Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

February 19, 2025
***Revised May 12, 2025**

Prepared for:

Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

Stormwater Management Permit ~ Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Project Description

The subject property is composed of an undeveloped lot totaling 497,145 square feet (11.41 acres) located at 1400 Hilldale Avenue, assessor's parcels 585-431-22A. The existing site is currently undeveloped with a portion of the site being wooded and the majority of the site consisting of brush. There is an existing graveled storage yard located towards the front of the site. There are several areas of existing bordering vegetated wetlands located on site. An area of existing bordering vegetated wetlands runs along the majority of the southern property line. This connects to an area of bordering vegetated wetlands to the northern property line, that divides the site into two areas of uplands. There is also an existing vernal pool that crosses onto the site located on the southern property line.

The soils on site have been mapped by the National Resource Conservation Service (NRCS) as being comprised mostly of Hinckley loamy sand and Montauk fine sandy loam. Deep-hole soil observation and percolation testing was conducted in January of 2018 by GZA GeoEnvironmental, Inc. The soils were consistent with the NRCS mapping, with subsurface conditions at the Site consisting of a layer of forest mat/top soil, underlain by subsoil, underlain by natural soil. Additional deep-hole soil observations were conducted by Dana F. Perkins, Inc. to determine soil conditions in the areas of the proposed infiltration systems. Even though sandy material was found in these areas, all infiltration calculations were calculated using the more conservative soil types as mapped by NRCS.

The Applicant is proposing the construction of an industrial outdoor storage yard, consisting of two separate paved areas. They are proposing an approximately 83,500 square foot paved storage area on the western portion of the site, and an approximately 95,700 square foot paved storage area on the eastern portion of the site. In addition to the paved storage areas, the applicant is proposing grading and stormwater management best-management practices. The purpose of the project is to expand their existing industrial outdoor storage yard located across the street at 6 Fondi Road. To address the issues of Stormwater Management, the Applicant has proposed best management practices (BMPs), including siltation and sedimentation control, deep-sump catch basins, Contech hydrodynamic separator units, and infiltration chambers to provide groundwater recharge for surface runoff from all paved areas. The following report shall demonstrate how the applicant intends to comply with the Standards of the Stormwater Management policies.

Stormwater Management Permit ~ Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Illicit Discharge Compliance Statement

Illicit discharges shall not be discharged to any Stormwater Management System, prior to, throughout, or after construction. Illicit Discharges include not only wastewater, but also stormwater runoff that has become contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil or grease. An Illicit Discharge **does not** include the following activities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual 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.

By signing below, as a Representative of the Applicant, I certify to the following:

1. No Illicit Discharges currently exist on site.
2. No Illicit Discharges are proposed on site.
3. I understand the negative impacts that Illicit Discharges could impose upon the Stormwater Management Systems, both existing and/or to be constructed on the property located at **1400 Hilldale Avenue ~ Haverhill, Massachusetts**
4. I have read and understand both the **Construction Period Stormwater Pollution Prevention Plan** and the **Long-Term Stormwater Pollution Prevent Plan** and shall maintain the integrity of their inspection and maintenance procedures.
5. I shall immediately report any Illicit Discharges to the following entities:
    a. Dana F. Perkins, Inc. ~ Engineering Department
    b. City of Haverhill ~ Board of Health
    c. City of Haverhill ~ Conservation Division

Sign Name: Sanj Singh

Print Name: SANJAY SINGH

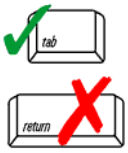
Date: 2/18/25

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.

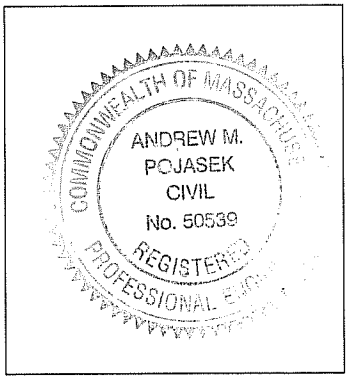
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



2/19/25

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): Other LID measures were considered for this project, but were prohibitive to the design of the project, as proposed

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.

Stormwater Management Permit

City of Haverhill

Comprehensive Stormwater Management Bylaw

Proposed Industrial Outdoor Storage Yard

1400 Hilldale Avenue
Haverhill, Massachusetts

CONSTRUCTION PERIOD
POLLUTION PREVENTION PLAN

Prepared for:

Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

Stormwater Management Permit ~ Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Construction Period Stormwater Pollution Prevention Plan

Index of Materials

Appendices

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Stormwater Pollution Prevention Plan Certification

I hereby certify, under penalty of law, that this document and all attachments were reviewed by me, and to the best of my knowledge the information submitted is true, accurate, and complete. I am aware that there are significant penalties for knowingly submitting false information including the possibility of fines and imprisonment.

Signed: _____

(must be signed by Company Officer)

Date: _____

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Contractor Certification

I hereby certify, under penalty of law, that I understand the terms and conditions of the National Pollutant Discharge Elimination System (N.P.D.E.S.) that authorizes the stormwater discharges associated with the construction activities for this particular construction site as identified on this part of the certification.

Signed: _____

Representative of: (name of Construction Company)

_____

Date: _____

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Construction / Implementation Checklist

1. Maintain Records of Construction Activities, including:
   - □ Dates when major grading activities occur.
   - □ Dates when construction activities temporarily cease on a portion of the site.
   - □ Dates when construction activities permanently cease on a portion of the site.
   - □ Dates when stabilization measures are initiated on the site.

2. Prepared Inspection Reports summarizing:
   - □ Name of inspector
   - □ Qualifications of inspector
   - □ Measures/areas inspected
   - □ Observed conditions
   - □ Changes necessary to the SWPPP

3. Report Releases of Reportable Quantities of Oil or Hazardous Materials (if they occur):
   - □ Notify National Response Center 800-424-8802 immediately
   - □ Notify permitting authoring in writing within 14 days
   - □ Modify the pollution prevention plan to include:
     - the date of release
     - circumstances leading to the release
     - steps taken to prevent reoccurrence of the release

4. Modify Pollution Prevention Plan as necessary to:
   - □ Comply with the minimum permit requirements when notified by EPA that the plan does not comply.
   - □ Address a change in design, construction operation or maintenance which has an effect on the potential for discharge of pollutants.
   - □ Prevent reoccurrence of reportable quantity releases of a hazardous material or oil.

This project is subject to the NPDES Construction General Permit issued by EPA. The Contractor/Applicant will need to file a Notice of Intent under the EPA NPDES Construction General Permit. Copies of the Notice of Intent and SWPPP under this permit shall be provided to the Haverhill Conservation Commission. The Haverhill Conservation Commission shall be notified prior to filing a Notice of Termination under the EPA permit.

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Site Description

Project Name: Proposed Industrial Outdoor Storage Yard

Project Location: 1400 Hilldale Avenue ~ Haverhill, MA 01832

Latitude & Latitude: 42.8117°, -71.1187°

Applicant Address: Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Party Responsible for Implementation of Construction Period S.W.P.P.P. : SITE CONTRACTOR

Approximate Project Area: 497,145 square-feet ± (11.41 Acres)

Total Area of Disturbance: 245,666 square-feet ± (5.64 Acres)

Total Proposed Impervious Area (full site): 4.1 acres ±

Total Area of Wetland Alteration: 1,701 SF±

Total Area of Wetland Restoration: 3,500 SF±

Stormwater Management BMP's Provided:
Deep-Sump Catch Basins, Hydrodynamic separators, Infiltration chambers

Utilities to be Provided:
Public electric

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Sequence of Major Construction Activities

1. Install erosion controls as shown on the Site Plans.
2. Install construction fencing, as necessary.
3. Install crushed stoned apron at the proposed construction entrances.
4. Cut and remove all necessary trees and stump the site.
5. General site grading shall be completed, including the installation of the retaining walls.
6. Install infiltration chambers and proposed drainage.
7. Utilities shall be installed.
8. Curb cuts shall be constructed.
9. Finalize site grading.
10. Loam and seed proposed grassed areas.
11. Install bituminous concrete pavement.
12. Site lighting, landscaping, and signage shall be installed.
13. Ensure full germination of all seeded areas. Repair any necessary areas.
14. Remove any sediment from all drainage structures.
15. Complete top course paving and striping.
16. Remove temporary erosion controls after entire site has been properly stabilized.

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Implementation and Maintenance of Erosion and Sediment Controls

Temporary Stabilization

Stockpiles of soil materials will be surrounded sediment filtermitt. Areas of the site that have been stripped of topsoil and are not part of the active construction area for at least 14 days shall be temporarily stabilized with 4,000 pounds per acre of straw mulch.

Permanent Stabilization

Disturbed portions of the site where construction activities permanently cease shall be stabilized with permanent seed, hydroseed, or sod no later than 14 days after the last construction activity.

Stormwater Management

Stormwater Management BMPs shall be inspected weekly during construction. Any accumulated sediment shall be removed and disposed of according to City of Haverhill regulations. During construction, sediment filtermitt shall be used to the extent practicable to direct stormwater towards pervious areas on-site rather than directly towards Stormwater Management BMPs.

Other Controls

Waste Disposal

Waste Materials: All waste materials including trash and construction debris shall be collected and stored in securely lidded metal dumpsters. Trash and/or construction debris shall not be allowed to remain exposed for any period of time. Metal dumpsters shall be emptied a minimum of once per week or more often as necessary. No construction waste materials shall be buried onsite. All personnel will be instructed regarding the proper procedure for waste disposal. It shall be the responsibility of the general contractor to ensure that these procedures are followed.

Hazardous Waste: All hazardous waste will be disposed of in the manner specified by local and/or State regulation or by the manufacturer. Site personnel will be instructed in these practices and the general contractor shall be responsible for seeing that these procedures are followed.

Sanitary Waste: All sanitary waste will be collected from the portable units as necessary by a licensed sanitary waste management contractor.

Offsite Vehicle Tracking

Dump trucks hauling material to and from the construction site shall be covered by a tarpaulin. Crushed-stone aprons shall be constructed at construction site entrances to reduce offsite vehicle tracking.

Dust Control

Dust control is important for controlling air quality on and off site during various phases of construction. Sprinkle irrigation using tanker trucks is effective to control dust from gravel/dirt haul roads and during earth-moving/grading phases of site preparation. On exposed soils where vehicular traffic is not expected and/or completed, vegetative cover and/or mulching can be used to stabilize soils. Stone graded out over exposed areas where vegetation cannot be established can be effective along high traffic areas.

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Maintenance / Inspection Procedures

The following maintenance and inspection procedures shall be followed so as to ensure proper erosion and sediment control throughout construction.

1. The siltation controls shall be installed prior to conducting any land-disturbing activities.
2. All erosion control measures shall be inspected once per week and following any storm event of 0.5 inches or greater.
3. Should dewatering activities be required, pumped groundwater shall be directed to a dewatering sump prior to discharge to any wetland resource area or stormwater management area.
4. All measures will be maintained in good working order and shall be repaired as necessary throughout construction. If a repair is necessary, it will be initiated within 24 hours of observation.
5. Sediment shall be removed from the erosion controls when it has accumulated to a depth of approximately 6 inches.
6. Any catch basins located immediately downstream from the construction site shall be inspected once per week and following any storm event of 0.5 inches or greater. Any significant sediment accumulation within these catch basins shall be removed within 24 hours of observation.
7. All seeded areas shall be inspected periodically to insure proper germination and adequate coverage and shall be reseeded as necessary. Any washouts shall be promptly repaired, reseeded and mulched.
8. Provide and maintain dumpsters for trash removal. Trash and construction debris shall be picked up daily.
9. The Contractor shall direct surface runoff to unpaved, pervious areas on the site to the maximum extent possible, utilizing temporary sediment filtermitt as required preventing erosion and sedimentation of offsite areas.
10. During construction and installation of the Stormwater Management BMPs, care should be taken to minimize any sediment intrusion into these systems. Any significant sediment accumulation within these systems shall be removed within 24 hours of observation.
11. The Contractor shall make every effort to minimize the amount of impervious pavement area tributary to the drainage system and Stormwater Management BMPs until the site has been stabilized. The Contractor shall continue to direct surface runoff to unpaved areas as noted above.
12. A maintenance inspection report will be made after each inspection during construction. A copy of the report form to be completed by the inspector is attached. These reports shall be compiled and kept on site during construction. They shall be retained by the contractor for a period of 3 years.

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Non-Stormwater Discharges

It is expected that the following non-stormwater discharges may occur from the site during the construction period.

1. Firefighting activities
2. Water from water line flushings
3. Landscape irrigation
4. Potable water sources
5. Pavement wash waters (where no spills or leaks of toxic or hazardous materials have occurred).
6. Uncontaminated groundwater (from dewatering excavation).

All of the above non-stormwater discharges will be directed to the pervious areas on site.

No other illicit discharges shall be permitted to discharge on site at any time. Suspected illicit discharges shall be reported to the Site Contractor immediately.

