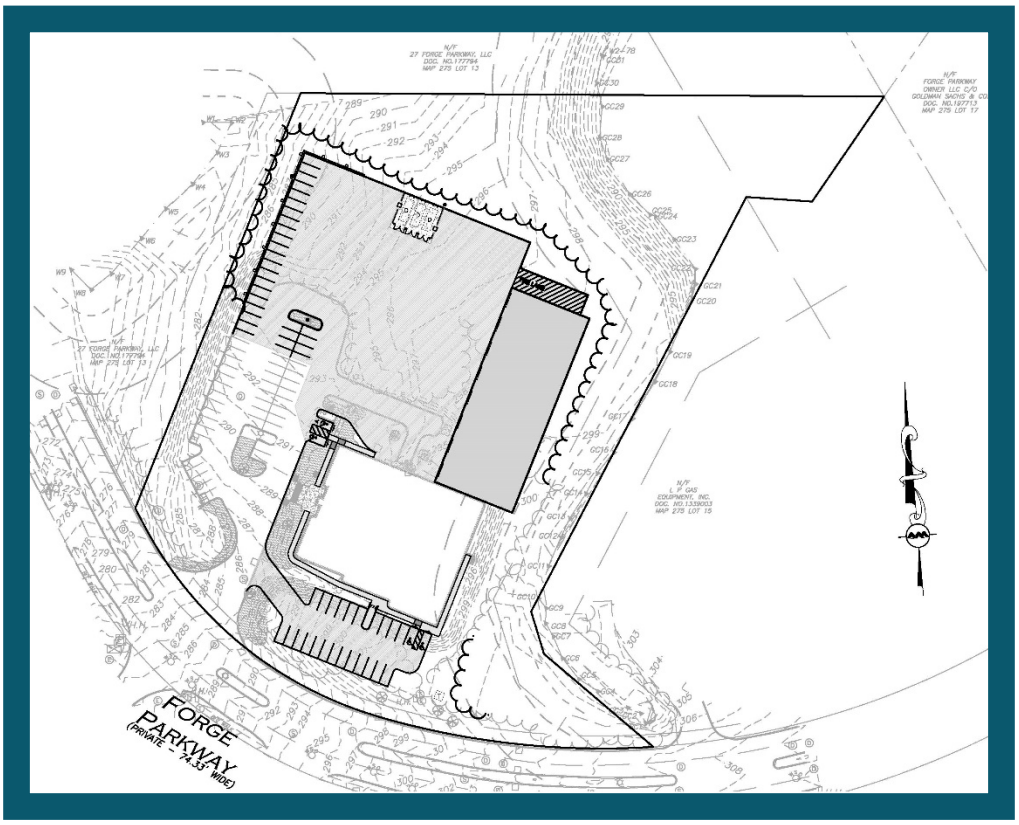
DRAINAGE REPORT

ALLEN & MAJOR
ASSOCIATES, INC.

25 Forge Parkway
Franklin, Massachusetts



APPLICANT:
TMC Holdings & Development 2, LLC
24 William Way
Bellingham, MA 02019

PREPARED BY:
Allen & Major Associates, Inc.
400 Harvey Road
Manchester, NH 03103

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ISSUED:
February 21, 2023

Revised:
December 14, 2023

A&M PROJECT NO.:
2712-02A

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SECTION 1.0 -
DRAINAGE REPORT

Introduction

The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the proposed construction of a 16,000 square foot building addition, 41 additional parking spaces, and paved contractor yard located at 25 Forge Parkway in Franklin, MA. The report will show by means of narrative, calculations and exhibits that the proposed stormwater management system will meet or exceed the Massachusetts Department of Environmental Protection (MassDEP) stormwater standards, and the Town's Stormwater Management Regulations.

The proposed SMS incorporates structural and non-structural Best Management Practices (BMPs) to provide stormwater peak flow mitigation, quality treatment, and conveyance.

The SMS for the proposed development includes a series of deep sump catch basins, proprietary water quality devices, two chamber infiltration systems, and outlet control structures. Some existing drainage infrastructure on site will remain.

Site Categorization for Stormwater Regulations

The proposed site improvements at 25 Forge Parkway are considered a new development under the DEP Stormwater Management Standards due to a net increase in impervious area. A new development project is required to meet all of the Stormwater Management Standards listed within the MA DEP Stormwater Handbook.

Site Location and Access

The site is a single lot with 582± feet of frontage on Forge Parkway, entirely within the Town of Franklin. The parcel is located approximately 0.85± miles west of Interstate 495 and 0.30± south of Route 140. The parcel is abutted by various warehouses and industrial uses, located within the Town's Industrial zone. The site is currently accessed by an existing curb cut along Forge Parkway. This same access will be utilized for the proposed development at the rear of the parcel.

Existing Site Conditions

The project site is located at 25 Forge Parkway, Franklin, Massachusetts, and is identified on the town Assessor's Map 275 as Parcel 14 and is approximately 5.91 acres. The project site is on the north side of Forge Parkway and is developed with an 18,619 square foot office building and 50 parking spaces. The rear of the site is wooded and undeveloped. The site topography ranges from moderate to steep slopes. The high point on-site is approximately elevation 307 in the southeastern corner of the site; the low point on-site is approximately elevation 278 in the southwestern corner of the site. The existing impervious area on-site is approximately 47,578 square feet. On the property presently, stormwater flows to three distinct locations. Stormwater from most of the rear portion of the site flows overland and discharges to 27 Forge Parkway, the neighboring parcel to the northwest. Flow from the front of the site flows both overland and through an existing

closed drainage system on-site, to the municipal drainage system in Forge Parkway. Stormwater from a small portion of the rear of the site flows to the pond in the northeast corner.

The surface drainage flows were analyzed at two Study Points. Study Point #1 summarizes runoff generated from northern portion of the parcel, routed to the existing 27 Forge Parkway wetland along the western property line. The areas on-site contributing to the wetland are undeveloped, composed of grass and woodlands. Study Point #2 summarizes runoff generated from existing developed portions of the parcel. This area is captured within existing stormwater infrastructure on-site and routed to the municipal drainage network within Forge Parkway.

Existing Soil Conditions

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Norfolk County. The soils on-site consist of Ridgebury & Woodbridge fine sandy loam and Charlton-Hollis-Rock outcrop complex. A copy of the NRCS Custom Soil Resource Report is included in the appendix of this report.

Further investigation on the underlying soils has been conducted by performing three (3) test pits within the site in locations identified for stormwater management. The test pit's show underlying soils to be primarily Loamy Sands. Loamy Sands have a Hydrologic Soil Group "A" designation which has been used throughout the design.

Test pit #1 was completed on February 10, 2023. All soil layers were observed to be loamy sand, with no weeping or standing water observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #2 was completed on February 10, 2023. All soil layers were observed to be loamy sand, with no weeping or standing water observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #3 was completed on February 10, 2023. The top two soil layers were observed to be loamy sand with the third layer being sandy loam. No weeping or standing water were observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #4 was completed on October 13, 2023. All soil layers were observed to be loamy sand, with no weeping or standing water observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #5 was completed on October 13, 2023. Both soil layers were observed to be loamy sand. The estimated seasonal high water table was observed at 86" below grade, with no weeping or standing water observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #6 was completed on October 13, 2023. Both soil layers were observed to be loamy sand. The estimated seasonal high-water table was observed at 90" below grade, with no weeping or standing water observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

Test pit #7 was completed on October 13, 2023. Both soil layers were observed to be loamy sand. The estimated seasonal high-water table was not observed to a depth of 90" below grade. Weeping and standing water were not observed. See the completed Commonwealth of Massachusetts – Form 11 for the test pit within the Appendix of the report.

An exfiltration rate for the Loamy Sands has been determined to be 2.41 inches per hour based upon Table 2.3.3 1982 Rawls Rate, Volume 3: Documenting Compliance with the Massachusetts's Stormwater Handbook.

FEMA Floodplain/Environmental Due Diligence

There are no portions of the site located within the FEMA Zone "AE" Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood (100-year floodplain) per the official Flood Insurance Rate Map (FIRM) effective date July 17, 2012, community panel 25021C0304E. See section 3 of this report for a copy of the FEMA FIRM.

Environmentally Sensitive Zones

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); Priority and Protected Habitat for rare and endangered species, and areas protected under the Wetlands Protection Act. The subject property is not located within any of these regulated areas.

Drainage Analysis Methodology

A peak rate of runoff was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
2. HydroCAD © Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.20-2g. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/ stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).

Proposed Conditions – Peak Rate of Runoff

The stormwater runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Further, the analysis has been prepared in accordance with the MassDEP and the Town of Franklin requirements and standard engineering practices. The peak rate of runoff has been estimated for each watershed during the 2, 10, 25, and 100-year storm events.

The proposed stormwater management system for the site consists of deep sump catch basins, proprietary water quality devices, a Stormtech MC-3500 chamber infiltration system with isolator row, Stormtech SC-740 chamber infiltration system with isolator row, and outlet control structures. These systems have been designed in accordance with the MA DEP Stormwater Management Policy to recharge groundwater and reduce rate of runoff from the parcel.

Stormwater runoff generated on the northern portion of the developed site and along the eastern property line will be captured within a series of catch basins or proprietary water quality devices and flow to the Stormtech MC-3500 chamber infiltration system. All pavement runoff will be treated within the system's isolator row; all roof and landscape (clean) runoff will be piped directly to the system. This system will infiltrate the 2- and 10-year design storm events while larger storm events will overflow through an outlet control structure to the existing wetland within the 27 Forge Parkway property. (Study Point 1)

Stormwater runoff generated on the currently developed portion of the site will be captured within the existing stormwater infrastructure, and discharge to the municipal drainage network within Forge Parkway (Study Point 2). The project proposes to install hoods on the existing catch basins to provide some treatment prior to discharge to the municipal system.

Stormwater runoff generated by the new parking lot on the southern portion of the site will be captured by proprietary water quality devices and flow to the Stormtech SC-740 infiltration system. This system has been sized to treat the water quality volume. Runoff in excess of the water quality volume will overflow to the existing drainage infrastructure on site and ultimately to the drainage network in Forge Parkway (Study Point 2).

The stormwater runoff model indicates that the proposed site development reduces the rate of runoff during all storm events at the identified points of analysis. The following tables provide a summary of the estimated peak rate, in Cubic Feet per Second (CFS) and total runoff volume, in cubic-feet (CF) at each of the two (2) Study Points for each of the design storm events. The HydroCAD worksheets are included in Section 4 and 5 of this report.

STUDY POINT #1 (Flow to wetland on 27 Forge Parkway property)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	0.02	0.39	1.05	3.02
Proposed Flow (CFS)	0.00	0.00	0.02	2.75
Decrease (CFS)	**0.02**	**0.39**	**1.03**	**0.27**
Existing Volume (CF)	629	3,771	7,571	17,948
Proposed Volume (CF)	0	89	531	14,124
Decrease (CF)	**629**	**3,682**	**7,040**	**3,824**

STUDY POINT #2 (Flow to drainage network within Forge Parkway right-of-way)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	3.39	6.62	9.25	14.75
Proposed Flow (CFS)	3.37	6.17	8.20	12.37
Decrease (CFS)	**0.02**	**0.45**	**1.05**	**2.38**
Existing Volume (CF)	14,533	28,007	39,279	63,483
Proposed Volume (CF)	12,504	23,118	31,851	50,333
Decrease (CF)	**2,029**	**4,889**	**7,428**	**13,150**

MASSDEP Stormwater Performance Standards

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for stormwater management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include:

- Deep Sump Catch Basins
- Proprietary water quality devices
- Stormtech MC-3500 & SC-740 Infiltration Systems
- Outlet Control Structures

Stormwater Best Management Practices (BMP's) have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw bale and/or silt fence barriers, inlet sediment traps, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the 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.*

   The proposed development will not introduce any new outfalls with direct discharge to a wetland area or waters of the Commonwealth of Massachusetts. All discharges will be treated for water quality and the rate will not be increased over existing conditions.

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 proposed development has been designed so that the post-development peak discharge rates do not exceed the predevelopment peak discharge rates. A summary of the existing and proposed discharge rates is included within this document.

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.*

   The existing annual recharge for the site has been approximated in the proposed condition. The proposed subsurface infiltration system is designed to meet this requirement. Stormwater runoff generated from the impervious areas of the proposed development are routed through the Stormtech MC-3500 and SC-740 Chamber Infiltration Systems. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

The test pit's show underlying soils to be primarily Loamy Sands. Loamy Sands have a Hydrologic Soil Group "A" designation (Table 2.3.3 1982 Rawls Rate, Volume 3: Documenting Compliance with the Massachusetts's Stormwater Handbook.)

See the appendix located at section 6 of this report for stormwater recharge calculations.

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

Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long-term Pollution Prevention Plan. The water quality volume for the site development is captured and treated using proprietary water quality devices and the Stormtech MC-3500 and SC-740 chamber infiltration systems.

The implemented BMPs have been designed to treat the contributing water quality volume. These water quality calculations can be seen within the appendix of this report.

The proposed stormwater management system has been designed to remove at least 80% of the average annual post-construction load for each treatment train. The TSS removal calculations can be seen within the appendix of this report.

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.

The site is considered a land use with higher potential pollutant loads due to the potential for storing fleet vehicles on the site. Pretreatment of the runoff, in excess of the required 44%, is provided by proprietary hydrodynamic separators upstream of the infiltration systems, therefore this requirement is met.

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.*

   The project site does not discharge stormwater within a Zone II or Interim Wellhead Protection Area or near a critical area. Critical Areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02, bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

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.

The proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines as there is an increase in the amount of impervious area.

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.*

   A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction has been developed. A detailed Site Preparation Plan in the Permit Drawings has been prepared, outlining the erosion and sedimentation controls to be used. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

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

   A Long-Term Operation & Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Section 2.0 of this report.

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

    There are no expected illicit discharges to the stormwater management system.

See the following pages for the MassDEP Stormwater Checklist.

Town of Franklin Stormwater Management Bylaw Standards

In addition to the MassDEP Stormwater Standards, the Town of Franklin has established its own Stormwater Management Bylaw, the standards of which are outlined in Section 153-16 of the General Legislation Bylaws. In addition to requiring that the project meet federal and state requirements, including the MassDEP Stormwater Standards above, the Stormwater Management Bylaw requires that all stormwater management systems for new developments shall be designed to:

(a) Retain the volume of runoff equivalent to one inch multiplied by the impervious surface on the site.

The proposed infiltration systems are designed to infiltrate **24,020** cubic feet of stormwater prior to overflow. The project proposes to increase the impervious area on site by **68,455** square feet, which means that the infiltration systems will retain the equivalent of **4.2** inches multiplied by the added impervious area (see calculation below).

$$\frac{24{,}020\ ft^3}{68{,}455 ft^2}\ x\ \frac{12\ inches}{foot} = 4.21\ inches$$

(b) Remove 90% of the average annual load of total suspended solids (TSS) and 60% of the average annual load of total phosphorus (TP)

Stormwater runoff from the proposed parking lot will be treated by a water quality device prior to discharge to the subsurface infiltration systems. The subsurface infiltration systems have been designed to infiltrate a volume that exceeds the Water Quality Volume. The treatment provided by the combination of the two BMPs exceeds 90% TSS removal. TSS removal calculations can be found in the appendix of this report. Phosphorus removal is provided by the infiltration systems. As mentioned above, the infiltration systems are designed to infiltrate a volume that exceeds the Water Quality Volume. System #1 has been designed such that **all** runoff from the 2- and 10-year storm events is infiltrated. The MassDEP Stormwater handbook, Volume 2, Chapter 2 specifies that infiltration basins provide between 60% and 70% phosphorus removal. Therefore, this requirement is met.

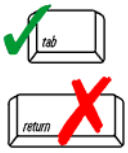
MASSDEP Stormwater Checklist

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

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 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.

SECTION 2.0 -
OPERATION & MAINTENANCE PLAN

Introduction

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the existing development at 25 Forge Parkway, Franklin, Massachusetts.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Demolition & Construction Maintenance Plan). The second section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long-Term Maintenance Plan – Facilities Description).

Notification Procedures for Change of Responsibility for O&M

The Stormwater Management System (SMS) for this project is owned by TMC Holdings & Development 2 LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the DPW and Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner has notified the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility. The owner must notify the Director of Public Works of changes in ownership or assignment of financial responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

Contact Information

Stormwater Management System Owner:

TMC Holdings & Development 2 LLC
24 William Way
Bellingham, MA 02019
Phone: (774) 295-4201

Owner Signature

Matthew Clark – President

4/3/2023
Date

Emergency Contact Information:

TMC Holdings & Development 2, LLC (Owner/Operator)	Phone: (774) 295-4201
Allen & Major Associates, Inc. (Site Civil Engineer)	Phone: (603) 627-5500
Franklin Department of Public Works	Phone: (508) 553-5500
Franklin Conservation Commission	Phone: (508) 520-4929
Franklin Fire Department (non-emergency line)	Phone: (508) 528-2323
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

Demolition & Construction Maintenance Plan

1. Call Digsafe: 1-888-344-7233
2. Contact the Town at least three (3) days prior to start of demolition and/or construction activities.
3. Install Erosion Control measures as shown on the Site Preparation Plan prepared by A&M. The Town shall review the installation of catch basin filters and tubular barrier protection prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. Install construction entrances, catch basin filters, and tubular sediment barriers at the locations shown on the Site Preparation Plan prepared by A&M.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).

7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
8. Install silt sacks at each drain inlet prior to any demolition and or construction activities.
9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the Town.
11. Sediment accumulation up-gradient of the tubular sediment barriers greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dams on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.

Long-Term Pollution Prevention Plan

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the

Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- Housekeeping
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- Storing of Materials & Water Products
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- Vehicle Washing
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- Spill Prevention & Response
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

  1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
  2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
  3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.

4. All spills shall be cleaned up immediately after discovery.
5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.
6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- Maintenance of Lawns, Gardens, and Other Landscaped Areas

  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

  - Fertilizer

    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

    Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

    Type: LESCO® 28-0-12 (Lawn Fertilizer)
    MERIT® 0.2 Plus Turf Fertilizer
    MOMENTUM™ Force Weed & Feed

- Suggested Aeration Program

  In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

  Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

  The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- Landscape Maintenance Program Practices:
  - Lawn
    1. Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
    2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
    3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
    4. Do not remove grass clippings after mowing.

5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.

- Shrubs
  1. Mulch not more than 3" depth with shredded pine or fir bark.
  2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
  3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- Trees
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- Invasive Species
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- Storage and Use of Herbicides and Pesticides

  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- Pet Waste Management
  The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.
- Operations and Management of Septic Systems
  There are no proposed septic systems within the limits of the project.
- Management of Deicing Chemicals and Snow
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the

storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

Long-Term Maintenance Plan – Facilities Description

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

Stormwater Collection System – On-Site:

The stormwater collection system on site is composed of a series of catch basins, proprietary water quality devices, drainage conveyance pipe, Stormtech MC-3500 infiltration system, and outlet control structure. All of the proposed on-site catch basins incorporate a deep sump and hooded outlet. The proposed catch basins and proprietary water quality devices are connected by a closed gravity pipe network that routes stormwater to the infiltration system for treatment prior to discharge.

Structural Pretreatment BMPs: Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

- Deep Sump Catch Basin:
  There are various catch basins located throughout the project site, both existing and proposed. Each catch basin unit shall be inspected four times per year. These units should be cleaned at each inspection or when the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

- Proprietary water quality devices:
  Inspect all hydrodynamic separators with the same frequency as catch basins. Remove sediment when the isolated sump has reached 75% of its capacity. Refer to the manufacturer's Maintenance Guide for additional information.

- Outlet Control Structures:
  The outlet control structures shall be inspected periodically, at least annually; remove debris and sediment when encountered. Review that the structures' internal weirs are functioning properly following any major storm events.
- Outfall Structure (Headwall) & Rip-Rap Apron:

  The outfall shall be inspected annually. Remove debris, sediment, and woody vegetation when encountered. Repair erosion and scouring by replacing rip-rap and/or regrading. Regrade outfall to be level if channelization occurs.

Infiltration BMPs:

- Subsurface Structure – Stormtech MC-3500 and SC-740 Chamber Systems:
  Inspect the catch basins/ drain manholes that inlet to the subsurface infiltration system as recommended to ensure no trash or debris is entering the system. JetVac maintenance is recommended if sediment within the isolator row has been collected to an average depth of 3".

Other Maintenance Activity:

- Mosquito Control:
  Both above ground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential. See the supplemental information for Mosquito Control in Stormwater Management Practices, and the Operation and Maintenance Plan Schedule for inspection schedule.

- Street Sweeping:
  Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Inspection and Maintenance Frequency and Corrective Measures

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the previously described BMPs will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Supplemental Information

- Operation & Maintenance Plan Schedule
- Massachusetts Stormwater Handbook, Chapter 5, Miscellaneous Stormwater Topics, Mosquito Control in Stormwater Management Practices
- Massachusetts DEP – Snow Disposal Guidance
- Stormtech MC-3500 & SC-740 Isolator Row Operation & Maintenance
- CDS Guide, Operation, Design, Performance and Maintenance
- Operation & Maintenance Figure

OPERATION AND MAINTENANCE PLAN SCHEDULE **Date:**

ALLEN & MAJOR ASSOCIATES, INC.

