

AHEAD OF THE STORM

Site: Horsford Gardens & Nursery

Location: Greenbush Road, Charlotte, Vermont



Primary Problem

Surface water runoff from the Horsford Gardens & Nursery contributes to either Holmes Creek or Pringle Brook. Runoff generated from the growing areas, rooftops, driveways and parking areas is collected in a series of swales. Although portions of the site drain to irrigation ponds used to water plants and trees grown at the nursery, much of the runoff collected in the swales drains off-site. *(See existing conditions site summary and plan.)*

Two Optimal Conservation Practices (OCPs) are recommended to treat runoff from a portion of the existing impervious cover and growing areas of the nursery. The primary goals are to improve water quality protection and flood resiliency by retaining runoff on-site. This project will begin to reverse the cumulative impacts from incremental development within the Holmes Creek watershed where past water quality sampling found high turbidity, nitrogen, and phosphorus levels in the stream.

Final Treatment Recommendations

1. Create a bio-retention area downstream of existing impervious surfaces and growing areas to slow runoff and retain water on-site. A riser structure will serve as the outlet directing normal overflow to an existing irrigation pond to increase retention time and storage, as well as recycle runoff for irrigation.
2. Create a bio-infiltration swale with tree check dam to pre-treat stormwater prior to entering the bio-retention area, slow runoff, improve vegetation, and increase available storage.

Site Constraints and Design Basis

Given that the site has historically been used as a nursery, much of the soil on site has been cultivated extensively, and therefore soils can be compacted with lowered infiltration making underground treatment practices less effective. The proposed design maximizes treatment while largely maintaining current land use, site features, and maintenance needs. The design makes use of an unused portion of the nursery where approximately 5.3 acres of the site drains through an existing swale. The area selected for bio-retention is along the main driveway and will be highly visible to customers to demonstrate its function as an educational tool. Runoff calculations indicate that the bio-retention area proposed will treat approximately 37% of the 1-inch rain storm (i.e., the Water Quality Volume – WQv), and 24% of the 2.1-inch rain storm (i.e., the Channel Protection Volume – CPv) (Table 1) on its own. However, the freeboard storage provided at the downstream irrigation pond will provide adequate volume to retain the combined WQv and CPv. The design minimizes long-term maintenance procedures and costs. *(See attached concept design plans, including operation and maintenance notes.)*

Table 1: Summary of Hydrology Calculations

WS ID	Description	Total Drainage Area (Acres)	Drainage Area on the Site (Acres)	Impervious Area on the Site (%)	WQv Generated on the Site (Cubic Feet)	CPv Generated on the Site (Cubic Feet)	10-yr Volume (Cubic Feet)	Treatment Volume (Cubic Feet)	Treatment Volume (%)
1	to bio-retention area	5.33	5.00	19.0	4,011	6,316	17,555	1,500	37% of WQv
2	to irrigation pond	3.62	3.40	29.0	3,838	4,312	11,892	33,750	100% of WQv

Cost

Final engineering design and construction for the OCP's is estimated to cost \$43,000 assuming that labor and materials are purchased at the market rate through a competitive bid process. Cost savings for this project may be achieved through donations or sole-source contracting if purchase requirements allow.

Ahead of the Storm

Existing Conditions Site Summary

Horsford Gardens & Nursery

Site Description

Horsford Gardens and Nursery maintains many fields, paths, driveways, parking lots and buildings as part of their nursery business (Figure 1). Stormwater runoff from a portion of the site is directed to existing onsite ponds used for irrigation, but a portion through the center of the property is collected in swales and drains to a tributary to the south, leaving the site. This project will reduce the amount of runoff leaving the site by implementing treatment measures and redirecting drainage towards an existing pond to increase onsite irrigation uses.

Drainage Patterns

The nursery uses a significant amount of water for irrigation and to store water onsite they have created a series of three storage ponds on the site. The ponds have pumps used to transfer water between them and optimize retention of water for irrigation. Despite capturing stormwater runoff and excess irrigation water from the majority of the site, the nursery does periodically run out of water during warm, dry periods. During these periods water is imported to the site by truck.

The central portion of the site does not drain to one of the existing ponds. In this area, runoff generally flows from an existing ridgeline located in the eastern portion of the property to the west towards the wholesale loading area, employee building and workshop, and upper nursery fields. This 5.3 acre area drains through a series of grass swales and undersized culverts under several nursery access drives towards the south into the headwater reach of Pringle Brook. The small culverts at the drive crossings are providing in-line detention in the swales during small rain events, however reportedly overtop often. Accumulated sediment is removed from the existing drainage swales on a regular basis.

A small raingarden was installed a few years ago to capture runoff from the loading area, just outside the employee building entrance. This raingarden is undersized and requires significant maintenance. The raingarden receives heavy sediment load from the gravel parking lot and washoff from trucks in the loading area. The raingarden is reportedly cleaned out once a year, with the small ditch leading to it being cleaned out 3 times a year. This raingarden does not have a forebay.

Site Constraints

The nursery uses land very efficiently, with only small areas not currently being used as part of their operation.

The slope of the project site is very shallow, so transfer of water from the lower drainage swale across the nursery into one of the existing ponds may be difficult.

Soils are potentially highly erodible across the site. Although a portion of the drainage area has soils classified as Hydrologic Soil Group (HSG) C, the site drains to an area of HSG B, so some infiltration can be achieved at the site.

Tile drainage is located under some of the fields and in a portion of the swale system.

As a commercial business with many customers visiting the site, aesthetics are important. This can be an asset if customers are interested in the treatment system and choose to implement something similar at their property.

Possible Treatment Options Identified

1. Create forebay for existing raingarden to capture sediment from loading area and grade loading area driveway to slope away from barn entrance.
2. Create bio-retention area to capture runoff from the central portion of site now draining south to Pringle Brook. Redirect overflow from this bio-retention area to the middle irrigation pond near the perennials.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Horsford Gardens & Nursery



Figure 1: Runoff travels from the east side of the property near the Route 7 entrance across the site to the west.



Figure 3: The loading area has high traffic from machinery and the surface is often muddy.



Figure 2: Runoff travels down the Route 7 entrance driveway and meets a swale that carries it to the southwest.



Figure 4: A swale system with small culverts carries water around the site, but requires frequent maintenance.

Ahead of the Storm
Existing Conditions Photo Documentation Summary
Horsford Gardens & Nursery



Figure 5: A small raingarden was installed to catch sediment leaving the loading area.



