Stormwater Management Report

975 Massachusetts Ave
Boxborough, MA

May 2025

Prepared for:
BHG109 LLC
881 Massachusetts Ave, Unit A
Boxborough, MA 01719

Prepared by:
Goldsmith, Prest & Ringwall, Inc.
39 Main Street, Suite 301
Ayer, MA 01432

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1. Introduction

The Project includes a stormwater management system designed to mitigate peak runoff rates, enhance water quality, and provide groundwater recharge in compliance with the 2008 Massachusetts Department of Environmental Protection Stormwater Handbook (2008 Handbook), and the Boxborough Stormwater Management Rules and Regulations for Construction and Post-Construction Activities, as adopted by the Boxborough Planning Board on August 1, 2022.

The design goals of the stormwater management system are:

- Provide effective drainage for all new surfaces.
- Maintain stormwater runoff rates for the 2-, 10-, 25-, 50-, and 100-year storm events at current levels in accordance with the latest Northeast Regional Climate Center extreme precipitation data.
- Achieve an overall site average annual pollutant removal equivalent to 90% of the average annual load of Total Suspended Solids (TSS) and 60% of the average annual load of Total Phosphorus (TP) related to the total post-construction impervious area on the site, which can be achieved through retaining the volume of runoff equivalent to, or greater than, 1.0 inch multiplied by the total post-construction impervious surface area on the new development site.
- Prevent degradation of water quality by controlling sediment, suspended solids, and contaminants through on-site stormwater control measures (SCMs) and source control.
- Preserve existing drainage patterns while delivering a cost-effective solution that meets regulatory and physical constraints.
- Establish construction-phase erosion and sediment controls, including inspection and maintenance protocols, to protect downstream waters.
- Develop a comprehensive long-term pollution prevention and operation and maintenance plan, to ensure effective pollution source control and system upkeep.

2. Existing Conditions

The Site is an existing 6.16± acres undeveloped land that consists of primarily woodland vegetation with frontage along Massachusetts Ave. The Site's topography features a hill located at the northern center of the site that generally slopes downward toward the street and abutting properties.

There is an existing culvert located at the corner of Sara's way and Mass Ave that has a discharge pipe out an existing stone wall onto the subject site. Said outlet is buried but appears to be intended to discharge onto a man-made drainage channel that runs parallel to Mass Ave on the subject site. The existing drainage appears to collect most of the Site's surface runoff and appears to flow from a high point location near the eastern property line, towards the west following the natural slope down to the abutting property. There is a strip of wetland area following the path of the drainage channel, said wetland area has been flagged by a wetland scientist and field surveyed along with the rest of the subject site.

Runoff from the site currently drains to two primary locations: the abutting properties in which the onsite drainage channel is discharging onto. These design points have been named correspondingly in the hydrologic analyses.

2.1. Regional Watershed

The site is located within the Merrimack Basin Watershed and is located within the Northeast Regional Mercury TMDL.

2.2. Critical Areas

Critical Areas require enhanced treatment and use of specific stormwater control measures (SCMs) in line with Standard 6 of the Handbook. These typically include treating the first inch of runoff with designated SCMs, pre-treatment, and implementing source control and pollution prevention measures.

The site contains an existing Bordering Vegetated Wetland area that is considered as a Class B Outstanding Resource Water due to its hydraulic connection to an existing Certified Vernal Pool located on the abutting property.

2.3. Soils

The on-site soils are classified by the National Resource Conservation Service (NRCS) as Hollis-Rock Outcrop-Charlton Complex, a moderately-drained, moderately permeable Hydrologic Class B soil with shallow depth to restrictive feature; and Scituate fine sandy loam, a type of soil classification with similar features as the Hollis-Rock Outcrop-Charlton Complex.

Onsite soil evaluation was performed by a licensed soil evaluator from this office during October of 2024 to locate onsite subsurface soil absorption system and to confirm NRCS soil textures, bedrock depths, estimated seasonal high groundwater elevations, and permeability data for stormwater management system design. Soil inspections revealed topsoil and subsoil layers with fine sandy loam textures, underlain by outwash deposits of loamy fine sand texture with varying depth to ledge. Seasonal high groundwater was observed in the range of 28 to 32-inch depths. Due to the shallow depth of groundwater and ledge, the on-site soils are considered as Hydrologic Class D soil, therefore the project is required to provide recharge volume to the maximum extent practicable.

3. Proposed Conditions

The project proposes to construct a commercial building near the center of the Site, associated parking spaces, and a driveway access off Mass Ave, crossing the strip of drainage channel and its adjacent Bordering Vegetated Wetland.

The site design prioritizes preserving environmentally sensitive features and minimizing disruptions to natural hydrology. To help retain natural drainage patterns the grading was limited, and the layout was tailored to closely follow the existing terrain wherever feasible.

The project proposes an onsite stormwater management system to address the increase in stormwater peak runoff rates, and treats runoff from the proposed impervious surfaces. To manage increased flow rates, a subsurface detention storage is proposed Wet Basin.

All stormwater control measures (SCMs) are designed to treat at least the first 1.0 inch of runoff from impervious areas. Proprietary water quality treatment structures are included and sized to handle the required water quality volume in compliance with the 2008 DEP Stormwater Handbook.

The proposed storm drain system was analyzed using standard engineering methods, including the Rational Formula, based on the 25-year storm event. A watershed map and detailed hydraulic calculations are provided in Attachment 2 and 3.

3.1. Stormwater Control Measures

Subsurface Detention Storage

The subsurface detention storage consists of underground 48” HDPE pipes, which is wrapped in geosynthetic material. Collected stormwater will be retain within said structure and slowly discharge out a Stormtech Jellyfish System to treat discharge.

Wet Basin

The Wet Basin is an open surface basin with a permanent pool to allow for sediment to settle and provide stormwater detention to reduce peak discharge rate. Discharge from the wet basin will be done through an outlet control structure and an overflow weir to allow for stormwater to continue through natural vegetation prior to reaching the on-site wetland area. Bottom of the Wet Basin has been set to a depth where signs of groundwater mottling were found in test pits, in order to ensure a permanent pool is being maintained.

4. Compliance with the 2008 Handbook Standards

The stormwater management system complies with the ten (10) Standards outlined in the 2008 Handbook, as summarized below:

STANDARD 1: No New Untreated Discharges or Erosions to Wetlands

Untreated stormwater will not be discharged directly into nearby wetlands or waters of the Commonwealth. Runoff from all impervious surfaces will be routed through SCMs designed for flow rate reduction and water quality treatment being released to the adjacent wetlands.

STANDARD 2: Peak Runoff Rate Attenuation

The stormwater management system is designed to ensure that peak discharge rates for the 2-, 10-, 25- and 100-year, 24-hour storm events under proposed conditions do not exceed existing levels. A hydrologic analysis of existing and proposed conditions is included in Attachment 2 and 3. A summary of peak runoff rates is provided in Table 1:

Table 1: Peak Runoff Rate Comparison (cfs)

	2-Year		10-Year		25-Year		50-Year		100-Year	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Analysis Point 1	7.72	7.57	16.89	15.86	27.50	21.23	27.50	25.67	32.49	31.53

The hydrologic models were based on “NOAA Atlas 14, Volume 10, Version 3, Point Precipitation Frequency Estimates” dated March 2025. Table 2 provides a listing of the rainfall intensity values used.

Table 2: Rainfall Intensity

Storm Event	Intensity (In/hr)
2-Year	3.23
10-Year	4.98
25-year	6.06
50-year	6.84
100-year	7.74

STANDARD 3: Groundwater Recharge

Due to the underlying shallow depth of restrictive features such as groundwater mottling and ledge, groundwater recharge is not practicable.

STANDARD 4: Water Quality

The project will comply with Standard 4 water quality requirements through on-site treatment trains achieving 80% TSS removal. See Appendix 5 for TSS removal worksheets. SCMs, such as deep sump hooded catch basins, and Contech Stormfilter, sediment forebay and wet basin, all of which are designed to capture and treat the first 1.0 inch of runoff from proposed impervious surfaces. All SCMs will be operated and maintained to ensure ongoing water quality treatment.

A Long-Term Pollution Prevention Plan has been developed to outline source control and pollution prevention measures. This plan is integrated with the Operation and Maintenance Plan (Standard 9), which specifies maintenance requirements for the SCMs.

STANDARD 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

This standard does not apply since the project does not involve any LUHPPLs.

STANDARD 6: Critical Areas

The SMCs align with the 2008 Handbook requirements for critical area. The stormwater management system is designed to capture and treat the first 1.0 inch of runoff. Proposed water quality treatment measures include street sweeping, deep sump hooded catch basins, and Stormtech Jellyfish system, Stormtech Filtera system, sediment forebay and wet basin.

STANDARD 7: Redevelopment

This standard does not apply since the Project is not a redevelopment.

STANDARD 8: Construction Period Pollution Prevention

The project will disturb more than one acre of land, requiring coverage under the Environmental Protection Agency's Construction General Permit and the development of a Stormwater Pollution Prevention Plan (SWPPP). A SWPPP has been developed or will be developed and submitted prior to construction.

STANDARD 9: A Long-Term Operation and Maintenance (O&M) Plan

An Operation and Maintenance Plan has been developed which specifies maintenance requirements for the SCMs in conjunction with the Long-Term Pollution Prevention Plan which outlines source control and pollution prevention measures.

STANDARD 10: Prohibition of Illicit Discharges

There will be no illicit discharges to the proposed stormwater management system associated with the proposed project. See the following for an illicit discharge statement.

Illicit Discharge Compliance Statement

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

An illicit Discharge is any discharge that is not entirely comprised of stormwater, except pursuant to a National Pollutant Discharge Elimination System (NPDES) permit (other than the NPDES permit for discharges from a municipal separate storm sewer) and discharges resulting from firefighting activities. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

The Site Owner is ultimately responsible for identifying and eliminating illicit discharges.

This statement is to verify:

1. Based on the available information to the best of my knowledge, no known or suspected illicit discharges to the stormwater management system on-site.

2. The design of the stormwater system includes no proposed illicit discharges.

Signature: Limhuot Tiv

Name: Limhuot Tiv, PE

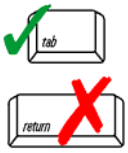
Date: 5/7/25

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

Limhuot Tiv 5/7/25

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): Wet Basin

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.

Attachment 1: Soil Information

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,680 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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 1:24,000.

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.

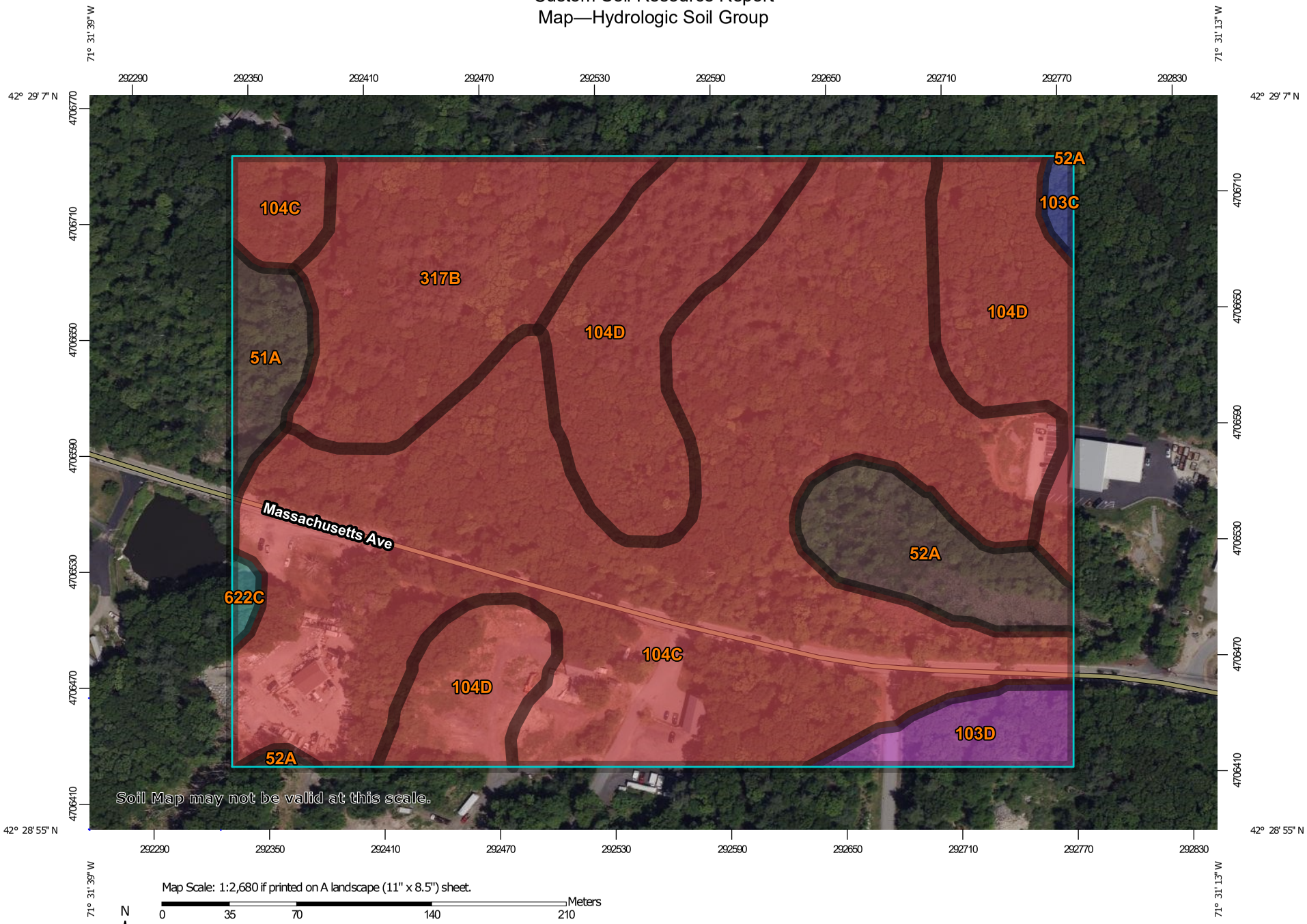
Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:2,680 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 35 70 140 210

Feet
0 100 200 400 600

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	B/D	0.9	2.7%
52A	Freetown muck, 0 to 1 percent slopes	B/D	1.9	5.4%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	0.2	0.5%
103D	Charlton-Hollis-Rock outcrop complex, 15 to 25 percent slopes	A	1.0	2.9%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	18.6	54.2%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	D	7.1	20.8%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	D	4.5	13.1%
622C	Paxton-Urban land complex, 3 to 15 percent slopes	C	0.1	0.4%
Totals for Area of Interest			**34.3**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

FORM 11 - SOIL EVALUATOR FORM

No. 241090 Date: 10/30/24

Commonwealth of Massachusetts
Boxborough, Massachusetts

Soil Suitability Assessment for On-Site Sewage Disposal

Performed by: Bruce Ringwall, GPR Inc Date: 10/24/24
Kolby Beauvais, NABH, R.S.
Witnessed by: Jim Garreffi, NABH, R.S.

