ASE
Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

Stormwater Management Report

October 22, 2018
Revision: February 1, 2019

Project Location:
Sizer Drive
Wales, MA

Assessors Map/Parcel:
Map 12, Parcels 40

Applicant:
Sunpin Holdings, LLC
12424 Wilshire Blvd. #40
Los Angeles, CA 90025

Owners:
Cindy Boucher
40 Sizer Drive
Wales, MA 01081

Representative:
Andrews Survey & Engineering, Inc.
104 Mendon Street
Uxbridge, MA 01569

Uxbridge
104 Mendon Street
Uxbridge, MA 01569
Tel. 508 278-3897 Fax. 508 278-2289

North Attleboro
500 East Washington Street
North Attleboro, MA 02760
Tel. 508 316-0452 Fax. 508 316-0963

www.andrews-engineering.com

STORMWATER MANAGEMENT REPORT

"Large-Scale Solar Photovoltaic Facility"
40 Sizer Drive
Wales, MA 08081

October 22, 2018
Revised: February 1, 2019

Prepared for:

Sunpin Holdings, LLC
12424 Wiltshire Blvd., #70
Los Angeles, CA 90025

Prepared by:

Andrews Survey & Engineering, Inc.
P.O. Box 312, 104 Mendon Street
Uxbridge, MA 01569

ASE Project #2018-137

Prepared by: Kristen Page 2/1/19
Kristen N. Page, EIT

COMMONWEALTH OF MASSACHUSETTS
RICHARD M. MAINVILLE
CIVIL
No. 28323
REGISTERED PROFESSIONAL ENGINEER

Reviewed by: 2/1/19
Richard M. Mainville, P.E.

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PART I - SUMMARY

1.0 Introduction

The project site is an undeveloped parcel, which is located at the southern end of Sizer Drive, Wales Massachusetts. The site contains approximately 100 acres of land most of which is forested. Of the 100 acres 13.8 acres will be utilized of this proposal, approximately 7.8 acres of fences in area will be used for solar arrays. A proposed access driveway is proposed through the east side of the arrays, with a wetland crossing to access the lower portion of the site. There is an existing house, garage and driveway on the property. The garage is proposed to be razed, and the existing house will remain and a residential driveway off of the access driveway is also proposed.

The proposed project consists of grading, site clearing, installation of solar panels, site drainage facilities and erosion control to create a solar ground mount facility. The project will utilize low impact development ("LID") techniques. The existing topography generally consists of a high ridge in the near the western center of the property sloping downward to the north and east. The highest point is elevation 915 at the southern boundary sloping northerly toward a centrally located intermittent stream which flows easterly and northerly on the property. Also the northern portion of the work area slopes southerly and easterly toward the intermittent stream.

The property is not located within the 100-year flood plain (Zone A) according to the current Flood Insurance Rate Map (FIRM) Panel 25013C0479E (dated July 16, 2013) and Panel 25013C0487E (dated July 16, 2013, as shown in the Appendix.

According to the most current GIS mapping of the Massachusetts Natural Heritage Atlas, Priority Habitat of Rare Species and Estimated Habitat of Rare Wetlands Wildlife is not located on or bordering the property. No known Areas of Critical Environmental Concern (ACEC) are located on or bordering the property.

2.0 Background Data

Soils information was taken from U.S.D.A. Natural Resource Conservation Service (NRCS) Soil Survey Report. Soils mapping indicated that the soils on the site are generally categorized as Paxton – fine sandy loam, and Brookfield – Brimfield – rock outcrop complex (steep) series soils. These soil types have a hydrologic soil group rating of C.

3.0 Stormwater Compliance

Standard 1 – No Untreated Discharges or Erosion to Wetland
No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Standard 2 – Peak Rate Attenuation
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. Evaluation of 100-year 24-hour storm to determine if off-site flooding will result for peak discharges from this storm.

The following table is a summary of the hydrologic calculations performed using HydroCAD© v.10.0 an USSCS TR-20 modeling system.

Peak Flow Summary Tables

Analysis Points – W1 (Wetland 1), OS-N (Offsite - North)

	2-year, 24-hour Storm (3.0 inches)	10-year, 24-hour Storm (4.5 inches)	25-year, 24-hour Storm (5.3 inches)	100-year, 24-hour Storm (6.5 inches)
Pre-development W1	8.36 cfs	21.99 cfs	30.28 cfs	43.50 cfs
Post-development W1	7.12 cfs	19.19 cfs	26.32 cfs	41.89 cfs
Rate Decrease	***-1.24***	***-2.80***	***-3.96***	***-1.61***
Pre-development OS-N	0.92 cfs	2.40 cfs	3.31 cfs	4.75 cfs
Post-development OS-N	0.50 cfs	1.27 cfs	1.73 cfs	2.46 cfs
Rate Decrease	***-0.42***	***-1.13***	***-1.58***	***-2.29***

This shows no increase in offsite runoff for 2, 10, 25 and 100-year storm events. Increases less than 0.1 cfs are considered negligible.

Standard 3 – Stormwater Recharge

Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions, based on soil types.

The prescribed stormwater runoff volume to be recharged to groundwater has been determined using the hydrologic soil classification and the proposed post development increase in impervious area:

Hydrologic Group	***Volume to Recharge (x Total Impervious Area)***
A	0.60 inches of runoff — No A soils were found on site
B	0.35 inches of runoff — No B soils were found on site
C	0.25 inches of runoff — 29,005 SF x 0.25 in = 604.2 CF
D	0.10 inches of runoff — No D soils were found on site

Capture Area Adjustment

Total Recharge volume required: 605 CF
Impervious areas that drain to recharge areas: 19,128 SF
Total Site Impervious/Impervious to Infiltration = 29005/19128 = 1.51
Total adjusted recharge needed = 913.5 CF
30,658 cf provided

Drawdown Within 72 Hours

To determine whether an infiltration BMP will drain within 72 hours, the following formula must be used:

$$Time_{drawdown} = \frac{Rv}{(K)\ (Bottom\ Area)}$$

Where:
Rv= Storage Volume
K = Saturated Hydraulic Conductivity For "Static" and "Simply Dynamic" Methods
Bottom Area = Bottom Area of Recharge Structure

Infiltration Basin 1
Time = 914 cf/(0.27 in/hr x 1/12ft/in x 4,315sf)
9.41 hours required to fully draw down

Standard 4 - Water Quality Treatment Volume
For new development, stormwater management systems must be designed to remove 80% of the average annual load (post-development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:

a) *Suitable nonstructural practices for source control and pollution prevention are implemented;*
b) *Stormwater management best management practices (BMPs) are sized to capture the prescribed runoff volume; and*
c) *Stormwater management BMPs are maintained as designed.*

V_{wq}=(D_{wq}/12 inches/ ft) x (A_{imp} x 43,560 sf/ acre)
V_{wq}=Required Water Quality Volume (cf)
D_{wq}=Required Water Quality Depth: 1 inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near another critical area, runoff from LUHPPL, or exfiltration to soils with infiltration rate greater than 2.4 inches/hour or greater, ½ inch for discharges near or to other areas.
A_{imp}= Impervious Area (acres)

Infiltration Basin 1
D_{WQ} = 0.5 inch
A_{IMP} = 29,005 sf
V_{WQ} = (0.5 in/ 12 in/ft)*(29,005 sf)
V_{WQ} = 1,209 cf (<1,264 cf recharge volume provided)

TSS Removal
See Part IV – TSS Removal Worksheet

All BMPs meet or exceed 80% TSS Removal.

Standard 5 – Land Uses with High Potential Pollutant Loads
Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pretreatment is prohibited.

The proposed use is not considered a use with a higher potential pollutant load as defined by the Stormwater Management Standards.

Standard 6 – Critical Areas
Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas). Critical areas are Outstanding Resource Waters (ORWs), shellfish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies.

The site is not located in a critical area

Standard 7 – Redevelopment
Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

This project is not a redevelopment project.

Standard 8 – Construction Period Controls
Erosion and sediment controls must be implemented to prevent impacts during construction or land disturbance activities.

Construction Period controls consist of silt fence and erosion control measures and practices contained within the plan set.

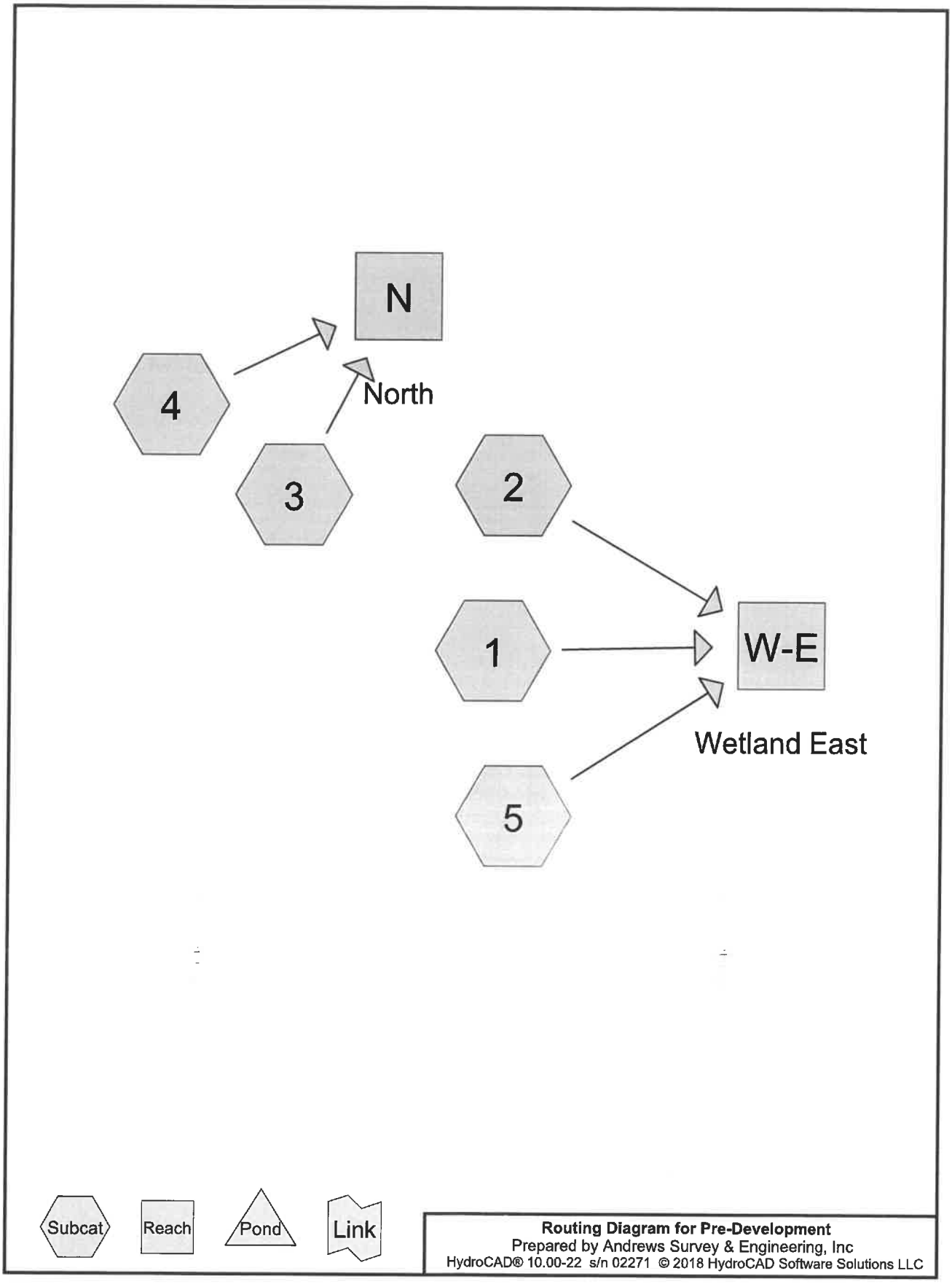
Standard 9 – Operation and Maintenance Plan
All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.