Inventory for Pollution Prevention Plan

The materials or substances listed below are expected to be present onsite during construction:

- Asphalt
- Gravel and various sized stones
- Polyethylene piping (drainage)
- Infiltration Chambers
- Petroleum Based Products
- Fertilizer

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Spill Prevention

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping

The following good housekeeping practices shall be followed onsite during construction:

- An effort will be made to store only enough product as required
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers
- Product will be kept in their original containers with the original manufacturer's label
- Substances will not be mixed with one another except as required by the manufacturer
- Whenever possible, all of a product will be used up before disposing of the container
- Materials shall be disposed of as recommended by the manufacturer.
- The site superintendent will inspect daily to ensure proper use and disposal of materials onsite

Hazardous Materials

The following practices shall be used to reduce the risks associated with hazardous materials:

- Products will be kept in original containers unless they are not resealable
- Original labels and material safety data will be retained
- If surplus product must be disposed of, manufacturer's or local and State recommended methods for proper disposal must be followed.

Product Specific Practices

The following product specific practices will be followed onsite:

Petroleum Products

All onsite vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.

Fertilizers

Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be working into the soil to limit exposure to stormwater runoff. Fertilizer shall be stored in a covered shed to prevent exposure the rain and stormwater runoff. The contents of any partially used bags of fertilizer shall be stored in sealable plastic bins to avoid spills.

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Construction Period Pollution Prevention Plan

Spill Prevention (continued)

Paints

All containers of paint shall be tightly sealed and stored when not in use. Excess paint shall not be discharged to the stormwater drainage system but will be properly disposed of according to the manufacturer's instructions and/or State and local regulations.

Concrete Trucks

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.

Spill Control Practices

In addition to the good housekeeping and material management practices previously discussed, the following practices will be followed for spill prevention and cleanup;

- Manufacturer's recommended methods of spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include, but are not limited to: brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- Spills of toxic or hazardous material will be reported to the appropriate State or local government agency, regardless of size.
- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up if another spill occurs. A description of the spill, what caused it, and the cleanup measures will also be included.
- The site superintendent responsible for the day-to-day operations will be the spill prevention and cleanup coordinator. He will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the office trailer onsite.

Emergency Contact Information

MassDEP's Emergency Response:	(888) 304-1133
Local Fire Department:	911
Local Board of Health:	(978) 374-2325
Local Conservation Department:	(978) 374-2334

Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Appendix A

Inspection Reports

Proposed Industrial Outdoor Storage Yard - 1400 Hilldale Avenue
Construction Period Pollution Prevention Plan

Inspection and Maintenance Report Form

Inspector: _____ Date: _____

Inspector Qualifications: _____

Days since last rainfall: _____ Amount of Last Rainfall: _____

Area	Date Since Last Disturbance	Method of Stabilization	Stabilized? (yes/no)	Condition

Stabilization Required: _____

To be performed by: _____ On or before: _____

Inspections to be completed every 7 days and within 24 hours of a rainfall even of 0.5 inches or more

Proposed Industrial Outdoor Storage Yard - Hilldale Avenue

Construction Period Pollution Prevention Plan

Other Controls

Inspector: _____ Date: _____

Inspector Qualifications: _____

Days since last rainfall: _____ Amount of Last Rainfall: _____

Condition of Sediment Filtermitt:

(straw wattles)

Condition of Mulched Areas:

Condition of Grassed Areas:

Condition of Slopes Onsite:

Does sediment get tracked onto adjacent roadways?

Other observations:

Maintenance Required: _____

Inspections to be completed every 7 days and within 24 hours of a rainfall even of 0.5 inches or more

To be performed by: _____ On or before: _____

Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

LONG - TERM
POLLUTION PREVENTION PLAN

Prepared for:

Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Long Term Pollution Prevention Plan

Site Description

Project Name: Proposed Industrial Outdoor Storage Yard

Project Location: 1400 Hilldale Avenue ~ Haverhill, MA 01832

Latitude & Latitude: 42.8117°, -71.1187°

Applicant Address: Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Party Responsible for Implementation of Long--Term Pollution Prevention Plan: **Applicant/Owner**

Name of Receiving Water: Bordering Vegetated Wetlands located on site. Closest receiving water is Little River located to the east of the site.

Estimated Operation and Maintenance Budget: $5,000/year

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts
Long Term Pollution Prevention Plan

Maintenance / Inspection Procedures

The following maintenance and inspection procedures shall be followed so as to ensure proper erosion and sediment control after construction is complete and the site has become completely stabilized:

1. Infiltration chambers should be inspected after every major storm event in the first few months after construction to ensure proper stabilization and function. Thereafter, the chambers shall be inspected once per year. This includes the inspection of all outlet pipes and rip rap splash pads.
2. Paved areas shall be monitored on a perpetual basis. Trash and any foreign debris shall be removed upon inspection.
3. Paved areas shall be swept at least twice per year, especially in late April or early May after the winter sanding season.
4. Any permanent dumpster(s) on site shall be fenced in, covered at all times, and shall be emptied regularly.
5. Any observed litter or debris should be removed from the stormwater management areas upon observation.
6. Vehicles stored on-site shall be maintained so as to ensure that no oils, greases, fuels, or any other foreign substance be allowed to enter any portion of the drainage systems.
7. Catch basins shall be inspected at least two times per year.
8. Sediment shall be removed from the catch basin on a minimum annual basis or when it has accumulated to within 2-feet of the outlet pipe elevation (sump at 50% capacity).
9. Contech Separator units shall be inspected and maintained in accordance with guidelines provided by Contech. At a minimum, the Contech units shall be inspected at least two times per year, and sediments should be removed on an annual basis, or when the depth of deposits are greater than, or equal to, half the sump depth.
10. Inspect all embankments for erosion. Any washed out areas must be repaired, then loamed, seeded and mulched, as necessary.
11. Inspection reports shall be prepared and compiled for reference.

<u>Snow Storage</u>

The Owner shall be responsible for maintaining adequate snow storage areas on site located within impervious areas only. The dumping of snow into existing wetland areas and/or buffer areas shall be prohibited.

Possible Snow Storage areas shown on the Site Plans shall be considered approximate. Alternatively, snow banks can be removed and transported via truck to a specified snow farm to be determined by the snow plowing contractor. The Owner shall be responsible for reviewing all requirements with the snow plowing contractor.

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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

Inspection

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

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

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

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

Cleaning

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

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

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

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

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

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

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

Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Stormwater Management Calculations

Prepared for:

Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

STORMWATER CALCULATIONS

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Required Recharge Volume

Total Proposed Impervious Area = 179,216 SF ± (Total)
95,057 SF± (A Soils)
84,159 SF± (C Soils)

Infiltration Standard for "A" Soils = 0.60 inches of runoff

Infiltration Standard for "C" Soils = 0.25 inches of runoff

Required Recharge Volume = Impervious Area x Infiltration Standard

Required Volume to Recharge = 95,057SF x (0.60 IN x 1 FT/12 IN) + 84,159SF x (0.25 IN x 1 FT/12 IN) = **6,507 CF**

Volume Provided in Infiltration Chambers

Storage volume provided per Infiltration System #1 = 13,736 CF ±

Storage volume provided per Infiltration System #2 = 12,160 CF ±

Total storage volume provided = 13,736 + 12,160 »» **25,896 CF**

25,896 CF > 6,507 CF

Water Quality Treatment Volume

The hydrodynamic separator units are sized based on flow capacity of a 1.0" Equivalent Water Quality Flow rate.

WQF = (Qu) x (A) x (WQV)

WQF = Water Quality Flow

Qu = the unit peak discharge in CSM/IN = 795 CSM/IN

A = impervious surface drainage area in square miles

WQV = water quality volume in watershed inches = 1 IN

CDS Unit 1

A = 50,886 SF = 0.00183 MILES²

WQF = 795 CSM/IN x 0.00183 MILES² x 1 IN »» 1.45 CFS

CDS2020 Treatment Capacity = 2.2 CFS > 1.45 CFS

CDS Unit 2

A = 44,822 SF = 0.00161 MILES²

WQF = 795 CSM/IN x 0.00162 MILES² x 1 IN »» 1.28 CFS

CDS2015_4 Treatment Capacity = 1.4 CFS > 1.28 CFS

CDS Unit 3

A = 53,702 SF = 0.00193 MILES²

WQF = 795 CSM/IN x 0.00193 MILES² x 1 IN »» 1.53 CFS

CDS2020 Treatment Capacity = 2.2 CFS > 1.53 CFS

CDS Unit 4

A = 29,805 SF = 0.00107 MILES²

WQF = 795 CSM/IN x 0.00107 MILES² x 1 IN »» 0.85 CFS

CDS2015_4 Treatment Capacity = 1.4 CFS > 0.85 CFS

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

INDUSTRIAL OUTDOOR STORAGE YARD
HAVERHILL, MA

Area	1.17 ac	Unit Site Designation	PROP. CDS #1
Weighted C	0.9	Rainfall Station #	69
t_c	6 min		
CDS Model	2020-5	CDS Treatment Capacity	**2.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	9.8
0.04	9.6%	19.8%	0.04	0.04	9.3
0.06	9.4%	29.3%	0.06	0.06	9.0
0.08	7.7%	37.0%	0.08	0.08	7.3
0.10	8.6%	45.6%	0.11	0.11	8.1
0.12	6.3%	51.9%	0.13	0.13	5.9
0.14	4.7%	56.5%	0.15	0.15	4.3
0.16	4.6%	61.2%	0.17	0.17	4.3
0.18	3.5%	64.7%	0.19	0.19	3.2
0.20	4.3%	69.1%	0.21	0.21	3.9
0.25	8.0%	77.1%	0.26	0.26	7.1
0.30	5.6%	82.7%	0.32	0.32	4.9
0.35	4.4%	87.0%	0.37	0.37	3.7
0.40	2.5%	89.5%	0.42	0.42	2.1
0.45	2.5%	92.1%	0.47	0.47	2.1
0.50	1.4%	93.5%	0.53	0.53	1.1
0.75	5.0%	98.5%	0.79	0.79	3.7
1.00	1.0%	99.5%	1.05	1.05	0.7
1.50	0.0%	99.5%	1.58	1.58	0.0
2.00	0.0%	99.5%	2.10	2.10	0.0
3.00	0.5%	100.0%	3.15	2.20	0.1
					90.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**84.2%**

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

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

INDUSTRIAL OUTDOOR STORAGE YARD
HAVERHILL, MA

Area	1.03 ac	Unit Site Designation	PROP. CDS #2
Weighted C	0.9	Rainfall Station #	69
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	9.8
0.04	9.6%	19.8%	0.04	0.04	9.2
0.06	9.4%	29.3%	0.06	0.06	8.9
0.08	7.7%	37.0%	0.07	0.07	7.2
0.10	8.6%	45.6%	0.09	0.09	7.9
0.12	6.3%	51.9%	0.11	0.11	5.8
0.14	4.7%	56.5%	0.13	0.13	4.2
0.16	4.6%	61.2%	0.15	0.15	4.2
0.18	3.5%	64.7%	0.17	0.17	3.2
0.20	4.3%	69.1%	0.19	0.19	3.8
0.25	8.0%	77.1%	0.23	0.23	6.9
0.30	5.6%	82.7%	0.28	0.28	4.7
0.35	4.4%	87.0%	0.32	0.32	3.6
0.40	2.5%	89.5%	0.37	0.37	2.0
0.45	2.5%	92.1%	0.42	0.42	1.9
0.50	1.4%	93.5%	0.46	0.46	1.0
0.75	5.0%	98.5%	0.69	0.69	3.2
1.00	1.0%	99.5%	0.93	0.93	0.5
1.50	0.0%	99.5%	1.39	1.39	0.0
2.00	0.0%	99.5%	1.85	1.40	0.0
3.00	0.5%	100.0%	2.78	1.40	0.1
					88.2
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**81.8%**

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

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

INDUSTRIAL OUTDOOR STORAGE YARD
HAVERHILL, MA

Area	1.23 ac	Unit Site Designation	PROP. CDS #3
Weighted C	0.9	Rainfall Station #	69
t_c	6 min		
CDS Model	2020-5	CDS Treatment Capacity	**2.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	9.8
0.04	9.6%	19.8%	0.04	0.04	9.2
0.06	9.4%	29.3%	0.07	0.07	9.0
0.08	7.7%	37.0%	0.09	0.09	7.3
0.10	8.6%	45.6%	0.11	0.11	8.0
0.12	6.3%	51.9%	0.13	0.13	5.9
0.14	4.7%	56.5%	0.16	0.16	4.3
0.16	4.6%	61.2%	0.18	0.18	4.3
0.18	3.5%	64.7%	0.20	0.20	3.2
0.20	4.3%	69.1%	0.22	0.22	3.9
0.25	8.0%	77.1%	0.28	0.28	7.1
0.30	5.6%	82.7%	0.33	0.33	4.9
0.35	4.4%	87.0%	0.39	0.39	3.7
0.40	2.5%	89.5%	0.44	0.44	2.1
0.45	2.5%	92.1%	0.50	0.50	2.1
0.50	1.4%	93.5%	0.55	0.55	1.1
0.75	5.0%	98.5%	0.83	0.83	3.6
1.00	1.0%	99.5%	1.11	1.11	0.6
1.50	0.0%	99.5%	1.66	1.66	0.0
2.00	0.0%	99.5%	2.22	2.20	0.0
3.00	0.5%	100.0%	3.33	2.20	0.1
					90.3
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**83.8%**

