

DRAINAGE REPORT

For

KS Partners owned & managed

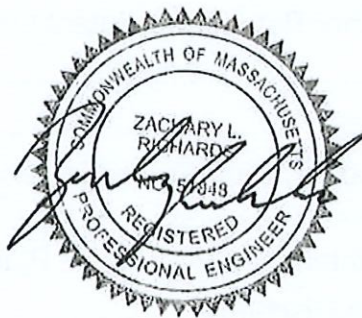
PROPOSED

"GMP LAB FACILITY"

**298 Concord Road
Billerica, Massachusetts
Middlesex County**

Prepared by:

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the development of a proposed Good Manufacturing Practice (GMP) lab facility building located at 298 Concord Road in the Town of Billerica, Massachusetts. The overall Property, which contains approximately 31.2 acres of land, currently contains three (3) existing buildings, paved impervious parking areas, utilities, and landscape amenities. The analysis area, herein referred to as the "Site", consists of the western parking area adjacent to Concord Road including the existing 298 building area, associated parking and portions of the existing landscape and stormwater basin totaling approximately 6.05 acres.

The proposed Project includes the construction of a new $\pm 121,630$ SF Good Manufacturing Practice (GMP) lab facility building, modifications to existing parking areas and utilities to accommodate the proposed building, and installation of new stormwater management features. The Project will also include additional landscaping and outdoor amenity space. The Project will result in an overall increase in impervious area. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at one (1) "design point" where stormwater runoff currently drains to under existing conditions. The design point is described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	4.45	2.70	-1.75	7.95	4.91	-3.04	10.79	7.34	-3.45	16.66	14.06	-2.60

**Flows are represented in cubic feet per second (cfs)*

Table 1.2: Design Point Volume Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	0.868	0.652	-0.216	1.626	1.283	-0.343	2.294	1.918	-0.376	3.761	3.360	-0.401

**Volumes are represented in acre feet (ac-ft)*

II. EXISTING SITE CONDITIONS

Existing Site Description

The limit of work on Site consists of approximately 6.05 acres of land located along the easterly side of Concord Road in the Town of Billerica, Massachusetts. The Site area consists of an existing building and paved impervious parking lot along with an existing stormwater basin. The Site analysis area is limited to the limit of work and does not include the existing buildings and parking facilities to remain on the Property.

On-Site Soil Information

The majority of the soils at the Site are mapped as Charlton-Urban Land – Hollis complex which are classified by the Natural Resource Conservation Service (NRCS) as Hydrologic Soil Group (HSG) "A". Based upon on-site soil testing performed on December 21, 2022 by a licensed soil evaluator in the State of Massachusetts, the soils on Site at the depths of the proposed infiltration depth were observed to be loamy sand which is generally consistent with the HSG "A". As such, the drainage analysis has utilized an infiltration rate of 2.41 in/hr which corresponds to the Rawl's rate for loamy sand, HSG "A".

During the soil testing performed on Site as described above, groundwater was observed on the Site between 3.2 and 5.3 feet below the surface elevation. In 2 of the 4 test pits, weeping from the side of the pit was observed 3.2 feet from the ground surface. Standing water in the pit was observed 6.8 – 8.9 feet below the ground surface. Based on the observed groundwater elevations, the Site is constrained relative to infiltration or other subsurface stormwater management features.

Refer to **Appendix C** for Test Pit Logs and additional information.

Existing Collection and Conveyance

The Site generally slopes from northeast to southwest to the existing wetland that borders the southern and western sides of the Site. The northern portion of the Site drains to several catch basins within the existing pavement areas and is conveyed via underground piping to an existing drain basin. The existing basin is located south of the #300 Concord Road and is broken into two portions connected with two 12" RCP pipes. The existing basin outlets through a riser structure

over to the existing wetland area underneath the access road. Located on the southwest corner of the basin is a rip rap emergency spillway, adjacent to the access road.

The existing parking lot to the southwest of the #298 building flows overland to existing catch basins and is conveyed via underground pipes to the wetlands. There does not appear to be any best management practices for this area. In addition, the northwestern portion of the Site to the rear of the #298 building flows via overland flow to existing drainage infrastructure.

Slopes on the site range from 1%-25% (in drainage basin areas) with on-site elevations ranging from 194 in the northern corner of the Site to 180 at the southwesterly portion of the property.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at one (1) "design point" as described below where stormwater runoff currently drains to under existing conditions. The existing site was subdivided into five (5) separate sub catchments, as described below, to analyze existing and proposed flow rates at the design point. The drainage analysis includes areas that are considered "off-site" drainage as they are not within the proposed limit of work but do contribute stormwater flows to the existing and proposed infrastructure.

Subcatchment EX-1 in total is 0.67 acres of mostly grassed areas with some paved areas. The area flows overland and is collected in an existing basin onsite. The existing basin provides some infiltration and attenuation before discharging into the larger basin in Subcatchment EX-2.

Subcatchment EX-2 in total is 3.55 acres of mostly grassed areas and building footprint. The building footprint runoff is collected via roof drains and conveyed via underground drainage infrastructure into the large stormwater basin on site. Overflow from the basin in larger storm events goes to the wetlands, DP1. The existing basin provides some infiltration and attenuation before discharging into the larger basin.

Subcatchment EX-3 in total is 0.22 acres of grassed area flows overland and is conveyed via underground drainage infrastructure to the existing wetland. The stormwater runoff from this Subcatchment is not treated or attenuated.

Subcatchment EX-4 in total is 1.98 acres of mostly paved areas and a building footprint with some landscape areas. The area flows overland and is conveyed via underground drainage

infrastructure to the large stormwater basin on site. Overflow from the basin in larger storm events goes to the wetlands, DP1. The existing basin provides some infiltration and attenuation before discharging into the larger basin in Subcatchment EX-2.

Subcatchment EX-5 in total is 4.05 acres of mostly paved parking areas and some landscape areas. The area flows overland and is conveyed via underground drainage infrastructure to the existing wetland. The stormwater runoff from the Subcatchment is not treated or attenuated.

Design Point #1 (DP1) is the existing wetland along the southwest property line. Under existing conditions, this design point receives stormwater flows from approximately 10.5 acres of land from the Site area, designated as subcatchment EX-1, EX-2, EX-3, EX-4 and EX-5.

Refer to **Table 1.1, 1.2, 6.1, and 6.2** for the existing conditions peak rates of runoff and volume of runoff. Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed Project will include the construction of a ±121,630 SF Good Manufacturing Practice (GMP) lab facility building, modifications to existing parking areas and utilities to accommodate the proposed building, additional landscaping, and installation of new stormwater management features. The project involves an overall increase in impervious area through the introduction of a larger building footprint. The paved portions of the Site have been designed to drain to proprietary water quality inlets. The inlets will capture and convey stormwater runoff, via an underground pipe system to the subsurface infiltration system. All impervious area within the parking area are conveyed to a subsurface infiltration chamber system and eventually outfall to the existing wetland. Rooftop runoff has been designed to flow through the subsurface infiltration system as well.

Proposed Development Collection and Conveyance

Water Quality Inlets are proposed to collect and route runoff from the paved parking areas to the proposed infiltration system. Roof drains are proposed to collect runoff from the proposed building and are routed to the proposed infiltration system. Pipes have been designed for the 25-year storm using the Rational Method. Pipe sizing calculations are included in **Appendix F**.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet, or exceed, the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards as well as the Town of Billerica Board of Health Stormwater Management Bylaw. Refer to **Section V** for additional information.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided into five (5) separate sub catchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Under proposed conditions DP#1 receives stormwater flows from approximately 10.5 acres of land, designated as watershed "PR-1" and "PR-2", "PR-3", "PR-4" and "PR-5".

Subcatchment PR-1 in total is 2.79 acres of building footprint area. The area flows through the proposed roof drain collection pipes and into the proposed subsurface infiltration system prior to discharging into to the existing wetland area.

Subcatchment PR-2 in total is 2.11 acres of pavement area and woods and grass areas of the existing drainage basin. The area flows overland and is collected in the existing basin onsite to the existing wetland area.

Subcatchment PR-3 in total is 1.38 acres of paved parking lot area and woods and grass. This area drains to proposed deep sump hooded catch basins and subsequently is routed through a Contech CDS unit for water quality prior to flowing into the proposed subsurface infiltration system which outlets to the existing wetland area.

Subcatchment PR-4 in total is 0.15 of woods and grass area. The area flows overland to the existing wetland area.

Subcatchment PR-5 in total is 4.05 acres of mostly existing paved parking areas and some landscape areas. The area flows overland and is conveyed via underground drainage infrastructure to the existing basin onsite, prior to discharge to the wetlands.

Refer to **Table 1.1, 1.2, 6.1 and 6.2** for the calculated proposed conditions peak rates of runoff and volumes. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on Cornell University Rainfall Data. Refer to **Appendix F** for more information.

Table 4.1: Cornell University Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.13	4.73	6.00	8.59

*Values derived from Cornell University Atlas of Precipitation Extremes for the Northeastern United States and Southern Canada

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events. Additionally, the proposed project meets, or exceeds, the MADEP Stormwater Management standards as well as the Town of Billerica Stormwater Management By-law. Compliance with these standards is described further below.

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas including the building roof and paved parking/driveway areas shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1** and **Table 6.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The stormwater runoff from the project will be collected and diverted to a proposed subsurface infiltration basin. The project as proposed will result in a net increase in impervious area of 1.75 acres and is required to infiltrate 3,808 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed subsurface infiltration basin will provide 14,672 cubic feet of volume below the lowest outlet for groundwater recharge. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing that the proposed infiltration basin will drain within 6.5 hours are included in **Appendix F** of this report.

A groundwater mounding analysis has been provided in **Appendix F** of this report. The analysis shows that the groundwater mound will have no effect on the proposed system.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins, CDS water quality inlets, CDS water quality unit, and a subsurface infiltration system. TSS removal calculations are included in **Appendix F** of this report. As a LUHPPL, the project is required to provide 1" water quality volume over the post-development impervious area. The project as proposed will produce a total post-construction impervious area within the site of 4.0 acres and is required to treat 14,525 cubic feet of water quality volume as defined in Stormwater Standard 4. The proposed subsurface infiltration

basin provides 14,672 cubic feet of water quality volume below the lowest outlet for water quality treatment. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

The Project will provide 44% TSS removal prior to infiltration and treat the 1.0 in water quality depth, as further illustrated in Appendix F of this report.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

Not Applicable for this project.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. Also, the existing basin located on site will have the same storage volume in existing and proposed conditions due to the proposed detention system and the contributing area going to this basin will be significantly less in proposed conditions. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 6.1** below:

Table 6.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	4.45	2.70	-1.75	7.95	4.91	-3.04	10.79	7.34	-3.45	16.66	14.06	-2.60

**Flows are represented in cubic feet per second (cfs)*

Table 6.2: Design Point Volume Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	0.868	0.652	-0.216	1.626	1.283	-0.343	2.294	1.918	-0.376	3.761	3.360	-0.401

**Volumes are represented in acre feet (ac-ft)*

As outlined in the table above, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the project meets or exceeds the MADEP Stormwater Management Standards as described further herein.

APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST



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 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

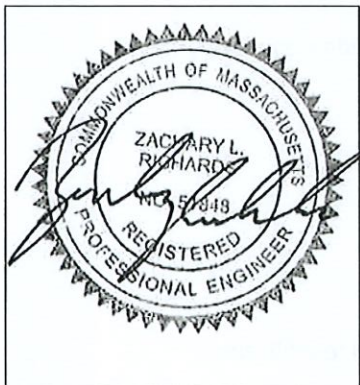
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

01/24/2023

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): Water Quality Structures, subsurface infiltration

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

Standard 3: Recharge

- ☒ Soil Analysis provided.
- ☒ Required Recharge Volume calculation provided.
- ☐ Required Recharge volume reduced through use of the LID site Design Credits.
- ☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - ☒ Static
 - ☐ Simple Dynamic
 - ☐ Dynamic Field¹
- ☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.
- ☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- ☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- ☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
 - ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
 - ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- ☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- ☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- ☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- ☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- ☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - ☒ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - ☐ is within the Zone II or Interim Wellhead Protection Area
 - ☐ is near or to other critical areas
 - ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - ☒ involves runoff from land uses with higher potential pollutant loads.
 - ☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - ☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- ☒ The BMP is sized (and calculations provided) based on:
 - ☒ The ½" or 1" Water Quality Volume or
 - ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- ☒ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the proprietary BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- ☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- ☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- ☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted *prior* to the discharge of stormwater to the post-construction stormwater BMPs.
- ☐ The NPDES Multi-Sector General Permit does *not* cover the land use.
- ☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- ☐ All exposure has been eliminated.
- ☐ All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☒ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- ☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- ☐ Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- ☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - ☐ Limited Project
 - ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - ☐ Bike Path and/or Foot Path
 - ☐ Redevelopment Project
 - ☐ Redevelopment portion of mix of new and redevelopment.
- ☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- ☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- ☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- ☐ The project is **not** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

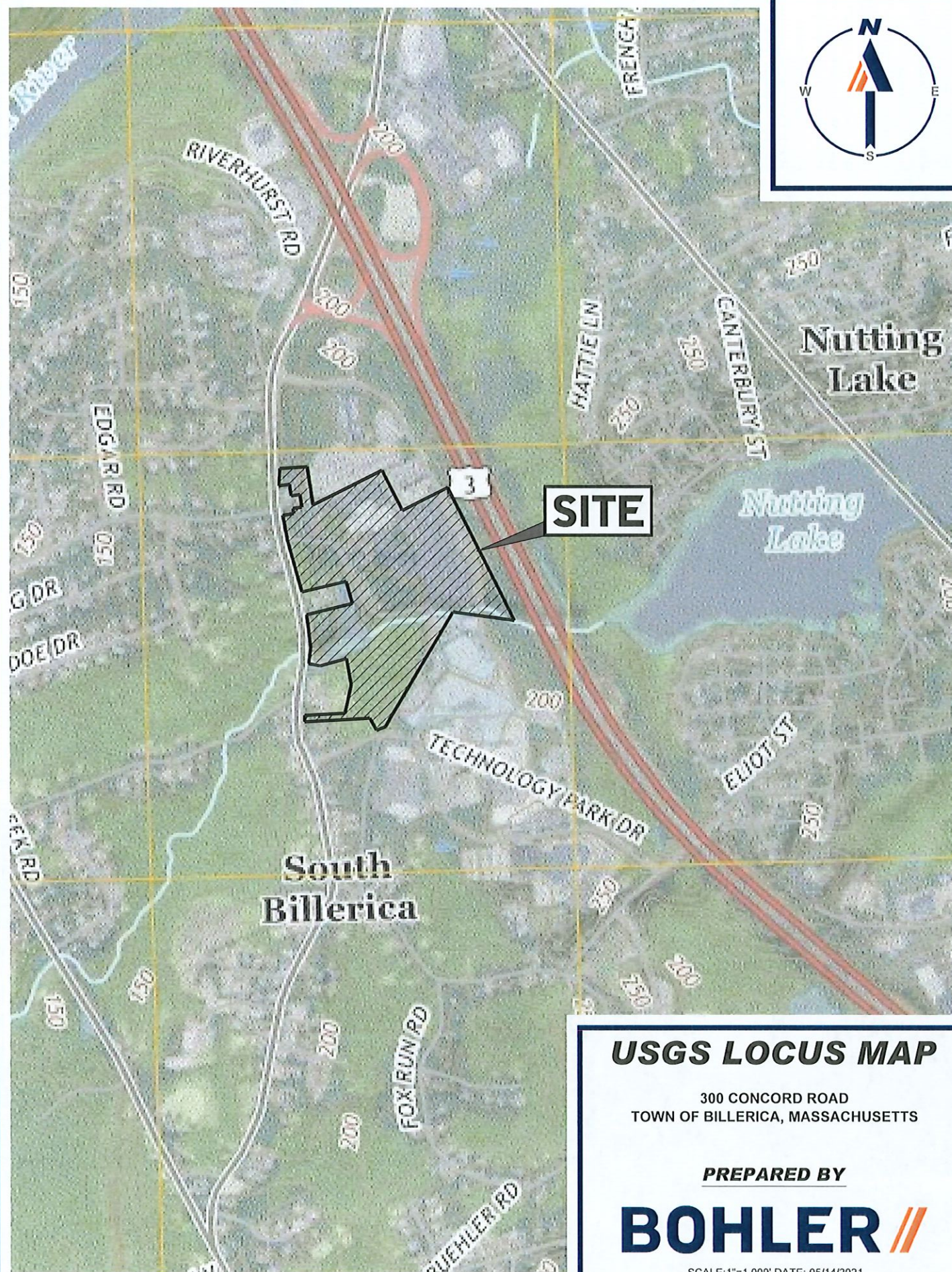
- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - ☒ Name of the stormwater management system owners;
 - ☒ Party responsible for operation and maintenance;
 - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
 - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
 - ☒ Description and delineation of public safety features;
 - ☒ Estimated operation and maintenance budget; and
 - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- ☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

APPENDIX B: PROJECT LOCATION MAPS

- USGS MAP
- FEMA FIRMETTE
- SITE AERIAL



USGS LOCUS MAP

300 CONCORD ROAD
TOWN OF BILLERICA, MASSACHUSETTS

PREPARED BY

BOHLER //

SCALE: 1"=1,000' DATE: 05/14/2021

National Flood Hazard Layer FIRMette



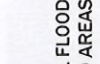
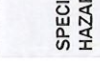
71°17'14"W 42°32'20"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
71°16'36"W 42°31'53"N

Legend

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

 Without Base Flood Elevation (BFE) Zone A, V, A99 With BFE or Depth Zone AE, AO, AH, VE, AR Regulatory Floodway	 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X	 Future Conditions 1% Annual Chance Flood Hazard Zone X	 Area of Minimal Flood Hazard Zone X	 Effective LOMRS	 Area of Undetermined Flood Hazard Zone L	 Channel, Culvert, or Storm Sewer	 Cross Sections with 1% Annual Chance Water Surface Elevation	 Digital Data Available	 N
 Regulatory Floodway	 Chance Flood Hazard Zone X	 Area with Reduced Flood Risk due to Levee. See Notes, Zone X	 Area with Flood Risk due to Levee Zone D	 Channel, Culvert, or Storm Sewer	 Limit of Study	 Jurisdiction Boundary	 Coastal Transect Baseline	 No Digital Data Available	
 Regulatory Floodway	 Chance Flood Hazard Zone X	 Area with Flood Risk due to Levee Zone D	 Area of Undetermined Flood Hazard Zone L	 Channel, Culvert, or Storm Sewer	 Limit of Study	 Jurisdiction Boundary	 Coastal Transect Baseline	 Unmapped	

OTHER AREAS OF FLOOD HAZARD

OTHER FEATURES

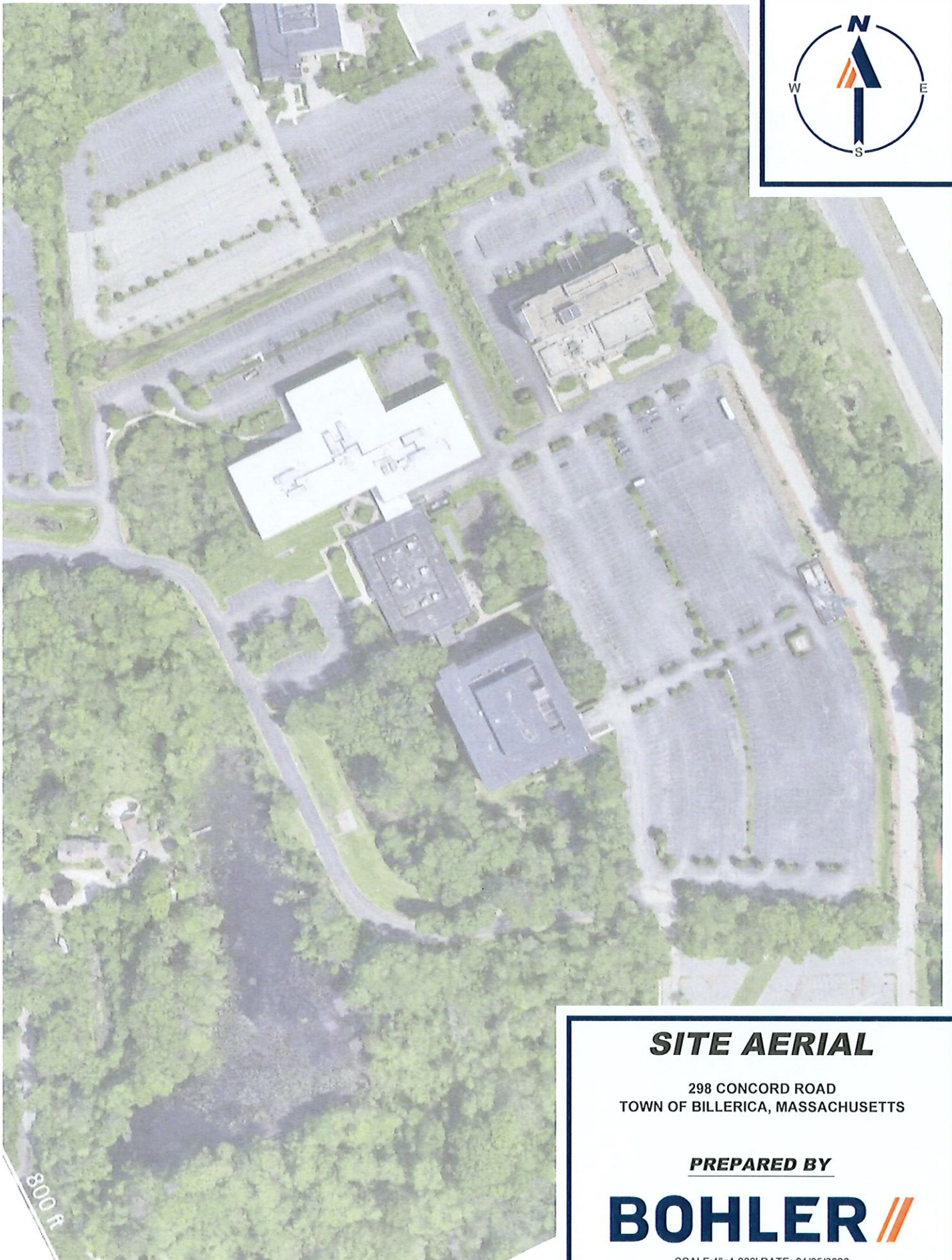
MAP PANELS

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **3/12/2021 at 4:07 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



