ENGINEERING, INC.
ENGINEERS
SURVEYORS

266 MAIN ST.
WAREHAM, MA 02571

TEL 508.295.6600
FAX 508.295.6634

STORMWATER REPORT

For

"6 Chapel Lane Site Development"

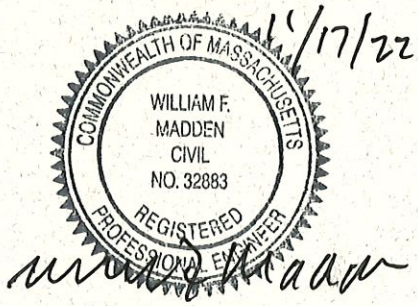
6 Chapel Lane
Wareham, MA

Prepared for

6 Chapel Lane, LLC
19 Depot Street
Wareham, MA 02571

Prepared by

G.A.F. Engineering, Inc.
266 Main Street
Wareham, MA 02571



11/17/22

November 14, 2022
G.A.F. Job No.: 20-9499

Table of Contents

DRAINAGE NARRATIVE

General Description

This project consists of the construction of three two-family homes on a lot containing 36,180 square feet of upland and 234 feet of frontage on Chapel Lane. The development includes a single access drive off the street which provides access to a parking lot in the rear of the duplex units.

The drainage system for the parking lot consists of two deep sump hooded catch basins, drain manholes which are specified with outlet hoods and four foot deep sumps, and underground leaching chambers for storage and infiltration of the runoff. Roof runoff from the houses will be piped to infiltration trenches.

Existing Conditions

The property was occupied by a church several years ago. The building and most of the foundation and concrete pads have been removed. The lot is lower than Chapel Lane and the adjacent properties along the sidelines. A small portion of the lot is graded toward the southeasterly abutter, who is also the project proponent. The area where the church foundation was removed is now the low point on the property. The rates and volumes of runoff calculated for the property stay within the property and infiltrate more or less uniformly.

Soils on the property as mapped by the USDA Natural Resources Conservation Service consist of Deerfield loamy fine sand (256B), 3 to 8 percent slopes along the westerly side of the lot, and Carver loamy coarse sand (259B), 3 to 8 percent slopes on the easterly side. These soils have a Hydrologic soil group (HSG) rating "A". Three test pits were excavated and logged by G.A.F. Engineering, Inc. on July 28, 2022. The locations and soil logs are shown on the site plans. The soils were confirmed to consist primarily of fine-medium sand and sand. Seasonal high groundwater was established at elevation 10.3 based on mottles observed in test pit 2.

There is no off-site design point since the present grades retain stormwater on the lot. Sub-catchment 1S in the pre-development analysis is the area of the lot in the urban grassed condition.

The volumes input for each storm event are as listed in the Point Precipitation Frequency Estimates published by NOAA Atlas 14, Volume 10, Version 3.

Proposed Conditions

The stormwater management system designed for the project utilizes infiltration trenches which are comprised of perforated pipe and chambers installed in washed crushed stone

portion of the lawn area is directed to a leaching trench which includes 1 row of 19 Cultec R-150XLHD chambers. The runoff is first collected in deep sump catch basins and drain manholes with sumps in order to provide 44% pretreatment prior to infiltration.

Each of these systems has been sized to store and infiltrate all calculated storm events using a Rawls rate of 8.27 inches per hour for HSG A soils.

Sub-catchment 1S is the majority of the access drive and all of the parking lot which is conveyed to the leaching trench with the Cultec units, modeled as Pond 1P.

Sub-catchment 2S is the full roof area of a duplex which is piped to a leaching trench with a 24" perforated ADS pipe installed 12" above the bottom. There are two of these installed between the three units. Pond 2P is the model for one of the trenches.

Sub-catchment 3S is half of the roof of a single unit. This is the roof area for the east side of the eastern unit and west side of the western unit. The two infiltration trenches for this roof runoff contain 12" perforated ADS pipe installed 12" above the bottom. Pond 3P is the model for one of the trenches.

Sub-catchment 4S is the remaining perimeter lawn area and a small portion of the access drive near Chapel Lane. There is a paved waterway specified to prevent runoff from flowing into the street. The perimeter lawn will remain lower than Chapel Lane and abutting properties along the lot lines with the exception of the narrow strip of lawn between the parking lot and property of the project proponent. Sub-catchment 4S is compared with pre-development area 1S, however all calculated flow remain on the subject lot.

In summary, the development of the project in accordance with the design will provide the required stormwater runoff mitigation as well as protection to downgradient properties in compliance with the Massachusetts Stormwater Handbook and the applicable Town of Wareham rules and regulations.

Drainage Summary

Table 1 – Pre-Development vs. Post-Development (1S/4S)

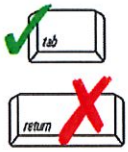
Storm Event	Pre		Post		Pre vs. Post changes	
	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)
2 yr	0	0	0	0.001	0	0.001
10 yr	0.03	0.014	0.03	0.009	0	-0.005
25 yr	0.15	0.032	0.11	0.018	-0.04	-0.014
100 yr	0.52	0.068	0.39	0.036	-0.13	-0.032

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.

---

[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.

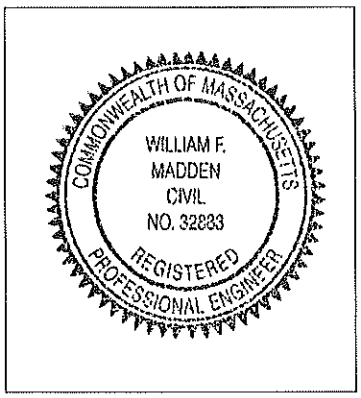
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



William F Madden 11/17/22
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): Roof Infiltration trenches specified to reduce surface runoff.

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

COMPLIANCE WITH THE STORMWATER MANAGEMENT STANDARDS

The Stormwater Management Standards

1. No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

    - *This project does not include any new stormwater conveyances or outfalls.*

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

    - *The drainage calculations confirm that this standard has been met.*

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

    - *Recharge volume calculations are included in the report and confirm that this standard is met.*

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

    a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
    b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
    c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

    - *This project has specified deep sump hooded catch basins and drain manholes for collection of runoff from paved surfaces prior to discharge*

to leaching chambers. A TSS Calculation Sheet is included in the report to document compliance.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

    - *This project is not considered a land use with higher potential pollutant load.*

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

    - *This project is not located within a Zone II of a public water supply and there are no critical areas downstream from the property.*

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

- *This project is considered new development.*

8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

    - *Construction period erosion and sedimentation control measures are included on the design plans and in this report.*

9. A post-construction operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

    - *The post-construction operation and maintenance plan has been listed on the design plans and in this report.*

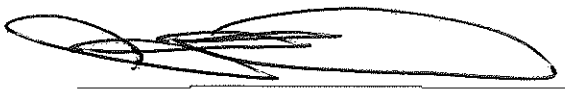
10. All illicit discharges to the stormwater management system are prohibited.

