STORMWATER MANAGEMENT REPORT

RANDALL ROAD EXTENSION
READING, MA 01867

Prepared For:

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NARRATIVE

The project will combine existing lots Map15 parcels 5,6,7,8 with Map 10 parcels 294 and 296. All lots are presently vacant and wooded with the exception of Map 10 parcel 294 the current use of which is a residential dwelling - #25 Springvale Rd.

Randall Road by extended by approximately 200 feet. The existing cul-de-sac located in front of #39 Randall Rd will be removed and a new cul-de-sac will be constructed at the end of the 200 feet extension. Three new dwellings will be constructed along the extended road.

The total area subject to development is 83,760 sf. However, approximately 20% of that area will remain undisturbed. The existing impervious area consists of the existing cul-de-sac and the roof area at #25 Springvale Rd. This area is equal to 6,835 sf. The remainder of the site is wooded and equals 76,925 sf.

A portion of the wooded area has been delineated as wetland and is subject to the jurisdiction of the Reading Conservation Commission. The applicant has appeared before the Conservation Commission and the Wetland Boundary has been approved.

The topography of the site generally slopes from south to north. A drainage ditch abuts the northerly boundary of the project. The high point of the site is approximately elevation 262 located near the dwelling at #25 Springvale Rd. The low point is approximately elevation 248 located in the northwest corner of Map 15 Parcel 5.

A soil survey was conducted using the USDA Web Soil Survey resources. The project is comprised of two main soil types. Tisbury Silt Loam occupies most of the project north of the undeveloped Randall Rd.. Haven Urban Land Complex lies mostly south of Randall Rd. A copy of the survey is attached (Appendix B). Five test pits were excavated throughout the site and in general confirm the findings of the Web Survey. Test pit data is also attached.

This report will document compliance with Massachusetts DEP Stormwater Management Standards.

STORMWATER MANAGEMENT STANDARDS

STANDARD 1 NO UNTREATED DISCHARGES

All discharges from impervious surfaces shall be treated in accordance with the Massachusetts stormwater management standards.

STANDARD 2 PEAK RATE ATTENUATION

Existing Conditions

The existing site was analyzed using the low point of the site as the point source discharge. This low point is located in the Northwest corner of Map 15 Parcel 5. Approximately 60,000 square feet of offsite area located west of our project was included in the analysis. This offsite area also discharges to the low point of analysis.

The existing site was modeled as one subcatchment 2S.

Proposed Conditions

The proposed development consists of the creation of three new residential lots and a Right of Way. The existing house located at #25 Springvale will remain.

The proposed developed site was divided into four subcatchments described as follows.

Subcatchment 2S (Trib to Wetland)- This subcatchment consists of the northerly portion of the site which discharges directly to the analysis point. This subcatchment also includes the 60,000 square feet of offsite area noted under existing conditions above.

Subcatchment 5S (Trib to Dbasin) This subcatchment consists of the area discharging to the detention basin.

Subcatchment 6s (Trib to TB1) This subcatchment consists of the area discharging to the Tree Box Filter 1.

Subcatchment 7s (Trib to TB2) This subcatchment consists of the area discharging to the Tree Box Filter 2.

Pond 2P (Detention Basin) was routed through the culvert under Randall Rd (Reach 11R), sediment forebay (11P) and Water Quality Swale (9P)

Water quality swale (9P), Tree Box Filter (TB2) and Subcatchment (2S) were combined utilizing Link 7L for comparison to existing condition Subcatchment 2S.

PEAK RATE OF RUNOFF COMPARISON TABLE

Comparison of Existing Subcatchment 2S to Proposed Link 7L

STORM FREQUENCY YEAR (RAINFALL)	EXISTING CONDITION 2S (CFS)	PROPOSED CONDITION 7L (CFS)
2 (3.1")	0.35	0.35
10(4.5")	1.43	1.28
25(5.3")	2.25	2.08
100(6.5")	3.64	3.30

STANDARD 3 RECHARGE

Target Depth Factor

Existing soils on site are Tisbury Silt Loam (C soil) and Haven Urban Land Complex (A soil).

All proposed impervious areas lie over the Tisbury Soil with the exception of the Lot 1 dwelling which will be recharged via cultic chambers. Therefore the Target Depth Factor = .25

Thus the required Groundwater Recharge for C soil = 0.25 inches X impervious area.

Proposed Impervious area for the entire site (excluding roof runoff) = 15,579 sf

Groundwater Recharge Required

= 0.25 inches/ 12 inches per foot X 15,779 sf = 328.7 cubic feet

Capture Area Adjustment Required

Due to the fact that not all of the impervious area is discharging to the detention basin a capture area adjustment must be made.

Ratio of total site impervious area to impervious area discharging to detention basin=

Total Area = 15,779 sf
Area discharging to detention basin = 10,989 sf

Ratio= 15779/10989 = 1.43

Adjusted required recharge volume = 1.43 X 328.7 = 470.0 cf

Sizing storage volume (simple dynamic method see Hydrocad analysis attached)

Required rainfall to generate recharge volume in peak 2 hours = 1.15"

Storage below outlet structure orifice elevation 245.61 = 340 cf
Exfiltration = .003 AF = 130.7 cf

130.7 + 340 = 470.7 > 470.0 OK

Summary for Subcatchment 5S: TRIB TO LOT 1

Runoff = 0.25 cfs @ 12.11 hrs, Volume= 0.011 af, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Type III 24-hr Rainfall=1.15"

	Area (sf)	CN	Description
*	10,989	98	Impervious
	10,989		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0299	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
0.4	24	0.0338	0.92		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.6	94	0.0338	2.76		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
7.7	193	Total			

Summary for Pond 2P: D POND

[82] Warning: Early inflow requires earlier time span
[79] Warning: Submerged Pond 5P Primary device # 1 OUTLET by 0.34'

Inflow Area = 0.252 ac,100.00% Impervious, Inflow Depth > 0.52"
Inflow = 0.25 cfs @ 12.11 hrs, Volume= 0.011 af
Outflow = 0.03 cfs @ 12.78 hrs, Volume= 0.003 af, Atten= 88%, Lag= 40.2 min
Discarded = 0.03 cfs @ 12.78 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 254.34' @ 12.78 hrs Surf.Area= 528 sf Storage= 340 cf

Plug-Flow detention time= 35.6 min calculated for 0.003 af (29% of inflow)
Center-of-Mass det. time= 8.8 min (734.9 - 726.1)

Volume	Invert	Avail.Storage	Storage Description
#1	253.33'	3,365 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
253.33	174	0	0
254.00	378	185	185
256.00	1,254	1,632	1,817
257.00	1,842	1,548	3,365

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.33'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	254.61'	**3.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.03 cfs @ 12.78 hrs HW=254.34' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=253.33' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Hydrograph for Pond 2P: D POND

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
1.00	0.00	0	253.33	0.00	0.00	**0.00**
2.00	0.00	0	253.33	0.00	0.00	0.00
3.00	0.00	0	253.33	0.00	0.00	0.00
4.00	0.00	0	253.33	0.00	0.00	0.00
5.00	0.00	0	253.33	0.00	0.00	0.00
6.00	0.00	1	253.33	0.00	0.00	0.00
7.00	0.00	1	253.34	0.00	0.00	0.00
8.00	0.00	2	253.34	0.00	0.00	0.00
9.00	0.01	4	253.35	0.01	0.01	0.00
10.00	0.01	6	253.36	0.01	0.01	0.00
11.00	0.02	14	253.41	0.01	0.01	0.00
12.00	**0.14**	**119**	**253.81**	**0.02**	**0.02**	0.00
13.00	**0.02**	**346**	**254.35**	**0.03**	**0.03**	0.00
14.00	0.01	307	254.28	0.03	0.03	0.00
15.00	0.01	257	254.17	0.03	0.03	0.00
16.00	0.01	205	254.05	0.02	0.02	0.00
17.00	0.01	154	253.92	0.02	0.02	0.00
18.00	0.00	107	253.77	0.02	0.02	0.00
19.00	0.00	65	253.63	0.01	0.01	0.00
20.00	0.00	31	253.49	0.01	0.01	0.00
21.00	0.00	4	253.35	0.01	0.01	0.00
22.00	0.00	2	253.34	0.00	0.00	0.00
23.00	0.00	2	253.34	0.00	0.00	0.00
24.00	0.00	2	253.34	0.00	0.00	0.00
25.00	0.00	0	253.33	0.00	0.00	0.00
26.00	0.00	0	253.33	0.00	0.00	0.00
27.00	0.00	0	253.33	0.00	0.00	0.00
28.00	0.00	0	253.33	0.00	0.00	0.00
29.00	0.00	0	253.33	0.00	0.00	0.00
30.00	0.00	0	253.33	0.00	0.00	0.00

Drawdown Analysis

Exfiltration starts at hour 9 and ends at hour 22 = 13 hours

13 hours < 72 hours OK

Mounding Analysis

Mounding Analysis was conducted using the Hantush Equation on line calculator provided by AQTESOLV. Inputs are as follows.

K (hydraulic conductivity) = 39.9 ft/day (loamy sand)
S (specific yield) = 0.16
T (time) = 1 days
H = Thickness of aquifer = 2.67 feet

Length and width of bottom area (assume square for calculation) = 6 X 29 = 174 sf

W (rate of infiltration) = Use Rawls Rate for Loamy Sand = 2.41 inches/hr = 4.82 ft/day

Time when infiltration stops 22 hours = .917 days

Height of Mound is 1.84 feet. Bottom of basin (El 253.33) is set at two feet above existing water table. Therefore mound will not breakout.