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

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

INDUSTRIAL OUTDOOR STORAGE YARD
HAVERHILL, MA

Area	0.68 ac	Unit Site Designation	PROP. CDS #4
Weighted C	0.9	Rainfall Station #	69
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	**1.4 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	9.8
0.04	9.6%	19.8%	0.02	0.02	9.3
0.06	9.4%	29.3%	0.04	0.04	9.0
0.08	7.7%	37.0%	0.05	0.05	7.3
0.10	8.6%	45.6%	0.06	0.06	8.1
0.12	6.3%	51.9%	0.07	0.07	5.9
0.14	4.7%	56.5%	0.09	0.09	4.3
0.16	4.6%	61.2%	0.10	0.10	4.3
0.18	3.5%	64.7%	0.11	0.11	3.3
0.20	4.3%	69.1%	0.12	0.12	4.0
0.25	8.0%	77.1%	0.15	0.15	7.2
0.30	5.6%	82.7%	0.18	0.18	4.9
0.35	4.4%	87.0%	0.22	0.22	3.8
0.40	2.5%	89.5%	0.25	0.25	2.2
0.45	2.5%	92.1%	0.28	0.28	2.1
0.50	1.4%	93.5%	0.31	0.31	1.1
0.75	5.0%	98.5%	0.46	0.46	3.8
1.00	1.0%	99.5%	0.62	0.62	0.7
1.50	0.0%	99.5%	0.92	0.92	0.0
2.00	0.0%	99.5%	1.23	1.23	0.0
3.00	0.5%	100.0%	1.85	1.40	0.1
					91.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**84.7%**

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

Infiltration BMPs ~ Draw Down Time

Infiltration Rate ("C" Soils) = 0.27 IN/HR = 0.0225 FT/HR

Total storage volume provided within Infiltration System #1 = 10,657 CF

Surface Area for Infiltration System #1 = 7,795 SF

Draw Down Rate (CF/HR) = 7,795 SF x 0.0225 FT/HR »» 175 CF/HR

Draw Down Time = 10,657 CF / (175 CF/HR) **»» 61 hours**

72 hours > 61 hours

Total storage volume provided within Infiltration System #2 = 10,657 CF

Surface Area for Infiltration System #2 = 7,795 SF

Draw Down Rate (CF/HR) = 7,795 SF x 0.0225 FT/HR »» 175 CF/HR

Draw Down Time = 10,657 CF / (175 CF/HR) **»» 61 hours**

72 hours > 61 hours

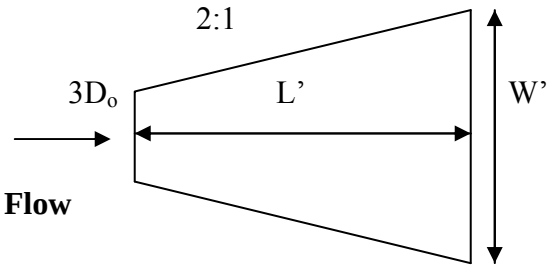
Rip Rap Splash Pad Sizing

Apron Length = $1.7(Q)/(D_0^{3/2}) + 8\ D_0$

Apron Width = $3D_0 + L_a$

D_0=Maximum inside culvert width

L_a=Length of Apron



Stone diameter = $0.02/TW * (Q/D_0)^{4/3}$

TW = tail water, assumed to be 0.3

The stone diameter is calculated to be the median diameter size of rip rap stone (inches).

Outfall	Pipe Diameter (feet)	Q Flow (cfs)	Length (min) (feet)	Width (min) (feet)	Stone Diameter (min) (inches)
FES #1	1.5	4.6	16.3	20.8	1.97
FES #2	1.5	2.7	14.5	19.0	0.23

*Q Flow is equal to the 25-year flow as calculated through HydroCAD.

** A minimum rip rap stone size of 6" should be utilized

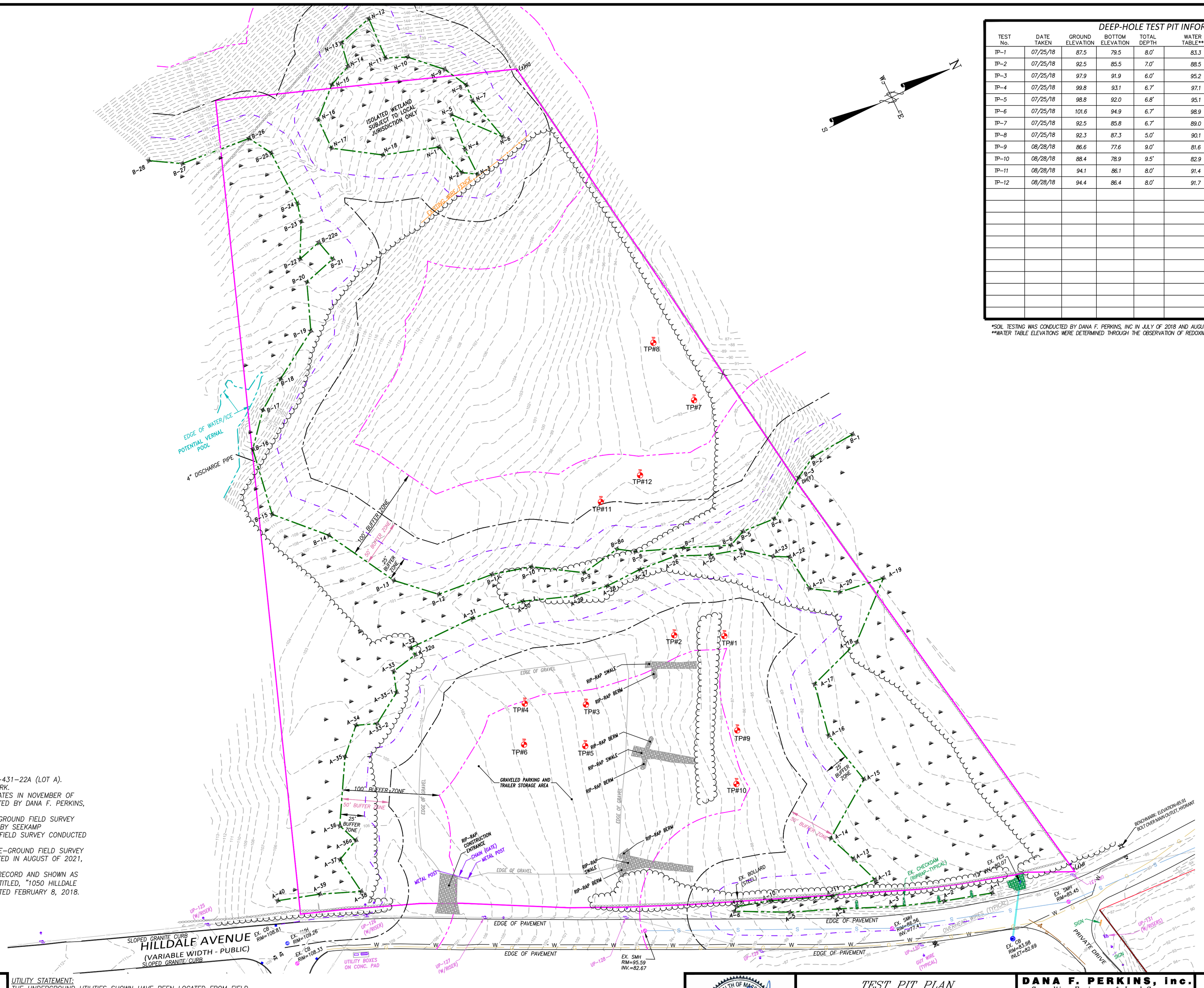
Location: Proposed Industrial Outdoor Storage Yard ~ **TSS Treatment Removal**
1400 Hilldale Avenue, Haverhill, MA

TSS Removal Calculation Worksheet

A **BMP**	B **TSS Removal Rate**	C **Starting TSS Load***	D **Amount Removed (BxC)**	E **Remaining Load (C-D)**
CDS Unit**	0.80	1.00	0.80	0.20
Subsurface Structures (Infiltration Chambers) w/Deep Sump Catch Basins pretreatment	0.80	0.20	016	0.04
			.	
		TOTAL TSS REMOVAL =	**96%**	

*Equals remaining load from previous BMP (E) which enters the BMP
**CDS TSS Removal rates from Contech have been providing showing greater than 80% removal rate.

Project: Proposed Industrial Outdoor Storage Yard ~ 1400 Hilldale Avenue, Haverhill, Massachusetts
Prepared By: Dana F. Perkins, Inc.
Date: May 12, 2025



DEEP-HOLE TEST PIT INFORMATION

TEST No.	DATE TAKEN	GROUND ELEVATION	BOTTOM ELEVATION	TOTAL DEPTH	WATER TABLE**	SOIL CLASSIFICATION	SOIL EVALUATOR
TP-1	07/25/18	87.5	79.5	8.0'	83.3	SAND	DANA F. PERKINS, INC.
TP-2	07/25/18	92.5	85.5	7.0'	88.5	SAND	DANA F. PERKINS, INC.
TP-3	07/25/18	97.9	91.9	6.0'	95.2	LOAMY SAND	DANA F. PERKINS, INC.
TP-4	07/25/18	99.8	93.1	6.7'	97.1	SAND	DANA F. PERKINS, INC.
TP-5	07/25/18	98.8	92.0	6.8'	95.1	SAND	DANA F. PERKINS, INC.
TP-6	07/25/18	101.6	94.9	6.7'	98.9	SAND	DANA F. PERKINS, INC.
TP-7	07/25/18	92.5	85.8	6.7'	89.0	SANDY LOAM	DANA F. PERKINS, INC.
TP-8	07/25/18	92.3	87.3	5.0'	90.1	SANDY LOAM	DANA F. PERKINS, INC.
TP-9	08/28/18	86.6	77.6	9.0'	81.6	LOAMY SAND	DANA F. PERKINS, INC.
TP-10	08/28/18	88.4	78.9	9.5'	82.9	LOAMY SAND	DANA F. PERKINS, INC.
TP-11	08/28/18	94.1	86.1	8.0'	91.4	LOAMY SAND	DANA F. PERKINS, INC.
TP-12	08/28/18	94.4	86.4	8.0'	91.7	SAND	DANA F. PERKINS, INC.

*SOIL TESTING WAS CONDUCTED BY DANA F. PERKINS, INC IN JULY OF 2018 AND AUGUST OF 2018.
**WATER TABLE ELEVATIONS WERE DETERMINED THROUGH THE OBSERVATION OF REDOXIMORPHIC FEATURES WITHIN THE TEST PITS.

GENERAL NOTES:

1. SUBJECT PROPERTY LOCATED ON HAVERHILL ASSESSORS PARCEL 585-431-22A (LOT A).
2. SUBJECT PROPERTY LOCATED IN ZONING DISTRICT BP - BUSINESS PARK.
3. DELINEATED WETLAND LINES ORIGINALLY FLAGGED BY MERIDIAN ASSOCIATES IN NOVEMBER OF 2017, AND LOCATED BY AN ON-THE-GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN FEBRUARY OF 2018.
4. WETLAND FLAGS REESTABLISHED IN THE FIELD THROUGH AN ON-THE-GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC., FIELD VERIFIED AND REVISED BY SEEKAMP ENVIRONMENTAL CONSULTING, AND LOCATED BY AN ON-THE-GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN JANUARY OF 2025.
5. EXISTING TOPOGRAPHY SHOWN HEREON IS THE RESULT OF AN ON-THE-GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN FEBRUARY OF 2018, UPDATED IN AUGUST OF 2021, AND UPDATED IN JANUARY OF 2025.
6. PROPERTY LINES SHOWN HEREON TAKEN FROM AVAILABLE PLANS OF RECORD AND SHOWN AS "LOT A" ON A SUBDIVISION PLAN PROVIDED BY MERIDIAN ASSOCIATES TITLED, "1050 HILLDALE AVENUE, PLAN OF LAND, LOCATED IN HAVERHILL, MASSACHUSETTS" DATED FEBRUARY 8, 2018.

RECORD OWNER:

SINGH REALTY GROUP, LLC
6 FONDI ROAD
HAVERHILL, MA

DATE	BY	REVISION

UTILITY STATEMENT:
THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES STATE THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

50 0 25 50 100 200
(IN FEET)
1 inch = 50 ft.

