

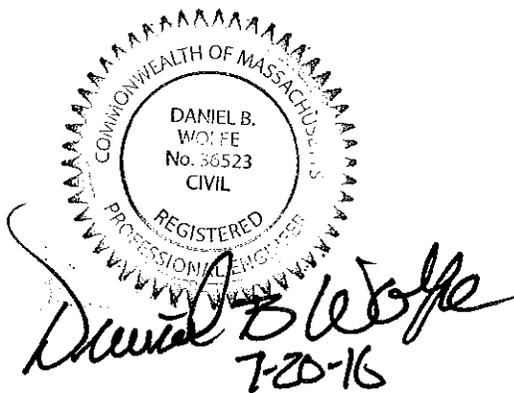
STORMWATER MANAGEMENT REPORT

FOR

248 HIGH STREET, LLC

JUNE, 2016

Revised July 20, 2016



PREPARED BY: DAVID E. ROSS ASSOCIATES, INC.
111 FITCHBURG ROAD
AYER, MA. 01432

Project No. 31342

DRAINAGE CALCULATIONS

Table of Contents:

| | <u>Pages</u> |
|--|-----------------------------|
| Narrative Summary | N1-N5 |
| HydroCAD SCS Method Calculations: | |
| <ul style="list-style-type: none">• Pre-Development Watershed Area Plan• Pre-Development Routing Diagram• Pre-Development Node Detailed Summaries | Sheet 1 of 2 1 2 - 7 |
| <ul style="list-style-type: none">• Post-Development Watershed Area Plan• Post-Development Routing Diagram• Post-Development Node Detailed Summaries | Sheet 2 of 2 8 9 – 20 |
| Appendix A | |
| <ul style="list-style-type: none">• USGS Locus Map• SCS Soil Mapping• Deep Hole Test Data | |
| Appendix B | |
| <ul style="list-style-type: none">• Stormwater Checklist• TSS Removal Calculations Worksheets• Operation and Maintenance Plan | |
| Appendix C | |
| <ul style="list-style-type: none">• Closed Drainage System Calculations | |

Narrative Summary

Drainage calculations have been prepared using the HydroCAD Stormwater Modeling System. HydroCAD uses the Soil Conservation Service (SCS) TR-20 AND TR-55 methodology.

Pre-Development Conditions:

The existing parcel is a 1.5 acre lot at 248 High Street in Acton. The lot has an existing house and decrepit barn structure. The lot is mostly wooded with some open area around the house. The southern corner of the lot (Watershed Area 2) along High Street currently drains into High Street, and the remainder of the lot (Watershed Area 1) drains towards the Town of Acton property abutting the site to the east.

The Soil Survey of Middlesex County, issued by the USDA Soil Conservation Service (SCS), now the Natural Resources Conservation Service, includes delineation of soils in the vicinity of the locus by name and by hydrologic characteristics. The soils located within the site are identified as Montauk and Ridgebury (see Appendix A). The Soil Survey identifies these soils to be in the "C" and "D" hydrologic soil groups, respectively.

The existing predevelopment drainage area has been divided into two drainage watersheds (Watersheds 1 and 2) as described above. Please refer to the "Pre-Development Watershed Area" plan, Sheet 1 of 2.

DRAINAGE CALCULATIONS

Post-Development Conditions:

The proposed project includes the construction of a new 20' wide paved roadway, 8 single family homes, driveways, and other associated site work. Stormwater runoff generated from the development will be collected, treated, and attenuated on-site by an underground detention system and associated treatment facilities. The proposed (post-development) runoff pattern from the site will generally continue as in predevelopment. The post-development points of analysis are the same as pre-development.

Under post-development conditions, the two pre-development watersheds have been divided into three subcatchments (Watersheds 10, 11, and 20). These watersheds are determined by the proposed development and grading of the site. Watershed 10 flows overland to the abutting Town of Acton parcel. Watershed 11 is collected by the proposed drainage system and the associated runoff is collected, treated, and attenuated through the use of the underground detention system. Discharges from the detention system are directed to the rear of the property towards the abutting land of the Town of Acton. The combined discharges from Watersheds 10 and 11 are reported in the analysis through the use of a Design Point similar to pre-development Watershed 1. Overland flows from Watershed 20 are discharged to High Street similar to pre-development Watershed 2.

The proposed stormwater management system will consist of deep sump hooded catch basins, a CDS stormwater treatment unit, and the underground detention system. This system has been designed in accordance with the Massachusetts Stormwater Management Policy.

Summary of Calculations

The following tables summarize the peak surface stormwater runoff (in cubic feet per second (CFS)) for each storm event. Calculations have been provided for the 2, 10, and 100-year storm events to illustrate the stormwater management systems performance under various design storm rates.

Tables I and II below are a summary of pre-development and post-development peak runoff rates for overland flow from the individual watershed areas on the site that are altered as a result of the proposed development (please refer to the "Pre & Post-Development Drainage Areas" plans for delineation of the watershed areas). Table III below is a summary of the overland flow rates from the proposed development compared to the pre-development overland flow rates to the design points described above.

| <u>WATERSHED</u> | PRE-DEVELOPMENT WATERSHEDS | | |
|------------------|-----------------------------------|---------|----------|
| | <i>FLOW (CFS)</i> | | |
| | 2 year | 10 year | 100 year |
| 1 | 0.97 | 2.34 | 4.80 |
| 2 | 0.33 | 0.75 | 1.47 |

TABLE I

DRAINAGE CALCULATIONS

| | POST-DEVELOPMENT WATERSHEDS | | |
|------------------|------------------------------------|---------|----------|
| <u>WATERSHED</u> | <i>FLOW (CFS)</i> | | |
| | 2 year | 10 year | 100 year |
| 10 | 0.68 | 1.43 | 2.68 |
| 11 | 1.67 | 2.93 | 4.89 |
| 20 | 0.36 | 0.75 | 1.41 |

TABLE II

| | | PRE & POST-DEVELOPMENT DESIGN POINTS | | |
|---------------------|-------------|---|-------------|-------------|
| <u>DESIGN POINT</u> | | <i>FLOW (CFS)</i> | | |
| | | 2 year | 10 year | 100 year |
| DP #1 | pre | 0.97 | 2.34 | 4.80 |
| | post | 0.86 | 2.33 | 4.80 |
| 2 | pre | 0.33 | 0.75 | 1.47 |
| | post | 0.36 | 0.75 | 1.41 |

TABLE III

Under post development conditions, the results indicate that the Design Point will experience a decrease in peak rate of runoff for the calculated storm events. The results indicate that there is a minor increase in runoff to High Street under the 2 year storm event. This increase will not cause any flooding of the street and should be considered negligible. Accordingly, we do not anticipate adverse effects or flooding of neighboring or down gradient properties or sensitive receptors.

DRAINAGE CALCULATIONS

Stormwater Management Standards

The proposed drainage system meets the Stormwater Management Policy (SMP) of the Massachusetts Department of Environmental Protection as follows:

Standard #1 NO UNTREATED DISCHARGES OR EROSION TO WETLANDS

The proposed project will not discharge untreated stormwater from any impervious surfaces or cause erosion to any wetland. Stormwater runoff from impervious surfaces will be collected and directed to the stormwater management system which includes deep sump hooded catch basins, water quality treatment unit, and an underground detention facility.

Standard #2 PEAK RATE ATTENUATION

The proposed project has been designed with stormwater controls to attenuate flows for the 2-year, 10-year, 25-year, and 100-year 24-hour design storm events. The post-development peak discharge rates for these storms are at or below the pre-development conditions.

Standard #3 STORMWATER RECHARGE

The proposed project contains approximately 37,830 area S.F. of new impervious area (roof area of approximately 12,472 S.F. and pavement area of approximately 23,358 S.F.). Rooftops, paved driveways and roadway areas will be discharged through the proposed underground detention basin. The site contains soils in HSG C and D hydrologic soils groups. HSG C and D soils require 0.25 inches and 0.10 inches, respectively, of recharge per impervious sq. ft.. The proposed impervious surface requires 719 cu. ft. $[(32,230 \times 0.25 / 12) + (5,600 \times 0.10 / 12)]$ of recharge. The proposed basin includes a storage volume below the outlet to store and recharge the prescribed recharge volume. The underground detention system has a recharge volume of 608 cu. ft. from elevation 217.4 to 217.9 within the 6" crushed stone base. The system will also infiltrate approximately 0.023 acre-feet (1,002 cu. ft.) of runoff for the 1 year storm event. Therefore, the total recharge provided is 1,610 cu. ft. This volume satisfies the recharge volume requirement.

The SMP requires the basin to drain within 72 hours using the Rawls Rate and the bottom surface area for the basin. Using the Rawls Table, the minimum infiltration rate is 0.27 inches/hour for the site. $\text{Drawdown Time} = \text{Req. Volume} / (\text{Infil Rate})(\text{Conversion for Inches to Feet})(\text{Bottom Area})$. The drawdown times listed below are calculated using the basins under the 100year storm event runoff volumes.

| | <u>Bottom Area</u> | <u>Drawdown Time</u> |
|-----------------|--------------------|----------------------|
| Detention Basin | 3,041 S.F. | 14.6 hours |

Standard #4 WATER QUALITY

Water quality volumes are based on 0.50 inch per square foot of impervious area. Given the total impervious non-roof surface for the project (23,358 S.F.), the required water quality volume is 973 C.F. $(23,358 \times .50 / 12)$. Treatment of the water quality volume is provided via the proposed CDS 2015-4-C treatment unit.