Roof Runoff

Lot 1

Roof area = 70 X 28 = 1960 sf

Soil Boundary splits roof. Therefore use average target factor of A and C soil.
(.6 +.25)/2 = .425 = Target Recharge Factor

Water Quality Requirement = 0.5 X impervious area
.5 > .425

Therefore use .5 inches X impervious area

= 0.5 inches/ 12 inches per foot X 1960 sf = 81.7 cubic feet

Groundwater Recharge Provided

Use 2 Cultec contactor 100 HD chambers @ 49.8 cf/chamber

2 X 49.8 = 99.6 cf 99.6 >81.7 **OK**

Lot 2

Roof area = 40' X 40' = 1600 sf

Recharge Target Factor – C soil = .25

Water Quality Requirement = 0.5 X impervious area
.5 > .25

Therefore use .5 inches X impervious area

= 0.5 inches/ 12 inches per foot X 1600 sf = 66.7 cubic feet

Groundwater Recharge Provided

Use 2 Cultec contactor 100 HD chambers @ 49.8 cf/chamber

2 X 49.8 = 99.6 cf

99.6 >66.7 **OK**

Lot 3

Roof area = 30' X 68' = 2,040 sf

Recharge Target Factor – C soil = .25

Water Quality Requirement = 0.5 X impervious area
.5 > .25

Therefore use .5 inches X impervious area

= 0.5 inches/ 12 inches per foot X 2040 sf = 85 cubic feet

Groundwater Recharge Provided

Use 2 Cultec contactor 100 HD chambers per roof @ 49.8 cf/chamber

2 X 49.8 = 99.6 cf

99.6 >85 **OK**

STANDARD 4 WATER QUALITY- TSS REMOVAL

Runoff discharging to water quality swale (FES 1)

Impervious Area = 10,989 sf. (not including roof runoff)

Water Quality Volume (WQV) Required =

10,989 X .5 inches/12 inches per foot = 457.9 cf required.

BMPs Utilized are street sweeping, deep sumps catch basins, sediment forebay and water quality swale (wet). See treatment train next page.

Sedimant Forebay volume required = .1 inches per impervious acre=

((.1inches /12 inch per foot) X 43,560 sf/acre)(10989 sf)/43560 sf) = 91.58 cf required

Volume Provided = 160.9 cf

160.9 cf > 91.58 cf **OK**

Water quality swale volume required = WQV = 457.9 cf

Volume provided = 508.5 cf

508.5 cf > 457.9 cf **OK**

Runoff discharging from treebox filters (TB1 ,TB2)

Water Quality Volume (WQV) Required = 1inch X impervious area.

TB1 impervious area = 2,261 sf TB2 impervious area = 3329 sf

See attached Hydrocad calculation showing treebox filters have a capacity of 1 inch of WQV.

See treatment train attached.

Long Term Pollution Prevention Plan

The Long Term Pollution Prevention Plan has been combined with the Operation and Maintenance Plan. See standard 9.

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: FES 1 Randall Rd. Extention, Reading Ma

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	0.10	1.00	0.10	0.90
Deep Sump and Hooded Catch Basin	0.25	0.90	0.23	0.68
Sediment Forebay	0.25	0.68	0.17	0.51
Water Quality Swale - Wet	0.70	0.51	0.35	0.15
	0.00	0.15	0.00	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: RANDALL RD EXT
Prepared By: JM
Date: 26-Sep-16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: FES 2 Randall Rd. Extention, Reading Ma

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 10%	0.10	1.00	0.10	0.90
Treebox Filter	0.80	0.90	0.72	0.18
	0.00	0.18	0.00	0.18
	0.00	0.18	0.00	0.18
	0.00	0.18	0.00	0.18

Total TSS Removal = 82%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: RANDALL RD EXT
Prepared By: JM
Date: 26-Sep-16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Summary for Subcatchment 6S. TB-1

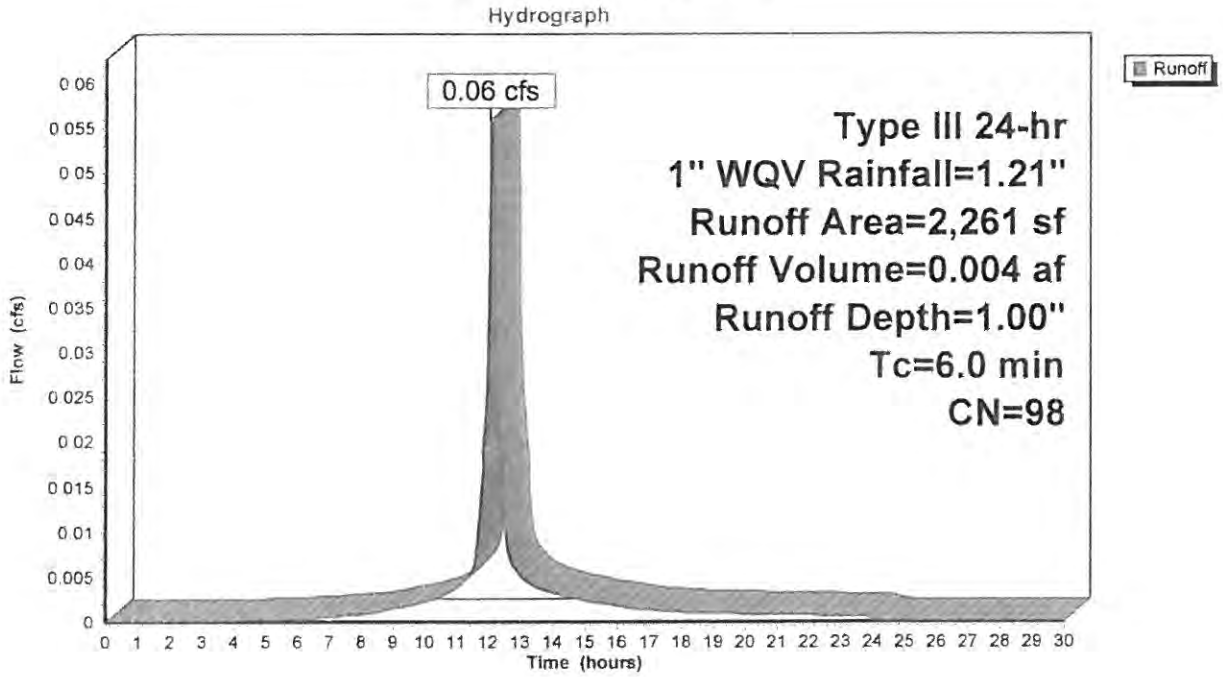
Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.004 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1" WQV Rainfall=1.21"

	Area (sf)	CN	Description
*	2,261	98	
	2,261		100.00% Impervious Area

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

Subcatchment 6S: CB3



Summary for Pond 4P: Filterra 4x4

Inflow Area = 0.052 ac,100.00% Impervious, Inflow Depth = 1.00" for 1" WQV event
Inflow = 0.06 cfs @ 12.09 hrs, Volume= 0.004 af
Outflow = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af, Atten= 7%, Lag= 0.2 min
Primary = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 2.28' @ 12.10 hrs Surf.Area= 0.000 ac Storage= 0.000 af

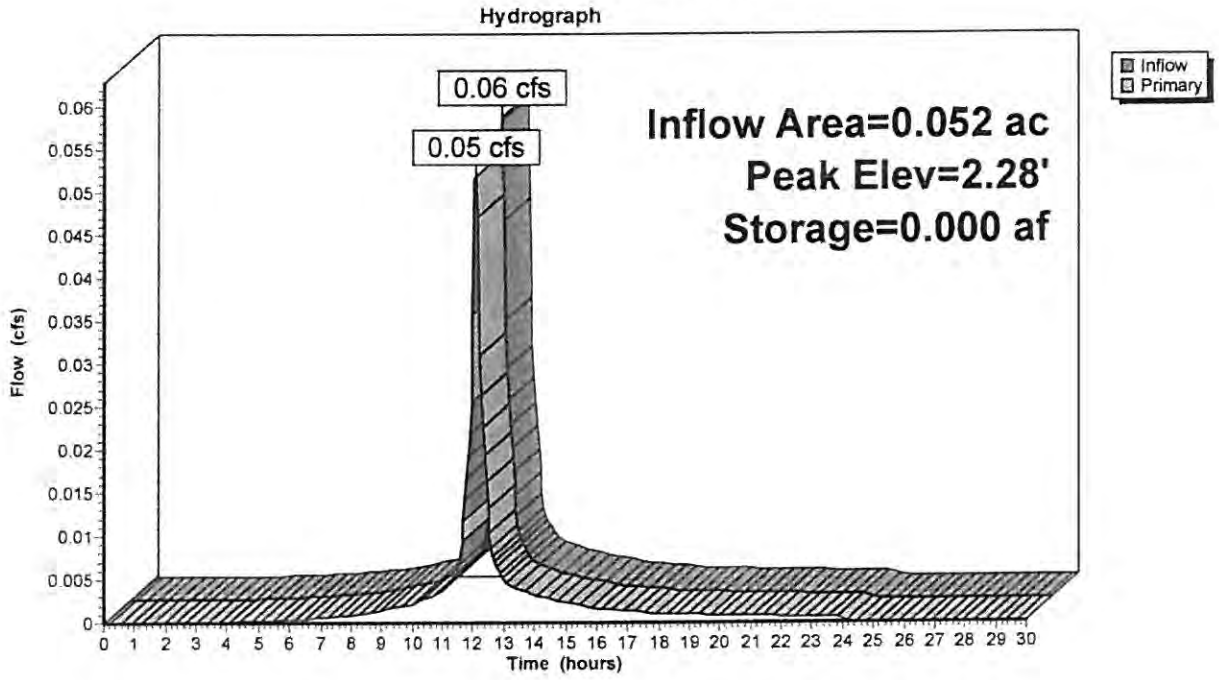
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	2.25'	0.000 af	**4.00'W x 4.00'L x 1.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	2.25'	**140.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.05 cfs @ 12.09 hrs HW=2.28' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Pond 4P: Filterra 4x4



TB-2

Summary for Subcatchment 7S:

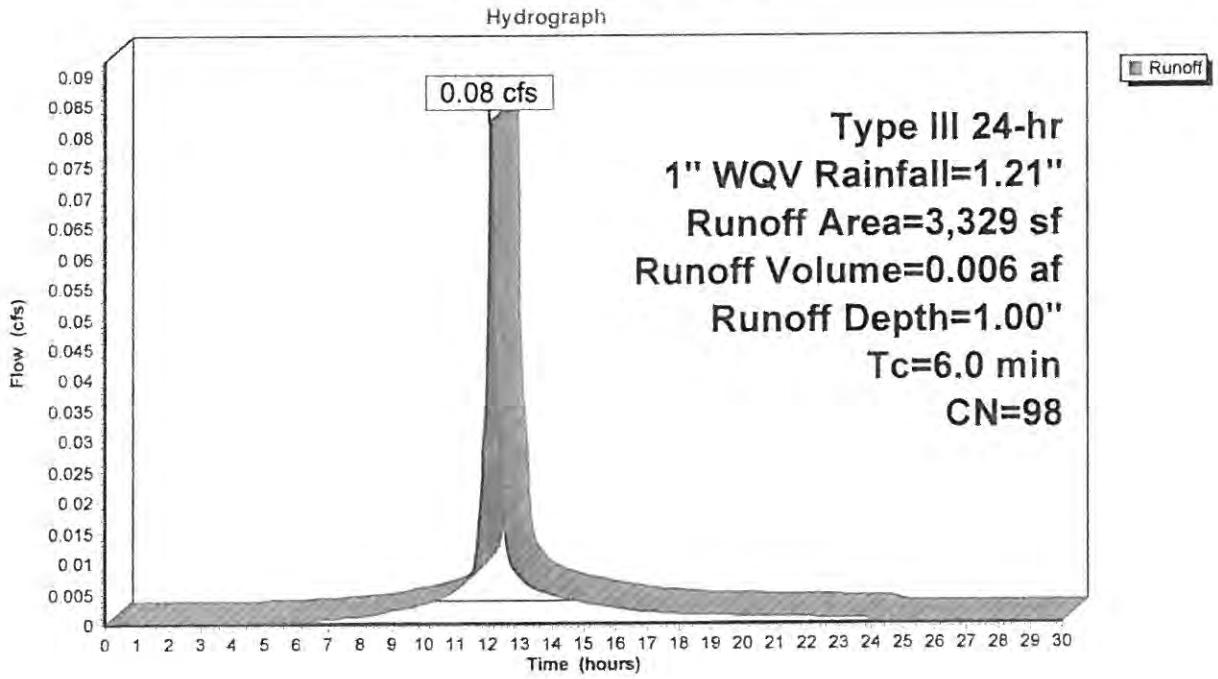
Runoff = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 1" WQV Rainfall=1.21"

	Area (sf)	CN	Description
*	3,329	98	
	3,329		100.00% Impervious Area

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

Subcatchment 7S: CB4



Summary for Pond 5P: Filterra 4x4

Inflow Area = 0.076 ac,100.00% Impervious, Inflow Depth = 1.00" for 1" WQV event
Inflow = 0.08 cfs @ 12.09 hrs, Volume= 0.006 af
Outflow = 0.05 cfs @ 12.00 hrs, Volume= 0.007 af, Atten= 37%, Lag= 0.0 min
Primary = 0.05 cfs @ 12.00 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 3.00' @ 12.19 hrs Surf.Area= 0.000 ac Storage= 0.000 af

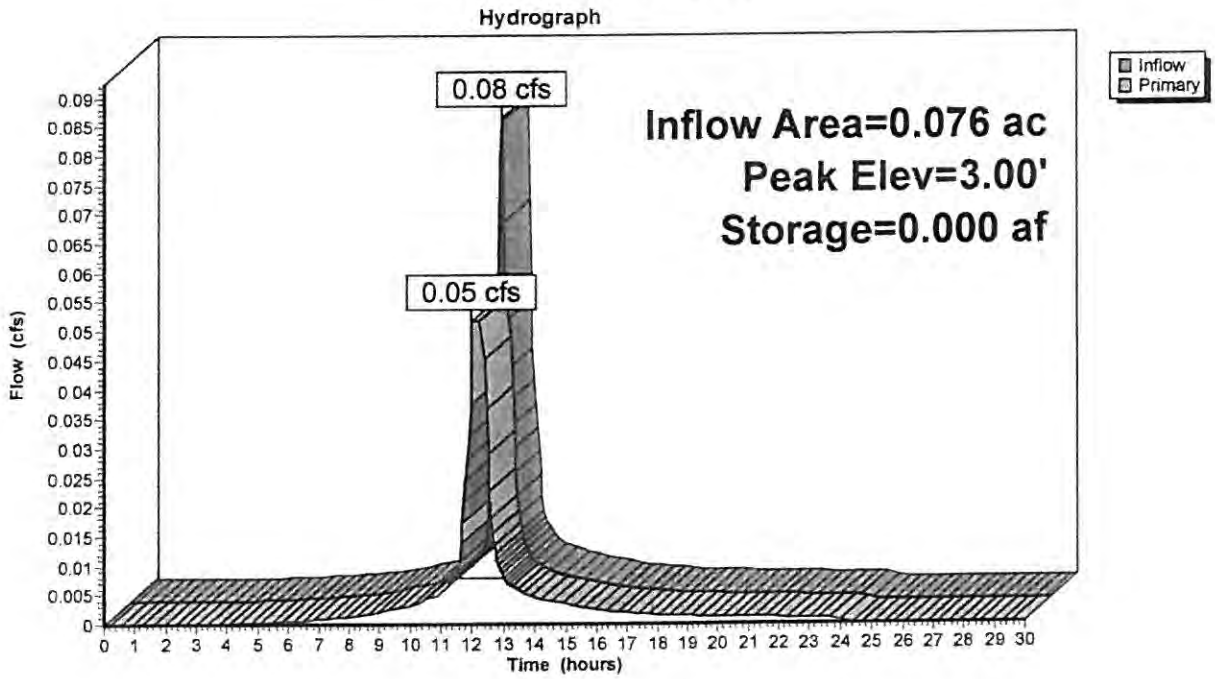
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	2.25'	0.000 af	**4.00'W x 4.00'L x 1.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	2.25'	**140.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.05 cfs @ 12.00 hrs HW=2.26' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Pond 5P: Filterra 4x4



STANDARD 5 LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

STANDARD 6 CRITICAL AREAS

STANDARD 7 REDEVELOPMENT

These standards do not apply to this project

STANDARD 8 CONSTRUCTION PERIOD POLLUTION PREVENTION AND SEDIMENTATION CONTROL

The entity responsible for implementation of the sedimentation control and pollution prevention during construction shall be the owner of the project at the time of construction.

Prior to any earth movement on the site, erosion control shall be set and staked in a permanent manner as shown on the Grading, Drainage and Erosion Control drawing.

Erosion control and sedimentation barriers shall be maintained continuously throughout the project until all disturbed areas have been revegetated.

Unless otherwise shown on the drawings all disturbed areas shall be covered with 6 inches of loam and seeded with an approved grass seed mixture.

STANDARD 9 OPERATION AND MAINTENANCE PLAN

The party responsible for the operation and maintenance of the stormwater drainage system shall be the Randall Road Extension Homeowners Association (HOA).

Deep Sump Catch Basins

Deep sump catch basins shall be inspected four times per year and cleaned whenever the depth of deposits is greater than one half of the sump.

Drain Manhole and Flared Ends

Drain manhole and flared ends shall also be inspected two times per year to insure they are functioning as designed. Repairs shall be made as necessary.

Detention Basin

The detention basin basin shall be inspected once per year to ensure proper operation. The basin shall be mowed two times per year and the grass clippings shall be removed as well as any other organic matter, trash or debris. Clogged surfaces shall be broken up by deep tilling and revegetated immediately.

Remove sediment from the basin as necessary. Wait until the basin floor is dry. Use light equipment

to remove top layer taking care not to compact the underlying soil. Deep till the remaining soil and revegetate as soon as possible.

Sediment forebay

The sediment forebay shall be inspected monthly and cleaned four times per year and when sediment depth is between 3 and 6 feet. Debris shall be removed and disposed of offsite. Sediment which shall be removed by vacuum.

Water Quality Swale

Inspect swales during the first few months after installation to make sure that the vegetation in the swales becomes adequately established. Thereafter, inspect swales twice a year. During the inspections, check the swales for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding and sedimentation. Regular maintenance includes mowing, fertilizing, liming, watering, pruning, and weed and pest control. Mow swales at least once per year. Do not cut the grass shorter than three to four inches, otherwise the effectiveness of the vegetation in reducing flow velocity and removing pollutants may be reduced. Do not let grass height exceed 6 inches.

Manually remove sediment and debris at least once per year, and periodically re-seed, if necessary, to maintain a dense growth of vegetation. Take care to protect water quality swales from snow removal and disposal practices and off-street parking. the operation and maintenance plan must clearly identify the property owner who is responsible for carrying out the required maintenance.

Filterra Treebox Filter

See O & M manual attached.

STANDARD 10 PROHIBITION OF ILLICIT DISCHARGES

No Illicit Discharges presently exist on this project site. The Homeowners Association shall ensure that no illicit discharges enter the stormwater system in the future. Illicit discharges are defined as any discharge not comprised entirely of stormwater. Illicit discharges do not include the following activities

Firefighting
Water line flushing
Landscape irrigation
Uncontaminated groundwater
Potable water sources
Foundation drains
Air conditioning condensation
Footing drains
Individual resident car washing
Flows from riparian habitats and wetlands
Dechlorinated water from swimming pools
Water used for street washing
Water used to clean residential buildings without detergents.

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.

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

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.

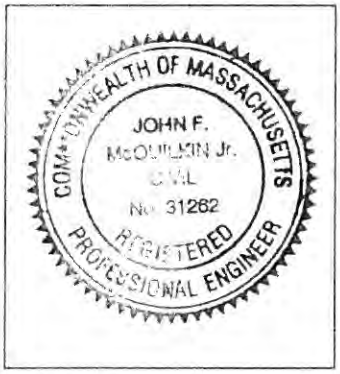
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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 for Stormwater Report

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:

- [X] 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)
- [X] Treebox Filter
- [X] Water Quality Swale
- [ ] Grass Channel
- [ ] Green Roof
- [ ] Other (describe): _____

Standard 1: No New Untreated Discharges

- [X] No new untreated discharges
- [X] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [X] 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.