SITE AERIAL

298 CONCORD ROAD
TOWN OF BILLERICA, MASSACHUSETTS

PREPARED BY

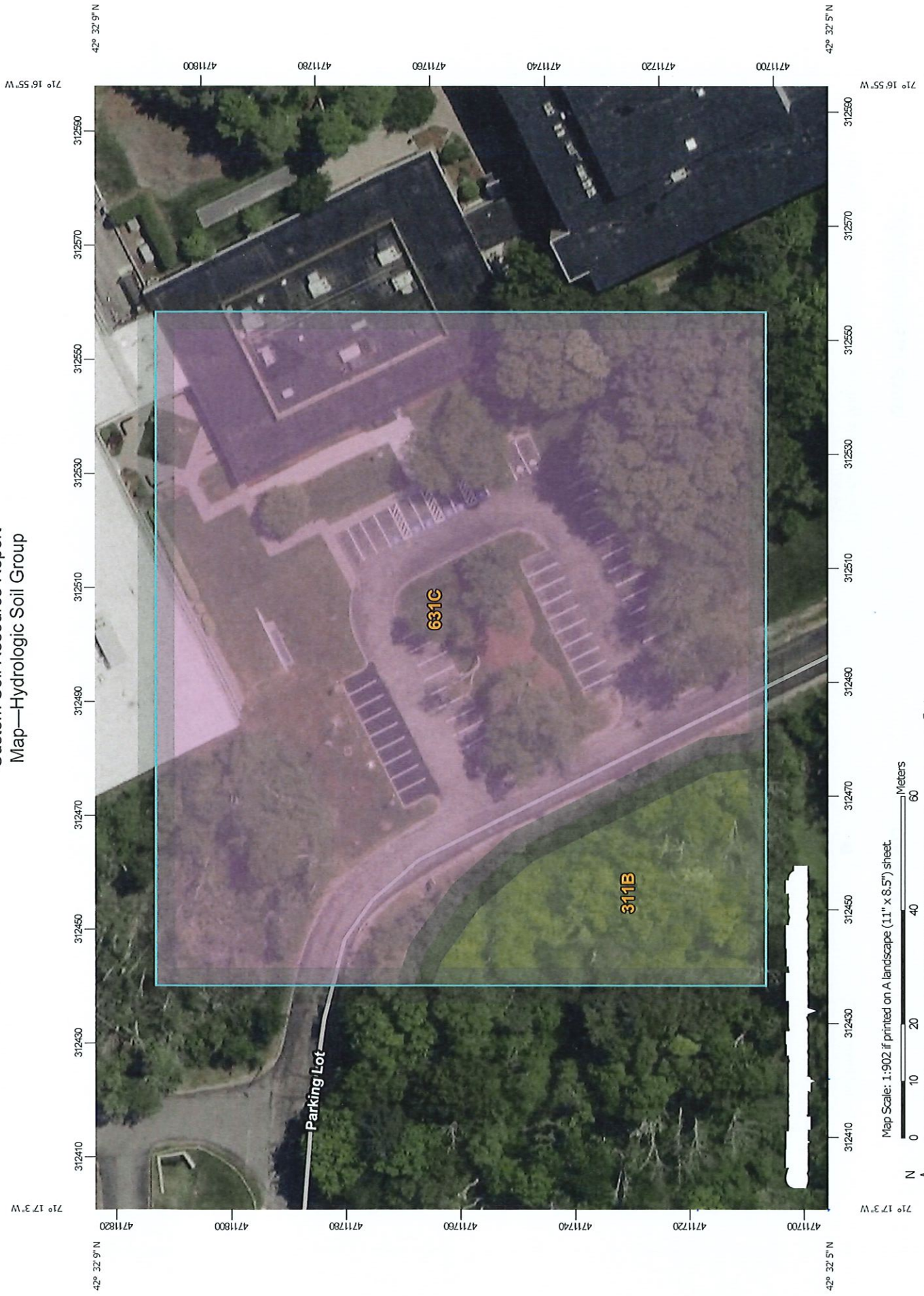
BOHLER //

SCALE: 1"=1,000' DATE: 01/05/2023

APPENDIX C: SOIL AND WETLAND INFORMATION

- NCRS CUSTOM SOIL RESOURCE REPORT
- TEST PIT LOGS AND TEST PIT MAP

Custom Soil Resource Report
Map—Hydrologic Soil Group



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

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

C

C/D

D

Not rated or not available

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: Middlesex County, Massachusetts
Survey Area Data: Version 22, 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—Hydrologic Soil Group

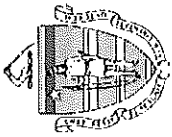
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	0.4	13.9%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	A	2.7	86.1%
Totals for Area of Interest			3.1	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



Commonwealth of Massachusetts
City/Town of

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

A. Facility Information

KS Partners, LLC
Owner Name
296-300 Concord Road
Street Address
Billerica
City
MA
State
Map 86, Block 108, Lot 5
Map/Lot #
01821
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade

2. Soil Survey Web Soil Survey Source 631C Soil Map Unit Charlton-Urban land-Hollis complex
Ground moraines, drumlins Possible 8-20" to lithic bedrock; >80" to water table
Landform Soil Limitations

Friable loamy eolian deposits over friable loamy basal till services from granite and gneiss; Friable, shallow loamy basal till over granite and gneiss
Soil Parent material

3. Surficial Geological Report 2007 - Stone and Stone
Year Published/Source
Non-sorted, nonstratified matrix of sand, some silt, and little clay containing scatter gravel clasts and few large boulders; in areas where till is generally 10-15 ft thick; Organic muck and peat that contain minor amounts of sand.
Description of Geologic Map Unit: Thin till; Swamp deposits

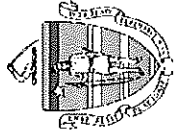
4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

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): 12/19/2022 (MA-XMW 78) Range: ☐ Above Normal ☐ Normal ☒ Below Normal
Month/Day/ Year

8. Other references reviewed: Site is not within Zone I, Zone II, IWPA, or Zone A; No NHESP habitat areas on-site; No domestic drinking water
(Zone II, IWPA, Zone A, EEA Data Portal, etc.) wells of record located near the site per EEA data portal.



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 # 12/21/2022 8:10 AM Sunny; 23 degrees 42.536280 -71.282870
Land Use Office parking lot grassed landscape area Short grass Vegetation None observed Weather Latitude Longitude
Description of Location: Edge of parking field (refer to attached map) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

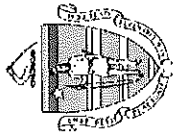
2. Soil Parent Material: Ablation till Ground moraine BS
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)
3. Distances from: Open Water Body >200 feet Drainage Way >100 feet Wetlands >100 feet
Property Line >100 feet Drinking Water Well >1,000 feet Other N/A feet
4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil/Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock
5. Groundwater Observed: ☒ Yes ☐ No If yes: 38" Depth to Weeping in Hole 81" Depth to 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	Ap	Loamy sand	10YR3/2	-	Cnc : - Dpl: -	-	-	-	Granular	Friable	Vegetation roots observed down to 6"
8-19	HTM	Gravelly medium sand	10YR5/4	-	Cnc : - Dpl: -	-	-	-	Single grain	Loose	
19-31	HTM	Gravelly loamy sand	10YR3/3	-	Cnc : - Dpl: -	-	-	-	Massive	Friable	
31-81+	BC	Sandy loam	10YR5/6	42"	Cnc : 7.5YR5/8 Dpl: -	10-15%	5-10%	-	Massive	Very friable	
					Cnc : Dpl: -						
					Cnc : Dpl: -						

Additional Notes:

Test pitting observations for stormwater applications only. No refusal in pit.



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 # 12/21/2022 9:00 AM Sunny, 25 degrees 42.536280 -71.282870
Longitude

1. Land Use Office parking lot grassed landscape area Short grass Vegetation None observed Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Description of Location: Edge of parking field (refer to attached map)

2. Soil Parent Material: Ablation till Ground moraine BS Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >100 feet Drainage Way >100 feet Wetlands 40 feet
Property Line >100 feet Drinking Water Well >1,000 feet Other N/A feet

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

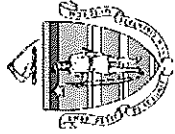
5. Groundwater Observed: ☒ Yes ☐ No If yes: 107" Depth to Weeping in Hole 107" Depth to Standing Water in Hole

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			
0-12	Ap	Sandy loam	10YR3/4	-	Cnc : - Dpl: -	-	-	-	Granular	Friable	
12-24	Bw	Fine sandy loam	10YR4/4	-	Cnc : - Dpl: -	-	-	-	Massive	Friable	
24-42	C	Sandy loam	10YR5/3	-	Cnc : - Dpl: -	-	5-10%	-	Massive	Very friable	
42-48	2C	Fine sandy loam	2.5Y5/2	-	Cnc : - Dpl: -	-	-	-	Massive	Very friable	
48-107+	3C	Loamy sand	10YR5/6	53"	Cnc : 7.5YR5/6 Dpl: -	10-15%	10-20%	10-15%	Massive	Friable	Large stones observed in digging bottom of pit
					Cnc : - Dpl: -						

Additional Notes:

Test pitting observations for stormwater applications only. No refusal in pit. No weeping in side wall of pit above standing water observed.



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 12/21/2022 10:45 AM Sunny: 30 degrees 42.536280 -71.282870
Hole # Date Time Weather Latitude Longitude

1. Land Use Office parking lot grassed landscape area Short grass Stone wall about 30 feet from pit
(e.g., woodland, agricultural field, vacant lot, etc.) Vegetation Surface Stones (e.g., cobbles, stones, boulders, etc.)
Description of Location: Edge of parking field (refer to attached map)

2. Soil Parent Material: Ablation till Ground moraine BS
Landform Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >200 ft Drainage Way >100 ft Wetlands >100 ft feet
Property Line >100 ft Drinking Water Well >100 ft feet Other N/A feet

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

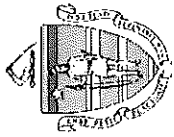
5. Groundwater Observed: ☒ Yes ☐ No If yes: N/A Depth to Weeping in Hole 88" Depth to Standing Water in Hole

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			
0-11	Ap	Loamy sand	10YR2/2	-	Cnc : - Dpl: -	-	-	-	Granular	Friable	
11-18	HTM	Fine sand	10YR5/4	-	Cnc : - Dpl: -	-	5%	-	Single grain	Loose	
18-25	HTM	Loamy sand	10YR4/4	-	Cnc : - Dpl: -	-	-	-	Massive	Friable	
25-78	BC	Gravelly loamy sand	10YR5/6	38"	Cnc : 7.5YR5/8 Dpl: -	10-15%	-	-	Massive	Very friable	
78-88+	C	Gravelly loamy sand	10YR5/4	-	Cnc : - Dpl: -	-	-	-	Massive	Very friable	
					Cnc : - Dpl: -						

Additional Notes:

Test pitting observations for stormwater applications only. No refusal in pit.



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 # 12/21/2022 10:00 AM Sunny; 27 degrees 42.536280 -71.282870
Longitude

1. Land Use Office parking lot grassed landscape area Short grass Vegetation Stone wall about 15 feet from pit Latitude 0-3% Slope (%)
Description of Location: Edge of parking field (refer to attached map) Surface Stones (e.g., cobbles, stones, boulders, etc.)