Location Address: or Lot No. 975 Mass Ave Boxborough, MA	Owner's Name: Breezy Ridge, LLC Address: 881 Mas Ave, Unit A Boxborough, MA 01719
☑ New Construction ☐ Upgrade	☐ Repair Telephone No.

Office Review ☐ ☑

Published Soil Survey Available: No Yes

Year Published Internet Publication Scale na Soil Map Unit 317B,104D,104C
Soil Name Charlton-Hollis Rock Outcrop Soil Limitations Depth to bedrock, well drained
Soil Name Hollis-Rock outcrop-Charlton Soil Limitations Depth to bedrock, well drained
Soil Name Scituate fine sandy loam Soil I☐ tations ☑ Moderately well drained

Surficial Geologic Report Available: No Yes

Year Published MASS GIS Publication Scale na
Geologic Material(Map Unit) Glacial Till
Landform Ground Morraine

Flood Insurance Rate Map: 25017C0332F

Above 500 Year Flood Boundary	No ☐	Yes ☐
Within 500 Year Flood Boundary	No ☑	Yes ☐
Within 100 Year Flood Boundary	No ☑	Yes ☐
Within Velocity Zone	No ☑	Yes ☐

Wetland Area:
National Wetlands Inventory Map (map unit) N/A
Wetlands Conservancy Program Map (map unit) N/A

Current Water Resource Conditions (USGS): Month October
Range: Above Normal ☐ Normal ☐ Below Normal ☑
Other Reference Reviewed USGS

Site Info.

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-1 Date: 10/24/24 Time: 8:45 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	50± feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-1 NB E-32/40 Suface El. 346.9

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-12	A	FSL	10YR3/3		
12-24	B	FSL	10YR5/6		
24-102	C	LFS	2.5Y5/3	@30" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 102"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 30"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-2 Date: 10/24/24 Time: 9:15 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	81± feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-2 NB E-32/40 Suface El. 346.9

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-24	B	FSL	10YR5/6		
24-108	C	LFS	2.5Y5/3	@34" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 108"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 34"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-3 Date: 10/24/24 Time: 9:40 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-3 NB E-32/40 Suface El. 349.5

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-6	A	FSL	10YR3/3		
6-22	B	FSL	10YR5/6		
22-80	C	LFS	2.5Y5/3	@28" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 80"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 28"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-4 Date: 10/24/24 Time: 10:00 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-4 NB E-32/40 Suface El. 348.8

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-6	A	FSL	10YR3/3		
6-20	B	FSL	10YR5/6		
20-54	C	LFS	2.5Y5/3	@32" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 54"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 32"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-5 Date: 10/24/24 Time: 10:30 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-5 NB E-32/42 Suface El. 347.0

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-100	C	LFS	2.5Y5/3	@32"	
				2.5Y6/2	
				2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 100"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 32"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-6 Date: 10/24/24 Time: 11:00 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-6 NB E-32/42 Suface El. 346.2

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-96	C	LFS	2.5Y5/3	@32" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 96"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 32"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-7 Date: 10/24/24 Time: 11:35 AM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-7 NB E-32/42 Suface El. 354.3

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-108	C	LFS	2.5Y5/3	@28" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 108"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 28"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-8 Date: 10/24/24 Time: 12:00 PM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-8 NB E-32/42 Suface El. 355.9

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-54	C	LFS	2.5Y5/3		

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 54"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole n/a
Aditional Notes Refusal @ 54"

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-9 Date: 10/24/24 Time: 12:30 PM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-9 NB E-32/42 Suface El. 352.0

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-54	C	LFS	2.5Y5/3		

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 54"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole n/a
Aditional Notes Refusal @ 54"

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-10 Date: 10/24/24 Time: 1:00 PM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-10 NB E-32/43 Suface El. 349.4

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0-8	A	FSL	10YR3/3		
8-22	B	FSL	10YR5/6		
22-72	C	LFS	2.5Y5/3	@28" 2.5Y6/2 2.5Y6/6	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 72"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 28"
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 975 Mass Ave
Boxborough, MA

On-Site Review

Deep Hole #: 1024-11 Date: 10/24/24 Time: 1:30 PM Weather: 55° Overcast
Location (identify on site plan) See Attached Sketch
Land Use Woodland Slope (%) 5-8% Surfaces Stones many
(eg woodland, agricultural field, vacant lot etc…)
Vegatation mixed hardwoods and pines
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body	>100 feet	Drainage Way	>100 feet
Possible Wet Area	>100 feet	Property Line	>100 feet
Drinking Water Well	>100 feet	Other:	
			feet

Deep Observation Hole Log

Hole # 1024-11 NB E-32/43 Suface El. 353.8

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 38"
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole n/a
Aditional Notes Refusal at 38"

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot#: 975 Mass Ave
Boxborough, MA

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole _____ inches _____
- ☐ Depth weeping from side of observation hole _____ inches _____
- ☑ Depth to soil mottles * inches See individual Reports
- ☐ Ground water adjustment _____ feet _____

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment Factor _____ Adjusted Ground Water Level _____

Depth of Naturally Occuring Pervious Material

Does at least five* feet of naturally occuring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? Yes

If not, what is the depth of naturally occuring pervious material? _____ Feet

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 training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated, on the attached soil evaluation form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature _____ Date _____

Notes: _____

_____

Signature

FORM 12 - PERCOLATION TEST

Location Address: or Lot # 975 Mass Ave Boxborough, MA	Owner's Name: Breezy Ridge, LLC Address: 881 Mas Ave, Unit A Boxborough, MA 01719 Telephone No.

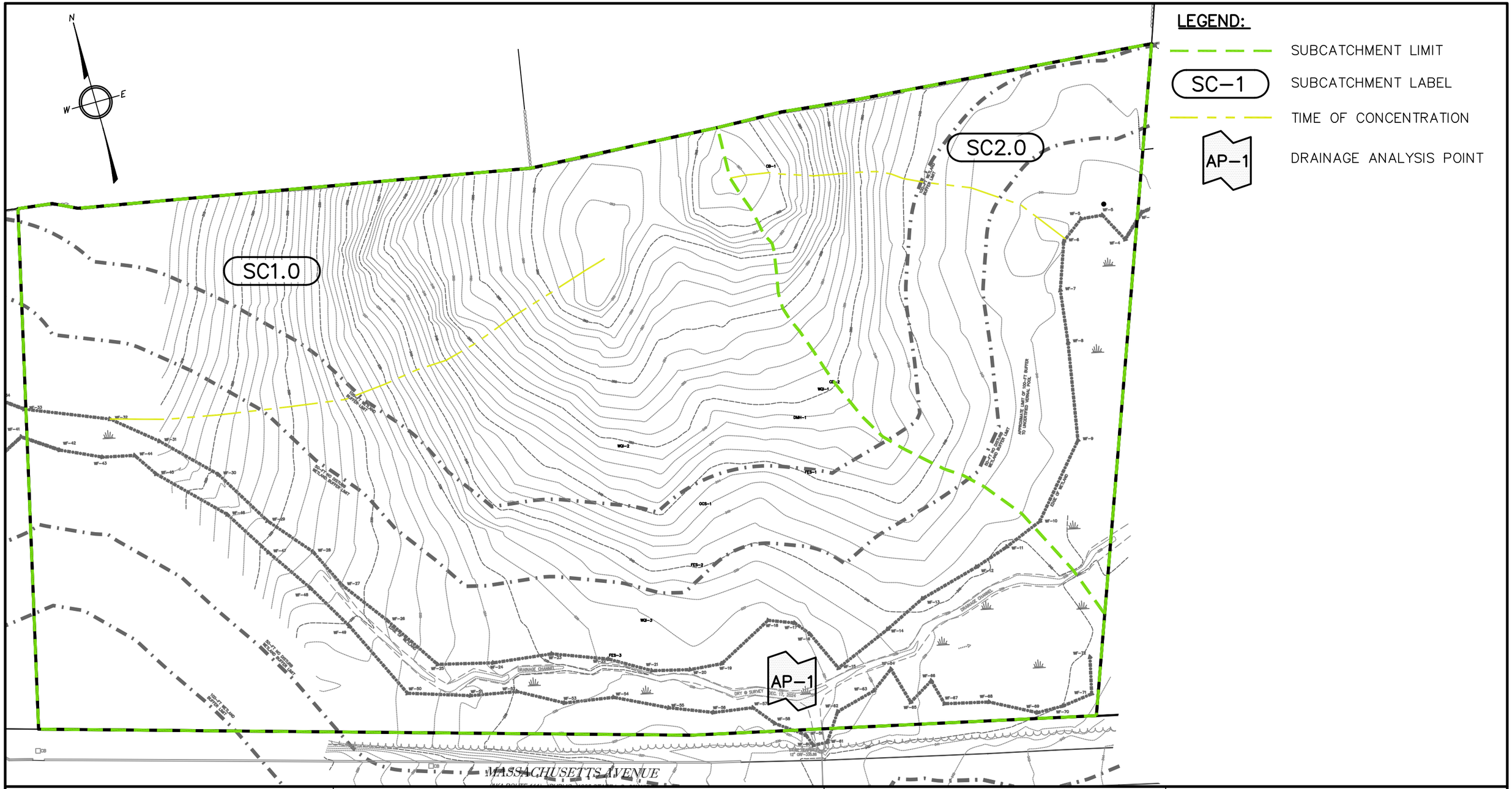
	10/24/24 (Date) 12:14 PM (Time)	10/24/24 (Date) 12:10 AM (Time)
Observation Hole #	1024-A	1024-B
Depth of Perc	54"	52"
Start Pre-Soak	12:14 PM	12:10 PM
End Pre-Soak	12:29 PM	12:25 PM
Time @ 12"	12:29 PM	12:25 PM
Time @ 9"	12:40 PM	12:31 PM
Time @ 6"	12:57 PM	12:40 PM
Time (9"-6")	17	9
Rate (Min./Inch)	6	3
	Test Passed:	Test Passed:
	Test Failed:	Test Failed:

Test performed By: Bruce Ringwall , GPR Inc.

Witnessed By: Kolby Beauvais, NABH, R.S. & Jim Garreffi, NABH, R.S.

Comments:

Attachment 2: Existing Conditions Hydrologic Calculations



GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 INCH = 60 FEET

GPR

Engineering Solutions for Land & Structures

GOLDSMITH, PREST & RINGWALL, INC.

39 MAIN ST., SUITE 301, AYER, MA 01432

CIVIL ENGINEERING • LAND SURVEYING • LAND PLANNING

VOICE: 978.772.1590 FAX: 978.772.1591

www.gpr-inc.com

PREPARED FOR:

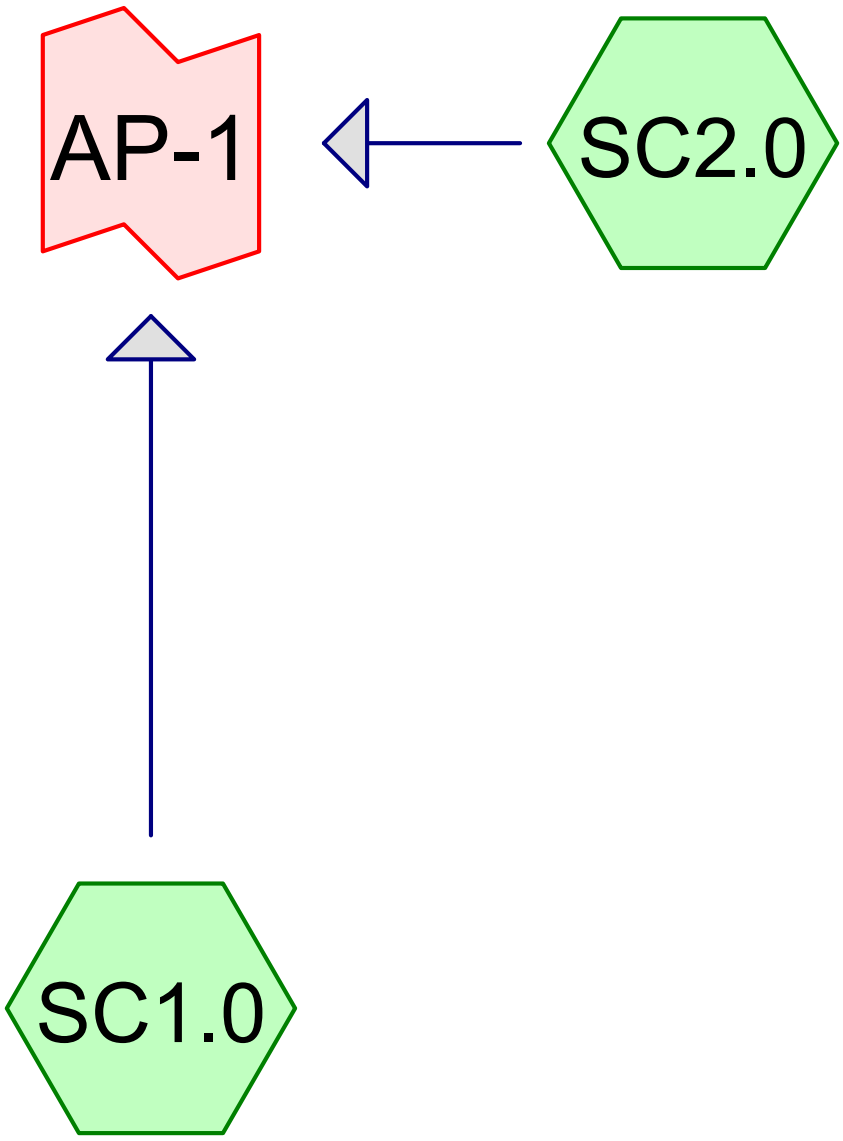
BHG109 LLC
881 MASSACHUSETTS AVE, UNIT A
BOXBOROUGH, MA 01719

WATERSHED MAP PRE–DEVELOPMENT

975 MASS AVE
BOXBOROUGH, MA

DES'D BY: LT	CHK'D BY: EAC	
DATE: MARCH 2025	PROJECT: 241090	1 OF 1

P:\24---\241090\DWG\PERMIT\SITE PLAN.DWG 03-20-25 12:43:00 PM – LAYOUT PRE



Subcat Reach Pond Link

Routing Diagram for PRE
Prepared by Goldsmith, Prest & Ringwall, Inc, Printed 3/24/2025