    - *An illicit discharge statement is included in this report.*

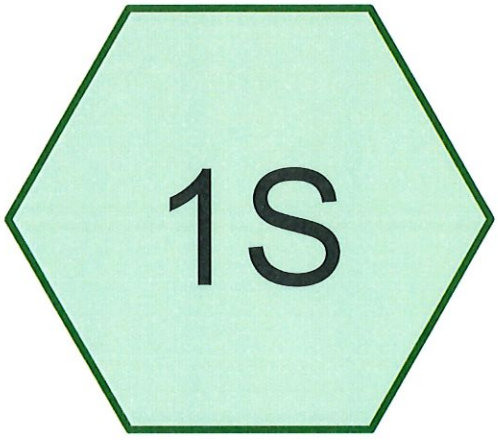
Date: 11/16/22

To whom it may concern:

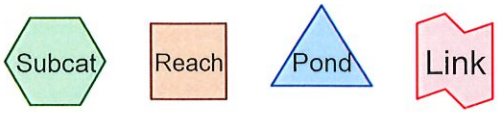
I hereby certify that no illicit discharge connections presently exist nor will any be permitted in the future for the property and future residences located at 6 Chapel Lane, Wareham, Mass., shown as Lot 1036 on Assessors Map 43.



6 Chapel Lane, LLC



Existing Conditions



Routing Diagram for 9499PRE
Prepared by GAF Engineering, Inc, Printed 11/16/2022
HydroCAD® 10.20-2g s/n 02319 © 2022 HydroCAD Software Solutions LLC

Project Notes

Rainfall events imported from "9499POST.hcp"

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.04	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.04	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.58	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.831	39	>75% Grass cover, Good, HSG A (1S)
0.831	**39**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.831	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
0.831		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.831	0.000	0.000	0.000	0.000	0.831	>75% Grass cover, Good	1S
0.831	**0.000**	**0.000**	**0.000**	**0.000**	**0.831**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Conditions Runoff Area=36,180 sf 0.00% Impervious Runoff Depth=0.01"
Flow Length=155' Tc=8.1 min CN=39 Runoff=0.00 cfs 0.000 af

Total Runoff Area = 0.831 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.01"
100.00% Pervious = 0.831 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 0.00 cfs @ 23.07 hrs, Volume= 0.000 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

Area (sf)	CN	Description
36,180	39	>75% Grass cover, Good, HSG A
36,180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.44"
0.9	105	0.0150	1.97		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	155	Total			

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Conditions Runoff Area=36,180 sf 0.00% Impervious Runoff Depth=0.21"
Flow Length=155' Tc=8.1 min CN=39 Runoff=0.03 cfs 0.014 af

Total Runoff Area = 0.831 ac Runoff Volume = 0.014 af Average Runoff Depth = 0.21"
100.00% Pervious = 0.831 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 0.03 cfs @ 12.50 hrs, Volume= 0.014 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

Area (sf)	CN	Description
36,180	39	>75% Grass cover, Good, HSG A
36,180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.44"
0.9	105	0.0150	1.97		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	155	Total			

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Conditions Runoff Area=36,180 sf 0.00% Impervious Runoff Depth=0.46"
Flow Length=155' Tc=8.1 min CN=39 Runoff=0.15 cfs 0.032 af

Total Runoff Area = 0.831 ac Runoff Volume = 0.032 af Average Runoff Depth = 0.46"
100.00% Pervious = 0.831 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing Conditions

Runoff = 0.15 cfs @ 12.37 hrs, Volume= 0.032 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=6.04"

Area (sf)	CN	Description
36,180	39	>75% Grass cover, Good, HSG A
36,180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.44"
0.9	105	0.0150	1.97		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	155	Total			

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Conditions Runoff Area=36,180 sf 0.00% Impervious Runoff Depth=0.99"
Flow Length=155' Tc=8.1 min CN=39 Runoff=0.52 cfs 0.068 af

Total Runoff Area = 0.831 ac Runoff Volume = 0.068 af Average Runoff Depth = 0.99"
100.00% Pervious = 0.831 ac 0.00% Impervious = 0.000 ac

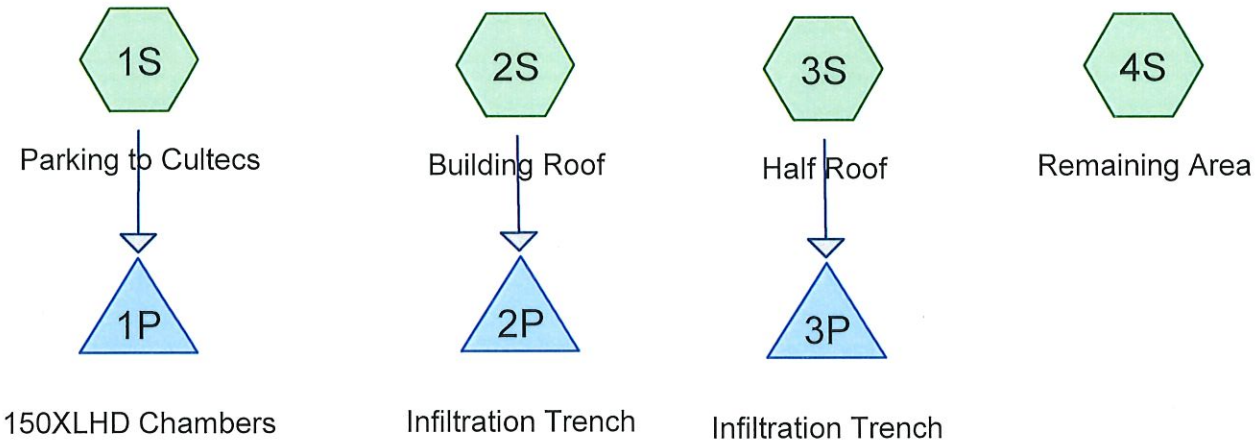
Summary for Subcatchment 1S: Existing Conditions

Runoff = 0.52 cfs @ 12.17 hrs, Volume= 0.068 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=7.58"

Area (sf)	CN	Description
36,180	39	>75% Grass cover, Good, HSG A
36,180		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.44"
0.9	105	0.0150	1.97		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	155	Total			