The Operation and Maintenance Plan has been developed and included in Part VI.

Standard 10 – Illicit Discharge to Drainage System
Illicit discharge. The owner will provide an illicit discharge statement to the NRC prior to construction.

"No illicit discharges" statement is included in the Operation and Maintenance Plan that is attached in Part VI.

PART II – PRE & POST-CONSTRUCTION COMPUTATIONS



Routing Diagram for Pre-Development
Prepared by Andrews Survey & Engineering, Inc

Summary for Subcatchment 1:

Runoff = 0.91 cfs @ 12.35 hrs, Volume= 4,484 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
84,447	70	Woods, Good, HSG C
84,447		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
9.5	365	0.0163	0.64		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.8	415	Total			

Summary for Subcatchment 2:

Runoff = 4.64 cfs @ 12.33 hrs, Volume= 22,418 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
415,469	70	Woods, Good, HSG C
5,460	98	Paved parking, HSG C
1,063	98	Unconnected roofs, HSG C
421,992	70	Weighted Average
415,469		98.45% Pervious Area
6,523		1.55% Impervious Area
1,063		16.30% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	50	0.0140	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
3.7	220	0.0390	0.99		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.8	352	0.1780	2.11		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
20.7	622	Total			

Summary for Subcatchment 3:

Runoff = 0.51 cfs @ 12.31 hrs, Volume= 2,410 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
45,332	70	Woods, Good, HSG C
45,332		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0	50	0.0123	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
4.3	352	0.0740	1.36		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.3	402	Total			

Summary for Subcatchment 4:

Runoff = 0.40 cfs @ 12.29 hrs, Volume= 1,855 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
34,868	70	Woods, Good, HSG C
34,868		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
5.8	315	0.0330	0.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.1	365	Total			

Summary for Subcatchment 5:

Runoff = 3.22 cfs @ 12.22 hrs, Volume= 13,315 cf, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
249,729	70	Woods, Good, HSG C
249,729		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0740	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
6.4	520	0.0740	1.36		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.7	570	Total			

Summary for Reach N: North

Inflow Area = 80,200 sf, 0.00% Impervious, Inflow Depth > 0.64" for 2-Year event
Inflow = 0.92 cfs @ 12.30 hrs, Volume= 4,265 cf
Outflow = 0.92 cfs @ 12.30 hrs, Volume= 4,265 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach W-E: Wetland East

Inflow Area = 756,168 sf, 0.86% Impervious, Inflow Depth > 0.64" for 2-Year event
Inflow = 8.36 cfs @ 12.30 hrs, Volume= 40,217 cf
Outflow = 8.36 cfs @ 12.30 hrs, Volume= 40,217 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Runoff Area=84,447 sf 0.00% Impervious Runoff Depth>1.53"
Flow Length=415' Tc=21.8 min CN=70 Runoff=2.38 cfs 10,734 cf

Subcatchment2: Runoff Area=421,992 sf 1.55% Impervious Runoff Depth>1.53"
Flow Length=622' Tc=20.7 min CN=70 Runoff=12.16 cfs 53,663 cf

Subcatchment3: Runoff Area=45,332 sf 0.00% Impervious Runoff Depth>1.53"
Flow Length=402' Tc=19.3 min CN=70 Runoff=1.34 cfs 5,768 cf

Subcatchment4: Runoff Area=34,868 sf 0.00% Impervious Runoff Depth>1.53"
Flow Length=365' Tc=18.1 min CN=70 Runoff=1.06 cfs 4,439 cf

Subcatchment5: Runoff Area=249,729 sf 0.00% Impervious Runoff Depth>1.53"
Flow Length=570' Slope=0.0740 '/' Tc=13.7 min CN=70 Runoff=8.45 cfs 31,851 cf

Reach N: North Inflow=2.40 cfs 10,207 cf
Outflow=2.40 cfs 10,207 cf

Reach W-E: Wetland East Inflow=21.99 cfs 96,248 cf
Outflow=21.99 cfs 96,248 cf

Total Runoff Area = 836,368 sf Runoff Volume = 106,456 cf Average Runoff Depth = 1.53"
99.22% Pervious = 829,845 sf 0.78% Impervious = 6,523 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Runoff Area=84,447 sf 0.00% Impervious Runoff Depth>2.07"
Flow Length=415' Tc=21.8 min CN=70 Runoff=3.28 cfs 14,592 cf

Subcatchment2: Runoff Area=421,992 sf 1.55% Impervious Runoff Depth>2.07"
Flow Length=622' Tc=20.7 min CN=70 Runoff=16.73 cfs 72,951 cf

Subcatchment3: Runoff Area=45,332 sf 0.00% Impervious Runoff Depth>2.08"
Flow Length=402' Tc=19.3 min CN=70 Runoff=1.85 cfs 7,841 cf

Subcatchment4: Runoff Area=34,868 sf 0.00% Impervious Runoff Depth>2.08"
Flow Length=365' Tc=18.1 min CN=70 Runoff=1.46 cfs 6,034 cf

Subcatchment5: Runoff Area=249,729 sf 0.00% Impervious Runoff Depth>2.08"
Flow Length=570' Slope=0.0740 '/' Tc=13.7 min CN=70 Runoff=11.63 cfs 43,291 cf

Reach N: North Inflow=3.31 cfs 13,875 cf
Outflow=3.31 cfs 13,875 cf

Reach W-E: Wetland East Inflow=30.28 cfs 130,834 cf
Outflow=30.28 cfs 130,834 cf

Total Runoff Area = 836,368 sf Runoff Volume = 144,709 cf Average Runoff Depth = 2.08"
99.22% Pervious = 829,845 sf 0.78% Impervious = 6,523 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Runoff Area=84,447 sf 0.00% Impervious Runoff Depth>2.96"
Flow Length=415' Tc=21.8 min CN=70 Runoff=4.71 cfs 20,827 cf

Subcatchment2: Runoff Area=421,992 sf 1.55% Impervious Runoff Depth>2.96"
Flow Length=622' Tc=20.7 min CN=70 Runoff=24.02 cfs 104,118 cf

Subcatchment3: Runoff Area=45,332 sf 0.00% Impervious Runoff Depth>2.96"
Flow Length=402' Tc=19.3 min CN=70 Runoff=2.66 cfs 11,191 cf

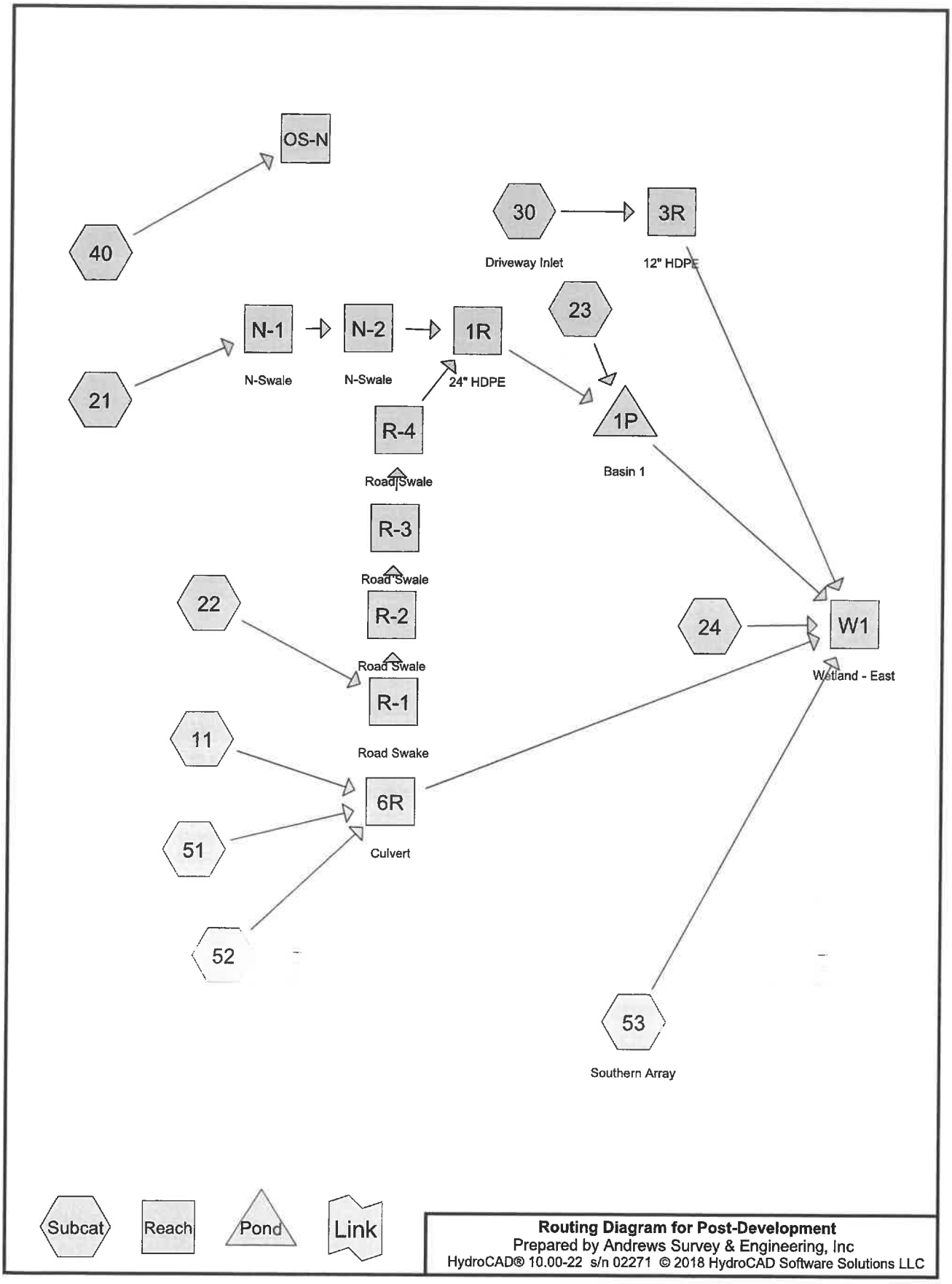
Subcatchment4: Runoff Area=34,868 sf 0.00% Impervious Runoff Depth>2.96"
Flow Length=365' Tc=18.1 min CN=70 Runoff=2.10 cfs 8,611 cf