Project: 25 Forge Parkway
Project Address: 25 Forge Parkway, Franklin, MA

Responsible for O&M Plan: TMC Holdings & Development 2, LLC
Address: 24 William Way, Bellingham, MA 02019
Phone: (774) 295-4201

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	ESTIMATED ANNUAL MAINTENANCE COST	INSPECTION PERFORMED	
					DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	DEEP SUMP CATCH BASIN & PROPRIETARY WATER QUALITY DEVICES	Four times per year (quarterly).	Inspect and clean catch basin units whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.	$1,000		
	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	$250		
	OUTFALL STRUCTURE (HEADWALL) & RIP-RAP APRON	Annual inspection	Remove sediment and debris. Remove woody vegetaion. Repair erosion and scouring. Replace rip-rap. Regrade outfall to be level if channelization occurs.	$500		
INFILTRATION BMPs	SUBSURFACE STRUCTURES	Inspect structure inlets at least twice a year. Remove debris that may clog the system as needed.	Because subsurface structures are installed underground, they are extremely difficult to maintain. Remove any debris that might clog the system.	$1,000		
OTHER MAINTENANCE ACTIVITY	MISQUITO CONTROL	Inspect BMPs as needed to ensure the system's drainage time is less than the maximum 72 hour period.	Massachusetts stormwater handbook requires all stormwater practices that are designed to drain do so within 72 hours to reduce the number of mosquitos that mature to adults since the aquatic stage of a mosquito is 7-10 days.	$200		
	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.	$500		
	STREET SWEEPING	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements	$1,500		

Chapter 5
Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, http://www.mass.gov/agr/mosquito/, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that "accept" them through local subdivision approval are responsible for their maintenance.[1] The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- ***Minimize Land Disturbance:*** Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- ***Catch Basin inlets:*** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

[1] MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- ***Check Dams:*** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- ***Design construction period sediment traps*** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- ***Construction period open conveyances:*** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- ***Revegetating Disturbed Surfaces:*** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- ***Sediment fences/hay bale barriers:*** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
    - ***Bioretention Areas/Rain Gardens/Sand Filter:*** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
    - ***Infiltration Trenches:*** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
    - ***Constructed Stormwater Wetlands:*** Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
    - ***Wet Basins:*** Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or "dead" zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- ***Basins:*** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- ***BMPs without a permanent pool of water:*** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- ***Energy Dissipators and Flow Spreaders:*** Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- ***Outlet control structures:*** Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- ***Rain Barrels and Cisterns:*** Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- ***Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:*** Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- ***Check dams:*** Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- ***Cisterns:*** Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- ***Water quality swales:*** Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- ***Larvicide Treatment:*** The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs*), the preferred

larvicide for stormwater BMPs, should be hand-broadcast.[2] Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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[2] *Bacillus thuringienis israelensis* or *Bti* is usually applied by helicopter to wetlands and floodplains

Roads and Stormwater BMPs

In general, the stormwater BMPs used for land development projects can also be used for new roadways and roadway improvement projects. However, for improvement of existing roads, there are often constraints that limit the choice of BMP. These constraints derive from the linear configuration of the road, the limited area within the existing right-of-way, the structural and safety requirements attendant to good roadway design, and the long-term maintainability of the roadway drainage systems. The MassHighway Handbook provides strategies for dealing with the constraints associated with providing stormwater BMPs for roadway redevelopment projects.

Roadway design can minimize impacts caused by stormwater. Reducing roadway width reduces the total and peak volume of runoff. Designing a road with country drainage (no road shoulders or curbs) disconnects roadway runoff. Disconnection of roadway runoff is eligible for the Low Impact Site Design Credit provided the drainage is disconnected in accordance with specifications outlined in Volume 3.

Like other parties, municipalities that work within wetlands jurisdictional areas and adjacent buffer zones must design and implement structural stormwater best management practices in accordance with the Stormwater Management Standards and the Stormwater Management Handbook. In addition, in municipalities and areas where state agencies operate stormwater systems, the DPWs (or other town or state agencies) must meet the "good housekeeping" requirement of the municipality's or agency's MS4 permit.

MassHighway has taken stormwater management one step further by working with MassDEP to develop the MassHighway Storm Water Handbook for Highways and Bridges. The purpose of the MassHighway Handbook is to provide guidance for persons involved in the design, permitting, review and implementation of state highway projects, especially those involving existing roadways where physical constraints often limit the stormwater management options available. These constraints, like those common to redevelopment sites, may make it difficult to comply precisely with the requirements of the Stormwater Management Standards and the Massachusetts Stormwater Handbook.[3] In response to these constraints, MassDEP and MHD developed specific design, permitting, review and implementation practices that meet the unique challenges of providing environmental protection for existing state roads. The information in the MassHighway Handbook may also aid in the planning and design of projects to build new highways and to add lanes to existing highways, since they may face similar difficulties in meeting the requirements of the Stormwater Management Standards.

Although it is very useful, the MassHighway Handbook does not allow MassHighway projects to proceed without individual review and approval by the issuing authority when subject to the Wetlands Protection Act Regulations, 310 CMR 10.00, or the 401 Water Quality Certification Regulations, 314 CMR 9.00. For example, MassHighway must provide a Conservation Commission with a project-specific Operation and Maintenance Plan in accordance with Standard 9 that documents how the project's post-construction BMPs will be operated and maintained.[4]

[3] The 2004 MassHighway Handbook outlines standardized methods for dealing with these constraints as they apply to highway redevelopment projects. MassDEP and MassHighway intend to work together to provide guidance for add a lane projects when the 2004 Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards.

[4] The general permit for municipal separate storm sewer systems (the MS4 Permit) requires MassHighway to develop and implement procedures for the proper operation and maintenance of stormwater BMPs. To

Some municipalities have asked if the MassHighway Handbook governs municipal road projects. The answer is no.[5] The MassHighway Handbook was developed in response to the unique problems and challenges arising out of the management of the state highway system. Like other project proponents, cities and towns planning road or other projects in areas subject to jurisdiction under the Wetlands Protection Act must design and implement LID, non-structural and structural best management practices in accordance with the Stormwater Management Standards and the Massachusetts Stormwater Handbook.

avoid duplication of effort, MassHighway may be able rely on the same procedures to fulfill the operation and maintenance requirements of Standard 9 and the MS 4 Permit.

[5] Although the MassHighway Handbook does not govern municipal road projects, cities and towns may find some of the information presented in the Handbook useful.

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection
Bureau of Water Resources
Snow Disposal Guidance

Effective Date: December 11, 2020

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into

waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address: **https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/**.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
    - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
    - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
    - Do not dispose of snow where trucks may cause shoreline damage or erosion.
    - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

  If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at

least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps***:

- Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

MC-3500 & MC-7200
Design Manual

StormTech® Chamber Systems for Stormwater Management

ADS StormTech™

8.0 General Notes

1. StormTech requires installing contractors to use and understand the latest StormTech **MC-3500 and MC-7200 Construction Guides** prior to beginning system installation.
2. StormTech offers installation consultations to installing contractors. Contact our Technical Service Department or local StormTech representative at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the installing contractor of the minimum installation requirements before beginning the system's construction. Call 860-529-8188 to speak to a Technical Service Representative or visit www.stormtech.com to receive a copy of our Construction Guide.
3. StormTech requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover is 18" (450mm) for the MC-3500 and 24"(600mm) for the MC-7200 not including pavement; MC-3500 maximum cover is 8.0' (1.98 m) and MC-7200 maximum cover is 7.0' (2.43 m) both including pavement. For designs with cover depths deeper than these maximums, please contact Stormtech. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is increased to 30" (762 mm).
4. The contractor must report any discrepancies with the bearing capacity of the subgrade materials to the design engineer.
5. AASHTO M288 Class 2 non-woven geotextile (ADS601 or equal) (filter fabric) must be used as indicated in the project plans.
6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech MC-3500 / MC-7200 Construction Guides.
7. Backfilling over the chambers must follow requirements as indicated in the most current version of StormTech MC-3500 / MC-7200 Construction Guides.
8. The contractor must refer to StormTech MC-3500 / MC-7200 Construction Guides for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at the StormTech website: www.stormtech.com. The contractor is responsible for preventing vehicles that exceed StormTech requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.
9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.
10. STORMTECH PRODUCT WARRANTY IS LIMITED. Contact StormTech for warranty information.

9.0 Inspection and Maintenance

9.1 Isolator Row Plus Inspection

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row Plus. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a con- fined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3" (76 mm), cleanout is required.

A StormTech Isolator Row Plus should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row Plus should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

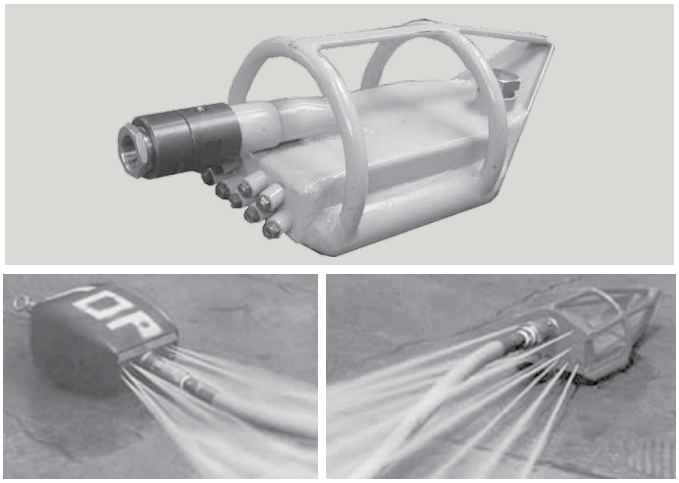
9.2 Isolator Row Plus Maintenance

JetVac maintenance is recommended if sediment has been collected to an average depth of 3" (76 mm) inside the Isolator Row Plus. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row Plus. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combi- nation vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" (1143 mm) are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. The JetVac process shall only be performed on StormTech Rows that have ADS Plus fabric over the foundation stone.

A Flamp (flared end ramp) is attached to the inlet pipe on the inside of the chamber end cap to provide a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance over time by distributing sediment and debris that would otherwise collect at the inlet. It also serves to improve the fluid and solid flow back into the inlet pipe during maintenance and cleaning, and to guide cleaning and inspection equipment back into the inlet pipe when complete.

Flamp (Flared End Ramp)

A typical JetVac truck (This is not a StormTech product.)



Examples of culvert cleaning nozzles appropriate for Isolator Row Plus maintenance. (These are not StormTech products).

MC-7200 MC-3500 DC-780 SC-740 SC-310 SC-160LP

A Family of Products and Services for the Stormwater Industry:

MC-3500 and MC-7200 Chambers and End Caps

SC-160LP, SC-310 and SC-740 Chambers & End Caps

DC-780 Chambers and End Caps

Fabricated End Caps

Fabricated Manifold Fittings

Patented Isolator Row PLUS for Maintenance and Water Quality

Chamber Separation Spacers

In-House System Layout Assistance

On-Site Educational Seminars

Worldwide Technical Sales Group

Centralized Product Applications Department

Research and Development Team

Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Website

StormTech provides state-of-the-art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that Saves Valuable Land and Protects Water Resources.

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SC-160LP, SC-310, SC-740 & DC-780 Design Manual

StormTech® Chamber Systems for Stormwater Management

ADS StormTech™

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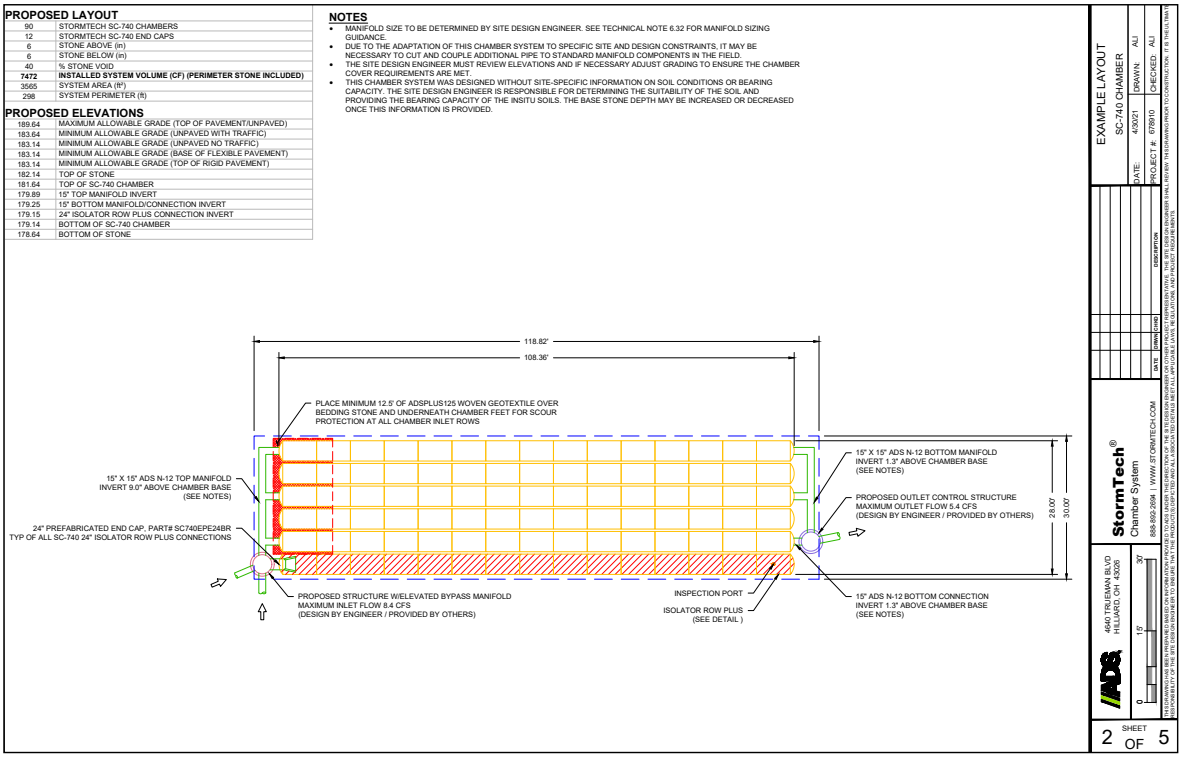
* For MC-3500 and MC-7200 designs, please refer to the MC-3500/MC-7200 Design Manual.

The StormTech Technical Services Department assists design professionals in specifying StormTech storm water systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. The Technical Department can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete and other manufactured storm water detention/retention products. Please note that it is the responsibility of the design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing this project.



This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

12.0 Inspection and Maintenance

12.1 Isolator Row Plus Inspection

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row PLUS. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3 (76 mm), cleanout is required.

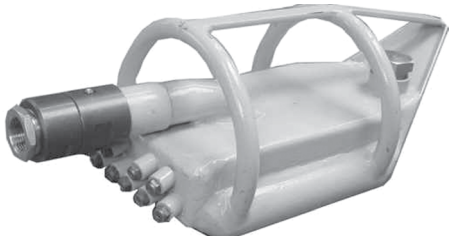
A StormTech Isolator Row PLUS should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row PLUS should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

12.2 Isolator Row Plus Maintenance

JetVac maintenance is recommended if sediment has been collected to an average depth of 3 (76 mm) inside the Isolator Row PLUS. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row PLUS. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45 (1143 mm) are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. The JetVac process shall only be performed on StormTech Rows that have ADS PLUS fabric over the foundation stone.

Looking down the Isolator Row PLUS

A typical JetVac truck (This is not a StormTech product.)



Examples of culvert cleaning nozzles appropriate for Isolator Row PLUS maintenance. (These are not StormTech products).

12.0 Inspection & Maintenance

StormTech Isolator Row Plus - Step-by-Step Maintenance Procedures

Step 1: Inspect Isolator Row PLUS for sediment

A) Inspection ports (if present)
   i. Remove lid from floor box frame
   ii. Remove cap from inspection riser
   iii. Using a flashlight and stadia rod, measure depth of sediment
   iv. If sediment is at, or above, 3" (76 mm) depth proceed to Step 2. If not proceed to Step 3.

B) All Isolator Plus Rows
   i. Remove cover from manhole at upstream end of Isolator Row PLUS
   ii. Using a flashlight, inspect down Isolator Row PLUS through outlet pipe
      1. Follow OSHA regulations for confined space entry if entering manhole
      2. Mirrors on poles or cameras may be used to avoid a confined space entry
   iii. If sediment is at or above the lower row of sidewall holes [approximately 3" (76 mm)]proceed to Step 2. If not proceed to Step 3.

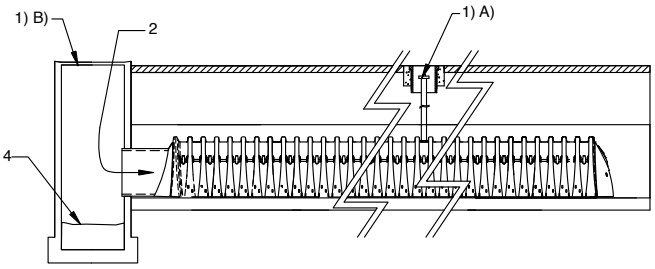
Step 2: Clean out Isolator Row PLUS using the JetVac process

A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 (1143 mm) or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required during jetting

Step 3: Replace all caps, lids and covers

Step 4: Inspect and clean catch basins and manholes upstream of the StormTech system following local guidelines.

Figure 20 – StormTech Isolator Row Plus (not to scale)



12.3 Eccentric Pipe Header Inspection

Theses guidelines do not supercede a pipe manufacturer's recommended I&M procedures. Consult with the manufacturer of the pipe header system for specific I&M procedures. Inspection of the header system should be carried out quarterly. On sites which generate higher levels of sediment more frequent inspections may be necessary. Headers may be accessed through risers, access ports or manholes. Measurement of sediment may be taken with a stadia rod or similar device. Cleanout of sediment should occur when the sediment volume has reduced the storage area by 25% or the depth of sediment has reached approximately 25% of the diameter of the structure.

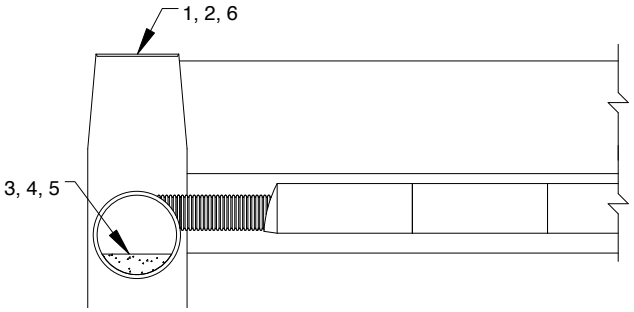
12.4 Eccentric Pipe Manifold Maintenance

Cleanout of accumulated material should be accomplished by vacuum pumping the material from the header. Cleanout should be accomplished during dry weather. Care should be taken to avoid flushing sediments out through the outlet pipes and into the chamber rows.

Eccentric Header Step-by-Step Maintenance Procedures

1. Locate manholes connected to the manifold system
2. Remove grates or covers
3. Using a stadia rod, measure the depth of sediment
4. If sediment is at a depth of about 25% pipe volume or 25% pipe diameter proceed to step 5. If not proceed to step 6.
5. Vacuum pump the sediment. Do not flush sediment out inlet pipes.
6. Replace grates and covers
7. Record depth and date and schedule next inspection

Figure 21 – Eccentric Manifold Maintenance



Please contact StormTech's Technical Services Department at 888-892-2894 for a spreadsheet to estimate cleaning intervals.

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

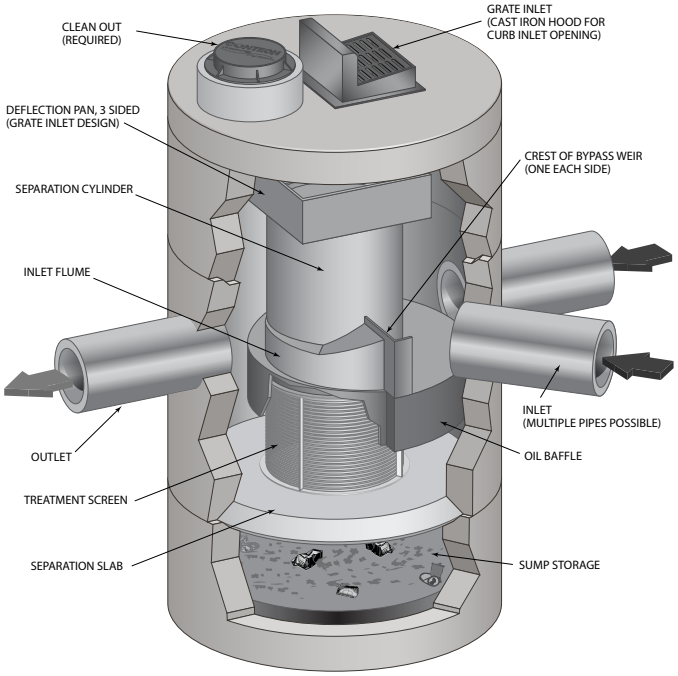
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