COMMONWEALTH OF MASSACHUSETTS
ANDREW M. POLIASIK
CIVIL
No. 50539
REGISTERED PROFESSIONAL ENGINEER
PROFESSIONAL ENGINEER

TEST PIT PLAN
INDUSTRIAL OUTDOOR STORAGE YARD
1400 HILLDALE AVENUE
HAVERHILL, MASSACHUSETTS

SCALE: 1" = 50' | DATE: FEBRUARY 19, 2025 | JOB NO. 51856D | SHEET 1 OF 1

DANA F. PERKINS, inc.
Consulting Engineers & Land Surveyors
1057 EAST STREET ~ TEWKSBURY, MASSACHUSETTS 01876
TEL: 978-858-0680 FAX: 978-640-0237
DANAFPERKINS.COM

PREPARED FOR:
SINGH REALTY GROUP, LLC
6 FONDI ROAD
HAVERHILL, MA

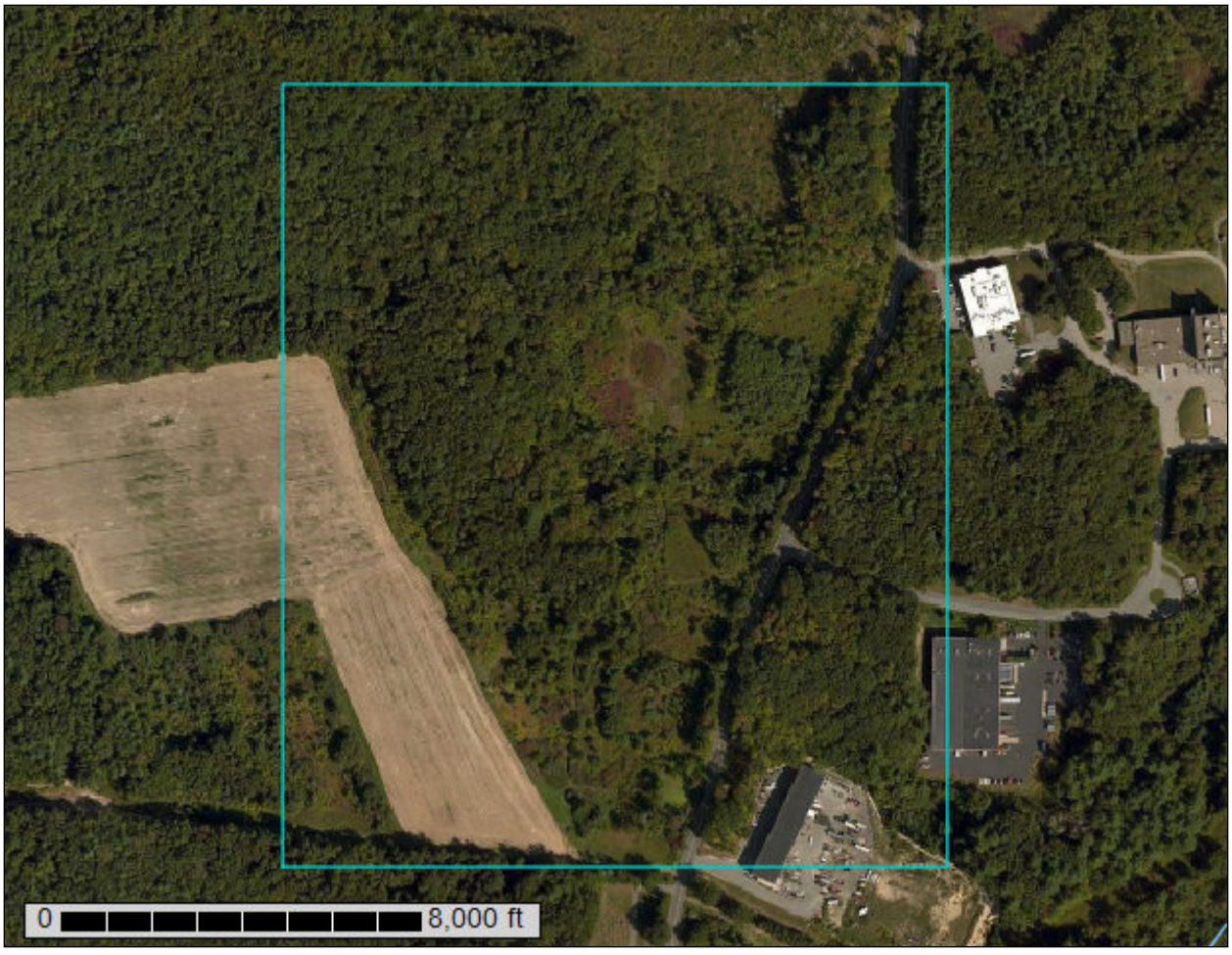
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part



June 14, 2018

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map

MAP 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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 13, Oct 6, 2017

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

Date(s) aerial images were photographed: Aug 29, 2014—Sep 19, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
16A	Scantic silt loam, 0 to 3 percent slopes	6.4	7.5%
31B	Walpole fine sandy loam, 3 to 8 percent slopes	5.5	6.4%
40A	Swanton fine sandy loam, 0 to 3 percent slopes	0.2	0.2%
51A	Swansea muck, 0 to 1 percent slopes	3.1	3.6%
228B	Buxton silt loam, 3 to 8 percent slopes	4.7	5.5%
253C	Hinckley loamy sand, 8 to 15 percent slopes	15.6	18.2%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	3.3	3.8%
275C	Agawam fine sandy loam, 8 to 15 percent slopes	4.2	4.9%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	2.3	2.7%
300C	Montauk fine sandy loam, 8 to 15 percent slopes	15.5	18.0%
300D	Montauk fine sandy loam, 15 to 25 percent slopes	4.6	5.4%
301C	Montauk fine sandy loam, 8 to 15 percent slopes, very stony	2.1	2.4%
301D	Montauk fine sandy loam, 15 to 35 percent slopes, very stony	0.0	0.0%
307E	Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony	15.5	18.0%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	3.0	3.4%
Totals for Area of Interest		**86.1**	**100.0%**

Map Unit Descriptions

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

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the

landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

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

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

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

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

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

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

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

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present

or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

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

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

Essex County, Massachusetts, Northern Part

16A—Scantic silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjrl
Elevation: 10 to 900 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Scantic and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scantic

Setting

Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Soft fine-silty glaciolacustrine deposits and/or soft fine-silty glaciomarine deposits over hard fine-silty glaciolacustrine deposits and/or hard fine-silty glaciomarine deposits

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 26 inches: silty clay loam
H3 - 26 to 60 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Maybid

Percent of map unit: 10 percent
Landform: Depressions

Hydric soil rating: Yes

Buxton

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

31B—Walpole fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vjxf
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Walpole and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Walpole

Setting

Landform: Terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits over loose sandy and gravelly glaciofluvial deposits

Typical profile

H1 - 0 to 10 inches: fine sandy loam
H2 - 10 to 24 inches: fine sandy loam
H3 - 24 to 60 inches: stratified gravelly sand to gravelly loamy sand to loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D

Hydric soil rating: Yes

Minor Components

Scarboro

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Sudbury

Percent of map unit: 3 percent
Hydric soil rating: No

Ninigret

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

40A—Swanton fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjvz
Elevation: 10 to 900 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Swanton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swanton

Setting

Landform: Depressions, depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose coarse-loamy glaciofluvial deposits over hard clayey glaciolacustrine deposits and/or firm clayey glaciomarine deposits

Typical profile

O - 0 to 1 inches: muck
H2 - 1 to 9 inches: fine sandy loam
H3 - 9 to 29 inches: fine sandy loam
H4 - 29 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: 18 to 40 inches to strongly contrasting textural stratification
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Whately variant

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Melrose

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

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Swansea

Setting

Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

228B—Buxton silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vj37
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Buxton

Setting

Landform: Valleys, valleys
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Soft fine-loamy glaciolacustrine deposits derived from mica schist over hard fine-loamy glaciolacustrine deposits derived from mica schist

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 30 inches: silt loam
H3 - 30 to 60 inches: silty clay

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Suffield
Percent of map unit: 15 percent
Hydric soil rating: No

Scantic
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

253C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting
Landform: Kame terraces, outwash deltas, outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile
Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities
Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Kame terraces, outwash deltas, outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Kame terraces, outwash deltas, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

257E—Hinckley and Windsor soils, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svm2
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 50 percent
Windsor and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Kame terraces, outwash deltas, outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Windsor

Setting

Landform: Kame terraces, outwash deltas, outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Convex, linear, concave
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 10 percent
Landform: Kame terraces, kames, outwash plains, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Crest, side slope, head slope, nose slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Convex, linear, concave

Hydric soil rating: No

275C—Agawam fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2tyqy
Elevation: 0 to 360 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Agawam and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Agawam

Setting

Landform: Kame terraces, kames, outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Backslope, shoulder, footslope, summit
Landform position (three-dimensional): Side slope, crest, tread, riser, rise, dip
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from gneiss, granite, schist, and/or phyllite

Typical profile

Ap - 0 to 11 inches: fine sandy loam
Bw1 - 11 to 16 inches: fine sandy loam
Bw2 - 16 to 26 inches: fine sandy loam
2C1 - 26 to 45 inches: loamy fine sand
2C2 - 45 to 55 inches: loamy fine sand
2C3 - 55 to 65 inches: loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 35 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Dunes, outwash plains, outwash terraces, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Kames, outwash plains, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ninigret

Percent of map unit: 5 percent
Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

300B—Montauk fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyrh
Elevation: 0 to 1,030 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Montauk and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Montauk

Setting

Landform: Hills, ground moraines, drumlins, recessionial moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bw1 - 4 to 26 inches: fine sandy loam
Bw2 - 26 to 34 inches: sandy loam
2Cd - 34 to 72 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Canton

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 4 percent
Landform: Drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

300C—Montauk fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w80p
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Montauk and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Montauk

Setting

Landform: Hills, ground moraines, drumlins, recessionial moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bw1 - 4 to 26 inches: fine sandy loam
Bw2 - 26 to 34 inches: sandy loam
2Cd - 34 to 72 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scituate
Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Canton
Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury
Percent of map unit: 4 percent
Landform: Drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

300D—Montauk fine sandy loam, 15 to 25 percent slopes

Map Unit Setting
National map unit symbol: 2w80q
Elevation: 0 to 950 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Montauk and similar soils: 85 percent

Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Montauk

Setting

Landform: Hills, ground moraines, drumlins, recessionial moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 4 inches: fine sandy loam
Bw1 - 4 to 26 inches: fine sandy loam
Bw2 - 26 to 34 inches: sandy loam
2Cd - 34 to 72 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Canton

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex

Hydric soil rating: No

Chatfield

Percent of map unit: 4 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

301C—Montauk fine sandy loam, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w80w
Elevation: 0 to 1,120 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Montauk, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Montauk, Very Stony

Setting

Landform: Ground moraines, hills, drumlins, recessionial moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: fine sandy loam
Bw1 - 6 to 28 inches: fine sandy loam
Bw2 - 28 to 36 inches: sandy loam
2Cd - 36 to 74 inches: gravelly loamy sand

Properties and qualities

Slope: 8 to 15 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scituate, very stony

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Canton, very stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 4 percent
Landform: Drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

301D—Montauk fine sandy loam, 15 to 35 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2w80x
Elevation: 0 to 1,150 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Montauk, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Montauk, Very Stony

Setting

Landform: Hills, ground moraines, drumlins, recessionial moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: fine sandy loam
Bw1 - 6 to 28 inches: fine sandy loam
Bw2 - 28 to 36 inches: sandy loam
2Cd - 36 to 74 inches: gravelly loamy sand

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 1.42 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Scituate, very stony

Percent of map unit: 6 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Canton, very stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

307E—Paxton fine sandy loam, 25 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w67q
Elevation: 0 to 1,400 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 25 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 1 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

311B—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2t2qr
Elevation: 0 to 1,440 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Woodbridge, Very Stony

Setting

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

Typical profile

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

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Paxton, very stony

Percent of map unit: 10 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Ridgebury, very stony

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

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Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Hydrological Analysis

Prepared for:

Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

Stormwater Summary

Pre-development Conditions

The existing conditions stormwater runoff consists of two separate subcatchments. A portion of the existing site is directed towards the abutting property located to the north of the site and a portion of the existing site is directed towards the existing bordering vegetated wetlands that is located on site.

Post-development Conditions

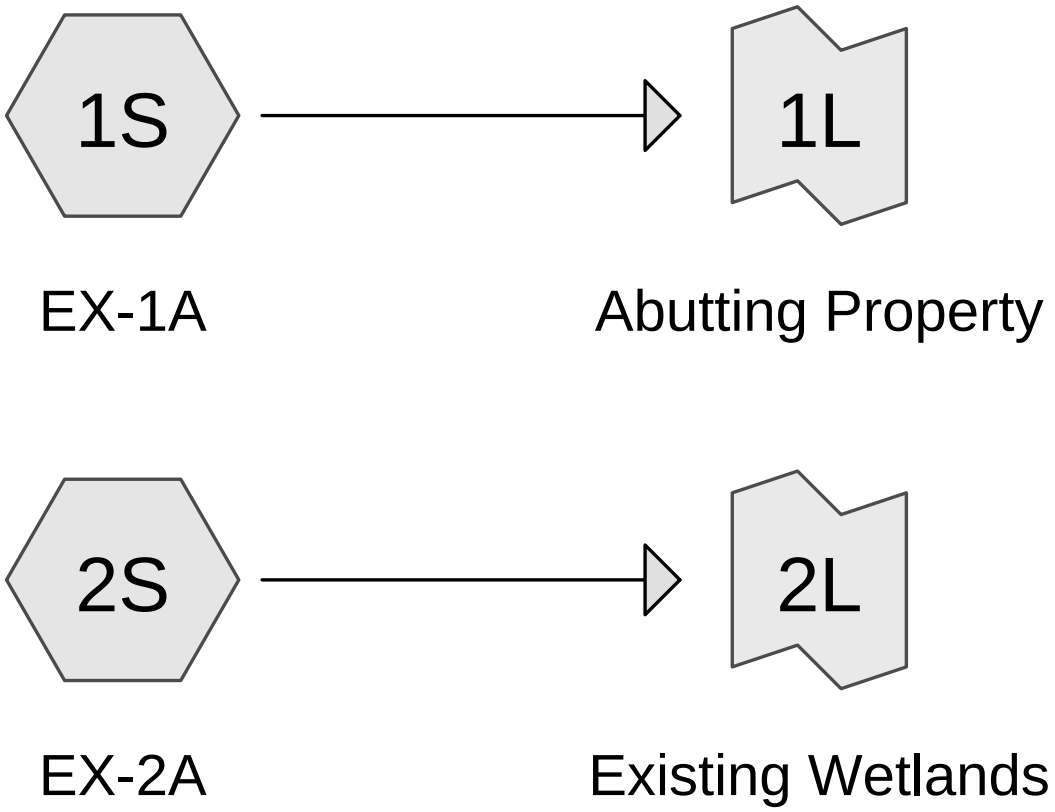
The project has been designed to capture and recharge the required recharge volume for post-development stormwater runoff on-site, with overflows directed towards the existing bordering vegetated wetlands located on site. A HydroCAD report has been included demonstrating that the proposed stormwater system reduces peak rates of runoff below pre-development rates.