Subcatchment5: Runoff Area=249,729 sf 0.00% Impervious Runoff Depth>2.97"
Flow Length=570' Slope=0.0740 '/' Tc=13.7 min CN=70 Runoff=16.69 cfs 61,773 cf

Reach N: North Inflow=4.75 cfs 19,802 cf
Outflow=4.75 cfs 19,802 cf

Reach W-E: Wetland East Inflow=43.50 cfs 186,719 cf
Outflow=43.50 cfs 186,719 cf

Total Runoff Area = 836,368 sf Runoff Volume = 206,520 cf Average Runoff Depth = 2.96"
99.22% Pervious = 829,845 sf 0.78% Impervious = 6,523 sf


OS-N
40
30
3R
Driveway Inlet
12" HDPE
23
N-1
N-2
1R
21
N-Swale
N-Swale
24" HDPE
R-4
1P
Road Swale
Basin 1
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51
Culvert
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Southern Array
Subcat
Reach
Pond
Link
Routing Diagram for Post-Development
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Summary for Subcatchment 11:

Runoff = 0.91 cfs @ 12.42 hrs, Volume= 5,337 cf, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
17,688	72	Woods/grass comb., Good, HSG C
51,693	71	Meadow, non-grazed, HSG C
14,838	70	Woods, Good, HSG C
84,219	71	Weighted Average
84,219		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.8	50	0.0091	0.05		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.00"
8.7	410	0.0127	0.79		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
26.5	460	Total			

Summary for Subcatchment 21:

Runoff = 1.11 cfs @ 12.15 hrs, Volume= 4,414 cf, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
69,665	71	Meadow, non-grazed, HSG C
69,665		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0800	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	539	0.0925	4.56		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.3	589	Total			

Summary for Subcatchment 22:

Runoff = 3.80 cfs @ 12.13 hrs, Volume= 14,113 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
19,128	89	Gravel roads, HSG C
568	98	Unconnected roofs, HSG C
1,387	70	Woods, Good, HSG C
5,426	72	Woods/grass comb., Good, HSG C
171,021	71	Meadow, non-grazed, HSG C
197,530	73	Weighted Average
196,962		99.71% Pervious Area
568		0.29% Impervious Area
568		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1700	0.15		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.00"
0.1	22	0.2700	3.64		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.9	109	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	80	0.1600	2.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.0	261	Total			

Summary for Subcatchment 23:

Runoff = 0.22 cfs @ 12.10 hrs, Volume= 794 cf, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
12,532	71	Meadow, non-grazed, HSG C
12,532		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 24:

Runoff = 1.76 cfs @ 12.11 hrs, Volume= 6,513 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
82,496	70	Woods, Good, HSG C
26,928	72	Woods/grass comb., Good, HSG C
109,424	70	Weighted Average
109,424		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1374	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.8	91	0.1407	1.88		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.7	141	Total			

Summary for Subcatchment 30: Driveway Inlet

Runoff = 0.78 cfs @ 12.19 hrs, Volume= 3,303 cf, Depth= 0.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
33,855	70	Woods, Good, HSG C
3,330	89	Gravel roads, HSG C
11,865	71	Meadow, non-grazed, HSG C
49,050	72	Weighted Average
49,050		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1126	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
5.4	572	0.1246	1.76		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.8	622	Total			

Summary for Subcatchment 40:

Runoff = 0.50 cfs @ 12.20 hrs, Volume= 2,209 cf, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
14,368	70	Woods, Good, HSG C
3,283	71	Meadow, non-grazed, HSG C
17,209	72	Woods/grass comb., Good, HSG C
34,860	71	Weighted Average
34,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0873	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
5.6	316	0.0354	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
12.7	366	Total			

Summary for Subcatchment 51:

Runoff = 0.53 cfs @ 12.19 hrs, Volume= 2,328 cf, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
29,384	70	Woods, Good, HSG C
9,725	72	Woods/grass comb., Good, HSG C
39,109	70	Weighted Average
39,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.0931	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
4.6	350	0.0644	1.27		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.5	400	Total			

Summary for Subcatchment 52:

Runoff = 1.03 cfs @ 12.15 hrs, Volume= 3,931 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
6,547	89	Gravel roads, HSG C
11,911	70	Woods, Good, HSG C
16,526	71	Meadow, non-grazed, HSG C
20,031	72	Woods/grass comb., Good, HSG C
55,015	73	Weighted Average
55,015		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.1200	0.13		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.00"
2.8	329	0.0800	1.98		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.1	379	Total			

Summary for Subcatchment 53: Southern Array

Runoff = 2.83 cfs @ 12.17 hrs, Volume= 11,723 cf, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.00"

Area (sf)	CN	Description
44,402	70	Woods, Good, HSG C
71,021	72	Woods/grass comb., Good, HSG C
69,577	71	Meadow, non-grazed, HSG C
185,000	71	Weighted Average
185,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1170	0.13		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.00"
4.4	519	0.0773	1.95		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.8	569	Total			

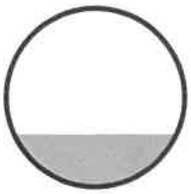
Summary for Reach 1R: 24" HDPE

Inflow Area = 267,195 sf, 0.21% Impervious, Inflow Depth = 0.83" for 2-Year event
Inflow = 4.56 cfs @ 12.22 hrs, Volume= 18,527 cf
Outflow = 4.50 cfs @ 12.23 hrs, Volume= 18,527 cf, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.89 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.42 fps, Avg. Travel Time= 0.4 min

Peak Storage= 47 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 24.26 cfs

24.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 60.7' Slope= 0.0082 '/'
Inlet Invert= 834.50', Outlet Invert= 834.00'



Summary for Reach 3R: 12" HDPE

Inflow Area =	49,050 sf,	0.00% Impervious,	Inflow Depth =	0.81"	for 2-Year event
Inflow =	0.78 cfs @	12.19 hrs, Volume=	3,303 cf		
Outflow =	0.78 cfs @	12.19 hrs, Volume=	3,303 cf,	Atten= 0%,	Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.87 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 3.35 fps, Avg. Travel Time= 0.2 min

Peak Storage= 5 cf @ 12.19 hrs
Average Depth at Peak Storage= 0.18'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 10.58 cfs

12.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 47.5' Slope= 0.0632 '/'
Inlet Invert= 827.00', Outlet Invert= 824.00'

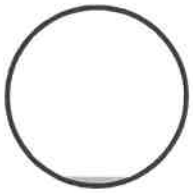
Summary for Reach 6R: Culvert

Inflow Area =	178,343 sf,	0.00% Impervious,	Inflow Depth =	0.78"	for 2-Year event
Inflow =	1.98 cfs @	12.20 hrs, Volume=	11,595 cf		
Outflow =	1.98 cfs @	12.20 hrs, Volume=	11,595 cf,	Atten= 0%,	Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 8.64 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 4.13 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 12.20 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 426.54 cfs

48.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 34.5' Slope= 0.0522 '/'
Inlet Invert= 867.80', Outlet Invert= 866.00'



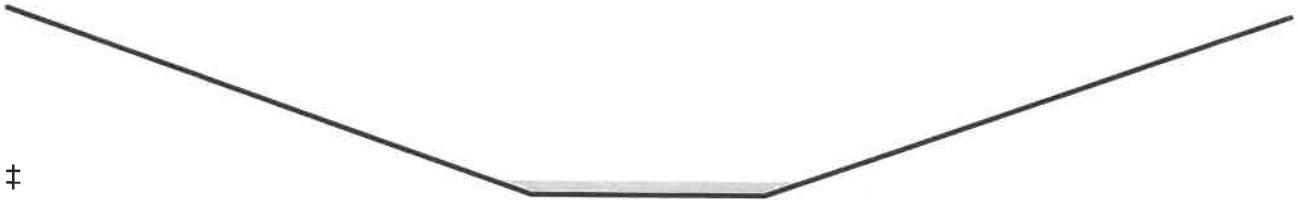
Summary for Reach N-1: N-Swale

Inflow Area =	69,665 sf,	0.00% Impervious,	Inflow Depth =	0.76"	for 2-Year event
Inflow =	1.11 cfs @	12.15 hrs, Volume=	4,414 cf		
Outflow =	1.07 cfs @	12.20 hrs, Volume=	4,414 cf,	Atten= 4%,	Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.08 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.51 fps, Avg. Travel Time= 3.8 min

Peak Storage= 92 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.12'
Bank-Full Depth= 1.50' Flow Area= 9.8 sf, Capacity= 167.05 cfs

2.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 341.0' Slope= 0.0801 '/'
Inlet Invert= 898.00', Outlet Invert= 870.70'



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Summary for Reach N-2: N-Swale

Inflow Area = 69,665 sf, 0.00% Impervious, Inflow Depth = 0.76" for 2-Year event
Inflow = 1.07 cfs @ 12.20 hrs, Volume= 4,414 cf
Outflow = 1.04 cfs @ 12.23 hrs, Volume= 4,414 cf, Atten= 3%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.55 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.95 fps, Avg. Travel Time= 3.0 min

Peak Storage= 71 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.17'
Bank-Full Depth= 1.50' Flow Area= 9.8 sf, Capacity= 83.81 cfs

2.00' x 1.50' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 11.00'
Length= 170.0' Slope= 0.1982 '/'
Inlet Invert= 870.70', Outlet Invert= 837.00'

‡

Summary for Reach OS-N:

Inflow Area = 34,860 sf, 0.00% Impervious, Inflow Depth = 0.76" for 2-Year event
Inflow = 0.50 cfs @ 12.20 hrs, Volume= 2,209 cf
Outflow = 0.50 cfs @ 12.20 hrs, Volume= 2,209 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Summary for Reach R-1: Road Swake

Inflow Area = 197,530 sf, 0.29% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 3.80 cfs @ 12.13 hrs, Volume= 14,113 cf
Outflow = 3.76 cfs @ 12.15 hrs, Volume= 14,113 cf, Atten= 1%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.62 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.99 fps, Avg. Travel Time= 1.7 min

Peak Storage= 140 cf @ 12.14 hrs
Average Depth at Peak Storage= 0.27'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 107.40 cfs

2.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 206.0' Slope= 0.0549 '/'
Inlet Invert= 872.60', Outlet Invert= 861.30'