Total suspended solids removal of a minimum of 80% to the proposed detention basin is met as demonstrated in the attached TSS Removal worksheets.

Standard #5 LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The project is not a land use with Higher Potential Pollutant Loads.

DRAINAGE CALCULATIONS

Standard #6 CRITICAL AREAS

The site is not located within a critical area. The water quality volume has been based on a 0.50" rainfall.

Standard #7 REDEVLEOPMENT

This site is not considered a redevelopment project.

Standard #8 CONSTRUCTION PERIOD CONTROLS

The necessary erosion and sedimentation controls have been included on the design plans. A Stormwater Pollution Prevention Plan is also included on the design plans (Sheet 9 of 9, "Erosion & Sedimentation Control Plan").

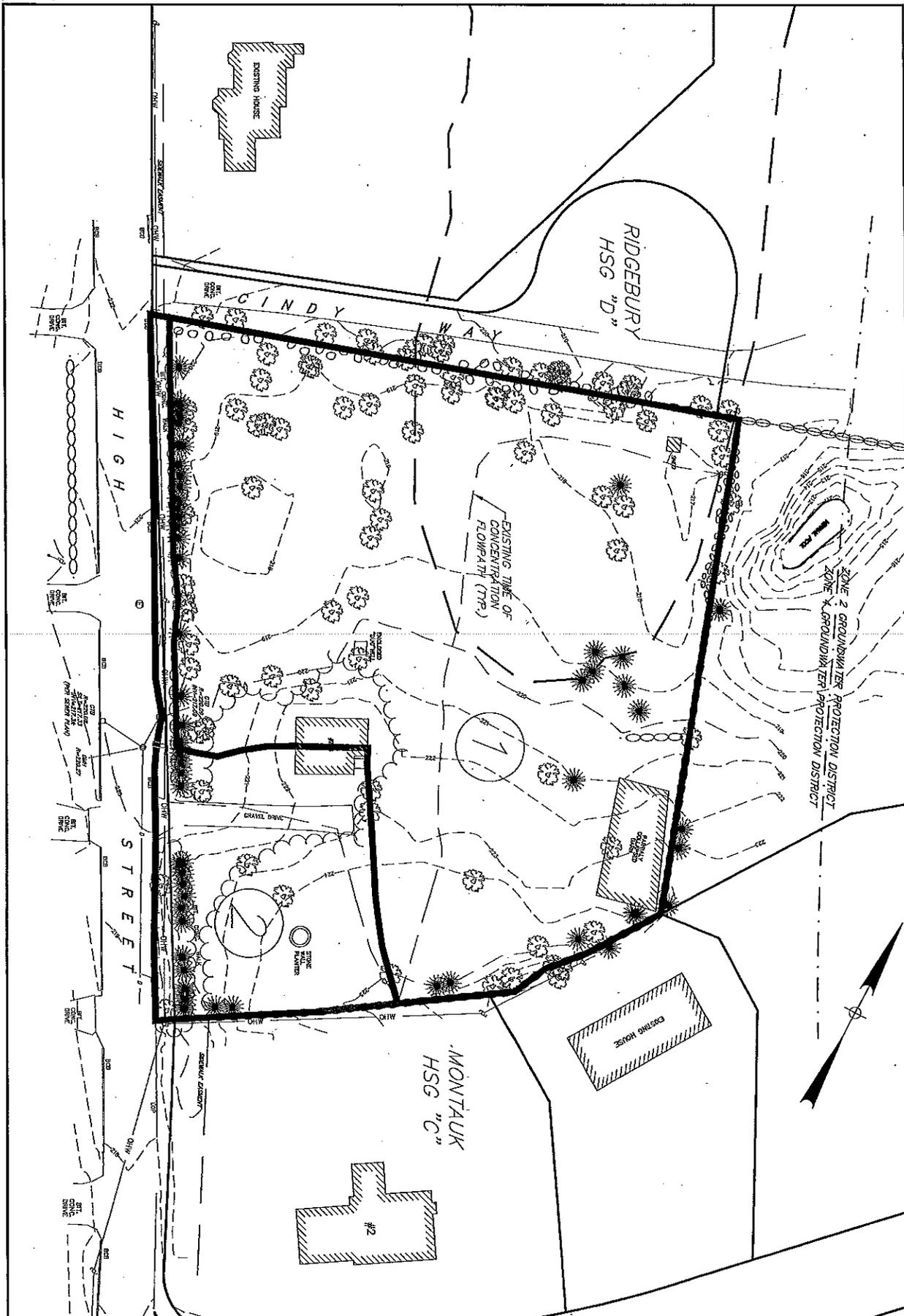
Standard #9 OPERATION AND MAINTENANCE PLAN

An Operation and Maintenance Plan is attached to the Stormwater Report with additional information provided on the design plans (Sheet 9 of 9, "Erosion & Sedimentation Control Plan").

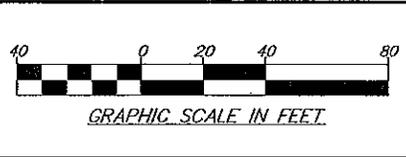
Standard #10 ILLICIT DISCHARGES TO THE DRAIN SYSTEM

There are no existing or proposed illicit discharges to the drainage system for the proposed project.

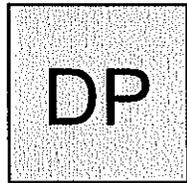
HYDROCAD DATA
Pre-Development



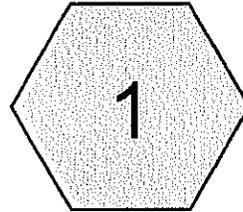

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 ENVIRONMENTAL CONSULTANTS



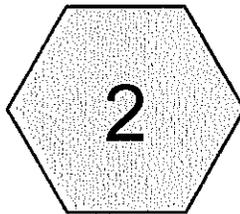
SHEET TITLE:
PRE-DEVELOPMENT WATERSHED AREA PLAN
 ADELINE WAY - ACTON, MA



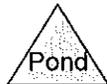
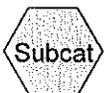
Design Point



To Northeast Corner of
Property



To High Street



2-YEAR STORM EVENT
Pre-Development

Pre-Development 6-2-16

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Type III 24-hr 2 Year Storm Rainfall=3.25"

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Page 2

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To Northeast Corner of Property

Runoff Area=53,336 sf 3.32% Impervious Runoff Depth>0.92"
Flow Length=360' Tc=17.2 min CN=73 Runoff=0.97 cfs 0.094 af

Subcatchment 2: To High Street

Runoff Area=13,094 sf 11.71% Impervious Runoff Depth>1.09"
Flow Length=165' Tc=11.5 min CN=76 Runoff=0.33 cfs 0.027 af

Reach DP: Design Point

Inflow=0.97 cfs 0.094 af
Outflow=0.97 cfs 0.094 af

Pre-Development 6-2-16

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Type III 24-hr 2 Year Storm Rainfall=3.25"

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Page 3

Summary for Subcatchment 1: To Northeast Corner of Property

Runoff = 0.97 cfs @ 12.26 hrs, Volume= 0.094 af, Depth> 0.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.25"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 34,965 | 70 | Woods, Good, HSG C |
| 14,552 | 77 | Woods, Good, HSG D |
| 2,048 | 74 | >75% Grass cover, Good, HSG C |
| 1,771 | 98 | Paved parking & roofs |
| 53,336 | 73 | Weighted Average |
| 51,565 | | Pervious Area |
| 1,771 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 6.8 | 310 | 0.0230 | 0.76 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 17.2 | 360 | Total | | | |

Summary for Subcatchment 2: To High Street

Runoff = 0.33 cfs @ 12.17 hrs, Volume= 0.027 af, Depth> 1.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.25"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 5,942 | 70 | Woods, Good, HSG C |
| 4,702 | 74 | >75% Grass cover, Good, HSG C |
| 1,533 | 98 | Paved parking & roofs |
| 917 | 89 | Gravel roads, HSG C |
| 13,094 | 76 | Weighted Average |
| 11,561 | | Pervious Area |
| 1,533 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 0.7 | 40 | 0.0380 | 0.97 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.4 | 75 | 0.0360 | 3.05 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 11.5 | 165 | Total | | | |

Summary for Reach DP: Design Point

Inflow Area = 1.224 ac, 3.32% Impervious, Inflow Depth > 0.92" for 2 Year Storm event
Inflow = 0.97 cfs @ 12.26 hrs, Volume= 0.094 af
Outflow = 0.97 cfs @ 12.26 hrs, Volume= 0.094 af, Atten= 0%, Lag= 0.0 min

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

10-YEAR STORM EVENT

Pre-Development

Pre-Development 6-2-16

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 4

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To Northeast Corner of Property

Runoff Area=53,336 sf 3.32% Impervious Runoff Depth>2.13"
Flow Length=360' Tc=17.2 min CN=73 Runoff=2.34 cfs 0.217 af

Subcatchment 2: To High Street

Runoff Area=13,094 sf 11.71% Impervious Runoff Depth>2.38"
Flow Length=165' Tc=11.5 min CN=76 Runoff=0.75 cfs 0.060 af