Subcatchment #1 – Abutting Property

Storm	Existing	Proposed	Difference
2-Year (3.2")	0.00 cfs	0.00 cfs	-0.00 cfs
10-Year (5.07")	0.01 cfs	0.01 cfs	-0.00 cfs
25-Year (6.24")	0.06 cfs	0.05 cfs	-0.01 cfs
100-Year (8.05")	0.54 cfs	0.37 cfs	-0.15 cfs

Subcatchment #2- Existing bordering vegetated wetlands

Storm	Existing	Proposed	Difference
2-Year (3.2")	0.62 cfs	0.43 cfs	-0.19 cfs
10-Year (5.07")	5.56 cfs	3.81 cfs	-1.75 cfs
25-Year (6.24")	10.15cfs	7.28 cfs	-2.87 cfs
100-Year (8.05")	18.42 cfs	16.21 cfs	-2.21 cfs



Subcat Reach Pond Link

Routing Diagram for Hydrology
Prepared by Dana F. Perkins, Inc.

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EX-1A Runoff Area=106,878 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=477' Tc=8.3 min CN=32 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: EX-2A Runoff Area=262,684 sf 0.00% Impervious Runoff Depth=0.25"
Flow Length=449' Tc=7.1 min CN=55 Runoff=0.62 cfs 0.126 af

Link 1L: Abutting Property Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link 2L: Existing Wetlands Inflow=0.62 cfs 0.126 af
Primary=0.62 cfs 0.126 af

Total Runoff Area = 8.484 ac Runoff Volume = 0.126 af Average Runoff Depth = 0.18"
100.00% Pervious = 8.484 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: EX-1A

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

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
27,518	30	Woods, Good, HSG A
5,256	70	Woods, Good, HSG C
74,104	30	Brush, Good, HSG A
106,878	32	Weighted Average
106,878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2186	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.9	190	0.1085	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	105	0.1371	2.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	98	0.1242	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0723	1.88		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	477	Total			

Summary for Subcatchment 2S: EX-2A

Runoff = 0.62 cfs @ 12.35 hrs, Volume= 0.126 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
21,076	30	Woods, Good, HSG A
16,861	70	Woods, Good, HSG C
95,342	30	Brush, Good, HSG A
84,007	65	Brush, Good, HSG C
45,398	96	Gravel surface, HSG A
262,684	55	Weighted Average
262,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	30	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.8	171	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.2	248	0.0650	1.27		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	449	Total			

Summary for Link 1L: Abutting Property

Inflow Area = 2.454 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-year event event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Existing Wetlands

Inflow Area = 6.030 ac, 0.00% Impervious, Inflow Depth = 0.25" for 2-year event event
Inflow = 0.62 cfs @ 12.35 hrs, Volume= 0.126 af
Primary = 0.62 cfs @ 12.35 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EX-1A Runoff Area=106,878 sf 0.00% Impervious Runoff Depth=0.03"
Flow Length=477' Tc=8.3 min CN=32 Runoff=0.01 cfs 0.006 af

Subcatchment 2S: EX-2A Runoff Area=262,684 sf 0.00% Impervious Runoff Depth=1.02"
Flow Length=449' Tc=7.1 min CN=55 Runoff=5.56 cfs 0.510 af

Link 1L: Abutting Property Inflow=0.01 cfs 0.006 af
Primary=0.01 cfs 0.006 af

Link 2L: Existing Wetlands Inflow=5.56 cfs 0.510 af
Primary=5.56 cfs 0.510 af

Total Runoff Area = 8.484 ac Runoff Volume = 0.516 af Average Runoff Depth = 0.73"
100.00% Pervious = 8.484 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: EX-1A

Runoff = 0.01 cfs @ 20.76 hrs, Volume= 0.006 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
27,518	30	Woods, Good, HSG A
5,256	70	Woods, Good, HSG C
74,104	30	Brush, Good, HSG A
106,878	32	Weighted Average
106,878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2186	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.9	190	0.1085	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	105	0.1371	2.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	98	0.1242	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0723	1.88		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	477	Total			

Summary for Subcatchment 2S: EX-2A

Runoff = 5.56 cfs @ 12.12 hrs, Volume= 0.510 af, Depth= 1.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
21,076	30	Woods, Good, HSG A
16,861	70	Woods, Good, HSG C
95,342	30	Brush, Good, HSG A
84,007	65	Brush, Good, HSG C
45,398	96	Gravel surface, HSG A
262,684	55	Weighted Average
262,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	30	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.8	171	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.2	248	0.0650	1.27		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	449	Total			

Summary for Link 1L: Abutting Property

Inflow Area = 2.454 ac, 0.00% Impervious, Inflow Depth = 0.03" for 10-year event event
Inflow = 0.01 cfs @ 20.76 hrs, Volume= 0.006 af
Primary = 0.01 cfs @ 20.76 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Existing Wetlands

Inflow Area = 6.030 ac, 0.00% Impervious, Inflow Depth = 1.02" for 10-year event event
Inflow = 5.56 cfs @ 12.12 hrs, Volume= 0.510 af
Primary = 5.56 cfs @ 12.12 hrs, Volume= 0.510 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EX-1A Runoff Area=106,878 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=477' Tc=8.3 min CN=32 Runoff=0.06 cfs 0.035 af

Subcatchment 2S: EX-2A Runoff Area=262,684 sf 0.00% Impervious Runoff Depth=1.66"
Flow Length=449' Tc=7.1 min CN=55 Runoff=10.15 cfs 0.833 af

Link 1L: Abutting Property Inflow=0.06 cfs 0.035 af
Primary=0.06 cfs 0.035 af

Link 2L: Existing Wetlands Inflow=10.15 cfs 0.833 af
Primary=10.15 cfs 0.833 af

Total Runoff Area = 8.484 ac Runoff Volume = 0.868 af Average Runoff Depth = 1.23"
100.00% Pervious = 8.484 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: EX-1A

Runoff = 0.06 cfs @ 14.60 hrs, Volume= 0.035 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
27,518	30	Woods, Good, HSG A
5,256	70	Woods, Good, HSG C
74,104	30	Brush, Good, HSG A
106,878	32	Weighted Average
106,878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2186	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.9	190	0.1085	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	105	0.1371	2.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	98	0.1242	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0723	1.88		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	477	Total			

Summary for Subcatchment 2S: EX-2A

Runoff = 10.15 cfs @ 12.11 hrs, Volume= 0.833 af, Depth= 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
21,076	30	Woods, Good, HSG A
16,861	70	Woods, Good, HSG C
95,342	30	Brush, Good, HSG A
84,007	65	Brush, Good, HSG C
45,398	96	Gravel surface, HSG A
262,684	55	Weighted Average
262,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	30	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.8	171	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.2	248	0.0650	1.27		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	449	Total			

Summary for Link 1L: Abutting Property

Inflow Area = 2.454 ac, 0.00% Impervious, Inflow Depth = 0.17" for 25-year event event
Inflow = 0.06 cfs @ 14.60 hrs, Volume= 0.035 af
Primary = 0.06 cfs @ 14.60 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Existing Wetlands

Inflow Area = 6.030 ac, 0.00% Impervious, Inflow Depth = 1.66" for 25-year event event
Inflow = 10.15 cfs @ 12.11 hrs, Volume= 0.833 af
Primary = 10.15 cfs @ 12.11 hrs, Volume= 0.833 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: EX-1A Runoff Area=106,878 sf 0.00% Impervious Runoff Depth=0.58"
Flow Length=477' Tc=8.3 min CN=32 Runoff=0.54 cfs 0.118 af

Subcatchment 2S: EX-2A Runoff Area=262,684 sf 0.00% Impervious Runoff Depth=2.82"
Flow Length=449' Tc=7.1 min CN=55 Runoff=18.42 cfs 1.416 af

Link 1L: Abutting Property Inflow=0.54 cfs 0.118 af
Primary=0.54 cfs 0.118 af

Link 2L: Existing Wetlands Inflow=18.42 cfs 1.416 af
Primary=18.42 cfs 1.416 af

Total Runoff Area = 8.484 ac Runoff Volume = 1.534 af Average Runoff Depth = 2.17"
100.00% Pervious = 8.484 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: EX-1A

Runoff = 0.54 cfs @ 12.39 hrs, Volume= 0.118 af, Depth= 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
27,518	30	Woods, Good, HSG A
5,256	70	Woods, Good, HSG C
74,104	30	Brush, Good, HSG A
106,878	32	Weighted Average
106,878		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.2186	0.18		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
1.9	190	0.1085	1.65		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.7	105	0.1371	2.59		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	98	0.1242	2.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	34	0.0723	1.88		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	477	Total			

Summary for Subcatchment 2S: EX-2A

Runoff = 18.42 cfs @ 12.11 hrs, Volume= 1.416 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
21,076	30	Woods, Good, HSG A
16,861	70	Woods, Good, HSG C
95,342	30	Brush, Good, HSG A
84,007	65	Brush, Good, HSG C
45,398	96	Gravel surface, HSG A
262,684	55	Weighted Average
262,684		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	30	0.0330	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.8	171	0.0468	3.48		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.2	248	0.0650	1.27		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	449	Total			

Summary for Link 1L: Abutting Property

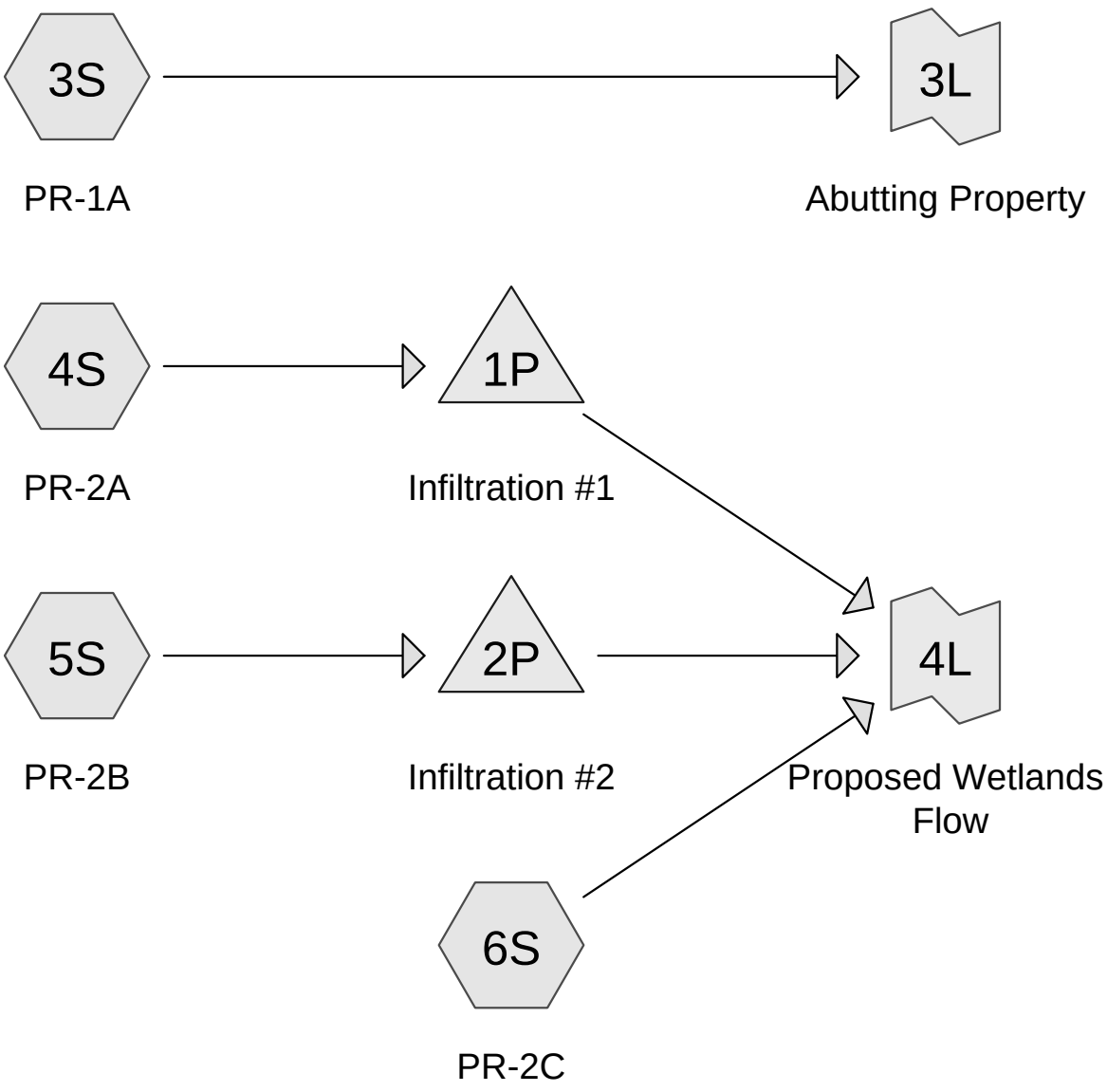
Inflow Area = 2.454 ac, 0.00% Impervious, Inflow Depth = 0.58" for 100-year event event
Inflow = 0.54 cfs @ 12.39 hrs, Volume= 0.118 af
Primary = 0.54 cfs @ 12.39 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Existing Wetlands

Inflow Area = 6.030 ac, 0.00% Impervious, Inflow Depth = 2.82" for 100-year event event
Inflow = 18.42 cfs @ 12.11 hrs, Volume= 1.416 af
Primary = 18.42 cfs @ 12.11 hrs, Volume= 1.416 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



Subcat Reach Pond Link

Routing Diagram for Hydrology-Revised
Prepared by Dana F. Perkins, Inc.