Summary for Reach R-2: Road Swale

Inflow Area = 197,530 sf, 0.29% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 3.76 cfs @ 12.15 hrs, Volume= 14,113 cf
Outflow = 3.67 cfs @ 12.17 hrs, Volume= 14,113 cf, Atten= 2%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.35 fps, Avg. Travel Time= 2.0 min

Peak Storage= 166 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 59.74 cfs

2.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 165.0' Slope= 0.0170 '/'
Inlet Invert= 861.30', Outlet Invert= 858.50'

Summary for Reach R-3: Road Swale

Inflow Area = 197,530 sf, 0.29% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 3.67 cfs @ 12.17 hrs, Volume= 14,113 cf
Outflow = 3.57 cfs @ 12.20 hrs, Volume= 14,113 cf, Atten= 3%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.55 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 2.3 min

Peak Storage= 178 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 108.21 cfs

2.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 273.0' Slope= 0.0557 '/'
Inlet Invert= 858.50', Outlet Invert= 843.30'

Summary for Reach R-4: Road Swale

Inflow Area =	197,530 sf,	0.29% Impervious,	Inflow Depth =	0.86"	for 2-Year event
Inflow =	3.57 cfs @	12.20 hrs, Volume=	14,113 cf		
Outflow =	3.52 cfs @	12.22 hrs, Volume=	14,113 cf,	Atten= 2%,	Lag= 1.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.53 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.62 fps, Avg. Travel Time= 1.8 min

Peak Storage= 141 cf @ 12.21 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.50' Flow Area= 7.5 sf, Capacity= 80.61 cfs

2.00' x 1.50' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 2.0 '/' Top Width= 8.00'
Length= 178.0' Slope= 0.0309 '/'
Inlet Invert= 843.30', Outlet Invert= 837.80'

Summary for Reach W1: Wetland - East

Inflow Area =	801,544 sf,	0.07% Impervious,	Inflow Depth =	0.71"	for 2-Year event
Inflow =	7.12 cfs @	12.16 hrs, Volume=	47,091 cf		
Outflow =	7.12 cfs @	12.16 hrs, Volume=	47,091 cf,	Atten= 0%,	Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Basin 1

Inflow Area = 279,727 sf, 0.20% Impervious, Inflow Depth = 0.83" for 2-Year event
Inflow = 4.68 cfs @ 12.22 hrs, Volume= 19,321 cf
Outflow = 0.94 cfs @ 12.90 hrs, Volume= 15,785 cf, Atten= 80%, Lag= 40.6 min
Discarded = 0.03 cfs @ 12.90 hrs, Volume= 1,828 cf
Primary = 0.91 cfs @ 12.90 hrs, Volume= 13,957 cf

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 836.69' @ 12.90 hrs Surf.Area= 5,108 sf Storage= 7,003 cf

Plug-Flow detention time= 185.7 min calculated for 15,785 cf (82% of inflow)
Center-of-Mass det. time= 107.2 min (989.4 - 882.2)

Volume	Invert	Avail.Storage	Storage Description
#1	834.00'	31,041 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
834.00	264	96.0	0	0	264
836.00	4,315	396.2	3,764	3,764	12,033
838.00	6,805	433.9	11,026	14,790	14,658
840.00	9,522	471.6	16,251	31,041	17,521

Device	Routing	Invert	Outlet Devices
#1	Discarded	834.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	836.00'	**24.0" Round Culvert** L= 85.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 836.00' / 826.00' S= 0.1176 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#3	Device 2	836.00'	**4.0" Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 2	837.50'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.03 cfs @ 12.90 hrs HW=836.69' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.91 cfs @ 12.90 hrs HW=836.69' (Free Discharge)
└**2=Culvert** (Passes 0.91 cfs of 2.14 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.91 cfs @ 3.48 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment11: Runoff Area=84,219 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=460' Tc=26.5 min CN=71 Runoff=2.30 cfs 12,257 cf

Subcatchment21: Runoff Area=69,665 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=589' Tc=9.3 min CN=71 Runoff=2.81 cfs 10,138 cf

Subcatchment22: Runoff Area=197,530 sf 0.29% Impervious Runoff Depth=1.90"
Flow Length=261' Tc=8.0 min CN=73 Runoff=9.14 cfs 31,204 cf

Subcatchment23: Runoff Area=12,532 sf 0.00% Impervious Runoff Depth=1.75"
Tc=6.0 min CN=71 Runoff=0.57 cfs 1,824 cf

Subcatchment24: Runoff Area=109,424 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=141' Tc=6.7 min CN=70 Runoff=4.61 cfs 15,262 cf

Subcatchment30: Driveway Inlet Runoff Area=49,050 sf 0.00% Impervious Runoff Depth=1.82"
Flow Length=622' Tc=11.8 min CN=72 Runoff=1.93 cfs 7,441 cf

Subcatchment40: Runoff Area=34,860 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=366' Tc=12.7 min CN=71 Runoff=1.27 cfs 5,073 cf

Subcatchment51: Runoff Area=39,109 sf 0.00% Impervious Runoff Depth=1.67"
Flow Length=400' Tc=11.5 min CN=70 Runoff=1.41 cfs 5,455 cf

Subcatchment52: Runoff Area=55,015 sf 0.00% Impervious Runoff Depth=1.90"
Flow Length=379' Tc=9.1 min CN=73 Runoff=2.44 cfs 8,691 cf

Subcatchment53: Southern Array Runoff Area=185,000 sf 0.00% Impervious Runoff Depth=1.75"
Flow Length=569' Tc=10.8 min CN=71 Runoff=7.16 cfs 26,923 cf

Reach 1R: 24" HDPE Avg. Flow Depth=0.95' Max Vel=7.55 fps Inflow=11.08 cfs 41,343 cf
24.0" Round Pipe n=0.011 L=60.7' S=0.0082 '/' Capacity=24.26 cfs Outflow=11.05 cfs 41,343 cf

Reach 3R: 12" HDPE Avg. Flow Depth=0.29' Max Vel=10.20 fps Inflow=1.93 cfs 7,441 cf
12.0" Round Pipe n=0.011 L=47.5' S=0.0632 '/' Capacity=10.58 cfs Outflow=1.92 cfs 7,441 cf

Reach 6R: Culvert Avg. Flow Depth=0.31' Max Vel=11.50 fps Inflow=5.13 cfs 26,402 cf
48.0" Round Pipe n=0.010 L=34.5' S=0.0522 '/' Capacity=426.54 cfs Outflow=5.12 cfs 26,402 cf

Reach N-1: N-Swale Avg. Flow Depth=0.20' Max Vel=5.55 fps Inflow=2.81 cfs 10,138 cf
n=0.022 L=341.0' S=0.0801 '/' Capacity=167.05 cfs Outflow=2.73 cfs 10,138 cf

Reach N-2: N-Swale Avg. Flow Depth=0.28' Max Vel=3.39 fps Inflow=2.73 cfs 10,138 cf
n=0.069 L=170.0' S=0.1982 '/' Capacity=83.81 cfs Outflow=2.66 cfs 10,138 cf

Reach OS-N: Inflow=1.27 cfs 5,073 cf
Outflow=1.27 cfs 5,073 cf

Reach R-1: Road Swake Avg. Flow Depth=0.43' Max Vel=7.27 fps Inflow=9.14 cfs 31,204 cf
n=0.022 L=206.0' S=0.0549 '/' Capacity=107.40 cfs Outflow=8.91 cfs 31,204 cf

Reach R-2: Road Swale Avg. Flow Depth=0.59' Max Vel=4.80 fps Inflow=8.91 cfs 31,204 cf
n=0.022 L=165.0' S=0.0170 '/' Capacity=59.74 cfs Outflow=8.78 cfs 31,204 cf

Reach R-3: Road Swale Avg. Flow Depth=0.42' Max Vel=7.28 fps Inflow=8.78 cfs 31,204 cf
n=0.022 L=273.0' S=0.0557 '/' Capacity=108.21 cfs Outflow=8.59 cfs 31,204 cf

Reach R-4: Road Swale Avg. Flow Depth=0.49' Max Vel=5.85 fps Inflow=8.59 cfs 31,204 cf
n=0.022 L=178.0' S=0.0309 '/' Capacity=80.61 cfs Outflow=8.43 cfs 31,204 cf

Reach W1: Wetland - East Inflow=19.19 cfs 113,580 cf
Outflow=19.19 cfs 113,580 cf

Pond 1P: Basin 1 Peak Elev=838.08' Storage=15,308 cf Inflow=11.43 cfs 43,167 cf
Discarded=0.04 cfs 2,037 cf Primary=4.16 cfs 37,551 cf Outflow=4.20 cfs 39,588 cf

Total Runoff Area = 836,404 sf Runoff Volume = 124,269 cf Average Runoff Depth = 1.78"
99.93% Pervious = 835,836 sf 0.07% Impervious = 568 sf

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment11: Runoff Area=84,219 sf 0.00% Impervious Runoff Depth=2.35"
Flow Length=460' Tc=26.5 min CN=71 Runoff=3.13 cfs 16,464 cf

Subcatchment21: Runoff Area=69,665 sf 0.00% Impervious Runoff Depth=2.35"
Flow Length=589' Tc=9.3 min CN=71 Runoff=3.83 cfs 13,619 cf

Subcatchment22: Runoff Area=197,530 sf 0.29% Impervious Runoff Depth=2.52"
Flow Length=261' Tc=8.0 min CN=73 Runoff=12.27 cfs 41,449 cf

Subcatchment23: Runoff Area=12,532 sf 0.00% Impervious Runoff Depth=2.35"
Tc=6.0 min CN=71 Runoff=0.77 cfs 2,450 cf

Subcatchment24: Runoff Area=109,424 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=141' Tc=6.7 min CN=70 Runoff=6.33 cfs 20,621 cf

Subcatchment30: Driveway Inlet Runoff Area=49,050 sf 0.00% Impervious Runoff Depth=2.43"
Flow Length=622' Tc=11.8 min CN=72 Runoff=2.61 cfs 9,938 cf

Subcatchment40: Runoff Area=34,860 sf 0.00% Impervious Runoff Depth=2.35"
Flow Length=366' Tc=12.7 min CN=71 Runoff=1.73 cfs 6,815 cf

Subcatchment51: Runoff Area=39,109 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=400' Tc=11.5 min CN=70 Runoff=1.94 cfs 7,370 cf

Subcatchment52: Runoff Area=55,015 sf 0.00% Impervious Runoff Depth=2.52"
Flow Length=379' Tc=9.1 min CN=73 Runoff=3.28 cfs 11,544 cf

Subcatchment53: Southern Array Runoff Area=185,000 sf 0.00% Impervious Runoff Depth=2.35"
Flow Length=569' Tc=10.8 min CN=71 Runoff=9.76 cfs 36,165 cf