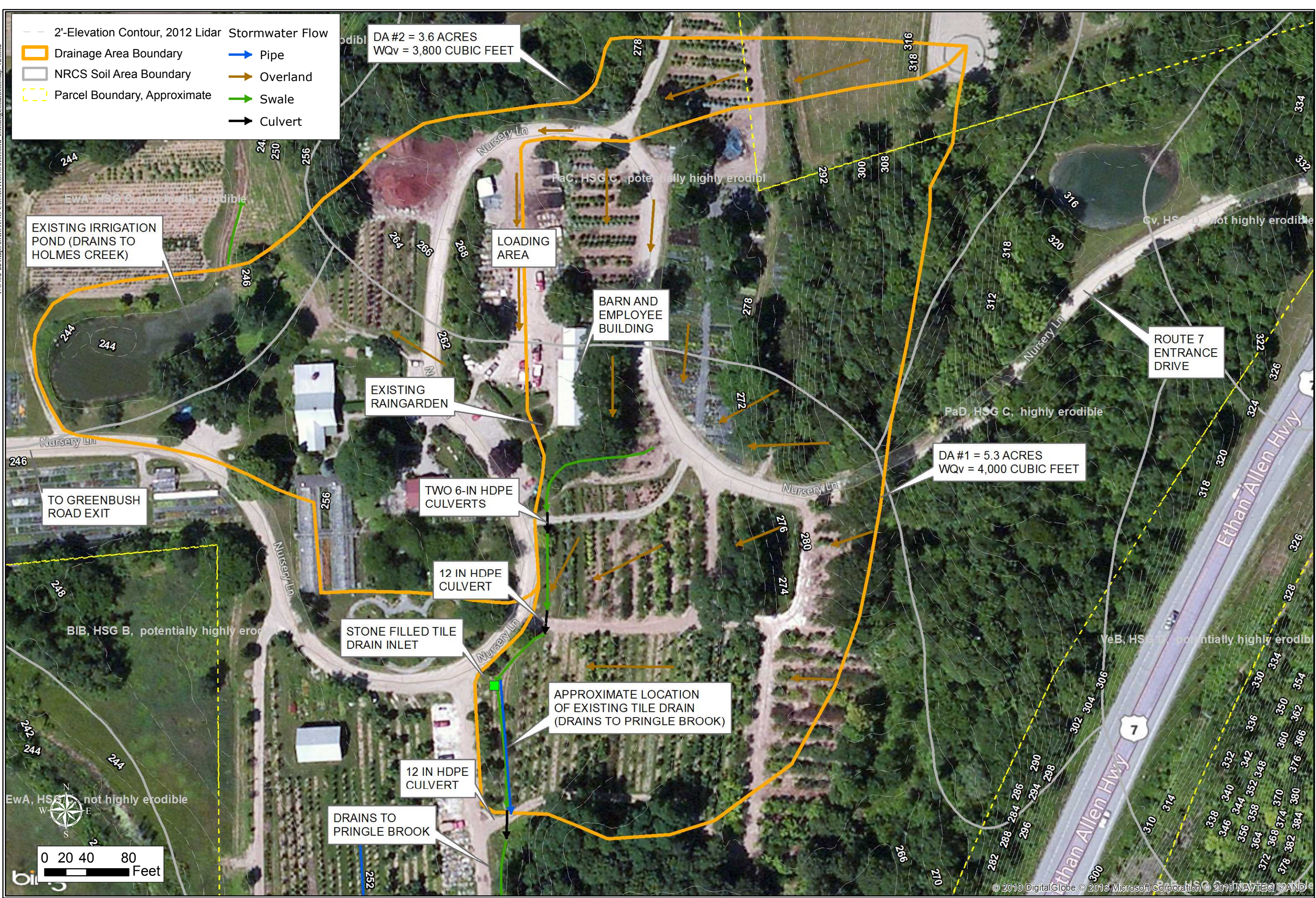
Figure 7: A possible bio-retention area has been identified along the swale system near the employee parking.



Figure 6: A swale carries water from the entrance area and many of the planted nursery fields to the south off of the site.



Figure 8: Water collected in the bio-retention area could overflow to an existing pond used to supply irrigation to the site.



Y:\3452-22\Maps\EXISTING CONDITIONS\Horsford ExistingConditionsMap_v2.mxd

- 2'-Elevation Contour, 2012 Lidar
- Orange outline: Drainage Area Boundary
- Grey outline: NRCS Soil Area Boundary
- Yellow dashed outline: Parcel Boundary, Approximate
- Blue arrow: Pipe
- Orange arrow: Overland
- Green arrow: Swale
- Black arrow: Culvert

DA #2 = 3.6 ACRES
WQv = 3,800 CUBIC FEET

DA #1 = 5.3 ACRES
WQv = 4,000 CUBIC FEET

EXISTING IRRIGATION POND (DRAINS TO HOLMES CREEK)

LOADING AREA

BARN AND EMPLOYEE BUILDING

EXISTING RAINGARDEN

ROUTE 7 ENTRANCE DRIVE

TO GREENBUSH ROAD EXIT

TWO 6-IN HDPE CULVERTS

12 IN HDPE CULVERT

STONE FILLED TILE DRAIN INLET

APPROXIMATE LOCATION OF EXISTING TILE DRAIN (DRAINS TO PRINGLE BROOK)

12 IN HDPE CULVERT


DRAINS TO PRINGLE BROOK

0 20 40 80 Feet


<p>EXISTING CONDITIONS</p> <p>AHEAD OF THE STORM</p> <p>HORSFORD GARDENS & NURSERY</p> <p>2111 GREENBUSH ROAD CHARLOTTE, VERMONT</p>	<p>CONCEPT DESIGN</p>	<p>SOURCE(S):</p> <p>2012 LIDAR 2 FT CONTOURS, VCGI BING AERIAL NRCS SOIL MAPPING MMI FIELD DATA</p>
<p>Map By: JCL MMI#: 3452-22 MXD: 1st Version: 7/15/2016 Revision: 7/29/2016 Scale: 1"=80'</p>		<p>01</p>


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Subwatershed Boundary
 Subwatershed Boundary