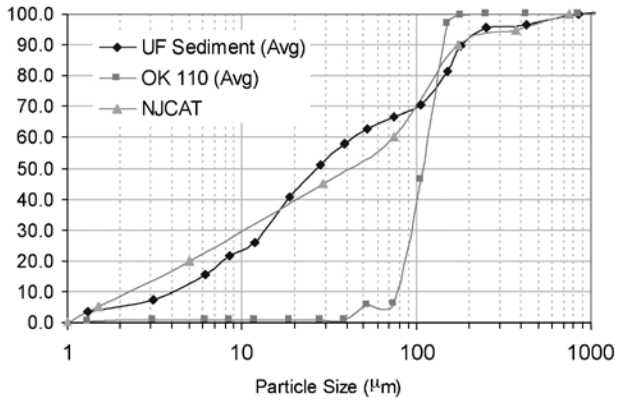


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

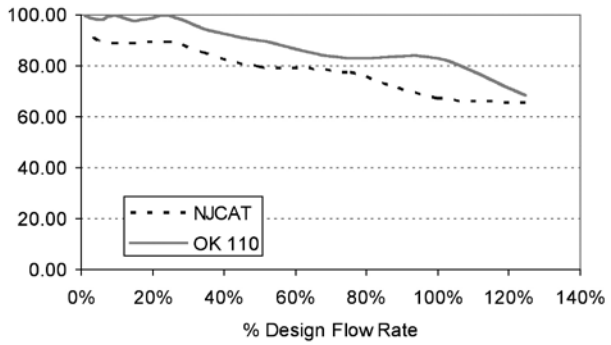


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

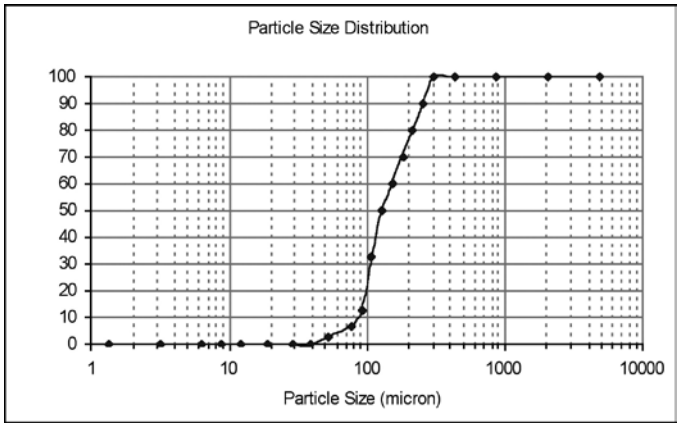


Figure 3. WASDOE PSD

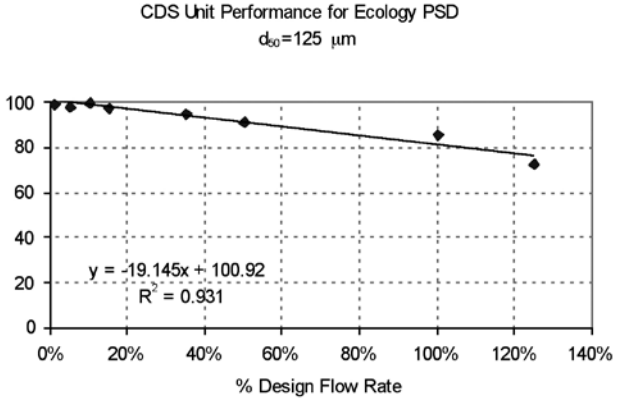


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

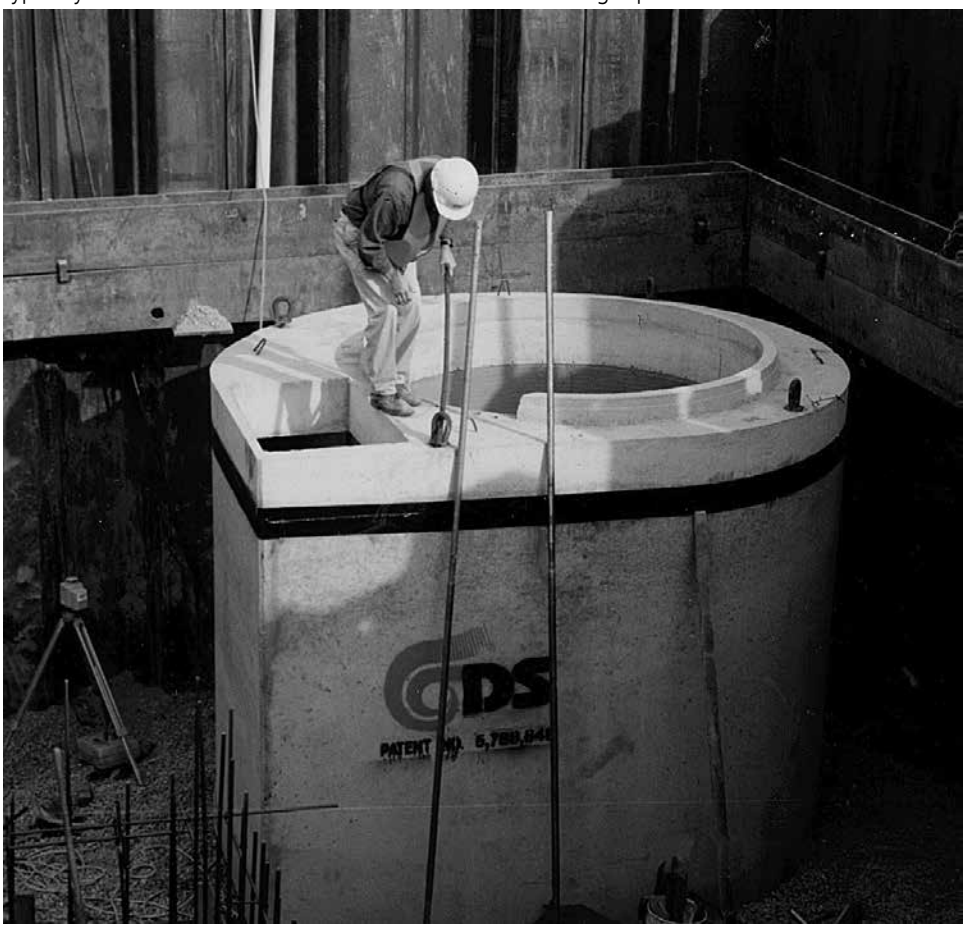
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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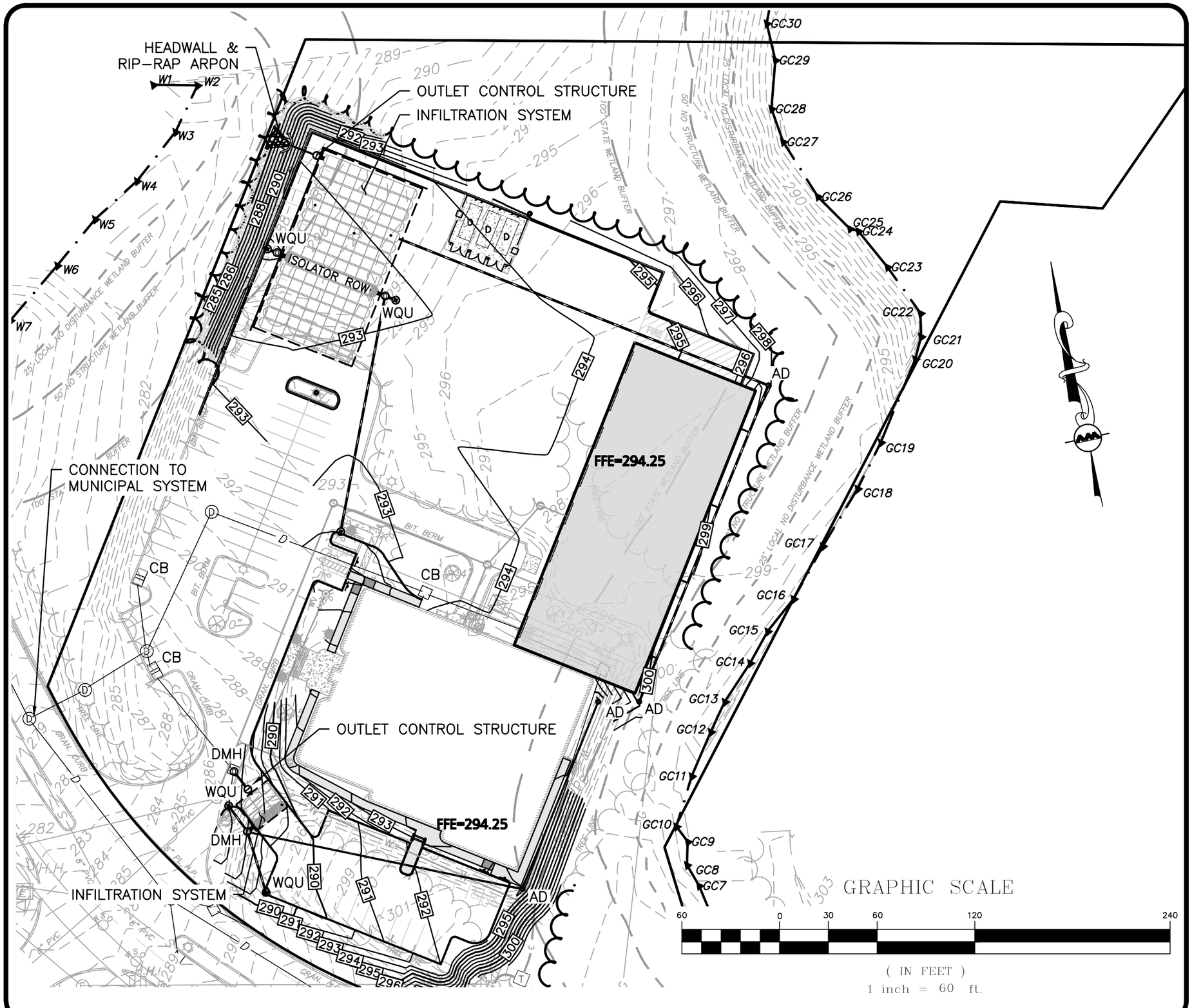


R:\PROJECTS\2712-02A\CIVIL\DRAWINGS\CURRENT\C-2712-02A_GRADING & DRAINAGE.DWG

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

TMC HOLDINGS & DEVELOPMENT 2, LLC
24 WILLIAM WAY
BELLINGHAM, MA 02019

PROJECT:

25 FORGE PARKWAY
FRANKLIN, MA

PROJECT NO.	2712-02A	DATE:	12-14-23
SCALE:	1" = 60'	DWG. NAME:	C2712-02A
DESIGNED BY:	SM	CHECKED BY:	BDJ

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
400 HARVEY ROAD
MANCHESTER, NH 03103
TEL: (603) 627-5500
FAX: (603) 627-5501
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:

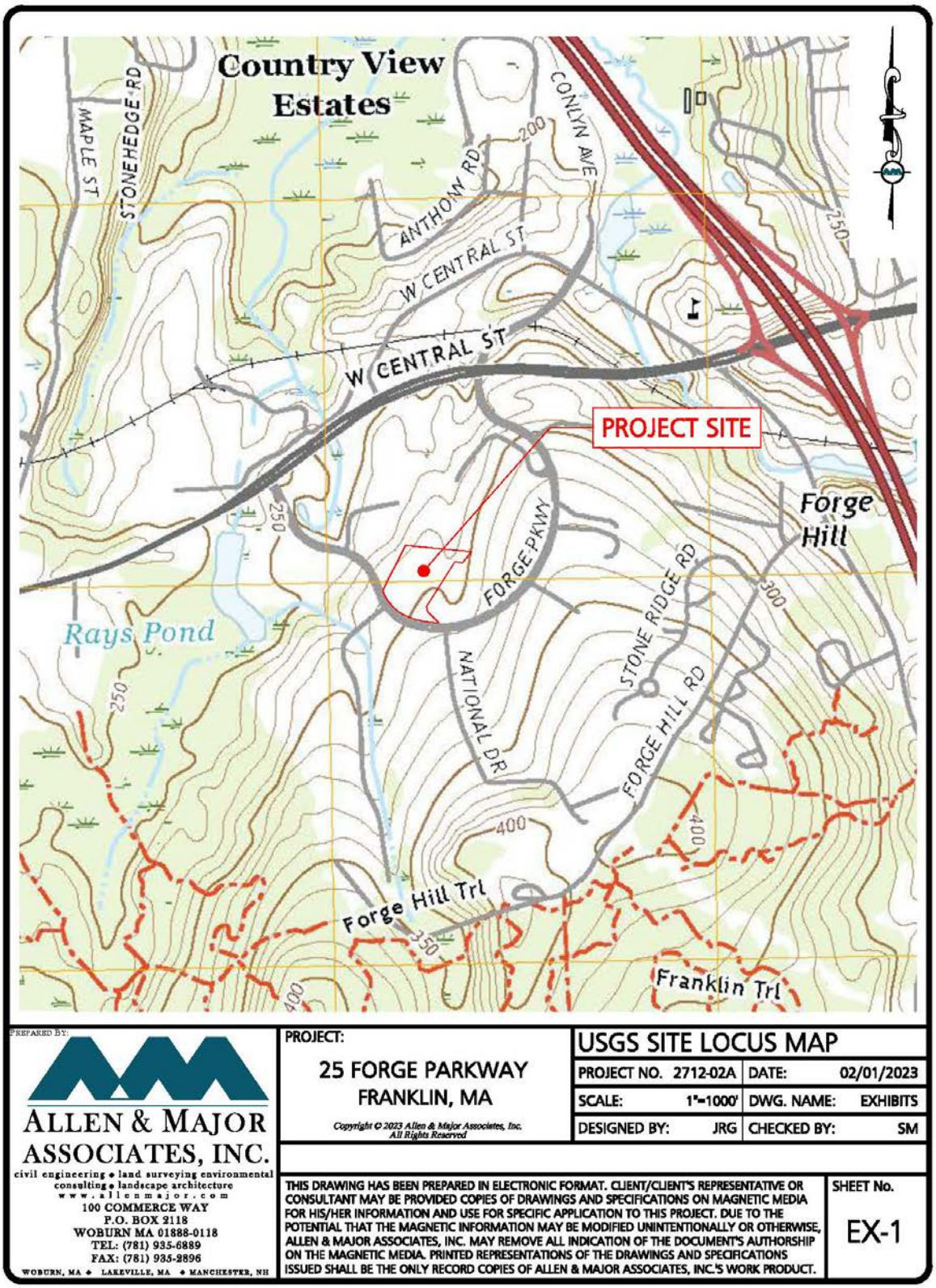
OPERATION & MAINTENANCE FIGURE

SHEET No.

1

SECTION 3.0 -
EXHIBITS

USGS Site Locus Map



PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering • land surveying environmental consulting • landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA • LAKEVILLE, MA • MANCHESTER, NH

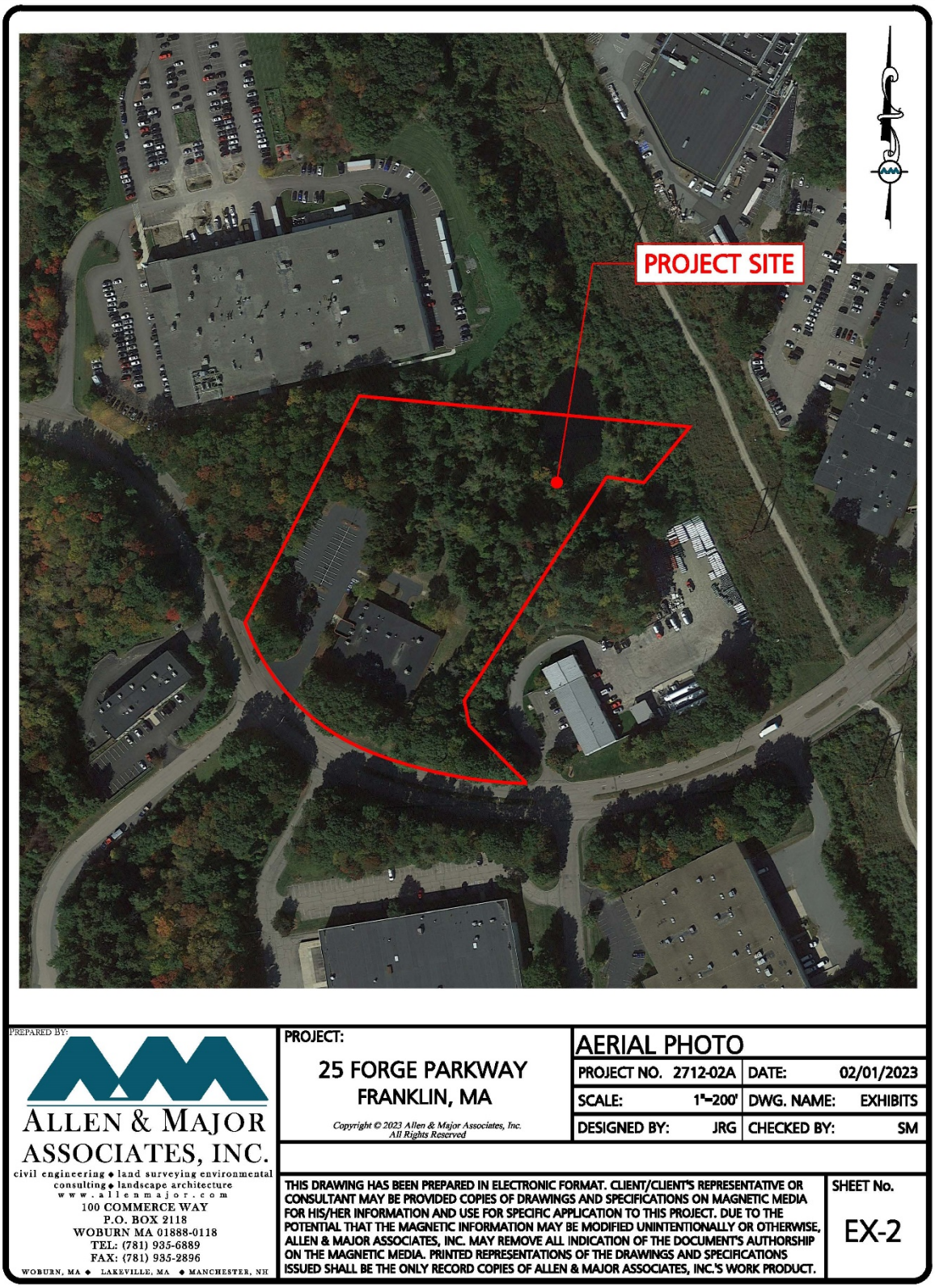
PROJECT:
25 FORGE PARKWAY
FRANKLIN, MA

USGS SITE LOCUS MAP

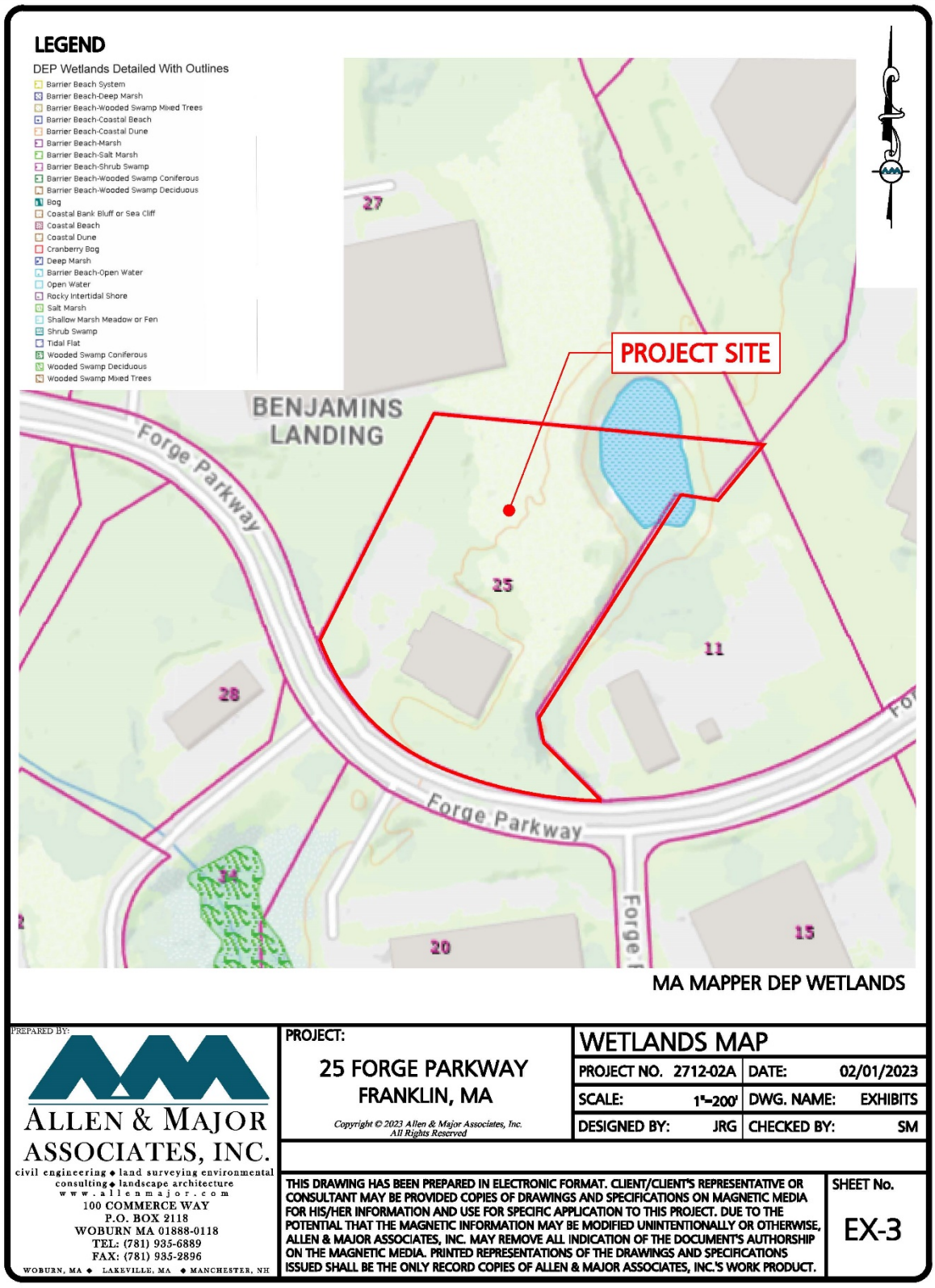
PROJECT NO. 2712-02A		DATE:	02/01/2023
SCALE:	1"=1000'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JRG	CHECKED BY:	SM