Reach 1R: 24" HDPE Avg. Flow Depth=1.14' Max Vel=8.12 fps Inflow=14.96 cfs 55,067 cf
24.0" Round Pipe n=0.011 L=60.7' S=0.0082 '/' Capacity=24.26 cfs Outflow=14.92 cfs 55,067 cf

Reach 3R: 12" HDPE Avg. Flow Depth=0.34' Max Vel=11.12 fps Inflow=2.61 cfs 9,938 cf
12.0" Round Pipe n=0.011 L=47.5' S=0.0632 '/' Capacity=10.58 cfs Outflow=2.61 cfs 9,938 cf

Reach 6R: Culvert Avg. Flow Depth=0.36' Max Vel=12.64 fps Inflow=7.01 cfs 35,378 cf
48.0" Round Pipe n=0.010 L=34.5' S=0.0522 '/' Capacity=426.54 cfs Outflow=7.01 cfs 35,378 cf

Reach N-1: N-Swale Avg. Flow Depth=0.23' Max Vel=6.11 fps Inflow=3.83 cfs 13,619 cf
n=0.022 L=341.0' S=0.0801 '/' Capacity=167.05 cfs Outflow=3.73 cfs 13,619 cf

Reach N-2: N-Swale Avg. Flow Depth=0.33' Max Vel=3.71 fps Inflow=3.73 cfs 13,619 cf
n=0.069 L=170.0' S=0.1982 '/' Capacity=83.81 cfs Outflow=3.64 cfs 13,619 cf

Reach OS-N: Inflow=1.73 cfs 6,815 cf
Outflow=1.73 cfs 6,815 cf

Reach R-1: Road Swake Avg. Flow Depth=0.51' Max Vel=7.92 fps Inflow=12.27 cfs 41,449 cf
n=0.022 L=206.0' S=0.0549 '/' Capacity=107.40 cfs Outflow=11.95 cfs 41,449 cf

Reach R-2: Road Swale Avg. Flow Depth=0.68' Max Vel=5.20 fps Inflow=11.95 cfs 41,449 cf
n=0.022 L=165.0' S=0.0170 '/' Capacity=59.74 cfs Outflow=11.81 cfs 41,449 cf

Reach R-3: Road Swale Avg. Flow Depth=0.50' Max Vel=7.94 fps Inflow=11.81 cfs 41,449 cf
n=0.022 L=273.0' S=0.0557 '/' Capacity=108.21 cfs Outflow=11.59 cfs 41,449 cf

Reach R-4: Road Swale Avg. Flow Depth=0.57' Max Vel=6.36 fps Inflow=11.59 cfs 41,449 cf
n=0.022 L=178.0' S=0.0309 '/' Capacity=80.61 cfs Outflow=11.33 cfs 41,449 cf

Reach W1: Wetland - East Inflow=26.32 cfs 153,898 cf
Outflow=26.32 cfs 153,898 cf

Pond 1P: Basin 1 Peak Elev=838.50' Storage=18,337 cf Inflow=15.44 cfs 57,517 cf
Discarded=0.05 cfs 2,130 cf Primary=7.26 cfs 51,796 cf Outflow=7.31 cfs 53,925 cf

Total Runoff Area = 836,404 sf Runoff Volume = 166,434 cf Average Runoff Depth = 2.39"
99.93% Pervious = 835,836 sf 0.07% Impervious = 568 sf

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment11: Runoff Area=84,219 sf 0.00% Impervious Runoff Depth=3.31"
Flow Length=460' Tc=26.5 min CN=71 Runoff=4.46 cfs 23,207 cf

Subcatchment21: Runoff Area=69,665 sf 0.00% Impervious Runoff Depth=3.31"
Flow Length=589' Tc=9.3 min CN=71 Runoff=5.44 cfs 19,196 cf

Subcatchment22: Runoff Area=197,530 sf 0.29% Impervious Runoff Depth=3.51"
Flow Length=261' Tc=8.0 min CN=73 Runoff=17.18 cfs 57,743 cf

Subcatchment23: Runoff Area=12,532 sf 0.00% Impervious Runoff Depth=3.31"
Tc=6.0 min CN=71 Runoff=1.09 cfs 3,453 cf

Subcatchment24: Runoff Area=109,424 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=141' Tc=6.7 min CN=70 Runoff=9.07 cfs 29,244 cf

Subcatchment30: Driveway Inlet Runoff Area=49,050 sf 0.00% Impervious Runoff Depth=3.41"
Flow Length=622' Tc=11.8 min CN=72 Runoff=3.69 cfs 13,926 cf

Subcatchment40: Runoff Area=34,860 sf 0.00% Impervious Runoff Depth=3.31"
Flow Length=366' Tc=12.7 min CN=71 Runoff=2.46 cfs 9,606 cf

Subcatchment51: Runoff Area=39,109 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=400' Tc=11.5 min CN=70 Runoff=2.79 cfs 10,452 cf

Subcatchment52: Runoff Area=55,015 sf 0.00% Impervious Runoff Depth=3.51"
Flow Length=379' Tc=9.1 min CN=73 Runoff=4.58 cfs 16,082 cf

Subcatchment53: Southern Array Runoff Area=185,000 sf 0.00% Impervious Runoff Depth=3.31"
Flow Length=569' Tc=10.8 min CN=71 Runoff=13.89 cfs 50,977 cf

Reach 1R: 24" HDPE Avg. Flow Depth=1.44' Max Vel=8.68 fps Inflow=21.23 cfs 76,939 cf
24.0" Round Pipe n=0.011 L=60.7' S=0.0082 '/' Capacity=24.26 cfs Outflow=21.03 cfs 76,939 cf

Reach 3R: 12" HDPE Avg. Flow Depth=0.41' Max Vel=12.23 fps Inflow=3.69 cfs 13,926 cf
12.0" Round Pipe n=0.011 L=47.5' S=0.0632 '/' Capacity=10.58 cfs Outflow=3.68 cfs 13,926 cf

Reach 6R: Culvert Avg. Flow Depth=0.42' Max Vel=14.08 fps Inflow=10.01 cfs 49,741 cf
48.0" Round Pipe n=0.010 L=34.5' S=0.0522 '/' Capacity=426.54 cfs Outflow=10.00 cfs 49,741 cf

Reach N-1: N-Swale Avg. Flow Depth=0.28' Max Vel=6.80 fps Inflow=5.44 cfs 19,196 cf
n=0.022 L=341.0' S=0.0801 '/' Capacity=167.05 cfs Outflow=5.33 cfs 19,196 cf

Reach N-2: N-Swale Avg. Flow Depth=0.40' Max Vel=4.12 fps Inflow=5.33 cfs 19,196 cf
n=0.069 L=170.0' S=0.1982 '/' Capacity=83.81 cfs Outflow=5.18 cfs 19,196 cf

Reach OS-N: Inflow=2.46 cfs 9,606 cf
Outflow=2.46 cfs 9,606 cf

Reach R-1: Road Swake Avg. Flow Depth=0.61' Max Vel=8.73 fps Inflow=17.18 cfs 57,743 cf
n=0.022 L=206.0' S=0.0549 '/' Capacity=107.40 cfs Outflow=16.74 cfs 57,743 cf

Reach R-2: Road Swale Avg. Flow Depth=0.81' Max Vel=5.70 fps Inflow=16.74 cfs 57,743 cf
n=0.022 L=165.0' S=0.0170 '/' Capacity=59.74 cfs Outflow=16.56 cfs 57,743 cf

Reach R-3: Road Swale Avg. Flow Depth=0.59' Max Vel=8.75 fps Inflow=16.56 cfs 57,743 cf
n=0.022 L=273.0' S=0.0557 '/' Capacity=108.21 cfs Outflow=16.30 cfs 57,743 cf

Reach R-4: Road Swale Avg. Flow Depth=0.69' Max Vel=7.02 fps Inflow=16.30 cfs 57,743 cf
n=0.022 L=178.0' S=0.0309 '/' Capacity=80.61 cfs Outflow=16.05 cfs 57,743 cf

Reach W1: Wetland - East Inflow=41.89 cfs 218,403 cf
Outflow=41.89 cfs 218,403 cf

Pond 1P: Basin 1 Peak Elev=839.23' Storage=24,138 cf Inflow=21.79 cfs 80,392 cf
Discarded=0.05 cfs 2,273 cf Primary=10.59 cfs 74,515 cf Outflow=10.65 cfs 76,788 cf

Total Runoff Area = 836,404 sf Runoff Volume = 233,886 cf Average Runoff Depth = 3.36"
99.93% Pervious = 835,836 sf 0.07% Impervious = 568 sf

Summary for Pond 1P: Basin 1

Inflow Area = 279,727 sf, 0.20% Impervious, Inflow Depth = 3.45" for 100-Year event
Inflow = 21.79 cfs @ 12.18 hrs, Volume= 80,392 cf
Outflow = 10.65 cfs @ 12.43 hrs, Volume= 76,788 cf, Atten= 51%, Lag= 15.2 min
Discarded = 0.05 cfs @ 12.43 hrs, Volume= 2,273 cf
Primary = 10.59 cfs @ 12.43 hrs, Volume= 74,515 cf

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 839.23' @ 12.43 hrs Surf.Area= 8,422 sf Storage= 24,138 cf

Plug-Flow detention time= 89.7 min calculated for 76,788 cf (96% of inflow)
Center-of-Mass det. time= 64.8 min (901.0 - 836.2)

Volume	Invert	Avail.Storage	Storage Description
#1	834.00'	31,041 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
834.00	264	96.0	0	0	264
836.00	4,315	396.2	3,764	3,764	12,033
838.00	6,805	433.9	11,026	14,790	14,658
840.00	9,522	471.6	16,251	31,041	17,521

Device	Routing	Invert	Outlet Devices
#1	Discarded	834.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	836.00'	**24.0" Round Culvert** L= 85.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 836.00' / 826.00' S= 0.1176 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#3	Device 2	836.00'	**4.0" Vert. Orifice/Grate X 3.00** C= 0.600
#4	Device 2	837.50'	**12.0" Vert. Orifice/Grate X 2.00** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 12.43 hrs HW=839.23' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=10.58 cfs @ 12.43 hrs HW=839.23' (Free Discharge)
└**2=Culvert** (Passes 10.58 cfs of 17.82 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 2.21 cfs @ 8.42 fps)
  └**4=Orifice/Grate** (Orifice Controls 8.38 cfs @ 5.33 fps)

PART III – RIPRAP SIZING CALCULATIONS

RIPRAP Sizing Calculations

Large Capacity Ground Mounted Solar, Sizer Dr - Wales, MA
ASE# 2018-137

FES1

Do=	1	ft
Q=	3.68	cfs (100-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	14.26	ft