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	3.23	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.98	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.06	2
4	100-Year	Type III 24-hr		Default	24.00	1	7.74	2
5	50-Year	Type III 24-hr		Default	24.00	1	6.87	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.158	77	Woods, Good, HSG D (SC1.0, SC2.0)
6.158	**77**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.0: Runoff Area=4.789 ac 0.00% Impervious Runoff Depth>1.23"
Flow Length=345' Tc=8.9 min CN=77 Runoff=5.98 cfs 0.491 af

Subcatchment SC2.0: Runoff Area=1.369 ac 0.00% Impervious Runoff Depth>1.23"
Flow Length=228' Tc=7.8 min CN=77 Runoff=1.79 cfs 0.140 af

Link AP-1: Inflow=7.72 cfs 0.632 af
Primary=7.72 cfs 0.632 af

Total Runoff Area = 6.158 ac Runoff Volume = 0.632 af Average Runoff Depth = 1.23"
100.00% Pervious = 6.158 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment SC1.0:

Runoff = 5.98 cfs @ 12.14 hrs, Volume= 0.491 af, Depth> 1.23"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
4.789	77	Woods, Good, HSG D
4.789		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
3.4	295	0.0845	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.9	345	Total			

Summary for Subcatchment SC2.0:

Runoff = 1.79 cfs @ 12.12 hrs, Volume= 0.140 af, Depth> 1.23"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
1.369	77	Woods, Good, HSG D
1.369		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	178	0.1124	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	228	Total			

Summary for Link AP-1:

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth > 1.23" for 2-Year event
Inflow = 7.72 cfs @ 12.13 hrs, Volume= 0.632 af
Primary = 7.72 cfs @ 12.13 hrs, Volume= 0.632 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.0: Runoff Area=4.789 ac 0.00% Impervious Runoff Depth>2.60"
Flow Length=345' Tc=8.9 min CN=77 Runoff=12.97 cfs 1.039 af

Subcatchment SC2.0: Runoff Area=1.369 ac 0.00% Impervious Runoff Depth>2.60"
Flow Length=228' Tc=7.8 min CN=77 Runoff=3.88 cfs 0.297 af

Link AP-1: Inflow=16.89 cfs 1.335 af
Primary=16.89 cfs 1.335 af

Total Runoff Area = 6.158 ac Runoff Volume = 1.335 af Average Runoff Depth = 2.60"
100.00% Pervious = 6.158 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment SC1.0:

Runoff = 12.97 cfs @ 12.13 hrs, Volume= 1.039 af, Depth> 2.60"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
4.789	77	Woods, Good, HSG D
4.789		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
3.4	295	0.0845	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.9	345	Total			

Summary for Subcatchment SC2.0:

Runoff = 3.88 cfs @ 12.11 hrs, Volume= 0.297 af, Depth> 2.60"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
1.369	77	Woods, Good, HSG D
1.369		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	178	0.1124	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	228	Total			

Summary for Link AP-1:

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth > 2.60" for 10-Year event
Inflow = 16.89 cfs @ 12.12 hrs, Volume= 1.335 af
Primary = 16.89 cfs @ 12.12 hrs, Volume= 1.335 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.0: Runoff Area=4.789 ac 0.00% Impervious Runoff Depth>3.53"
Flow Length=345' Tc=8.9 min CN=77 Runoff=17.58 cfs 1.407 af

Subcatchment SC2.0: Runoff Area=1.369 ac 0.00% Impervious Runoff Depth>3.53"
Flow Length=228' Tc=7.8 min CN=77 Runoff=5.26 cfs 0.402 af

Link AP-1: Inflow=22.90 cfs 1.810 af
Primary=22.90 cfs 1.810 af

Total Runoff Area = 6.158 ac Runoff Volume = 1.810 af Average Runoff Depth = 3.53"
100.00% Pervious = 6.158 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment SC1.0:

Runoff = 17.58 cfs @ 12.13 hrs, Volume= 1.407 af, Depth> 3.53"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
4.789	77	Woods, Good, HSG D
4.789		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
3.4	295	0.0845	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.9	345	Total			

Summary for Subcatchment SC2.0:

Runoff = 5.26 cfs @ 12.11 hrs, Volume= 0.402 af, Depth> 3.53"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
1.369	77	Woods, Good, HSG D
1.369		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	178	0.1124	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	228	Total			

Summary for Link AP-1:

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth > 3.53" for 25-Year event
Inflow = 22.90 cfs @ 12.12 hrs, Volume= 1.810 af
Primary = 22.90 cfs @ 12.12 hrs, Volume= 1.810 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.0: Runoff Area=4.789 ac 0.00% Impervious Runoff Depth>5.03"
Flow Length=345' Tc=8.9 min CN=77 Runoff=24.92 cfs 2.007 af

Subcatchment SC2.0: Runoff Area=1.369 ac 0.00% Impervious Runoff Depth>5.03"
Flow Length=228' Tc=7.8 min CN=77 Runoff=7.46 cfs 0.574 af

Link AP-1: Inflow=32.49 cfs 2.581 af
Primary=32.49 cfs 2.581 af

Total Runoff Area = 6.158 ac Runoff Volume = 2.581 af Average Runoff Depth = 5.03"
100.00% Pervious = 6.158 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment SC1.0:

Runoff = 24.92 cfs @ 12.13 hrs, Volume= 2.007 af, Depth> 5.03"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
4.789	77	Woods, Good, HSG D
4.789		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
3.4	295	0.0845	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.9	345	Total			

Summary for Subcatchment SC2.0:

Runoff = 7.46 cfs @ 12.11 hrs, Volume= 0.574 af, Depth> 5.03"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
1.369	77	Woods, Good, HSG D
1.369		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	178	0.1124	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	228	Total			

Summary for Link AP-1:

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth > 5.03" for 100-Year event
Inflow = 32.49 cfs @ 12.12 hrs, Volume= 2.581 af
Primary = 32.49 cfs @ 12.12 hrs, Volume= 2.581 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.0: Runoff Area=4.789 ac 0.00% Impervious Runoff Depth>4.24"
Flow Length=345' Tc=8.9 min CN=77 Runoff=21.10 cfs 1.693 af

Subcatchment SC2.0: Runoff Area=1.369 ac 0.00% Impervious Runoff Depth>4.24"
Flow Length=228' Tc=7.8 min CN=77 Runoff=6.31 cfs 0.484 af

Link AP-1: Inflow=27.50 cfs 2.178 af
Primary=27.50 cfs 2.178 af

Total Runoff Area = 6.158 ac Runoff Volume = 2.178 af Average Runoff Depth = 4.24"
100.00% Pervious = 6.158 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment SC1.0:

Runoff = 21.10 cfs @ 12.13 hrs, Volume= 1.693 af, Depth> 4.24"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
4.789	77	Woods, Good, HSG D
4.789		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
3.4	295	0.0845	1.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.9	345	Total			

Summary for Subcatchment SC2.0:

Runoff = 6.31 cfs @ 12.11 hrs, Volume= 0.484 af, Depth> 4.24"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
1.369	77	Woods, Good, HSG D
1.369		100.00% Pervious Area

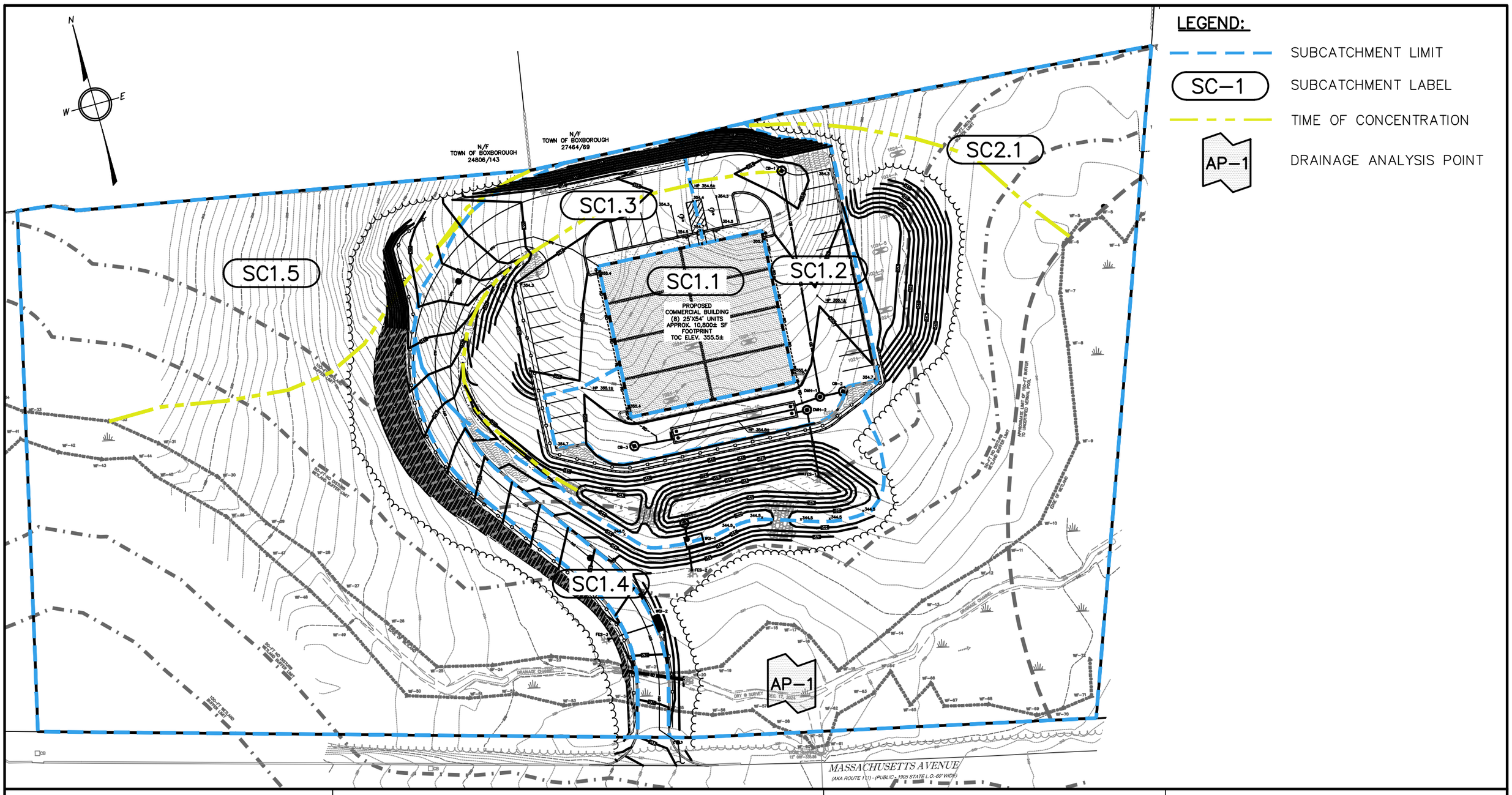
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	178	0.1124	1.68		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.8	228	Total			

Summary for Link AP-1:

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth > 4.24" for 50-Year event
Inflow = 27.50 cfs @ 12.12 hrs, Volume= 2.178 af
Primary = 27.50 cfs @ 12.12 hrs, Volume= 2.178 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Attachment 3: Proposed Conditions Hydrologic Calculations



GRAPHIC SCALE

60 0 30 60 120

(IN FEET)

1 INCH = 60 FEET

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PREPARED FOR:

BHG109 LLC
881 MASSACHUSETTS AVE, UNIT A
BOXBOROUGH, MA 01719

WATERSHED MAP POST-DEVELOPMENT

975 MASS AVE
BOXBOROUGH, MA

DES'D BY: LT	CHK'D BY: EAC	
DATE: MARCH 2025	PROJECT: 241090	1 OF 1

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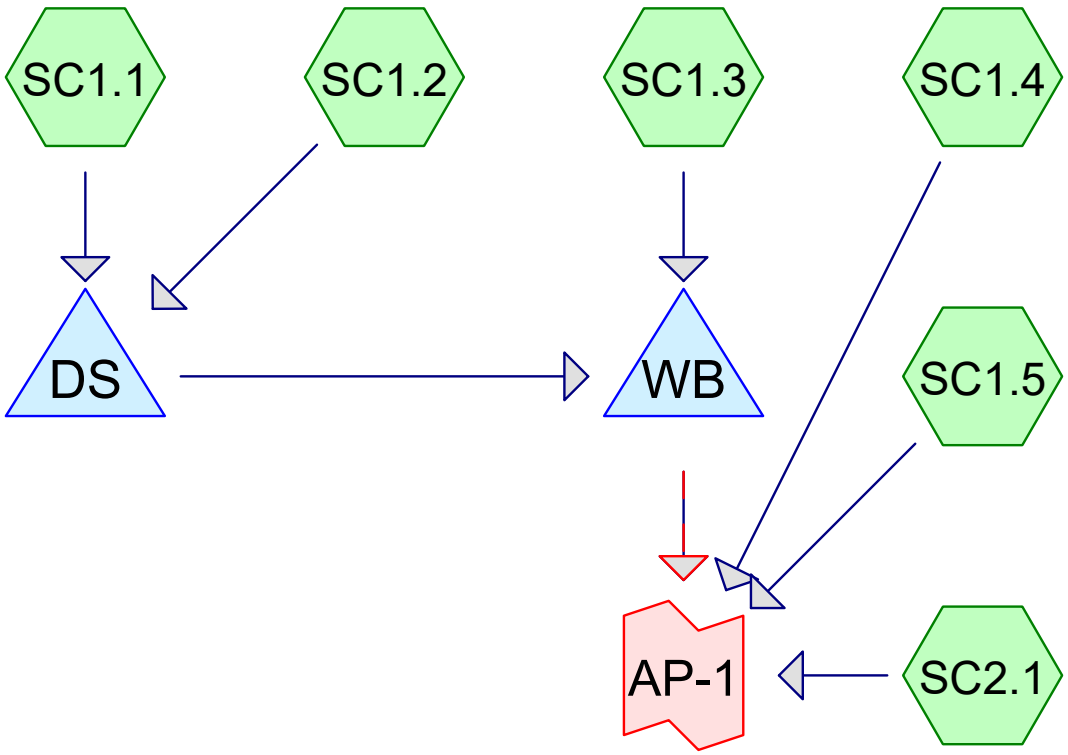


Subcat Reach Pond Link

Routing Diagram for POST

Prepared by Goldsmith, Prest & Ringwall, Inc, Printed 4/22/2025

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	3.23	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.98	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.06	2
4	100-Year	Type III 24-hr		Default	24.00	1	7.74	2
5	50-Year	Type III 24-hr		Default	24.00	1	6.87	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.979	80	>75% Grass cover, Good, HSG D (SC1.2, SC1.3, SC1.5, SC2.1)
0.789	98	Paved parking, HSG D (SC1.2, SC1.3, SC1.4)
0.248	98	Roofs, HSG D (SC1.1)
4.142	77	Woods, Good, HSG D (SC1.3, SC1.5, SC2.1)
6.158	**81**	**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.1: Runoff Area=0.248 ac 100.00% Impervious Runoff Depth>3.00"
Tc=6.0 min CN=98 Runoff=0.77 cfs 0.062 af

Subcatchment SC1.2: Runoff Area=0.411 ac 89.41% Impervious Runoff Depth>2.78"
Tc=6.0 min CN=96 Runoff=1.24 cfs 0.095 af

Subcatchment SC1.3: Runoff Area=0.766 ac 37.52% Impervious Runoff Depth>1.94"
Flow Length=317' Tc=6.0 min CN=87 Runoff=1.73 cfs 0.124 af

Subcatchment SC1.4: Runoff Area=0.134 ac 100.00% Impervious Runoff Depth>3.00"
Tc=6.0 min CN=98 Runoff=0.42 cfs 0.033 af

Subcatchment SC1.5: Runoff Area=2.484 ac 0.00% Impervious Runoff Depth>1.23"
Flow Length=333' Tc=8.8 min CN=77 Runoff=3.15 cfs 0.255 af

Subcatchment SC2.1: Runoff Area=2.115 ac 0.00% Impervious Runoff Depth>1.23"
Flow Length=228' Tc=7.0 min CN=77 Runoff=2.84 cfs 0.217 af

Pond DS: Peak Elev=349.34' Storage=1,220 cf Inflow=2.01 cfs 0.157 af
Outflow=1.16 cfs 0.157 af

Pond WB: Peak Elev=342.64' Storage=1,844 cf Inflow=2.39 cfs 0.281 af
Primary=1.68 cfs 0.278 af Secondary=0.00 cfs 0.000 af Outflow=1.68 cfs 0.278 af

Link AP-1: Inflow=7.57 cfs 0.783 af
Primary=7.57 cfs 0.783 af

Total Runoff Area = 6.158 ac Runoff Volume = 0.786 af Average Runoff Depth = 1.53"
83.16% Pervious = 5.121 ac 16.84% Impervious = 1.037 ac

Summary for Subcatchment SC1.1:

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 0.062 af, Depth> 3.00"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
0.248	98	Roofs, HSG D
0.248		100.00% Impervious Area

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

Summary for Subcatchment SC1.2:

Runoff = 1.24 cfs @ 12.08 hrs, Volume= 0.095 af, Depth> 2.78"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
0.044	80	>75% Grass cover, Good, HSG D
0.368	98	Paved parking, HSG D
0.411	96	Weighted Average
0.044		10.59% Pervious Area
0.368		89.41% Impervious Area

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

Summary for Subcatchment SC1.3:

Runoff = 1.73 cfs @ 12.09 hrs, Volume= 0.124 af, Depth> 1.94"
Routed to Pond WB :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
0.468	80	>75% Grass cover, Good, HSG D
0.011	77	Woods, Good, HSG D
0.287	98	Paved parking, HSG D
0.766	87	Weighted Average
0.479		62.48% Pervious Area
0.287		37.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	207	0.0400	6.03	18.08	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
1.6	317	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment SC1.4:

Runoff = 0.42 cfs @ 12.08 hrs, Volume= 0.033 af, Depth> 3.00"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
0.134	98	Paved parking, HSG D
0.134		100.00% Impervious Area

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

Summary for Subcatchment SC1.5:

Runoff = 3.15 cfs @ 12.13 hrs, Volume= 0.255 af, Depth> 1.23"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
2.321	77	Woods, Good, HSG D
0.163	80	>75% Grass cover, Good, HSG D
2.484	77	Weighted Average
2.484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.4	283	0.1484	1.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	333	Total			

Summary for Subcatchment SC2.1:

Runoff = 2.84 cfs @ 12.11 hrs, Volume= 0.217 af, Depth> 1.23"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (ac)	CN	Description
0.305	80	>75% Grass cover, Good, HSG D
1.810	77	Woods, Good, HSG D
2.115	77	Weighted Average
2.115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.1	178	0.0787	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	228	Total			

Summary for Pond DS:

Inflow Area = 0.659 ac, 93.39% Impervious, Inflow Depth > 2.86" for 2-Year event
Inflow = 2.01 cfs @ 12.08 hrs, Volume= 0.157 af
Outflow = 1.16 cfs @ 12.21 hrs, Volume= 0.157 af, Atten= 42%, Lag= 7.3 min
Primary = 1.16 cfs @ 12.21 hrs, Volume= 0.157 af
Routed to Pond WB :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 349.34' @ 12.21 hrs Surf.Area= 631 sf Storage= 1,220 cf

Plug-Flow detention time= 14.5 min calculated for 0.157 af (100% of inflow)
Center-of-Mass det. time= 13.4 min (779.8 - 766.4)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	2,011 cf	**48.0" Round Pipe Storage** x 2 L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	344.00'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.00' / 341.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	347.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.16 cfs @ 12.21 hrs HW=349.33' TW=342.61' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.16 cfs of 6.56 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 7.09 fps)
3=Orifice/Grate (Orifice Controls 0.54 cfs @ 2.24 fps)

Summary for Pond WB:

Inflow Area = 1.425 ac, 63.36% Impervious, Inflow Depth > 2.36" for 2-Year event
Inflow = 2.39 cfs @ 12.14 hrs, Volume= 0.281 af
Outflow = 1.68 cfs @ 12.32 hrs, Volume= 0.278 af, Atten= 30%, Lag= 10.8 min
Primary = 1.68 cfs @ 12.32 hrs, Volume= 0.278 af
Routed to Link AP-1 :
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link AP-1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 342.64' @ 12.32 hrs Surf.Area= 3,292 sf Storage= 1,844 cf

Plug-Flow detention time= 29.4 min calculated for 0.277 af (99% of inflow)
Center-of-Mass det. time= 22.7 min (819.3 - 796.6)

Volume	Invert	Avail.Storage	Storage Description
#1	342.00'	7,587 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
342.00	2,474	0	0	2,474
343.00	3,799	3,113	3,113	3,818
344.00	5,185	4,474	7,587	5,229

Device	Routing	Invert	Outlet Devices
#1	Primary	341.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 341.00' / 340.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	342.00'	**1.0' long x 0.70' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#3	Device 1	343.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	343.20'	**12.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.68 cfs @ 12.32 hrs HW=342.64' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.68 cfs of 3.19 cfs potential flow)
  ├─**2=Sharp-Crested Vee/Trap Weir** (Weir Controls 1.68 cfs @ 2.62 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=342.00' TW=0.00' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1:

Inflow Area = 6.158 ac, 16.84% Impervious, Inflow Depth > 1.53" for 2-Year event
Inflow = 7.57 cfs @ 12.13 hrs, Volume= 0.783 af
Primary = 7.57 cfs @ 12.13 hrs, Volume= 0.783 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.1: Runoff Area=0.248 ac 100.00% Impervious Runoff Depth>4.74"
Tc=6.0 min CN=98 Runoff=1.20 cfs 0.098 af

Subcatchment SC1.2: Runoff Area=0.411 ac 89.41% Impervious Runoff Depth>4.51"
Tc=6.0 min CN=96 Runoff=1.95 cfs 0.155 af

Subcatchment SC1.3: Runoff Area=0.766 ac 37.52% Impervious Runoff Depth>3.55"
Flow Length=317' Tc=6.0 min CN=87 Runoff=3.10 cfs 0.226 af

Subcatchment SC1.4: Runoff Area=0.134 ac 100.00% Impervious Runoff Depth>4.74"
Tc=6.0 min CN=98 Runoff=0.65 cfs 0.053 af

Subcatchment SC1.5: Runoff Area=2.484 ac 0.00% Impervious Runoff Depth>2.60"
Flow Length=333' Tc=8.8 min CN=77 Runoff=6.85 cfs 0.539 af

Subcatchment SC2.1: Runoff Area=2.115 ac 0.00% Impervious Runoff Depth>2.60"
Flow Length=228' Tc=7.0 min CN=77 Runoff=6.15 cfs 0.459 af

Pond DS: Peak Elev=350.07' Storage=1,655 cf Inflow=3.15 cfs 0.253 af
Outflow=2.25 cfs 0.252 af

Pond WB: Peak Elev=343.05' Storage=3,314 cf Inflow=5.05 cfs 0.479 af
Primary=3.10 cfs 0.474 af Secondary=0.00 cfs 0.000 af Outflow=3.10 cfs 0.474 af

Link AP-1: Inflow=15.86 cfs 1.525 af
Primary=15.86 cfs 1.525 af

Total Runoff Area = 6.158 ac Runoff Volume = 1.529 af Average Runoff Depth = 2.98"
83.16% Pervious = 5.121 ac 16.84% Impervious = 1.037 ac

Summary for Subcatchment SC1.1:

Runoff = 1.20 cfs @ 12.08 hrs, Volume= 0.098 af, Depth> 4.74"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
0.248	98	Roofs, HSG D
0.248		100.00% Impervious Area

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

Summary for Subcatchment SC1.2:

Runoff = 1.95 cfs @ 12.08 hrs, Volume= 0.155 af, Depth> 4.51"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
0.044	80	>75% Grass cover, Good, HSG D
0.368	98	Paved parking, HSG D
0.411	96	Weighted Average
0.044		10.59% Pervious Area
0.368		89.41% Impervious Area

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

Summary for Subcatchment SC1.3:

Runoff = 3.10 cfs @ 12.09 hrs, Volume= 0.226 af, Depth> 3.55"
Routed to Pond WB :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
0.468	80	>75% Grass cover, Good, HSG D
0.011	77	Woods, Good, HSG D
0.287	98	Paved parking, HSG D
0.766	87	Weighted Average
0.479		62.48% Pervious Area
0.287		37.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	207	0.0400	6.03	18.08	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
1.6	317	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment SC1.4:

Runoff = 0.65 cfs @ 12.08 hrs, Volume= 0.053 af, Depth> 4.74"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
0.134	98	Paved parking, HSG D
0.134		100.00% Impervious Area

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

Summary for Subcatchment SC1.5:

Runoff = 6.85 cfs @ 12.13 hrs, Volume= 0.539 af, Depth> 2.60"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
2.321	77	Woods, Good, HSG D
0.163	80	>75% Grass cover, Good, HSG D
2.484	77	Weighted Average
2.484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.4	283	0.1484	1.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	333	Total			

Summary for Subcatchment SC2.1:

Runoff = 6.15 cfs @ 12.10 hrs, Volume= 0.459 af, Depth> 2.60"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 10-Year Rainfall=4.98"

Area (ac)	CN	Description
0.305	80	>75% Grass cover, Good, HSG D
1.810	77	Woods, Good, HSG D
2.115	77	Weighted Average
2.115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.1	178	0.0787	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	228	Total			

Summary for Pond DS:

Inflow Area = 0.659 ac, 93.39% Impervious, Inflow Depth > 4.60" for 10-Year event
Inflow = 3.15 cfs @ 12.08 hrs, Volume= 0.253 af
Outflow = 2.25 cfs @ 12.17 hrs, Volume= 0.252 af, Atten= 29%, Lag= 4.9 min
Primary = 2.25 cfs @ 12.17 hrs, Volume= 0.252 af
Routed to Pond WB :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 350.07' @ 12.17 hrs Surf.Area= 541 sf Storage= 1,655 cf