Subcat Reach Pond Link

Routing Diagram for 9499POST
Prepared by GAF Engineering, Inc, Printed 11/16/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.04	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.04	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.58	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.449	39	>75% Grass cover, Good, HSG A (1S, 4S)
0.038	98	Building Roof (2S)
0.011	98	Entrance Drive to High Point (4S)
0.023	98	Half Building Roof (3S)
0.257	98	Pavement, sidewalk, porches (1S)
0.778	**64**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.449	HSG A	1S, 4S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.329	Other	1S, 2S, 3S, 4S
0.778		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.449	0.000	0.000	0.000	0.000	0.449	>75% Grass cover, Good	1S, 4S
0.000	0.000	0.000	0.000	0.038	0.038	Building Roof	2S
0.000	0.000	0.000	0.000	0.011	0.011	Entrance Drive to High Point	4S
0.000	0.000	0.000	0.000	0.023	0.023	Half Building Roof	3S
0.000	0.000	0.000	0.000	0.257	0.257	Pavement, sidewalk, porches	1S
0.449	**0.000**	**0.000**	**0.000**	**0.329**	**0.778**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Parking to Cultecs Runoff Area=14,770 sf 75.83% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=84 Runoff=0.75 cfs 0.053 af

Subcatchment 2S: Building Roof Runoff Area=1,645 sf 100.00% Impervious Runoff Depth=3.21"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.010 af

Subcatchment 3S: Half Roof Runoff Area=987 sf 100.00% Impervious Runoff Depth=3.21"
Tc=6.0 min CN=98 Runoff=0.08 cfs 0.006 af

Subcatchment 4S: Remaining Area Runoff Area=16,475 sf 3.03% Impervious Runoff Depth=0.02"
Flow Length=240' Tc=3.1 min CN=41 Runoff=0.00 cfs 0.001 af

Pond 1P: 150XLHD Chambers Peak Elev=12.82' Storage=294 cf Inflow=0.75 cfs 0.053 af
Outflow=0.31 cfs 0.053 af

Pond 2P: Infiltration Trench Peak Elev=13.32' Storage=65 cf Inflow=0.13 cfs 0.010 af
Outflow=0.05 cfs 0.010 af

Pond 3P: Infiltration Trench Peak Elev=12.94' Storage=31 cf Inflow=0.08 cfs 0.006 af
Outflow=0.03 cfs 0.006 af

Total Runoff Area = 0.778 ac Runoff Volume = 0.070 af Average Runoff Depth = 1.08"
57.69% Pervious = 0.449 ac 42.31% Impervious = 0.329 ac

Summary for Subcatchment 1S: Parking to Cultecs

Runoff = 0.75 cfs @ 12.09 hrs, Volume= 0.053 af, Depth= 1.89"
Routed to Pond 1P : 150XLHD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	11,200	98	Pavement, sidewalk, porches
	3,570	39	>75% Grass cover, Good, HSG A
	14,770	84	Weighted Average
	3,570		24.17% Pervious Area
	11,200		75.83% Impervious Area

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

Summary for Subcatchment 2S: Building Roof

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af, Depth= 3.21"
Routed to Pond 2P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	1,645	98	Building Roof
	1,645		100.00% Impervious Area

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

Summary for Subcatchment 3S: Half Roof

Runoff = 0.08 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 3.21"
Routed to Pond 3P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	987	98	Half Building Roof
	987		100.00% Impervious Area

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

Summary for Subcatchment 4S: Remaining Area

Runoff = 0.00 cfs @ 20.66 hrs, Volume= 0.001 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	500	98	Entrance Drive to High Point
	15,975	39	>75% Grass cover, Good, HSG A
	16,475	41	Weighted Average
	15,975		96.97% Pervious Area
	500		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.44"
2.5	190	0.0060	1.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	240	Total			

Summary for Pond 1P: 150XLHD Chambers

Inflow Area = 0.339 ac, 75.83% Impervious, Inflow Depth = 1.89" for 2 Year Storm event
Inflow = 0.75 cfs @ 12.09 hrs, Volume= 0.053 af
Outflow = 0.31 cfs @ 12.33 hrs, Volume= 0.053 af, Atten= 59%, Lag= 14.2 min
Discarded = 0.31 cfs @ 12.33 hrs, Volume= 0.053 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 12.82' @ 12.33 hrs Surf.Area= 1,400 sf Storage= 294 cf

Plug-Flow detention time= 4.9 min calculated for 0.053 af (100% of inflow)
Center-of-Mass det. time= 5.0 min (831.2 - 826.3)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	1,473 cf	**7.00'W x 200.00'L x 3.00'H Prismatoid** 4,200 cf Overall - 518 cf Embedded = 3,682 cf x 40.0% Voids
#2	13.30'	518 cf	**Cultec R-150XLHD** x 19 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		1,991 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.31 cfs @ 12.33 hrs HW=12.82' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Summary for Pond 2P: Infiltration Trench

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 3.21" for 2 Year Storm event
Inflow = 0.13 cfs @ 12.08 hrs, Volume= 0.010 af
Outflow = 0.05 cfs @ 12.31 hrs, Volume= 0.010 af, Atten= 62%, Lag= 13.9 min
Discarded = 0.05 cfs @ 12.31 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 13.32' @ 12.31 hrs Surf.Area= 160 sf Storage= 65 cf

Plug-Flow detention time= 7.2 min calculated for 0.010 af (100% of inflow)
Center-of-Mass det. time= 7.2 min (762.1 - 754.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	179 cf	**4.00'W x 40.00'L x 3.50'H Prismatoid** 560 cf Overall - 113 cf Embedded = 447 cf x 40.0% Voids
#2	13.30'	113 cf	**24.0" Round Pipe Storage** Inside #1 L= 36.0'
		292 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.05 cfs @ 12.31 hrs HW=13.32' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Summary for Pond 3P: Infiltration Trench

Inflow Area = 0.023 ac,100.00% Impervious, Inflow Depth = 3.21" for 2 Year Storm event
Inflow = 0.08 cfs @ 12.08 hrs, Volume= 0.006 af
Outflow = 0.03 cfs @ 12.26 hrs, Volume= 0.006 af, Atten= 56%, Lag= 10.6 min
Discarded = 0.03 cfs @ 12.26 hrs, Volume= 0.006 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 12.94' @ 12.26 hrs Surf.Area= 120 sf Storage= 31 cf

Plug-Flow detention time= 4.6 min calculated for 0.006 af (100% of inflow)
Center-of-Mass det. time= 4.6 min (759.5 - 754.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	133 cf	**3.00'W x 40.00'L x 3.00'H Prismatoid** 360 cf Overall - 28 cf Embedded = 332 cf x 40.0% Voids
#2	13.30'	28 cf	**12.0" Round Pipe Storage** Inside #1 L= 36.0'
		161 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.03 cfs @ 12.26 hrs HW=12.94' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Parking to Cultecs Runoff Area=14,770 sf 75.83% Impervious Runoff Depth=3.31"
Tc=6.0 min CN=84 Runoff=1.31 cfs 0.093 af

Subcatchment 2S: Building Roof Runoff Area=1,645 sf 100.00% Impervious Runoff Depth=4.80"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.015 af