Drainage Area

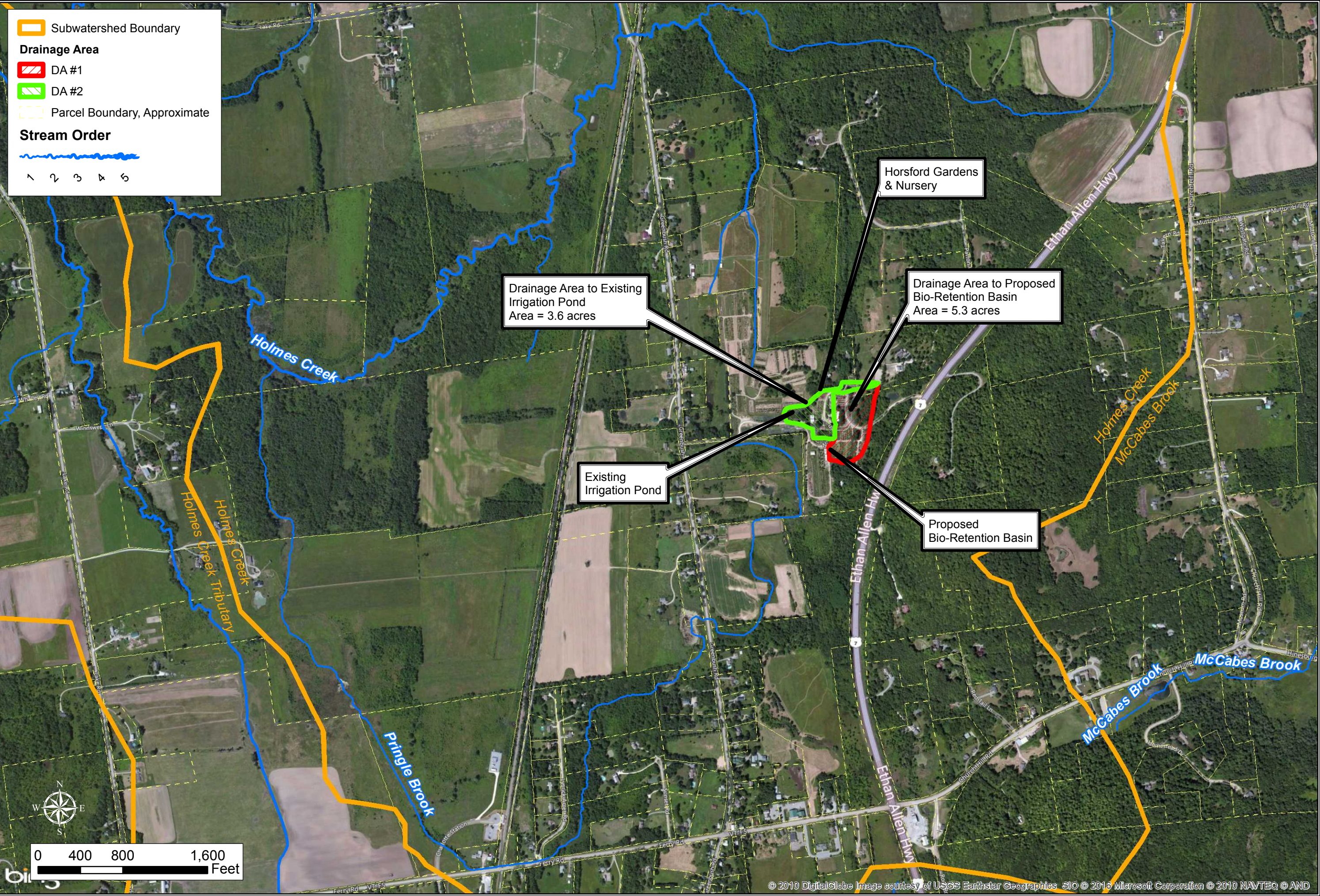
 DA #1

 DA #2

 Parcel Boundary, Approximate

Stream Order

 1 2 3 4 5



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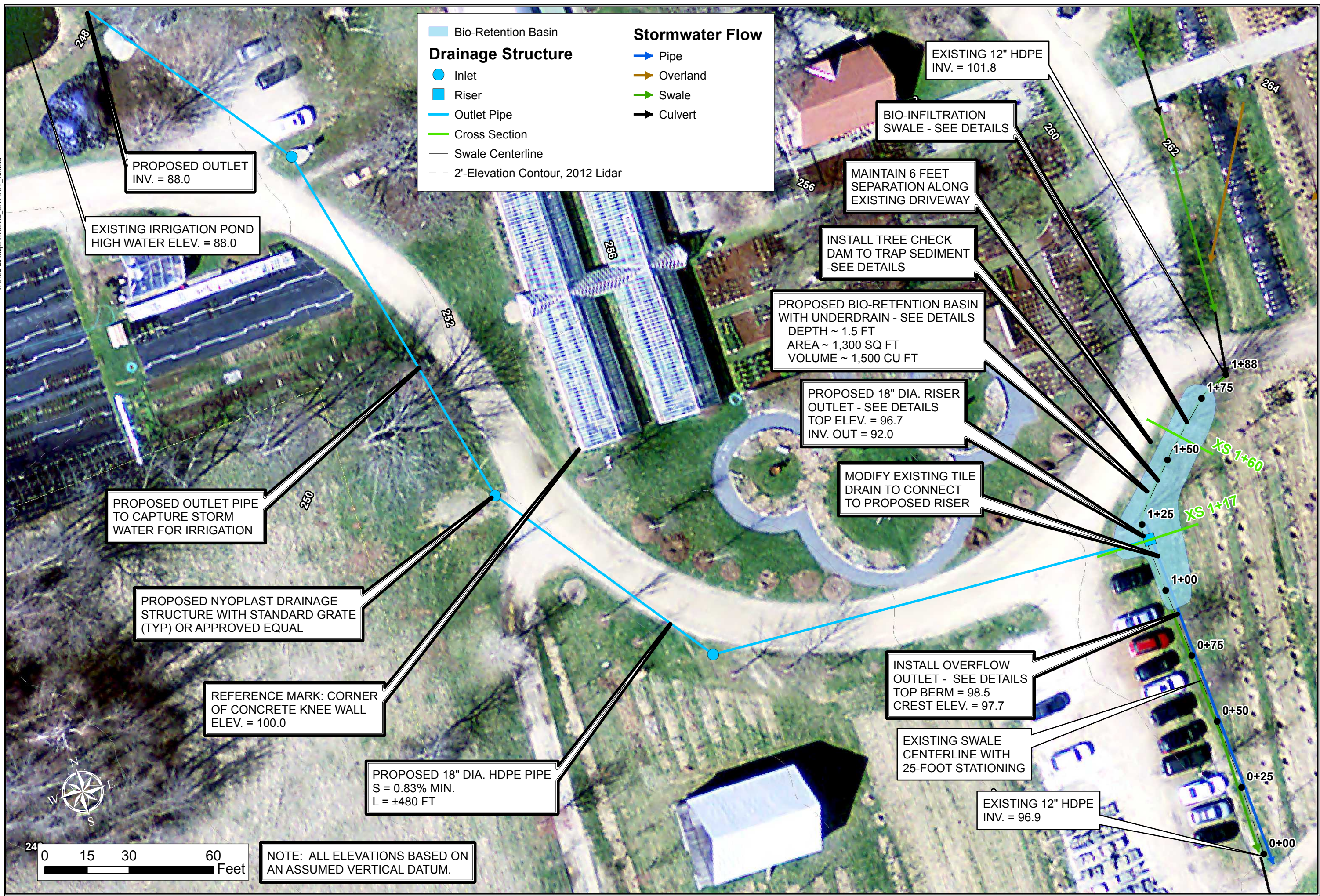
SOURCE(S):
 2012 LIDAR 2 FT CONTOURS, VCGI
 BING AERIAL
 NRCS SOIL MAPPING
 MMI FIELD DATA

CONCEPT DESIGN

PROJECT SITE OVERVIEW MAP
AHEAD OF THE STORM
HORSFORD GARDENS & NURSERY
 2111 GREENBUSH ROAD
 CHARLOTTE, VERMONT

Map By: JCL
 MMI#: 3452-22
 MXD:
 1st Version: 7/15/2016
 Revision: 7/29/2016
 Scale: 1"=800'

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Drainage Structure

- Bio-Retention Basin
- Inlet
- Riser
- Outlet Pipe
- Cross Section
- Swale Centerline
- - 2'-Elevation Contour, 2012 Lidar