Reach DP: Design Point

Inflow=2.34 cfs 0.217 af
Outflow=2.34 cfs 0.217 af

Pre-Development 6-2-16

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 5

Summary for Subcatchment 1: To Northeast Corner of Property

Runoff = 2.34 cfs @ 12.25 hrs, Volume= 0.217 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10 Year Storm Rainfall=5.04"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 34,965 | 70 | Woods, Good, HSG C |
| 14,552 | 77 | Woods, Good, HSG D |
| 2,048 | 74 | >75% Grass cover, Good, HSG C |
| 1,771 | 98 | Paved parking & roofs |
| 53,336 | 73 | Weighted Average |
| 51,565 | | Pervious Area |
| 1,771 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 6.8 | 310 | 0.0230 | 0.76 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 17.2 | 360 | Total | | | |

Summary for Subcatchment 2: To High Street

Runoff = 0.75 cfs @ 12.16 hrs, Volume= 0.060 af, Depth> 2.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10 Year Storm Rainfall=5.04"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 5,942 | 70 | Woods, Good, HSG C |
| 4,702 | 74 | >75% Grass cover, Good, HSG C |
| 1,533 | 98 | Paved parking & roofs |
| 917 | 89 | Gravel roads, HSG C |
| 13,094 | 76 | Weighted Average |
| 11,561 | | Pervious Area |
| 1,533 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 0.7 | 40 | 0.0380 | 0.97 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.4 | 75 | 0.0360 | 3.05 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 11.5 | 165 | Total | | | |

Summary for Reach DP: Design Point

Inflow Area = 1.224 ac, 3.32% Impervious, Inflow Depth > 2.13" for 10 Year Storm event
 Inflow = 2.34 cfs @ 12.25 hrs, Volume= 0.217 af
 Outflow = 2.34 cfs @ 12.25 hrs, Volume= 0.217 af, Atten= 0%, Lag= 0.0 min

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

100-YEAR STORM EVENT

Pre-Development

Pre-Development 6-2-16

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Type III 24-hr 100 Year Storm Rainfall=7.87"

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Page 6

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

Subcatchment 1: To Northeast Corner of Property

Runoff Area=53,336 sf 3.32% Impervious Runoff Depth>4.38"
Flow Length=360' Tc=17.2 min CN=73 Runoff=4.80 cfs 0.446 af

Subcatchment 2: To High Street

Runoff Area=13,094 sf 11.71% Impervious Runoff Depth>4.72"
Flow Length=165' Tc=11.5 min CN=76 Runoff=1.47 cfs 0.118 af

Reach DP: Design Point

Inflow=4.80 cfs 0.446 af
Outflow=4.80 cfs 0.446 af

Pre-Development 6-2-16

Type III 24-hr 100 Year Storm Rainfall=7.87"

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Page 7

Summary for Subcatchment 1: To Northeast Corner of Property

Runoff = 4.80 cfs @ 12.24 hrs, Volume= 0.446 af, Depth> 4.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 100 Year Storm Rainfall=7.87"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 34,965 | 70 | Woods, Good, HSG C |
| 14,552 | 77 | Woods, Good, HSG D |
| 2,048 | 74 | >75% Grass cover, Good, HSG C |
| 1,771 | 98 | Paved parking & roofs |
| 53,336 | 73 | Weighted Average |
| 51,565 | | Pervious Area |
| 1,771 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 6.8 | 310 | 0.0230 | 0.76 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 17.2 | 360 | Total | | | |

Summary for Subcatchment 2: To High Street

Runoff = 1.47 cfs @ 12.16 hrs, Volume= 0.118 af, Depth> 4.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Type III 24-hr 100 Year Storm Rainfall=7.87"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 5,942 | 70 | Woods, Good, HSG C |
| 4,702 | 74 | >75% Grass cover, Good, HSG C |
| 1,533 | 98 | Paved parking & roofs |
| 917 | 89 | Gravel roads, HSG C |
| 13,094 | 76 | Weighted Average |
| 11,561 | | Pervious Area |
| 1,533 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 10.4 | 50 | 0.0300 | 0.08 | | Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.25" |
| 0.7 | 40 | 0.0380 | 0.97 | | Shallow Concentrated Flow, Woodland Kv= 5.0 fps |
| 0.4 | 75 | 0.0360 | 3.05 | | Shallow Concentrated Flow, Unpaved Kv= 16.1 fps |
| 11.5 | 165 | Total | | | |

Summary for Reach DP: Design Point

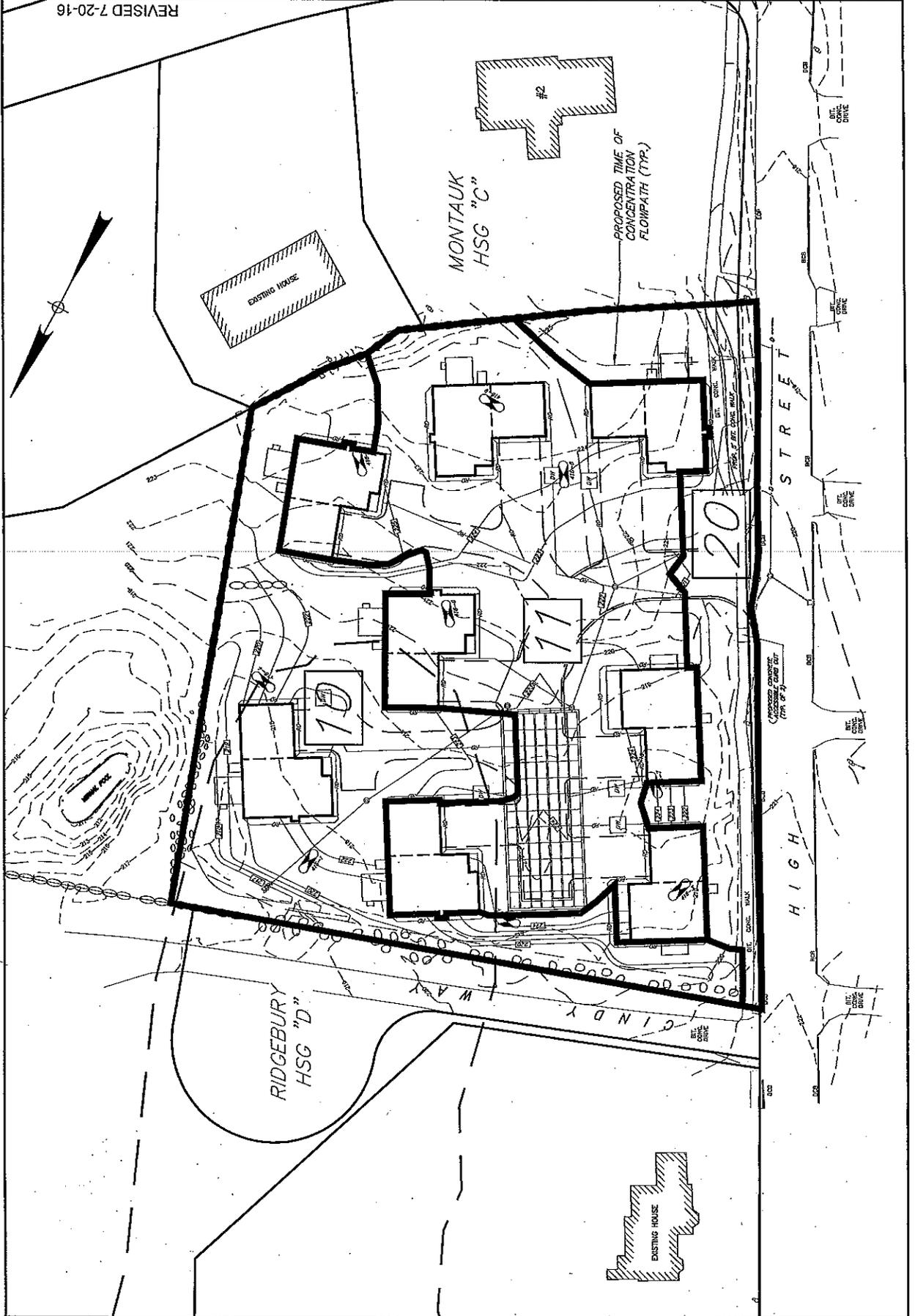
Inflow Area = 1.224 ac, 3.32% Impervious, Inflow Depth > 4.38" for 100 Year Storm event