2. Soil Parent Material: Ablation till Ground moraine BS Position on Landscape (SU, SH, BS, FS, TS, Plain)

3. Distances from: Open Water Body >100 feet Drainage Way 50 feet Wetlands 35 feet
Property Line >100 feet Drinking Water Well >1,000 feet Other N/A feet

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

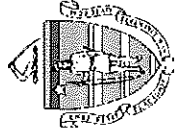
5. Groundwater Observed: ☒ Yes ☐ No If yes: 37" Depth to Weeping in Hole 93" Depth to Standing Water in Hole

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			
0-16	Ap	Sandy loam	10YR3/4	-	Cnc : - Dpl: -	-	-	-	Granular	Friable	
16-39	Bw	Fine sandy loam	10YR4/4	-	Cnc : - Dpl: -	-	-	-	Massive	Friable	
39-55	C	Sandy loam	10YR5/3	-	Cnc : - Dpl: -	-	10%	-	Massive	Very friable	
55-61	2C	Fine sandy loam	2.5Y5/2	-	Cnc : - Dpl: -	-	-	-	Massive	Very friable	
61-93+	3C	Loamy sand	10YR5/6	64"	Cnc : 7.5YR5/8 Dpl: -	10%	10-15%	-	Massive	Friable	
					Cnc : - Dpl: -						

Additional Notes:

Test pitting observations for stormwater applications only. No refusal in pit.



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

D. Determination of High Groundwater Elevation

1. Method Used (Choose one):

☒ Depth to soil redoximorphic features

☒ Depth to observed standing water in observation hole

☐ Depth to adjusted seasonal high groundwater (S_h)
(USGS methodology)

Obs. Hole #1-4

See logs inches

See logs inches

inches

Obs. Hole #1-4

See logs inches

See logs 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

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 O, A, and E Horizons)?

Upper boundary:

inches

Lower boundary:

inches

c. If no, at what depth was impervious material observed?

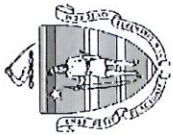
Upper boundary:

inches

Lower boundary:

inches

*N/A - Test pitting observations for stormwater applications only.



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.

Jared Walsh
Signature of Soil Evaluator

Jared Walsh, E.I.T. / License #14670

Typed or Printed Name of Soil Evaluator / License #

12/21/2022

Date

11/01/2025

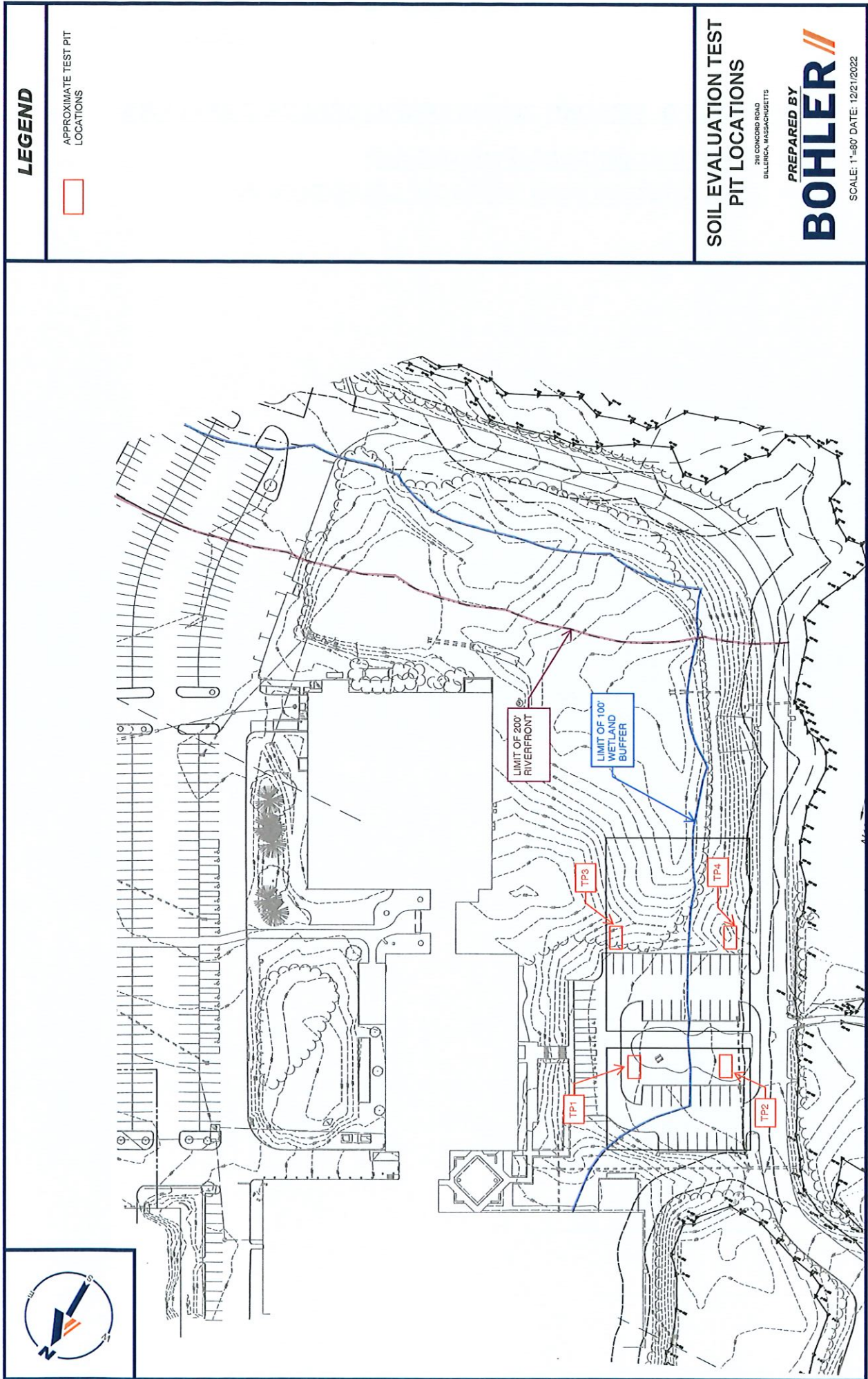
Expiration Date of License

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:



LEGEND

APPROXIMATE TEST PIT LOCATIONS

SOIL EVALUATION TEST PIT LOCATIONS

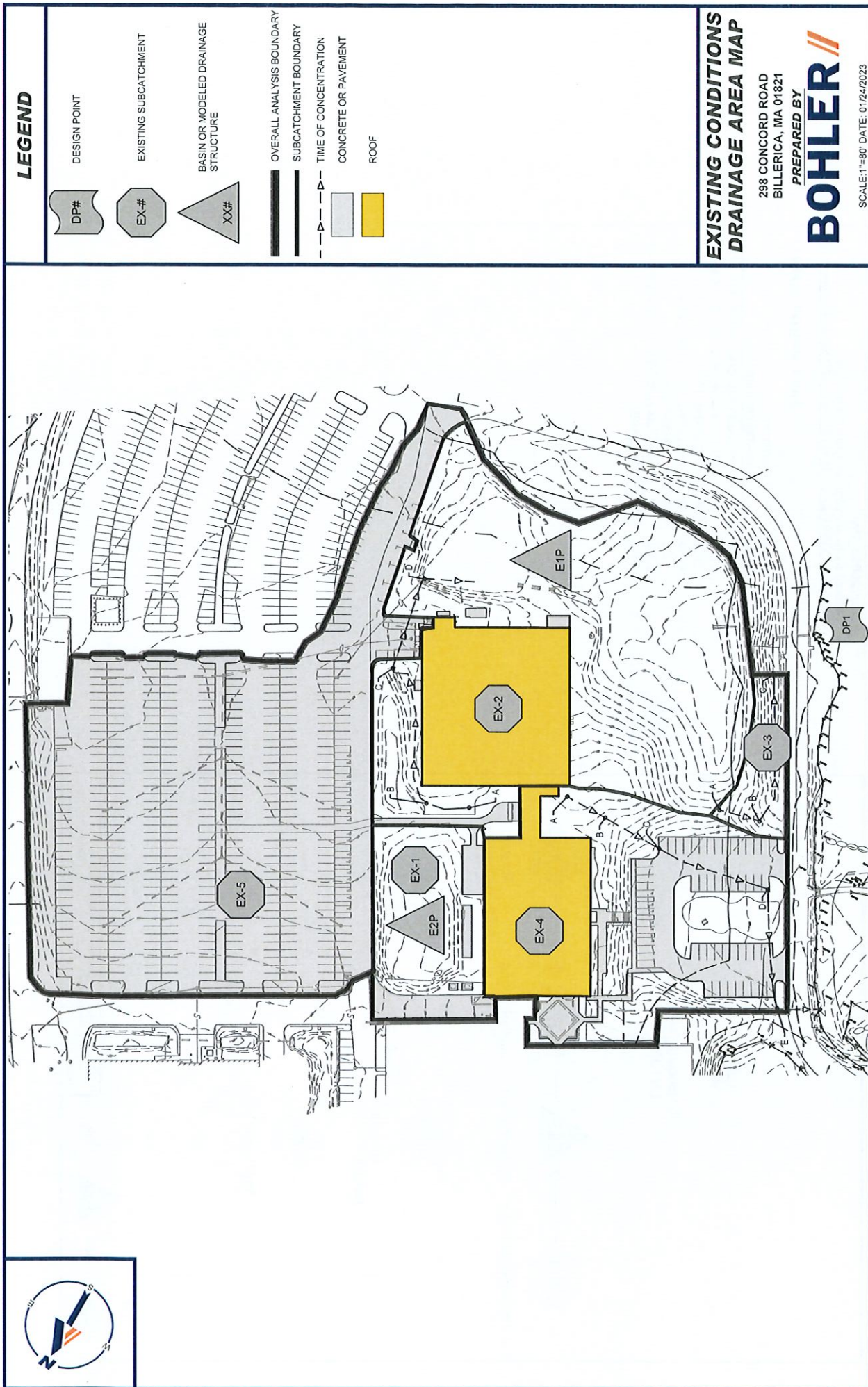
294 CONCORD ROAD
DILLERICA, MASSACHUSETTS

PREPARED BY BOHLER

SCALE: 1"=80' DATE: 12/21/2022

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- EXISTING CONDITIONS DRAINAGE MAP
- EXISTING CONDITIONS HYDROCAD COMPUTATIONS



LEGEND

- DESIGN POINT
DP#
- EXISTING SUBCATCHMENT
EX-#
- BASIN OR MODELED DRAINAGE STRUCTURE
XX#
- OVERALL ANALYSIS BOUNDARY
SUBCATCHMENT BOUNDARY
- TIME OF CONCENTRATION
- CONCRETE OR PAVEMENT
- ROOF