Stormwater Flow

- Pipe
- Overland
- Swale
- Culvert

PROPOSED OUTLET INV. = 88.0

EXISTING IRRIGATION POND HIGH WATER ELEV. = 88.0

PROPOSED OUTLET PIPE TO CAPTURE STORM WATER FOR IRRIGATION

PROPOSED NYOPLAST DRAINAGE STRUCTURE WITH STANDARD GRATE (TYP) OR APPROVED EQUAL

REFERENCE MARK: CORNER OF CONCRETE KNEE WALL ELEV. = 100.0

PROPOSED 18" DIA. HDPE PIPE S = 0.83% MIN. L = ±480 FT

EXISTING 12" HDPE INV. = 101.8

BIO-INFILTRATION SWALE - SEE DETAILS

MAINTAIN 6 FEET SEPARATION ALONG EXISTING DRIVEWAY

INSTALL TREE CHECK DAM TO TRAP SEDIMENT -SEE DETAILS

PROPOSED BIO-RETENTION BASIN WITH UNDERDRAIN - SEE DETAILS DEPTH ~ 1.5 FT AREA ~ 1,300 SQ FT VOLUME ~ 1,500 CU FT

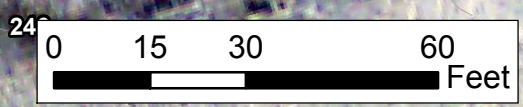
PROPOSED 18" DIA. RISER OUTLET - SEE DETAILS TOP ELEV. = 96.7 INV. OUT = 92.0

MODIFY EXISTING TILE DRAIN TO CONNECT TO PROPOSED RISER

INSTALL OVERFLOW OUTLET - SEE DETAILS TOP BERM = 98.5 CREST ELEV. = 97.7

EXISTING SWALE CENTERLINE WITH 25-FOOT STATIONING

EXISTING 12" HDPE INV. = 96.9



NOTE: ALL ELEVATIONS BASED ON AN ASSUMED VERTICAL DATUM.

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SOURCE(S):
 2012 LIDAR 2 FT CONTOURS, VCGI
 BING AERIAL
 NRCS SOIL MAPPING
 MMI FIELD DATA

LAYOUT
AHEAD OF THE STORM
HORSFORD GARDENS & NURSERY
 2111 GREENBUSH ROAD
 CHARLOTTE, VERMONT

CONCEPT DESIGN

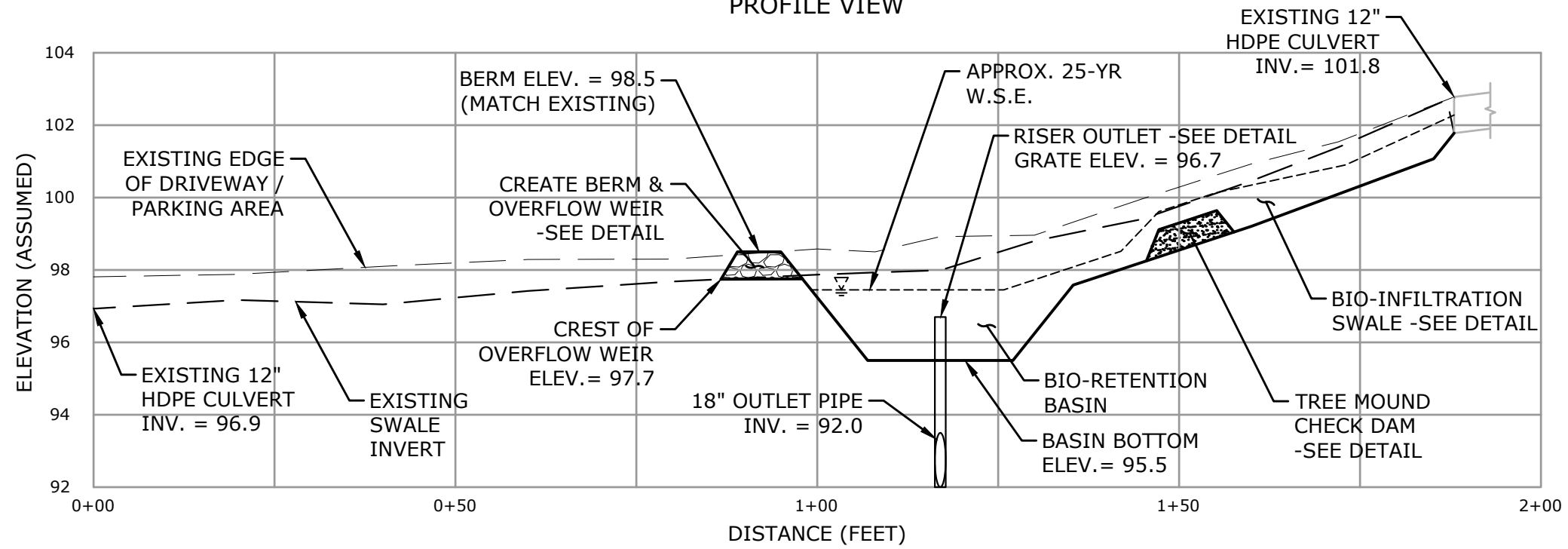
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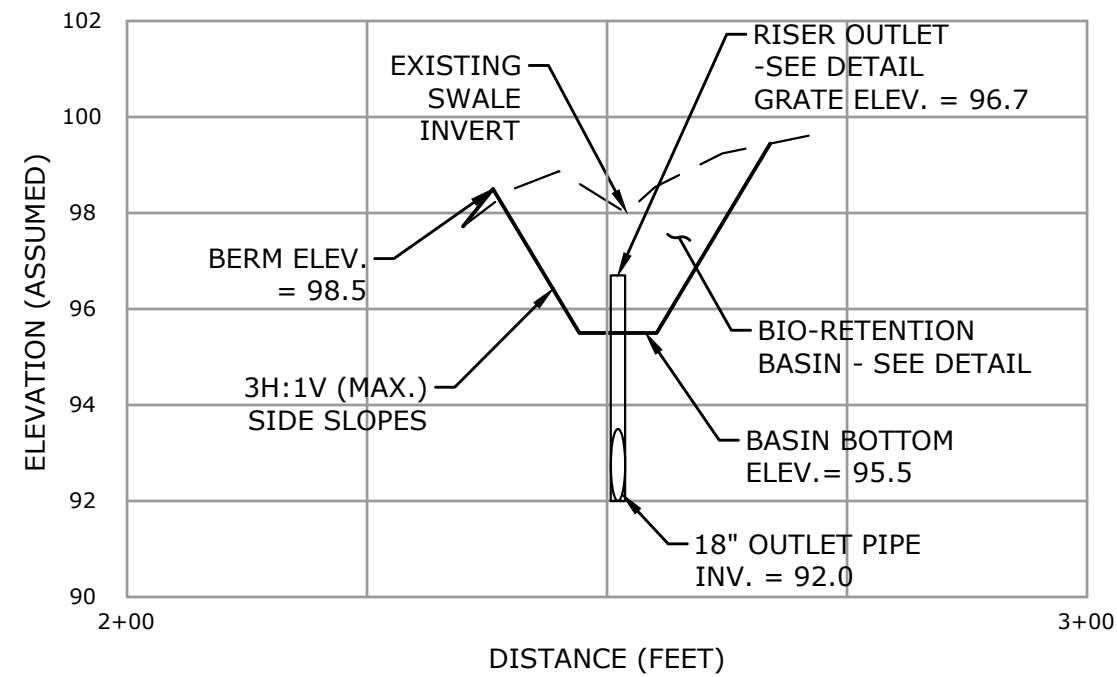
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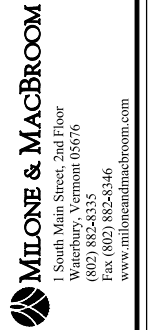
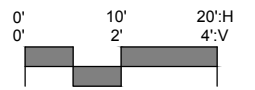
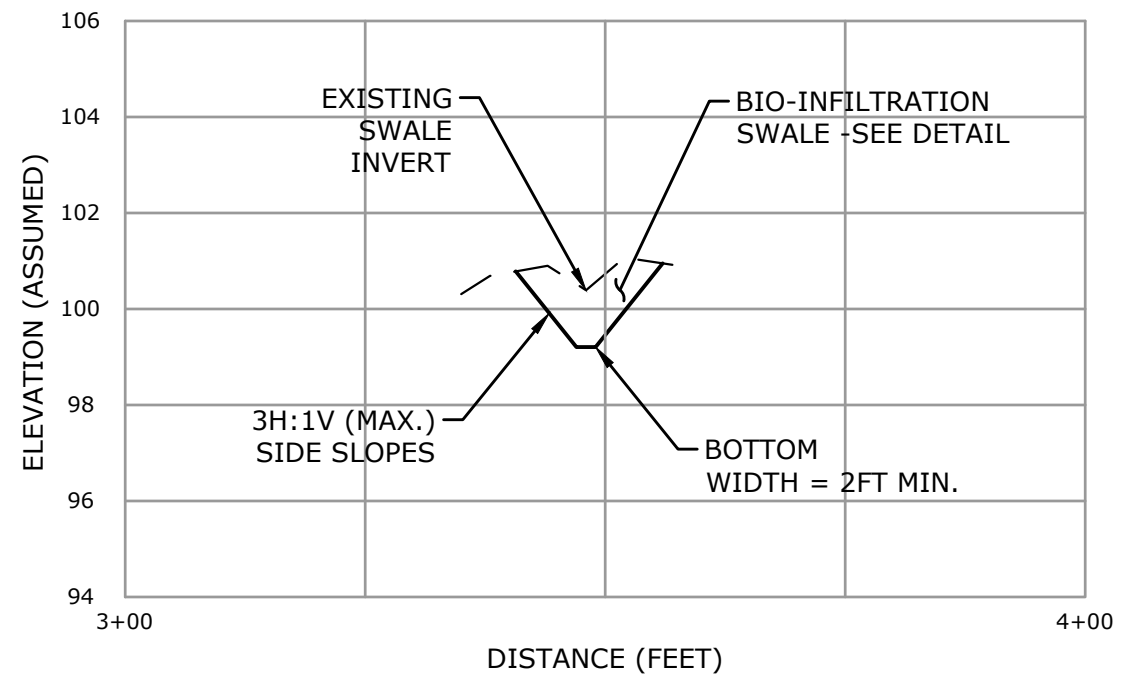
PROFILE VIEW