Subcatchment 3S: Half Roof Runoff Area=987 sf 100.00% Impervious Runoff Depth=4.80"
Tc=6.0 min CN=98 Runoff=0.11 cfs 0.009 af

Subcatchment 4S: Remaining Area Runoff Area=16,475 sf 3.03% Impervious Runoff Depth=0.28"
Flow Length=240' Tc=3.1 min CN=41 Runoff=0.03 cfs 0.009 af

Pond 1P: 150XLHD Chambers Peak Elev=13.64' Storage=848 cf Inflow=1.31 cfs 0.093 af
Outflow=0.37 cfs 0.093 af

Pond 2P: Infiltration Trench Peak Elev=13.95' Storage=125 cf Inflow=0.19 cfs 0.015 af
Outflow=0.06 cfs 0.015 af

Pond 3P: Infiltration Trench Peak Elev=13.51' Storage=61 cf Inflow=0.11 cfs 0.009 af
Outflow=0.04 cfs 0.009 af

Total Runoff Area = 0.778 ac Runoff Volume = 0.127 af Average Runoff Depth = 1.95"
57.69% Pervious = 0.449 ac 42.31% Impervious = 0.329 ac

Summary for Subcatchment 1S: Parking to Cultecs

Runoff = 1.31 cfs @ 12.09 hrs, Volume= 0.093 af, Depth= 3.31"
Routed to Pond 1P : 150XLHD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

	Area (sf)	CN	Description
*	11,200	98	Pavement, sidewalk, porches
	3,570	39	>75% Grass cover, Good, HSG A
	14,770	84	Weighted Average
	3,570		24.17% Pervious Area
	11,200		75.83% Impervious Area

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

Summary for Subcatchment 2S: Building Roof

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.015 af, Depth= 4.80"
Routed to Pond 2P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

	Area (sf)	CN	Description
*	1,645	98	Building Roof
	1,645		100.00% Impervious Area

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

Summary for Subcatchment 3S: Half Roof

Runoff = 0.11 cfs @ 12.08 hrs, Volume= 0.009 af, Depth= 4.80"
Routed to Pond 3P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

	Area (sf)	CN	Description
*	987	98	Half Building Roof
	987		100.00% Impervious Area

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

Summary for Subcatchment 4S: Remaining Area

Runoff = 0.03 cfs @ 12.35 hrs, Volume= 0.009 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.04"

	Area (sf)	CN	Description
*	500	98	Entrance Drive to High Point
	15,975	39	>75% Grass cover, Good, HSG A
	16,475	41	Weighted Average
	15,975		96.97% Pervious Area
	500		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.44"
2.5	190	0.0060	1.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	240	Total			

Summary for Pond 1P: 150XLHD Chambers

Inflow Area = 0.339 ac, 75.83% Impervious, Inflow Depth = 3.31" for 10 Year Storm event
Inflow = 1.31 cfs @ 12.09 hrs, Volume= 0.093 af
Outflow = 0.37 cfs @ 12.44 hrs, Volume= 0.093 af, Atten= 71%, Lag= 21.0 min
Discarded = 0.37 cfs @ 12.44 hrs, Volume= 0.093 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 13.64' @ 12.44 hrs Surf.Area= 1,400 sf Storage= 848 cf

Plug-Flow detention time= 13.1 min calculated for 0.093 af (100% of inflow)
Center-of-Mass det. time= 13.1 min (823.3 - 810.2)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	1,473 cf	**7.00'W x 200.00'L x 3.00'H Prismatoid** 4,200 cf Overall - 518 cf Embedded = 3,682 cf x 40.0% Voids
#2	13.30'	518 cf	**Cultec R-150XLHD** x 19 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		1,991 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.37 cfs @ 12.44 hrs HW=13.64' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.37 cfs)

Summary for Pond 2P: Infiltration Trench

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 4.80" for 10 Year Storm event
Inflow = 0.19 cfs @ 12.08 hrs, Volume= 0.015 af
Outflow = 0.06 cfs @ 12.38 hrs, Volume= 0.015 af, Atten= 69%, Lag= 17.9 min
Discarded = 0.06 cfs @ 12.38 hrs, Volume= 0.015 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 13.95' @ 12.38 hrs Surf.Area= 160 sf Storage= 125 cf

Plug-Flow detention time= 11.9 min calculated for 0.015 af (100% of inflow)
Center-of-Mass det. time= 11.9 min (759.8 - 747.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	179 cf	**4.00'W x 40.00'L x 3.50'H Prismatoid** 560 cf Overall - 113 cf Embedded = 447 cf x 40.0% Voids
#2	13.30'	113 cf	**24.0" Round Pipe Storage** Inside #1 L= 36.0'
		292 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.06 cfs @ 12.38 hrs HW=13.95' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 3P: Infiltration Trench

Inflow Area = 0.023 ac,100.00% Impervious, Inflow Depth = 4.80" for 10 Year Storm event
Inflow = 0.11 cfs @ 12.08 hrs, Volume= 0.009 af
Outflow = 0.04 cfs @ 12.31 hrs, Volume= 0.009 af, Atten= 62%, Lag= 13.5 min
Discarded = 0.04 cfs @ 12.31 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 13.51' @ 12.31 hrs Surf.Area= 120 sf Storage= 61 cf

Plug-Flow detention time= 7.6 min calculated for 0.009 af (100% of inflow)
Center-of-Mass det. time= 7.6 min (755.5 - 747.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	133 cf	**3.00'W x 40.00'L x 3.00'H Prismatoid** 360 cf Overall - 28 cf Embedded = 332 cf x 40.0% Voids
#2	13.30'	28 cf	**12.0" Round Pipe Storage** Inside #1 L= 36.0'
		161 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.04 cfs @ 12.31 hrs HW=13.51' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Parking to Cultecs Runoff Area=14,770 sf 75.83% Impervious Runoff Depth=4.23"
Tc=6.0 min CN=84 Runoff=1.66 cfs 0.120 af

Subcatchment 2S: Building Roof Runoff Area=1,645 sf 100.00% Impervious Runoff Depth=5.80"
Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018 af

Subcatchment 3S: Half Roof Runoff Area=987 sf 100.00% Impervious Runoff Depth=5.80"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment 4S: Remaining Area Runoff Area=16,475 sf 3.03% Impervious Runoff Depth=0.57"
Flow Length=240' Tc=3.1 min CN=41 Runoff=0.11 cfs 0.018 af

Pond 1P: 150XLHD Chambers Peak Elev=14.14' Storage=1,253 cf Inflow=1.66 cfs 0.120 af
Outflow=0.41 cfs 0.120 af

Pond 2P: Infiltration Trench Peak Elev=14.32' Storage=165 cf Inflow=0.22 cfs 0.018 af
Outflow=0.06 cfs 0.018 af