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: PR-1A Runoff Area=48,586 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=470' Tc=8.9 min CN=34 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: PR-2A Runoff Area=94,271 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=6.96 cfs 0.535 af

Subcatchment 5S: PR-2B Runoff Area=102,307 sf 80.84% Impervious Runoff Depth=1.84"
Tc=5.0 min CN=86 Runoff=5.24 cfs 0.359 af

Subcatchment 6S: PR-2C Runoff Area=125,929 sf 0.00% Impervious Runoff Depth=0.13"
Tc=5.0 min CN=50 Runoff=0.07 cfs 0.031 af

Pond 1P: Infiltration #1 Peak Elev=87.66' Storage=14,748 cf Inflow=6.96 cfs 0.535 af
Discarded=0.05 cfs 0.179 af Primary=0.38 cfs 0.161 af Outflow=0.43 cfs 0.340 af

Pond 2P: Infiltration #2 Peak Elev=96.39' Storage=13,037 cf Inflow=5.24 cfs 0.359 af
Discarded=0.05 cfs 0.156 af Primary=0.00 cfs 0.000 af Outflow=0.05 cfs 0.156 af

Link 3L: Abutting Property Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link 4L: Proposed Wetlands Flow Inflow=0.43 cfs 0.192 af
Primary=0.43 cfs 0.192 af

Total Runoff Area = 8.519 ac Runoff Volume = 0.925 af Average Runoff Depth = 1.30"
52.31% Pervious = 4.456 ac 47.69% Impervious = 4.063 ac

Summary for Subcatchment 3S: PR-1A

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

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
18,937	30	Woods, Good, HSG A
4,895	70	Woods, Good, HSG C
24,754	30	Brush, Good, HSG A
48,586	34	Weighted Average
48,586		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.1600	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	30	0.0930	1.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	131	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	46	0.0870	2.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	56	0.0350	1.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	157	0.2020	3.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	470	Total			

Summary for Subcatchment 4S: PR-2A

Runoff = 6.96 cfs @ 12.07 hrs, Volume= 0.535 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
94,271	98	Paved parking, HSG A
94,271		100.00% Impervious Area

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

Summary for Subcatchment 5S: PR-2B

Runoff = 5.24 cfs @ 12.07 hrs, Volume= 0.359 af, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
82,704	98	Paved parking, HSG A
17,328	30	Woods, Good, HSG A
2,275	70	Woods, Good, HSG C
102,307	86	Weighted Average
19,603		19.16% Pervious Area
82,704		80.84% Impervious Area

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

Summary for Subcatchment 6S: PR-2C

Runoff = 0.07 cfs @ 12.46 hrs, Volume= 0.031 af, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year event Rainfall=3.20"

Area (sf)	CN	Description
31,717	30	Brush, Good, HSG A
18,178	65	Brush, Good, HSG C
24,639	39	>75% Grass cover, Good, HSG A
32,427	74	>75% Grass cover, Good, HSG C
13,264	30	Woods, Good, HSG A
5,704	70	Woods, Good, HSG C
125,929	50	Weighted Average
125,929		100.00% Pervious Area

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

Summary for Pond 1P: Infiltration #1

Inflow Area = 2.164 ac,100.00% Impervious, Inflow Depth = 2.97" for 2-year event event
Inflow = 6.96 cfs @ 12.07 hrs, Volume= 0.535 af
Outflow = 0.43 cfs @ 13.56 hrs, Volume= 0.340 af, Atten= 94%, Lag= 89.3 min
Discarded = 0.05 cfs @ 5.08 hrs, Volume= 0.179 af
Primary = 0.38 cfs @ 13.56 hrs, Volume= 0.161 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 87.66' @ 13.56 hrs Surf.Area= 7,795 sf Storage= 14,748 cf

Plug-Flow detention time= 619.7 min calculated for 0.340 af (64% of inflow)
Center-of-Mass det. time= 516.7 min (1,272.1 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	85.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	85.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	87.25'	**18.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 87.25' / 86.95' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	87.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	90.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height
#5	Device 2	88.00'	**12.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 5.08 hrs HW=85.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.38 cfs @ 13.56 hrs HW=87.66' (Free Discharge)
└**2=Culvert** (Passes 0.38 cfs of 0.68 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.38 cfs @ 2.19 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**5=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 2P: Infiltration #2

Inflow Area = 2.349 ac, 80.84% Impervious, Inflow Depth = 1.84" for 2-year event event
Inflow = 5.24 cfs @ 12.07 hrs, Volume= 0.359 af
Outflow = 0.05 cfs @ 9.98 hrs, Volume= 0.156 af, Atten= 99%, Lag= 0.0 min
Discarded = 0.05 cfs @ 9.98 hrs, Volume= 0.156 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 96.39' @ 24.04 hrs Surf.Area= 7,795 sf Storage= 13,037 cf

Plug-Flow detention time= 1,014.1 min calculated for 0.156 af (43% of inflow)
Center-of-Mass det. time= 894.7 min (1,716.3 - 821.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	94.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	94.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	95.30'	**18.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.30' / 94.55' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	96.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	97.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	99.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height

Discarded OutFlow Max=0.05 cfs @ 9.98 hrs HW=94.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=94.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 3L: Abutting Property

Inflow Area = 1.115 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-year event event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Proposed Wetlands Flow

Inflow Area = 7.404 ac, 54.87% Impervious, Inflow Depth = 0.31" for 2-year event event
Inflow = 0.43 cfs @ 13.55 hrs, Volume= 0.192 af
Primary = 0.43 cfs @ 13.55 hrs, Volume= 0.192 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: PR-1A Runoff Area=48,586 sf 0.00% Impervious Runoff Depth=0.07"
Flow Length=470' Tc=8.9 min CN=34 Runoff=0.01 cfs 0.006 af

Subcatchment 4S: PR-2A Runoff Area=94,271 sf 100.00% Impervious Runoff Depth=4.83"
Tc=5.0 min CN=98 Runoff=11.12 cfs 0.872 af

Subcatchment 5S: PR-2B Runoff Area=102,307 sf 80.84% Impervious Runoff Depth=3.53"
Tc=5.0 min CN=86 Runoff=9.94 cfs 0.691 af

Subcatchment 6S: PR-2C Runoff Area=125,929 sf 0.00% Impervious Runoff Depth=0.72"
Tc=5.0 min CN=50 Runoff=1.63 cfs 0.174 af

Pond 1P: Infiltration #1 Peak Elev=88.67' Storage=20,748 cf Inflow=11.12 cfs 0.872 af
Discarded=0.05 cfs 0.184 af Primary=2.58 cfs 0.488 af Outflow=2.63 cfs 0.673 af

Pond 2P: Infiltration #2 Peak Elev=97.18' Storage=17,908 cf Inflow=9.94 cfs 0.691 af
Discarded=0.05 cfs 0.164 af Primary=0.62 cfs 0.293 af Outflow=0.67 cfs 0.456 af

Link 3L: Abutting Property Inflow=0.01 cfs 0.006 af
Primary=0.01 cfs 0.006 af

Link 4L: Proposed Wetlands Flow Inflow=3.81 cfs 0.955 af
Primary=3.81 cfs 0.955 af

Total Runoff Area = 8.519 ac Runoff Volume = 1.743 af Average Runoff Depth = 2.46"
52.31% Pervious = 4.456 ac 47.69% Impervious = 4.063 ac

Summary for Subcatchment 3S: PR-1A

Runoff = 0.01 cfs @ 15.42 hrs, Volume= 0.006 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
18,937	30	Woods, Good, HSG A
4,895	70	Woods, Good, HSG C
24,754	30	Brush, Good, HSG A
48,586	34	Weighted Average
48,586		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.1600	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	30	0.0930	1.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	131	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	46	0.0870	2.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	56	0.0350	1.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	157	0.2020	3.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	470	Total			

Summary for Subcatchment 4S: PR-2A

Runoff = 11.12 cfs @ 12.07 hrs, Volume= 0.872 af, Depth= 4.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
94,271	98	Paved parking, HSG A
94,271		100.00% Impervious Area

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

Summary for Subcatchment 5S: PR-2B

Runoff = 9.94 cfs @ 12.07 hrs, Volume= 0.691 af, Depth= 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
82,704	98	Paved parking, HSG A
17,328	30	Woods, Good, HSG A
2,275	70	Woods, Good, HSG C
102,307	86	Weighted Average
19,603		19.16% Pervious Area
82,704		80.84% Impervious Area

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

Summary for Subcatchment 6S: PR-2C

Runoff = 1.63 cfs @ 12.11 hrs, Volume= 0.174 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year event Rainfall=5.07"

Area (sf)	CN	Description
31,717	30	Brush, Good, HSG A
18,178	65	Brush, Good, HSG C
24,639	39	>75% Grass cover, Good, HSG A
32,427	74	>75% Grass cover, Good, HSG C
13,264	30	Woods, Good, HSG A
5,704	70	Woods, Good, HSG C
125,929	50	Weighted Average
125,929		100.00% Pervious Area

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

Summary for Pond 1P: Infiltration #1

Inflow Area = 2.164 ac,100.00% Impervious, Inflow Depth = 4.83" for 10-year event event
Inflow = 11.12 cfs @ 12.07 hrs, Volume= 0.872 af
Outflow = 2.63 cfs @ 12.44 hrs, Volume= 0.673 af, Atten= 76%, Lag= 22.3 min
Discarded = 0.05 cfs @ 3.15 hrs, Volume= 0.184 af
Primary = 2.58 cfs @ 12.44 hrs, Volume= 0.488 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 88.67' @ 12.44 hrs Surf.Area= 7,795 sf Storage= 20,748 cf

Plug-Flow detention time= 403.7 min calculated for 0.673 af (77% of inflow)
Center-of-Mass det. time= 321.1 min (1,067.9 - 746.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	85.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	85.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	87.25'	**18.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 87.25' / 86.95' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	87.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	90.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height
#5	Device 2	88.00'	**12.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 3.15 hrs HW=85.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.58 cfs @ 12.44 hrs HW=88.67' (Free Discharge)
└**2=Culvert** (Passes 2.58 cfs of 5.55 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.02 cfs @ 5.21 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**5=Orifice/Grate** (Orifice Controls 1.56 cfs @ 2.79 fps)

Summary for Pond 2P: Infiltration #2

Inflow Area = 2.349 ac, 80.84% Impervious, Inflow Depth = 3.53" for 10-year event event
Inflow = 9.94 cfs @ 12.07 hrs, Volume= 0.691 af
Outflow = 0.67 cfs @ 13.56 hrs, Volume= 0.456 af, Atten= 93%, Lag= 89.0 min
Discarded = 0.05 cfs @ 8.23 hrs, Volume= 0.164 af
Primary = 0.62 cfs @ 13.56 hrs, Volume= 0.293 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 97.18' @ 13.56 hrs Surf.Area= 7,795 sf Storage= 17,908 cf

Plug-Flow detention time= 516.9 min calculated for 0.456 af (66% of inflow)
Center-of-Mass det. time= 418.8 min (1,221.8 - 803.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	94.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	94.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	95.30'	**18.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.30' / 94.55' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	96.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	97.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	99.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height

Discarded OutFlow Max=0.05 cfs @ 8.23 hrs HW=94.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.62 cfs @ 13.56 hrs HW=97.18' (Free Discharge)
└**2=Culvert** (Passes 0.62 cfs of 7.14 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.62 cfs @ 3.16 fps)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 3L: Abutting Property

Inflow Area = 1.115 ac, 0.00% Impervious, Inflow Depth = 0.07" for 10-year event event
Inflow = 0.01 cfs @ 15.42 hrs, Volume= 0.006 af
Primary = 0.01 cfs @ 15.42 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Proposed Wetlands Flow