Plug-Flow detention time= 13.4 min calculated for 0.252 af (100% of inflow)
Center-of-Mass det. time= 12.4 min (768.8 - 756.4)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	2,011 cf	**48.0" Round Pipe Storage** x 2 L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	344.00'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.00' / 341.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	347.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.24 cfs @ 12.17 hrs HW=350.06' TW=342.95' (Dynamic Tailwater)
↑**1=Culvert** (Passes 2.24 cfs of 7.04 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.71 cfs @ 8.19 fps)
3=Orifice/Grate (Orifice Controls 1.53 cfs @ 4.37 fps)

Summary for Pond WB:

Inflow Area = 1.425 ac, 63.36% Impervious, Inflow Depth > 4.03" for 10-Year event
Inflow = 5.05 cfs @ 12.11 hrs, Volume= 0.479 af
Outflow = 3.10 cfs @ 12.30 hrs, Volume= 0.474 af, Atten= 39%, Lag= 11.7 min
Primary = 3.10 cfs @ 12.30 hrs, Volume= 0.474 af
Routed to Link AP-1 :
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link AP-1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 343.05' @ 12.30 hrs Surf.Area= 3,866 sf Storage= 3,314 cf

Plug-Flow detention time= 26.1 min calculated for 0.474 af (99% of inflow)
Center-of-Mass det. time= 20.6 min (804.5 - 784.0)

Volume	Invert	Avail.Storage	Storage Description
#1	342.00'	7,587 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
342.00	2,474	0	0	2,474
343.00	3,799	3,113	3,113	3,818
344.00	5,185	4,474	7,587	5,229

Device	Routing	Invert	Outlet Devices
#1	Primary	341.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 341.00' / 340.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	342.00'	**1.0' long x 0.70' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#3	Device 1	343.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	343.20'	**12.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.09 cfs @ 12.30 hrs HW=343.05' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.09 cfs of 3.72 cfs potential flow)
  ├─**2=Sharp-Crested Vee/Trap Weir** (Orifice Controls 2.85 cfs @ 4.07 fps)
  └─**3=Orifice/Grate** (Weir Controls 0.24 cfs @ 0.74 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=342.00' TW=0.00' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1:

Inflow Area = 6.158 ac, 16.84% Impervious, Inflow Depth > 2.97" for 10-Year event
Inflow = 15.86 cfs @ 12.12 hrs, Volume= 1.525 af
Primary = 15.86 cfs @ 12.12 hrs, Volume= 1.525 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.1: Runoff Area=0.248 ac 100.00% Impervious Runoff Depth>5.82"
Tc=6.0 min CN=98 Runoff=1.46 cfs 0.120 af

Subcatchment SC1.2: Runoff Area=0.411 ac 89.41% Impervious Runoff Depth>5.58"
Tc=6.0 min CN=96 Runoff=2.39 cfs 0.191 af

Subcatchment SC1.3: Runoff Area=0.766 ac 37.52% Impervious Runoff Depth>4.57"
Flow Length=317' Tc=6.0 min CN=87 Runoff=3.95 cfs 0.292 af

Subcatchment SC1.4: Runoff Area=0.134 ac 100.00% Impervious Runoff Depth>5.82"
Tc=6.0 min CN=98 Runoff=0.79 cfs 0.065 af

Subcatchment SC1.5: Runoff Area=2.484 ac 0.00% Impervious Runoff Depth>3.53"
Flow Length=333' Tc=8.8 min CN=77 Runoff=9.28 cfs 0.730 af

Subcatchment SC2.1: Runoff Area=2.115 ac 0.00% Impervious Runoff Depth>3.53"
Flow Length=228' Tc=7.0 min CN=77 Runoff=8.33 cfs 0.622 af

Pond DS: Peak Elev=350.65' Storage=1,923 cf Inflow=3.85 cfs 0.312 af
Outflow=2.78 cfs 0.311 af

Pond WB: Peak Elev=343.23' Storage=4,010 cf Inflow=6.36 cfs 0.603 af
Primary=3.92 cfs 0.597 af Secondary=0.14 cfs 0.001 af Outflow=4.07 cfs 0.598 af

Link AP-1: Inflow=21.23 cfs 2.015 af
Primary=21.23 cfs 2.015 af

Total Runoff Area = 6.158 ac Runoff Volume = 2.020 af Average Runoff Depth = 3.94"
83.16% Pervious = 5.121 ac 16.84% Impervious = 1.037 ac

Summary for Subcatchment SC1.1:

Runoff = 1.46 cfs @ 12.08 hrs, Volume= 0.120 af, Depth> 5.82"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
0.248	98	Roofs, HSG D
0.248		100.00% Impervious Area

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

Summary for Subcatchment SC1.2:

Runoff = 2.39 cfs @ 12.08 hrs, Volume= 0.191 af, Depth> 5.58"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
0.044	80	>75% Grass cover, Good, HSG D
0.368	98	Paved parking, HSG D
0.411	96	Weighted Average
0.044		10.59% Pervious Area
0.368		89.41% Impervious Area

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

Summary for Subcatchment SC1.3:

Runoff = 3.95 cfs @ 12.09 hrs, Volume= 0.292 af, Depth> 4.57"
Routed to Pond WB :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
0.468	80	>75% Grass cover, Good, HSG D
0.011	77	Woods, Good, HSG D
0.287	98	Paved parking, HSG D
0.766	87	Weighted Average
0.479		62.48% Pervious Area
0.287		37.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	207	0.0400	6.03	18.08	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
1.6	317	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment SC1.4:

Runoff = 0.79 cfs @ 12.08 hrs, Volume= 0.065 af, Depth> 5.82"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
0.134	98	Paved parking, HSG D
0.134		100.00% Impervious Area

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

Summary for Subcatchment SC1.5:

Runoff = 9.28 cfs @ 12.13 hrs, Volume= 0.730 af, Depth> 3.53"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
2.321	77	Woods, Good, HSG D
0.163	80	>75% Grass cover, Good, HSG D
2.484	77	Weighted Average
2.484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.4	283	0.1484	1.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	333	Total			

Summary for Subcatchment SC2.1:

Runoff = 8.33 cfs @ 12.10 hrs, Volume= 0.622 af, Depth> 3.53"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 25-Year Rainfall=6.06"

Area (ac)	CN	Description
0.305	80	>75% Grass cover, Good, HSG D
1.810	77	Woods, Good, HSG D
2.115	77	Weighted Average
2.115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.1	178	0.0787	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	228	Total			

Summary for Pond DS:

Inflow Area = 0.659 ac, 93.39% Impervious, Inflow Depth > 5.67" for 25-Year event
Inflow = 3.85 cfs @ 12.08 hrs, Volume= 0.312 af
Outflow = 2.78 cfs @ 12.16 hrs, Volume= 0.311 af, Atten= 28%, Lag= 4.8 min
Primary = 2.78 cfs @ 12.16 hrs, Volume= 0.311 af
Routed to Pond WB :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 350.65' @ 12.16 hrs Surf.Area= 364 sf Storage= 1,923 cf

Plug-Flow detention time= 13.2 min calculated for 0.311 af (100% of inflow)
Center-of-Mass det. time= 12.3 min (764.8 - 752.5)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	2,011 cf	**48.0" Round Pipe Storage** x 2 L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	344.00'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.00' / 341.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	347.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.77 cfs @ 12.16 hrs HW=350.63' TW=343.14' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.77 cfs of 7.39 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.78 cfs @ 8.96 fps)
  └─**3=Orifice/Grate** (Orifice Controls 1.99 cfs @ 5.70 fps)

Summary for Pond WB:

Inflow Area = 1.425 ac, 63.36% Impervious, Inflow Depth > 5.08" for 25-Year event
Inflow = 6.36 cfs @ 12.10 hrs, Volume= 0.603 af
Outflow = 4.07 cfs @ 12.28 hrs, Volume= 0.598 af, Atten= 36%, Lag= 10.8 min
Primary = 3.92 cfs @ 12.28 hrs, Volume= 0.597 af
Routed to Link AP-1 :
Secondary = 0.14 cfs @ 12.28 hrs, Volume= 0.001 af
Routed to Link AP-1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 343.23' @ 12.28 hrs Surf.Area= 4,095 sf Storage= 4,010 cf

Plug-Flow detention time= 24.5 min calculated for 0.597 af (99% of inflow)
Center-of-Mass det. time= 19.5 min (798.3 - 778.8)

Volume	Invert	Avail.Storage	Storage Description
#1	342.00'	7,587 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
342.00	2,474	0	0	2,474
343.00	3,799	3,113	3,113	3,818
344.00	5,185	4,474	7,587	5,229

Device	Routing	Invert	Outlet Devices
#1	Primary	341.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 341.00' / 340.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	342.00'	**1.0' long x 0.70' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#3	Device 1	343.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	343.20'	**12.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.92 cfs @ 12.28 hrs HW=343.23' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 3.92 cfs @ 5.00 fps)
↑—**2=Sharp-Crested Vee/Trap Weir** (Passes < 3.20 cfs potential flow)
—**3=Orifice/Grate** (Passes < 2.22 cfs potential flow)

Secondary OutFlow Max=0.14 cfs @ 12.28 hrs HW=343.23' TW=0.00' (Dynamic Tailwater)
↑—**4=Broad-Crested Rectangular Weir** (Weir Controls 0.14 cfs @ 0.44 fps)

Summary for Link AP-1:

Inflow Area = 6.158 ac, 16.84% Impervious, Inflow Depth > 3.93" for 25-Year event
Inflow = 21.23 cfs @ 12.12 hrs, Volume= 2.015 af
Primary = 21.23 cfs @ 12.12 hrs, Volume= 2.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.1: Runoff Area=0.248 ac 100.00% Impervious Runoff Depth>7.50"
Tc=6.0 min CN=98 Runoff=1.87 cfs 0.155 af

Subcatchment SC1.2: Runoff Area=0.411 ac 89.41% Impervious Runoff Depth>7.26"
Tc=6.0 min CN=96 Runoff=3.07 cfs 0.249 af

Subcatchment SC1.3: Runoff Area=0.766 ac 37.52% Impervious Runoff Depth>6.19"
Flow Length=317' Tc=6.0 min CN=87 Runoff=5.27 cfs 0.395 af

Subcatchment SC1.4: Runoff Area=0.134 ac 100.00% Impervious Runoff Depth>7.50"
Tc=6.0 min CN=98 Runoff=1.01 cfs 0.084 af

Subcatchment SC1.5: Runoff Area=2.484 ac 0.00% Impervious Runoff Depth>5.03"
Flow Length=333' Tc=8.8 min CN=77 Runoff=13.16 cfs 1.041 af

Subcatchment SC2.1: Runoff Area=2.115 ac 0.00% Impervious Runoff Depth>5.03"
Flow Length=228' Tc=7.0 min CN=77 Runoff=11.80 cfs 0.887 af

Pond DS: Peak Elev=357.92' Storage=2,011 cf Inflow=4.94 cfs 0.404 af
Outflow=6.33 cfs 0.403 af

Pond WB: Peak Elev=343.42' Storage=4,831 cf Inflow=11.23 cfs 0.798 af
Primary=4.14 cfs 0.746 af Secondary=3.35 cfs 0.047 af Outflow=7.48 cfs 0.793 af

Link AP-1: Inflow=31.53 cfs 2.804 af
Primary=31.53 cfs 2.804 af

Total Runoff Area = 6.158 ac Runoff Volume = 2.810 af Average Runoff Depth = 5.48"
83.16% Pervious = 5.121 ac 16.84% Impervious = 1.037 ac

Summary for Subcatchment SC1.1:

Runoff = 1.87 cfs @ 12.08 hrs, Volume= 0.155 af, Depth> 7.50"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
0.248	98	Roofs, HSG D
0.248		100.00% Impervious Area

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

Summary for Subcatchment SC1.2:

Runoff = 3.07 cfs @ 12.08 hrs, Volume= 0.249 af, Depth> 7.26"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
0.044	80	>75% Grass cover, Good, HSG D
0.368	98	Paved parking, HSG D
0.411	96	Weighted Average
0.044		10.59% Pervious Area
0.368		89.41% Impervious Area

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

Summary for Subcatchment SC1.3:

Runoff = 5.27 cfs @ 12.09 hrs, Volume= 0.395 af, Depth> 6.19"
Routed to Pond WB :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
0.468	80	>75% Grass cover, Good, HSG D
0.011	77	Woods, Good, HSG D
0.287	98	Paved parking, HSG D
0.766	87	Weighted Average
0.479		62.48% Pervious Area
0.287		37.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	207	0.0400	6.03	18.08	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
1.6	317	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment SC1.4:

Runoff = 1.01 cfs @ 12.08 hrs, Volume= 0.084 af, Depth> 7.50"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
0.134	98	Paved parking, HSG D
0.134		100.00% Impervious Area

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

Summary for Subcatchment SC1.5:

Runoff = 13.16 cfs @ 12.12 hrs, Volume= 1.041 af, Depth> 5.03"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
2.321	77	Woods, Good, HSG D
0.163	80	>75% Grass cover, Good, HSG D
2.484	77	Weighted Average
2.484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.4	283	0.1484	1.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	333	Total			

Summary for Subcatchment SC2.1:

Runoff = 11.80 cfs @ 12.10 hrs, Volume= 0.887 af, Depth> 5.03"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 100-Year Rainfall=7.74"

Area (ac)	CN	Description
0.305	80	>75% Grass cover, Good, HSG D
1.810	77	Woods, Good, HSG D
2.115	77	Weighted Average
2.115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.1	178	0.0787	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	228	Total			

Summary for Pond DS:

Inflow Area = 0.659 ac, 93.39% Impervious, Inflow Depth > 7.35" for 100-Year event
Inflow = 4.94 cfs @ 12.08 hrs, Volume= 0.404 af
Outflow = 6.33 cfs @ 12.12 hrs, Volume= 0.403 af, Atten= 0%, Lag= 2.1 min
Primary = 6.33 cfs @ 12.12 hrs, Volume= 0.403 af
Routed to Pond WB :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 357.92' @ 12.12 hrs Storage= 2,011 cf

Plug-Flow detention time= 12.9 min calculated for 0.402 af (100% of inflow)
Center-of-Mass det. time= 12.1 min (760.2 - 748.2)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	2,011 cf	**48.0" Round Pipe Storage** x 2 L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	344.00'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.00' / 341.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	347.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.28 cfs @ 12.12 hrs HW=357.76' TW=343.34' (Dynamic Tailwater)
└─**1=Culvert** (Passes 6.28 cfs of 10.87 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.37 cfs @ 15.67 fps)
  └─**3=Orifice/Grate** (Orifice Controls 4.91 cfs @ 14.06 fps)

Summary for Pond WB:

Inflow Area = 1.425 ac, 63.36% Impervious, Inflow Depth > 6.72" for 100-Year event
Inflow = 11.23 cfs @ 12.12 hrs, Volume= 0.798 af
Outflow = 7.48 cfs @ 12.17 hrs, Volume= 0.793 af, Atten= 33%, Lag= 3.2 min
Primary = 4.14 cfs @ 12.17 hrs, Volume= 0.746 af
Routed to Link AP-1 :
Secondary = 3.35 cfs @ 12.17 hrs, Volume= 0.047 af
Routed to Link AP-1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 343.42' @ 12.17 hrs Surf.Area= 4,357 sf Storage= 4,831 cf

Plug-Flow detention time= 22.4 min calculated for 0.791 af (99% of inflow)
Center-of-Mass det. time= 17.9 min (790.6 - 772.8)

Volume	Invert	Avail.Storage	Storage Description
#1	342.00'	7,587 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
342.00	2,474	0	0	2,474
343.00	3,799	3,113	3,113	3,818
344.00	5,185	4,474	7,587	5,229

Device	Routing	Invert	Outlet Devices
#1	Primary	341.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 341.00' / 340.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	342.00'	**1.0' long x 0.70' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#3	Device 1	343.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	343.20'	**12.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.13 cfs @ 12.17 hrs HW=343.41' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.13 cfs @ 5.26 fps)
  ├─**2=Sharp-Crested Vee/Trap Weir** (Passes < 3.53 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 5.43 cfs potential flow)

Secondary OutFlow Max=3.15 cfs @ 12.17 hrs HW=343.41' TW=0.00' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 3.15 cfs @ 1.24 fps)

Summary for Link AP-1:

Inflow Area = 6.158 ac, 16.84% Impervious, Inflow Depth > 5.46" for 100-Year event
Inflow = 31.53 cfs @ 12.13 hrs, Volume= 2.804 af
Primary = 31.53 cfs @ 12.13 hrs, Volume= 2.804 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Time span=0.00-24.00 hrs, dt=0.04 hrs, 601 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment SC1.1: Runoff Area=0.248 ac 100.00% Impervious Runoff Depth>6.63"
Tc=6.0 min CN=98 Runoff=1.66 cfs 0.137 af

Subcatchment SC1.2: Runoff Area=0.411 ac 89.41% Impervious Runoff Depth>6.39"
Tc=6.0 min CN=96 Runoff=2.72 cfs 0.219 af

Subcatchment SC1.3: Runoff Area=0.766 ac 37.52% Impervious Runoff Depth>5.35"
Flow Length=317' Tc=6.0 min CN=87 Runoff=4.59 cfs 0.342 af

Subcatchment SC1.4: Runoff Area=0.134 ac 100.00% Impervious Runoff Depth>6.63"
Tc=6.0 min CN=98 Runoff=0.89 cfs 0.074 af

Subcatchment SC1.5: Runoff Area=2.484 ac 0.00% Impervious Runoff Depth>4.24"
Flow Length=333' Tc=8.8 min CN=77 Runoff=11.14 cfs 0.878 af

Subcatchment SC2.1: Runoff Area=2.115 ac 0.00% Impervious Runoff Depth>4.24"
Flow Length=228' Tc=7.0 min CN=77 Runoff=10.00 cfs 0.748 af

Pond DS: Peak Elev=351.93' Storage=2,011 cf Inflow=4.38 cfs 0.356 af
Outflow=3.69 cfs 0.355 af

Pond WB: Peak Elev=343.33' Storage=4,433 cf Inflow=7.75 cfs 0.697 af
Primary=4.04 cfs 0.672 af Secondary=1.48 cfs 0.020 af Outflow=5.52 cfs 0.692 af

Link AP-1: Inflow=25.67 cfs 2.392 af
Primary=25.67 cfs 2.392 af

Total Runoff Area = 6.158 ac Runoff Volume = 2.398 af Average Runoff Depth = 4.67"
83.16% Pervious = 5.121 ac 16.84% Impervious = 1.037 ac

Summary for Subcatchment SC1.1:

Runoff = 1.66 cfs @ 12.08 hrs, Volume= 0.137 af, Depth> 6.63"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
0.248	98	Roofs, HSG D
0.248		100.00% Impervious Area

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

Summary for Subcatchment SC1.2:

Runoff = 2.72 cfs @ 12.08 hrs, Volume= 0.219 af, Depth> 6.39"
Routed to Pond DS :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
0.044	80	>75% Grass cover, Good, HSG D
0.368	98	Paved parking, HSG D
0.411	96	Weighted Average
0.044		10.59% Pervious Area
0.368		89.41% Impervious Area

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

Summary for Subcatchment SC1.3:

Runoff = 4.59 cfs @ 12.09 hrs, Volume= 0.342 af, Depth> 5.35"
Routed to Pond WB :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
0.468	80	>75% Grass cover, Good, HSG D
0.011	77	Woods, Good, HSG D
0.287	98	Paved parking, HSG D
0.766	87	Weighted Average
0.479		62.48% Pervious Area
0.287		37.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.20		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.23"
0.3	60	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	207	0.0400	6.03	18.08	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=1.00' Z= 3.0 '/' Top.W=6.00' n= 0.030 Earth, grassed & winding
1.6	317	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment SC1.4:

Runoff = 0.89 cfs @ 12.08 hrs, Volume= 0.074 af, Depth> 6.63"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
0.134	98	Paved parking, HSG D
0.134		100.00% Impervious Area

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

Summary for Subcatchment SC1.5:

Runoff = 11.14 cfs @ 12.12 hrs, Volume= 0.878 af, Depth> 4.24"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
2.321	77	Woods, Good, HSG D
0.163	80	>75% Grass cover, Good, HSG D
2.484	77	Weighted Average
2.484		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.1000	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.4	283	0.1484	1.93		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	333	Total			

Summary for Subcatchment SC2.1:

Runoff = 10.00 cfs @ 12.10 hrs, Volume= 0.748 af, Depth> 4.24"
Routed to Link AP-1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs
Type III 24-hr 50-Year Rainfall=6.87"

Area (ac)	CN	Description
0.305	80	>75% Grass cover, Good, HSG D
1.810	77	Woods, Good, HSG D
2.115	77	Weighted Average
2.115		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.2000	0.17		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.23"
2.1	178	0.0787	1.40		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	228	Total			

Summary for Pond DS:

Inflow Area = 0.659 ac, 93.39% Impervious, Inflow Depth > 6.48" for 50-Year event
Inflow = 4.38 cfs @ 12.08 hrs, Volume= 0.356 af
Outflow = 3.69 cfs @ 12.14 hrs, Volume= 0.355 af, Atten= 16%, Lag= 3.6 min
Primary = 3.69 cfs @ 12.14 hrs, Volume= 0.355 af
Routed to Pond WB :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 351.93' @ 12.15 hrs Storage= 2,011 cf

Plug-Flow detention time= 13.1 min calculated for 0.355 af (100% of inflow)
Center-of-Mass det. time= 12.2 min (762.4 - 750.2)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	2,011 cf	**48.0" Round Pipe Storage** x 2 L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	344.00'	**12.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.00' / 341.00' S= 0.1071 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	347.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.90'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.58 cfs @ 12.14 hrs HW=351.78' TW=343.25' (Dynamic Tailwater)
↑**1=Culvert** (Passes 3.58 cfs of 8.05 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.90 cfs @ 10.34 fps)
3=Orifice/Grate (Orifice Controls 2.68 cfs @ 7.68 fps)

Summary for Pond WB:

Inflow Area = 1.425 ac, 63.36% Impervious, Inflow Depth > 5.87" for 50-Year event
Inflow = 7.75 cfs @ 12.12 hrs, Volume= 0.697 af
Outflow = 5.52 cfs @ 12.21 hrs, Volume= 0.692 af, Atten= 29%, Lag= 5.8 min
Primary = 4.04 cfs @ 12.21 hrs, Volume= 0.672 af
Routed to Link AP-1 :
Secondary = 1.48 cfs @ 12.21 hrs, Volume= 0.020 af
Routed to Link AP-1 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs / 2
Peak Elev= 343.33' @ 12.21 hrs Surf.Area= 4,231 sf Storage= 4,433 cf

Plug-Flow detention time= 23.5 min calculated for 0.692 af (99% of inflow)
Center-of-Mass det. time= 18.7 min (794.3 - 775.7)

Volume	Invert	Avail.Storage	Storage Description
#1	342.00'	7,587 cf	**Custom Stage Data (Pyramidal)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
342.00	2,474	0	0	2,474
343.00	3,799	3,113	3,113	3,818
344.00	5,185	4,474	7,587	5,229

Device	Routing	Invert	Outlet Devices
#1	Primary	341.00'	**12.0" Round Culvert** L= 36.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 341.00' / 340.00' S= 0.0278 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	342.00'	**1.0' long x 0.70' rise Sharp-Crested Vee/Trap Weir** Cv= 2.62 (C= 3.28)
#3	Device 1	343.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	343.20'	**12.0' long x 18.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.03 cfs @ 12.21 hrs HW=343.32' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.03 cfs @ 5.13 fps)
  ├─**2=Sharp-Crested Vee/Trap Weir** (Passes < 3.38 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 3.79 cfs potential flow)

Secondary OutFlow Max=1.41 cfs @ 12.21 hrs HW=343.32' TW=0.00' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.41 cfs @ 0.94 fps)

Summary for Link AP-1:

Inflow Area = 6.158 ac, 16.84% Impervious, Inflow Depth > 4.66" for 50-Year event
Inflow = 25.67 cfs @ 12.12 hrs, Volume= 2.392 af
Primary = 25.67 cfs @ 12.12 hrs, Volume= 2.392 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.04 hrs

Attachment 4: Hydraulic Calculations

Stormwater Management Standard 4: Water Quality Volume

Calculated By: LT | Checked By: EAC | 375 Mass Ave, Boxborough, MA

Date: 5/2/2025 | Date: | Job 241090

$$V_{WQ} = \frac{D_{WQ}}{12\ in/ft} \times \frac{A_{imp}}{43{,}560\ sf/acre}$$

Where: V_{WQ} = Required Water Quality Volume [cf]

D_{WQ} = Water Quality Depth [in] = **1.0** Inches

1-in 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 2.41 in/hr or greater; 0.5-in for other discharges.

A_{IMP} = Proposed Impervious Area (may exclude roof areas) [Ac]

1. Required Water Quality Volume:

Drainage Area/ Treatment Train	A_{IMP} [Ac]	D_{WQ} [in]	V_{WQ} [cf]
SC1.1	0.25	1.0	900
SC1.2	0.37	1.0	1,336
SC1.3	0.29	1.0	1,042
SC1.4	0.13	1.0	486
SC1.5	0.00	1.0	0
SC2.1	0.00	1.0	0

Total Required Water Quality Volume: 3,764 cf

2. Provided Water Quality Volume:

Drainage Area/ Treatment Train	Stormwater Control Measure	Water Quality Volume Provided [CF]
SC1.1	Contech StormFilter*	900
SC1.2	Contech StormFilter*	1,336
SC1.3	Sediment Forebay & Wet Basin	2,200
SC1.4	Contech StormFilter*	486
SC1.5	Grass	0
SC2.1	Grass	0

*StormFilter has been designed to provide 89% TSS removal to treat 1 inch of catchment area. See system design certification letter as provided by Contech.

Total Provided Water Quality Volume: 4,922 cf

Provided Water Quality Vol. ≥ Req'd Water Quality Vol. Design is Compliant

Wet Basin Permanent Pool Water Budget

Calculated By: LT | Checked By: EAC | 975 Mass Ave, Boxborough, MA

Date: 5/2/2025 | Date: | Job 241090

$$\Delta S = P - ET - Q - D$$

Where: ΔS = Change in storage
P = Precipitation
ET = Evapotranspiration
Q = Runoff (Assumed to be 0 for Wet Basin)
D = Deep drainage or percolation (Assumed to be 0 for Wet Basin)

12 months Precipitation Data from NOAA (Inches)

May-24	4.9	Nov-24	3.0
Jun-24	3.0	Dec-24	6.9
July-24	3.0	Jan-25	1.4
August-24	4.9	Feb-25	4.9
Sep-24	2.0	Mar-25	6.9
Oct-24	1.4	Apr-25	3.0

Total = **45.3** **inches**

12 months Evaporation Data from NOAA (Inches)

May-24	2.8	Nov-24	0.4
Jun-24	3.5	Dec-24	0.0
July-24	3.5	Jan-25	0.0
August-24	2.8	Feb-25	0.0
Sep-24	1.6	Mar-25	0.4
Oct-24	1.0	Apr-25	1.0

Total = **17.0** **inches**

Precipitation within the region generally exceeds evaporation based on the past 12 months NOAA monitoring data, therefore wet basin should be able to maintain a permanent pool.