APPENDIX A

RUNOFF CALCULATIONS

Rainfall Data

TYPE III 24 HOUR -2 YEAR STORM EVENT = 3.10"

TYPE III 24 HOUR -10 YEAR STORM EVENT = 4.50"

TYPE III 24 HOUR -25 YEAR STORM EVENT = 5.30"

TYPE III 24 HOUR -100 YEAR STORM EVENT = 6.50"

TRIB TO WETLAND

Subcat Reach Pond Link

Routing Diagram for 373-572 Randall Rd. Exist. Cond.
Prepared by JM ASSOCIATES, Printed 9/27/2016
HydroCAD® 10.00-11 s/n 01195 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment 2S: TRIB TO WETLAND

Runoff = 0.35 cfs @ 12.74 hrs, Volume= 0.085 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.10"

	Area (sf)	CN	Description
*	3,804	98	IMPERVIOUS
	13,347	39	>75% Grass cover, Good, HSG A
	27,574	30	Woods, Good, HSG A
	86,870	70	Woods, Good, HSG C
	131,595	59	Weighted Average
	127,791		97.11% Pervious Area
	3,804		2.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
38.8	800	Total			

Summary for Subcatchment 2S: TRIB TO WETLAND

Runoff = 1.43 cfs @ 12.63 hrs, Volume= 0.242 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	3,804	98	IMPERVIOUS
	13,347	39	>75% Grass cover, Good, HSG A
	27,574	30	Woods, Good, HSG A
	86,870	70	Woods, Good, HSG C
	131,595	59	Weighted Average
	127,791		97.11% Pervious Area
	3,804		2.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
38.8	800	Total			

Summary for Subcatchment 2S: TRIB TO WETLAND

Runoff = 2.25 cfs @ 12.60 hrs, Volume= 0.354 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	3,804	98	IMPERVIOUS
	13,347	39	>75% Grass cover, Good, HSG A
	27,574	30	Woods, Good, HSG A
	86,870	70	Woods, Good, HSG C
	131,595	59	Weighted Average
	127,791		97.11% Pervious Area
	3,804		2.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
38.8	800	Total			

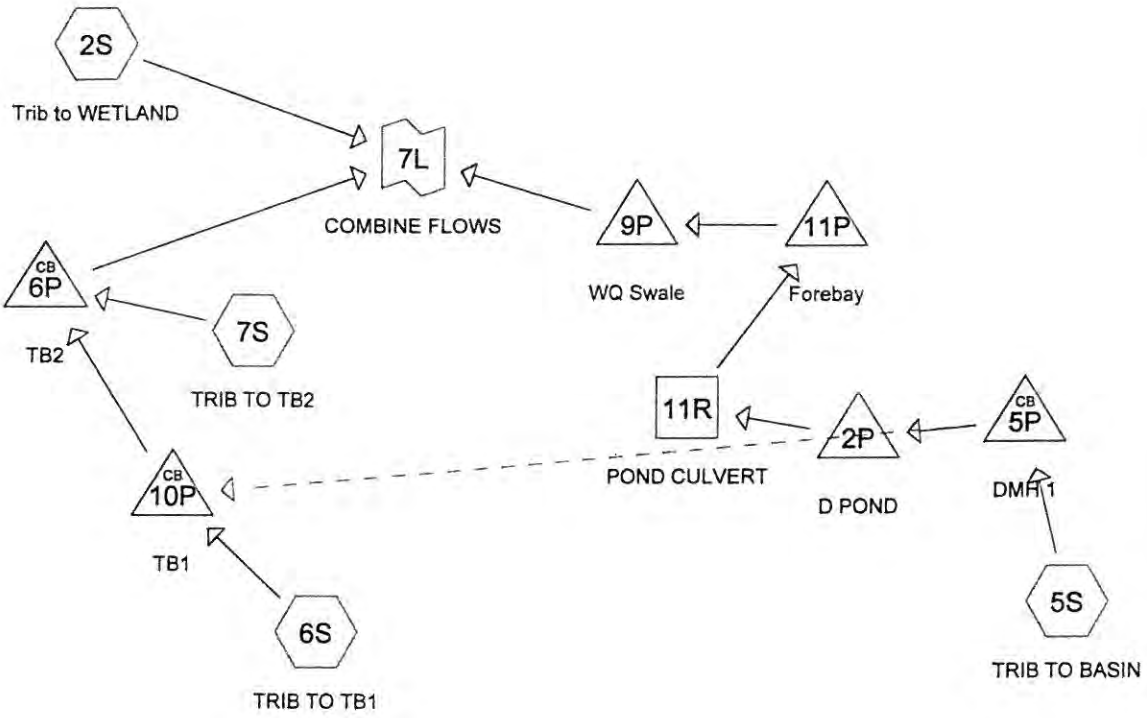
Summary for Subcatchment 2S: TRIB TO WETLAND

Runoff = 3.64 cfs @ 12.58 hrs, Volume= 0.545 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-yr Rainfall=6.50"

	Area (sf)	CN	Description
*	3,804	98	IMPERVIOUS
	13,347	39	>75% Grass cover, Good, HSG A
	27,574	30	Woods, Good, HSG A
	86,870	70	Woods, Good, HSG C
	131,595	59	Weighted Average
	127,791		97.11% Pervious Area
	3,804		2.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
38.8	800	Total			



Subcat Reach Pond Link

Routing Diagram for 373-572 Randall Rd. Prop. Cond.
Prepared by JM ASSOCIATES, Printed 9/27/2016
HydroCAD® 10.00-11 s/n 01195 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment 2S: Trib to WETLAND

Runoff = 0.31 cfs @ 12.76 hrs, Volume= 0.072 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

	Area (sf)	CN	Description
*	4,319	98	Impervious
	13,803	39	>75% Grass cover, Good, HSG A
	16,918	74	>75% Grass cover, Good, HSG C
	19,213	30	Woods, Good, HSG A
	48,126	70	Woods, Good, HSG C
	102,379	60	Weighted Average
	98,060		95.78% Pervious Area
	4,319		4.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0300	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
40.6	825	Total			

Summary for Subcatchment 5S: TRIB TO BASIN

Runoff = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

	Area (sf)	CN	Description
*	13,969	98	Impervious
	5,588	39	>75% Grass cover, Good, HSG A
	3,105	74	>75% Grass cover, Good, HSG C
	1,224	30	Woods, Good, HSG A
	23,886	78	Weighted Average
	9,917		41.52% Pervious Area
	13,969		58.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0299	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
0.4	24	0.0338	0.92		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.6	94	0.0338	2.76		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
7.7	193	Total			

Summary for Subcatchment 6S: TRIB TO TB1

Runoff = 0.02 cfs @ 12.48 hrs, Volume= 0.004 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

	Area (sf)	CN	Description
*	2,261	98	Impervious
	3,567	39	>75% Grass cover, Good, HSG A
	1,535	74	>75% Grass cover, Good, HSG C
	3,110	30	Woods, Good, HSG A
	10,473	54	Weighted Average
	8,212		78.41% Pervious Area
	2,261		21.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	75	0.0533	0.11		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	20	0.0447	1.06		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.2	47	0.0447	3.17		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
0.5	69	0.0290	2.55		**Shallow Concentrated Flow, SCF along berm** Grassed Waterway Kv= 15.0 fps
0.2	36	0.0277	3.38		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
12.9	247	Total			

Summary for Subcatchment 7S: TRIB TO TB2

Runoff = 0.31 cfs @ 12.01 hrs, Volume= 0.019 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

	Area (sf)	CN	Description
*	3,329	98	Impervious
	1,010	74	>75% Grass cover, Good, HSG C
	4,339	92	Weighted Average
	1,010		23.28% Pervious Area
	3,329		76.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	75	0.0608	1.99		**Sheet Flow, Sheet flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	77	0.0608	5.01		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
0.9	152	Total			

Summary for Reach 11R: POND CULVERT

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 0.36" for 2-yr event
Inflow = 0.13 cfs @ 12.55 hrs, Volume= 0.017 af
Outflow = 0.13 cfs @ 12.56 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.94 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.80 fps, Avg. Travel Time= 0.8 min

Peak Storage= 4 cf @ 12.56 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.48 cfs

12.0" Round Pipe
n= 0.015
Length= 90.0' Slope= 0.0314 '/'
Inlet Invert= 253.33', Outlet Invert= 250.50'

Summary for Pond 2P: D POND

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.20" for 2-yr event
Inflow = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af
Outflow = 0.18 cfs @ 12.55 hrs, Volume= 0.055 af, Atten= 74%, Lag= 26.0 min
Discarded = 0.05 cfs @ 12.55 hrs, Volume= 0.038 af
Primary = 0.13 cfs @ 12.55 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.06' @ 12.55 hrs Surf.Area= 842 sf Storage= 832 cf

Plug-Flow detention time= 139.6 min calculated for 0.055 af (100% of inflow)
Center-of-Mass det. time= 139.6 min (992.2 - 852.5)

Volume	Invert	Avail.Storage	Storage Description
#1	253.33'	3,365 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
253.33	174	0	0
254.00	378	185	185
256.00	1,254	1,632	1,817
257.00	1,842	1,548	3,365

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.33'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	254.61'	**3.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 12.55 hrs HW=255.06' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.13 cfs @ 12.55 hrs HW=255.06' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 2.75 fps)

Summary for Pond 5P: DMH 1

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.20" for 2-yr event
Inflow = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af
Outflow = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min
Primary = 0.71 cfs @ 12.12 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.43' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**12.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 255.00' / 254.00' S= 0.0227 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Primary OutFlow Max=0.71 cfs @ 12.12 hrs HW=255.43' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.71 cfs @ 2.22 fps)

Summary for Pond 6P: TB2

Inflow Area = 0.340 ac, 37.74% Impervious, Inflow Depth = 0.80" for 2-yr event
Inflow = 0.31 cfs @ 12.01 hrs, Volume= 0.023 af
Outflow = 0.31 cfs @ 12.01 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min
Primary = 0.31 cfs @ 12.01 hrs, Volume= 0.023 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.77' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.50'	**12.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.50' / 250.00' S= 0.0185 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.31 cfs @ 12.01 hrs HW=250.77' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.31 cfs @ 1.77 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 9P: WQ Swale

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 0.31" for 2-yr event
Inflow = 0.13 cfs @ 12.58 hrs, Volume= 0.014 af
Outflow = 0.04 cfs @ 14.32 hrs, Volume= 0.003 af, Atten= 73%, Lag= 104.7 min
Primary = 0.04 cfs @ 14.32 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.76' @ 14.32 hrs Surf.Area= 583 sf Storage= 531 cf

Plug-Flow detention time= 146.8 min calculated for 0.003 af (24% of inflow)
Center-of-Mass det. time= 99.6 min (905.2 - 805.7)