Inflow Area = 7.404 ac, 54.87% Impervious, Inflow Depth = 1.55" for 10-year event event
Inflow = 3.81 cfs @ 12.42 hrs, Volume= 0.955 af
Primary = 3.81 cfs @ 12.42 hrs, Volume= 0.955 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: PR-1A Runoff Area=48,586 sf 0.00% Impervious Runoff Depth=0.26"
Flow Length=470' Tc=8.9 min CN=34 Runoff=0.05 cfs 0.024 af

Subcatchment 4S: PR-2A Runoff Area=94,271 sf 100.00% Impervious Runoff Depth=6.00"
Tc=5.0 min CN=98 Runoff=13.71 cfs 1.082 af

Subcatchment 5S: PR-2B Runoff Area=102,307 sf 80.84% Impervious Runoff Depth=4.64"
Tc=5.0 min CN=86 Runoff=12.89 cfs 0.908 af

Subcatchment 6S: PR-2C Runoff Area=125,929 sf 0.00% Impervious Runoff Depth=1.26"
Tc=5.0 min CN=50 Runoff=3.61 cfs 0.304 af

Pond 1P: Infiltration #1 Peak Elev=89.23' Storage=23,640 cf Inflow=13.71 cfs 1.082 af
Discarded=0.05 cfs 0.186 af Primary=4.46 cfs 0.696 af Outflow=4.51 cfs 0.882 af

Pond 2P: Infiltration #2 Peak Elev=97.88' Storage=21,873 cf Inflow=12.89 cfs 0.908 af
Discarded=0.05 cfs 0.167 af Primary=1.57 cfs 0.504 af Outflow=1.62 cfs 0.671 af

Link 3L: Abutting Property Inflow=0.05 cfs 0.024 af
Primary=0.05 cfs 0.024 af

Link 4L: Proposed Wetlands Flow Inflow=7.28 cfs 1.504 af
Primary=7.28 cfs 1.504 af

Total Runoff Area = 8.519 ac Runoff Volume = 2.318 af Average Runoff Depth = 3.27"
52.31% Pervious = 4.456 ac 47.69% Impervious = 4.063 ac

Summary for Subcatchment 3S: PR-1A

Runoff = 0.05 cfs @ 12.51 hrs, Volume= 0.024 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
18,937	30	Woods, Good, HSG A
4,895	70	Woods, Good, HSG C
24,754	30	Brush, Good, HSG A
48,586	34	Weighted Average
48,586		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.1600	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	30	0.0930	1.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	131	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	46	0.0870	2.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	56	0.0350	1.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	157	0.2020	3.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	470	Total			

Summary for Subcatchment 4S: PR-2A

Runoff = 13.71 cfs @ 12.07 hrs, Volume= 1.082 af, Depth= 6.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
94,271	98	Paved parking, HSG A
94,271		100.00% Impervious Area

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

Summary for Subcatchment 5S: PR-2B

Runoff = 12.89 cfs @ 12.07 hrs, Volume= 0.908 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
82,704	98	Paved parking, HSG A
17,328	30	Woods, Good, HSG A
2,275	70	Woods, Good, HSG C
102,307	86	Weighted Average
19,603		19.16% Pervious Area
82,704		80.84% Impervious Area

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

Summary for Subcatchment 6S: PR-2C

Runoff = 3.61 cfs @ 12.09 hrs, Volume= 0.304 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year event Rainfall=6.24"

Area (sf)	CN	Description
31,717	30	Brush, Good, HSG A
18,178	65	Brush, Good, HSG C
24,639	39	>75% Grass cover, Good, HSG A
32,427	74	>75% Grass cover, Good, HSG C
13,264	30	Woods, Good, HSG A
5,704	70	Woods, Good, HSG C
125,929	50	Weighted Average
125,929		100.00% Pervious Area

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

Summary for Pond 1P: Infiltration #1

Inflow Area = 2.164 ac,100.00% Impervious, Inflow Depth = 6.00" for 25-year event event
Inflow = 13.71 cfs @ 12.07 hrs, Volume= 1.082 af
Outflow = 4.51 cfs @ 12.34 hrs, Volume= 0.882 af, Atten= 67%, Lag= 15.9 min
Discarded = 0.05 cfs @ 2.51 hrs, Volume= 0.186 af
Primary = 4.46 cfs @ 12.34 hrs, Volume= 0.696 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 89.23' @ 12.34 hrs Surf.Area= 7,795 sf Storage= 23,640 cf

Plug-Flow detention time= 341.6 min calculated for 0.882 af (81% of inflow)
Center-of-Mass det. time= 267.4 min (1,011.0 - 743.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	85.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	85.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	87.25'	**18.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 87.25' / 86.95' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	87.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	90.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height
#5	Device 2	88.00'	**12.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 2.51 hrs HW=85.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=4.46 cfs @ 12.34 hrs HW=89.22' (Free Discharge)
└**2=Culvert** (Passes 4.46 cfs of 7.43 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.24 cfs @ 6.32 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**5=Orifice/Grate** (Orifice Controls 3.22 cfs @ 4.10 fps)

Summary for Pond 2P: Infiltration #2

Inflow Area = 2.349 ac, 80.84% Impervious, Inflow Depth = 4.64" for 25-year event event
Inflow = 12.89 cfs @ 12.07 hrs, Volume= 0.908 af
Outflow = 1.62 cfs @ 12.61 hrs, Volume= 0.671 af, Atten= 87%, Lag= 32.5 min
Discarded = 0.05 cfs @ 7.33 hrs, Volume= 0.167 af
Primary = 1.57 cfs @ 12.61 hrs, Volume= 0.504 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 97.88' @ 12.61 hrs Surf.Area= 7,795 sf Storage= 21,873 cf

Plug-Flow detention time= 408.6 min calculated for 0.671 af (74% of inflow)
Center-of-Mass det. time= 322.2 min (1,117.6 - 795.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	94.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	94.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	95.30'	**18.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.30' / 94.55' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	96.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	97.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	99.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height

Discarded OutFlow Max=0.05 cfs @ 7.33 hrs HW=94.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.57 cfs @ 12.61 hrs HW=97.88' (Free Discharge)
└**2=Culvert** (Passes 1.57 cfs of 9.08 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.00 cfs @ 5.11 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.57 cfs @ 2.09 fps)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 3L: Abutting Property

Inflow Area = 1.115 ac, 0.00% Impervious, Inflow Depth = 0.26" for 25-year event event
Inflow = 0.05 cfs @ 12.51 hrs, Volume= 0.024 af
Primary = 0.05 cfs @ 12.51 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Proposed Wetlands Flow

Inflow Area = 7.404 ac, 54.87% Impervious, Inflow Depth = 2.44" for 25-year event event
Inflow = 7.28 cfs @ 12.27 hrs, Volume= 1.504 af
Primary = 7.28 cfs @ 12.27 hrs, Volume= 1.504 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: PR-1A Runoff Area=48,586 sf 0.00% Impervious Runoff Depth=0.74"
Flow Length=470' Tc=8.9 min CN=34 Runoff=0.37 cfs 0.068 af

Subcatchment 4S: PR-2A Runoff Area=94,271 sf 100.00% Impervious Runoff Depth=7.81"
Tc=5.0 min CN=98 Runoff=17.72 cfs 1.409 af

Subcatchment 5S: PR-2B Runoff Area=102,307 sf 80.84% Impervious Runoff Depth=6.38"
Tc=5.0 min CN=86 Runoff=17.45 cfs 1.249 af

Subcatchment 6S: PR-2C Runoff Area=125,929 sf 0.00% Impervious Runoff Depth=2.28"
Tc=5.0 min CN=50 Runoff=7.37 cfs 0.549 af

Pond 1P: Infiltration #1 Peak Elev=90.41' Storage=27,773 cf Inflow=17.72 cfs 1.409 af
Discarded=0.05 cfs 0.188 af Primary=7.67 cfs 1.019 af Outflow=7.72 cfs 1.207 af

Pond 2P: Infiltration #2 Peak Elev=98.95' Storage=26,336 cf Inflow=17.45 cfs 1.249 af
Discarded=0.05 cfs 0.172 af Primary=5.08 cfs 0.839 af Outflow=5.13 cfs 1.010 af

Link 3L: Abutting Property Inflow=0.37 cfs 0.068 af
Primary=0.37 cfs 0.068 af

Link 4L: Proposed Wetlands Flow Inflow=16.21 cfs 2.407 af
Primary=16.21 cfs 2.407 af

Total Runoff Area = 8.519 ac Runoff Volume = 3.275 af Average Runoff Depth = 4.61"
52.31% Pervious = 4.456 ac 47.69% Impervious = 4.063 ac

Summary for Subcatchment 3S: PR-1A

Runoff = 0.37 cfs @ 12.35 hrs, Volume= 0.068 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
18,937	30	Woods, Good, HSG A
4,895	70	Woods, Good, HSG C
24,754	30	Brush, Good, HSG A
48,586	34	Weighted Average
48,586		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.1600	0.16		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
0.3	30	0.0930	1.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	131	0.1050	1.62		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	46	0.0870	2.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	56	0.0350	1.31		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.8	157	0.2020	3.15		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.9	470	Total			

Summary for Subcatchment 4S: PR-2A

Runoff = 17.72 cfs @ 12.07 hrs, Volume= 1.409 af, Depth= 7.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
94,271	98	Paved parking, HSG A
94,271		100.00% Impervious Area

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

Summary for Subcatchment 5S: PR-2B

Runoff = 17.45 cfs @ 12.07 hrs, Volume= 1.249 af, Depth= 6.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
82,704	98	Paved parking, HSG A
17,328	30	Woods, Good, HSG A
2,275	70	Woods, Good, HSG C
102,307	86	Weighted Average
19,603		19.16% Pervious Area
82,704		80.84% Impervious Area

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

Summary for Subcatchment 6S: PR-2C

Runoff = 7.37 cfs @ 12.08 hrs, Volume= 0.549 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year event Rainfall=8.05"

Area (sf)	CN	Description
31,717	30	Brush, Good, HSG A
18,178	65	Brush, Good, HSG C
24,639	39	>75% Grass cover, Good, HSG A
32,427	74	>75% Grass cover, Good, HSG C
13,264	30	Woods, Good, HSG A
5,704	70	Woods, Good, HSG C
125,929	50	Weighted Average
125,929		100.00% Pervious Area

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

Summary for Pond 1P: Infiltration #1

Inflow Area = 2.164 ac,100.00% Impervious, Inflow Depth = 7.81" for 100-year event event
Inflow = 17.72 cfs @ 12.07 hrs, Volume= 1.409 af
Outflow = 7.72 cfs @ 12.23 hrs, Volume= 1.207 af, Atten= 56%, Lag= 9.7 min
Discarded = 0.05 cfs @ 1.87 hrs, Volume= 0.188 af
Primary = 7.67 cfs @ 12.23 hrs, Volume= 1.019 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2

Peak Elev= 90.41' @ 12.23 hrs Surf.Area= 7,795 sf Storage= 27,773 cf

Plug-Flow detention time= 284.5 min calculated for 1.207 af (86% of inflow)
Center-of-Mass det. time= 220.5 min (960.7 - 740.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	85.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	85.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	87.25'	**18.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 87.25' / 86.95' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	87.25'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	90.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height
#5	Device 2	88.00'	**12.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.05 cfs @ 1.87 hrs HW=85.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=7.67 cfs @ 12.23 hrs HW=90.41' (Free Discharge)
└**2=Culvert** (Passes 7.67 cfs of 10.42 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.61 cfs @ 8.21 fps)
  ├**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.83 cfs @ 1.33 fps)
  └**5=Orifice/Grate** (Orifice Controls 5.22 cfs @ 6.65 fps)

Summary for Pond 2P: Infiltration #2

Inflow Area = 2.349 ac, 80.84% Impervious, Inflow Depth = 6.38" for 100-year event event
Inflow = 17.45 cfs @ 12.07 hrs, Volume= 1.249 af
Outflow = 5.13 cfs @ 12.39 hrs, Volume= 1.010 af, Atten= 71%, Lag= 18.9 min
Discarded = 0.05 cfs @ 6.22 hrs, Volume= 0.172 af
Primary = 5.08 cfs @ 12.39 hrs, Volume= 0.839 af

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 98.95' @ 12.39 hrs Surf.Area= 7,795 sf Storage= 26,336 cf

Plug-Flow detention time= 310.7 min calculated for 1.010 af (81% of inflow)
Center-of-Mass det. time= 237.2 min (1,023.9 - 786.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	94.00'	10,657 cf	**73.75'W x 105.70'L x 5.75'H Field A** 44,823 cf Overall - 18,181 cf Embedded = 26,642 cf x 40.0% Voids
#2A	94.75'	18,181 cf	**Cultec R-902HD** x 280 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 10 Rows of 28 Chambers Cap Storage= +2.8 cf x 2 x 10 rows = 55.2 cf
		28,838 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	94.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	95.30'	**18.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.30' / 94.55' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 1.77 sf
#3	Device 2	96.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	97.50'	**12.0" Vert. Orifice/Grate** C= 0.600
#5	Device 2	99.00'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 1.0' Crest Height