**EXISTING CONDITIONS
DRAINAGE AREA MAP**

298 CONCORD ROAD
BILLERICA, MA 01821

PREPARED BY

BOHLER

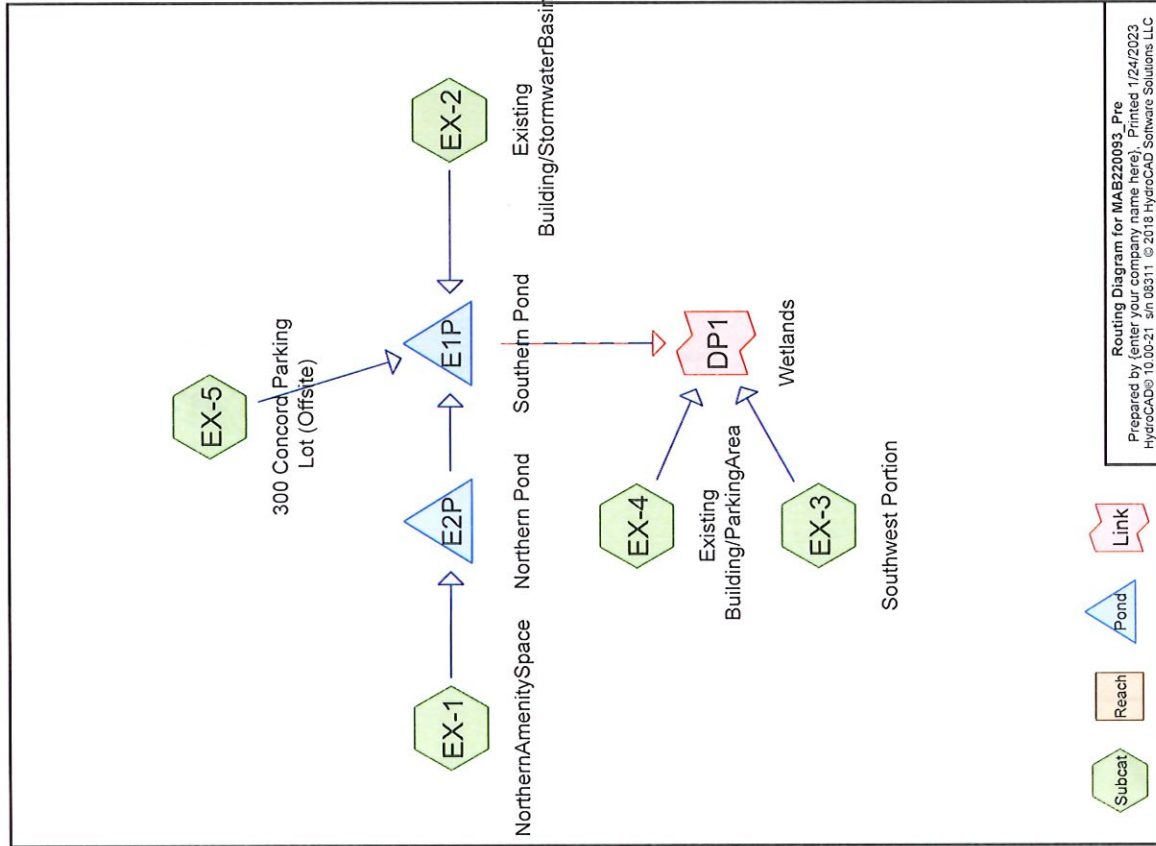
SCALE: 1"=80' DATE: 01/24/2023

MAB220093_Pre

Prepared by (enter your company name here)
HydroCAD® 10.00-21 s/n 08311 © 2018 HydroCAD Software Solutions LLC Printed 1/24/2023 Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.497	39	>75% Grass cover, Good, HSG A (EX-1, EX-4, EX-5)
0.272	61	>75% Grass cover, Good, HSG B (EX-5)
3.636	98	Paved parking (EX-5)
0.953	98	Paved parking, HSG A (EX-1, EX-2, EX-4)
1.282	98	Roofs, HSG A (EX-2, EX-4)
2.832	32	Woods/grass comb., Good, HSG A (EX-2, EX-3)
10.471	71	TOTAL AREA



Summary for Subcatchment EX-2: Existing Building/StormwaterBasin

Runoff = 0.02 cfs @ 15.65 hrs, Volume= 0.010 af, Depth= 0.04"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 1-yr Rainfall=2.61"

Area (sf)	CN	Description
31,607	98	Roofs, HSG A
9,433	98	Paved parking, HSG A
113,702	32	Woods/grass comb., Good, HSG A
154,742	50	Weighted Average
113,702		73.48% Pervious Area
41,040		26.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0020	0.06		Sheet Flow, A-B
3.4	160	0.0129	0.80		Grass, Short n= 0.150 P2= 3.13"
0.3	109	0.0129	6.70	5.26	Shallow Concentrated Flow, B-C
					Short Grass Pasture Kv= 7.0 fps
					Pipe Channel, RCP, Round 12"
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
					n= 0.010 PVC, smooth interior
					Shallow Concentrated Flow, Pipe to bottom of pond
					Woodland Kv= 5.0 fps
22.2	375	Total			

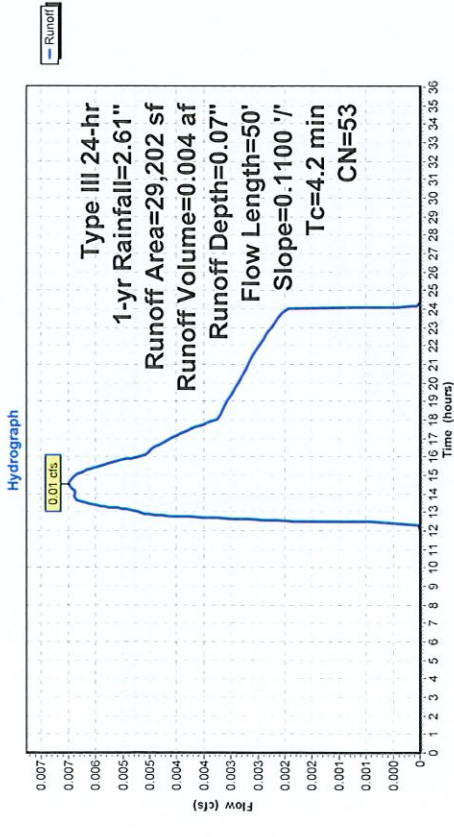
Summary for Subcatchment EX-1: NorthernAmenitySpace

Runoff = 0.01 cfs @ 14.55 hrs, Volume= 0.004 af, Depth= 0.07"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 1-yr Rainfall=2.61"

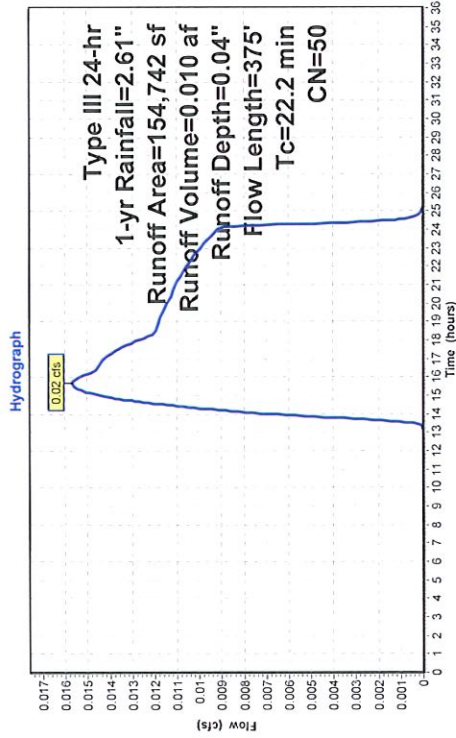
Area (sf)	CN	Description
6,712	98	Paved parking, HSG A
22,490	39	>75% Grass cover, Good, HSG A
29,202	53	Weighted Average
22,490		77.02% Pervious Area
6,712		22.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.1100	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.13"

Subcatchment EX-1: NorthernAmenitySpace



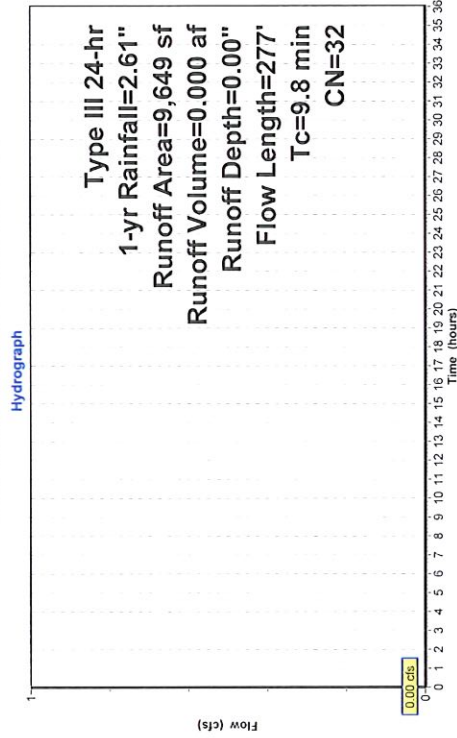
Subcatchment EX-2: Existing Building/StormwaterBasin



Summary for Subcatchment EX-3: Southwest Portion

Runoff	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af,	Depth=	0.00"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs							
Type III 24-hr 1-yr Rainfall=2.61"							
Area (sf)		CN	Description				
9,649		32	Woods/grass comb., Good, HSG A				
9,649		100.00% Pervious Area					
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description		
5.0	59	0.1000	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.13"		
4.8	218	0.0116	0.75		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps		
9.8	277	Total					

Subcatchment EX-3: Southwest Portion

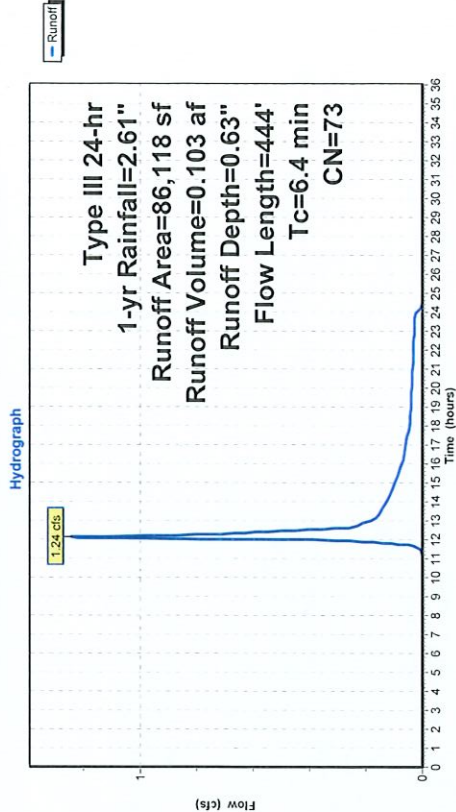


Summary for Subcatchment EX-4: Existing Building/ParkingArea

Runoff = 1.24 cfs @ 12.11 hrs, Volume= 0.103 af, Depth= 0.63"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
 Type III 24-hr 1-yr Rainfall=2.61"

Area (sf)	CN	Description			
24,221	98	Roofs, HSG A			
25,378	98	Paved parking, HSG A			
36,519	39	>75% Grass cover, Good, HSG A			
86,118	73	Weighted Average			
36,519		42.41% Pervious Area			
49,599		57.59% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		Sheet Flow, Grass: Short n= 0.150 P2= 3.13"
0.6	70	0.0850	2.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.7	134	0.0246	3.18		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	139	0.0140	5.81	4.57	Pipe Channel, RCP_Round 12" 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.4	51	0.0009	2.34	7.35	Pipe Channel, RCP_Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
6.4	444	Total			