Pond 3P: Infiltration Trench Peak Elev=13.81' Storage=81 cf Inflow=0.13 cfs 0.011 af
Outflow=0.05 cfs 0.011 af

Total Runoff Area = 0.778 ac Runoff Volume = 0.167 af Average Runoff Depth = 2.57"
57.69% Pervious = 0.449 ac 42.31% Impervious = 0.329 ac

Summary for Subcatchment 1S: Parking to Cultecs

Runoff = 1.66 cfs @ 12.09 hrs, Volume= 0.120 af, Depth= 4.23"
Routed to Pond 1P : 150XLHD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.04"

	Area (sf)	CN	Description
*	11,200	98	Pavement, sidewalk, porches
	3,570	39	>75% Grass cover, Good, HSG A
	14,770	84	Weighted Average
	3,570		24.17% Pervious Area
	11,200		75.83% Impervious Area

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

Summary for Subcatchment 2S: Building Roof

Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af, Depth= 5.80"
Routed to Pond 2P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.04"

	Area (sf)	CN	Description
*	1,645	98	Building Roof
	1,645		100.00% Impervious Area

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

Summary for Subcatchment 3S: Half Roof

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 5.80"
Routed to Pond 3P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.04"

	Area (sf)	CN	Description
*	987	98	Half Building Roof
	987		100.00% Impervious Area

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

Summary for Subcatchment 4S: Remaining Area

Runoff = 0.11 cfs @ 12.11 hrs, Volume= 0.018 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.04"

	Area (sf)	CN	Description
*	500	98	Entrance Drive to High Point
	15,975	39	>75% Grass cover, Good, HSG A
	16,475	41	Weighted Average
	15,975		96.97% Pervious Area
	500		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.44"
2.5	190	0.0060	1.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	240	Total			

Summary for Pond 1P: 150XLHD Chambers

Inflow Area = 0.339 ac, 75.83% Impervious, Inflow Depth = 4.23" for 25 Year Storm event
Inflow = 1.66 cfs @ 12.09 hrs, Volume= 0.120 af
Outflow = 0.41 cfs @ 12.47 hrs, Volume= 0.120 af, Atten= 75%, Lag= 23.1 min
Discarded = 0.41 cfs @ 12.47 hrs, Volume= 0.120 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 14.14' @ 12.47 hrs Surf.Area= 1,400 sf Storage= 1,253 cf

Plug-Flow detention time= 18.7 min calculated for 0.120 af (100% of inflow)
Center-of-Mass det. time= 18.7 min (822.0 - 803.2)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	1,473 cf	**7.00'W x 200.00'L x 3.00'H Prismatoid** 4,200 cf Overall - 518 cf Embedded = 3,682 cf x 40.0% Voids
#2	13.30'	518 cf	**Cultec R-150XLHD** x 19 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		1,991 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.41 cfs @ 12.47 hrs HW=14.14' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.41 cfs)

Summary for Pond 2P: Infiltration Trench

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 5.80" for 25 Year Storm event
Inflow = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af
Outflow = 0.06 cfs @ 12.41 hrs, Volume= 0.018 af, Atten= 71%, Lag= 19.5 min
Discarded = 0.06 cfs @ 12.41 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 14.32' @ 12.41 hrs Surf.Area= 160 sf Storage= 165 cf

Plug-Flow detention time= 14.7 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 14.7 min (759.8 - 745.0)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	179 cf	**4.00'W x 40.00'L x 3.50'H Prismatoid** 560 cf Overall - 113 cf Embedded = 447 cf x 40.0% Voids
#2	13.30'	113 cf	**24.0" Round Pipe Storage** Inside #1 L= 36.0'
		292 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.06 cfs @ 12.41 hrs HW=14.32' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Summary for Pond 3P: Infiltration Trench

Inflow Area = 0.023 ac,100.00% Impervious, Inflow Depth = 5.80" for 25 Year Storm event
Inflow = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af
Outflow = 0.05 cfs @ 12.34 hrs, Volume= 0.011 af, Atten= 64%, Lag= 15.1 min
Discarded = 0.05 cfs @ 12.34 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 13.81' @ 12.34 hrs Surf.Area= 120 sf Storage= 81 cf

Plug-Flow detention time= 9.4 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 9.4 min (754.5 - 745.0)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	133 cf	**3.00'W x 40.00'L x 3.00'H Prismatoid** 360 cf Overall - 28 cf Embedded = 332 cf x 40.0% Voids
#2	13.30'	28 cf	**12.0" Round Pipe Storage** Inside #1 L= 36.0'
		161 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.05 cfs @ 12.34 hrs HW=13.81' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Parking to Cultecs Runoff Area=14,770 sf 75.83% Impervious Runoff Depth=5.69"
Tc=6.0 min CN=84 Runoff=2.20 cfs 0.161 af

Subcatchment 2S: Building Roof Runoff Area=1,645 sf 100.00% Impervious Runoff Depth=7.34"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Subcatchment 3S: Half Roof Runoff Area=987 sf 100.00% Impervious Runoff Depth=7.34"
Tc=6.0 min CN=98 Runoff=0.17 cfs 0.014 af

Subcatchment 4S: Remaining Area Runoff Area=16,475 sf 3.03% Impervious Runoff Depth=1.16"
Flow Length=240' Tc=3.1 min CN=41 Runoff=0.39 cfs 0.036 af

Pond 1P: 150XLHD Chambers Peak Elev=15.13' Storage=1,893 cf Inflow=2.20 cfs 0.161 af
Outflow=0.49 cfs 0.161 af

Pond 2P: Infiltration Trench Peak Elev=14.93' Storage=228 cf Inflow=0.28 cfs 0.023 af
Outflow=0.07 cfs 0.023 af

Pond 3P: Infiltration Trench Peak Elev=14.32' Storage=114 cf Inflow=0.17 cfs 0.014 af
Outflow=0.06 cfs 0.014 af

Total Runoff Area = 0.778 ac Runoff Volume = 0.234 af Average Runoff Depth = 3.62"
57.69% Pervious = 0.449 ac 42.31% Impervious = 0.329 ac

Summary for Subcatchment 1S: Parking to Cultecs

Runoff = 2.20 cfs @ 12.09 hrs, Volume= 0.161 af, Depth= 5.69"
Routed to Pond 1P : 150XLHD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.58"

	Area (sf)	CN	Description
*	11,200	98	Pavement, sidewalk, porches
	3,570	39	>75% Grass cover, Good, HSG A
	14,770	84	Weighted Average
	3,570		24.17% Pervious Area
	11,200		75.83% Impervious Area

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

Summary for Subcatchment 2S: Building Roof

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 7.34"
Routed to Pond 2P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.58"

	Area (sf)	CN	Description
*	1,645	98	Building Roof
	1,645		100.00% Impervious Area