CROSS SECTION VIEW - XS 1+17



CROSS SECTION VIEW - XS 1+60



REVISIONS

NO.	DATE	DESCRIPTION
07/29/2016		

CONCEPT DESIGN

DETAILS - PROFILE & CROSS SECTIONS

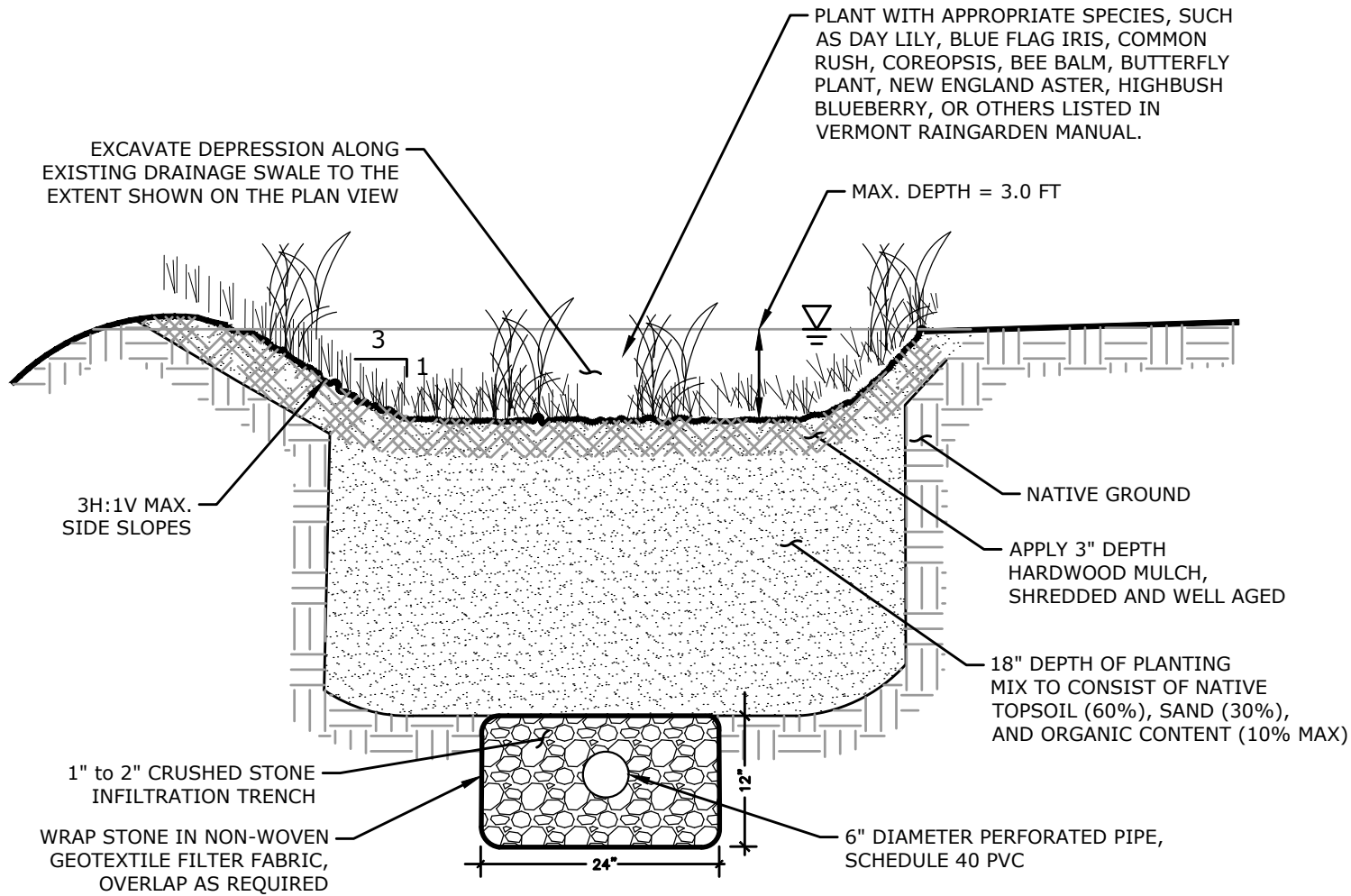
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HORSFORD GARDENS & NURSERY**
2111 GREENBUSH ROAD
CHARLOTTE, VERMONT