$W=3Do+0.4La$

W=	8.70	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.23	ft
	2.73	in

FES2

Do=	2	ft
Q=	10.68	cfs (100-yr Storm)
Tw=	1	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	22.42	ft

$W=3Do+0.4La$

W=	14.97	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.19	ft
	2.24	in

PART IV – SUPPLEMENTAL DOCUMENTATION

DEP Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

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[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

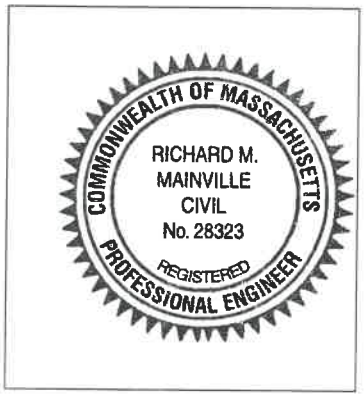
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date 2/11/19

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☒ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☒ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☒ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

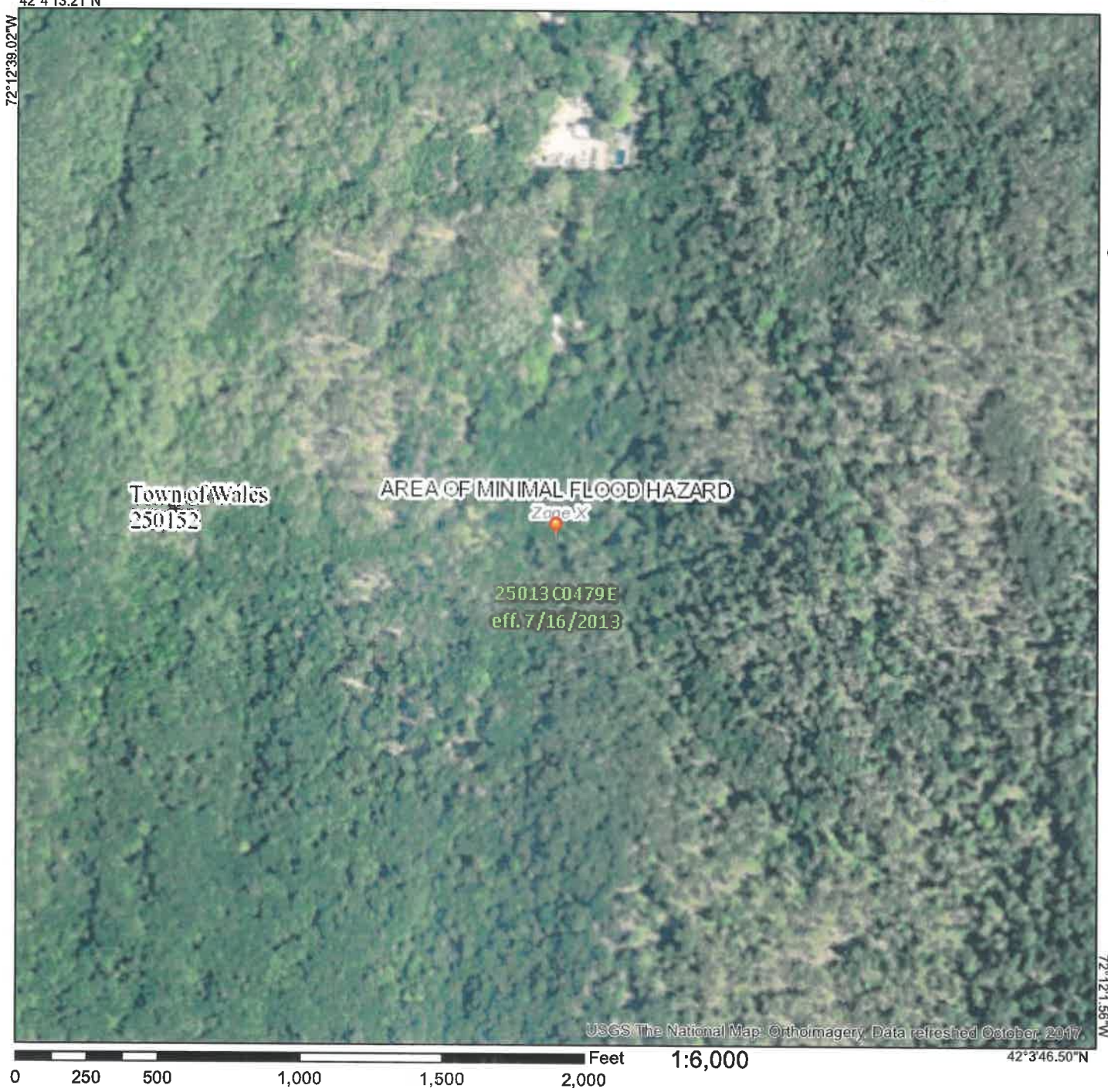
☐ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Flood Insurance Rate Map

National Flood Hazard Layer FIRMette

FEMA



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/31/2019 at 3:43:06 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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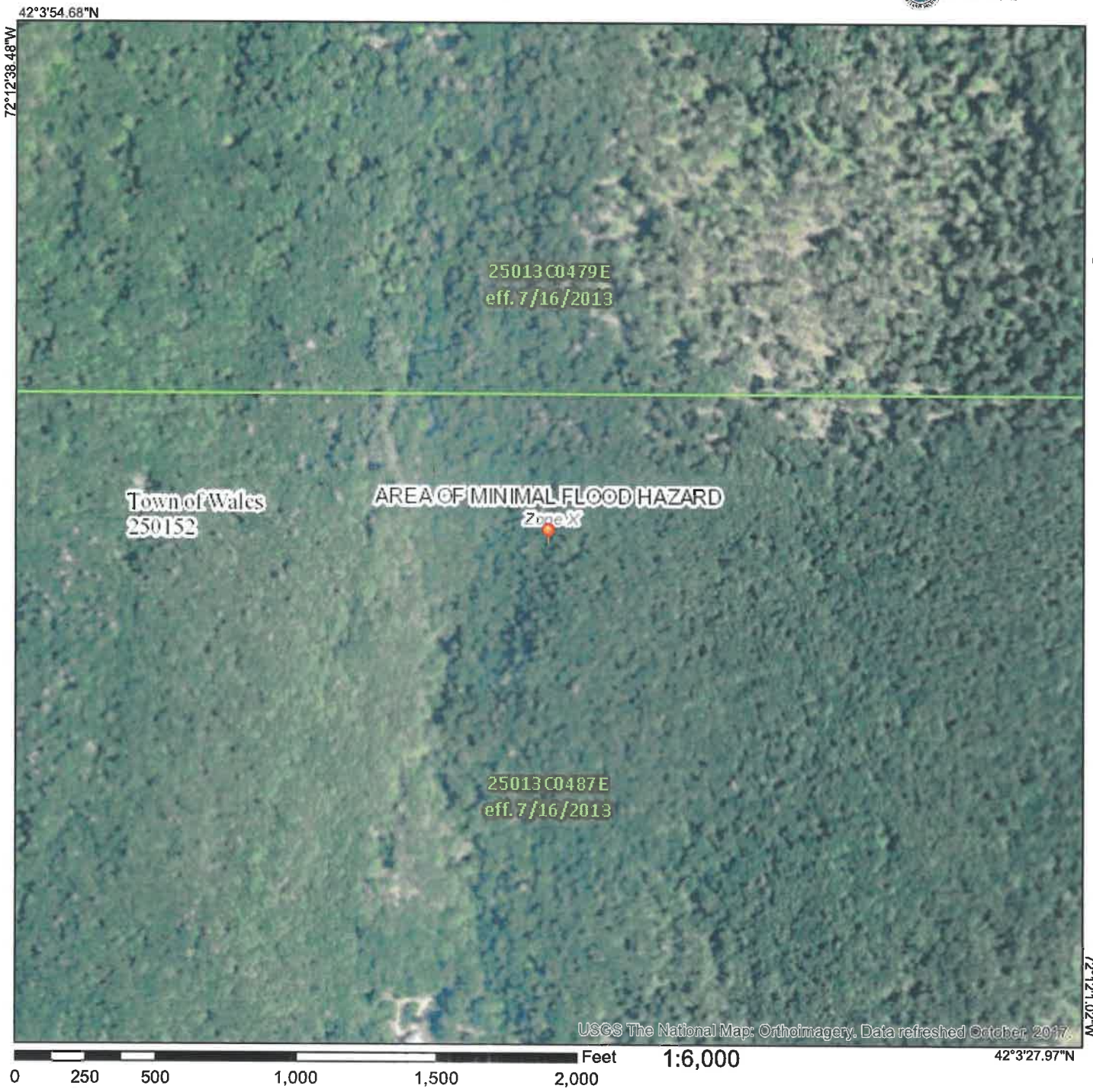
National Flood Hazard Layer FIRMette



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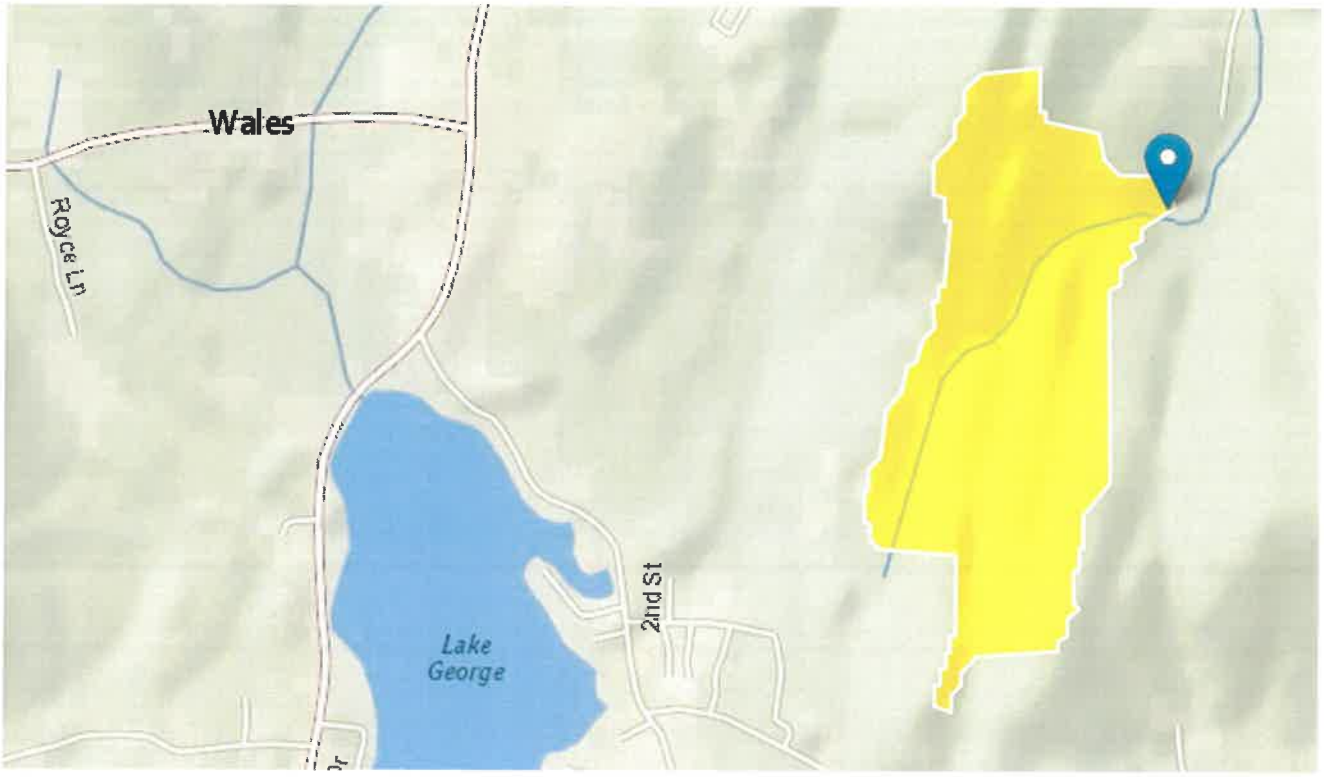
StreamStats Report for Wetland Crossing