Sediment Forebay Sizing

Calculated By: LT
Date: 3/24/2025

Checked By: EAC
Date:

975 Mass Ave, Boxborough, MA
Job 241090

Per the 2008 MassDEP Stormwater Handbook (Volume 2, Chapter 2)
Minimum storage of a sediment forebay = 0.1-inch x tributary impervious area

Forebay for Basin-0x

Required Treatment Volume

Tributary Impervious Area = 1.43 acres

Required Treatment Volume = 517.28 cf

Provided Treatment Volume

Forebay Elevation Increment	Area [sf]	Storage at Elevation Increment [cf]	Cumulative Storage [cf]
343.0	470	0	0
344.0	810	640	640
344.5	980	448	**1087.5**

Provided Treatment Volume = 1,728 cf

Existing Drainage Channel Analysis

Calculated By: LT Checked By: EAC 975 Mass Ave, Boxborough, MA

Date: 3/24/2025 Date: Job 241090

Uniform Flow Capcity Calculation

Q=(1.49/n)AR^(2/3)S^0.5

Existing Drainage Channel			**Proposed half-buried 24" RCP culvert**		
A =	3	SF	**A =**	1.57	SF
P =	5	FT	**P =**	5.14	FT
R =	0.60	FT	**R =**	0.31	FT
n =	0.06	(Poor channel)	**n =**	0.023	(Firm gravel)
S =	0.007	FT/FT	**S =**	0.01	FT/FT
Q =	**4.43**	**CFS**	**Q =**	**4.61**	**CFS**

Rational Method Calculation for Catchment Area for Drainage Channel

Q = C I A

C	Runoff Coefficient	0.5		(Forest) + (Business Areas)
I	Rainfall Intensity	0.32	In/hr	(100-yr 24-hr storm event)
A	Drainage Channel Catchment Area	6.5	acres	(Based on MassGIS info)

Q =	**1.04**	**CFS**

Based on the Rational Method Calculation and Uniform Flow Capacity Calculations for both the existing drainage channel and proposed culvert, the proposed half-buried 24" culvert is sufficient to handle the estimated flow for the existing drainage channel.

Pipe Performance Summary

Calculated By: LT Checked By: EAC 975 Mass Ave, Boxborough, MA

Date: 4/22/2025 Date: Job 241090

FROM			TO															
Structure	Rim	Invert	Structure	Invert	Pipe Size (in)	Pipe Type	Length (ft)	Slope (ft/ft)	Slope (%)	Manning's n	Pipe Area (sf)	Hydraulic Radius (ft)	Q_{full} (cfs)	V_{full} (ft/s)	Q_{25}	Q_{25} / Q_{full}	Propotional Flow d/D	V_{25} / V_{full}	V_{25}
CB-1	353.70	350.70	DMH-1	349.30	12	HDPE	145.0	0.01	1%	0.013	0.785	0.250	3.5	4.5	1.2	0.34	0.40	0.90	4.0
CB-2	354.00	350.00	DMH-1	349.30	12	HDPE	10.0	0.07	7%	0.013	0.785	0.250	9.5	12.0	0.8	0.08	0.21	0.64	7.7
CB-3	354.00	350.00	DS	349.00	12	HDPE	25.0	0.04	4%	0.013	0.785	0.250	7.1	9.1	1.6	0.22	0.35	0.85	7.7
DMH-1	354.30	349.20	DS	349.00	24	HDPE	17.0	0.01	1%	0.013	3.142	0.500	24.6	7.8	2.7	0.11	0.25	0.72	5.6
DS	--	349.00	DMH-2	348.90	8	HDPE	10.0	0.01	1%	0.013	0.349	0.167	1.2	3.5	2.0	1.64	1.00	1.00	3.5
DMH-2	354.30	341.00	FES-1	340.00	12	HDPE	28.0	0.04	4%	0.013	0.785	0.250	6.8	8.6	4.3	0.64	0.58	1.05	9.0
OCS-1	343.00	341.00	WQI-1	340.80	12	HDPE	7.0	0.03	3%	0.013	0.785	0.250	6.0	7.7	3.9	0.65	0.58	1.05	8.1
WQI-1	344.50	340.30	FES-2	340.00	12	HDPE	15.0	0.02	2%	0.013	0.785	0.250	5.1	6.4	3.9	0.77	0.58	1.05	6.8
WQI-2	339.50	336.50	FES-3	336.25	8	HDPE	30.0	0.01	1%	0.013	0.349	0.167	1.1	3.2	0.2	0.16	0.72	0.28	0.9

Abbreviations:

CB - Catch Basin; WQI - Water Quality Inlet; DMH - Drain Manhole; FES - Flared End Section; DS - Detention Storage; OCS - Outlet Control Structure

Attachment 5: TSS Removal, TP Removal

Phosphorus Removal

Calculated By: LT
Date: 3/24/2025

Checked By: EAC
Date:

975 Mass Ave, Boxborough, MA
Job 241090

Estimated Unmitigated Phosphorus Loading

Land Use	Area [ac]	Phosphorus Loading Rate [lbs/ac/yr]	Estimated Annual Phosphorus Load [lbs/yr]
Commercial and Industrial	**1.04**	1.78	1.84
Multi Family Residential	**0.00**	2.32	-
Medium -Density Residential	**0.00**	1.96	-
Low Density Residential	**0.00**	1.52	-
Highway	**0.00**	1.34	-
Forest Pervious	**4.14**	0.13	0.54
Agriculture Pervious	**0.00**	0.45	-
Developed Land Pervious HSG A	**0.00**	0.03	-
Developed Land Pervious HSG B	**0.00**	0.12	-
Developed Land Pervious HSG C	**0.00**	0.21	-
Developed Land Pervious HSG D	**0.98**	0.37	0.36

Estimated Unmitigated Phosphorus Loading (TP_1): **2.74** **lbs/yr**

Required TP Reduction: 60%

Required TP Loading Reduction: **1.65** **lbs/yr**

Phosphorus Loading Rate Reduction

Stormwater Control Measure	Tributary Area [ac]		Total Tributary Phosphorus Loading Rate [lbs/ac/yr]	TP Removal Rate Per Appendix F Attachment 3 of MS4 Permit	Estimated Annual TP Load Reduction [lbs/yr]
	Pervious HSG D	Impervious Commercial and Industrial			
Water Quality Inlet-1	**0.04**	**0.62**	1.13	82%	0.92
Water Quality Inlet-2	**0.00**	**0.10**	0.19	82%	0.15
Wet Basin	**0.48**	**0.29**	0.70	82%	0.58
	0.00	**0.00**	0.00	0%	0.00
	0.00	**0.00**	0.00	0%	0.00
	0.00	**0.00**	0.00	0%	0.00

Total Estimated Annual TP Load Reduction = TP_{Red}: **1.65** **lbs/yr**

Estimated Annual TP Load = TP_1 - TP_{Red}: **1.09** **lbs/yr**

Provided Reduction: **60%**

Stormwater Management Standard 4: TSS Removal

Location #1: Wet Basin and Stormfilter

TSS Removal Calculation Worksheet

A SCM	B TSS Removal Rate	C Starting TSS Load	D Amount Removed (B*C)	E Remaining Load (C-D)
Sediment Forebay / Catch Basin	0.25	1.00	0.25	0.75
Wet Basin	0.80	0.75	0.60	0.15
Contech Stormfilter	0.89	0.15	0.13	0.02
		-	-	-

Total TSS Removal = 98%

Location #2: along driveway close to roadway

TSS Removal Calculation Worksheet

A SCM	B TSS Removal Rate	C Starting TSS Load	D Amount Removed (B*C)	E Remaining Load (C-D)
Contech Stormfilter	0.89	1.00	0.89	0.11
		-	-	-

Total TSS Removal = **89%**

Site Total Weighted Average TSS Removal Rate =		**97.8%**
Location #1 Area =	1.43	ac
Location #2 Area =	0.10	ac
Uncaptured Area =	0.03	ac

The Stormwater Management StormFilter®- PhosphoSorb®

Field Performance Summary

A three year field performance evaluation of The Stormwater Management StormFilter® (StormFilter) with PhosphoSorb® media operating at a specific flow rate of 1.67 gpm/ft^2 was completed at a 0.06 acre roadway site in Zigzag, Oregon. The Quality Assurance Project Plan (QAPP) for this evaluation followed the Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE, 2011). The StormFilter with PhosphoSorb Technical Evaluation Report resulted in a General Use Level Designation from Washington State Department of Ecology for Total Suspended Solids (TSS) and Total Phosphorus removal.

Results of the field performance evaluation for 17 qualified events are provided in Table 1.

Table 1. StormFilter with PhosphoSorb Field Evaluation Results

	Parameter	Sample population (n)	Average Influent (mg/L)	Average Effluent (mg/L)	Average Removal (%)	Aggregate Pollutant Load Reduction [1] (%)
Solids	TSS	17	380	40	88	89
	SSC<500 µm	15	325	40	87	89
	Silt and Clay[2]	16	153	32	78	82
Nutrients	Total Phosphorus	17	0.33	0.07	73	82
	Total Nitrogen	17	1.14	0.57	43	50
Metals	Total Zinc	15	0.129	0.024	78	81
	Dissolved Zinc	7	0.016	0.01	28	32
	Total Copper	15	0.026	0.005	79	82
	Dissolved Copper	7	0.004	0.003	30	28
	Total Aluminum	16	5.85	1.08	83	83
	Total Lead	15	0.009	0.003	64	70

[1] Treatment Efficiency Calculation, Method #2 (TAPE, 2008)
[2] Suspended Solids less than 62.5 microns

Load Reduction

89% TSS

82% Total Phosphorus

50% Total Nitrogen

Data were analyzed using the TAPE bootstrap confidence interval calculator for TSS and Total Phosphorus. The lower 95% confidence interval for TSS removal efficiency was 85%. The lower 95% confidence interval for total phosphorus removal efficiency was 67%. The upper 95% confidence interval for total phosphorus effluent concentration was 0.084 mg/L.

Over the entire 37 month evaluation period, the total effluent volume recorded at the site was 376,244 gallons. A total of 14,060 gallons were bypassed through the system accounting for 4% of the total recorded volume. A total of 26 events contained bypass flow, with 23 of those events producing peak flows exceeding the design treatment capacity of the system. The three events with bypass flows occurring below the design treatment capacity triggered maintenance. During the evaluation period, the system lasted between 10 and 12 months between maintenance events and retained an average of 291 pounds of sediment per maintenance event.

References

Contech Engineered Solutions, LLC. (2015). The Stormwater Management StormFilter® PhosphoSorb® at a Specific Flow Rate of 1.67 gpm/ft^2 General Use Level Designation Technical Evaluation Report. Portland, OR. Author.

Washington State Department of Ecology (Ecology). (2011). Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE). Olympia, Washington. (Referred to as TAPE, 2011)

Washington State Department of Ecology (Ecology). (2008). Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol – Ecology (TAPE). Olympia, Washington. (Referred to as TAPE, 2008)

Contech Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME 04074
www.ContechES.com

May 5, 2025

Design Summary

975 Massachusetts Ave, Boxborough, MA

CES PROJECT: 845278

Information Provided:

- MA WQ Storm: 1" runoff depth
- WQI 1 Drainage Area: 1.43 ac
- WQI 1 WQ outflow from detention: 0.285 cfs
- WQI 2 Drainage Area: 0.13 sf
- WQI 2 WQ inflow: 0.12 cfs

Contech Engineered Solutions (Contech) has reviewed the StormFilter (SF) design for this project. We believe the SF configuration with Phosphosorb (Psorb) media cartridges to be appropriate water quality solutions for this site providing TSS, Phosphorus and Nitrogen reductions from stormwater runoff.

WQI 1: StormFilter Media Cartridge Filtration System

The StormFilter system is designed in accordance with the maximum drain down rate of 1.67 gallons per minute per square foot of filter surface area (12.53 gpm per 18" cartridge). The StormFilter vault for this site location is designed with an upstream water quality volume (WQv) detention system to retain, route and treat the entire water quality (WQ) event flow from the contributing drainage area to the treatment unit. The resultant volume from the WQ event storm is detained in the upstream detention to an elevation below any bypass flow paths resulting in a routed WQ storm event volume through the SF cartridges.

The engineer of record provided a drainage area of 1.43 acres (100% impervious). In order to adequately treat the runoff from this area, Contech recommends a StormFilter Peak Diversion 6'x12' Vault (model SFPD0612) with quantity 11 x 18" Psorb cartridges.

The SF system requires a hydraulic headwater condition to fully immerse the media and activate the cartridge float valve. For 18" SF cartridges, this headwater condition is 2.3 ft above SF outlet invert. This is achieved by the either physical inlet to outlet pipe elevation drop or an upstream WQ detention filling during the WQ storm flow to the required SF float valve activation elevation.

WQI 2: StormFilter Media Cartridge Filtration System

The StormFilter system is designed in accordance with the maximum drain down rate of 1.67 gallons per minute per square foot of filter surface area (18.8 gpm per 27" cartridge). The StormFilter vault for this site location is designed to accept surface inflow, route and treat the entire water quality (WQ) event flow from the contributing drainage area to the treatment unit. The resultant volume from the WQ

Contech Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME 04074
www.ContechES.com

event storm is treated by the StormFilter structure without any bypass flow occurring resulting in a routed WQ storm event volume through the SF cartridges.

The engineer of record provided a drainage area of 0.13 acres (100% impervious). In order to adequately treat the runoff from this area, Contech recommends a StormFilter Steel Catch Basin (model SFCB3-S) with quantity 3 x 27" Psorb cartridges.

The SF system requires a hydraulic headwater condition to fully immerse the media and activate the cartridge float valve. For 27" SF cartridges, this headwater condition is 3.05 ft above SF outlet invert. This is achieved with the inlet bay of the catch basin unit on filling during the WQ storm flow to the required SF float valve activation elevation.