Subcatchment EX-4: Existing Building/ParkingArea



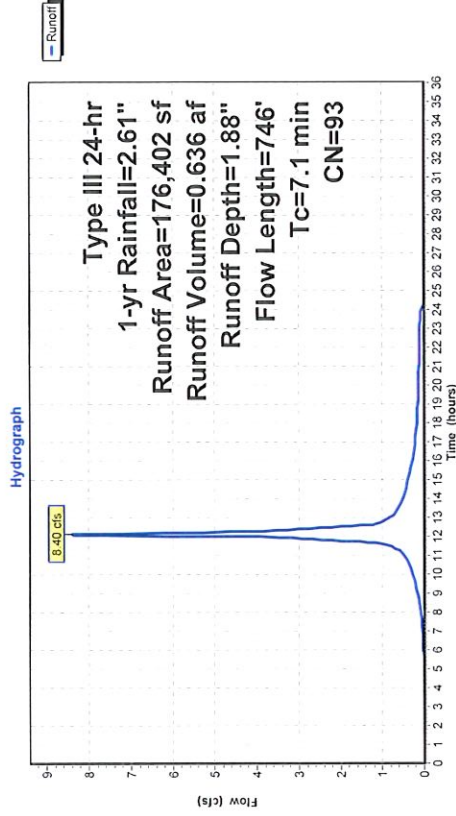
Summary for Subcatchment EX-5: 300 Concord Parking Lot (Offsite)

Runoff = 8.40 cfs @ 12.10 hrs, Volume= 0.636 af, Depth= 1.88"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
 Type III 24-hr 1-yr Rainfall=2.61"

Area (sf)	CN	Description
11,835	61	>75% Grass cover, Good, HSG B
158,372	98	Paved parking
6,195	39	>75% Grass cover, Good, HSG A
176,402	93	Weighted Average
18,030		10.22% Pervious Area
158,372		89.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	39	0.0610	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.13"
2.0	199	0.0227	1.64		Sheet Flow, B-C Smooth surfaces n= 0.011 P2= 3.13"
0.7	149	0.0047	3.37	2.65	Pipe Channel, C-D 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.3	95	0.0095	6.28	11.09	Pipe Channel, D-E 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
0.8	163	0.0018	3.31	10.40	Pipe Channel, E-F 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
0.3	101	0.0059	5.99	18.82	Pipe Channel, F-G 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
7.1	746	Total			

Subcatchment EX-5: 300 Concord Parking Lot (Offsite)



Summary for Pond E1P: Southern Pond

Inflow Area = 8.272 ac, 57.20% Impervious, Inflow Depth = 0.94" for 1-yr event
Inflow = 8.40 cfs @ 12.10 hrs, Volume= 0.649 af
Outflow = 3.17 cfs @ 12.37 hrs, Volume= 0.649 af, Atten= 62%, Lag= 16.2 min
Discarded = 0.59 cfs @ 12.37 hrs, Volume= 0.100 af
Primary = 2.59 cfs @ 12.37 hrs, Volume= 0.550 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 182.68' @ 12.37 hrs Surf.Area= 10,525 sf Storage= 4,950 cf

Plug-Flow detention time= 10.0 min calculated for 0.649 af (100% of inflow)
Center-of-Mass det. time= 10.0 min (817.5 - 807.4)

Volume				Storage Description	
		Invert	Avail.Storage	Custom Stage Data (Prismatic) Listed below (Recalc)	
#1	182.00'	182.00'	125.224 cf		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)		
182.00	4,062	0	0		
183.00	13,585	8,824	8,824		
184.00	23,965	18,775	27,599		
185.00	32,014	27,990	55,588		
186.00	39,111	35,563	91,151		
186.20	4,802	4,391	95,542		
187.00	9,192	5,598	101,139		
188.00	12,047	10,620	111,759		
189.00	14,884	13,466	125,224		

Device	Routing	Invert	Outlet Devices
#1	Discarded	182.00'	2.410 in/hr Exfiltration over Surface area
#2	Secondary	186.00'	35.0' long x 8.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64
			2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#3	Primary	179.70'	15.0" Round Culvert
			L= 95.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 179.70' / 178.50' S= 0.0126' / Cc= 0.900
#4	Device 3	182.30'	8.0" Vert. Orifice/Grate
#5	Device 3	180.70'	8.0" Vert. Orifice/Grate C= 0.600
			8.0" Vert. Orifice/Grate C= 0.600

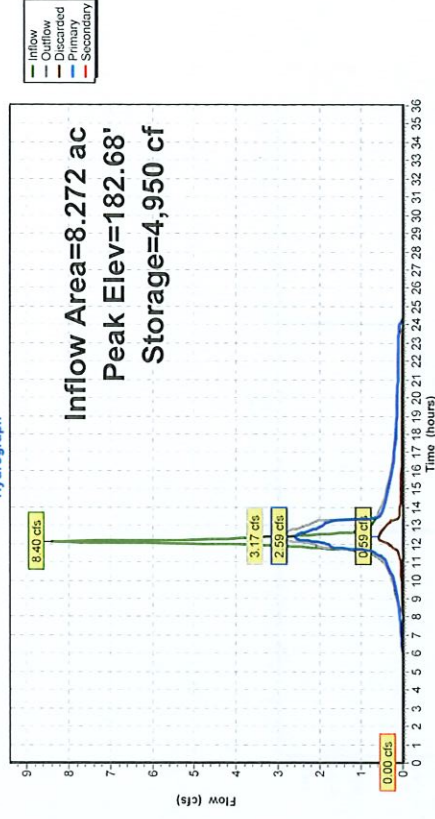
Discarded OutFlow Max=0.59 cfs @ 12.37 hrs HW=182.68' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.59 cfs)

Primary OutFlow Max=2.58 cfs @ 12.37 hrs HW=182.68' (Free Discharge)
3=Culvert (Passes 2.58 cfs of 9.06 cfs potential flow)
4=Orifice/Grate (Orifice Controls 0.43 cfs @ 2.09 fps)
5=Orifice/Grate (Orifice Controls 2.16 cfs @ 6.18 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=182.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond E1P: Southern Pond

Hydrograph



Summary for Pond E2P: Northern Pond

Inflow Area = 0.670 ac, 22.98% Impervious, Inflow Depth = 0.07" for 1-yr event
 Inflow = 0.01 cfs @ 14.55 hrs, Volume= 0.004 af
 Outflow = 0.01 cfs @ 14.57 hrs, Volume= 0.004 af, Atten= 0%, Lag= 1.3 min
 Discarded = 0.00 cfs @ 14.57 hrs, Volume= 0.000 af
 Primary = 0.01 cfs @ 14.57 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
 Peak Elev= 189.00' @ 14.57 hrs Surf.Area= 2,163 sf Storage= 1 cf
 Plug-Flow detention time= 1.4 min calculated for 0.004 af (100% of inflow)
 Center-of-Mass det. time= 1.4 min (1,042.9 - 1,041.6)

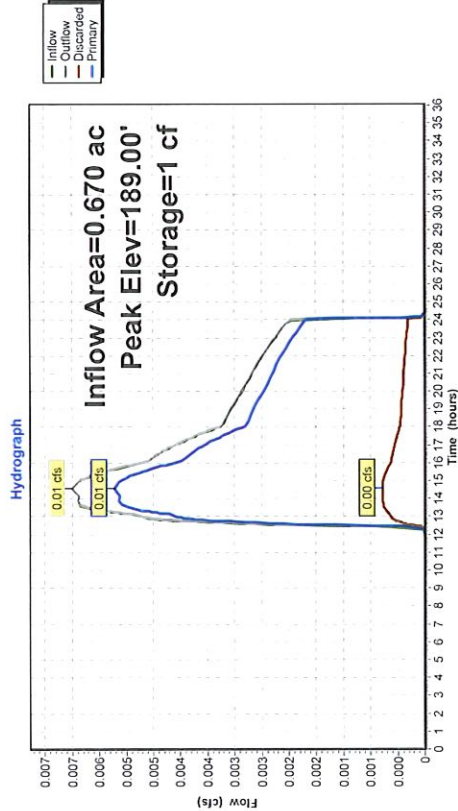
Volume	Invert	Avail. Storage	Storage Description
#1	189.00'	45,190 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
189.00	2,162	0	0
190.00	7,890	5,026	5,026
191.00	11,894	9,792	14,818
192.00	14,847	13,271	28,089
193.00	19,355	17,101	45,190

Device	Routing	Invert	Outlet Devices
#1	Discarded	189.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	189.00'	50.0' long x 8.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64
			2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Discarded OutFlow Max=0.12 cfs @ 14.57 hrs HW=189.00' (Free Discharge)
 1=Exfiltration (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 14.57 hrs HW=189.00' (Free Discharge)
 2=Broad-Crested Rectangular Weir (Weir Controls 0.00 cfs @ 0.04 fps)

Pond E2P: Northern Pond



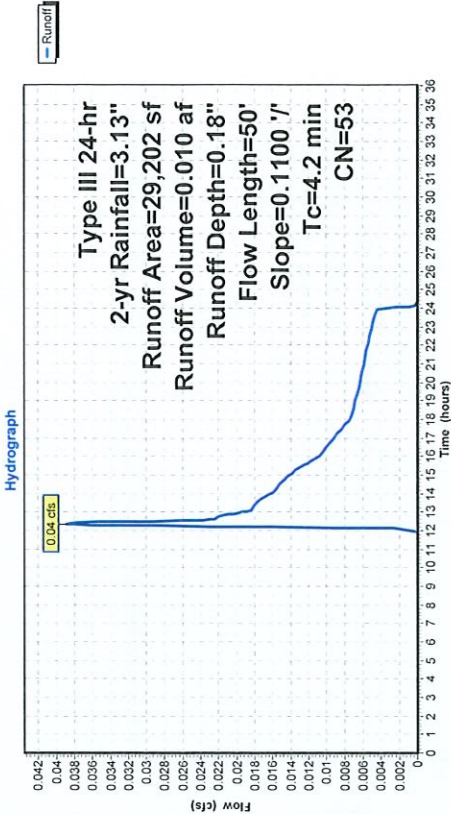
Summary for Subcatchment EX-1: NorthernAmenitySpace

Runoff = 0.04 cfs @ 12.37 hrs, Volume= 0.010 af, Depth= 0.18"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-yr Rainfall=3.13"

Area (sf)	CN	Description
6,712	98	Paved parking, HSG A
22,490	39	>75% Grass cover, Good, HSG A
29,202	53	Weighted Average
22,490		77.02% Pervious Area
6,712		22.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.1100	0.20		
					Sheet Flow,
					Grass: Dense n= 0.240 P2= 3.13"

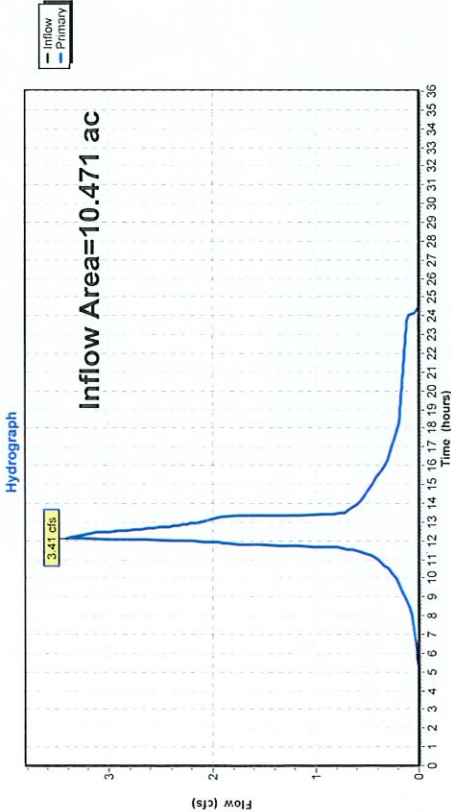
Subcatchment EX-1: NorthernAmenitySpace



Summary for Link DP1: Wetlands

Inflow Area = 10.471 ac, 56.07% Impervious, Inflow Depth = 0.75" for 1-yr event
Inflow = 3.41 cfs @ 12.14 hrs, Volume= 0.653 af
Primary = 3.41 cfs @ 12.14 hrs, Volume= 0.653 af, Atten= 0%, Lag= 0.0 min
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