Volume	Invert	Avail.Storage	Storage Description
#1	248.33'	531 cf	**6.00'W x 31.60'L x 1.42'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.04 cfs @ 14.32 hrs HW=249.76' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.31 fps)

Summary for Pond 10P: TB1

Inflow Area = 0.240 ac, 21.59% Impervious, Inflow Depth = 0.20" for 2-yr event
Inflow = 0.02 cfs @ 12.48 hrs, Volume= 0.004 af
Outflow = 0.02 cfs @ 12.48 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min
Primary = 0.02 cfs @ 12.48 hrs, Volume= 0.004 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.76' @ 12.48 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.70'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.70' / 250.20' S= 0.0208 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.01 cfs @ 12.48 hrs HW=250.76' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.01 cfs @ 0.82 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.70' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 11P: Forebay

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 0.36" for 2-yr event
Inflow = 0.13 cfs @ 12.56 hrs, Volume= 0.017 af
Outflow = 0.13 cfs @ 12.58 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.7 min
Primary = 0.13 cfs @ 12.58 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.79' @ 12.58 hrs Surf.Area= 199 sf Storage= 110 cf

Plug-Flow detention time= 26.3 min calculated for 0.014 af (86% of inflow)
Center-of-Mass det. time= 10.1 min (805.7 - 795.6)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	221 cf	**8.70'W x 10.10'L x 1.25'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.13 cfs @ 12.58 hrs HW=249.79' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.48 fps)

Summary for Link 7L: COMBINE FLOWS

Inflow Area = 3.239 ac, 16.93% Impervious, Inflow Depth = 0.37" for 2-yr event
Inflow = 0.35 cfs @ 12.73 hrs, Volume= 0.099 af
Primary = 0.35 cfs @ 12.73 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs

Summary for Subcatchment 2S: Trib to WETLAND

Runoff = 1.18 cfs @ 12.64 hrs, Volume= 0.200 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	4,319	98	Impervious
	13,803	39	>75% Grass cover, Good, HSG A
	16,918	74	>75% Grass cover, Good, HSG C
	19,213	30	Woods, Good, HSG A
	48,126	70	Woods, Good, HSG C
	102,379	60	Weighted Average
	98,060		95.78% Pervious Area
	4,319		4.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0300	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
40.6	825	Total			

Summary for Subcatchment 5S: TRIB TO BASIN

Runoff = 1.39 cfs @ 12.11 hrs, Volume= 0.105 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	13,969	98	Impervious
	5,588	39	>75% Grass cover, Good, HSG A
	3,105	74	>75% Grass cover, Good, HSG C
	1,224	30	Woods, Good, HSG A
	23,886	78	Weighted Average
	9,917		41.52% Pervious Area
	13,969		58.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0299	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
0.4	24	0.0338	0.92		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.6	94	0.0338	2.76		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
7.7	193	Total			

Summary for Subcatchment 6S: TRIB TO TB1

Runoff = 0.11 cfs @ 12.23 hrs, Volume= 0.014 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	2,261	98	Impervious
	3,567	39	>75% Grass cover, Good, HSG A
	1,535	74	>75% Grass cover, Good, HSG C
	3,110	30	Woods, Good, HSG A
	10,473	54	Weighted Average
	8,212		78.41% Pervious Area
	2,261		21.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	75	0.0533	0.11		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	20	0.0447	1.06		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.2	47	0.0447	3.17		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
0.5	69	0.0290	2.55		**Shallow Concentrated Flow, SCF along berm** Grassed Waterway Kv= 15.0 fps
0.2	36	0.0277	3.38		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
12.9	247	Total			

Summary for Subcatchment 7S: TRIB TO TB2

Runoff = 0.48 cfs @ 12.01 hrs, Volume= 0.030 af, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	3,329	98	Impervious
	1,010	74	>75% Grass cover, Good, HSG C
	4,339	92	Weighted Average
	1,010		23.28% Pervious Area
	3,329		76.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	75	0.0608	1.99		**Sheet Flow, Sheet flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	77	0.0608	5.01		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
0.9	152	Total			

Summary for Reach 11R: POND CULVERT

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.17" for 10-yr event
Inflow = 0.26 cfs @ 12.55 hrs, Volume= 0.053 af
Outflow = 0.26 cfs @ 12.56 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.56 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.21 fps, Avg. Travel Time= 0.7 min

Peak Storage= 6 cf @ 12.56 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.48 cfs

12.0" Round Pipe
n= 0.015
Length= 90.0' Slope= 0.0314 '/'
Inlet Invert= 253.33', Outlet Invert= 250.50'

Summary for Pond 2P: D POND

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.29" for 10-yr event
Inflow = 1.39 cfs @ 12.11 hrs, Volume= 0.105 af
Outflow = 0.32 cfs @ 12.55 hrs, Volume= 0.105 af, Atten= 77%, Lag= 26.3 min
Discarded = 0.07 cfs @ 12.55 hrs, Volume= 0.051 af
Primary = 0.26 cfs @ 12.55 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.90' @ 12.55 hrs Surf.Area= 1,211 sf Storage= 1,695 cf

Plug-Flow detention time= 116.2 min calculated for 0.105 af (100% of inflow)
Center-of-Mass det. time= 116.2 min (949.8 - 833.5)

Volume	Invert	Avail.Storage	Storage Description
#1	253.33'	3,365 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
253.33	174	0	0
254.00	378	185	185
256.00	1,254	1,632	1,817
257.00	1,842	1,548	3,365

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.33'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	254.61'	**3.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.07 cfs @ 12.55 hrs HW=255.90' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.26 cfs @ 12.55 hrs HW=255.90' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.26 cfs @ 5.20 fps)

Summary for Pond 5P: DMH 1

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.29" for 10-yr event
Inflow = 1.39 cfs @ 12.11 hrs, Volume= 0.105 af
Outflow = 1.39 cfs @ 12.11 hrs, Volume= 0.105 af, Atten= 0%, Lag= 0.0 min
Primary = 1.39 cfs @ 12.11 hrs, Volume= 0.105 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.62' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**12.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 255.00' / 254.00' S= 0.0227 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Primary OutFlow Max=1.39 cfs @ 12.11 hrs HW=255.62' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.39 cfs @ 2.69 fps)

Summary for Pond 6P: TB2

Inflow Area = 0.340 ac, 37.74% Impervious, Inflow Depth = 1.54" for 10-yr event
Inflow = 0.49 cfs @ 12.01 hrs, Volume= 0.044 af
Outflow = 0.49 cfs @ 12.01 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 0.49 cfs @ 12.01 hrs, Volume= 0.044 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.85' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.50'	**12.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.50' / 250.00' S= 0.0185 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.49 cfs @ 12.01 hrs HW=250.85' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.49 cfs @ 2.01 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 9P: WQ Swale

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.12" for 10-yr event
Inflow = 0.26 cfs @ 12.57 hrs, Volume= 0.051 af
Outflow = 0.12 cfs @ 12.81 hrs, Volume= 0.009 af, Atten= 53%, Lag= 14.3 min
Primary = 0.12 cfs @ 12.81 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.78' @ 12.81 hrs Surf.Area= 583 sf Storage= 531 cf

Plug-Flow detention time= 57.6 min calculated for 0.009 af (18% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.33'	531 cf	**6.00'W x 31.60'L x 1.42'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.12 cfs @ 12.81 hrs HW=249.78' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.12 cfs @ 0.46 fps)

Summary for Pond 10P: TB1

Inflow Area = 0.240 ac, 21.59% Impervious, Inflow Depth = 0.69" for 10-yr event
Inflow = 0.11 cfs @ 12.23 hrs, Volume= 0.014 af
Outflow = 0.11 cfs @ 12.23 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min
Primary = 0.11 cfs @ 12.23 hrs, Volume= 0.014 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.86' @ 12.23 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.70'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.70' / 250.20' S= 0.0208 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.10 cfs @ 12.23 hrs HW=250.86' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.10 cfs @ 1.34 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.70' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 11P: Forebay

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.17" for 10-yr event
Inflow = 0.26 cfs @ 12.56 hrs, Volume= 0.053 af
Outflow = 0.26 cfs @ 12.57 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.5 min
Primary = 0.26 cfs @ 12.57 hrs, Volume= 0.051 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.80' @ 12.57 hrs Surf.Area= 202 sf Storage= 113 cf

Plug-Flow detention time= 13.8 min calculated for 0.051 af (96% of inflow)
Center-of-Mass det. time= 5.1 min (824.2 - 819.1)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	221 cf	**8.70'W x 10.10'L x 1.25'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.25 cfs @ 12.57 hrs HW=249.80' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.25 cfs @ 0.59 fps)

Summary for Link 7L: COMBINE FLOWS

Inflow Area = 3.239 ac, 16.93% Impervious, Inflow Depth = 0.94" for 10-yr event
Inflow = 1.28 cfs @ 12.63 hrs, Volume= 0.253 af
Primary = 1.28 cfs @ 12.63 hrs, Volume= 0.253 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs

Summary for Subcatchment 2S: Trib to WETLAND

Runoff = 1.82 cfs @ 12.63 hrs, Volume= 0.290 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	4,319	98	Impervious
	13,803	39	>75% Grass cover, Good, HSG A
	16,918	74	>75% Grass cover, Good, HSG C
	19,213	30	Woods, Good, HSG A
	48,126	70	Woods, Good, HSG C
	102,379	60	Weighted Average
	98,060		95.78% Pervious Area
	4,319		4.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0300	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
40.6	825	Total			

Summary for Subcatchment 5S: TRIB TO BASIN

Runoff = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	13,969	98	Impervious
	5,588	39	>75% Grass cover, Good, HSG A
	3,105	74	>75% Grass cover, Good, HSG C
	1,224	30	Woods, Good, HSG A
	23,886	78	Weighted Average
	9,917		41.52% Pervious Area
	13,969		58.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0299	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
0.4	24	0.0338	0.92		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.6	94	0.0338	2.76		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
7.7	193	Total			

