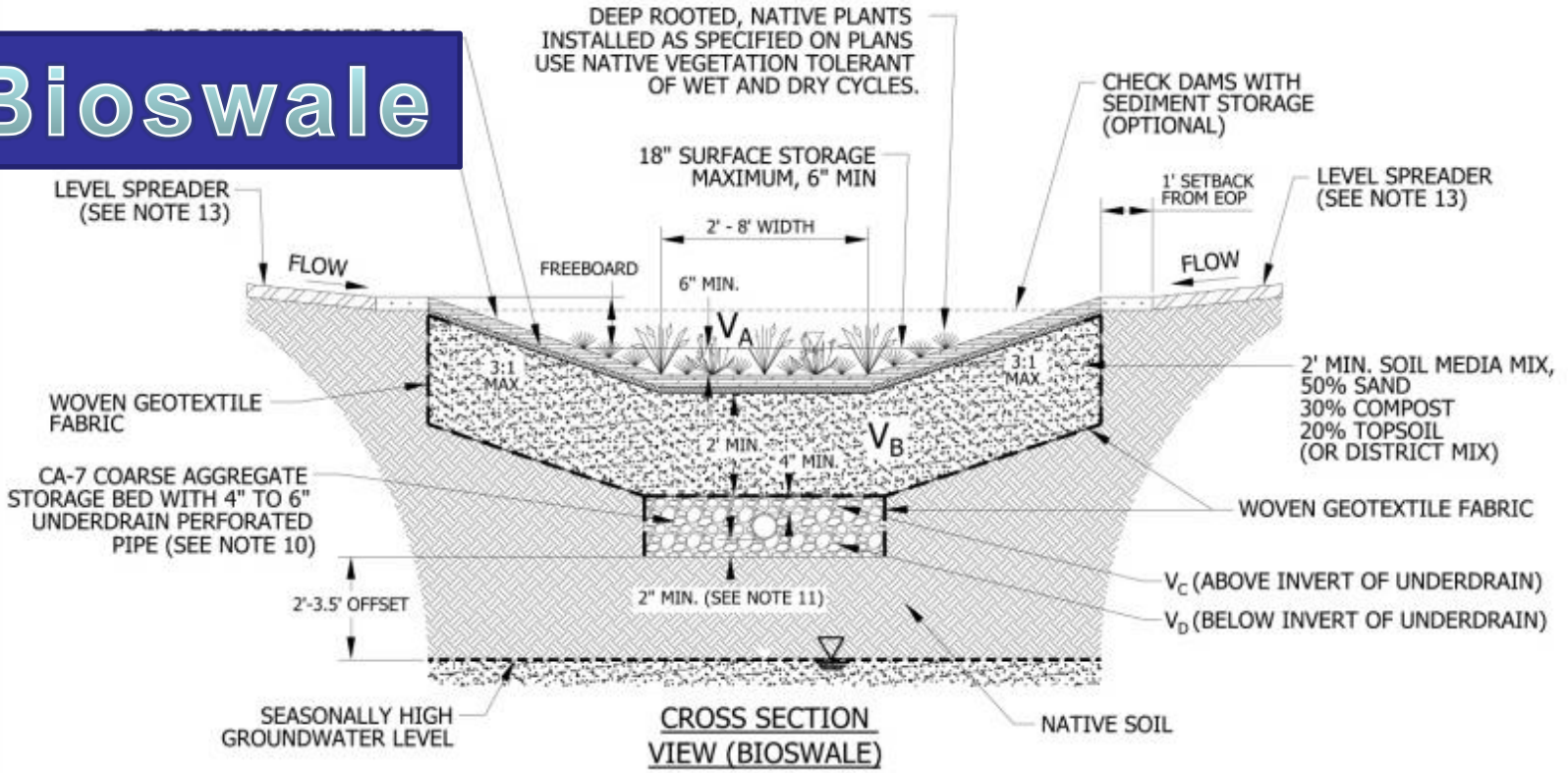



| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

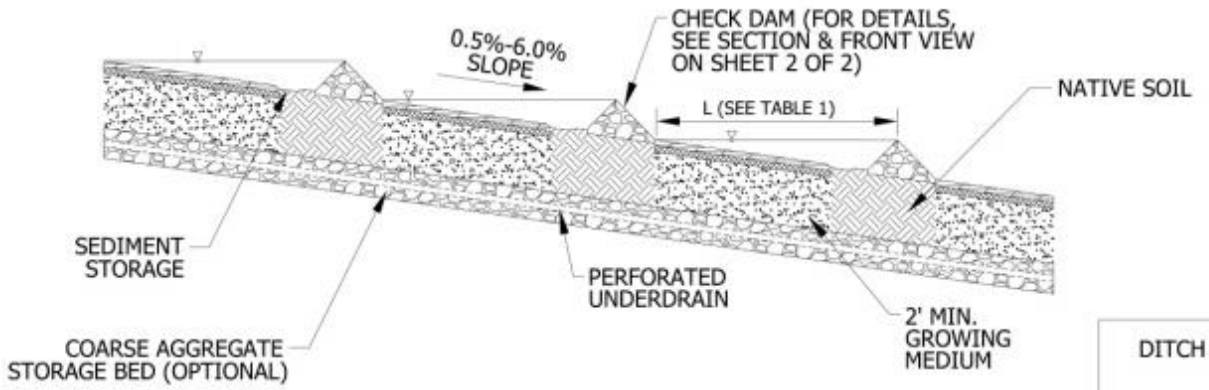



| VOLUME TYPE | POROSITY | MEDIA VOLUME | STORAGE VOLUME | VOLUME PROVIDED |
|---|---|---|---|---|
| SURFACE STORAGE | 1.00 | $V_A$ | 1.00 x $V_A$ | |
| SOIL MEDIA MIX | 0.25 | $V_B$ | 0.5 x 0.25 x $V_B$ | |
| COARSE AGG. (ABOVE INVERT) | 0.36 | $V_C$ | 0.5 x 0.36 x $V_C$ | |
| COARSE AGG. (BELOW INVERT) | 0.36 | $V_D$ | 0.36 x $V_D$ | |
| | | | TOTAL | |

# Bioswale




CROSS SECTION VIEW (BIOSWALE)




PROFILE VIEW

Table 1

| DITCH SLOPE (%) | SPACING L (feet) |
|---|---|
| 1 | 200 |
| 2 | 100 |
| 4 | 50 |
| 6 | 33 |

SLOPES ABOVE 6% ARE NOT RECOMMENDED