Link DP1: Wetlands



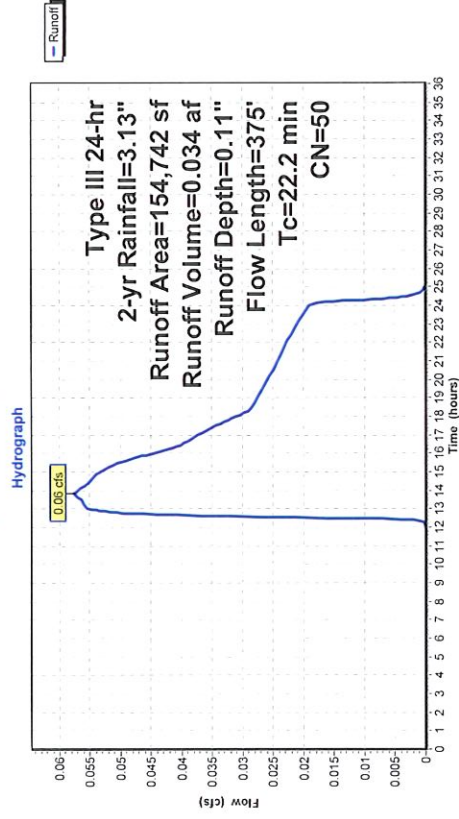
Summary for Subcatchment EX-2: Existing Building/StormwaterBasin

Runoff = 0.06 cfs @ 13.83 hrs, Volume= 0.034 af, Depth= 0.11"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
 Type III 24-hr 2-yr Rainfall=3.13"

Area (sf)	CN	Description
31,607	98	Roofs, HSG A
9,433	98	Paved parking, HSG A
113,702	32	Woods/grass comb., Good, HSG A
154,742	50	Weighted Average
113,702		73.48% Pervious Area
41,040		26.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0020	0.06		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.13"
3.4	160	0.0129	0.80		Shallow Concentrated Flow, B-C Short Grass Pasture Kv= 7.0 fps
0.3	109	0.0129	6.70	5.26	Pipe Channel, RCP, Round 12" 12.0' Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
4.2	56	0.0020	0.22		Shallow Concentrated Flow, Pipe to bottom of pond Woodland Kv= 5.0 fps
22.2	375	Total			

Subcatchment EX-2: Existing Building/StormwaterBasin



Summary for Subcatchment EX-4: Existing Building/Parking Area

Runoff = 1.99 cfs @ 12.10 hrs, Volume= 0.155 af, Depth= 0.94"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-yr Rainfall=3.13"

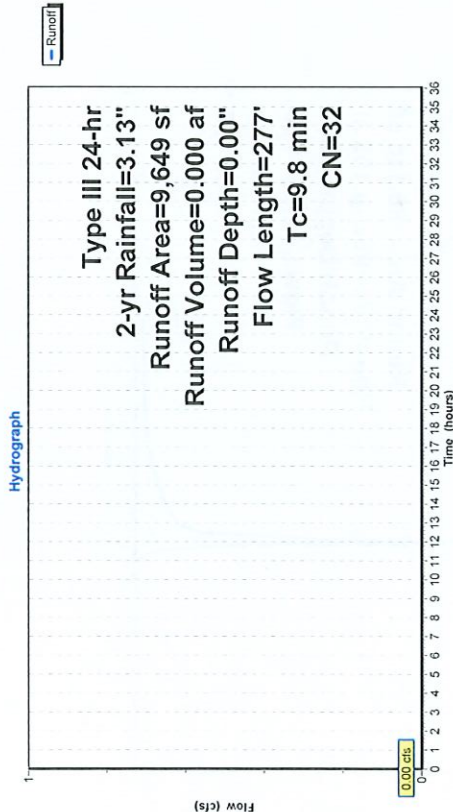
Area (sf)	CN	Description			
24,221	98	Roofs, HSG A			
25,378	98	Paved parking, HSG A			
36,519	39	>75% Grass cover, Good, HSG A			
86,118	73	Weighted Average			
36,519		42.41% Pervious Area			
49,599		57.59% Impervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		Sheet Flow, Grass: Short n= 0.150 P2= 3.13"
0.6	70	0.0850	2.04		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
0.7	134	0.0246	3.18		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	139	0.0140	5.81	4.57	Pipe Channel, RCP, Round 12" 12.0" Round Area= 0.8 sf Perim= 3.1' n= 0.012 Corrugated PP, smooth interior
0.4	51	0.0009	2.34	7.35	Pipe Channel, RCP, Round 24" 24.0" Round Area= 3.1 sf Perim= 6.3' n= 0.012 Corrugated PP, smooth interior

Summary for Subcatchment EX-3: Southwest Portion

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-yr Rainfall=3.13"

Area (sf)		CN	Description		
9,649	32	Woods/grass comb., Good, HSG A			
9,649		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	59	0.1000	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.13" Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
4.8	218	0.0116	0.75		

Subcatchment EX-3: Southwest Portion



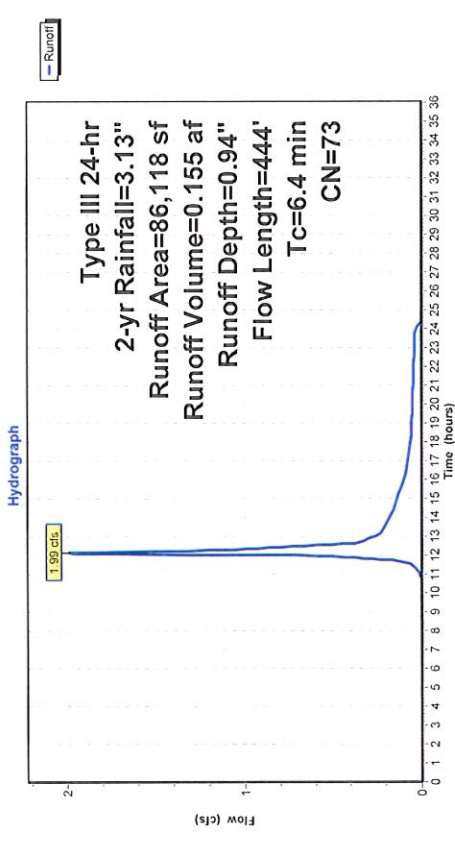
Summary for Subcatchment EX-5: 300 Concord Parking Lot (Offsite)

Runoff = 10.50 cfs @ 12.10 hrs, Volume= 0.803 af, Depth= 2.38"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 2-yr Rainfall=3.13"

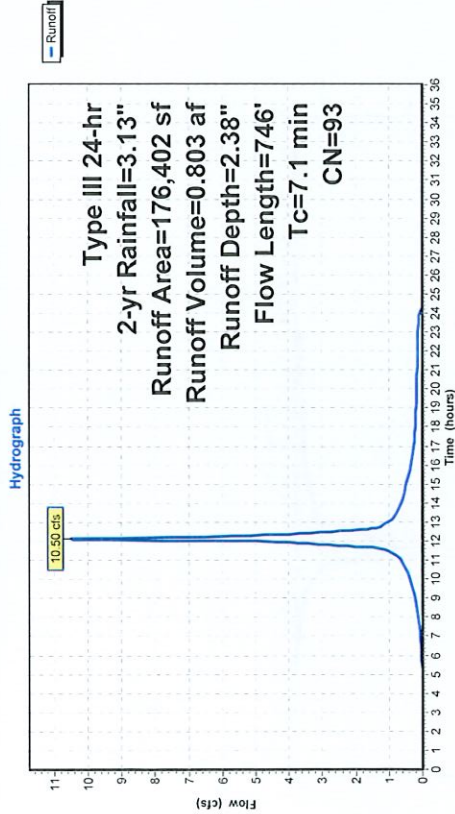
Area (sf)	CN	Description
11,835	61	>75% Grass cover, Good, HSG B
158,372	98	Paved parking
6,195	39	>75% Grass cover, Good, HSG A
176,402	93	Weighted Average
18,030		10.22% Pervious Area
158,372		89.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	39	0.0610	0.22		Sheet Flow, A-B Grass: Short n= 0.150 P2= 3.13"
2.0	199	0.0227	1.64		Sheet Flow, B-C Smooth surfaces, n= 0.011 P2= 3.13"
0.7	149	0.0047	3.37	2.65	Pipe Channel, C-D 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.3	95	0.0095	6.28	11.09	Pipe Channel, D-E 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
0.8	163	0.0018	3.31	10.40	Pipe Channel, E-F 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
0.3	101	0.0059	5.99	18.82	Pipe Channel, F-G 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Concrete pipe, finished
7.1	746	Total			

Subcatchment EX-4: Existing Building/ParkingArea



Subcatchment EX-5: 300 Concord Parking Lot (Offsite)



Summary for Pond E1P: Southern Pond

Inflow Area = 8.272 ac, 57.20% Impervious, Inflow Depth = 1.23" for 2-yr event
Inflow = 10.50 cfs @ 12.10 hrs, Volume= 0.845 af
Outflow = 3.74 cfs @ 12.39 hrs, Volume= 0.845 af, Atten= 64%, Lag= 17.4 min
Discarded = 0.66 cfs @ 12.39 hrs, Volume= 0.132 af
Primary = 3.06 cfs @ 12.39 hrs, Volume= 0.714 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 182.86' @ 12.39 hrs Surf.Area= 12,214 sf Storage= 6,966 cf

Plug-Flow detention time= 12.3 min calculated for 0.845 af (100% of inflow)
Center-of-Mass det. time= 12.3 min (818.3 - 806.0)

Volume		Invert	Avail.Storage	Storage Description
#1	182.00'	Surf.Area	Inc.Store	Cum.Store
Elevation (feet)	(sq-ft)	(cubic-feet)	(cubic-feet)	
182.00	4,062	0	0	0
183.00	13,585	8,824	8,824	8,824
184.00	23,965	18,775	27,599	27,599
185.00	32,014	27,990	55,588	55,588
186.00	39,111	35,563	91,151	91,151
186.20	4,802	4,391	95,542	95,542
187.00	9,192	5,598	101,139	101,139
188.00	12,047	10,620	111,759	111,759
189.00	14,884	13,466	125,224	125,224