Summary for Subcatchment 6S: TRIB TO TB1

Runoff = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	2,261	98	Impervious
	3,567	39	>75% Grass cover, Good, HSG A
	1,535	74	>75% Grass cover, Good, HSG C
	3,110	30	Woods, Good, HSG A
	10,473	54	Weighted Average
	8,212		78.41% Pervious Area
	2,261		21.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	75	0.0533	0.11		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	20	0.0447	1.06		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.2	47	0.0447	3.17		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
0.5	69	0.0290	2.55		**Shallow Concentrated Flow, SCF along berm** Grassed Waterway Kv= 15.0 fps
0.2	36	0.0277	3.38		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
12.9	247	Total			

Summary for Subcatchment 7S: TRIB TO TB2

Runoff = 0.58 cfs @ 12.01 hrs, Volume= 0.036 af, Depth= 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	3,329	98	Impervious
	1,010	74	>75% Grass cover, Good, HSG C
	4,339	92	Weighted Average
	1,010		23.28% Pervious Area
	3,329		76.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	75	0.0608	1.99		**Sheet Flow, Sheet flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	77	0.0608	5.01		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
0.9	152	Total			

Summary for Reach 11R: POND CULVERT

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.68" for 25-yr event
Inflow = 0.30 cfs @ 12.56 hrs, Volume= 0.077 af
Outflow = 0.30 cfs @ 12.58 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.7 min

Peak Storage= 7 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.48 cfs

12.0" Round Pipe
n= 0.015
Length= 90.0' Slope= 0.0314 '/'
Inlet Invert= 253.33', Outlet Invert= 250.50'

Summary for Pond 2P: D POND

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.97" for 25-yr event
Inflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af
Outflow = 0.38 cfs @ 12.56 hrs, Volume= 0.136 af, Atten= 79%, Lag= 27.2 min
Discarded = 0.08 cfs @ 12.56 hrs, Volume= 0.059 af
Primary = 0.30 cfs @ 12.56 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 256.34' @ 12.56 hrs Surf.Area= 1,456 sf Storage= 2,284 cf

Plug-Flow detention time= 113.7 min calculated for 0.136 af (100% of inflow)
Center-of-Mass det. time= 113.7 min (939.8 - 826.1)

Volume	Invert	Avail.Storage	Storage Description
#1	253.33'	3,365 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
253.33	174	0	0
254.00	378	185	185
256.00	1,254	1,632	1,817
257.00	1,842	1,548	3,365

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.33'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	254.61'	**3.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.08 cfs @ 12.56 hrs HW=256.34' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.30 cfs @ 12.56 hrs HW=256.34' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.11 fps)

Summary for Pond 5P: DMH 1

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.97" for 25-yr event
Inflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af
Outflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.0 min
Primary = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.73' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**12.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 255.00' / 254.00' S= 0.0227 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Primary OutFlow Max=1.80 cfs @ 12.11 hrs HW=255.73' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.80 cfs @ 2.92 fps)

Summary for Pond 6P: TB2

Inflow Area = 0.340 ac, 37.74% Impervious, Inflow Depth = 2.04" for 25-yr event
Inflow = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af
Outflow = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min
Primary = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.90' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.50'	**12.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.50' / 250.00' S= 0.0185 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.62 cfs @ 12.01 hrs HW=250.90' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.62 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 9P: WQ Swale

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.63" for 25-yr event
Inflow = 0.30 cfs @ 12.58 hrs, Volume= 0.074 af
Outflow = 0.11 cfs @ 12.63 hrs, Volume= 0.011 af, Atten= 62%, Lag= 2.7 min
Primary = 0.11 cfs @ 12.63 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.78' @ 12.63 hrs Surf.Area= 583 sf Storage= 531 cf

Plug-Flow detention time= 59.3 min calculated for 0.011 af (15% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.33'	531 cf	**6.00'W x 31.60'L x 1.42'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.11 cfs @ 12.63 hrs HW=249.78' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.45 fps)

Summary for Pond 10P: TB1

Inflow Area = 0.240 ac, 21.59% Impervious, Inflow Depth = 1.07" for 25-yr event
Inflow = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af
Outflow = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min
Primary = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.91' @ 12.21 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.70'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.70' / 250.20' S= 0.0208 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 12.21 hrs HW=250.91' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.19 cfs @ 1.57 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.70' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 11P: Forebay

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.68" for 25-yr event
Inflow = 0.30 cfs @ 12.58 hrs, Volume= 0.077 af
Outflow = 0.30 cfs @ 12.58 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.5 min
Primary = 0.30 cfs @ 12.58 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.81' @ 12.58 hrs Surf.Area= 203 sf Storage= 115 cf

Plug-Flow detention time= 11.9 min calculated for 0.074 af (97% of inflow)
Center-of-Mass det. time= 4.4 min (837.5 - 833.2)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	221 cf	**8.70'W x 10.10'L x 1.25'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.30 cfs @ 12.58 hrs HW=249.81' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.30 cfs @ 0.62 fps)

Summary for Link 7L: COMBINE FLOWS

Inflow Area = 3.239 ac, 16.93% Impervious, Inflow Depth = 1.33" for 25-yr event
Inflow = 2.08 cfs @ 12.63 hrs, Volume= 0.359 af
Primary = 2.08 cfs @ 12.63 hrs, Volume= 0.359 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs

Summary for Subcatchment 2S: Trib to WETLAND

Runoff = 1.82 cfs @ 12.63 hrs, Volume= 0.290 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	4,319	98	Impervious
	13,803	39	>75% Grass cover, Good, HSG A
	16,918	74	>75% Grass cover, Good, HSG C
	19,213	30	Woods, Good, HSG A
	48,126	70	Woods, Good, HSG C
	102,379	60	Weighted Average
	98,060		95.78% Pervious Area
	4,319		4.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0300	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
5.2	270	0.0300	0.87		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
28.7	480	0.0031	0.28		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
40.6	825	Total			

Summary for Subcatchment 5S: TRIB TO BASIN

Runoff = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	13,969	98	Impervious
	5,588	39	>75% Grass cover, Good, HSG A
	3,105	74	>75% Grass cover, Good, HSG C
	1,224	30	Woods, Good, HSG A
	23,886	78	Weighted Average
	9,917		41.52% Pervious Area
	13,969		58.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	75	0.0299	0.19		**Sheet Flow, Sheet flow** Grass: Short n= 0.150 P2= 3.10"
0.4	24	0.0338	0.92		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.6	94	0.0338	2.76		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
7.7	193	Total			

Summary for Subcatchment 6S: TRIB TO TB1

Runoff = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	2,261	98	Impervious
	3,567	39	>75% Grass cover, Good, HSG A
	1,535	74	>75% Grass cover, Good, HSG C
	3,110	30	Woods, Good, HSG A
	10,473	54	Weighted Average
	8,212		78.41% Pervious Area
	2,261		21.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	75	0.0533	0.11		**Sheet Flow, Sheet flow** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	20	0.0447	1.06		**Shallow Concentrated Flow, SCF over woods** Woodland Kv= 5.0 fps
0.2	47	0.0447	3.17		**Shallow Concentrated Flow, SCF over grass** Grassed Waterway Kv= 15.0 fps
0.5	69	0.0290	2.55		**Shallow Concentrated Flow, SCF along berm** Grassed Waterway Kv= 15.0 fps
0.2	36	0.0277	3.38		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
12.9	247	Total			

Summary for Subcatchment 7S: TRIB TO TB2

Runoff = 0.58 cfs @ 12.01 hrs, Volume= 0.036 af, Depth= 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

	Area (sf)	CN	Description
*	3,329	98	Impervious
	1,010	74	>75% Grass cover, Good, HSG C
	4,339	92	Weighted Average
	1,010		23.28% Pervious Area
	3,329		76.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	75	0.0608	1.99		**Sheet Flow, Sheet flow** Smooth surfaces n= 0.011 P2= 3.10"
0.3	77	0.0608	5.01		**Shallow Concentrated Flow, SCF over pavement** Paved Kv= 20.3 fps
0.9	152	Total			

Summary for Reach 11R: POND CULVERT

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.68" for 25-yr event
Inflow = 0.30 cfs @ 12.56 hrs, Volume= 0.077 af
Outflow = 0.30 cfs @ 12.58 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.73 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.7 min

Peak Storage= 7 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.16'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.48 cfs

12.0" Round Pipe
n= 0.015
Length= 90.0' Slope= 0.0314 '/'
Inlet Invert= 253.33', Outlet Invert= 250.50'

Summary for Pond 2P: D POND

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.97" for 25-yr event
Inflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af
Outflow = 0.38 cfs @ 12.56 hrs, Volume= 0.136 af, Atten= 79%, Lag= 27.2 min
Discarded = 0.08 cfs @ 12.56 hrs, Volume= 0.059 af
Primary = 0.30 cfs @ 12.56 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 256.34' @ 12.56 hrs Surf.Area= 1,456 sf Storage= 2,284 cf

Plug-Flow detention time= 113.7 min calculated for 0.136 af (100% of inflow)
Center-of-Mass det. time= 113.7 min (939.8 - 826.1)

Volume	Invert	Avail.Storage	Storage Description
#1	253.33'	3,365 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
253.33	174	0	0
254.00	378	185	185
256.00	1,254	1,632	1,817
257.00	1,842	1,548	3,365

Device	Routing	Invert	Outlet Devices
#1	Discarded	253.33'	**2.410 in/hr Exfiltration over Surface area**
#2	Primary	254.61'	**3.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.08 cfs @ 12.56 hrs HW=256.34' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.30 cfs @ 12.56 hrs HW=256.34' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.11 fps)

Summary for Pond 5P: DMH 1

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 2.97" for 25-yr event
Inflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af
Outflow = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.0 min
Primary = 1.80 cfs @ 12.11 hrs, Volume= 0.136 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 255.73' @ 12.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	255.00'	**12.0" Round Culvert** L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 255.00' / 254.00' S= 0.0227 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Primary OutFlow Max=1.80 cfs @ 12.11 hrs HW=255.73' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.80 cfs @ 2.92 fps)

Summary for Pond 6P: TB2

Inflow Area = 0.340 ac, 37.74% Impervious, Inflow Depth = 2.04" for 25-yr event
Inflow = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af
Outflow = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min
Primary = 0.63 cfs @ 12.01 hrs, Volume= 0.058 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.90' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.50'	**12.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.50' / 250.00' S= 0.0185 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.62 cfs @ 12.01 hrs HW=250.90' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.62 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.50' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 9P: WQ Swale