SHEET No.
EX-1

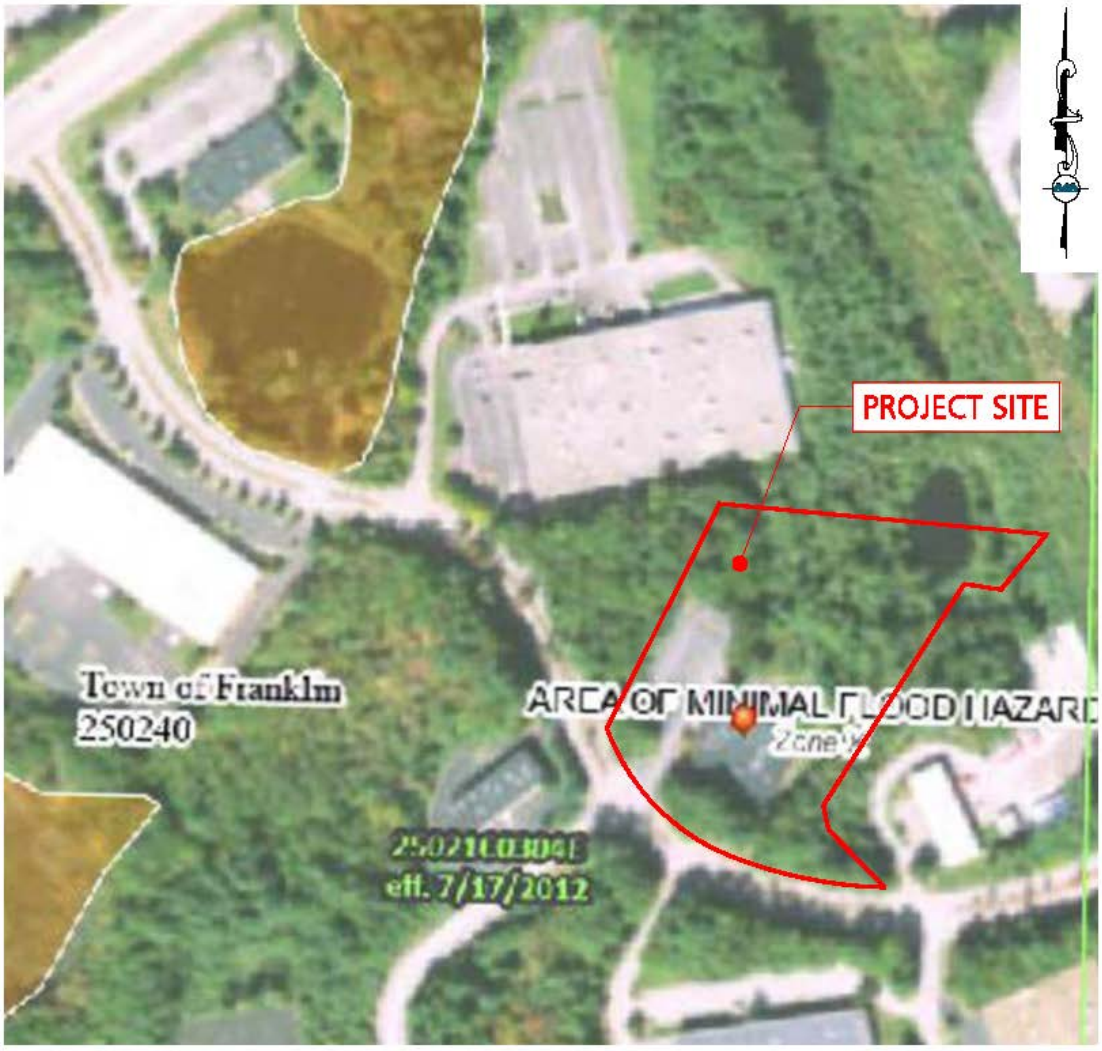
Aerial Photo



MASSDEP Wetlands Map



FEMA Flood Insurance Rate Map



FEMA FLOOD INSURANCE RATE MAP
NORFOLK COUNTY, MASSACHUSETTS
MAP NUMBER 25021C0304E
EFFECTIVE DATE: JULY 17, 2012

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civil engineering • land surveying environmental consulting • landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA • LAKEVILLE, MA • MANCHESTER, NH

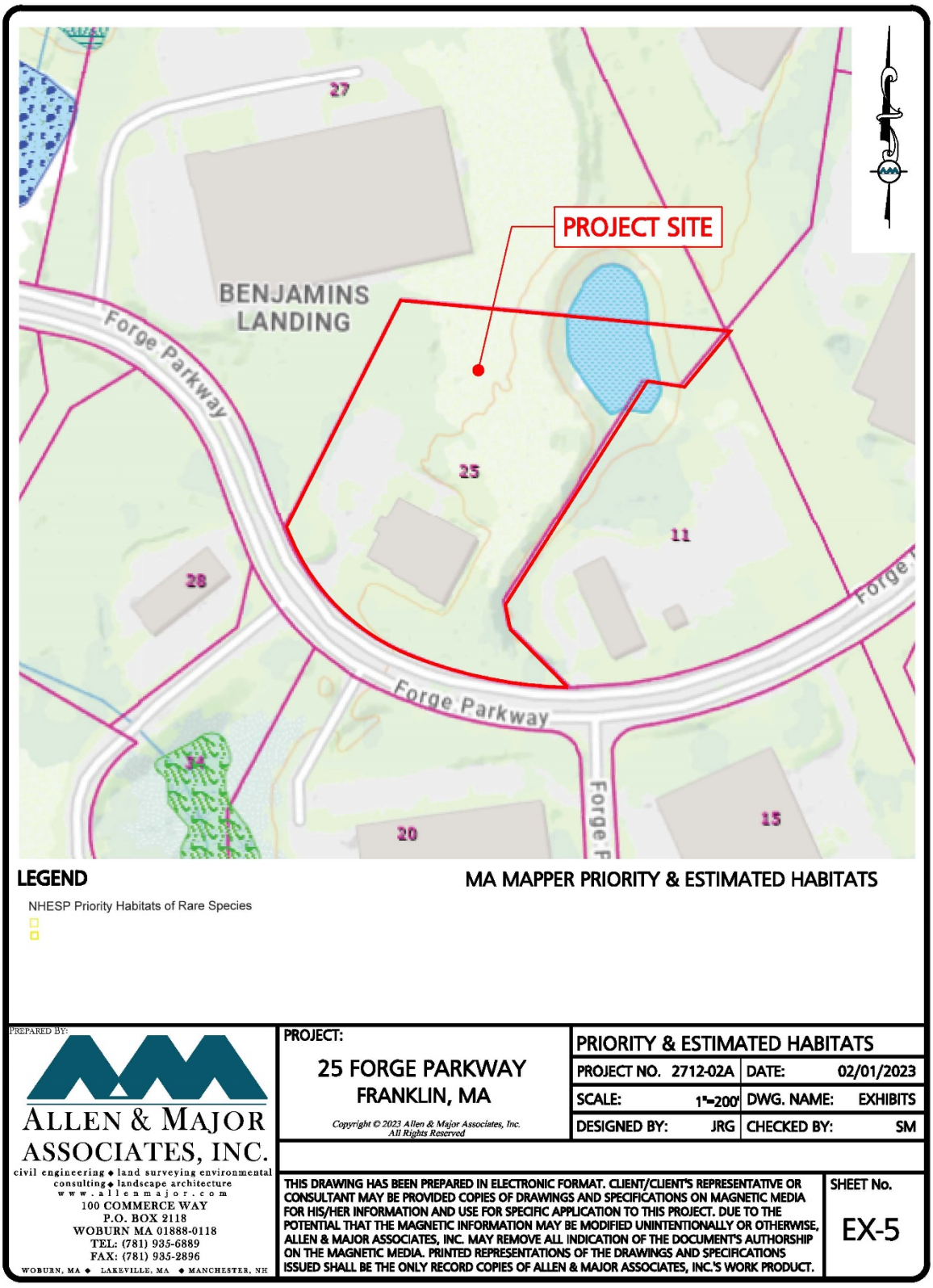
PROJECT:
25 FORGE PARKWAY
FRANKLIN, MA

FEMA FIRM MAP

PROJECT NO. 2712-02A		DATE:	02/01/2023
SCALE:	1"=250'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JRG	CHECKED BY:	SM

SHEET No.
EX-4

NHESP Map


PROJECT SITE
BENJAMINS LANDING
Forge Parkway
Forge Parkway
27
25
11
28
34
20
15
LEGEND
NHESP Priority Habitats of Rare Species
MA MAPPER PRIORITY & ESTIMATED HABITATS
PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH
PROJECT:
25 FORGE PARKWAY
FRANKLIN, MA
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PRIORITY & ESTIMATED HABITATS
PROJECT NO. 2712-02A
DATE: 02/01/2023
SCALE: 1"=200'
DWG. NAME: EXHIBITS
DESIGNED BY: JRG
CHECKED BY: SM
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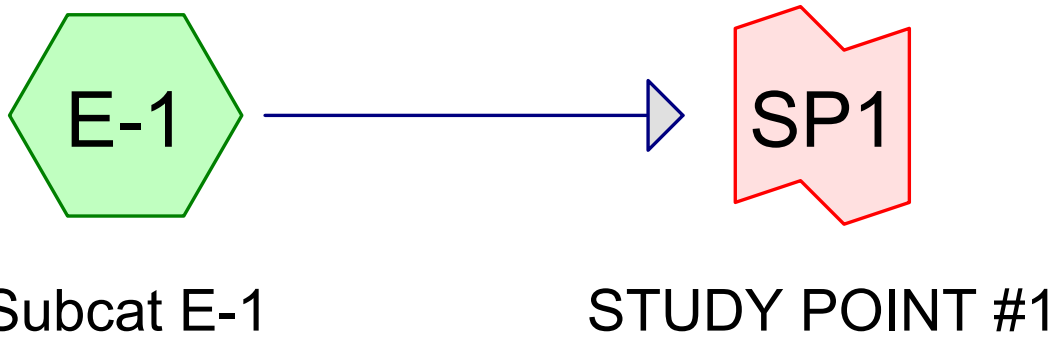
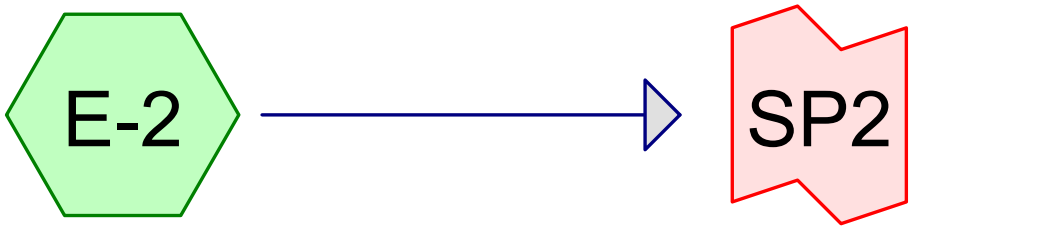
SHEET No.
EX-5

SECTION 4.0 -
EXISTING DRAINAGE ANALYSIS

Existing HydroCAD



Subcat E-1 STUDY POINT #1



Subcat E-2 STUDY POINT #2

Subcat Reach Pond Link

Routing Diagram for 2712-02A - Existing HydroCAD
Prepared by Allen & Major Associates, Inc, Printed 11/15/2023

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.27	2
2	10-year	Type III 24-hr		Default	24.00	1	4.90	2
3	25-year	Type III 24-hr		Default	24.00	1	6.17	2
4	100-year	Type III 24-hr		Default	24.00	1	8.78	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
5,794	39	>75% Grass cover, Good, HSG A (E-1, E-2)
23,228	74	>75% Grass cover, Good, HSG C (E-1, E-2)
19,493	80	>75% Grass cover, Good, HSG D (E-2)
18,333	98	Paved parking, HSG A (E-2)
1,695	98	Paved parking, HSG C (E-2)
8,572	98	Paved parking, HSG D (E-2)
6,241	98	Roofs, HSG C (E-2)
12,739	98	Roofs, HSG D (E-2)
64,294	30	Woods, Good, HSG A (E-1, E-2)
16,045	70	Woods, Good, HSG C (E-1, E-2)
33,410	77	Woods, Good, HSG D (E-1, E-2)
209,842	**66**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
88,421	HSG A	E-1, E-2
0	HSG B	
47,208	HSG C	E-1, E-2
74,213	HSG D	E-1, E-2
0	Other	
209,842		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
5,794	0	23,228	19,493	0	48,514	>75% Grass cover, Good	
18,333	0	1,695	8,572	0	28,599	Paved parking	
0	0	6,241	12,739	0	18,980	Roofs	
64,294	0	16,045	33,410	0	113,749	Woods, Good	
88,421	**0**	**47,208**	**74,213**	**0**	**209,842**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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 E-1: Subcat E-1 Runoff Area=90,058 sf 0.00% Impervious Runoff Depth=0.08"
Flow Length=497' Tc=29.0 min CN=47 Runoff=0.02 cfs 629 cf

Subcatchment E-2: Subcat E-2 Runoff Area=119,784 sf 39.72% Impervious Runoff Depth=1.46"
Flow Length=319' Tc=16.4 min CN=80 Runoff=3.39 cfs 14,533 cf

Link SP1: STUDY POINT #1 Inflow=0.02 cfs 629 cf
Primary=0.02 cfs 629 cf

Link SP2: STUDY POINT #2 Inflow=3.39 cfs 14,533 cf
Primary=3.39 cfs 14,533 cf

Total Runoff Area = 209,842 sf Runoff Volume = 15,162 cf Average Runoff Depth = 0.87"
77.33% Pervious = 162,263 sf 22.67% Impervious = 47,579 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 0.02 cfs @ 14.98 hrs, Volume= 629 cf, Depth= 0.08"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
2,041	39	>75% Grass cover, Good, HSG A
6	74	>75% Grass cover, Good, HSG C
55,993	30	Woods, Good, HSG A
3,372	70	Woods, Good, HSG C
28,646	77	Woods, Good, HSG D
90,058	47	Weighted Average
90,058		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.2	50	0.0064	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
9.8	447	0.0230	0.76		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
29.0	497	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 3.39 cfs @ 12.23 hrs, Volume= 14,533 cf, Depth= 1.46"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
3,753	39	>75% Grass cover, Good, HSG A
23,222	74	>75% Grass cover, Good, HSG C
19,493	80	>75% Grass cover, Good, HSG D
18,333	98	Paved parking, HSG A
1,695	98	Paved parking, HSG C
8,572	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
8,302	30	Woods, Good, HSG A
12,672	70	Woods, Good, HSG C
4,764	77	Woods, Good, HSG D
119,784	80	Weighted Average
72,205		60.28% Pervious Area
47,579		39.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.8	34	0.0220	0.74		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	235	0.0720	1.88		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.4	319	Total			

Summary for Link SP1: STUDY POINT #1

Inflow Area = 90,058 sf, 0.00% Impervious, Inflow Depth = 0.08" for 2-year event
Inflow = 0.02 cfs @ 14.98 hrs, Volume= 629 cf
Primary = 0.02 cfs @ 14.98 hrs, Volume= 629 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 119,784 sf, 39.72% Impervious, Inflow Depth = 1.46" for 2-year event
Inflow = 3.39 cfs @ 12.23 hrs, Volume= 14,533 cf
Primary = 3.39 cfs @ 12.23 hrs, Volume= 14,533 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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 E-1: Subcat E-1 Runoff Area=90,058 sf 0.00% Impervious Runoff Depth=0.50"
Flow Length=497' Tc=29.0 min CN=47 Runoff=0.39 cfs 3,771 cf

Subcatchment E-2: Subcat E-2 Runoff Area=119,784 sf 39.72% Impervious Runoff Depth=2.81"
Flow Length=319' Tc=16.4 min CN=80 Runoff=6.62 cfs 28,007 cf

Link SP1: STUDY POINT #1 Inflow=0.39 cfs 3,771 cf
Primary=0.39 cfs 3,771 cf

Link SP2: STUDY POINT #2 Inflow=6.62 cfs 28,007 cf
Primary=6.62 cfs 28,007 cf

Total Runoff Area = 209,842 sf Runoff Volume = 31,778 cf Average Runoff Depth = 1.82"
77.33% Pervious = 162,263 sf 22.67% Impervious = 47,579 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 0.39 cfs @ 12.60 hrs, Volume= 3,771 cf, Depth= 0.50"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
2,041	39	>75% Grass cover, Good, HSG A
6	74	>75% Grass cover, Good, HSG C
55,993	30	Woods, Good, HSG A
3,372	70	Woods, Good, HSG C
28,646	77	Woods, Good, HSG D
90,058	47	Weighted Average
90,058		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.2	50	0.0064	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
9.8	447	0.0230	0.76		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
29.0	497	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 6.62 cfs @ 12.23 hrs, Volume= 28,007 cf, Depth= 2.81"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
3,753	39	>75% Grass cover, Good, HSG A
23,222	74	>75% Grass cover, Good, HSG C
19,493	80	>75% Grass cover, Good, HSG D
18,333	98	Paved parking, HSG A
1,695	98	Paved parking, HSG C
8,572	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
8,302	30	Woods, Good, HSG A
12,672	70	Woods, Good, HSG C
4,764	77	Woods, Good, HSG D
119,784	80	Weighted Average
72,205		60.28% Pervious Area
47,579		39.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.8	34	0.0220	0.74		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	235	0.0720	1.88		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.4	319	Total			

Summary for Link SP1: STUDY POINT #1

Inflow Area = 90,058 sf, 0.00% Impervious, Inflow Depth = 0.50" for 10-year event
Inflow = 0.39 cfs @ 12.60 hrs, Volume= 3,771 cf
Primary = 0.39 cfs @ 12.60 hrs, Volume= 3,771 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 119,784 sf, 39.72% Impervious, Inflow Depth = 2.81" for 10-year event
Inflow = 6.62 cfs @ 12.23 hrs, Volume= 28,007 cf
Primary = 6.62 cfs @ 12.23 hrs, Volume= 28,007 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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 E-1: Subcat E-1 Runoff Area=90,058 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=497' Tc=29.0 min CN=47 Runoff=1.05 cfs 7,571 cf

Subcatchment E-2: Subcat E-2 Runoff Area=119,784 sf 39.72% Impervious Runoff Depth=3.93"
Flow Length=319' Tc=16.4 min CN=80 Runoff=9.25 cfs 39,279 cf

Link SP1: STUDY POINT #1 Inflow=1.05 cfs 7,571 cf
Primary=1.05 cfs 7,571 cf

Link SP2: STUDY POINT #2 Inflow=9.25 cfs 39,279 cf
Primary=9.25 cfs 39,279 cf

Total Runoff Area = 209,842 sf Runoff Volume = 46,850 cf Average Runoff Depth = 2.68"
77.33% Pervious = 162,263 sf 22.67% Impervious = 47,579 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 1.05 cfs @ 12.53 hrs, Volume= 7,571 cf, Depth= 1.01"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
2,041	39	>75% Grass cover, Good, HSG A
6	74	>75% Grass cover, Good, HSG C
55,993	30	Woods, Good, HSG A
3,372	70	Woods, Good, HSG C
28,646	77	Woods, Good, HSG D
90,058	47	Weighted Average
90,058		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.2	50	0.0064	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
9.8	447	0.0230	0.76		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
29.0	497	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 9.25 cfs @ 12.22 hrs, Volume= 39,279 cf, Depth= 3.93"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
3,753	39	>75% Grass cover, Good, HSG A
23,222	74	>75% Grass cover, Good, HSG C
19,493	80	>75% Grass cover, Good, HSG D
18,333	98	Paved parking, HSG A
1,695	98	Paved parking, HSG C
8,572	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
8,302	30	Woods, Good, HSG A
12,672	70	Woods, Good, HSG C
4,764	77	Woods, Good, HSG D
119,784	80	Weighted Average
72,205		60.28% Pervious Area
47,579		39.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.8	34	0.0220	0.74		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	235	0.0720	1.88		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.4	319	Total			

Summary for Link SP1: STUDY POINT #1

Inflow Area = 90,058 sf, 0.00% Impervious, Inflow Depth = 1.01" for 25-year event
Inflow = 1.05 cfs @ 12.53 hrs, Volume= 7,571 cf
Primary = 1.05 cfs @ 12.53 hrs, Volume= 7,571 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 119,784 sf, 39.72% Impervious, Inflow Depth = 3.93" for 25-year event
Inflow = 9.25 cfs @ 12.22 hrs, Volume= 39,279 cf
Primary = 9.25 cfs @ 12.22 hrs, Volume= 39,279 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 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 E-1: Subcat E-1 Runoff Area=90,058 sf 0.00% Impervious Runoff Depth=2.39"
Flow Length=497' Tc=29.0 min CN=47 Runoff=3.02 cfs 17,948 cf

Subcatchment E-2: Subcat E-2 Runoff Area=119,784 sf 39.72% Impervious Runoff Depth=6.36"
Flow Length=319' Tc=16.4 min CN=80 Runoff=14.75 cfs 63,483 cf

Link SP1: STUDY POINT #1 Inflow=3.02 cfs 17,948 cf
Primary=3.02 cfs 17,948 cf

Link SP2: STUDY POINT #2 Inflow=14.75 cfs 63,483 cf
Primary=14.75 cfs 63,483 cf

Total Runoff Area = 209,842 sf Runoff Volume = 81,431 cf Average Runoff Depth = 4.66"
77.33% Pervious = 162,263 sf 22.67% Impervious = 47,579 sf

Summary for Subcatchment E-1: Subcat E-1

Runoff = 3.02 cfs @ 12.47 hrs, Volume= 17,948 cf, Depth= 2.39"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
2,041	39	>75% Grass cover, Good, HSG A
6	74	>75% Grass cover, Good, HSG C
55,993	30	Woods, Good, HSG A
3,372	70	Woods, Good, HSG C
28,646	77	Woods, Good, HSG D
90,058	47	Weighted Average
90,058		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.2	50	0.0064	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
9.8	447	0.0230	0.76		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
29.0	497	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 14.75 cfs @ 12.22 hrs, Volume= 63,483 cf, Depth= 6.36"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
3,753	39	>75% Grass cover, Good, HSG A
23,222	74	>75% Grass cover, Good, HSG C
19,493	80	>75% Grass cover, Good, HSG D
18,333	98	Paved parking, HSG A
1,695	98	Paved parking, HSG C
8,572	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
8,302	30	Woods, Good, HSG A
12,672	70	Woods, Good, HSG C
4,764	77	Woods, Good, HSG D
119,784	80	Weighted Average
72,205		60.28% Pervious Area
47,579		39.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.8	34	0.0220	0.74		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
2.1	235	0.0720	1.88		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.4	319	Total			

Summary for Link SP1: STUDY POINT #1

Inflow Area = 90,058 sf, 0.00% Impervious, Inflow Depth = 2.39" for 100-year event
Inflow = 3.02 cfs @ 12.47 hrs, Volume= 17,948 cf
Primary = 3.02 cfs @ 12.47 hrs, Volume= 17,948 cf, Atten= 0%, Lag= 0.0 min