BMC DESIGNED	BMC DRAWN	JCL CHECKED
SCALE 1" = 4'V 1" = 20'H		
DATE 7/15/2016		
PROJECT NO. 3452-22		

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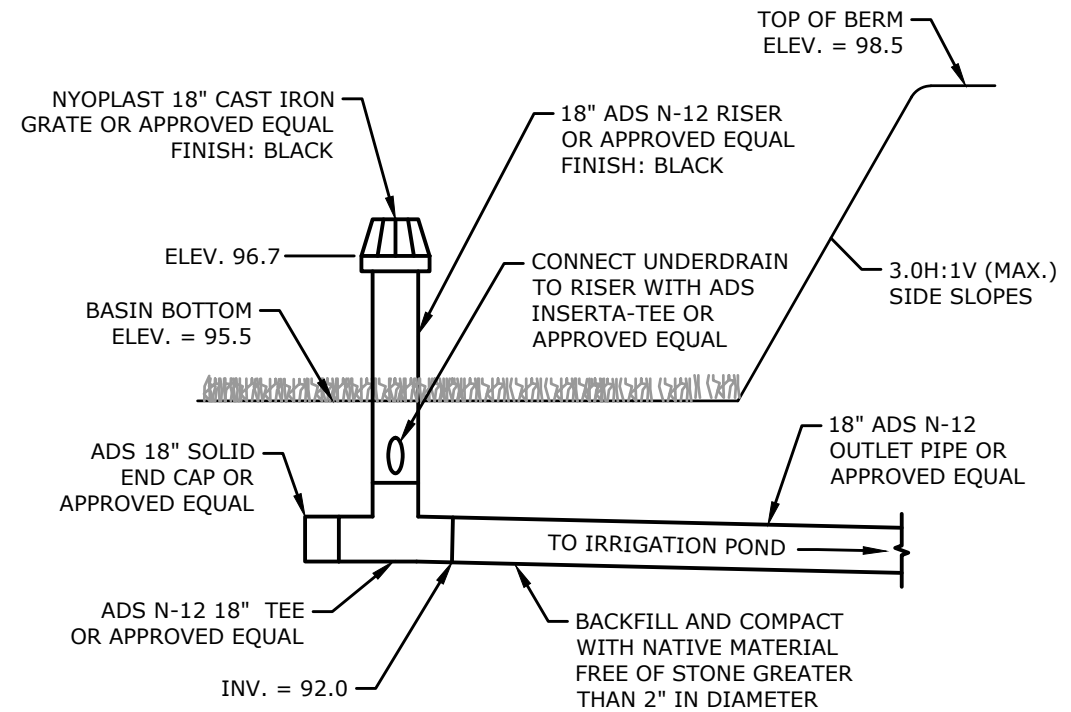
BIO-RETENTION AREA
NOT TO SCALE

INSTALLATION NOTES:

1. THE VERMONT RAINGARDEN MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED ARE AVAILABLE IN THAT MANUAL INCLUDING ADDITIONAL APPROPRIATE PLANT SPECIES.
2. PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.
3. THE UNDERDRAIN SHOULD CONNECT TO THE RISER OUTLET (SEE DETAIL).

OPERATION AND MAINTENANCE NOTES:

1. MAINTENANCE OF THE BIO-RETENTION AREA IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
2. DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
3. PERIODICALLY, INCLUDING AFTER LARGE STORMS AND REGULARLY DURING THE FALL, REMOVE LEAVES AND DEBRIS ACCUMULATED AT INLET, AT RISER OUTLET, OR AT OVERFLOW WEIR.
4. THE ACCUMULATION OF SEDIMENT WITHIN THE BIO-RETENTION AREA SHOULD BE MONITORED AND INSPECTED A MINIMUM OF ONCE ANNUALLY. REMOVE SEDIMENT AFTER APPROXIMATELY THREE (3) TO SIX (6) INCHES OF SEDIMENT HAS ACCUMULATED.
5. ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.



RISER OUTLET
NOT TO SCALE

INSTALLATION NOTES:

1. MAINTAIN APPROXIMATELY 2-FEET OF COVER OVER THE OUTLET PIPE TO INCREASE STRENGTH AND PREVENT POTENTIAL FLOTATION.
2. INSTALL RISER USING ADS N-12 PIPE AND FITTING OR APPROVED EQUAL.
3. DIRECT THE OUTLET PIPE TO THE EXISTING IRRIGATION POND TO RECLAIM STORMWATER FOR IRRIGATION PURPOSES.
4. BIO-RETENTION UNDERDRAIN SHALL CONNECT TO THE RISER TO RECLAIM ADDITIONAL STORMWATER THAT IS NOT INFILTRATED.

OPERATION AND MAINTENANCE NOTES:

1. PERIODICALLY, INCLUDING AFTER LARGE STORMS AND REGULARLY DURING THE FALL, REMOVE LEAVES AND DEBRIS ACCUMULATED AT THE GRATE OF THE RISER OUTLET.
2. IF RISER OR OUTLET PIPE BECOMES CLOGGED, REMOVE GRATE AND REMOVE DEBRIS AS NEEDED.
3. INSPECT DRAINAGE STRUCTURES ALONG THE OUTLET PIPE ANNUALLY AND AFTER LARGE STORMS, REMOVE LEAVES, DEBRIS, OR ACCUMULATED SEDIMENT AS NEEDED TO PREVENT CLOGGING.
4. INSPECT MANHOLE COVERS FOR DAMAGE AND REPLACE AS NEEDED.
5. MONITOR FOR EROSION AT THE OUTLET PIPE OUTFALL AT THE EXISTING IRRIGATION POND. ADDRESS EXCESSIVE EROSION AS NEEDED TO PREVENT GULLYING AT THE OUTFALL.