Inflow Area = 0.548 ac, 58.48% Impervious, Inflow Depth = 1.63" for 25-yr event
Inflow = 0.30 cfs @ 12.58 hrs, Volume= 0.074 af
Outflow = 0.11 cfs @ 12.63 hrs, Volume= 0.011 af, Atten= 62%, Lag= 2.7 min
Primary = 0.11 cfs @ 12.63 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 249.78' @ 12.63 hrs Surf.Area= 583 sf Storage= 531 cf

Plug-Flow detention time= 59.3 min calculated for 0.011 af (15% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.33'	531 cf	**6.00'W x 31.60'L x 1.42'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	249.75'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.11 cfs @ 12.63 hrs HW=249.78' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.45 fps)

Summary for Pond 10P: TB1

Inflow Area = 0.240 ac, 21.59% Impervious, Inflow Depth = 1.07" for 25-yr event
Inflow = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af
Outflow = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min
Primary = 0.19 cfs @ 12.21 hrs, Volume= 0.021 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 250.91' @ 12.21 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	250.70'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 250.70' / 250.20' S= 0.0208 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf
#2	Secondary	253.50'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.19 cfs @ 12.21 hrs HW=250.91' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.19 cfs @ 1.57 fps)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=250.70' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Link 7L: COMBINE FLOWS

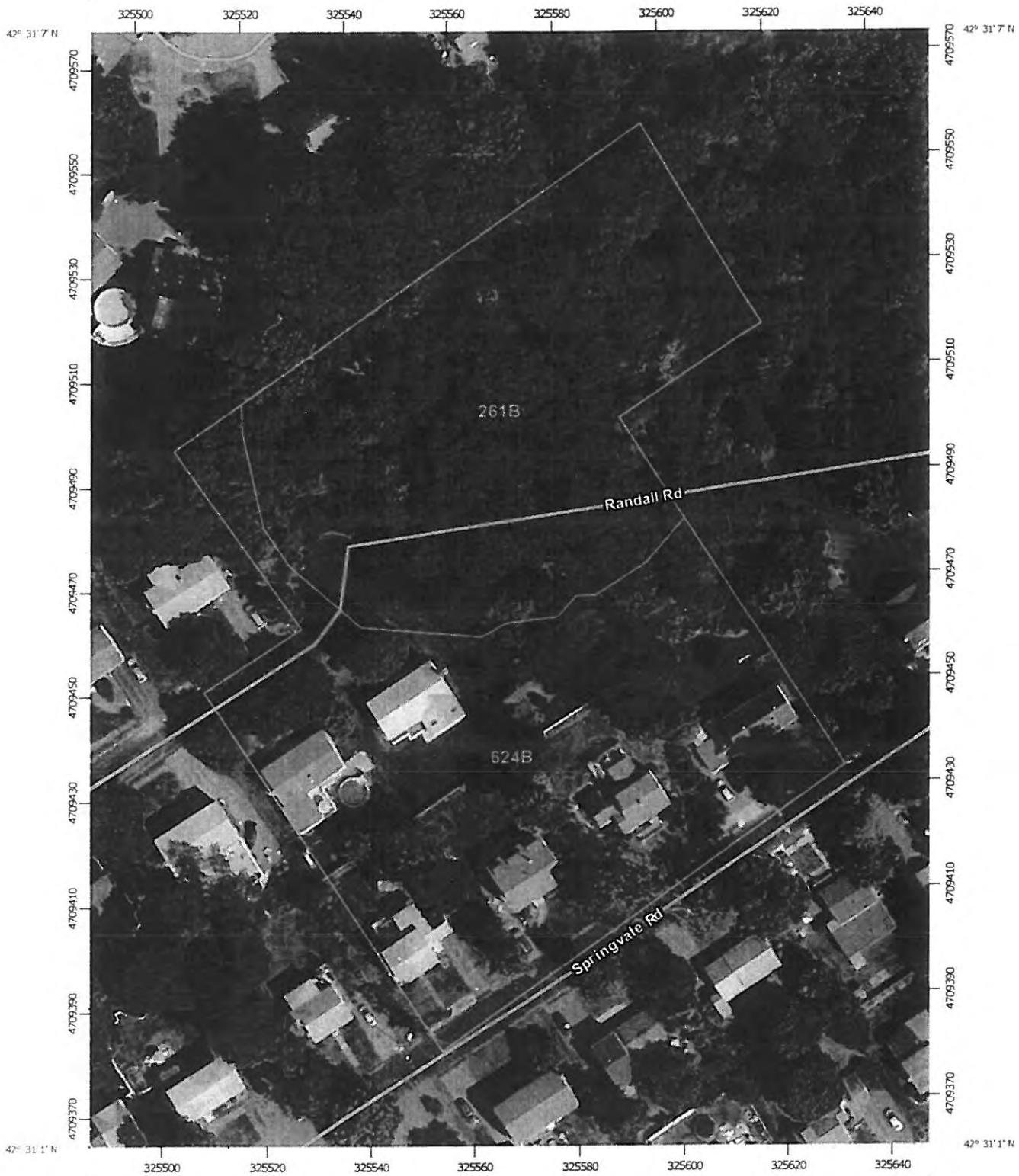
Inflow Area = 3.239 ac, 16.93% Impervious, Inflow Depth = 2.04" for 100-yr event
Inflow = 3.30 cfs @ 12.58 hrs, Volume= 0.552 af
Primary = 3.30 cfs @ 12.58 hrs, Volume= 0.552 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.01 hrs

APPENDIX B

SOIL SURVEY, SOIL EVALUATION
TEXTURAL ANALYSIS

Soil Map—Middlesex County, Massachusetts
(Randall Rd. Extension 5-13-16)



Map Scale: 1:1,040 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Middlesex County, Massachusetts
Survey Area Data: Version 15, Sep 28, 2015

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

Date(s) aerial images were photographed: Aug 10, 2014—Aug 25, 2014

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.

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
261B	Tisbury silt loam, 3 to 8 percent slopes	1.4	45.8% C
624B	Haven-Urban land complex, 0 to 8 percent slopes	1.7	54.2% A
Totals for Area of Interest		**3.1**	**100.0%**

Soil Evaluation

Test pits performed on: May 2, 2016
Test pits performed by: Michael O'Neill, PE
Test pits witnessed by: Town of Reading Engineering Dept.

Test Pit #1				
Depth	Layer	Texture	Color	Comments
0"-12"	A	Fine Sandy Loam	2.5 Y 3/3	
12"-36"	Bw	Fine Sandy Loam	10 YR 5/8	
36"-58"	C1	Loamy Sand	10 YR 6/6	
58"-82"	C2	Gravelly Coarse Sand	10 YR 6/3	

ESHGW @ 50", LC @ 50" 10 YR 7/1, HC 7.5 YR 5/6

Weeping @ 62"

Test Pit #2				
Depth	Layer	Texture	Color	Comments
0"-55"	Fill	-	-	
55"-80"	C1	Silt	2.5 YR 6/2	
80"-112"	C2	Gravelly Coarse Sand	7.5 YR 5/6	

ESHGW @ 55", LC @ 55", HC @ 80" 7.5 YR 6/6

Weeping @ 84"

Test Pit #3				
Depth	Layer	Texture	Color	Comments
0"-7"	Ap	Fine Sandy Loam	10 YR 3/4	
7"-17"	Bw	Fine Sandy Loam	10 YR 5/1	
17"-30"	C1	Silt	6/5b	
30"-100"	C2	Fine Loamy Sand	2.5 Y 5/6	

ESHGW @ 17", LC @ 20" 10 YR 7/1, HC @ 20" 7.5 YR 5/6

Weeping @ 70"

Test Pit #4				
Depth	Layer	Texture	Color	Comments
0"-58"	Fill	-	-	
58"-80"	C1	Silt	6/5b	
80"-110"	C2	Gravelly Coarse Sand	7.5 YR 5/6	

ESHGW @ 58"

Weeping @ 86"

Test Pit #5				
Depth	Layer	Texture	Color	Comments
0"-42"	Fill/Ab	-	-	
42"-72"	C1	Silt	6/5b	
72"-102"	C2	Gravelly Coarse Sand	7.5 YR 5/6	

ESHGW @ 32"

Weeping @ 32"

HC @ 72"

APPENDIX C

FILTERRA OPERATION & MAINTENANCE MANUAL

Operation & Maintenance (OM) Manual v01

filterra®

Bioretention Systems

CONTECH®

ENGINEERED SOLUTIONS

filterra®
Bioretention Systems

Table of Contents

Overview

- Filterra® General Description
- Filterra® Schematic
- Basic Operations
- Design