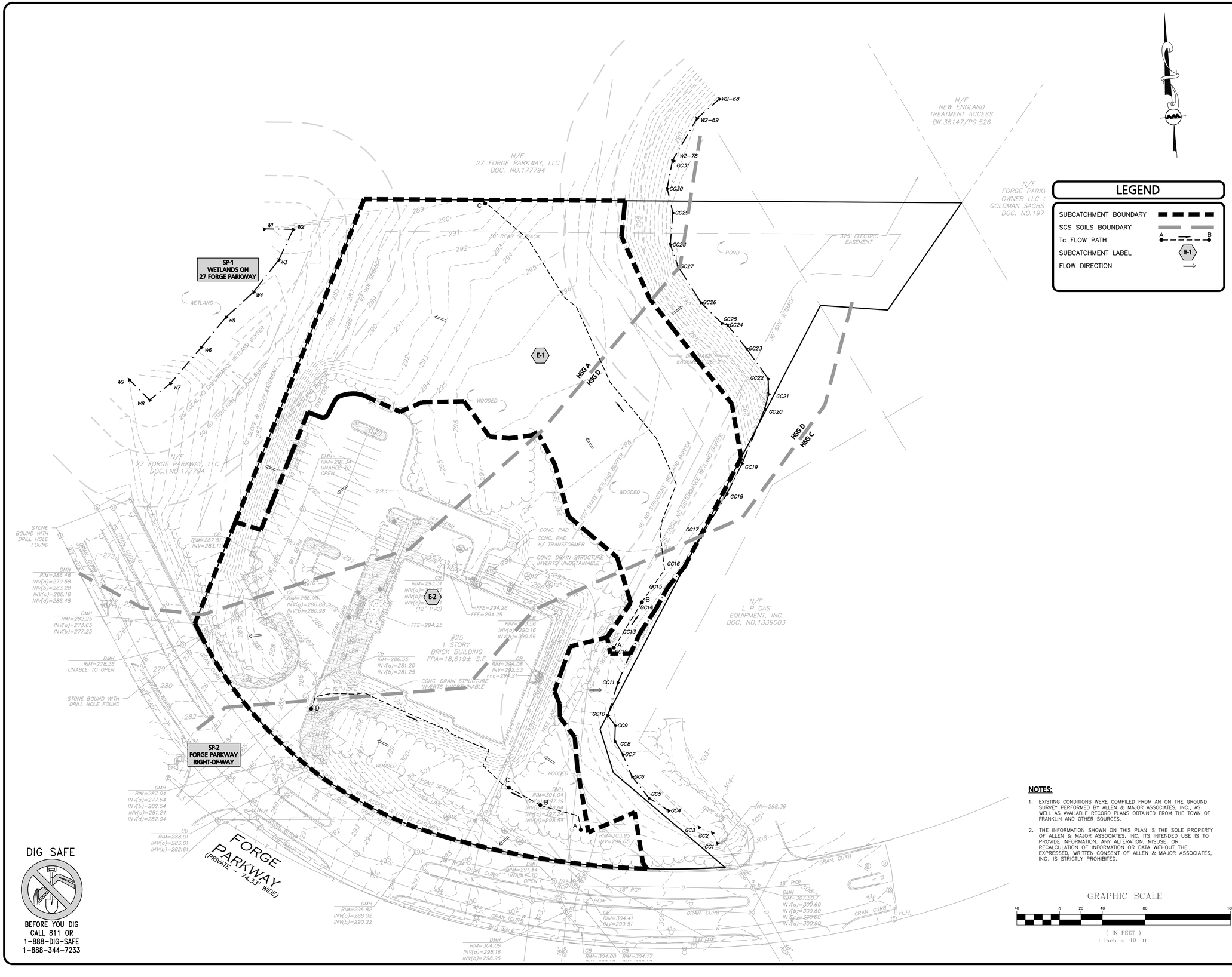
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 119,784 sf, 39.72% Impervious, Inflow Depth = 6.36" for 100-year event
Inflow = 14.75 cfs @ 12.22 hrs, Volume= 63,483 cf
Primary = 14.75 cfs @ 12.22 hrs, Volume= 63,483 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Existing Watershed Plan



LEGEND

- SUBCATCHMENT BOUNDARY
- SCS SOILS BOUNDARY
- Tc FLOW PATH (A → B)
- SUBCATCHMENT LABEL (E-1)
- FLOW DIRECTION

DIG SAFE

BEFORE YOU DIG
CALL 811 OR
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1-888-344-7233

NOTES:

1. EXISTING CONDITIONS WERE COMPILED FROM AN ON THE GROUND SURVEY PERFORMED BY ALLEN & MAJOR ASSOCIATES, INC., AS WELL AS AVAILABLE RECORD PLANS OBTAINED FROM THE TOWN OF FRANKLIN AND OTHER SOURCES.
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GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

TMC HOLDINGS & DEVELOPMENT 2, LLC
24 WILLIAM WAY
BELLINGHAM, MA 02019

PROJECT:

25 FORGE PARKWAY
FRANKLIN, MA

PROJECT NO.	2712-02A	DATE:	02-21-23
SCALE:	1" = 40'	DWG. NAME:	C-2712-02A
DESIGNED BY:	SM/JRG	CHECKED BY:	BDJ

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

DRAWING TITLE:

EXISTING WATERSHED PLAN

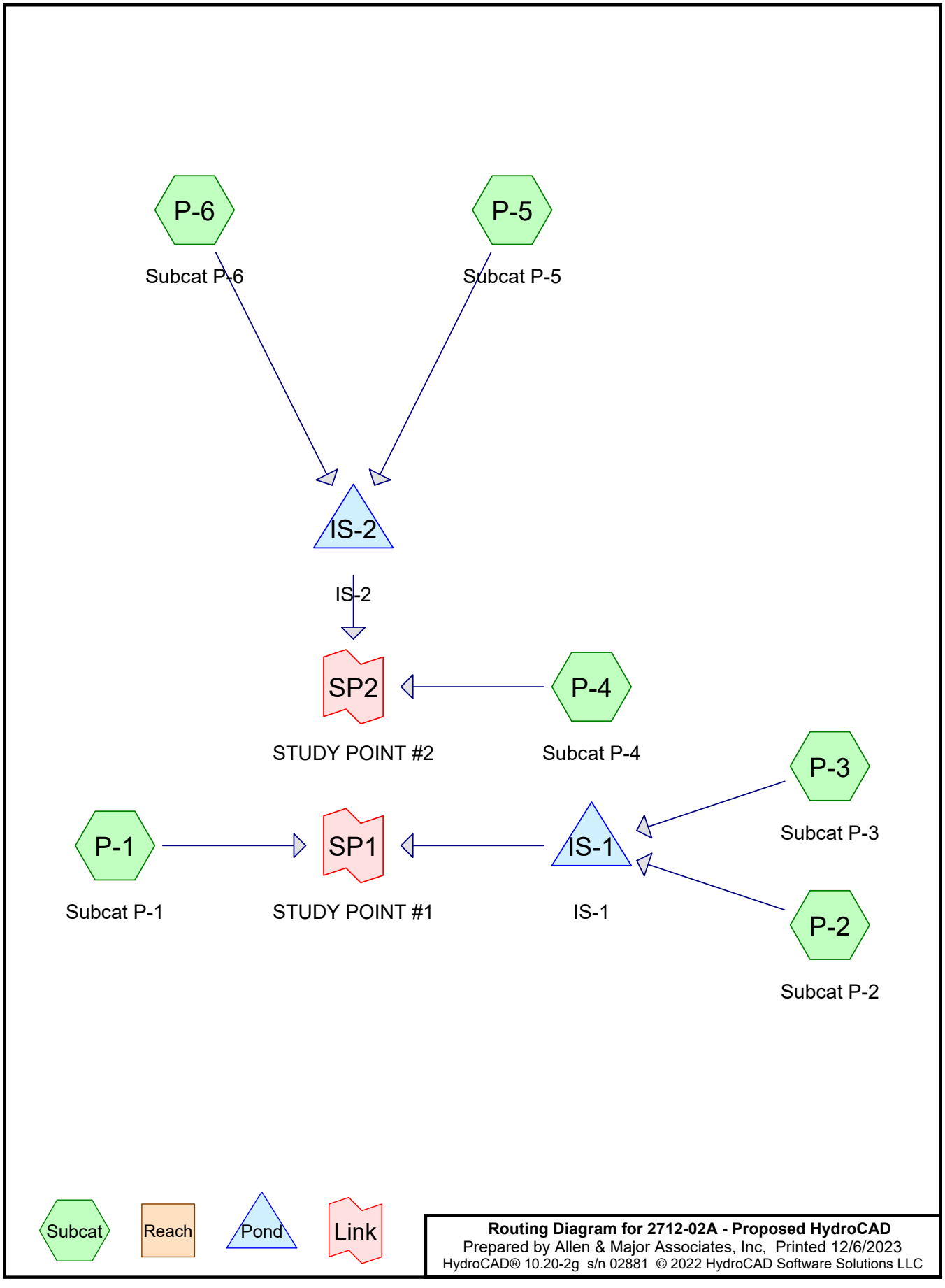
SHEET No.

WS-1

R:\PROJECTS\2712-02A\CIVIL\DRAWINGS\CURRENT\C-2712-02A_WATERSHED-EXISTING.DWG

SECTION 5.0 -
PROPOSED DRAINAGE ANALYSIS

Proposed HydroCAD


P-6
Subcat P-6
P-5
Subcat P-5
IS-2
IS-2
SP2
STUDY POINT #2
P-4
Subcat P-4
P-3
Subcat P-3
P-1
Subcat P-1
SP1
STUDY POINT #1
IS-1
IS-1
P-2
Subcat P-2
Subcat
Reach
Pond
Link

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type III 24-hr		Default	24.00	1	3.27	2
2	10-year	Type III 24-hr		Default	24.00	1	4.90	2
3	25-year	Type III 24-hr		Default	24.00	1	6.17	2
4	100-year	Type III 24-hr		Default	24.00	1	8.78	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
12,063	39	>75% Grass cover, Good, HSG A (P-1, P-2, P-4)
19,491	74	>75% Grass cover, Good, HSG C (P-2, P-4, P-5, P-6)
11,654	80	>75% Grass cover, Good, HSG D (P-2, P-4, P-6)
50,656	98	Paved parking, HSG A (P-1, P-2, P-4)
11,321	98	Paved parking, HSG C (P-4, P-5, P-6)
19,075	98	Paved parking, HSG D (P-2, P-4, P-6)
7,362	98	Roofs, HSG C (P-3, P-4, P-5)
27,617	98	Roofs, HSG D (P-2, P-3, P-4)
25,702	30	Woods, Good, HSG A (P-1, P-2, P-4)
9,033	70	Woods, Good, HSG C (P-2, P-4, P-5)
15,866	77	Woods, Good, HSG D (P-1, P-2, P-4)
209,842	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
88,421	HSG A	P-1, P-2, P-4
0	HSG B	
47,208	HSG C	P-2, P-3, P-4, P-5, P-6
74,213	HSG D	P-1, P-2, P-3, P-4, P-6
0	Other	
209,842		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
12,063	0	19,491	11,654	0	43,209	>75% Grass cover, Good	
50,656	0	11,321	19,075	0	81,053	Paved parking	
0	0	7,362	27,617	0	34,980	Roofs	
25,702	0	9,033	15,866	0	50,601	Woods, Good	
88,421	**0**	**47,208**	**74,213**	**0**	**209,842**	**TOTAL AREA**	

Summary for Subcatchment P-1: Subcat P-1

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
8,284	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
23,588	30	Woods, Good, HSG A
202	77	Woods, Good, HSG D
32,075	33	Weighted Average
32,075		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	50	0.0273	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.28"
5.3	160	0.0410	0.51		**Shallow Concentrated Flow, B-C** Forest w/Heavy Litter Kv= 2.5 fps
24.0	210	Total			

Summary for Subcatchment P-2: Subcat P-2

Runoff = 4.34 cfs @ 12.09 hrs, Volume= 13,601 cf, Depth= 2.23"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
1,790	39	>75% Grass cover, Good, HSG A
1,630	74	>75% Grass cover, Good, HSG C
4,928	80	>75% Grass cover, Good, HSG D
36,683	98	Paved parking, HSG A
11,507	98	Paved parking, HSG D
0	98	Roofs, HSG D
33	30	Woods, Good, HSG A
3,561	70	Woods, Good, HSG C
12,943	77	Woods, Good, HSG D
73,075	90	Weighted Average
24,885		34.05% Pervious Area
48,190		65.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR 55 min.**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 1.17 cfs @ 12.08 hrs, Volume= 4,050 cf, Depth= 3.04"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
1,122	98	Roofs, HSG C
14,878	98	Roofs, HSG D
16,000	98	Weighted Average
16,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 2.79 cfs @ 12.19 hrs, Volume= 11,145 cf, Depth= 2.06"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
1,989	39	>75% Grass cover, Good, HSG A
7,801	74	>75% Grass cover, Good, HSG C
6,538	80	>75% Grass cover, Good, HSG D
13,973	98	Paved parking, HSG A
1,746	98	Paved parking, HSG C
7,469	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
2,080	30	Woods, Good, HSG A
1,626	70	Woods, Good, HSG C
2,720	77	Woods, Good, HSG D
64,923	88	Weighted Average
22,755		35.05% Pervious Area
42,168		64.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	32	0.0250	1.11		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
14.0	82	Total			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.67 cfs @ 12.20 hrs, Volume= 2,708 cf, Depth= 1.59"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
9,129	74	>75% Grass cover, Good, HSG C
7,407	98	Paved parking, HSG C
0	98	Roofs, HSG C
3,846	70	Woods, Good, HSG C
20,382	82	Weighted Average
12,975		63.66% Pervious Area
7,407		36.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	50	0.0160	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.3	51	0.1800	2.97		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.7	147	0.0270	3.34		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
14.3	248	Total			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 630 cf, Depth= 2.23"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.27"

Area (sf)	CN	Description
931	74	>75% Grass cover, Good, HSG C
188	80	>75% Grass cover, Good, HSG D
2,168	98	Paved parking, HSG C
100	98	Paved parking, HSG D
3,387	90	Weighted Average
1,119		33.04% Pervious Area
2,268		66.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Pond IS-1: IS-1

Test Pits 1, 2, and 4 indicate loamy sand to a depth of 9.2' below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 89,075 sf, 72.06% Impervious, Inflow Depth = 2.38" for 2-year event
Inflow = 5.51 cfs @ 12.09 hrs, Volume= 17,651 cf
Outflow = 0.43 cfs @ 11.45 hrs, Volume= 17,651 cf, Atten= 92%, Lag= 0.0 min
Discarded = 0.43 cfs @ 11.45 hrs, Volume= 17,651 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link SP1 : STUDY POINT #1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 286.25' @ 13.22 hrs Surf.Area= 7,672 sf Storage= 7,073 cf
Flood Elev= 290.75' Surf.Area= 7,672 sf Storage= 27,142 cf

Plug-Flow detention time= 136.6 min calculated for 17,648 cf (100% of inflow)
Center-of-Mass det. time= 136.6 min (931.2 - 794.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	284.75'	12,592 cf	**117.92'W x 65.06'L x 6.00'H Field A** 46,030 cf Overall - 14,551 cf Embedded = 31,479 cf x 40.0% Voids
#2A	285.50'	14,551 cf	**ADS_StormTech MC-3500 d +Cap** x 128 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 128 Chambers in 16 Rows Cap Storage= 14.9 cf x 2 x 16 rows = 476.8 cf
		27,142 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	284.75'	**0.43 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	286.50'	**8.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 286.50' / 286.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	289.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.43 cfs @ 11.45 hrs HW=284.81' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=284.75' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond IS-2: IS-2

Test Pit 7 indicates loamy sand to a depth of 90" below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 23,769 sf, 40.70% Impervious, Inflow Depth = 1.69" for 2-year event
Inflow = 0.79 cfs @ 12.18 hrs, Volume= 3,339 cf
Outflow = 0.74 cfs @ 12.24 hrs, Volume= 3,339 cf, Atten= 7%, Lag= 3.8 min
Discarded = 0.03 cfs @ 10.86 hrs, Volume= 1,980 cf
Primary = 0.71 cfs @ 12.24 hrs, Volume= 1,359 cf
Routed to Link SP2 : STUDY POINT #2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 283.54' @ 12.24 hrs Surf.Area= 512 sf Storage= 759 cf
Flood Elev= 284.75' Surf.Area= 512 sf Storage= 1,048 cf

Plug-Flow detention time= 159.8 min calculated for 3,339 cf (100% of inflow)
Center-of-Mass det. time= 159.8 min (995.8 - 835.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	281.25'	496 cf	**20.50'W x 24.98'L x 3.50'H Field A** 1,792 cf Overall - 551 cf Embedded = 1,241 cf x 40.0% Voids
#2A	281.75'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 4 Rows
		1,048 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	281.25'	**0.03 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	281.75'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 281.75' / 281.55' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	283.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.5' Crest Height
#4	Device 3	282.08'	**10.0" Round Culvert** L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 282.08' / 282.00' S= 0.0400 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.03 cfs @ 10.86 hrs HW=281.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.70 cfs @ 12.24 hrs HW=283.54' (Free Discharge)
└**2=Culvert** (Passes 0.70 cfs of 4.30 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.70 cfs @ 1.24 fps)
└**4=Culvert** (Passes 0.70 cfs of 0.99 cfs potential flow)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 121,150 sf, 52.98% Impervious, Inflow Depth = 0.00" for 2-year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 88,692 sf, 58.45% Impervious, Inflow Depth = 1.69" for 2-year event
Inflow = 3.37 cfs @ 12.23 hrs, Volume= 12,504 cf
Primary = 3.37 cfs @ 12.23 hrs, Volume= 12,504 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.00 cfs @ 17.47 hrs, Volume= 89 cf, Depth= 0.03"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
8,284	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
23,588	30	Woods, Good, HSG A
202	77	Woods, Good, HSG D
32,075	33	Weighted Average
32,075		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	50	0.0273	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.28"
5.3	160	0.0410	0.51		**Shallow Concentrated Flow, B-C** Forest w/Heavy Litter Kv= 2.5 fps
24.0	210	Total			

Summary for Subcatchment P-2: Subcat P-2

Runoff = 7.18 cfs @ 12.09 hrs, Volume= 23,018 cf, Depth= 3.78"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
1,790	39	>75% Grass cover, Good, HSG A
1,630	74	>75% Grass cover, Good, HSG C
4,928	80	>75% Grass cover, Good, HSG D
36,683	98	Paved parking, HSG A
11,507	98	Paved parking, HSG D
0	98	Roofs, HSG D
33	30	Woods, Good, HSG A
3,561	70	Woods, Good, HSG C
12,943	77	Woods, Good, HSG D
73,075	90	Weighted Average
24,885		34.05% Pervious Area
48,190		65.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR 55 min.**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 1.76 cfs @ 12.08 hrs, Volume= 6,218 cf, Depth= 4.66"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
1,122	98	Roofs, HSG C
14,878	98	Roofs, HSG D
16,000	98	Weighted Average
16,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 4.77 cfs @ 12.18 hrs, Volume= 19,336 cf, Depth= 3.57"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
1,989	39	>75% Grass cover, Good, HSG A
7,801	74	>75% Grass cover, Good, HSG C
6,538	80	>75% Grass cover, Good, HSG D
13,973	98	Paved parking, HSG A
1,746	98	Paved parking, HSG C
7,469	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
2,080	30	Woods, Good, HSG A
1,626	70	Woods, Good, HSG C
2,720	77	Woods, Good, HSG D
64,923	88	Weighted Average
22,755		35.05% Pervious Area
42,168		64.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	32	0.0250	1.11		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
14.0	82	Total			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 1.26 cfs @ 12.19 hrs, Volume= 5,078 cf, Depth= 2.99"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
9,129	74	>75% Grass cover, Good, HSG C
7,407	98	Paved parking, HSG C
0	98	Roofs, HSG C
3,846	70	Woods, Good, HSG C
20,382	82	Weighted Average
12,975		63.66% Pervious Area
7,407		36.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	50	0.0160	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.3	51	0.1800	2.97		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.7	147	0.0270	3.34		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
14.3	248	Total			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.33 cfs @ 12.09 hrs, Volume= 1,067 cf, Depth= 3.78"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=4.90"

Area (sf)	CN	Description
931	74	>75% Grass cover, Good, HSG C
188	80	>75% Grass cover, Good, HSG D
2,168	98	Paved parking, HSG C
100	98	Paved parking, HSG D
3,387	90	Weighted Average
1,119		33.04% Pervious Area
2,268		66.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Pond IS-1: IS-1

Test Pits 1, 2, and 4 indicate loamy sand to a depth of 9.2' below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 89,075 sf, 72.06% Impervious, Inflow Depth = 3.94" for 10-year event
Inflow = 8.94 cfs @ 12.08 hrs, Volume= 29,236 cf
Outflow = 0.43 cfs @ 10.63 hrs, Volume= 29,236 cf, Atten= 95%, Lag= 0.0 min
Discarded = 0.43 cfs @ 10.63 hrs, Volume= 29,236 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link SP1 : STUDY POINT #1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 287.43' @ 14.49 hrs Surf.Area= 7,672 sf Storage= 14,075 cf
Flood Elev= 290.75' Surf.Area= 7,672 sf Storage= 27,142 cf

Plug-Flow detention time= 291.8 min calculated for 29,232 cf (100% of inflow)
Center-of-Mass det. time= 291.8 min (1,074.0 - 782.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	284.75'	12,592 cf	**117.92'W x 65.06'L x 6.00'H Field A** 46,030 cf Overall - 14,551 cf Embedded = 31,479 cf x 40.0% Voids
#2A	285.50'	14,551 cf	**ADS_StormTech MC-3500 d +Cap** x 128 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 128 Chambers in 16 Rows Cap Storage= 14.9 cf x 2 x 16 rows = 476.8 cf
		27,142 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	284.75'	**0.43 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	286.50'	**8.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 286.50' / 286.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	289.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.43 cfs @ 10.63 hrs HW=284.81' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=284.75' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond IS-2: IS-2

Test Pit 7 indicates loamy sand to a depth of 90" below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 23,769 sf, 40.70% Impervious, Inflow Depth = 3.10" for 10-year event
Inflow = 1.47 cfs @ 12.18 hrs, Volume= 6,145 cf
Outflow = 1.44 cfs @ 12.21 hrs, Volume= 6,145 cf, Atten= 2%, Lag= 1.8 min
Discarded = 0.03 cfs @ 9.47 hrs, Volume= 2,363 cf
Primary = 1.41 cfs @ 12.21 hrs, Volume= 3,782 cf
Routed to Link SP2 : STUDY POINT #2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 283.69' @ 12.21 hrs Surf.Area= 512 sf Storage= 804 cf
Flood Elev= 284.75' Surf.Area= 512 sf Storage= 1,048 cf