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

Summary for Subcatchment 3S: Half Roof

Runoff = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 7.34"
Routed to Pond 3P : Infiltration Trench

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.58"

	Area (sf)	CN	Description
*	987	98	Half Building Roof
	987		100.00% Impervious Area

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

Summary for Subcatchment 4S: Remaining Area

Runoff = 0.39 cfs @ 12.07 hrs, Volume= 0.036 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.58"

	Area (sf)	CN	Description
*	500	98	Entrance Drive to High Point
	15,975	39	>75% Grass cover, Good, HSG A
	16,475	41	Weighted Average
	15,975		96.97% Pervious Area
	500		3.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0250	1.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.44"
2.5	190	0.0060	1.25		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.1	240	Total			

Summary for Pond 1P: 150XLHD Chambers

Inflow Area = 0.339 ac, 75.83% Impervious, Inflow Depth = 5.69" for 100 Year Storm event
Inflow = 2.20 cfs @ 12.09 hrs, Volume= 0.161 af
Outflow = 0.49 cfs @ 12.49 hrs, Volume= 0.161 af, Atten= 78%, Lag= 24.5 min
Discarded = 0.49 cfs @ 12.49 hrs, Volume= 0.161 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.13' @ 12.49 hrs Surf.Area= 1,400 sf Storage= 1,893 cf

Plug-Flow detention time= 26.5 min calculated for 0.161 af (100% of inflow)
Center-of-Mass det. time= 26.5 min (821.4 - 795.0)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	1,473 cf	**7.00'W x 200.00'L x 3.00'H Prismatoid** 4,200 cf Overall - 518 cf Embedded = 3,682 cf x 40.0% Voids
#2	13.30'	518 cf	**Cultec R-150XLHD** x 19 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		1,991 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.49 cfs @ 12.49 hrs HW=15.13' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.49 cfs)

Summary for Pond 2P: Infiltration Trench

Inflow Area = 0.038 ac,100.00% Impervious, Inflow Depth = 7.34" for 100 Year Storm event
Inflow = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af
Outflow = 0.07 cfs @ 12.43 hrs, Volume= 0.023 af, Atten= 73%, Lag= 21.0 min
Discarded = 0.07 cfs @ 12.43 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 14.93' @ 12.43 hrs Surf.Area= 160 sf Storage= 228 cf

Plug-Flow detention time= 18.7 min calculated for 0.023 af (100% of inflow)
Center-of-Mass det. time= 18.7 min (760.6 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	179 cf	**4.00'W x 40.00'L x 3.50'H Prismatoid** 560 cf Overall - 113 cf Embedded = 447 cf x 40.0% Voids
#2	13.30'	113 cf	**24.0" Round Pipe Storage** Inside #1 L= 36.0'
		292 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 12.43 hrs HW=14.93' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Summary for Pond 3P: Infiltration Trench

Inflow Area = 0.023 ac,100.00% Impervious, Inflow Depth = 7.34" for 100 Year Storm event
Inflow = 0.17 cfs @ 12.08 hrs, Volume= 0.014 af
Outflow = 0.06 cfs @ 12.36 hrs, Volume= 0.014 af, Atten= 67%, Lag= 16.6 min
Discarded = 0.06 cfs @ 12.36 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 14.32' @ 12.36 hrs Surf.Area= 120 sf Storage= 114 cf

Plug-Flow detention time= 11.9 min calculated for 0.014 af (100% of inflow)
Center-of-Mass det. time= 11.9 min (753.8 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1	12.30'	133 cf	**3.00'W x 40.00'L x 3.00'H Prismatoid** 360 cf Overall - 28 cf Embedded = 332 cf x 40.0% Voids
#2	13.30'	28 cf	**12.0" Round Pipe Storage** Inside #1 L= 36.0'
		161 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	12.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.06 cfs @ 12.36 hrs HW=14.32' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

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: 6 Chapel Lane, Wareham, Mass

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)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Deep Sump and Hooded Manhole	0.25	0.75	0.19	0.56
Infiltration Trench	0.80	0.56	0.45	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = 89%

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

Project: 6 Chapel Lane, LLC

Prepared By: G.A.F. Engineering, Inc.

Date: 14-Sep-22

*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

Water Quality Volume Calculation

Required Water Quality Depth = 1.0 inch volume from impervious surfaces.

Impervious Area to Cultec System Pond 1P = 11,700 sf

WQV = 11,700 sf x 1.0 in x 1 ft/12 in = 975 cf

Volume Available in System = 1,991 cf (HydroCAD)

1,991 cf > 975 cf OK

Required Recharge Volume Calculation

Chamber System

Total Impervious Area to Chamber System Pond 1 = 11,700 sf

Required Recharge Depth = 0.6 inches (HSG A Soil)

Required Recharge Volume = 11,700 sf x 0.6"/12 = 585 cf

Available Storage = 1,991 cf (HydroCAD)

1,991 cf > 585 cf - OK

Recharge System Drawdown time (72 hours maximum for 100 year storm volume)

$$\text{Time} = \frac{\text{Storage Volume}}{(\text{Rawls Rate})\ (\text{Bottom Area})}$$

$$\text{Time} = \frac{1{,}890\ \text{cf}}{(8.27\ \text{inches/hour})\ (1\text{ft}/12\text{inches})\ (1400\ \text{sf})}$$

= 1.96 hours < 72 hours – OK

Trench Systems

Roof Area to Infiltration Trench Pond 2P = 1,645 sf

Required Recharge Volume = 1,645 sf x 0.6"/12 = 82.25 cf

Available Storage = 299 cf

299 cf > 82.25 cf – OK

Recharge System Drawdown time

$$\text{Time} = \frac{228\ \text{cf}}{(8.27\ \text{inches/hour})\ (1\text{ft}/12\text{inches})\ (160\ \text{sf})}$$

= 2.06 hours < 72 hours - OK

Roof Area to Infiltration Trench Pond 3P = 987 sf

Required Recharge Volume = 987 sf x 0.6"/12 = 49.35 cf

Available Storage = 161 cf

161 cf > 49.35 cf – OK

Recharge System Drawdown time

$$\text{Time} = \frac{114 \text{ cf}}{(8.27 \text{ inches/hour})\ (1\text{ft}/12\text{inches})\ (120 \text{ sf})}$$

= 1.38 hours < 72 hours - OK

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
16.5400	*R*	Recharge (infiltration) rate (feet/day)
0.200	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
165.40	K	Horizontal hydraulic conductivity, Kh (feet/day)*
1.500	x	1/2 length of basin (x direction, in feet)
20.000	y	1/2 width of basin (y direction, in feet)
1.000	t	duration of infiltration period (days)
25.000	hi(0)	initial thickness of saturated zone (feet)