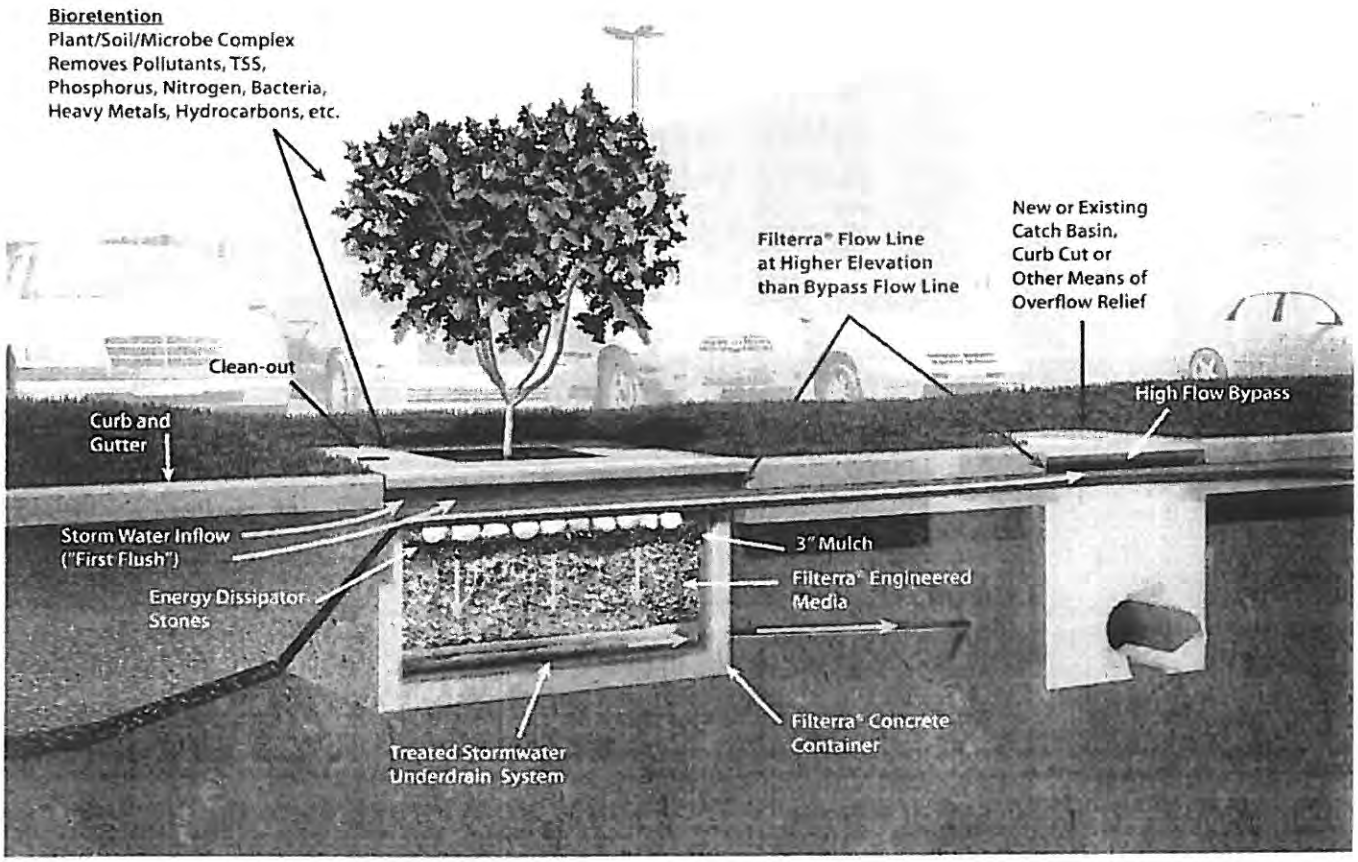
Maintenance

- Maintenance Overview
  - » Why Maintain?
  - » When to Maintain?
- Exclusion of Services
- Maintenance Visit Summary
- Maintenance Tools, Safety Equipment and Supplies
- Maintenance Visit Procedure
- Maintenance Checklist

CONTECH®
ENGINEERED SOLUTIONS

General Description

The following general specifications describe the general operations and maintenance requirements for the Contech Engineered Solutions LLC stormwater bioretention filtration system, the Filterra®. The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, pre-constructed drop-in place unit designed for applications in the urban landscape to treat contaminated runoff.



Stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The mixture immobilizes pollutants which are then decomposed, volatilized and incorporated into the biomass of the Filterra® system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged. Higher flows bypass the Filterra® to a downstream inlet or outfall. Maintenance is a simple, inexpensive and safe operation that does not require confined space access, pumping or vacuum equipment or specialized tools. Properly trained landscape personnel can effectively maintain Filterra® Stormwater systems by following instructions in this manual.

Basic Operations

Filterra® is a bioretention system in a concrete box. Contaminated stormwater runoff enters the filter box through the curb inlet spreading over the 3-inch layer of mulch on the surface of the filter media. As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the soil media where the finer particles are removed and other chemical reactions take place to immobilize and capture pollutants in the soil media. The cleansed water passes into an underdrain and flows to a pipe system or other appropriate discharge point. Once the pollutants are in the soil, the bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a very complex variety of biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

Design and Installation

Each project presents different scopes for the use of Filterra® systems. To ensure the safe and specified function of the stormwater BMP, Contech reviews each application before supply. Information and help may be provided to the design engineer during the planning process. Correct Filterra® box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction. The contractor is responsible for the correct installation of Filterra units as shown in approved plans. A comprehensive installation manual is available at www.conteches.com.

Maintenance

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement.

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the expected lifespan of your Filterra media.
- Avoid more costly media replacement.
- Help reduce pollutant loads leaving your property.

Simple maintenance of the Filterra® is required to continue effective pollutant removal from stormwater runoff before discharge into downstream waters. This procedure will also extend the longevity of the living biofilter system. The unit will recycle and accumulate pollutants within the biomass, but is also subjected to other materials entering the throat. This may include trash, silt and leaves etc. which will be contained within the void below the top grate and above the mulch layer. Too much silt may inhibit the Filterra's® flow rate, which is the reason for site stabilization before activation. Regular replacement of the mulch stops accumulation of such sediment.

When to Maintain?

Contech includes a 1-year maintenance plan with each system purchase. Annual included maintenance consists of a maximum of two (2) scheduled visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as the unit installed, curb and gutter and transitions in place and activation (by Supplier) when mulch and plant are added and temporary throat protection removed.

Activation cannot be carried out until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands while the fall visit helps the system by removing excessive leaf litter.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required; regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency; e.g. some fast food restaurants require more frequent trash removal. Contributing drainage areas which are subject to new development wherein the recommended erosion and sediment control measures have not been implemented may require additional maintenance visits.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the Supplier and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the (maintenance) Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance to the Supplier (i.e. no pruning or fertilizing).

Exclusion of Services

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant of the Filterra® system.

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the Supplier maintenance contract. Should a major contamination event occur the Owner must block off the outlet pipe of the Filterra® (where the cleaned runoff drains to, such as drop inlet) and block off the throat of the Filterra®. The Supplier should be informed immediately.

Maintenance Visit Summary

Each maintenance visit consists of the following simple tasks (detailed instructions below).

1. Inspection of Filterra® and surrounding area
2. Removal of tree grate and erosion control stones
3. Removal of debris, trash and mulch
4. Mulch replacement
5. Plant health evaluation and pruning or replacement as necessary
6. Clean area around Filterra®
7. Complete paperwork

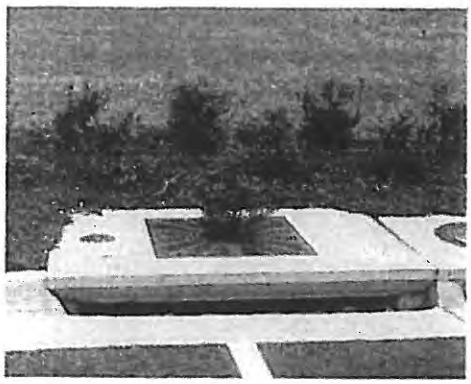
Maintenance Tools, Safety Equipment and Supplies

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes. A T-Bar or crowbar should be used for moving the tree grates (up to 170 lbs ea.). Most visits require minor trash removal and a full replacement of mulch. See below for actual number of bagged mulch that is required in each unit size. Mulch should be a double shredded, hardwood variety; do not use colored or dyed mulch. Some visits may require additional Filterra® engineered soil media available from the Supplier.

Box Length	Box Width	Filter Surface Area (ft^2)	Volume at 3" (ft^3)	# of 2 ft^3 Mulch Bags
4	4	16	4	2
6	4	24	6	3
8	4	32	8	4
6	6	36	9	5
8	6	48	12	6
10	6	60	15	8
12	6	72	18	9
13	7	91	23	12

Maintenance Visit Procedure

Keep sufficient documentation of maintenance actions to predict location specific maintenance frequencies and needs. An example Maintenance Report is included in this manual.



1. Inspection of Filterra® and surrounding area

- Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

Record on Maintenance Report the following:

Standing Water	yes | no
Damage to Box Structure	yes | no
Damage to Grate	yes | no
Is Bypass Clear	yes | no

If yes answered to any of these observations, record with close-up photograph (numbered).

2. Removal of tree grate and erosion control stones

- Remove cast iron grates for access into Filterra® box.
- Dig out silt (if any) and mulch and remove trash & foreign items.

Record on Maintenance Report the following:

Silt/Clay	yes | no
Cups/ Bags	yes | no
Leaves	yes | no
# of Buckets Removed	_____

3. Removal of debris, trash and mulch

- After removal of mulch and debris, measure distance from the top of the Filterra® engineered media soil to the bottom of the top slab. If this distance is greater than 12", add Filterra® media (not top soil or other) to recharge to a 9" distance

Record on Maintenance Report the following:

Distance of Bottom of Top Slab (inches)	_____
# of Buckets of Media Added	_____

4. Mulch replacement

- Please see mulch specifications.
- Add double shredded mulch evenly across the entire unit to a depth of 3".
- Ensure correct repositioning of erosion control stones by the Filterra® inlet to allow for entry of trash during a storm event.
- Replace Filterra® grates correctly using appropriate lifting or moving tools, taking care not to damage the plant.

5. Plant health evaluation and pruning or replacement as necessary

- Examine the plant's health and replace if dead.
- Prune as necessary to encourage growth in the correct directions

Record on Maintenance Report the following:

Height above Grate	_____(ft)
Width at Widest Point	_____(ft)
Health	alive | dead
Damage to Plant	yes | no
Plant Replaced	yes | no

6. Clean area around Filterra®

- Clean area around unit and remove all refuse to be disposed of appropriately.

7. Complete paperwork

- Deliver Maintenance Report and photographs to appropriate location (normally Contech during maintenance contract period).
- Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations.

Maintenance Checklist

Drainage System Failure	Problem	Conditions to Check	Condition that Should Exist	Actions
Inlet	Excessive sediment or trash accumulation.	Accumulated sediments or trash impair free flow of water into Filterra.	Inlet should be free of obstructions allowing free distributed flow of water into Filterra.	Sediments and/or trash should be removed.
Mulch Cover	Trash and floatable debris accumulation.	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover.	Trash and debris should be removed and mulch cover raked level. Ensure bark nugget mulch is not used.
Mulch Cover	"Ponding" of water on mulch cover.	"Ponding" in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover.	Recommend contact manufacturer and replace mulch as a minimum.
Vegetation	Plants not growing or in poor condition.	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact manufacturer for advice.
Vegetation	Plant growth excessive.	Plants should be appropriate to the species and location of Filterra.		Trim/prune plants in accordance with typical landscaping and safety needs.
Structure	Structure has visible cracks.	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks.		Vault should be repaired.
Maintenance is ideally to be performed twice annually.				

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