Plug-Flow detention time= 108.7 min calculated for 6,144 cf (100% of inflow)
Center-of-Mass det. time= 108.7 min (927.7 - 819.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	281.25'	496 cf	**20.50'W x 24.98'L x 3.50'H Field A** 1,792 cf Overall - 551 cf Embedded = 1,241 cf x 40.0% Voids
#2A	281.75'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 4 Rows
		1,048 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	281.25'	**0.03 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	281.75'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 281.75' / 281.55' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	283.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.5' Crest Height
#4	Device 3	282.08'	**10.0" Round Culvert** L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 282.08' / 282.00' S= 0.0400 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.03 cfs @ 9.47 hrs HW=281.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.41 cfs @ 12.21 hrs HW=283.69' (Free Discharge)
└**2=Culvert** (Passes 1.41 cfs of 4.54 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Passes 1.41 cfs of 2.03 cfs potential flow)
└**4=Culvert** (Inlet Controls 1.41 cfs @ 2.59 fps)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 121,150 sf, 52.98% Impervious, Inflow Depth = 0.01" for 10-year event
Inflow = 0.00 cfs @ 17.47 hrs, Volume= 89 cf
Primary = 0.00 cfs @ 17.47 hrs, Volume= 89 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 88,692 sf, 58.45% Impervious, Inflow Depth = 3.13" for 10-year event
Inflow = 6.17 cfs @ 12.19 hrs, Volume= 23,118 cf
Primary = 6.17 cfs @ 12.19 hrs, Volume= 23,118 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.02 cfs @ 14.00 hrs, Volume= 531 cf, Depth= 0.20"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
8,284	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
23,588	30	Woods, Good, HSG A
202	77	Woods, Good, HSG D
32,075	33	Weighted Average
32,075		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	50	0.0273	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.28"
5.3	160	0.0410	0.51		**Shallow Concentrated Flow, B-C** Forest w/Heavy Litter Kv= 2.5 fps
24.0	210	Total			

Summary for Subcatchment P-2: Subcat P-2

Runoff = 9.38 cfs @ 12.08 hrs, Volume= 30,518 cf, Depth= 5.01"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
1,790	39	>75% Grass cover, Good, HSG A
1,630	74	>75% Grass cover, Good, HSG C
4,928	80	>75% Grass cover, Good, HSG D
36,683	98	Paved parking, HSG A
11,507	98	Paved parking, HSG D
0	98	Roofs, HSG D
33	30	Woods, Good, HSG A
3,561	70	Woods, Good, HSG C
12,943	77	Woods, Good, HSG D
73,075	90	Weighted Average
24,885		34.05% Pervious Area
48,190		65.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR 55 min.**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 2.22 cfs @ 12.08 hrs, Volume= 7,909 cf, Depth= 5.93"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
1,122	98	Roofs, HSG C
14,878	98	Roofs, HSG D
16,000	98	Weighted Average
16,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 6.31 cfs @ 12.18 hrs, Volume= 25,914 cf, Depth= 4.79"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
1,989	39	>75% Grass cover, Good, HSG A
7,801	74	>75% Grass cover, Good, HSG C
6,538	80	>75% Grass cover, Good, HSG D
13,973	98	Paved parking, HSG A
1,746	98	Paved parking, HSG C
7,469	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
2,080	30	Woods, Good, HSG A
1,626	70	Woods, Good, HSG C
2,720	77	Woods, Good, HSG D
64,923	88	Weighted Average
22,755		35.05% Pervious Area
42,168		64.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	32	0.0250	1.11		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
14.0	82	Total			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 1.74 cfs @ 12.19 hrs, Volume= 7,038 cf, Depth= 4.14"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
9,129	74	>75% Grass cover, Good, HSG C
7,407	98	Paved parking, HSG C
0	98	Roofs, HSG C
3,846	70	Woods, Good, HSG C
20,382	82	Weighted Average
12,975		63.66% Pervious Area
7,407		36.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	50	0.0160	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.3	51	0.1800	2.97		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.7	147	0.0270	3.34		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
14.3	248	Total			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.43 cfs @ 12.08 hrs, Volume= 1,415 cf, Depth= 5.01"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.17"

Area (sf)	CN	Description
931	74	>75% Grass cover, Good, HSG C
188	80	>75% Grass cover, Good, HSG D
2,168	98	Paved parking, HSG C
100	98	Paved parking, HSG D
3,387	90	Weighted Average
1,119		33.04% Pervious Area
2,268		66.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Pond IS-1: IS-1

Test Pits 1, 2, and 4 indicate loamy sand to a depth of 9.2' below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 89,075 sf, 72.06% Impervious, Inflow Depth = 5.18" for 25-year event
Inflow = 11.60 cfs @ 12.08 hrs, Volume= 38,427 cf
Outflow = 0.43 cfs @ 9.95 hrs, Volume= 38,427 cf, Atten= 96%, Lag= 0.0 min
Discarded = 0.43 cfs @ 9.95 hrs, Volume= 38,427 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link SP1 : STUDY POINT #1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 288.67' @ 15.33 hrs Surf.Area= 7,672 sf Storage= 20,473 cf
Flood Elev= 290.75' Surf.Area= 7,672 sf Storage= 27,142 cf

Plug-Flow detention time= 425.8 min calculated for 38,422 cf (100% of inflow)
Center-of-Mass det. time= 425.8 min (1,201.6 - 775.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	284.75'	12,592 cf	**117.92'W x 65.06'L x 6.00'H Field A** 46,030 cf Overall - 14,551 cf Embedded = 31,479 cf x 40.0% Voids
#2A	285.50'	14,551 cf	**ADS_StormTech MC-3500 d +Cap** x 128 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 128 Chambers in 16 Rows Cap Storage= 14.9 cf x 2 x 16 rows = 476.8 cf
		27,142 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	284.75'	**0.43 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	286.50'	**8.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 286.50' / 286.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	289.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.43 cfs @ 9.95 hrs HW=284.81' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=284.75' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)
↑**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond IS-2: IS-2

Test Pit 7 indicates loamy sand to a depth of 90" below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 23,769 sf, 40.70% Impervious, Inflow Depth = 4.27" for 25-year event
Inflow = 2.01 cfs @ 12.18 hrs, Volume= 8,453 cf
Outflow = 1.95 cfs @ 12.21 hrs, Volume= 8,453 cf, Atten= 3%, Lag= 2.2 min
Discarded = 0.03 cfs @ 8.66 hrs, Volume= 2,515 cf
Primary = 1.92 cfs @ 12.21 hrs, Volume= 5,938 cf
Routed to Link SP2 : STUDY POINT #2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 283.94' @ 12.21 hrs Surf.Area= 512 sf Storage= 874 cf
Flood Elev= 284.75' Surf.Area= 512 sf Storage= 1,048 cf

Plug-Flow detention time= 85.3 min calculated for 8,453 cf (100% of inflow)
Center-of-Mass det. time= 85.3 min (895.6 - 810.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	281.25'	496 cf	**20.50'W x 24.98'L x 3.50'H Field A** 1,792 cf Overall - 551 cf Embedded = 1,241 cf x 40.0% Voids
#2A	281.75'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 4 Rows
		1,048 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	281.25'	**0.03 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	281.75'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 281.75' / 281.55' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	283.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.5' Crest Height
#4	Device 3	282.08'	**10.0" Round Culvert** L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 282.08' / 282.00' S= 0.0400 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.03 cfs @ 8.66 hrs HW=281.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.92 cfs @ 12.21 hrs HW=283.94' (Free Discharge)
└**2=Culvert** (Passes 1.92 cfs of 4.91 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Passes 1.92 cfs of 5.11 cfs potential flow)
└**4=Culvert** (Inlet Controls 1.92 cfs @ 3.52 fps)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 121,150 sf, 52.98% Impervious, Inflow Depth = 0.05" for 25-year event
Inflow = 0.02 cfs @ 14.00 hrs, Volume= 531 cf
Primary = 0.02 cfs @ 14.00 hrs, Volume= 531 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 88,692 sf, 58.45% Impervious, Inflow Depth = 4.31" for 25-year event
Inflow = 8.20 cfs @ 12.19 hrs, Volume= 31,851 cf
Primary = 8.20 cfs @ 12.19 hrs, Volume= 31,851 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P-1: Subcat P-1

Runoff = 0.26 cfs @ 12.55 hrs, Volume= 2,379 cf, Depth= 0.89"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
8,284	39	>75% Grass cover, Good, HSG A
0	98	Paved parking, HSG A
23,588	30	Woods, Good, HSG A
202	77	Woods, Good, HSG D
32,075	33	Weighted Average
32,075		100.00% Pervious Area
0		0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	50	0.0273	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.28"
5.3	160	0.0410	0.51		**Shallow Concentrated Flow, B-C** Forest w/Heavy Litter Kv= 2.5 fps
24.0	210	Total			

Summary for Subcatchment P-2: Subcat P-2

Runoff = 13.84 cfs @ 12.08 hrs, Volume= 46,125 cf, Depth= 7.57"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,790	39	>75% Grass cover, Good, HSG A
1,630	74	>75% Grass cover, Good, HSG C
4,928	80	>75% Grass cover, Good, HSG D
36,683	98	Paved parking, HSG A
11,507	98	Paved parking, HSG D
0	98	Roofs, HSG D
33	30	Woods, Good, HSG A
3,561	70	Woods, Good, HSG C
12,943	77	Woods, Good, HSG D
73,075	90	Weighted Average
24,885		34.05% Pervious Area
48,190		65.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR 55 min.**

Summary for Subcatchment P-3: Subcat P-3

Runoff = 3.17 cfs @ 12.08 hrs, Volume= 11,386 cf, Depth= 8.54"
Routed to Pond IS-1 : IS-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,122	98	Roofs, HSG C
14,878	98	Roofs, HSG D
16,000	98	Weighted Average
16,000		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 9.45 cfs @ 12.18 hrs, Volume= 39,668 cf, Depth= 7.33"
Routed to Link SP2 : STUDY POINT #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
1,989	39	>75% Grass cover, Good, HSG A
7,801	74	>75% Grass cover, Good, HSG C
6,538	80	>75% Grass cover, Good, HSG D
13,973	98	Paved parking, HSG A
1,746	98	Paved parking, HSG C
7,469	98	Paved parking, HSG D
6,241	98	Roofs, HSG C
12,739	98	Roofs, HSG D
2,080	30	Woods, Good, HSG A
1,626	70	Woods, Good, HSG C
2,720	77	Woods, Good, HSG D
64,923	88	Weighted Average
22,755		35.05% Pervious Area
42,168		64.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	50	0.0154	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.5	32	0.0250	1.11		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
14.0	82	Total			

Summary for Subcatchment P-5: Subcat P-5

Runoff = 2.73 cfs @ 12.19 hrs, Volume= 11,215 cf, Depth= 6.60"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
9,129	74	>75% Grass cover, Good, HSG C
7,407	98	Paved parking, HSG C
0	98	Roofs, HSG C
3,846	70	Woods, Good, HSG C
20,382	82	Weighted Average
12,975		63.66% Pervious Area
7,407		36.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	50	0.0160	0.06		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
0.3	51	0.1800	2.97		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.7	147	0.0270	3.34		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
14.3	248	Total			

Summary for Subcatchment P-6: Subcat P-6

Runoff = 0.64 cfs @ 12.08 hrs, Volume= 2,138 cf, Depth= 7.57"
Routed to Pond IS-2 : IS-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.78"

Area (sf)	CN	Description
931	74	>75% Grass cover, Good, HSG C
188	80	>75% Grass cover, Good, HSG D
2,168	98	Paved parking, HSG C
100	98	Paved parking, HSG D
3,387	90	Weighted Average
1,119		33.04% Pervious Area
2,268		66.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Pond IS-1: IS-1

Test Pits 1, 2, and 4 indicate loamy sand to a depth of 9.2' below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 89,075 sf, 72.06% Impervious, Inflow Depth = 7.75" for 100-year event
Inflow = 17.01 cfs @ 12.08 hrs, Volume= 57,511 cf
Outflow = 2.92 cfs @ 12.54 hrs, Volume= 57,511 cf, Atten= 83%, Lag= 27.5 min
Discarded = 0.43 cfs @ 8.72 hrs, Volume= 45,766 cf
Primary = 2.49 cfs @ 12.54 hrs, Volume= 11,745 cf
Routed to Link SP1 : STUDY POINT #1

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 290.36' @ 12.54 hrs Surf.Area= 7,672 sf Storage= 25,955 cf
Flood Elev= 290.75' Surf.Area= 7,672 sf Storage= 27,142 cf

Plug-Flow detention time= 400.0 min calculated for 57,503 cf (100% of inflow)
Center-of-Mass det. time= 400.1 min (1,166.7 - 766.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	284.75'	12,592 cf	**117.92'W x 65.06'L x 6.00'H Field A** 46,030 cf Overall - 14,551 cf Embedded = 31,479 cf x 40.0% Voids
#2A	285.50'	14,551 cf	**ADS_StormTech MC-3500 d +Cap** x 128 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 128 Chambers in 16 Rows Cap Storage= 14.9 cf x 2 x 16 rows = 476.8 cf
		27,142 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	284.75'	**0.43 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	286.50'	**8.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 286.50' / 286.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#3	Device 2	289.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.43 cfs @ 8.72 hrs HW=284.81' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.43 cfs)

Primary OutFlow Max=2.49 cfs @ 12.54 hrs HW=290.36' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.49 cfs @ 7.14 fps)
└**3=Sharp-Crested Rectangular Weir** (Passes 2.49 cfs of 10.03 cfs potential flow)

Summary for Pond IS-2: IS-2

Test Pit 7 indicates loamy sand to a depth of 90" below grade with no refusal and no ESHWT encountered. The infiltration rate for loamy sand is 2.41 inches per hour (Rawls Rates)

Inflow Area = 23,769 sf, 40.70% Impervious, Inflow Depth = 6.74" for 100-year event
Inflow = 3.12 cfs @ 12.17 hrs, Volume= 13,353 cf
Outflow = 3.01 cfs @ 12.22 hrs, Volume= 13,353 cf, Atten= 4%, Lag= 2.6 min
Discarded = 0.03 cfs @ 7.23 hrs, Volume= 2,688 cf
Primary = 2.98 cfs @ 12.22 hrs, Volume= 10,665 cf
Routed to Link SP2 : STUDY POINT #2

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 284.69' @ 12.22 hrs Surf.Area= 512 sf Storage= 1,035 cf
Flood Elev= 284.75' Surf.Area= 512 sf Storage= 1,048 cf

Plug-Flow detention time= 58.8 min calculated for 13,352 cf (100% of inflow)
Center-of-Mass det. time= 58.8 min (856.6 - 797.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	281.25'	496 cf	**20.50'W x 24.98'L x 3.50'H Field A** 1,792 cf Overall - 551 cf Embedded = 1,241 cf x 40.0% Voids
#2A	281.75'	551 cf	**ADS_StormTech SC-740 +Cap** x 12 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 12 Chambers in 4 Rows
		1,048 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	281.25'	**0.03 cfs Exfiltration at all elevations** Phase-In= 0.01'
#2	Primary	281.75'	**12.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 281.75' / 281.55' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	283.40'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.5' Crest Height
#4	Device 3	282.08'	**10.0" Round Culvert** L= 2.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 282.08' / 282.00' S= 0.0400 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.55 sf

Discarded OutFlow Max=0.03 cfs @ 7.23 hrs HW=281.29' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.98 cfs @ 12.22 hrs HW=284.69' (Free Discharge)
└**2=Culvert** (Passes 2.98 cfs of 5.90 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Passes 2.98 cfs of 19.00 cfs potential flow)
└**4=Culvert** (Inlet Controls 2.98 cfs @ 5.46 fps)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 121,150 sf, 52.98% Impervious, Inflow Depth = 1.40" for 100-year event
Inflow = 2.75 cfs @ 12.54 hrs, Volume= 14,124 cf
Primary = 2.75 cfs @ 12.54 hrs, Volume= 14,124 cf, Atten= 0%, Lag= 0.0 min

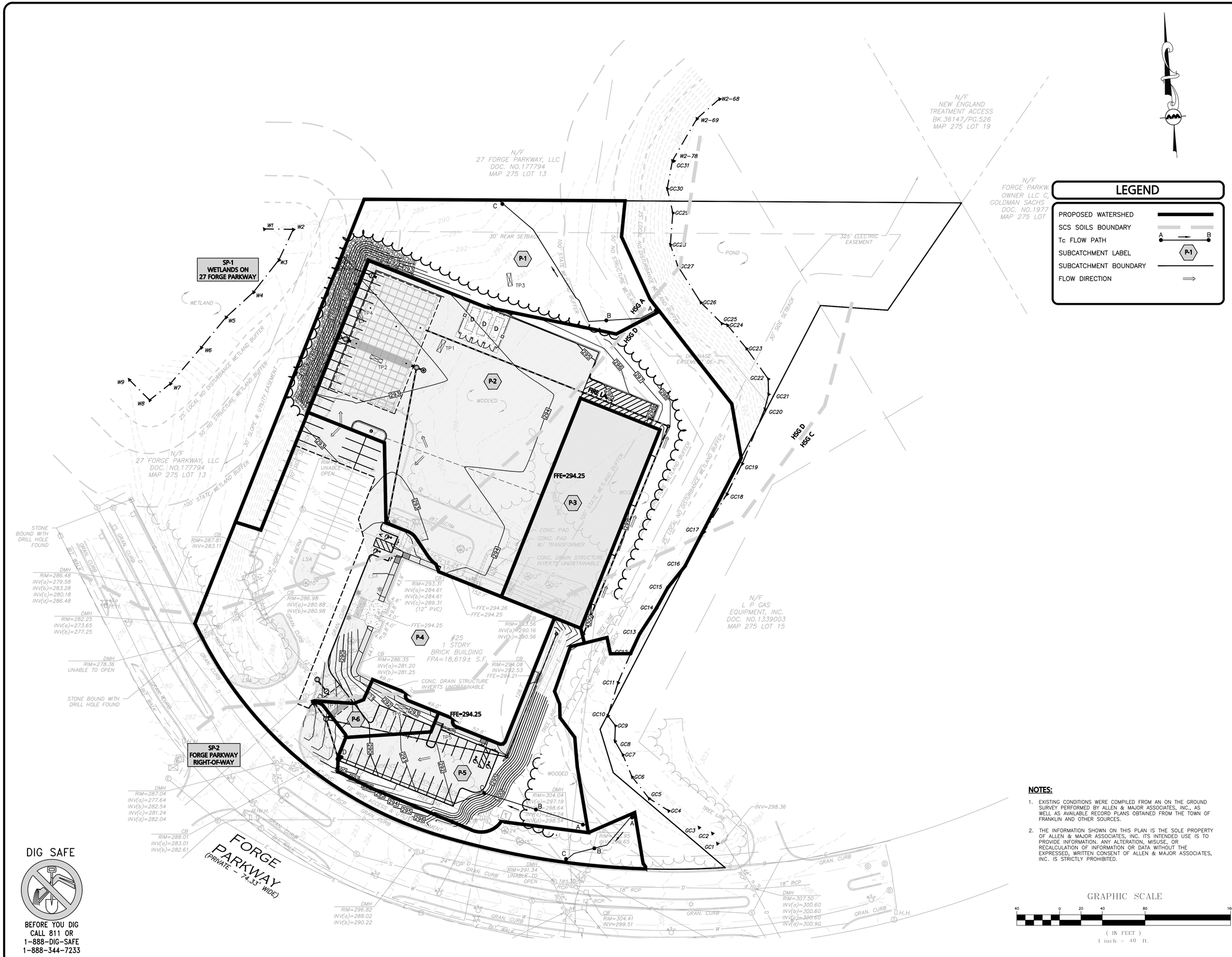
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 88,692 sf, 58.45% Impervious, Inflow Depth = 6.81" for 100-year event
Inflow = 12.37 cfs @ 12.19 hrs, Volume= 50,333 cf
Primary = 12.37 cfs @ 12.19 hrs, Volume= 50,333 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Proposed Watershed Plan



LEGEND

- PROPOSED WATERSHED
- SCS SOILS BOUNDARY
- Tc FLOW PATH (A → B)
- SUBCATCHMENT LABEL (P-1)
- SUBCATCHMENT BOUNDARY
- FLOW DIRECTION

NOTES:

1. EXISTING CONDITIONS WERE COMPILED FROM AN ON THE GROUND SURVEY PERFORMED BY ALLEN & MAJOR ASSOCIATES, INC., AS WELL AS AVAILABLE RECORD PLANS OBTAINED FROM THE TOWN OF FRANKLIN AND OTHER SOURCES.
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GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

REV	DATE	DESCRIPTION

APPLICANT\OWNER:

TMC HOLDINGS & DEVELOPMENT 2, LLC
24 WILLIAM WAY
BELLINGHAM, MA 02019

PROJECT:

25 FORGE PARKWAY
FRANKLIN, MA

PROJECT NO.	2712-02A	DATE:	02-21-23
SCALE:	1" = 40'	DWG. NAME:	C-2712-02A
DESIGNED BY:	SM/JRG	CHECKED BY:	BDJ

PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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DRAWING TITLE:

PROPOSED WATERSHED PLAN

SHEET No.

WS-2

R:\PROJECTS\2712-02A\CIVIL\DRAWINGS\CURRENT\C-2712-02A_WATERSHED-PROPOSED.DWG

SECTION 6.0 -
APPENDIX

Illicit Discharge Compliance Statement

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME: TMC Holdings & Development 2, LLC

ADDRESS: 25 Forge Parkway

Franklin, MA 02038

TEL. NUMBER: (774) 295-4201

Owner Signature

Matthew Clark – President

4/3/2023

Date

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.