StreamStats Report

Region ID: MA
Workspace ID: MA20190123163650173000
Clicked Point (Latitude, Longitude): 42.06644, -72.20671
Time: 2019-01-23 11:39:25 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.14	square miles
ELEV	Mean Basin Elevation	984	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	0	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	0	dimensionless
BSLDEM250	Mean basin slope computed from 1:250K DEM	7.803	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.14	square miles	0.16	512
ELEV	Mean Basin Elevation	984	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	0	percent	0	32.3

Peak-Flow Statistics Disclaimers [Peak Statewide 2016 5156]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errorsOne or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Statewide 2016 5156]

Statistic	Value	Unit
2 Year Peak Flood	13.3	ft^3/s
5 Year Peak Flood	23.4	ft^3/s
10 Year Peak Flood	32	ft^3/s
25 Year Peak Flood	45.2	ft^3/s
50 Year Peak Flood	56.4	ft^3/s
100 Year Peak Flood	68.9	ft^3/s
200 Year Peak Flood	82.7	ft^3/s
500 Year Peak Flood	103	ft^3/s

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Flow-Duration Statistics Parameters [Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.14	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0	square mile per mile	0	1.29
MAREGION	Massachusetts Region	0	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	7.803	percent	0.32	24.6

Flow-Duration Statistics Disclaimers [Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report [Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
50 Percent Duration	0.129	ft^3/s
60 Percent Duration	0.0729	ft^3/s
70 Percent Duration	0.0325	ft^3/s
75 Percent Duration	0.0225	ft^3/s
80 Percent Duration	0.0189	ft^3/s
85 Percent Duration	0.0132	ft^3/s
90 Percent Duration	0.00919	ft^3/s
95 Percent Duration	0.00485	ft^3/s
98 Percent Duration	0.00274	ft^3/s
99 Percent Duration	0.0018	ft^3/s

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

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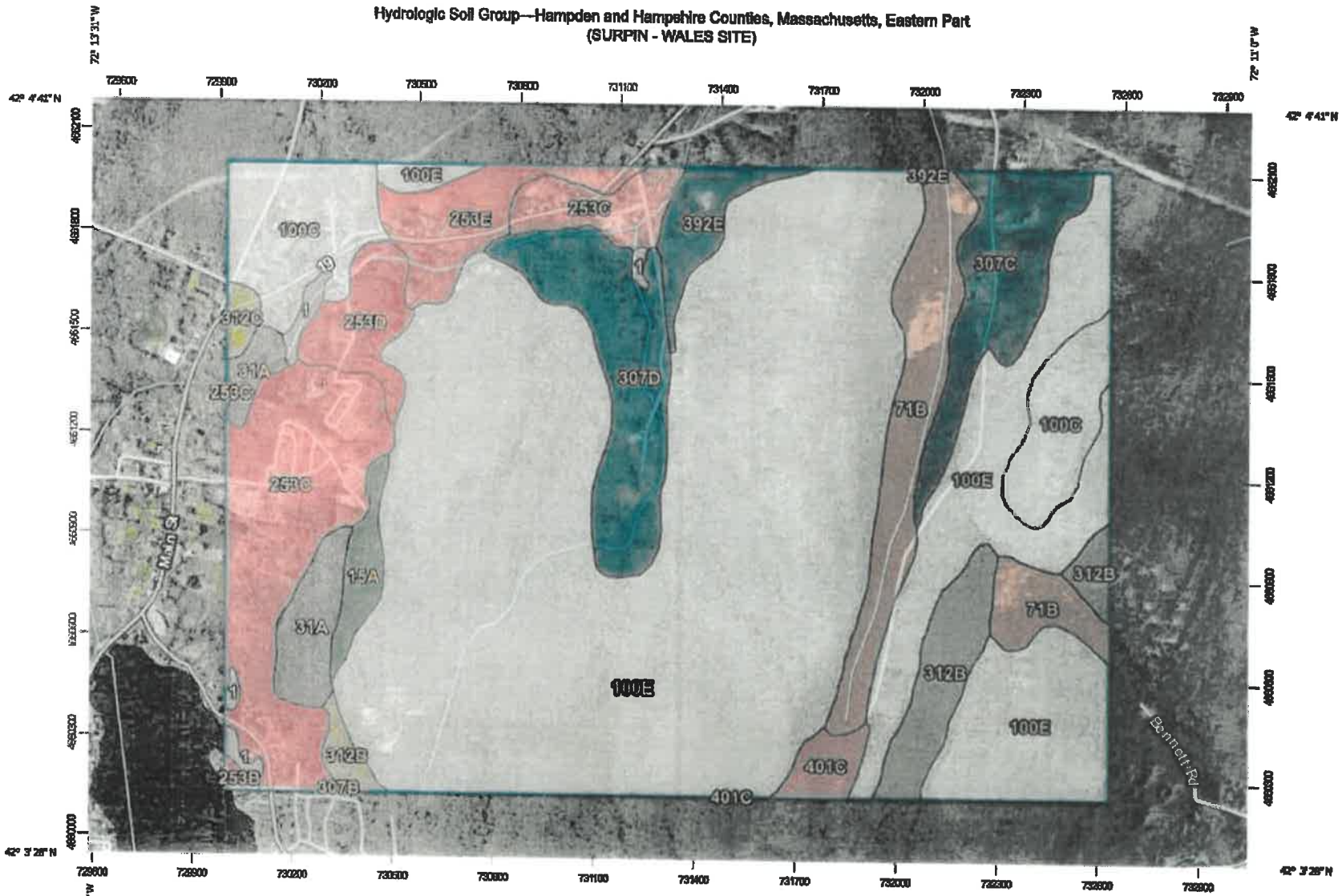
Application Version: 4.3.0

NRCS Soil Survey Report

Hydrologic Soil Group—Hampden and Hampshire Counties, Massachusetts, Eastern Part
(SURPIN - WALES SITE)



Map Scale: 1:15,800 if printed on A landscape (11" x 8.5") sheet.

N

0 200 400 800 1200 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Hampden and Hampshire Counties, Massachusetts, Eastern Part
Survey Area Data: Version 13, Sep 11, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 9, 2011—May 12, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
	Water		6.8	0.6%
19A	Scarboro-Rippowam complex, 0 to 3 percent slopes	A/D	11.9	1.0%
71A	Walpole sandy loam, 0 to 3 percent slopes	B/D	25.7	2.1%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	66.4	5.6%
100C	Brookfield-Brimfield-Rock outcrop complex, strongly sloping		71.8	5.9%
100E	Brookfield-Brimfield-Rock outcrop complex, steep		692.3	56.7%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	1.6	0.1%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	109.8	9.0%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	22.9	1.9%
253E	Hinckley loamy sand, 25 to 35 percent slopes	A	30.7	2.5%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	0.2	0.0%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	C	46.8	3.8%
307D	Paxton fine sandy loam, 15 to 25 percent slopes, extremely stony	C	60.4	5.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	39.1	3.2%
312C	Woodbridge fine sandy loam, 8 to 15 percent slopes, extremely stony	C/D	4.3	0.4%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	C	18.3	1.5%
401C	Brookfield fine sandy loam, 8 to 15 percent slopes, extremely stony	A	10.1	0.8%
Totals for Area of Interest			1,221.0	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

TSS Removal Worksheet

TSS TO REMOVAL DETENTION BASIN

A	B	C	D	E
BMP	**TSS Removal Rate**	**Starting TSS Load***	**Amount Removed (B x C)**	**Remaining Load (C - D)**
Infiltration Basin (w/forbay)	80.0%	100.0%	80.0%	20.0%
		Total TSS Removal =	80.0%	

* Equals remaining load from previous BMP (E)

PART V – MAPS

Watershed Map Existing Conditions

Watershed Map Developed Conditions

PART VI – LONG TERM POLLUTION PREVENTION AND STORMWATER SYSTEM OPERATION AND MAINTENANCE PLAN

Long Term Pollution Prevention and Stormwater System Operation and Maintenance Plan

TABLE OF CONTENTS

Preface:

The goal of this manual is to improve water quality by initiating performance standards for the operation and maintenance of stormwater management structures, facilities, and recognized practices. The stormwater performance standards are set up to meet the statutory and regulatory authorities of the Department of Environmental Protection, including the Wetland Protection Act, surface water discharge permits under the Clean Waters Act, the 401 certification program for fill in wetlands, and the 401 certification of federal permits based on the water quality standards.

The local Conservation Commission and the Department of Environmental Protection are responsible for ensuring the protection of wetlands through the issuance of permits for activities in flood plains and in or near wetlands, as per the Wetlands Protection Act, MGL c.131 s. 40. Proposed work within a resource area or a one hundred (100') foot buffer zone requires an order of conditions.

Resource areas include freshwater and coastal wetlands, banks, beaches, and dunes bordering on estuaries, streams, riverfront, ponds, lakes, or the ocean; lands under any of these bodies of water; land subject to tidal action, coastal storm flowage, or flooding.

The discharge of pollutants to water of the Commonwealth without a permit is prohibited under the state Clean Waters Act, MGL c. 21, ss 26-53. Stormwater discharges are subject to regulations when two criteria are met under 314 CMR 3.04(2). First, there must be "conveyance or system of conveyances (including pipes, ditches, and channels) primarily used for collecting and conveying stormwater runoff." 314 CMR 3.04(2)(a). Second, the stormwater runoff must be "contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, or oil and grease," or, be designated on a case-by-case basis. Such designations must be made when the "stormwater discharge" is subject to effluent or toxic pollutant limitations, is located in an industrial plant area, or may be a significant contributor of pollutants to waters of the Commonwealth. Any activity resulting in a discharge to waters of the United States must comply with Section 401 of the Federal Clean Water Act and comply with state water quality standards. All stormwater discharges must be set back from the receiving waters or wetlands and best management practices (BMP) must be implemented. A permit is required for any stormwater discharge to an Outstanding Resource Water (ORW) which meets the regulatory definition in 314 CMR 3.04(2). Outstanding Resource Waters are defined under Surface Water Quality Standards 314 CMR 4.06 and include public surface water supplies, coastal and some inland Areas of Critical Environmental Concern (ACECs), and certified vernal pools.