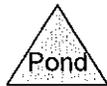
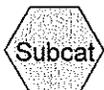
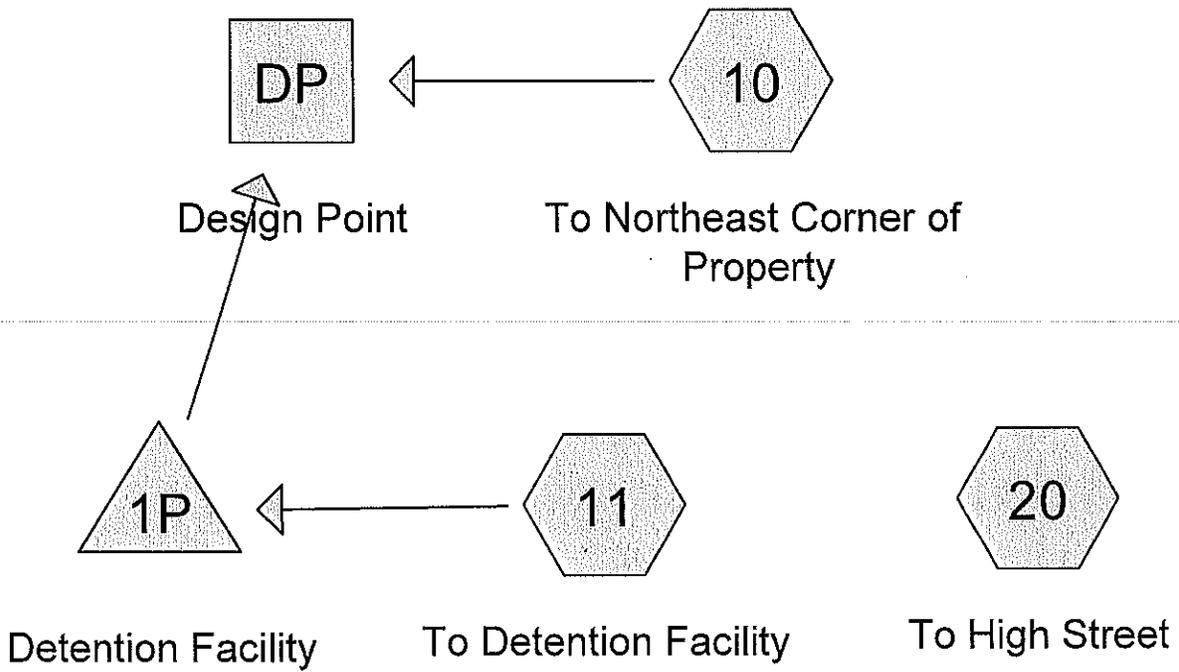
Inflow = 4.80 cfs @ 12.24 hrs, Volume= 0.446 af

Outflow = 4.80 cfs @ 12.24 hrs, Volume= 0.446 af, Atten= 0%, Lag= 0.0 min

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

HYDROCAD DATA
Post-Development





2-YEAR STORM EVENT

Post-Development

Post-Development 7-20-16

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Type III 24-hr 2 Year Storm Rainfall=3.25"

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Page 2

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: To Northeast Corner of Property

Runoff Area=22,345 sf 15.35% Impervious Runoff Depth>1.44"
Flow Length=260' Tc=11.2 min CN=80 Runoff=0.72 cfs 0.061 af

Subcatchment 11: To Detention Facility

Runoff Area=33,509 sf 61.68% Impervious Runoff Depth>2.12"
Flow Length=170' Tc=9.4 min CN=89 Runoff=1.67 cfs 0.136 af

Subcatchment 20: To High Street

Runoff Area=10,576 sf 23.14% Impervious Runoff Depth>1.37"
Flow Length=115' Tc=7.7 min CN=79 Runoff=0.36 cfs 0.028 af

Reach DP: Design Point

Inflow=0.86 cfs 0.155 af
Outflow=0.86 cfs 0.155 af

Pond 1P: Detention Facility

Peak Elev=218.80' Storage=2,842 cf Inflow=1.67 cfs 0.136 af
Discarded=0.02 cfs 0.025 af Primary=0.21 cfs 0.094 af Outflow=0.23 cfs 0.118 af

Post-Development 7-20-16

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Type III 24-hr 2 Year Storm Rainfall=3.25"

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Page 3

Summary for Subcatchment 10: To Northeast Corner of Property

Runoff = 0.72 cfs @ 12.16 hrs, Volume= 0.061 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.25"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 1,753 | 70 | Woods, Good, HSG C |
| 410 | 77 | Woods, Good, HSG D |
| 8,594 | 74 | >75% Grass cover, Good, HSG C |
| 8,157 | 80 | >75% Grass cover, Good, HSG D |
| 3,431 | 98 | Paved parking & roofs |
| 22,345 | 80 | Weighted Average |
| 18,914 | | Pervious Area |
| 3,431 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 6.2 | 50 | 0.0400 | 0.14 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 5.0 | 210 | 0.0100 | 0.70 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 11.2 | 260 | Total | | | |

Summary for Subcatchment 11: To Detention Facility

Runoff = 1.67 cfs @ 12.13 hrs, Volume= 0.136 af, Depth> 2.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.25"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 670 | 70 | Woods, Good, HSG C |
| 11,785 | 74 | >75% Grass cover, Good, HSG C |
| 386 | 80 | >75% Grass cover, Good, HSG D |
| 20,668 | 98 | Paved parking & roofs |
| 33,509 | 89 | Weighted Average |
| 12,841 | | Pervious Area |
| 20,668 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 8.1 | 50 | 0.0200 | 0.10 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 1.1 | 75 | 0.0270 | 1.15 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 0.2 | 45 | 0.0280 | 3.40 | | Shallow Concentrated Flow, Paved Kv= 20.3 fps |
| 9.4 | 170 | Total | | | |

Summary for Subcatchment 20: To High Street

Runoff = 0.36 cfs @ 12.12 hrs, Volume= 0.028 af, Depth> 1.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.25"

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Type III 24-hr 2 Year Storm Rainfall=3.25"

Printed 7/20/2016

Page 4

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 2,254 | 70 | Woods, Good, HSG C |
| 5,875 | 74 | >75% Grass cover, Good, HSG C |
| 2,447 | 98 | Paved parking & roofs |
| 10,576 | 79 | Weighted Average |
| 8,129 | | Pervious Area |
| 2,447 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|--|
| 6.9 | 50 | 0.0300 | 0.12 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 0.8 | 65 | 0.0360 | 1.33 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 7.7 | 115 | Total | | | |

Summary for Reach DP: Design Point

Inflow Area = 1.282 ac, 43.15% Impervious, Inflow Depth > 1.45" for 2 Year Storm event
 Inflow = 0.86 cfs @ 12.17 hrs, Volume= 0.155 af
 Outflow = 0.86 cfs @ 12.17 hrs, Volume= 0.155 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention Facility

Inflow Area = 0.769 ac, 61.68% Impervious, Inflow Depth > 2.12" for 2 Year Storm event
 Inflow = 1.67 cfs @ 12.13 hrs, Volume= 0.136 af
 Outflow = 0.23 cfs @ 12.82 hrs, Volume= 0.118 af, Atten= 86%, Lag= 41.1 min
 Discarded = 0.02 cfs @ 9.25 hrs, Volume= 0.025 af
 Primary = 0.21 cfs @ 12.82 hrs, Volume= 0.094 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 218.80' @ 12.82 hrs Surf.Area= 3,039 sf Storage= 2,842 cf

Plug-Flow detention time= 183.3 min calculated for 0.118 af (87% of inflow)
 Center-of-Mass det. time= 125.6 min (938.3 - 812.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|---------|---------------|--|
| #1 | 217.40' | 2,711 cf | Custom Stage Data (Prismatic) Listed below (Recalc) 10,637 cf Overall - 3,859 cf Embedded = 6,778 cf x 40.0% Voids |
| #2 | 217.90' | 3,859 cf | 44.6"W x 30.0"H x 7.12'L StormTech SC-740 x 84 Inside #1 |
| | | 6,570 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|------------------|-------------------|------------------------|------------------------|
| 217.40 | 3,039 | 0 | 0 |
| 220.90 | 3,039 | 10,637 | 10,637 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|---------|--|
| #1 | Discarded | 217.40' | 0.270 in/hr Exfiltration over Surface area |
| #2 | Primary | 217.85' | 12.0" x 72.0' long Culvert RCP, square edge headwall, Ke= 0.500 Outlet Invert= 217.49' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.010 |
| #3 | Device 2 | 217.90' | 3.0" Vert. Orifice/Grate C= 0.600 |
| #4 | Device 2 | 218.80' | 5.9" Vert. Orifice/Grate X 2.00 C= 0.600 |
| #5 | Device 2 | 220.30' | 4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

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Type III 24-hr 2 Year Storm Rainfall=3.25"

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Page 5

Discarded OutFlow Max=0.02 cfs @ 9.25 hrs HW=217.44' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.21 cfs @ 12.82 hrs HW=218.80' (Free Discharge)

↑2=Culvert (Passes 0.21 cfs of 2.32 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 0.21 cfs @ 4.24 fps)

↑4=Orifice/Grate (Controls 0.00 cfs)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

10-YEAR STORM EVENT
Post-Development

Post-Development 7-20-16

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 6

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: To Northeast Corner of Property

Runoff Area=22,345 sf 15.35% Impervious Runoff Depth>2.92"
Flow Length=260' Tc=11.2 min CN=80 Runoff=1.47 cfs 0.125 af

Subcatchment 11: To Detention Facility

Runoff Area=33,509 sf 61.68% Impervious Runoff Depth>3.81"
Flow Length=170' Tc=9.4 min CN=89 Runoff=2.93 cfs 0.244 af

Subcatchment 20: To High Street

Runoff Area=10,576 sf 23.14% Impervious Runoff Depth>2.83"
Flow Length=115' Tc=7.7 min CN=79 Runoff=0.75 cfs 0.057 af

Reach DP: Design Point

Inflow=2.33 cfs 0.321 af
Outflow=2.33 cfs 0.321 af

Pond 1P: Detention Facility

Peak Elev=219.35' Storage=4,098 cf Inflow=2.93 cfs 0.244 af
Discarded=0.02 cfs 0.028 af Primary=1.28 cfs 0.196 af Outflow=1.30 cfs 0.223 af