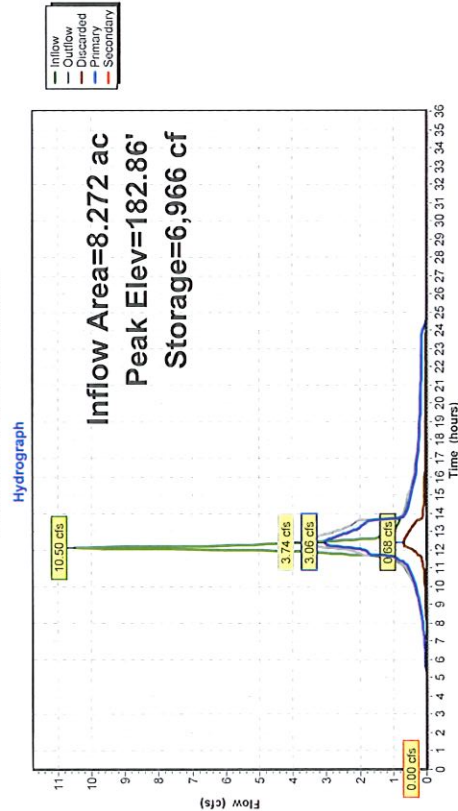
Device Routing		Invert	Outlet Devices
#1	Discarded	182.00'	2.410 in/hr Exfiltration over Surface area
#2	Secondary	186.00'	35.0' long x 8.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64
			2.64 2.65 2.65 2.66 2.66 2.66 2.70 2.74
#3	Primary	179.70'	15.0" Round Culvert
			L= 95.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 179.70' / 178.50' S= 0.0126' / Cc= 0.900
#4	Device 3	182.30'	n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#5	Device 3	180.70'	8.0" Vert. Orifice/Grate C= 0.600
			8.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.68 cfs @ 12.39 hrs HW=182.86' (Free Discharge)
└─1=Exfiltration (Exfiltration Controls 0.68 cfs)

Primary OutFlow Max=3.06 cfs @ 12.39 hrs HW=182.86' (Free Discharge)
└─3=Culvert (Passes 3.06 cfs of 9.40 cfs potential flow)
└─4=Orifice/Grate (Orifice Controls 0.79 cfs @ 2.54 fps)
└─5=Orifice/Grate (Orifice Controls 2.27 cfs @ 6.50 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=182.00' (Free Discharge)
└─2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond E1P: Southern Pond



Summary for Pond E2P: Northern Pond

Inflow Area = 0.670 ac, 22.98% Impervious, Inflow Depth = 0.18" for 2-yr event
Inflow = 0.04 cfs @ 12.37 hrs, Volume= 0.010 af
Outflow = 0.04 cfs @ 12.39 hrs, Volume= 0.010 af, Atten= 1%, Lag= 1.4 min
Discarded = 0.00 cfs @ 12.39 hrs, Volume= 0.001 af
Primary = 0.03 cfs @ 12.39 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 189.00' @ 12.39 hrs Surf Area= 2,170 sf Storage= 3 cf

Plug-Flow detention time= 1.4 min calculated for 0.010 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (979.5 - 978.2)

Volume		Invert	Avail Storage	Storage Description
#1	189.00'		45,190 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
189.00	2,162	0	0	
190.00	7,890	5,026	5,026	
191.00	11,694	9,792	14,818	
192.00	14,847	13,271	28,089	
193.00	19,355	17,101	45,190	

Device		Routing	Invert	Outlet Devices
#1	Discarded	189.00'		2,410 in/hr Exfiltration over Surface area
#2	Primary	189.00'		50.0' long x 8.0' breadth Broad-Crested Rectangular Weir
		Head (feet)	0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00	
		2.50 3.00 3.50 4.00 4.50 5.00 5.50		
		Coef. (English)	2.43 2.54 2.70 2.69 2.68 2.68 2.68 2.64 2.64 2.64	
			2.64 2.65 2.66 2.66 2.66 2.66 2.70 2.74	

Discarded OutFlow Max=0.12 cfs @ 12.39 hrs HW=189.00' (Free Discharge)
└─1=Exfiltration (Exfiltration Controls 0.12 cfs)

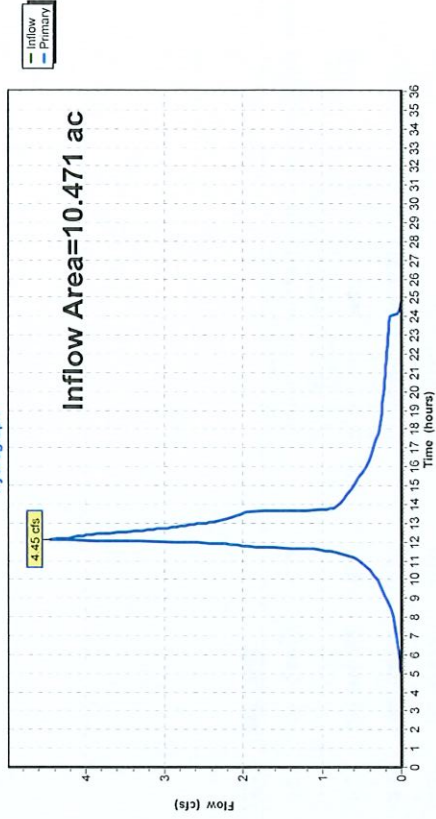
Primary OutFlow Max=0.01 cfs @ 12.39 hrs HW=189.00' (Free Discharge)
└─2=Broad-Crested Rectangular Weir (Weir Controls 0.01 cfs @ 0.09 fps)

Summary for Link DP1: Wetlands

Inflow Area = 10.471 ac, 56.07% Impervious, Inflow Depth = 1.00" for 2-yr event
Inflow = 4.45 cfs @ 12.13 hrs, Volume= 0.868 af
Primary = 4.45 cfs @ 12.13 hrs, Volume= 0.868 af, Atten= 0%, Lag= 0.0 min
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

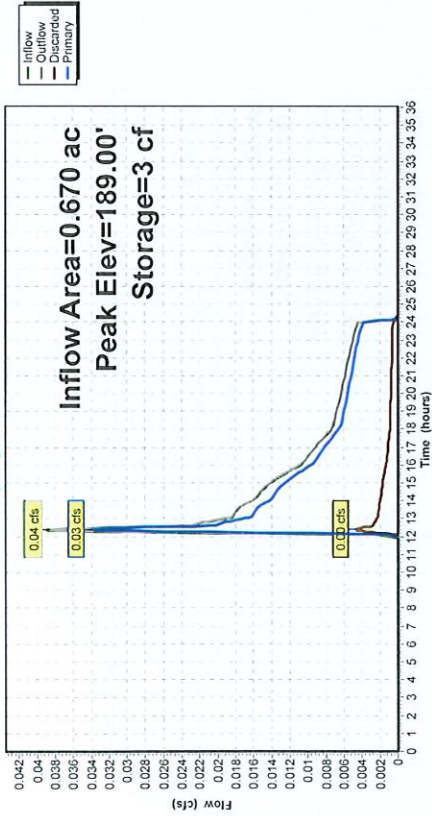
Link DP1: Wetlands

Hydrograph



Pond E2P: Northern Pond

Hydrograph



Summary for Subcatchment EX-2: Existing Building/StormwaterBasin

Runoff = 0.97 cfs @ 12.46 hrs, Volume= 0.173 af, Depth= 0.59"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-yr Rainfall=4.73"

Area (sf)	CN	Description
31,607	98	Roofs, HSG A
9,433	98	Paved parking, HSG A
113,702	32	Woods/grass comb., Good, HSG A
154,742	50	Weighted Average
113,702		73.48% Pervious Area
41,040		26.52% Impervious Area

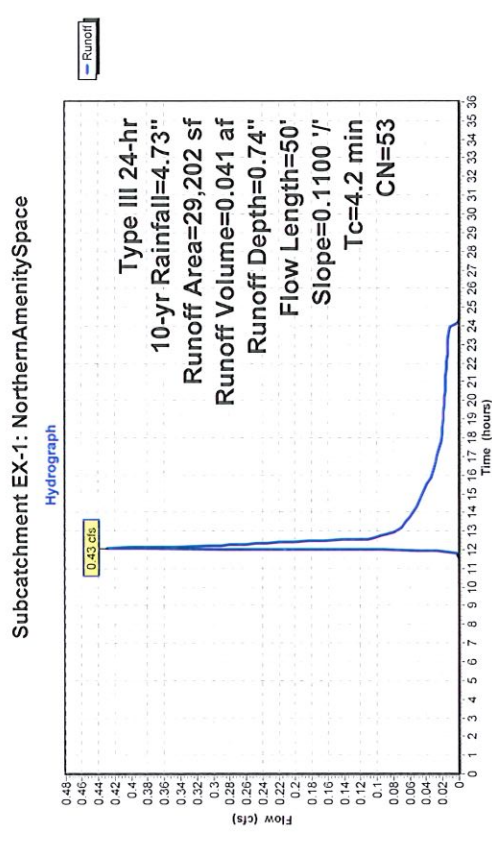
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0020	0.06		Sheet Flow, A-B
3.4	160	0.0129	0.80		Grass: Short n= 0.150 P2= 3.13"
0.3	109	0.0129	6.70	5.26	Shallow Concentrated Flow, B-C
					Short Grass Pasture Kv= 7.0 fps
					Pipe Channel, RCP Round 12"
					n= 0.010 PVC, smooth interior
4.2	56	0.0020	0.22		Shallow Concentrated Flow, Pipe to bottom of pond
22.2	375	Total			Woodland Kv= 5.0 fps

Summary for Subcatchment EX-1: NorthernAmenitySpace

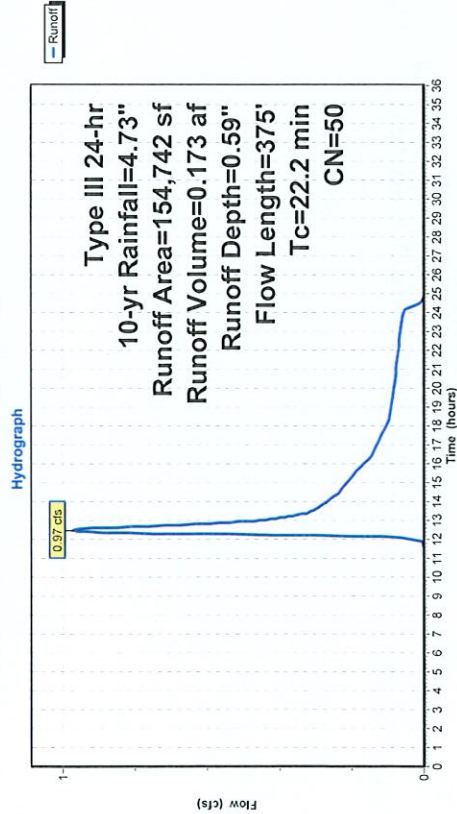
Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.041 af, Depth= 0.74"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Type III 24-hr 10-yr Rainfall=4.73"

Area (sf)	CN	Description
6,712	98	Paved parking, HSG A
22,490	39	>75% Grass cover, Good, HSG A
29,202	53	Weighted Average
22,490		77.02% Pervious Area
6,712		22.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	50	0.1100	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.13"



Subcatchment EX-2: Existing Building/StormwaterBasin



Summary for Subcatchment EX-3: Southwest Portion

Runoff = 0.00 cfs @ 22.73 hrs, Volume= 0.000 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs

Type III 24-hr 10-yr Rainfall=4.73"

Area (sf)	CN	Description			
9,649	32	Woods/grass comb., Good, HSG A			
9,649		100.00% Pervious Area			
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	59	0.1000	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.13"
4.8	218	0.0116	0.75		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
9.8	277	Total			

Subcatchment EX-3: Southwest Portion