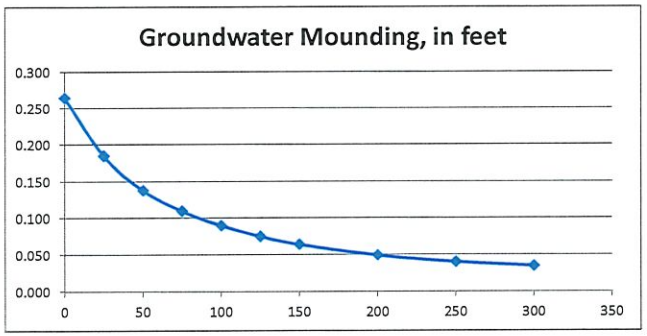
25.265	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
0.265	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Conversion Table	
inch/hour	feet/day
0.67	1.33
2.00	4.00
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.265	0
0.185	25
0.138	50
0.110	75
0.090	100
0.076	125
0.065	150
0.050	200
0.040	250
0.035	300

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
16.5400	*R*	**Recharge (infiltration) rate (feet/day)**
0.200	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
3.500	x	**1/2 length of basin (x direction, in feet)**
100.000	y	**1/2 width of basin (y direction, in feet)**
1.000	t	**duration of infiltration period (days)**
25.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

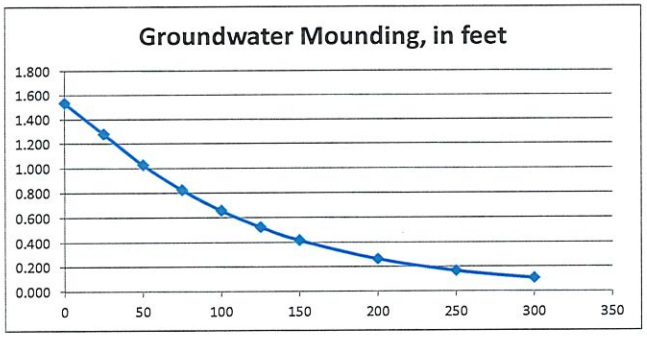
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

26.537	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.537	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.537	0
1.280	25
1.028	50
0.825	75
0.660	100
0.527	125
0.420	150
0.266	200
0.168	250
0.107	300

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Construction Period Pollution Prevention and

Erosion & Sedimentation Control Plan

Narrative: This project consists of the construction of three two-family dwellings with associated access drive, parking lot, sidewalk, utilities, and stormwater management system.

Responsible Parties: The site contractor and owner.

Construction Period Operation / Maintenance Plan:

- Provide sufficient refuse containers and empty as needed.
- Inspect erosion controls daily. Repair or replace as needed.
- Police the area for safety hazards and trash on a daily basis.
- Store materials away from drainage and resource areas.
- Provide or receive only the materials which can be installed promptly.
- Inspect vehicles for leaks and repair or replace when necessary.
- Provide dust control with watering.
- Maintain truck runoff pads.
- Maintain an inspection log to document problem areas and corrective actions.
- Provide temporary stabilization of disturbed areas and soil stockpiles which will remain in place for more than 30 days. (erosion control fabric, mulch, hydroseed, etc.)
- Provide a contact person for complaints and notification of problems.

Construction Sequence:

- Install erosion controls per the plans.
- Install silt sacks and outlet hoods in existing catch basins.
- Clear trees, remove existing debris and unwanted materials.
- Rough grade the site access drive, parking lot, building pads and yard.
- Install underground drainage chambers.
- Install underground utilities and building foundations.
- Install catch basins and drain manholes
- Install roof drain conveyance pipes.
- Install gravel base material and base course of pavement.
- Install top course of pavement.
- Install landscaping.
- Loam and seed disturbed areas.
- Maintain erosion controls until all areas are stabilized with vegetation.

Maintenance Schedule:

- Erosion controls are to be inspected daily and repaired or replaced as needed.
- Trash is to be picked up daily.
- Water shall be used for dust control as needed.
- Silt sacks shall be emptied or replaced when full.
- Vehicles shall be inspected daily for any leaks and repaired or replaced as needed.

Long Term Operation and Maintenance Plan

Responsible Party: Current and Future Owners
6 Chapel Lane
Wareham, MA 02571

The property owner is responsible for the inspection, operation and maintenance of the Stormwater Management System. The manager of the facility will be provided with copies of the approved site design and as-built plans to make them aware of the locations of system components. A copy of this Operation and Maintenance (O & M) Plan should also be provided.

System Description: The drainage system consists of a number of Best Management Practices, BMPs, which collect, treat, and infiltrate stormwater runoff from all storm events up to and including the 100 year storm event. Paved areas are graded to deep sump catch basins located at the south side of the parking lot. The catch basins discharge to drain manholes specified with deep sumps and outlet hoods. The drain manholes discharge to an underground infiltration system consisting of leaching chambers surrounded by crushed stone. The roof runoff from the buildings will be piped directly into leaching trenches consisting of perforated pipe surrounded by crushed stone. There is a paved waterway located at the entrance drive near Chapel Lane which is the discharge point for the first 25 feet of driveway entrance. The runoff enters the paved waterway and spills into a crushed stone pad before infiltrating in the front yard.

Parking Lot Sweeping: Parking lot sweeping is an effective non-structural source control that will remove sediment from paved surfaces. Parking lot sweeping should be done with a high efficiency vacuum sweeper or regenerative air sweeper. Parking lot sweeping should be done twice per year. Once removed from paved surfaces, the sweepings must be handled and disposed of properly in one of the ways approved by MassDEP. (See Policy #BAW-18-001: Reuse and Disposal of Street Sweepings)

Deep Sump Catch Basins and Drain Manholes: Deep sump catch basins and drain manholes are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff and serve as temporary spill containment devices for floatables such as oils and grease. Inspect catch basins monthly and clean out at least two times per year at the end of the foliage and snow removal seasons. Sediment must also be removed whenever the depth of the deposits is greater than or equal to one-half the distance from the bottom of the structure to the outlet invert. Sediment shall be removed through the use of a vacuum truck. Sediment must be handled and disposed of properly in one of the ways approved by MassDEP. Refer to their policy on the management of catch basin cleanings. If there is evidence that they have been contaminated by a spill or other means, the cleanings must be evaluated in accordance with the MassDEP hazardous waste regulations, 310 CMR 30.00 and handled as hazardous waste.

Leaching Trenches and Chambers: Leaching trenches and chambers shall be inspected after every major storm event for the first few months after installation to ensure proper stabilization and function. Thereafter inspection shall occur annually. Water depth in the pits and galleys should be observed in the inspection ports after major storms to determine proper function. Exfiltration rates are determined by the drop in water level over the time it takes for the unit to empty. A comparison of exfiltration rate measurements taken over a period of years can provide helpful information in the event that clogging problems occur.