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REVISIONS
07/29/2016

CONCEPT DESIGN

**AHEAD OF THE STORM
HORSFORD GARDENS & NURSERY**
2111 GREENBUSH ROAD
CHARLOTTE, VERMONT

BMC DESIGNED	BMC DRAWN	JCL CHECKED
SCALE 1" = 5'V 1" = 20'H		
DATE 7/15/2016		
PROJECT NO. 3452-22		

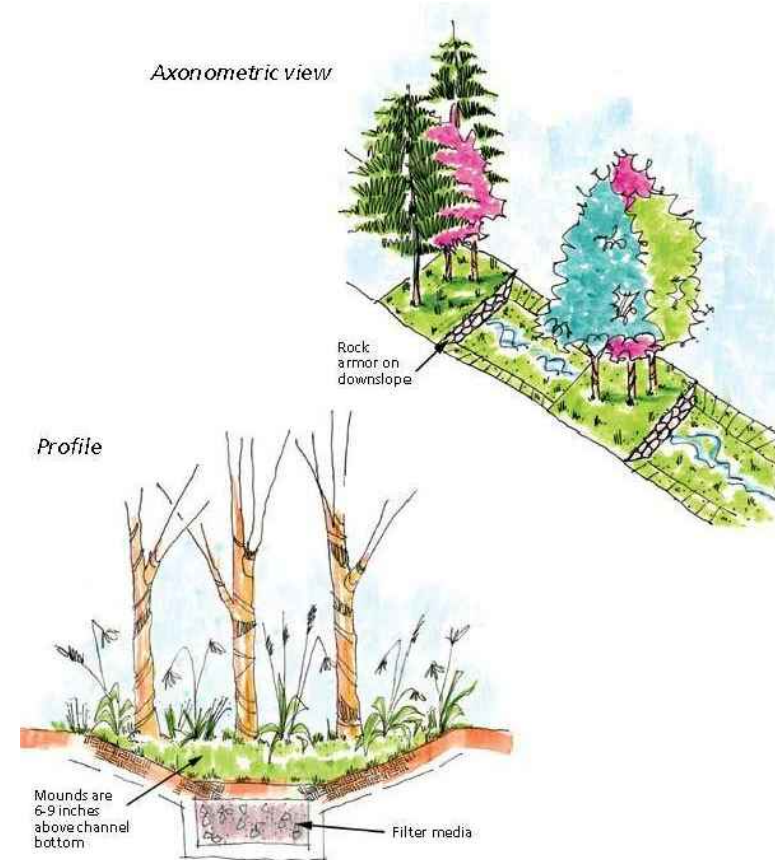
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OPERATION AND MAINTENANCE NOTES

1. THE CONCEPTUAL STORMWATER PLAN HAS BEEN DESIGNED TO MINIMIZE MAINTENANCE TO THE SYSTEM AND ONLY REQUIRE MAINTENANCE THAT CAN EASILY BE COMPLETED BY HORSFORD STAFF WITH EQUIPMENT ONSITE.
2. PERIODICALLY, INCLUDING AFTER LARGE STORMS AND REGULARLY DURING THE FALL, REMOVE LEAVES AND DEBRIS ACCUMULATED AT EXISTING CULVERTS, ALONG THE BIO-INFILTRATION SWALE INCLUDING TREE MOUND CHECK DAM, AND AT THE OVERFLOW WEIR.
3. THE ACCUMULATION OF SEDIMENT WITHIN THE FOREBAY / BIO-INFILTRATION SWALE SHOULD BE MONITORED AND INSPECTED A MINIMUM OF ONCE ANNUALLY. REMOVE SEDIMENT AFTER APPROXIMATELY 6 INCHES OF SEDIMENT HAS ACCUMULATED.
4. BIO-INFILTRATION SWALE CAN BE MOWED OR BRUSH-HOGGED AT THE END OF EACH GROWING SEASON.
5. RESEEDING OF THE SPECIFIED SEED MIX SHOULD OCCUR AFTER REMOVAL OF SEDIMENT OR RESHAPING OF BIO-INFILTRATION SWALE OR BIO-RETENTION AREA.
6. INSPECT THE OVERFLOW WEIR AT A MINIMUM ONCE ANNUALLY AND AFTER LARGE STORMS. MONITOR OVERFLOW WEIR FOR EXCESSIVE EROSION OR DISPLACE STONE ARMORING, AND REPAIR AS NEEDED. REMOVED ACCUMULATED SEDIMENT AND DEBRIS TO MAINTAIN DESIGN WIDTH AND DEPTH.
7. SEE SPECIFIC OPERATION AND MAINTENANCE NOTES FOR BIO-RETENTION AREA AND RISER OUTLET.



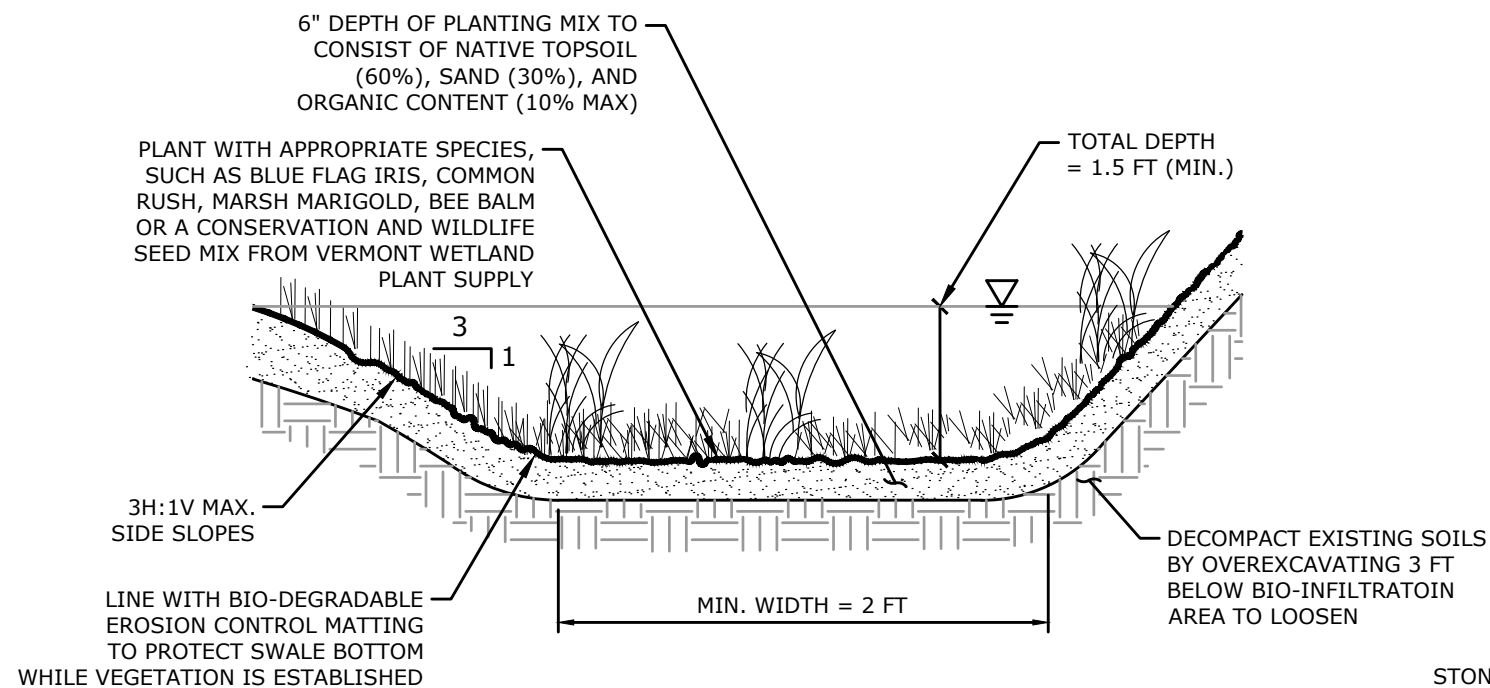
NOTES:

INSTALL TREE MOUND CHECK DAMS ALONG BIO-INFILTRATION SWALE AS SHOWN ON PLAN TO REDUCE EFFECTIVE SLOPE OF SWALE AND SLOW WATER. REFER TO THE BIO-INFILTRATION SWALE DETAIL FOR SWALE DIMENSIONS AND SPECIFICATIONS.