Post-Development 7-20-16

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 7

Summary for Subcatchment 10: To Northeast Corner of Property

Runoff = 1.47 cfs @ 12.16 hrs, Volume= 0.125 af, Depth> 2.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 1,753 | 70 | Woods, Good, HSG C |
| 410 | 77 | Woods, Good, HSG D |
| 8,594 | 74 | >75% Grass cover, Good, HSG C |
| 8,157 | 80 | >75% Grass cover, Good, HSG D |
| 3,431 | 98 | Paved parking & roofs |
| 22,345 | 80 | Weighted Average |
| 18,914 | | Pervious Area |
| 3,431 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 6.2 | 50 | 0.0400 | 0.14 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 5.0 | 210 | 0.0100 | 0.70 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 11.2 | 260 | Total | | | |

Summary for Subcatchment 11: To Detention Facility

Runoff = 2.93 cfs @ 12.13 hrs, Volume= 0.244 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 670 | 70 | Woods, Good, HSG C |
| 11,785 | 74 | >75% Grass cover, Good, HSG C |
| 386 | 80 | >75% Grass cover, Good, HSG D |
| 20,668 | 98 | Paved parking & roofs |
| 33,509 | 89 | Weighted Average |
| 12,841 | | Pervious Area |
| 20,668 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 8.1 | 50 | 0.0200 | 0.10 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 1.1 | 75 | 0.0270 | 1.15 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 0.2 | 45 | 0.0280 | 3.40 | | Shallow Concentrated Flow, Paved Kv= 20.3 fps |
| 9.4 | 170 | Total | | | |

Summary for Subcatchment 20: To High Street

Runoff = 0.75 cfs @ 12.11 hrs, Volume= 0.057 af, Depth> 2.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 8

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 2,254 | 70 | Woods, Good, HSG C |
| 5,875 | 74 | >75% Grass cover, Good, HSG C |
| 2,447 | 98 | Paved parking & roofs |
| 10,576 | 79 | Weighted Average |
| 8,129 | | Pervious Area |
| 2,447 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 6.9 | 50 | 0.0300 | 0.12 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 0.8 | 65 | 0.0360 | 1.33 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 7.7 | 115 | Total | | | |

Summary for Reach DP: Design Point

Inflow Area = 1.282 ac, 43.15% Impervious, Inflow Depth > 3.00" for 10 Year Storm event
 Inflow = 2.33 cfs @ 12.23 hrs, Volume= 0.321 af
 Outflow = 2.33 cfs @ 12.23 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention Facility

Inflow Area = 0.769 ac, 61.68% Impervious, Inflow Depth > 3.81" for 10 Year Storm event
 Inflow = 2.93 cfs @ 12.13 hrs, Volume= 0.244 af
 Outflow = 1.30 cfs @ 12.38 hrs, Volume= 0.223 af, Atten= 56%, Lag= 15.1 min
 Discarded = 0.02 cfs @ 7.50 hrs, Volume= 0.028 af
 Primary = 1.28 cfs @ 12.38 hrs, Volume= 0.196 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 219.35' @ 12.38 hrs Surf.Area= 3,039 sf Storage= 4,098 cf

Plug-Flow detention time= 141.0 min calculated for 0.223 af (91% of inflow)
 Center-of-Mass det. time= 99.2 min (895.6 - 796.4)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|---------|---------------|--|
| #1 | 217.40' | 2,711 cf | Custom Stage Data (Prismatic) Listed below (Recalc) |
| | | | 10,637 cf Overall - 3,859 cf Embedded = 6,778 cf x 40.0% Voids |
| #2 | 217.90' | 3,859 cf | 44.6"W x 30.0"H x 7.12'L StormTech SC-740 x 84 Inside #1 |
| | | 6,570 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|------------------|-------------------|------------------------|------------------------|
| 217.40 | 3,039 | 0 | 0 |
| 220.90 | 3,039 | 10,637 | 10,637 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|---------|---|
| #1 | Discarded | 217.40' | 0.270 in/hr Exfiltration over Surface area |
| #2 | Primary | 217.85' | 12.0" x 72.0' long Culvert RCP, square edge headwall, Ke= 0.500 Outlet Invert= 217.49' S= 0.0050 /' Cc= 0.900 n= 0.010 |
| #3 | Device 2 | 217.90' | 3.0" Vert. Orifice/Grate C= 0.600 |
| #4 | Device 2 | 218.80' | 5.9" Vert. Orifice/Grate X 2.00 C= 0.600 |
| #5 | Device 2 | 220.30' | 4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

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Type III 24-hr 10 Year Storm Rainfall=5.04"

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Page 9

Discarded OutFlow Max=0.02 cfs @ 7.50 hrs HW=217.44' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.28 cfs @ 12.38 hrs HW=219.35' (Free Discharge)

↑2=Culvert (Passes 1.28 cfs of 3.47 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 0.27 cfs @ 5.54 fps)

↑4=Orifice/Grate (Orifice Controls 1.01 cfs @ 2.65 fps)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

100-YEAR STORM EVENT

Post-Development

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Type III 24-hr 100 Year Storm Rainfall=7.87"

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Page 10

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: To Northeast Corner of Property

Runoff Area=22,345 sf 15.35% Impervious Runoff Depth>5.49"
Flow Length=260' Tc=11.2 min CN=80 Runoff=2.73 cfs 0.235 af

Subcatchment 11: To Detention Facility

Runoff Area=33,509 sf 61.68% Impervious Runoff Depth>6.55"
Flow Length=170' Tc=9.4 min CN=89 Runoff=4.89 cfs 0.420 af

Subcatchment 20: To High Street

Runoff Area=10,576 sf 23.14% Impervious Runoff Depth>5.38"
Flow Length=115' Tc=7.7 min CN=79 Runoff=1.41 cfs 0.109 af

Reach DP: Design Point

Inflow=4.80 cfs 0.600 af
Outflow=4.80 cfs 0.600 af

Pond 1P: Detention Facility

Peak Elev=220.37' Storage=5,923 cf Inflow=4.89 cfs 0.420 af
Discarded=0.02 cfs 0.031 af Primary=2.66 cfs 0.365 af Outflow=2.68 cfs 0.396 af

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Type III 24-hr 100 Year Storm Rainfall=7.87"

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Page 11

Summary for Subcatchment 10: To Northeast Corner of Property

Runoff = 2.73 cfs @ 12.15 hrs, Volume= 0.235 af, Depth> 5.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100 Year Storm Rainfall=7.87"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 1,753 | 70 | Woods, Good, HSG C |
| 410 | 77 | Woods, Good, HSG D |
| 8,594 | 74 | >75% Grass cover, Good, HSG C |
| 8,157 | 80 | >75% Grass cover, Good, HSG D |
| 3,431 | 98 | Paved parking & roofs |
| 22,345 | 80 | Weighted Average |
| 18,914 | | Pervious Area |
| 3,431 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 6.2 | 50 | 0.0400 | 0.14 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 5.0 | 210 | 0.0100 | 0.70 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 11.2 | 260 | Total | | | |

Summary for Subcatchment 11: To Detention Facility

Runoff = 4.89 cfs @ 12.13 hrs, Volume= 0.420 af, Depth> 6.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100 Year Storm Rainfall=7.87"

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 670 | 70 | Woods, Good, HSG C |
| 11,785 | 74 | >75% Grass cover, Good, HSG C |
| 386 | 80 | >75% Grass cover, Good, HSG D |
| 20,668 | 98 | Paved parking & roofs |
| 33,509 | 89 | Weighted Average |
| 12,841 | | Pervious Area |
| 20,668 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 8.1 | 50 | 0.0200 | 0.10 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 1.1 | 75 | 0.0270 | 1.15 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 0.2 | 45 | 0.0280 | 3.40 | | Shallow Concentrated Flow, Paved Kv= 20.3 fps |
| 9.4 | 170 | Total | | | |

Summary for Subcatchment 20: To High Street

Runoff = 1.41 cfs @ 12.11 hrs, Volume= 0.109 af, Depth> 5.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100 Year Storm Rainfall=7.87"

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Type III 24-hr 100 Year Storm Rainfall=7.87"

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Page 12

| Area (sf) | CN | Description |
|-----------|----|-------------------------------|
| 2,254 | 70 | Woods, Good, HSG C |
| 5,875 | 74 | >75% Grass cover, Good, HSG C |
| 2,447 | 98 | Paved parking & roofs |
| 10,576 | 79 | Weighted Average |
| 8,129 | | Pervious Area |
| 2,447 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|----------|---------------|---------------|-------------------|----------------|---|
| 6.9 | 50 | 0.0300 | 0.12 | | Sheet Flow, Grass: Dense n= 0.240 P2= 3.25" |
| 0.8 | 65 | 0.0360 | 1.33 | | Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps |
| 7.7 | 115 | Total | | | |

Summary for Reach DP: Design Point

Inflow Area = 1.282 ac, 43.15% Impervious, Inflow Depth > 5.61" for 100 Year Storm event
 Inflow = 4.80 cfs @ 12.18 hrs, Volume= 0.600 af
 Outflow = 4.80 cfs @ 12.18 hrs, Volume= 0.600 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Detention Facility

Inflow Area = 0.769 ac, 61.68% Impervious, Inflow Depth > 6.55" for 100 Year Storm event
 Inflow = 4.89 cfs @ 12.13 hrs, Volume= 0.420 af
 Outflow = 2.68 cfs @ 12.31 hrs, Volume= 0.396 af, Atten= 45%, Lag= 10.9 min
 Discarded = 0.02 cfs @ 5.45 hrs, Volume= 0.031 af
 Primary = 2.66 cfs @ 12.31 hrs, Volume= 0.365 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 220.37' @ 12.31 hrs Surf.Area= 3,039 sf Storage= 5,923 cf