Rainfall Data

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.439 degrees West
Latitude	42.084 degrees North
Elevation	0 feet
Date/Time	Mon, 30 Jan 2023 14:01:08 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.45	0.56	0.73	0.91	1.15	**1yr**	0.79	1.08	1.33	1.69	2.14	2.74	3.01	**1yr**	2.42	2.89	3.33	4.03	4.67	**1yr**
2yr	0.36	0.55	0.68	0.90	1.13	1.43	**2yr**	0.98	1.31	1.65	2.07	2.60	3.27	3.59	**2yr**	2.89	3.45	3.96	4.72	5.34	**2yr**
5yr	0.42	0.66	0.83	1.11	1.42	1.80	**5yr**	1.22	1.63	2.09	2.63	3.29	4.11	4.58	**5yr**	3.64	4.40	5.04	5.96	6.63	**5yr**
10yr	0.48	0.75	0.95	1.29	1.68	2.16	**10yr**	1.45	1.93	2.51	3.16	3.94	4.90	5.50	**10yr**	4.33	5.29	6.05	7.11	7.82	**10yr**
25yr	0.56	0.90	1.15	1.59	2.11	2.74	**25yr**	1.82	2.41	3.20	4.02	5.00	6.17	7.02	**25yr**	5.46	6.75	7.71	8.99	9.72	**25yr**
50yr	0.65	1.04	1.33	1.86	2.51	3.28	**50yr**	2.17	2.84	3.84	4.82	5.99	7.36	8.45	**50yr**	6.51	8.13	9.26	10.74	11.46	**50yr**
100yr	0.74	1.20	1.54	2.19	2.99	3.92	**100yr**	2.58	3.36	4.60	5.79	7.17	8.78	10.17	**100yr**	7.77	9.78	11.13	12.83	13.51	**100yr**
200yr	0.86	1.39	1.81	2.58	3.56	4.69	**200yr**	3.07	3.98	5.51	6.94	8.58	10.48	12.25	**200yr**	9.28	11.78	13.39	15.34	15.95	**200yr**
500yr	1.03	1.69	2.21	3.21	4.49	5.97	**500yr**	3.88	4.98	7.03	8.84	10.90	13.26	15.68	**500yr**	11.74	15.08	17.10	19.43	19.85	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.46	0.61	0.75	0.91	**1yr**	0.65	0.89	1.09	1.41	1.85	2.45	2.69	**1yr**	2.17	2.59	2.97	3.34	4.21	**1yr**
2yr	0.34	0.53	0.65	0.88	1.09	1.29	**2yr**	0.94	1.26	1.48	1.94	2.49	3.16	3.47	**2yr**	2.80	3.34	3.83	4.56	5.18	**2yr**
5yr	0.39	0.60	0.74	1.02	1.30	1.54	**5yr**	1.12	1.51	1.75	2.30	2.90	3.79	4.21	**5yr**	3.35	4.05	4.66	5.50	6.16	**5yr**
10yr	0.43	0.66	0.82	1.15	1.48	1.76	**10yr**	1.28	1.72	1.99	2.60	3.26	4.33	4.88	**10yr**	3.83	4.70	5.42	6.34	7.02	**10yr**
25yr	0.50	0.76	0.94	1.34	1.77	2.08	**25yr**	1.52	2.03	2.35	3.07	3.80	5.19	5.93	**25yr**	4.59	5.70	6.57	7.64	8.37	**25yr**
50yr	0.55	0.83	1.04	1.49	2.01	2.36	**50yr**	1.73	2.31	2.67	3.48	4.28	5.94	6.88	**50yr**	5.26	6.62	7.62	8.82	9.57	**50yr**
100yr	0.61	0.92	1.15	1.67	2.28	2.68	**100yr**	1.97	2.62	3.03	3.95	4.82	6.81	8.00	**100yr**	6.03	7.69	8.83	10.19	10.96	**100yr**
200yr	0.67	1.01	1.29	1.86	2.60	3.06	**200yr**	2.24	2.99	3.44	4.49	5.43	7.83	9.28	**200yr**	6.93	8.93	10.24	11.78	12.56	**200yr**
500yr	0.77	1.15	1.48	2.15	3.06	3.63	**500yr**	2.64	3.55	4.07	5.34	6.37	9.42	11.37	**500yr**	8.33	10.94	12.43	14.31	15.08	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.50	0.61	0.82	1.01	1.22	**1yr**	0.87	1.19	1.39	1.80	2.33	2.96	3.23	**1yr**	2.62	3.11	3.77	4.40	5.07	**1yr**
2yr	0.37	0.57	0.71	0.96	1.18	1.39	**2yr**	1.02	1.36	1.59	2.08	2.65	3.40	3.75	**2yr**	3.01	3.60	4.10	4.90	5.53	**2yr**
5yr	0.46	0.71	0.89	1.22	1.55	1.81	**5yr**	1.34	1.77	2.07	2.68	3.37	4.49	4.97	**5yr**	3.97	4.78	5.42	6.49	7.17	**5yr**
10yr	0.56	0.85	1.06	1.48	1.91	2.22	**10yr**	1.65	2.17	2.53	3.25	4.04	5.53	6.18	**10yr**	4.90	5.95	6.73	8.04	8.73	**10yr**
25yr	0.71	1.08	1.35	1.93	2.53	2.92	**25yr**	2.19	2.86	3.29	4.17	5.14	7.31	8.24	**25yr**	6.47	7.93	8.94	10.65	11.30	**25yr**
50yr	0.86	1.30	1.62	2.33	3.14	3.59	**50yr**	2.71	3.51	4.03	5.04	6.16	9.03	10.25	**50yr**	7.99	9.86	11.09	13.19	13.74	**50yr**
100yr	1.04	1.57	1.97	2.84	3.90	4.42	**100yr**	3.36	4.32	4.93	6.10	7.40	11.16	12.73	**100yr**	9.88	12.24	13.74	16.32	16.70	**100yr**
200yr	1.26	1.89	2.40	3.47	4.84	5.44	**200yr**	4.18	5.32	6.05	7.39	8.87	13.78	15.81	**200yr**	12.19	15.20	17.02	20.17	20.30	**200yr**
500yr	1.64	2.44	3.13	4.55	6.48	7.15	**500yr**	5.59	6.99	7.91	9.52	11.29	18.20	21.06	**500yr**	16.11	20.25	22.64	26.68	26.24	**500yr**

Powered by ACIS Northeast Regional Climate Center

Manning's Number Tables

Manning's Roughness Coefficients ("n")

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe	
Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic)	
Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgtn.)	
Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay	
Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels	
Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged	
Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.

Soils Map

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts

January 30, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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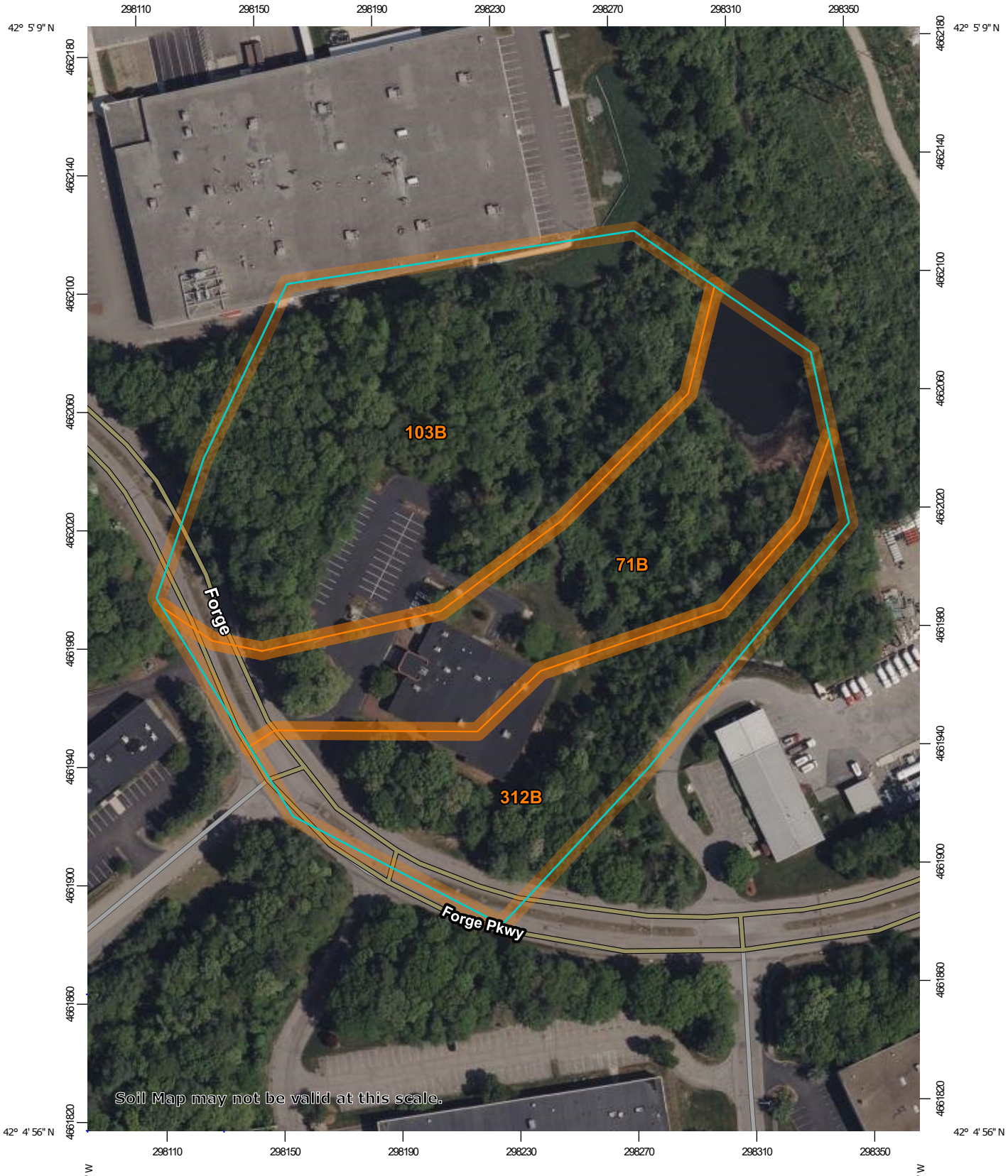
Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,820 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 18, 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: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	2.7	29.8%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	4.2	46.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	2.1	23.4%
Totals for Area of Interest		**9.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Norfolk and Suffolk Counties, Massachusetts

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony
Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony
Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony
Percent of map unit: 2 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: vktd
Elevation: 0 to 480 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Charlton and similar soils: 40 percent
Hollis and similar soils: 25 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope

Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Canton

Percent of map unit: 7 percent
Hydric soil rating: No

Chatfield

Percent of map unit: 5 percent
Hydric soil rating: No

Scituate

Percent of map unit: 2 percent
Hydric soil rating: No

Whitman

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

312B—Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2t2qs
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Woodbridge, extremely stony, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Extremely Stony

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 9 inches: fine sandy loam
Bw1 - 9 to 20 inches: fine sandy loam
Bw2 - 20 to 32 inches: fine sandy loam
Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, extremely stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 8 percent
Landform: Hills, drainageways, drumlins, depressions, ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

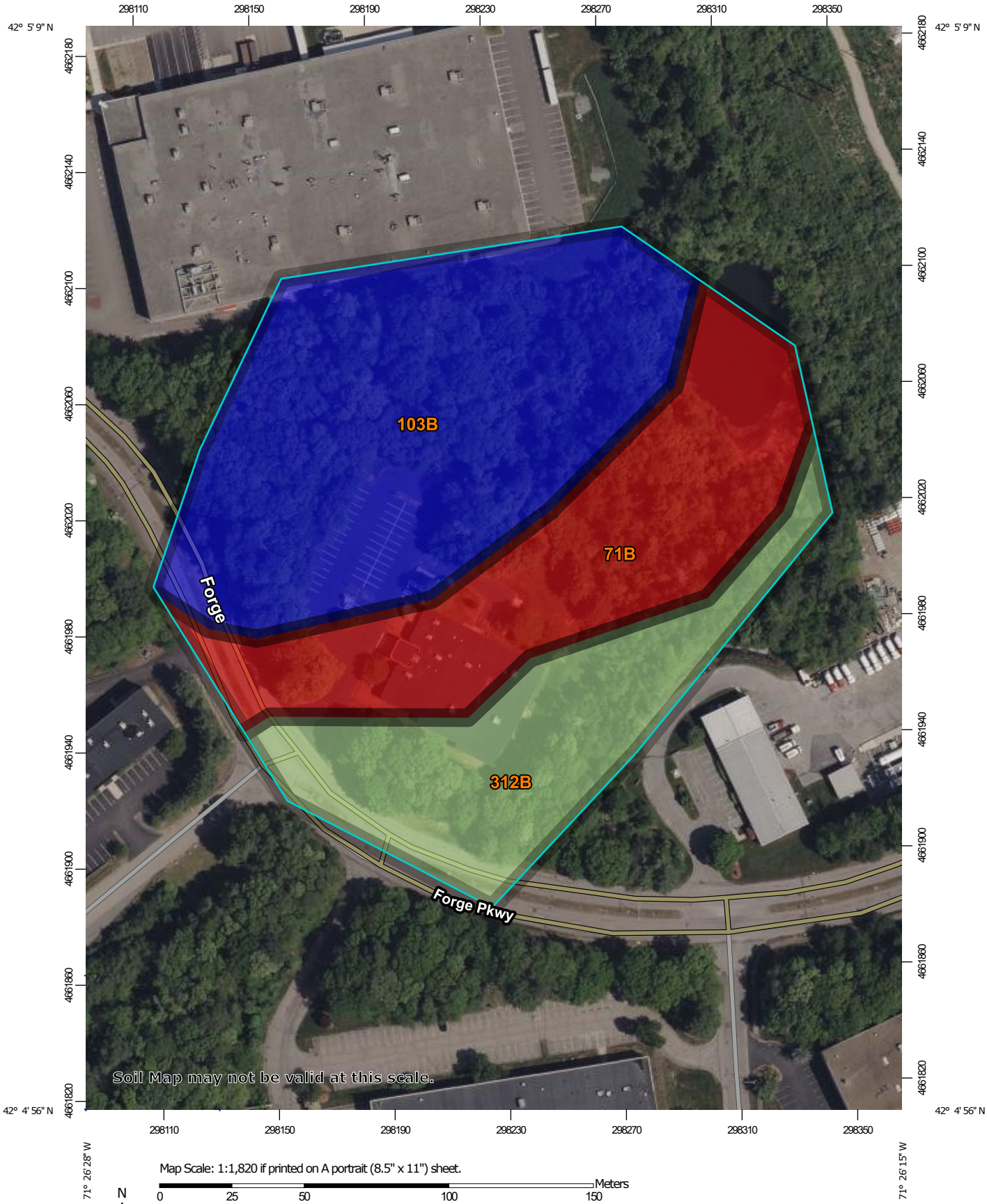
Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Map—Saturated Hydraulic Conductivity (Ksat)



Map Scale: 1:1,820 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 7.6281

> 7.6281 and <= 12.6190

> 12.6190 and <= 23.2900

Not rated or not available

Soil Rating Lines

<= 7.6281

> 7.6281 and <= 12.6190

> 12.6190 and <= 23.2900

Not rated or not available

Soil Rating Points

<= 7.6281

> 7.6281 and <= 12.6190

> 12.6190 and <= 23.2900

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 18, 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: May 22, 2022—Jun 5, 2022

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.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	7.6281	2.7	29.8%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	23.2900	4.2	46.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	12.6190	2.1	23.4%
Totals for Area of Interest			**9.1**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 100

Units of Measure: Centimeters

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

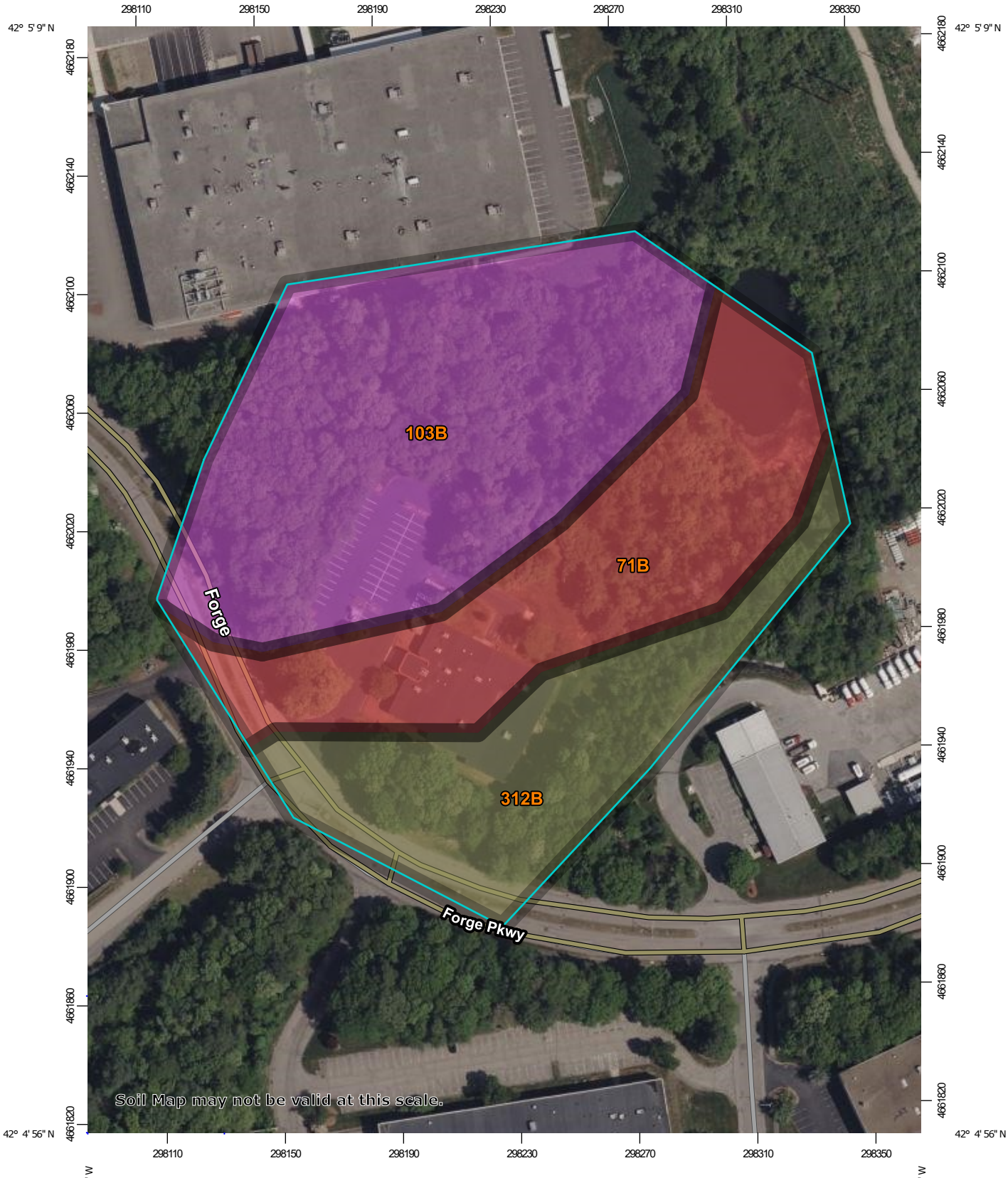
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:1,820 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil 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

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Hydrologic Soil Group

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	2.7	29.8%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	4.2	46.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	2.1	23.4%
Totals for Area of Interest			**9.1**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table—Available Water Capacity

Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	0.09	0.8	5.7%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.12	4.2	29.7%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	0.13	4.0	28.6%
302B	Montauk fine sandy loam, 0 to 8 percent slopes, extremely stony	0.12	0.0	0.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	0.11	4.9	35.3%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	0.10	0.1	0.8%
Totals for Area of Interest			**14.0**	**100.0%**

Rating Options—Available Water Capacity

Units of Measure: centimeters per centimeter

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 100

Units of Measure: Inches

Form 11 Test Pit Logs

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

TMC Holdings & Development 2, LLC
Owner Name

25 Forge Parkway
Street Address

Map 275 / Lot 14
Map/Lot #

Franklin
City

MA
State

02038
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: USDA NRCS (Source) 103B (Soil Map Unit)

Charlton-Hollis-Rock outcrop complex
Soil Name

None
Soil Limitations

Friable loamy, ablation till from igneous rock
Soil Parent material

Hill
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: (Year Published/Source) (Map Unit)

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): February (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: Topographic survey performed by Allen & Major Associates, June 2021

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP1 (Hole #) | 02-10-23 (Date) | 9:00 a.m. (Time) | clear, 50 deg. (Weather) | 42.084624± (Latitude) | -71.439649± (Longitude:)

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5% (Slope (%))

Description of Location:

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 235± feet | Property Line 11± feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8"	A	Loamy Sand	10YR 3/4						Massive Friable	Dry	
8-24"	Bw	Loamy Sand	10YR 5/8						Massive Friable	Dry	
24-66"	C	Loamy Sand	2.5Y 6/4						Massive Friable	Dry	Large boulder at the bottom of the excavation

Additional Notes:

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP2 (Hole #) | 02-10-23 (Date) | 10:00 a.m. (Time) | clear, 50 deg. (Weather) | 42.084600± (Latitude) | -71.439813± (Longitude:)

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5% (Slope (%))

Description of Location: See Site Plan

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 125± feet
Property Line 62± feet | Drinking Water Well >200 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8"	A	Loamy Sand	10YR 3/4						Massive Friable	Dry	
8-28"	Bw	Loamy Sand	10YR 5/8						Massive Friable	Dry	
28-108"	C	Loamy Sand	2.5Y 6/4						Massive Friable	Dry	Several boulders encountered

Additional Notes:

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole # TP1	Obs. Hole # TP2
☒ Depth observed standing water in observation hole	None inches	None inches
☒ Depth weeping from side of observation hole	None inches	None inches
☒ Depth to soil redoximorphic features (mottles)	None inches	None inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: None encountered inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	28 inches	Lower boundary:	108 inches
c. If no, at what depth was impervious material observed?	Upper boundary:	_____ inches	Lower boundary:	_____ inches

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	02-10-23 Date
Brian D. Jones, P.E., S.E. #2731 Typed or Printed Name of Soil Evaluator / License #	06-30-2025 Expiration Date of License
None - performed for stormwater management (not septic) Name of Approving Authority Witness	 Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

TMC Holdings & Development 2, LLC
Owner Name

25 Forge Parkway
Street Address

Map 275 / Lot 14
Map/Lot #

Franklin
City

MA
State

02038
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: USDA NRCS (Source) 103B (Soil Map Unit)

Charlton-Hollis-Rock outcrop complex
Soil Name

None
Soil Limitations

Friable loamy, ablation till from igneous rock
Soil Parent material

Hill
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: (Year Published/Source) (Map Unit)

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): February (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: Topographic survey performed by Allen & Major Associates, June 2021

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP3 (Hole #) | 02-10-23 (Date) | 11:00 a.m. (Time) | clear, 50 deg. (Weather) | 42.084670± (Latitude) | -71.439277± (Longitude:

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5% (Slope (%))

Description of Location:

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 151± feet | Property Line 70± feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-36"	HTM	Loamy Sand	10YR 4/4						Massive Friable	Dry	
36-60"	C1	Loamy Sand	2.5Y 6/4						Massive Friable	Dry	
60-100"	C2	Sandy Loam	10YR 5/6						Massive Firm	Dry	