Public Safety Features: The drainage system frames, grates, and covers have all been specified for H20 loading. Catch basin grates are bicycle and pedestrian safe.

Operation and Maintenance Budget: The estimated annual cost for inspection and sediment removal associated with the maintenance of the Stormwater Management System is $2,500.

Reference: For full details on drainage system Construction, Operation and Maintenance refer to the current edition of the Massachusetts Stormwater Handbook.

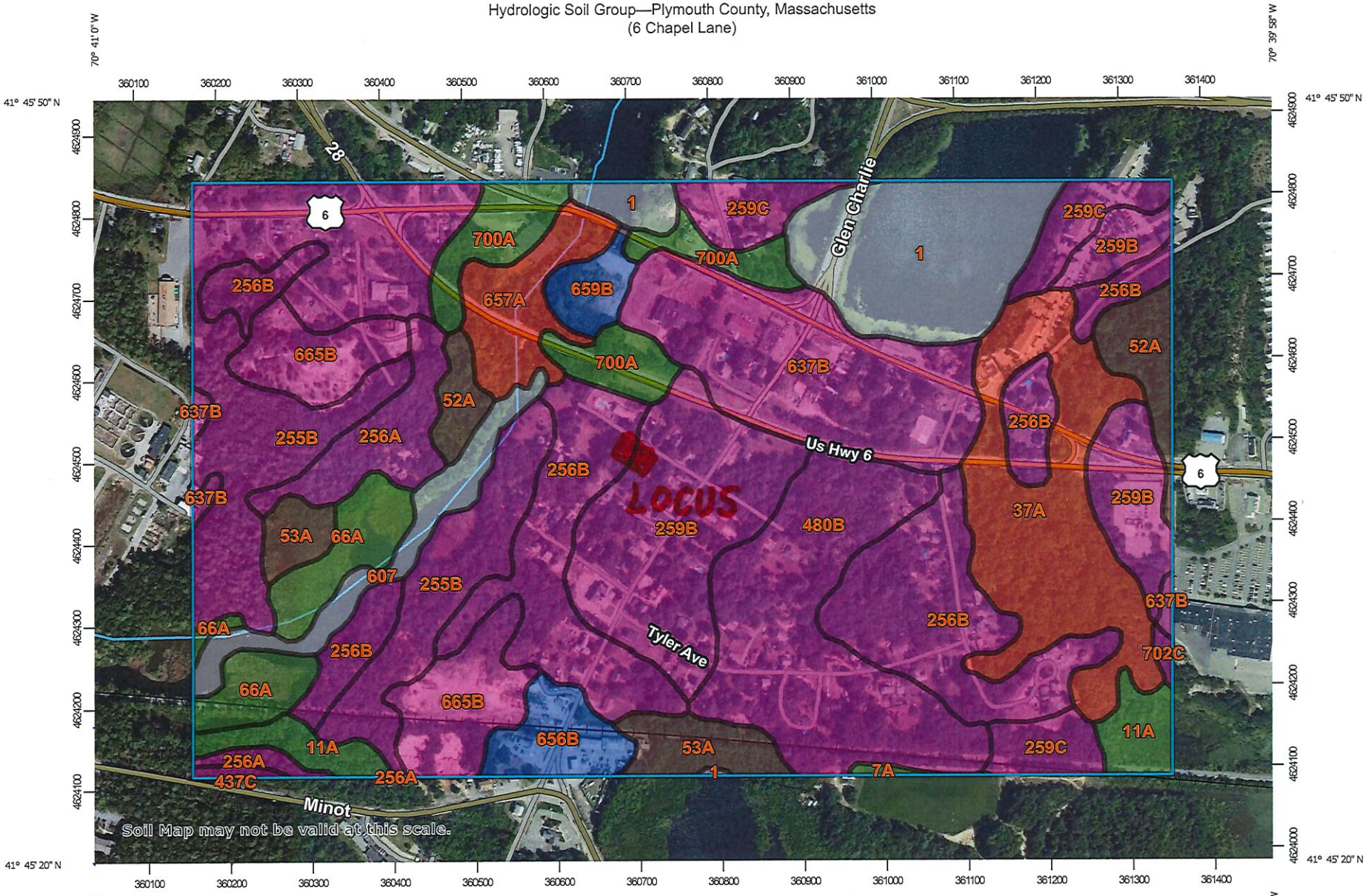
OPERATION AND MAINTENANCE LOG

This template is intended to comply with the operation and maintenance log requirements of the 2008 DEP Stormwater Management Handbook. Copies of this log should be made for all inspections and kept on file for three years from the inspection date.

Name/Company of Inspector:
Date/Time of Inspection:
Weather Conditions: (Note current weather and any recent precipitation events)

Stormwater BMP	Inspection Observations	Actions Required

Hydrologic Soil Group—Plymouth County, Massachusetts
(6 Chapel Lane)



Map Scale: 1:6,570 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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:
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: Plymouth County, Massachusetts
Survey Area Data: Version 15, Sep 9, 2022

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

Date(s) aerial images were photographed: Dec 31, 2009—Oct 9, 2020

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		14.2	6.6%
7A	Rainberry coarse sand, 0 to 3 percent slopes, sanded surface	A/D	0.3	0.1%
11A	Rainberry coarse sand, 0 to 3 percent slopes	A/D	4.4	2.0%
37A	Massasoit - Mashpee complex, 0 to 3 percent slopes	D	16.6	7.7%
52A	Freetown muck, 0 to 1 percent slopes	B/D	4.7	2.2%
53A	Freetown muck, ponded, 0 to 1 percent slopes	B/D	4.8	2.2%
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	A/D	6.6	3.1%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	29.1	13.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	5.6	2.6%
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	A	29.8	13.8%
259B	Carver loamy coarse sand, 3 to 8 percent slopes	A	21.3	9.9%
259C	Carver loamy coarse sand, 8 to 15 percent slopes	A	7.8	3.6%
437C	Plymouth loamy coarse sand, 8 to 15 percent slopes, bouldery	A	0.4	0.2%
480B	Plymouth - Carver complex, 3 to 8 percent slopes	A	18.6	8.7%
607	Water, saline		4.7	2.2%
637B	Carver - Urban land complex, 0 to 8 percent slopes	A	17.2	8.0%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	B	3.8	1.7%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
657A	Aquepts, 0 to 3 percent slopes	D	5.4	2.5%
659B	Udorthents, 0 to 8 percent slopes, gravelly	B	2.1	1.0%
665B	Udipsamments, 0 to 8 percent slopes	A	9.8	4.6%
700A	Udipsamments, wet substratum, 0 to 3 percent slopes	A/D	7.8	3.6%
702C	Udipsamments, 8 to 15 percent slopes	A	0.3	0.1%
Totals for Area of Interest			**215.4**	**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