This manual is set up to explain how to operate and maintain Best Management Practices that control erosion and minimize delivery of sediment and other pollutants to surrounding water and air.

Chapter 1 is an introduction to the site and describes the Best Management Practices used on this site.

Chapter 2 outlines the inspection and maintenance schedules for the site.

Chapter 3 outlines the operation and function of the Best Management Practices.

Chapter 4 describes how and when the Best Management Practices should be inspected and how frequently they must be maintained and cleaned.

1. Project Description

Sunpin Holdings, LLC intends to develop a portion of the property located at southern end of Sizer Drive in Wales, MA. The project consists of the construction of a large-scale ground-mounted solar electric generating facility on parcels of land owned by Barbara Lee.

The site is situated on the southern end of Sizer Drive and the subject parcels are comprised of approximately 100± acres of land. The existing site conditions can be classified as a single family residence and undeveloped woodlands located in General Rural Zone.

The property is bounded on the north by the end of Sizer Drive and residential lots, and on the east south and west by vacant parcels being used for vacant land.

Vegetation throughout the site mainly consists of mature forest with a mixture of deciduous and evergreen species. Topography slopes in all directions from a high point in the central portion of the site.

The property includes various wetland resources described in the enclosed wetland resource evaluation prepared by EcoTec, Inc. One wetland crossing, alterations and replication is proposed as part of the project and erosion control barriers are proposed throughout the work area to contain sediment carried in stormwater runoff and to provide a limit of work barrier.

The proposed project consists the construction of solar panels, grading, drainage and erosion controls. The runoff from the proposed site will either flow into proposed detention basins or maintain existing drainage paths.

Stormwater runoff from the development will be collected and treated in a number of Best Management Practices (BMP's), including detention basins.

To control erosion and minimize delivery of sediment and other pollutants into the atmosphere and adjacent wetlands, Best Management Practices (BMP's) have been provided within the site's stormwater management system. These practices include but are not limited to:

- Detention Basin;
- Drop Inlet and outlet
- Grass Swales

This manual is designed to help responsible parties become aware of urban non-point pollution problems and to provide detailed information about operating and maintaining stormwater management practices. The success of the Best Management Practices is dependent on their continued operations and maintenance.

2. Maintenance Requirements

- Owner
  The owner(s) of the BMP's shall be the person, persons, trust, corporation, etc., or their successors who have title to the land on which the BMP is located. It is anticipated that all BMP's will be owned and maintained by Sunpin Holdings, LLC, until the title of the land upon which they are located are transferred. At that time, the purchaser of the property will assume all responsibilities set forth within this document.

- Operation and Maintenance Responsibilities

  - The party or parties responsible for the funding, operation and maintenance of the BMP's shall be the OWNER or their designees.
  - BMP's each have specific maintenance requirements to ensure long-term effectiveness. These stormwater management systems will be operated, inspected and maintained on a regular basis by a qualified professional with expertise in inspecting drainage system components. All of the stormwater BMP's shall be kept in good working order at all times.
  - A maintenance agreement providing for the funding, operation and maintenance of all the stormwater management BMP's shall be provided.

- Source of Funding for Operation and Maintenance
  - The party or parties responsible for the funding, operation and maintenance of the BMP's shall be the OWNER or their designees.
  - A maintenance agreement providing for the funding, operation and maintenance of all the stormwater management BMP's shall be provided.
  - Approximate estimated annual maintenance costs for the site are:
    - Detention Basin - $750
    - Grass Swales $500
    - Drop Inlet $200

- Schedule for Inspection and Maintenance:
  - BMP's each have specific maintenance requirements to ensure long-term effectiveness. These stormwater management systems will be operated, inspected and maintained on a regular basis in accordance with this manual. All of the stormwater BMP's shall be kept in good working order at all times.
  - As a minimum, the owner shall follow the general guidelines outlined herein for the BMP's provided on this site.
  - An Operation and Maintenance log must be maintained for the last three years, outlining inspections, repairs, replacement and disposal for each Best Management Practice (BMP). In the case of disposal, the log shall indicate the type and material and the disposal location. This rolling log shall be made available to the Mass DEP and/or the Planning Board upon request.
  -

3. Operation of Best Management Practices

Detention Basins

Are stormwater runoff impoundments that are constructed over permeable soils which allow for the recharge of treated runoff into the groundwater. The functions of a detention basin include:

- Provide groundwater recharge;
- Reduce local flooding;
- Preserve the natural water balance of the site.

4. Inspection and Maintenance of Best Management Practices

Grass Swale

At a minimum, the grass channel shall be inspected after every major storm event (1-inch of rain or greater) for the first six (6) months and twice per year thereafter. Sediment and debris shall be removed from the grass channel once per year. Sediment should be removed from the channel by hand methods in a manner to limit the disturbance of vegetation and underlying soils. Grass within the channel shall be mowed as necessary to maintain the grass height between three (3) and six (6) inches. Remove grass clippings and inspect for signs of erosion and the formation of rills and/or gullies. Reseed or re-sod with an alternative grass species if the original grass cover is not successfully established. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket or similar practice to ensure that no scour occurs in the grass channel, while the seeds germinate and develop roots.

Deep Sump Drop Inlet with outlet pipe, flared end section and rip rap

At a minimum, deep sump drop inlet shall be inspected four times per year. Inlet inspection should be conducted at the end of the foliage and snow removal seasons. Each structure should be cleaned whenever the depth of sediment deposits is greater than or equal to one half the depth of the sump from the bottom of the structure to the bottom of the lowest pipe invert. Structures shall be inspected for a buildup of sediments, oils and debris, cracks, breaks, or deformations. Any function of the catch basin or manhole structure that is not in working order will be replaced with similar materials, as per the detail, to prevent the storm sewer system from failing.

The sump will be cleaned by means of hand held shovels, scallop shovel and/or vacuum trucks. The grate opening shall be clear of any foreign or lodged object. Sands and salts used in the winter will be removed from the catch basin sumps in the early spring. Leaves, pine needles, and branches brought down by autumn winds, rain, and cold weather will be removed from the catch basins sumps in the late fall.

Collected sediment and debris will be properly disposed of per local, state and federal requirements. Any sediment and debris removed from a catch basin deemed to be contaminated must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

Sediment Forebay

At a minimum, the forebay shall be inspected after every major storm event (1-inch of rain or

greater) for the first six (6) months, then monthly thereafter. Sediment and debris should be removed a minimum of four (4) times per year, starting in the spring and spaced at even time increments until the late fall season, thereafter.

Rip-rap area between the flared end section and the gabion wall, as well as the gabion wall itself shall be inspected within the sediment forebay. Riprap should be checked after every major storm event (1-inch of rain or greater) for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap has been damaged, it should be repaired immediately before further damage can take place.

Collected sediment and debris will be properly disposed of per local, state and federal requirements. Any sediment and debris removed from the sediment forebay deemed to be contaminated must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

Infiltration Basin- Detention Basin (including drawdown device, flared end sections and rip-rap apron)

At a minimum shall be inspected after every major storm event (1-inch of rain or greater) for the first six (6) months, then in the spring and fall of every year, thereafter. Note how long water remains standing in basin after a storm; standing water within the basin >72 hours after storm events suggests potential clogging and should be immediately addressed. Also, check for signs of differential settlement, cracking, erosion, leakage in embankments, tree growth in embankments, condition of riprap aprons, sediment accumulation and the health of the turf. If necessary, the drawdown device in each infiltration basin shall be utilized to conduct the required maintenance.

At a minimum, inspect drawdown devices, flared end sections and rip-rap aprons associated with the infiltration basins at least twice a year. Inspect the drawdown device for sediment collection, erosion, and overall operation. Inspect the flared end sections for condition of the riprap stone, signs of erosion, integrity and joint connection with the drawdown device pipe, and vegetative growth. Riprap outfalls should be checked after every major storm event (1-inch of rain or greater) for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap has been damaged, it should be repaired immediately before further damage can take place.

Infiltration basins shall be mowed a minimum of twice per year. Grass clippings and accumulated organic matter should be removed to a non-sensitive area. Repairs and reseeding should be done as required. Sediment and debris should be removed manually when infiltration basin is thoroughly dry, a minimum of once per year or when the sediment level reaches a depth of 3".

At a minimum, inspect and clean pretreatment devices associated with the infiltration basins at least twice a year.

Grass Swales

At a minimum, the grass channel shall be inspected after every major storm event (1-inch of rain or greater) for the first six (6) months and twice per year thereafter. Sediment and debris shall be removed from the grass channel once per year. Sediment should be removed from the channel by hand methods in a manner to limit the disturbance of vegetation and underlying soils. Grass within the channel shall be mowed as necessary to maintain the grass height between three (3) and six (6) inches. Remove grass clippings and inspect for signs of erosion and the formation of rills and/or gullies. Reseed or re-sod with an alternative grass species if the original grass cover is not successfully established. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket or similar practice to ensure that no scour occurs in the grass channel, while the seeds germinate and develop roots.

Best Management Practices (BMP) Inspection Log

General Information			
Project Name	Sunpin holding, LLC - Large-Scale Solar Photovoltaic Facility		
Location	40 Sizer Drive, Ware, MA		
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Type of Inspection: ❑ Regular ❑ Emergency			
Weather Information			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *The structural BMPs are identified on the BEST MANAGEMENT PRACTICES LOCUS included within the LONG TERM POLLUTION PREVENTION & STORMWATER SYSTEM OPERATION & MAINTENANCE PLAN. Carry a copy of the Locus map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1	Detention Basin	❑Yes ❑No	❑Yes ❑No	
2	Drop Inlet	❑Yes ❑No	❑Yes ❑No	
3	Flared End Sections	❑Yes ❑No	❑Yes ❑No	
4	Grass Swales	❑Yes ❑No	❑Yes ❑No	
5	Outlet Structures	❑Yes ❑No	❑Yes ❑No	
6	Access Road Culvert	❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	
8		❑Yes ❑No	❑Yes ❑No	
9		❑Yes ❑No	❑Yes ❑No	
10		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
2	Are storm drain inlets properly working?	❑Yes ❑No	❑Yes ❑No	
3	Is trash/litter from site areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
4	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
5	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
5	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
6	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature: _____ **Date:** _____