Additional Notes:
HTM: Human Transported Material

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP4 (Hole #) | 10-13-23 (Date) | 8:30 a.m. (Time) | clear, 60 deg. (Weather) | 42.084670± (Latitude) | -71.439277± (Longitude:)

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5% (Slope (%))

Description of Location: _____

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 93± feet
Property Line 40± feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-8"	A	Loamy Sand	10YR 3/4						Massive Friable	Dry	
8-24"	Bw	Loamy Sand	10YR 5/8						Massive Friable	Dry	
24-110"	C	Loamy Sand	2.5YR 6/4						Massive Friable	Dry	

Additional Notes: _____

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole # TP3	Obs. Hole # TP4
☒ Depth observed standing water in observation hole	None inches	None inches
☒ Depth weeping from side of observation hole	None inches	None inches
☒ Depth to soil redoximorphic features (mottles)	None inches	None inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: None encountered inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	24 inches	Lower boundary:	110 inches
c. If no, at what depth was impervious material observed?	Upper boundary:	_____ inches	Lower boundary:	_____ inches

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	10-13-23 Date
Brian D. Jones, P.E., S.E. #2731 Typed or Printed Name of Soil Evaluator / License #	06-30-2025 Expiration Date of License
None - performed for stormwater management (not septic) Name of Approving Authority Witness	 Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

TMC Holdings & Development 2, LLC
Owner Name

25 Forge Parkway
Street Address

Map 275 / Lot 14
Map/Lot #

Franklin
City

MA
State

02038
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: USDA NRCS (Source) 312B (Soil Map Unit)

Woodbridge fine sandy loam
Soil Name

None
Soil Limitations

Friable loamy, ablation till from igneous rock
Soil Parent material

Hill
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: (Year Published/Source) (Map Unit)

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): October (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: Topographic survey performed by Allen & Major Associates, June 2021

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP5 (Hole #) | 10-13-2023 (Date) | 9:00 a.m. (Time) | clear, 60 deg. (Weather) | 42.084624± (Latitude) | -71.439649± (Longitude:

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 50% (Slope (%))

Description of Location:

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 415± feet | Property Line 97± feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18"	HTM	Loamy Sand	7.5YR 3/4						Massive Friable	Dry	Topsoil
18-98"	C	Loamy Sand	2.5YR 6/3						Massive Friable	Dry	5% cobbles, larger boulder at the bottom

Additional Notes:
HTM: Human Transported Material

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP6 (Hole #) | 10-13-23 (Date) | 9:30 a.m. (Time) | clear, 60 deg. (Weather) | 42.084600± (Latitude) | -71.439813± (Longitude:)

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 25% (Slope (%))

Description of Location: See Site Plan

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 370± feet
Property Line 95± feet | Drinking Water Well >200 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18"	HTM	Loamy Sand	7.5YR 3/3						Massive Friable	Dry	Topsoil
18-98"	C	Loamy Sand	2.5YR 6/3						Massive Friable	Dry	5% cobbles

Additional Notes:
HTM: Human Transported Material

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:	Obs. Hole # TP5	Obs. Hole # TP6
☒ Depth observed standing water in observation hole	None inches	None inches
☒ Depth weeping from side of observation hole	None inches	None inches
☒ Depth to soil redoximorphic features (mottles)	86 inches	90 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: None encountered inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	18 inches	Lower boundary:	98 inches
c. If no, at what depth was impervious material observed?	Upper boundary:	_____ inches	Lower boundary:	_____ inches

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	10-13-23 Date
Brian D. Jones, P.E., S.E. #2731 Typed or Printed Name of Soil Evaluator / License #	06-30-2025 Expiration Date of License
None - performed for stormwater management (not septic) Name of Approving Authority Witness	 Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

TMC Holdings & Development 2, LLC
Owner Name

25 Forge Parkway
Street Address

Map 275 / Lot 14
Map/Lot #

Franklin
City

MA
State

02038
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: USDA NRCS (Source) 312B (Soil Map Unit)

Woodbridge fine sandy loam
Soil Name

None
Soil Limitations

Friable loamy, ablation till from igneous rock
Soil Parent material

Hill
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: (Year Published/Source) (Map Unit)

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: N/A (Wetland Type)

7. Current Water Resource Conditions (USGS): October (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed: Topographic survey performed by Allen & Major Associates, June 2021

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP7 (Hole #) | 10-13-2023 (Date) | 10:00 a.m. (Time) | clear, 60 deg. (Weather) | 42.084624± (Latitude) | -71.439649± (Longitude:

1. Land Use: Commercial Property (e.g., woodland, agricultural field, vacant lot, etc.) | Wooded (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 30% (Slope (%))

Description of Location:

2. Soil Parent Material: Friable loamy, ablation till from igneous rock | Hill (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >100 feet | Wetlands 320± feet | Property Line 60± feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: None Depth Weeping from Pit | None Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18"	HTM	Loamy Sand	7.5YR 3/4						Massive Friable	Dry	Topsoil
18-90"	C	Loamy Sand	2.5YR 6/3						Massive Friable	Dry	5% cobbles

Additional Notes:
HTM: Human Transported Material

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: _____ Hole # _____ Date _____ Time _____ Weather _____ Latitude _____ Longitude:

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

Description of Location: _____

2. Soil Parent Material: _____ _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes: _____

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # TP7	Obs. Hole # _____
☒ Depth observed standing water in observation hole	None inches	_____ inches
☒ Depth weeping from side of observation hole	None inches	_____ inches
☒ Depth to soil redoximorphic features (mottles)	90 inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: None encountered inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)?	Upper boundary:	18 inches	Lower boundary:	90 inches
c. If no, at what depth was impervious material observed?	Upper boundary:	_____ inches	Lower boundary:	_____ inches

Commonwealth of Massachusetts
City/Town of Franklin

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	10-13-23 Date
Brian D. Jones, P.E., S.E. #2731 Typed or Printed Name of Soil Evaluator / License #	06-30-2025 Expiration Date of License
None - performed for stormwater management (not septic) Name of Approving Authority Witness	 Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

MA Groundwater Recharge Calculation

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2712-02A	**Sheet**	1 of 1
Project Description	25 Forge Parkway		
	Franklin, MA		
Calculated By	SM	**Date**	11/22/23
Checked By	BDJ	**Date**	11/22/23

Standard # 3: Groundwater Recharge

Proposed recharge system: Stormtech MC-3500 Chamber Infitration System

In accordance with *MADEP – Volume 2, Technical Guide for Compliance with Massachusetts Stormwater Management Standards, dated January 2008*

A soils require a Volume to recharge of	**0.60**	**inches**
B soils require a Volume to recharge of	**0.35**	**inches**
C soils require a Volume to recharge of	**0.25**	**inches**
D soils require a Volume to recharge of	**0.10**	**inches**

Impervious area within: A-soils =	32,323	sf
Impervious area within: B-soils =	0	sf
Impervious area within: C-soils =	10,747	sf
Impervious area within: D-soils =	25,381	sf

Weighted Groundwater Recharge Depth = **0.36** **in**

Total Site Volume required to be recharged =

68,451 sf x 1" / 12 x 0.36 in = **2,052** **cf**

Site volume recharge provided by = volume within the infiltration system below the invert out. See the HydroCAD stage storage table within the Appendix of the Drainage Report

= **24,020** cf Total Volume Recharged > **2,052** **cf** (OK)

Water Quality Volume Calculation

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2712-02A	**Sheet**	1 of 1
Project Description	25 Forge Parkway		
	Franklin, MA		
Calculated By	SM	**Date**	11/22/23
Checked By	BDJ	**Date**	11/22/23

Standard # 4: Water Quality

$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) * (A_{IMP})$

Where:

V_{WQ} = Required Water Quality Volume (in cubic feet)

D_{WQ} = Water Quality Depth: one-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near another critical area, runoff from a LUHPPL, or exfiltration to soils with infiltration rate greater than 2.4 inches/hour or greater; ½-inch for discharges near or to other areas.

A_{IMP} = Impervious Area (in square feet)

Proposed Development Impervious = Total Site Impervious - Existing Impervious

Total Site Impervious	=	116,033 sf
Existing Impervious	=	47,578 sf
Proposed Development Impervious	=	68,455 sf

D_{WQ} = 1.0 in

A_{IMP} = 68,455 sf

$V_{WQ} = (D_{WQ}/12 \text{ inches/foot}) * (A_{IMP})$

V_{WQ} = 0.083 ft x 68,455 sf = **5,705 cf** (Water Quality Treatment Volume Required)

Runoff is pretreated by proprietary treatment devices prior to being directed to the two infiltration systems. Runoff receives further treatment by the systems' isolator rows. The infiltration systems have been designed to infiltrate a cumulative volume of **24,020** cubic feet, which exceeds the 5,705 cubic feet required.

Infiltration System Drain Calculation

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2712-02A	**Sheet**	1 of 2
Project Description	25 Forge Parkway		
	Franklin, MA		
Calculated By	SM	**Date**	11/22/23
Checked By	BDJ	**Date**	11/22/23

Drawdown within 72 hours Analysis for Static Method

Infiltration System #1 - Stormtech MC-3500

Infiltration Rate: 2.41 inches/hour *(From table 2.3.3: Rawls, Brakensiek, Saxton, 1982)*

Volume Provide for Infiltration: 23,307 cf

Basin bottom area: 7,672 sf

$Time_{drawdown}$ = (Required Recharge Volume in cubic feet as determined by the Static Method)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

$Time_{drawdown}$ = (23,307 cf) (1 / 2.41 in/hr) (12 in./ft.) (1 / 7,672 sf)

= 15.13 hours

Drawdown within 72 hours Analysis for Static Method

Infiltration System #2 - Stormtech SC-740

Infiltration Rate: 2.41 inches/hour *(From table 2.3.3: Rawls, Brakensiek, Saxton, 1982)*

Volume Provide for Infiltration: 713 cf

Basin bottom area: 512 sf

Time $_{drawdown}$ = (Required Recharge Volume in cubic feet as determined by the Static Method)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

Time $_{drawdown}$ = (713 cf) (1 / 2.41 in/hr) (12 in./ft.) (1 / 512 sf)

= 6.93 hours

TSS Removal Calculation

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2712-02A	**Sheet**	1 of 1
Project Description	25 Forge Parkway		
	Franklin, MA		
Calculated By	JRG	**Date**	04/12/23
Checked By	SM	**Date**	04/12/23

The calculations below provide the TSS removal rate of the stormwater management system

Stormwater Management BMP	TSS Removal rate
Parking Lot Sweeping	5 %
CDS1515-3	83 %
Infiltration System - Isolator Row	80 %

Average Annual Load	=	1.0	
Parking Lot Sweeping	=	5.0	% Removal Rate
		95.0	% TSS Load Remains

TSS Load Remaining	=	95.0	%
CDS1515-3	=	82.7	% Removal Rate
		16.4	% TSS Load Remains

TSS Load Remaining	=	16.4	%
Infiltration System - Isolator Row	=	80.0	% Removal Rate
		3.3	% TSS Load Remains

Percentage of TSS Remaining	-	Initial TSS Load	=	Final TSS Removal Rate
3.29	-	100.0	=	96.7 %

For this drainage area, this system as designed will remove an estimated
96.7 % of the annual TSS load and therefore will meet the TSS removal standard.

Project: 25 Forge Parkway
Location: Franklin, MA
Prepared For: Allen & Major Associates

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

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

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

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" 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" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQ-01	0.34	0.0005297	6.0	0.100	1.00	774.00	0.41
WQ-02	0.59	0.0009203	6.0	0.100	1.00	774.00	0.71
WQ-03	0.29	0.0004516	6.0	0.100	1.00	774.00	0.35
WQ-04	0.16	0.0002500	6.0	0.100	1.00	774.00	0.19
WQ-05	0.05	0.0000813	6.0	0.100	1.00	774.00	0.06

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

25 FORGE PARKWAY
FRANKLIN, MA

Area	**0.34 ac**	Unit Site Designation	**WQ-01**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.01	0.01	9.1
0.06	8.7%	27.5%	0.02	0.02	8.4
0.08	10.1%	37.6%	0.02	0.02	9.6
0.10	7.2%	44.8%	0.03	0.03	6.8
0.12	6.0%	50.8%	0.04	0.04	5.7
0.14	6.3%	57.1%	0.04	0.04	5.9
0.16	5.6%	62.7%	0.05	0.05	5.3
0.18	4.7%	67.4%	0.05	0.05	4.4
0.20	3.6%	71.0%	0.06	0.06	3.4
0.25	8.2%	79.1%	0.08	0.08	7.5
0.50	14.9%	94.0%	0.15	0.15	12.9
0.75	3.2%	97.3%	0.23	0.23	2.6
1.00	1.2%	98.5%	0.31	0.31	0.9
1.50	0.7%	99.2%	0.46	0.46	0.5
2.00	0.8%	100.0%	0.61	0.61	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					92.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**86.1%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

25 FORGE PARKWAY
FRANKLIN, MA

Area	**0.59 ac**	Unit Site Designation	**WQ-02**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.02	0.02	9.1
0.06	8.7%	27.5%	0.03	0.03	8.3
0.08	10.1%	37.6%	0.04	0.04	9.5
0.10	7.2%	44.8%	0.05	0.05	6.7
0.12	6.0%	50.8%	0.06	0.06	5.6
0.14	6.3%	57.1%	0.07	0.07	5.8
0.16	5.6%	62.7%	0.08	0.08	5.1
0.18	4.7%	67.4%	0.10	0.10	4.3
0.20	3.6%	71.0%	0.11	0.11	3.3
0.25	8.2%	79.1%	0.13	0.13	7.2
0.50	14.9%	94.0%	0.27	0.27	11.8
0.75	3.2%	97.3%	0.40	0.40	2.3
1.00	1.2%	98.5%	0.53	0.53	0.8
1.50	0.7%	99.2%	0.80	0.80	0.3
2.00	0.8%	100.0%	1.06	1.00	0.2
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					89.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**82.7%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

25 FORGE PARKWAY
FRANKLIN, MA

Area	**0.29 ac**	Unit Site Designation	**WQ-03**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.0
0.04	9.5%	18.8%	0.01	0.01	9.1
0.06	8.7%	27.5%	0.02	0.02	8.4
0.08	10.1%	37.6%	0.02	0.02	9.7
0.10	7.2%	44.8%	0.03	0.03	6.8
0.12	6.0%	50.8%	0.03	0.03	5.7
0.14	6.3%	57.1%	0.04	0.04	6.0
0.16	5.6%	62.7%	0.04	0.04	5.3
0.18	4.7%	67.4%	0.05	0.05	4.4
0.20	3.6%	71.0%	0.05	0.05	3.4
0.25	8.2%	79.1%	0.07	0.07	7.6
0.50	14.9%	94.0%	0.13	0.13	13.2
0.75	3.2%	97.3%	0.20	0.20	2.7
1.00	1.2%	98.5%	0.26	0.26	1.0
1.50	0.7%	99.2%	0.39	0.39	0.5
2.00	0.8%	100.0%	0.52	0.52	0.5
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					93.2
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**86.8%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

25 FORGE PARKWAY
FRANKLIN, MA

Area	**0.16 ac**	Unit Site Designation	**WQ-04**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.00	0.00	9.1
0.04	9.5%	18.8%	0.01	0.01	9.2
0.06	8.7%	27.5%	0.01	0.01	8.4
0.08	10.1%	37.6%	0.01	0.01	9.7
0.10	7.2%	44.8%	0.01	0.01	6.9
0.12	6.0%	50.8%	0.02	0.02	5.8
0.14	6.3%	57.1%	0.02	0.02	6.0
0.16	5.6%	62.7%	0.02	0.02	5.4
0.18	4.7%	67.4%	0.03	0.03	4.5
0.20	3.6%	71.0%	0.03	0.03	3.4
0.25	8.2%	79.1%	0.04	0.04	7.7
0.50	14.9%	94.0%	0.07	0.07	13.8
0.75	3.2%	97.3%	0.11	0.11	2.9
1.00	1.2%	98.5%	0.14	0.14	1.1
1.50	0.7%	99.2%	0.22	0.22	0.6
2.00	0.8%	100.0%	0.29	0.29	0.6
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					95.0
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**88.6%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

25 FORGE PARKWAY
FRANKLIN, MA

Area	0.05 ac	Unit Site Designation	WQ-05
Weighted C	0.9	Rainfall Station #	68
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.00	0.00	9.1
0.04	9.5%	18.8%	0.00	0.00	9.2
0.06	8.7%	27.5%	0.00	0.00	8.5
0.08	10.1%	37.6%	0.00	0.00	9.8
0.10	7.2%	44.8%	0.00	0.00	6.9
0.12	6.0%	50.8%	0.01	0.01	5.8
0.14	6.3%	57.1%	0.01	0.01	6.1
0.16	5.6%	62.7%	0.01	0.01	5.4
0.18	4.7%	67.4%	0.01	0.01	4.5
0.20	3.6%	71.0%	0.01	0.01	3.5
0.25	8.2%	79.1%	0.01	0.01	7.9
0.50	14.9%	94.0%	0.02	0.02	14.3
0.75	3.2%	97.3%	0.04	0.04	3.1
1.00	1.2%	98.5%	0.05	0.05	1.2
1.50	0.7%	99.2%	0.07	0.07	0.7
2.00	0.8%	100.0%	0.09	0.09	0.7
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					96.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**90.0%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Stage Storage Calculations

Stage-Area-Storage for Pond IS-1: IS-1

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
284.75	0	287.40	13,927	290.05	24,994
284.80	153	287.45	14,211	290.10	25,148
284.85	307	287.50	14,493	290.15	25,301
284.90	460	287.55	14,774	290.20	25,455
284.95	614	287.60	15,052	290.25	25,608
285.00	767	287.65	15,330	290.30	25,761
285.05	921	287.70	15,605	290.35	25,915
285.10	1,074	287.75	15,878	290.40	26,068
285.15	1,227	287.80	16,149	290.45	26,222
285.20	1,381	287.85	16,419	290.50	26,375
285.25	1,534	287.90	16,686	290.55	26,529
285.30	1,688	287.95	16,951	290.60	26,682
285.35	1,841	288.00	17,213	290.65	26,836
285.40	1,995	288.05	17,473	290.70	26,989
285.45	2,148	288.10	17,731	290.75	**27,142**
285.50	2,301	288.15	17,986		
285.55	2,622	288.20	18,239		
285.60	2,942	288.25	18,488		
285.65	3,261	288.30	18,735		
285.70	3,579	288.35	18,979		
285.75	3,897	288.40	19,219		
285.80	4,215	288.45	19,456		
285.85	4,532	288.50	19,689		
285.90	4,848	288.55	19,919		
285.95	5,163	288.60	20,144		
286.00	5,478	288.65	20,365		
286.05	5,792	288.70	20,581		
286.10	6,106	288.75	20,792		
286.15	6,418	288.80	20,995		
286.20	6,731	288.85	21,191		
286.25	7,042	288.90	21,378		
286.30	7,352	288.95	21,556		
286.35	7,662	289.00	21,729		
286.40	7,971	289.05	21,898		
286.45	8,279	289.10	22,063		
286.50	8,586	289.15	22,225		
286.55	8,892	289.20	22,384		
286.60	9,197	289.25	22,539		
286.65	9,502	289.30	22,693		
286.70	9,805	289.35	22,846		
286.75	10,108	289.40	23,000		
286.80	10,409	289.45	23,153		
286.85	10,709	289.50	23,307		
286.90	11,008	289.55	23,460		
286.95	11,306	289.60	23,613		
287.00	11,602	289.65	23,767		
287.05	11,897	289.70	23,920		
287.10	12,191	289.75	24,074		
287.15	12,484	289.80	24,227		
287.20	12,776	289.85	24,381		
287.25	13,065	289.90	24,534		
287.30	13,354	289.95	24,687		
287.35	13,641	290.00	24,841		

Stage-Area-Storage for Pond IS-2: IS-2

Elevation (feet)	Storage (cubic-feet)
281.25	0
281.30	10
281.35	20
281.40	31
281.45	41
281.50	51
281.55	61
281.60	72
281.65	82
281.70	92
281.75	102
281.80	122
281.85	142
281.90	162
281.95	181
282.00	201
282.05	221
282.10	240
282.15	260
282.20	279
282.25	298
282.30	317
282.35	337
282.40	356
282.45	375
282.50	393
282.55	412
282.60	431
282.65	450
282.70	468
282.75	486
282.80	505
282.85	523
282.90	541
282.95	559
283.00	577
283.05	594
283.10	612
283.15	629
283.20	646
283.25	663
283.30	680
283.35	697
283.40	713
283.45	730
283.50	746
283.55	761
283.60	777
283.65	792
283.70	807
283.75	822
283.80	837
283.85	851
283.90	864
283.95	877
284.00	890
284.05	902
284.10	913
284.15	924
284.20	935
284.25	945
284.30	955
284.35	966
284.40	976
284.45	986
284.50	996
284.55	1,007
284.60	1,017
284.65	1,027
284.70	1,037
284.75	**1,048**

Hantush Groundwater Mounding Spreadsheet

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		
3.0380	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
66.02	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
58.960	**x**	**1/2 length of basin (x direction, in feet)**
32.530	**y**	**1/2 width of basin (y direction, in feet)**
0.625	**t**	**duration of infiltration period (days)**
20.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

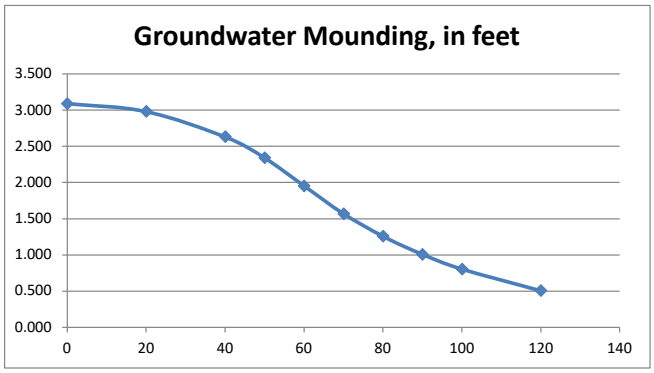
hours	**days**
36	1.50

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).

23.089	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
3.089	**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**
3.089	**0**
2.981	**20**
2.631	**40**
2.341	**50**
1.953	**60**
1.568	**70**
1.257	**80**
1.006	**90**
0.802	**100**
0.504	**120**

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.