Plug-Flow detention time= 110.7 min calculated for 0.395 af (94% of inflow)
 Center-of-Mass det. time= 79.2 min (861.1 - 781.9)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|---------|---------------|---|
| #1 | 217.40' | 2,711 cf | Custom Stage Data (Prismatic) Listed below (Recalc) 10,637 cf Overall - 3,859 cf Embedded = 6,778 cf x 40.0% Voids |
| #2 | 217.90' | 3,859 cf | 44.6"W x 30.0"H x 7.12'L StormTech SC-740 x 84 Inside #1 |
| | | 6,570 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|------------------|-------------------|------------------------|------------------------|
| 217.40 | 3,039 | 0 | 0 |
| 220.90 | 3,039 | 10,637 | 10,637 |

| Device | Routing | Invert | Outlet Devices |
|--------|-----------|---------|---|
| #1 | Discarded | 217.40' | 0.270 in/hr Exfiltration over Surface area |
| #2 | Primary | 217.85' | 12.0" x 72.0' long Culvert RCP, square edge headwall, Ke= 0.500 Outlet Invert= 217.49' S= 0.0050 '/' Cc= 0.900 n= 0.010 |
| #3 | Device 2 | 217.90' | 3.0" Vert. Orifice/Grate C= 0.600 |
| #4 | Device 2 | 218.80' | 5.9" Vert. Orifice/Grate X 2.00 C= 0.600 |
| #5 | Device 2 | 220.30' | 4.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

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Type III 24-hr 100 Year Storm Rainfall=7.87"

Printed 7/20/2016

Page 13

Discarded OutFlow Max=0.02 cfs @ 5.45 hrs HW=217.44' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 0.02 cfs)

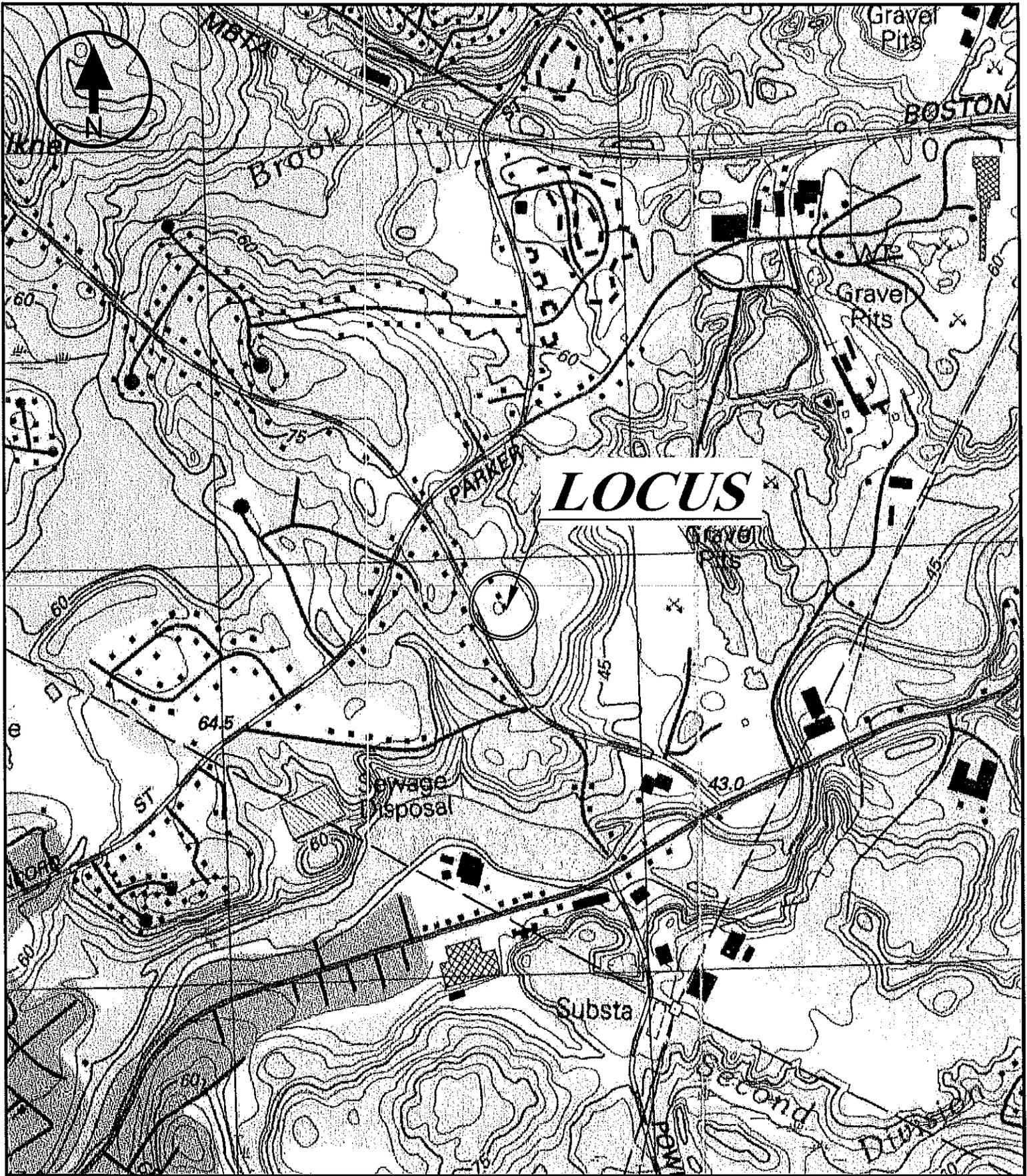
Primary OutFlow Max=2.63 cfs @ 12.31 hrs HW=220.36' (Free Discharge)

↑2=Culvert (Passes 2.63 cfs of 5.12 cfs potential flow)

↑3=Orifice/Grate (Orifice Controls 0.36 cfs @ 7.36 fps)

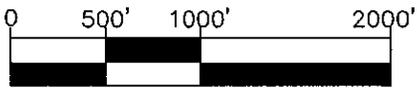
↑4=Orifice/Grate (Orifice Controls 2.10 cfs @ 5.52 fps)

↑5=Broad-Crested Rectangular Weir (Weir Controls 0.17 cfs @ 0.70 fps)



**DAVID E. ROSS
ASSOCIATES, INC.**

CIVIL ENGINEERS - ENVIRONMENTAL CONSULTANTS
LAND SURVEYORS - LANDSCAPE ARCHITECTS



GRAPHIC SCALE

SHEET TITLE:

USGS LOCUS MAP

ADELINE WAY
ACTON, MA

SOURCE: MASSGIS USGS TILES

Hydrologic Soil Group—Middlesex County, Massachusetts
(248 High Street - Acton, MA)



Map Scale: 1:2,110 if printed on A landscape (11" x 8.5") sheet.



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



Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017) | | | | |
|--|---|--------|--------------|----------------|
| Map unit symbol | Map unit name | Rating | Acres In AOI | Percent of AOI |
| 71B | Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony | D | 1.1 | 13.1% |
| 254B | Merrimac fine sandy loam, 3 to 8 percent slopes | A | 0.5 | 6.0% |
| 302B | Montauk fine sandy loam, 0 to 8 percent slopes, extremely stony | C | 7.0 | 80.9% |
| Totals for Area of Interest | | | 8.7 | 100.0% |

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

OBSERVATION TEST HOLE DATA

SOIL EVALUATOR: ROBERT E. OLIVA, D.E.R.A

4/15/16

416-1: ELEV. = 217.3'

0" - 8" A 10YR 3/3 FINE SANDY LOAM
8" - 19" Bw 10YR 5/8 LOAMY SAND
19" - 40" C1 10YR 6/8 M. SAND
40" - 124" C2 10YR 6/4 SANDY LOAM

MOTTLING AT 24"
WEEPING AT 36"
NO REFUSAL
E.S.H.W.T. AT 24" (215.3')

416-2: ELEV. = 218.8'

0" - 10" A 10YR 3/3 FINE SANDY LOAM
10" - 24" Bw 10YR 4/8 SANDY LOAM
24" - 42" C1 10YR 4/4 LOAMY SAND
42" - 110" C2 2.5Y 5/4 SANDY LOAM

MOTTLING AT 42"
WEEPING AT 64"
NO REFUSAL
E.S.H.W.T. AT 42" (215.3')

416-3: ELEV. = 218.4'

0" - 10" A 10YR 3/3 FINE SANDY LOAM
10" - 22" Bw 10YR 5/8 SANDY LOAM
22" - 32" C1 2.5Y 5/6 LOAMY SAND
32" - 118" C2 2.5Y 5/4 SANDY LOAM

MOTTLING AT 32"
WEEPING AT 41"
NO REFUSAL
E.S.H.W.T. AT 32" (215.7')

416-4: ELEV. = 218.1'

0" - 10" A 10YR 3/3 FINE SANDY LOAM
10" - 30" Bw 10YR 5/8 SANDY LOAM
30" - 48" C1 2.5Y 5/6 SANDY LOAM
48" - 122" C2 2.5Y 5/4 LOAMY SAND

MOTTLING AT 46"
NO WEEPING, NO G.W.
NO REFUSAL
E.S.H.W.T. AT 46" (214.1')

416-5: ELEV. = 222.6'

0" - 2" A 10YR 3/3 FINE SANDY LOAM
2" - 15" Bw 10YR 5/8 SANDY LOAM
15" - 52" C1 2.5Y 4/4 SANDY LOAM
52" - 118" C2 2.5Y 5/6 SANDY LOAM