REFERENCED FROM: URBAN WATERSHED FORESTRY MANUAL, PART 2: CONSERVING AND PLANTING TREES AT DEVELOPMENT SITES. UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE. NA-TP-01-06. MAY 2006.

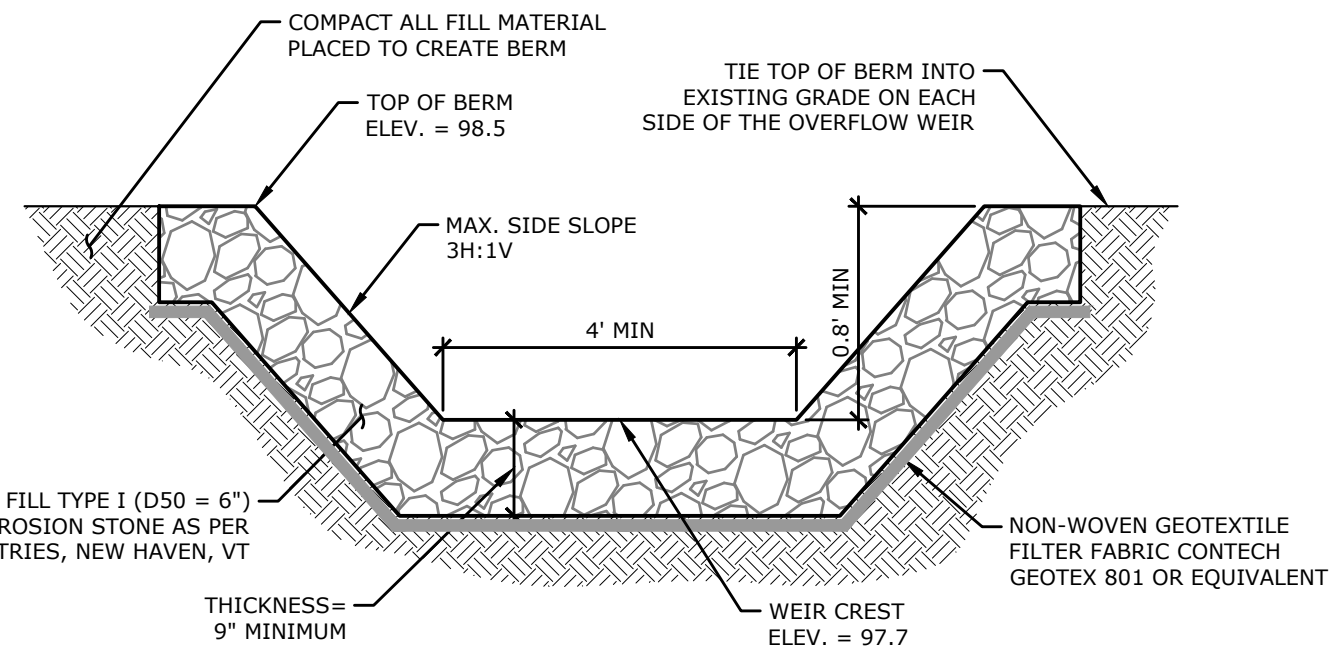
TREE MOUND CHECK DAM

NOT TO SCALE



BIO-INFILTRATION SWALE

NOT TO SCALE



BERM & OVERFLOW WEIR

NOT TO SCALE

REVISIONS

07/29/2016

DETAILS

CONCEPT DESIGN

AHEAD OF THE STORM
HORSFORD GARDENS & NURSERY
2111 GREENBUSH ROAD
CHARLOTTE, VERMONT

BMC

DESIGNED

BMC

DRAWN

JCL

CHECKED

SCALE

1" = 5'V

1" = 20'H

DATE

7/15/2016

PROJECT NO.

3452-22

SHEET NO.

06

OPINION OF PROBABLE COST - CONCEPTUAL DESIGN
HORSFORD GARDENS & NURSERY
BIO-RETENTION TREATMENT AREA

Charlotte, Vermont
MMI #3452-22
October 25, 2016



Item	ITEM/DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	COST
CONSTRUCTION LABOR					
1	Labor to Install Plants	HR	12	\$35	\$420
2	Labor to Install Riser & Outlet Pipe System	HR	20	\$35	\$700
3	Labor to Install Underdrain and Modify Tile Drain	HR	16	\$35	\$560
4	Labor to Install Overflow Outlet and Tree Check Dam	HR	6	\$35	\$210
5	Labor to Restore Site and Install Erosion Control Matting	HR	6	\$35	\$210
CONSTRUCTION EQUIPMENT					
6	Excavator Rental / Operator	HR	40	\$110	\$4,400
7	Haul Excess Fill Off Site (1 hr round trip)	HR	20	\$80	\$1,600
8	Haul Materials to Site (Hinesburg, 1 hr round trip)	HR	20	\$80	\$1,600
CONSTRUCTION MATERIALS					
9	Native Topsoil (Supplement Existing Topsoil as needed)	TN	9	\$30	\$270
10	Compost Soil Ammendment, Delivered	CY	2	\$85	\$170
11	Sand Soil Ammendment	TN	9	\$15	\$135
12	Crushed Stone for Underdrain / Tile Drain	TN	25	\$13	\$325
13	Bedding Material for Outlet Pipe / Drainage Structures	TN	265	\$13	\$3,445
14	6-inch Ditch Stone for Overflow Outlet / Splash Pad	TN	11	\$20	\$220
15	Hardwood Mulch	CY	12	\$45	\$540
16	Riser Structure and Outlet Pipe System	LS	1	\$14,000	\$14,000
17	Underdrain Pipe & Fittings	FT	150	\$3	\$450
18	Geotextile Filter Fabric	SY	115	\$4	\$460
19	Bio-degradable Erosion Control Matting	SY	40	\$3	\$120
20	Seed for Restoring Disturbed Areas	LS	1	\$100	\$100
21	Plants for Bio-retention Area & Bio-Infiltration Swale	LS	1	\$2,300	\$2,300
CONSTRUCTION MISCELLANEOUS					
22	Mobilization/ Demobilization	LS	1	\$1,000	\$1,000
ENGINEERING SERVICES					
23	Construction Plans				\$3,500
24	Contractor Selection				\$1,000
25	Construction Oversight (Part-time)				\$5,000
Construction Subtotal					\$33,235
Engineering Services Subtotal					\$9,500
TOTAL (ROUNDED)					\$43,000