Maintenance:

Contech offers a network of Preferred Service Providers that have the capability to perform all necessary inspections, compliance reporting and cleaning services. Contech recommends inspecting the system annually and maintaining the system at the recommendation of the annual inspection. Full maintenance is typically required every 24-36 months. Please contact Contech's Maintenance Department for all questions regarding maintenance at (804) 317-3231 or visit our website at www.ContechES.com.

Thank you for the opportunity to present this information to you and your client.

Sincerely,

David Adams
Senior Project Engineer
Contech Engineered Solutions
dave.adams@ContechES.com
207-885-6191

StormFilter Design Calculation

Contech Engineered Solutions, LLC Engineer:	**JBS**
Date	**5/2/2025**

Site Information

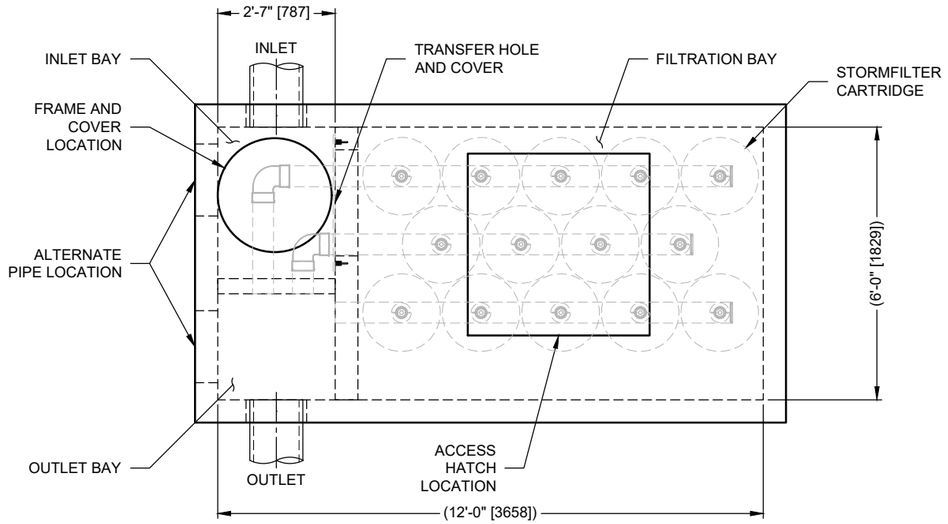
Project Name	**975 Massachusetts Ave**	
Project City	**Boxborough**	
Project State	**MA**	
Site Designation	**WQI-1**	
Drainage Area, Ad	**1.43**	ac
Impervious Area, Ai	**1.43**	ac
Pervious Area, Ap	**0.00**	
% Impervious	**100%**	
Runoff Coefficient, Rc	**0.95**	
Water quality flow	**0.285**	cfs
Peak storm flow	**5.00**	cfs

Filter System

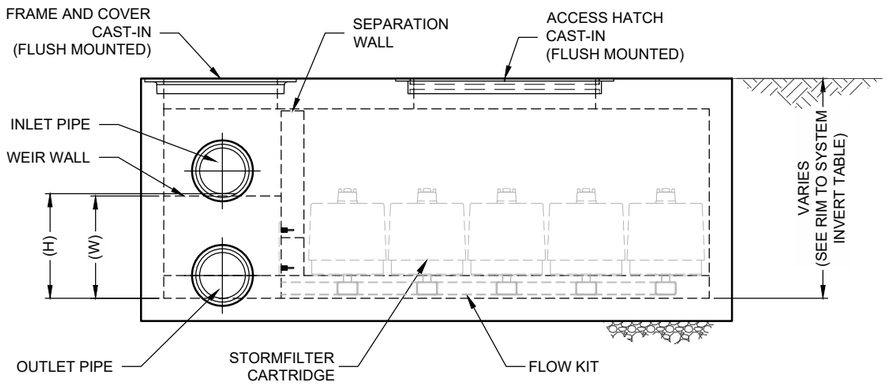
Filtration brand	**StormFilter**	
Cartridge height	**18**	in
Specific Flow Rate	**1.67**	gpm/ft^2
Flow rate per cartridge	**12.53**	gpm

SUMMARY

Number of Cartridges	11



PLAN



ELEVATION

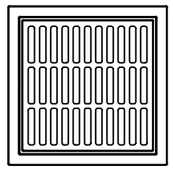
The Stormwater Management StormFilter®

STORMFILTER DESIGN NOTES

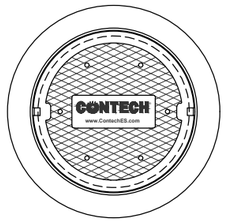
- STORMFILTER TREATMENT CAPACITY VARIES BY CARTRIDGE COUNT AND LOCALLY APPROVED SURFACE AREA SPECIFIC FLOW RATE. PEAK CONVEYANCE CAPACITY TO BE DETERMINED BY ENGINEER OF RECORD
- A 6' x 12' [1829 x 3658] PEAK DIVERSION STYLE STORMFILTER IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (14) AND IS AVAILABLE IN A LEFT INLET (AS SHOWN) OR A RIGHT INLET CONFIGURATION
- ALL PARTS AND INTERNAL ASSEMBLY PROVIDED BY CONTECH UNLESS NOTED OTHERWISE

CARTRIDGE SIZE (in. [mm])	27 [686]			18 [457]			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H) (ft. [mm])	3.05 [930]			2.3 [701]			1.8 [549]		
HEIGHT OF WEIR (W) (ft. [mm])	3.00 [914]			2.25 [686]			1.75 [533]		
SPECIFIC FLOW RATE (gpm/sf [L/s/m^2])	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]	2 [1.36]	1.67* [1.13]*	1 [0.68]
CARTRIDGE FLOW RATE (gpm [L/s])	22.5 [1.42]	18.79 [1.19]	11.25 [0.71]	15 [0.95]	12.53 [0.79]	7.5 [0.47]	10 [0.63]	8.35 [0.53]	5 [0.32]

* 1.67 gpm/sf [1.13 L/s/m^2] SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY



FRAME AND GRATE
(24" SQUARE)
(NOT TO SCALE)



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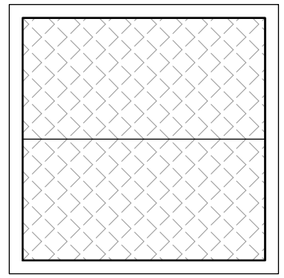
(NOT TO SCALE)



ACCESS HATCH
(48" SQUARE)
(NOT TO SCALE)

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (cfs [L/s])	
PEAK FLOW RATE (cfs [L/s])	
RETURN PERIOD OF PEAK FLOW (yrs)	
CARTRIDGE FLOW RATE	
CARTRIDGE SIZE (27, 18, LOW DROP (LD))	
MEDIA TYPE (PERLITE, ZPG, PSORB)	
NUMBER OF CARTRIDGES REQUIRED	
FILTER BAY RIM ELEVATION	

PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES/SPECIAL REQUIREMENTS:

RIM TO SYSTEM INVERT

CARTRIDGE SIZE	MIN. HEIGHT	MAX. HEIGHT
LOW DROP / 18"	3'-6"	4'-10"
27"	4'-2"	4'-10"

PERFORMANCE SPECIFICATION

FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. **RADIAL MEDIA DEPTH SHALL BE 7-INCHES**. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST **38 SECONDS**. SPECIFIC FLOW RATE SHALL BE **2 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM).**

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
4. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
5. STRUCTURE SHALL MEET AASHTO HS-20 LOAD RATING, ASSUMING EARTH COVER OF 0'-0", AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE.
C. CONTRACTOR TO ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
F. CONTRACTOR TO REMOVE THE TRANSFER HOLE COVER WHEN THE SYSTEM IS BROUGHT ONLINE.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SFPD0612-S
6' x 12' PEAK DIVERSION STORMFILTER
SHALLOW STANDARD DETAIL

StormFilter Design Calculation

Contech Engineered Solutions, LLC Engineer:	**JBS**
Date	**5/2/2025**

Site Information

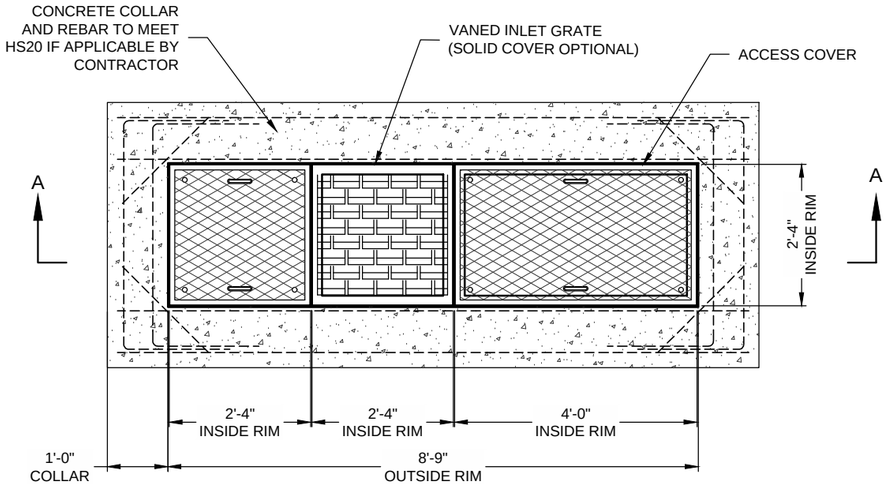
Project Name	**975 Massachusetts Ave**	
Project City	**Boxborough**	
Project State	**MA**	
Site Designation	**WQI-2**	
Drainage Area, Ad	**0.13**	ac
Impervious Area, Ai	**0.13**	ac
Pervious Area, Ap	**0.00**	
% Impervious	**100%**	
Runoff Coefficient, Rc	**0.95**	
Water quality flow	**0.12**	cfs
Peak storm flow	**5.00**	cfs

Filter System

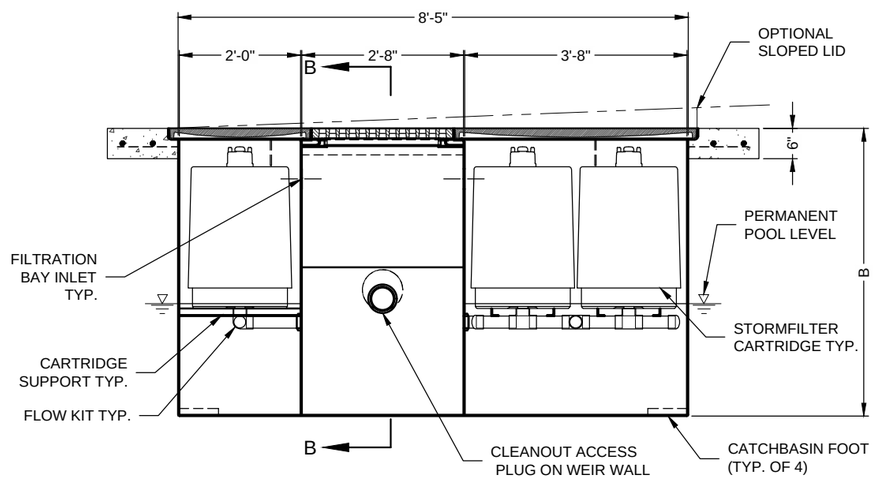
Filtration brand	**StormFilter**	
Cartridge height	**27**	in
Specific Flow Rate	**1.67**	gpm/ft^2
Flow rate per cartridge	**18.8**	gpm

SUMMARY

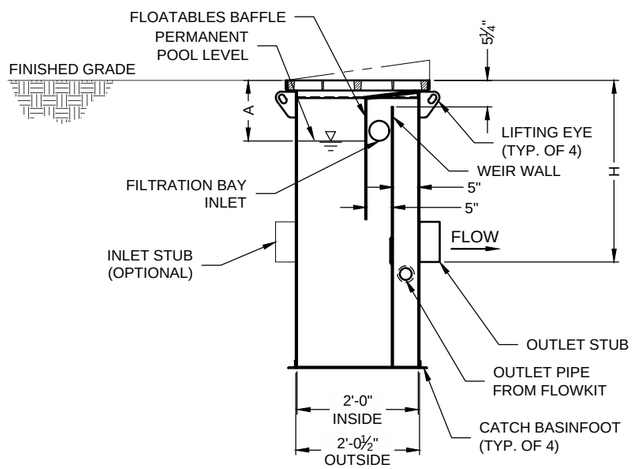
Number of Cartridges	3



PLAN VIEW



SECTION A-A



SECTION B-B

STORMFILTER STEEL CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 3 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF THREE CARTRIDGES. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			18" DEEP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			3.3'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	15	12.53	7.5
PEAK HYDRAULIC CAPACITY	1.0			1.0			2.25		
INLET PERMANENT POOL LEVEL (A)	1'-0"			1'-0"			2'-0"		
OVERALL STRUCTURE HEIGHT (B)	4'-9"			3'-9"			4'-9"		

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ANGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. MANUFACTURER TO APPLY A SURFACE BEAD WELD IN THE SHAPE OF THE LETTER "O" ABOVE THE OUTLET PIPE STUB ON THE EXTERIOR SURFACE OF THE STEEL SFCB.
6. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
7. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
8. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
9. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

3-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (cfs)	X.XX
PEAK FLOW RATE (<1 cfs)	X.XX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
CARTRIDGE FLOW RATE (gpm)	XX
MEDIA TYPE (PERLITE, ZPG, PSORB)	XXXXX
RIM ELEVATION	XXX.XX'

PIPE DATA:	I.E.	DIAMETER
INLET STUB	XXX.XX'	XX"
OUTLET STUB	XXX.XX'	XX"

CONFIGURATION

OUTLET INLET

OUTLET INLET

SLOPED LID	YES\NO
SOLID COVER	YES\NO
NOTES/SPECIAL REQUIREMENTS:	

The Stormwater Management StormFilter®

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-526-3999 513-645-7000 513-645-7993 FAX

3 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL

Attachment 6: Long Term Pollution Prevention Plan and Operation and Maintenance Manual