MOTTLING AT 52"
NO WEEPING, G.W. AT 116"
NO REFUSAL
E.S.H.W.T. AT 52" (218.3')

416-6: ELEV. = 221.0'

0" - 10" A 10YR 3/3 FINE SANDY LOAM
10" - 29" Bw 10YR 5/8 SANDY LOAM
29" - 108" C 2.5Y 4/4 SANDY LOAM

MOTTLING AT 46"
NO WEEPING, NO G.W.
NO REFUSAL
E.S.H.W.T. AT 46" (217.2')

416-7: ELEV. = 217.8'

0" - 10" A 10YR 3/3 FINE SANDY LOAM
10" - 27" Bw 10YR 5/8 SANDY LOAM
27" - 112" C 2.5Y 5/4 SANDY LOAM

MOTTLING AT 42"
WEEPING AT 62"
NO REFUSAL
E.S.H.W.T. AT 42" (214.8')

416-8: ELEV. = 223.1'

0" - 6" A 10YR 3/3 FINE SANDY LOAM
6" - 18" Bw 10YR 5/8 SANDY LOAM
18" - 102" Cr --- FRACTURED ROCK/LEDGE

NO MOTTLING OBSERVED
NO WEEPING
NO REFUSAL, MACHINE STILL ABLE TO REMOVE ROCK
E.S.H.W.T. NOT DETERMINED

416-9: ELEV. = 224.8'

0" - 12" A 10YR 3/3
12" - 32" Bw 10YR 5/6
32" - 102" Cr 10YR 5/8 (SOME SOIL, DECAYED ROCK)

MOTTLING AT 40"
NO WEEPING, NO G.W.
NO REFUSAL, MACHINE STILL ABLE TO REMOVE ROCK
E.S.H.W.T. NOT DETERMINED

APPENDIX B
Stormwater Checklist
TSS Removal Calculations Worksheets
Operation and Maintenance Plan



Checklist for Stormwater Report

A. Introduction

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 8²
- 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.

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

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:

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3

-
- Use of "country drainage" versus curb and gutter conveyance and pipe
 - Bioretention Cells (includes Rain Gardens)
 - Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
 - Treebox Filter
 - Water Quality Swale
 - Grass Channel
 - Green Roof
 - Other (describe): _____

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- 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.

TSS Removal Calculation Worksheet

Location: Adeline Way - 248 High Street, LLC

| A BMP | B TSS Removal Rate | C Starting TSS Load * | D Amount Removed (BxC) | E Remaining Load (C-D) |
|----------------------------|--------------------------|-----------------------------|------------------------------|------------------------------|
| Deep Sump/Hood CB | 25% | 1.00 | 0.25 | 0.75 |
| CDS2015-4-C | 80% | 0.75 | 0.60 | 0.15 |
| | | | | |
| | | | | |
| | | | | |
| <i>Total TSS Removal =</i> | | | 0.85 | |

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

Project: 31342

Prepared By: REO

Date: 6/8/2016

**CDS ESTIMATED NET ANNUAL TSS REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD**



**248 HIGH STREET
ACTON, MA
for SYSTEM: DMH 1**

| | | | | |
|------------|------|---------|------------------------|-----|
| Area | 0.22 | acres | CDS Model | |
| Weighted C | 0.90 | | 2015-4 | |
| Tc | 6 | minutes | CDS Treatment Capacity | |
| | | | 1.4 | cfs |

| <u>Rainfall Intensity¹</u> (in/hr) | <u>Percent Rainfall Volume¹</u> | <u>Cumulative Rainfall Volume</u> | <u>Total Flowrate (cfs)</u> | <u>Treated Flowrate (cfs)</u> | <u>Removal Efficiency (%)</u> | <u>Incremental Removal (%)</u> |
|--|--|-----------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|
| 0.02 | 10.2% | 10.2% | 0.00 | 0.00 | 97.0 | 9.9 |
| 0.04 | 9.6% | 19.8% | 0.01 | 0.01 | 96.8 | 9.3 |
| 0.06 | 9.4% | 29.3% | 0.01 | 0.01 | 96.6 | 9.1 |
| 0.08 | 7.7% | 37.0% | 0.02 | 0.02 | 96.4 | 7.5 |
| 0.10 | 8.6% | 45.6% | 0.02 | 0.02 | 96.3 | 8.3 |
| 0.12 | 6.3% | 51.9% | 0.02 | 0.02 | 96.1 | 6.0 |
| 0.14 | 4.7% | 56.5% | 0.03 | 0.03 | 95.9 | 4.5 |
| 0.16 | 4.6% | 61.2% | 0.03 | 0.03 | 95.7 | 4.4 |
| 0.18 | 3.5% | 64.7% | 0.04 | 0.04 | 95.5 | 3.4 |
| 0.20 | 4.3% | 69.1% | 0.04 | 0.04 | 95.3 | 4.1 |
| 0.25 | 8.0% | 77.1% | 0.05 | 0.05 | 94.8 | 7.6 |
| 0.30 | 5.6% | 82.7% | 0.06 | 0.06 | 94.3 | 5.3 |
| 0.35 | 4.4% | 87.0% | 0.07 | 0.07 | 93.8 | 4.1 |
| 0.40 | 2.5% | 89.5% | 0.08 | 0.08 | 93.4 | 2.4 |
| 0.45 | 2.5% | 92.1% | 0.09 | 0.09 | 92.9 | 2.3 |
| 0.50 | 1.4% | 93.5% | 0.10 | 0.10 | 92.4 | 1.3 |
| 0.75 | 5.0% | 98.5% | 0.15 | 0.15 | 90.0 | 4.5 |
| 1.00 | 1.0% | 99.5% | 0.20 | 0.20 | 87.6 | 0.9 |
| 1.50 | 0.0% | 99.5% | 0.30 | 0.30 | 82.8 | 0.0 |
| 2.00 | 0.0% | 99.5% | 0.40 | 0.40 | 77.9 | 0.0 |
| 3.00 | 0.5% | 100.0% | 0.59 | 0.59 | 68.3 | 0.3 |
| | | | | | | 95.2 |

| | |
|---|--------------|
| Removal Efficiency Adjustment ² = | 6.5% |
| Predicted % Annual Rainfall Treated = | 93.5% |
| Predicted Net Annual Load Removal Efficiency = | 88.8% |

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
 2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Project: 248 High Street
 Location: 248 High Street - Acton, MA
 Prepared For: Rob Oliva - David E. Ross Associates - Ayer, MA



Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 0.50" of runoff.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

| Structure Name | Impv. (acres) | A (miles ²) | t _c (min) | t _c (hr) | WQV (in) |
|----------------|---------------|-------------------------|----------------------|---------------------|----------|
| WQU | 0.22 | 0.0003438 | 6.0 | 0.100 | 0.50 |
| | | 0.0000000 | | 0.000 | |
| | | 0.0000000 | | 0.000 | |

Procedure:

Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the t_c, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi²/watershed inches (csm/in).

| Structure Name | qu (csm/in.) |
|----------------|--------------|
| WQU | 752.00 |
| 0 | |
| 0 | |

1. Compute Q Rate using the following equation:

$$Q_{0.5} = (qu) (A) (WQV)$$

where:

Q_{0.5} = flow rate associated with first 1/2" of runoff

qu = the unit peak discharge, in csm/in.

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1/2" in this case)

| Structure Name | Q _{0.5} (cfs) |
|----------------|------------------------|
| WQU | 0.118 |
| 0 | 0.000 |
| 0 | 0.000 |

248 HIGH STREET, LLC
248 HIGH STREET – ACTON, MA

STORMWATER COLLECTION AND TREATMENT SYSTEM

OPERATION AND MAINTENANCE PLAN
JUNE, 2016

This Operation and Maintenance Plan outlines the efforts necessary to ensure that the stormwater collection and treatment system of this site operates in accordance with Massachusetts Department of Environmental Protection Stormwater Management policy. In the event that the system performance becomes inadequate, adjustments in the Plan may become necessary to improve the performance.

It is noted that the following restrictions on the use of this property are recommended, for the protection of groundwater and sensitive environmental receptors:

Use of salt on paved areas is to be minimized. Under any conditions where sand or other non-toxic materials are suitable, they are to be used.

Use of pesticides, herbicides and fertilizers are to be restricted and/or eliminated.

1. Long Term Pollution Prevention Plan.

In accordance with DEP Stormwater Standards, the development and implementation of suitable practices for source control and pollution prevention shall be incorporated in a Long Term Pollution Prevention Plan (LTPPP). The primary focus of the LTPPP is to establish procedures and controls for limiting the potential sources of pollutants, including nutrients that may contribute to excessive contaminant levels in the site's stormwater runoff. To this end the following sources controls and procedures will be in place at the site:

- **Good House Keeping** – It shall be the responsibility of the property owner to keep the site clean at all times. Refuse disposal and pickup shall occur on a regular basis and all material shall be disposed of in designated locations.
- **Storing Material and waste products inside or under cover** – No material storage is to take place outside at the facility on either paved or lawn areas. All materials stored on-site will conform to all storage requirements of local, state, and federal agencies.
- **Routine inspections and maintenance of stormwater BMP's** – Refer to the Operation & Maintenance procedures for each BMP as described herein and on the O&M plan.
- **Maintenance of lawns and other landscaped areas** – All landscaping and maintenance shall be performed by an authorized company chosen by the property owner.
- **Storage and use of fertilizers, herbicides and pesticides** – All landscape maintenance will be conducted by an authorized company chosen by the property

owner. Any application of herbicides or pesticides will be applied by a licensed applicator.

- **Proper management of deicing chemicals and snow** – Deicing chemicals and snow removal shall primarily be the responsibility of the property owner. Excess snow is to be trucked offsite, if required. Snow is to be stored such that snowmelt is controlled. The minimum amount of deicing chemicals needed is to be used. Avoid disposing of snow on top of storm drain catch basins.

2. Inspection.

It is necessary that the components which contribute to drainage, collection, treatment, storage and discharge of stormwater be regularly, routinely inspected to verify that conditions are suitable for its operation. Inspection of the system should be performed monthly, particularly during the first year of operation, but must take place quarterly at a minimum. As experience determines the frequency of necessary maintenance, inspections may be adjusted to match conditions which increase the necessity of maintenance.

The components requiring inspection, and the criteria required for verification are as follows and shown on the enclosed figure.

Onsite Drainage Areas: Areas that drain into the collection area from onsite must be inspected to verify that soil surfaces are stable and that erosion of soils into the collection system is not occurring.

Paved Surfaces: Inspect paved surfaces for accumulation of sand, litter, eroded soils or other deleterious materials. Verify that no hazardous materials, such as fuel oil, motor oils or other material has occurred.

Catch Basins: Inspect catch basins and the water quality inlet to ensure that they are watertight, have adequate sump capacity, oil/gas traps are in place, all frames and grates are free from structural damage and draining freely. Verify that there is no accumulation of oil or gasoline in the structure.

CDS Treatment Unit: Inspection of the CDS Treatment should include noting the presence of all installed components and the presence of collected sediments, floating debris and oil/gas. The CDS Treatment unit shall be emptied of sediments by the use of a vacuum truck when the depth of sediments has reached those levels prescribed by the manufacturer.

Stormtech Detention System: Verify that the floor of the system has not accumulated sediment, and that erosion of the floor has occurred. Any time that the system retains stormwater greater than 6" in depth and for a period greater than 72 hours (when precipitation is not occurring), a full and thorough inspection of the drainage system should be conducted.

3. Maintenance Activities

When inspection reveals that maintenance is appropriate, the following maintenance activities are necessary:

Onsite Drainage areas. In the event that erosion of onsite soils is occurring, the soils must be stabilized against further erosion. Permanently finish the surface against erosion. By placing stable vegetation such as loam and grass seed, or by armoring the surface against erosion with riprap placed on filter fabric blanket.

Paved Surfaces. Pick up all litter, junk or other material left on the surface. Upon detecting accumulation of sand, sediment or other materials, the paved surface must be swept to remove all such materials. All paved surfaces shall be swept biannually at a minimum. All street sweepings collected must be disposed of in accordance with current Massachusetts Department of Environmental Protection standards for such waste disposal. Any material deposits deemed to be hazardous must be removed and disposed of by a licensed contractor.

Catch Basins. Upon detecting accumulation of sand, sediment or other materials to a depth greater than 2 feet at any time during the year within the catch basins, it shall be removed and disposed of offsite in accordance with all local and state regulations. Regardless of the depth of sediment accumulation, catch basins shall be cleaned at least once per year. Upon detecting accumulation of any oil or gasoline, it shall be removed and disposed of offsite in accordance with all local and state regulations.

CDS Treatment Unit: Upon detecting accumulation of sand, sediment or other materials to a depth greater than recommended by the manufacturer, at any time during the year within the CDS unit, it shall be removed and disposed of offsite in accordance with all local and state regulations. The CDS Treatment unit shall be emptied of sediments by the use of a vacuum truck. Regardless of the depth of sediment accumulation, the CDS unit shall be cleaned at least once per year. Upon detecting accumulation of any oil or gasoline, it shall be removed and disposed of offsite in accordance with all local and state regulations.

Stormtech Detention System: Once constructed, the structure should be inspected after several storm events to confirm drainage system functions. Any problem should be addressed immediately. The structure should be inspected once per year to ensure that it is operating as designed. Sediment should be removed as necessary, and at least once every five years.

4. Record keeping.

It is necessary that a record of each inspection and maintenance activity be kept. Such information should include the following:

- Person performing the activity
- The date of the activity, and the weather conditions
- The preceding weather conditions
- The site conditions (dry, heavy snow cover, saturated conditions, etc.)
- The specific activity (inspection, cleaning, etc)
- The facility inspected
- The conditions of the facility
- The results of the activity

The records should be utilized to determine what frequency of inspection and maintenance is appropriate for the system, and what times of year such activities may be needed more frequently. Any activity performed subsequent to a major storm event or prolonged weather episode should be noted so that system performance may be evaluated in association with prevailing conditions.

5. Estimated Operation & Maintenance Budget

Below are the estimated annual maintenance costs for routine and non-routine tasks:

| | |
|--------------------------------------|-------------------------|
| Clean Hooded Deep Sump Catch Basins: | \$400 |
| Sweep Paved Roadway: | \$1,000 |
| Clean Outfall | \$100 |
| Stormtech Detention System: | \$1,000 |
| CDS Treatment Unit: | <u>\$800</u> |
| | Total: \$3,300/annually |

6. Ownership and operation responsibilities

Responsibility for the proper operation and maintenance of this system, during construction, including financial responsibilities in accordance with this Operation and Maintenance Plan and with the requirements of the Town of Acton and the Massachusetts Department of Environmental Protection are that of the Owner, 248 High Street, LLC. This responsibility shall lie with the Owner up until such time that ownership is transferred to a homeowners association, who shall own the system in its entirety and be responsible for operation and maintenance of the system.

OPERATION AND MAINTENANCE LOG FORM
ADELINE WAY - ACTON, MA.

Date of Inspection: _____

Circle Yes or No

Weather Conditions _____

Inspection 1. Paved Surfaces:

| | |
|---------------------------------|----------|
| Evidence of litter | Yes / No |
| Evidence of sand | Yes / No |
| Evidence of eroded soil | Yes / No |
| Evidence of hazardous materials | Yes / No |
| Curbing intact and aligned | Yes / No |

Inspection 2. Catch Basins:

| | |
|--|----------|
| Evidence of litter | Yes / No |
| Evidence of accumulation of solids in sump | Yes / No |
| Evidence of oil or gasoline | Yes / No |
| Oil/Gas trap intact | Yes / No |
| Structural damage | Yes / No |

Inspection 3. CDS Treatment Unit:

| | |
|--|----------|
| Evidence of litter | Yes / No |
| Evidence of accumulation of solids in sump | Yes / No |
| Evidence of oil or gasoline | Yes / No |
| Internal components intact | Yes / No |
| Structural damage | Yes / No |

Inspection 4. Pipe Outfall (FES):

| | |
|-------------------------------------|----------|
| Evidence of erosion | Yes / No |
| Excessive silt accumulating | Yes / No |
| Evidence of vegetation accumulation | Yes / No |

Inspection 5. Outlet Structures/Manholes:

| | |
|--|----------|
| Evidence of litter | Yes / No |
| Evidence of accumulation of solids in sump | Yes / No |
| Evidence of oil or gasoline | Yes / No |
| Structural damage | Yes / No |

Inspection 6. Underground Detention System:

| | |
|--|----------|
| Evidence of accumulation of solids in system | Yes / No |
| Evidence of oil or gasoline | Yes / No |
| Standing water in system | Yes / No |

If any above the above inspections yield a YES, a complete description of the problem and the corrective action taken must be documented below.

Signature of Inspector: _____

APPENDIX C
Closed Drainage System Calculations

DESIGN OF STORM SEWERS

PROJECT NAME 248 HIGH STREET - ALTON
 PROJECT NO. 31342 SHEET 1 OF 1
 CALCULATED BY RED DATE 6/2/16
 REV. 7/20/16

| A | FLOW PATH | B | | C | D | E | F | G | H | I | J | K | L | M | N | O | P | REMARKS | |
|---|-----------|-----------|-------|------|------|-----|-----|------|----|--------|-------|-----|-----|-----|----|-----|------|------------------|--|
| | | AREA (Ac) | TOTAL | | | | | | | | | | | | | | | | |
| | FROM | | | | | | | | | | | | | | | | | | |
| | DMH 1 | 0.14 | 0.14 | 0.60 | 10.0 | 100 | 0.5 | 0.55 | 10 | 0.0046 | 0.010 | 1.8 | 4.9 | 3.6 | 26 | 0.1 | 10.1 | | |
| | DMH 1 | 0.39 | 0.39 | 0.53 | 10.0 | 100 | 0.5 | 1.35 | 10 | 0.0043 | 0.010 | 1.8 | 4.2 | 3.6 | 28 | 0.1 | 10.1 | | |
| | DMH 2 | 0.53 | 0.53 | 0.55 | 10.1 | 100 | 0.5 | 1.90 | 12 | 0.005 | 0.010 | 3.4 | 4.2 | 4.3 | 51 | 0.2 | 10.3 | | |
| | DMH 3 | | | | | 100 | | 2.40 | 12 | 0.005 | 0.010 | 3.4 | 4.2 | 4.5 | 72 | | | 100 YR FLOW FROM | |
| | DMH 4 | | | | | 100 | | 2.70 | 12 | 0.005 | 0.010 | 3.4 | 4.2 | 4.5 | 52 | | | DETENTION SYSTEM | |