Discarded OutFlow Max=0.05 cfs @ 6.22 hrs HW=94.06' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=5.08 cfs @ 12.39 hrs HW=98.95' (Free Discharge)
└**2=Culvert** (Passes 5.08 cfs of 11.43 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.40 cfs @ 7.14 fps)
  ├**4=Orifice/Grate** (Orifice Controls 3.68 cfs @ 4.69 fps)
  └**5=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 3L: Abutting Property

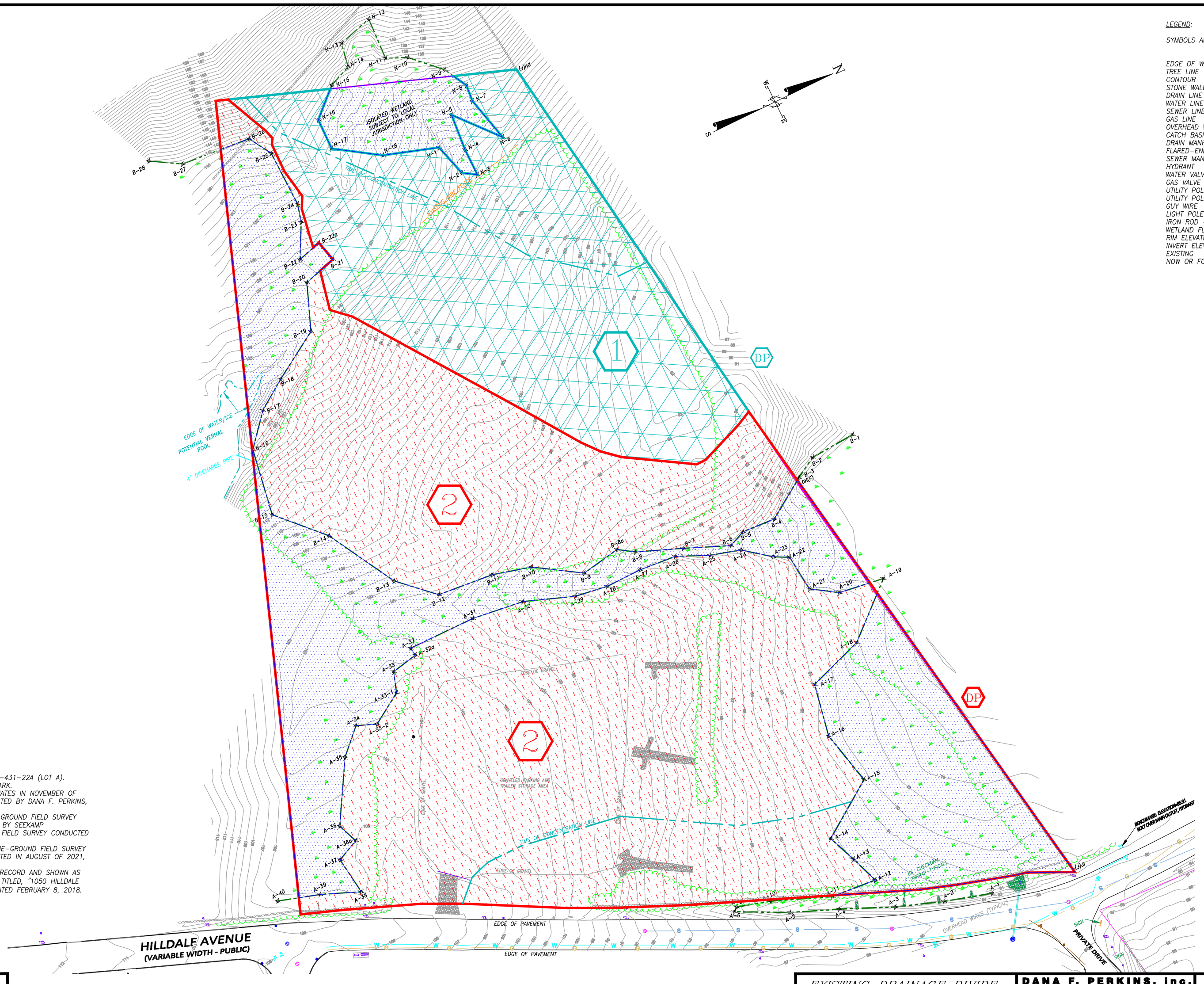
Inflow Area = 1.115 ac, 0.00% Impervious, Inflow Depth = 0.74" for 100-year event event
Inflow = 0.37 cfs @ 12.35 hrs, Volume= 0.068 af
Primary = 0.37 cfs @ 12.35 hrs, Volume= 0.068 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Link 4L: Proposed Wetlands Flow

Inflow Area = 7.404 ac, 54.87% Impervious, Inflow Depth = 3.90" for 100-year event event
Inflow = 16.21 cfs @ 12.23 hrs, Volume= 2.407 af
Primary = 16.21 cfs @ 12.23 hrs, Volume= 2.407 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs



LEGEND:

SYMBOLS AND ABBREVIATIONS SHOWN ON THIS PLAN

EDGE OF WETLANDS	
TREE LINE	
CONTOUR	100
STONE WALL	
DRAIN LINE	
WATER LINE	W
SEWER LINE	S
GAS LINE	G
OVERHEAD WIRES	
CATCH BASIN – CB	■
DRAIN MANHOLE – DMH	◍
FLARED–END SECTION – FES	▻
SEWER MANHOLE	◎
HYDRANT	
WATER VALVE	⋈
GAS VALVE	⋈
UTILITY POLE	
UTILITY POLE WITH RISERS	
GUY WIRE	→
LIGHT POLE	•
IRON ROD – FOUND	∘ IR(F)
WETLAND FLAG	⚑ A–1
RIM ELEVATION	RIM=100.00
INVERT ELEVATION	INV.=100.00
EXISTING	EX.
NOW OR FORMERLY	N/F

GENERAL NOTES:

1. *SUBJECT PROPERTY LOCATED ON HAVERHILL ASSESSORS PARCEL 585–431–22A (LOT A).*
2. *SUBJECT PROPERTY LOCATED IN ZONING DISTRICT BP – BUSINESS PARK.*
3. *DELINEATED WETLAND LINES ORIGINALLY FLAGGED BY MERIDIAN ASSOCIATES IN NOVEMBER OF 2017, AND LOCATED BY AN ON–THE–GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN FEBRUARY OF 2018.*
4. *WETLAND FLAGS REESTABLISHED IN THE FIELD THROUGH AN ON–THE–GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC., FIELD VERIFIED AND REVISED BY SEEKAMP ENVIRONMENTAL CONSULTING, AND LOCATED BY AN ON–THE–GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN JANUARY OF 2025.*
5. *EXISTING TOPOGRAPHY SHOWN HEREON IS THE RESULT OF AN ON–THE–GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN FEBRUARY OF 2018, UPDATED IN AUGUST OF 2021, AND UPDATED IN JANUARY OF 2025.*
6. *PROPERTY LINES SHOWN HEREON TAKEN FROM AVAILABLE PLANS OF RECORD AND SHOWN AS "LOT A" ON A SUBDIVISION PLAN PROVIDED BY MERIDIAN ASSOCIATES TITLED, "1050 HILLDALE AVENUE, PLAN OF LAND, LOCATED IN HAVERHILL, MASSACHUSETTS" DATED FEBRUARY 8, 2018.*

RECORD OWNER:

SINGH REALTY GROUP, LLC
6 FONDI ROAD
HAVERHILL, MA

DATE	BY	REVISION

UTILITY STATEMENT:
THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES STATE THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

50 0 25 50 100 200
(IN FEET)
1 inch = 50 ft.

EXISTING DRAINAGE DIVIDE
INDUSTRIAL OUTDOOR STORAGE YARD
1400 HILLDALE AVENUE
HAVERHILL, MASSACHUSETTS

SCALE: 1" = 50' | DATE: FEBRUARY 19, 2025 | JOB NO. 51856D | SHEET 1 OF 2

DANA F. PERKINS, Inc.
Consulting Engineers & Land Surveyors
1057 EAST STREET ~ TEWKSBURY, MASSACHUSETTS 01876
TEL: 978–858–0680 FAX: 978–640–0237
DANAFPERKINS.COM

PREPARED FOR:
SINGH REALTY GROUP
6 FONDI ROAD
HAVERHILL, MA

LEGEND:

SYMBOLS AND ABBREVIATIONS SHOWN ON THIS PLAN

CONTOUR	—100—
CHAIN LINK FENCE	○
STOCKADE FENCE	□
PROPOSED CONTOUR	100
PROPOSED DRAIN LINE	
PROPOSED SEWER LINE	PS
CATCH BASIN ~ CB	■ ●
DRAIN MANHOLE ~ DMH	D
SEWER MANHOLE	S
PROPOSED CATCH BASIN ~ CB	■ ●
PROPOSED DRAIN MANHOLE ~ DMH	D
PROPOSED SPOT ELEVATION	•100x00
INVERT ELEVATION	INV=100.00
CORRUGATED METAL PIPE	CMP
HIGH–DENSITY POLYETHYLENE (PIPE)	HDPE
FINISH FLOOR ELEVATION	F.F.=100.00
BITUMINOUS	BIT.
CONCRETE	CONC.
EXISTING	EX.
PROPOSED	PROP.
SQUARE FEET	SF

GENERAL NOTES:

1. SUBJECT PROPERTY LOCATED ON HAVERHILL ASSESSORS PARCEL 585–431–22A (LOT A).
2. SUBJECT PROPERTY LOCATED IN ZONING DISTRICT BP – BUSINESS PARK.
3. DELINEATED WETLAND LINES ORIGINALLY FLAGGED BY MERIDIAN ASSOCIATES IN NOVEMBER OF 2017, AND LOCATED BY AN ON–THE–GROUND FIELD SURVEY CONDUCTED BY DANA F. PERKINS, INC. IN FEBRUARY OF 2018.
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RECORD OWNER:

SINGH REALTY GROUP, LLC
6 FONDI ROAD
HAVERHILL, MA

DATE	BY	REVISION
05/12/25	AMP	REVISIONS PER PEER REVIEW AND TOWN COMMENTS

50 0 25 50 100 200
(IN FEET)
1 inch = 50 ft.

COMMONWEALTH OF MASSACHUSETTS
ANDREW M. POJASEK
CIVIL
No. 50359
REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER

PROPOSED DRAINAGE DIVIDE
INDUSTRIAL OUTDOOR STORAGE YARD
1400 HILLDALE AVENUE
HAVERHILL, MASSACHUSETTS

SCALE: 1" = 50' | DATE: FEBRUARY 19, 2025 | JOB NO. 51856D | SHEET 2 OF 2

DANA F. PERKINS, inc.
Consulting Engineers & Land Surveyors
1057 EAST STREET ~ TEWKSBURY, MASSACHUSETTS 01876
TEL: 978–858–0680 FAX: 978–640–0237
DANAFPERKINS.COM

PREPARED FOR:
SINGH REALTY GROUP
6 FONDI ROAD
HAVERHILL, MA

Stormwater Management Permit

Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

Hydraulic Calculations

Prepared for:

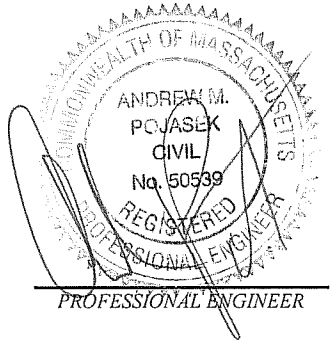
Singh Realty Group, LLC
6 Fondi Road
Haverhill, MA 01832

Prepared by:

Dana F. Perkins, Inc.
1057 East Street
Tewksbury, MA 01876

Submitted To:
City of Haverhill ~ Conservation Commission

Dana F. Perkins, Inc.
Consulting Engineers & Land Surveyors
1057 East Street
Tewksbury, MA 01876



LOCATION: Proposed Industrial Outdoor Storage Yard
1400 Hilldale Avenue
Haverhill, Massachusetts

COMPUTED BY: AMP
CHECKED BY: EED

DATE: February 19, 2025
SHEET: 1 of 1

25-YEAR STORM
DESIGN EVENT

PROFESSIONAL ENGINEER

LOCATION		AREA x COEFFICIENT							TIME OF FLOW			DESIGN					PROFILE				
		PERVIOUS			IMPERVIOUS							ALL PIPES ARE CIRCULAR HDPE UNLESS NOTED								INVERT ELEV.	
FROM	TO	AREA	C	SUBTOTAL	AREA	C	SUBTOTAL	TOTAL	Total	I	Q	PIPE SIZE	SLOPE	n	CAPACITY FULL	VELOCITY FULL	LENGTH	FALL	RIM ELEV.	UPPER	LOWER
		(acres)			(acres)				(min.)	(in/hr)	(c. f. s.)	(inches)	(ft. per ft.)		(c. f. s.)	(ft. / sec)	(ft.)	(ft.)	(ft.)	(ft.)	(ft.)
CB #1	CDS #1	0.000	0.30	0.000	1.168	0.90	1.051	1.051	5.00	6.5	6.83	18	0.005	0.012	8.06	4.56	26	0.13	92.00	88.50	88.37
CDS #1	INFIL	-	-	-	-	-	-	1.051	5.00	6.5	6.83	18	0.012	0.012	12.49	7.07	10	0.12	92.60	88.37	88.25
CB #2	CDS #2	0.000	0.30	0.000	1.029	0.90	0.926	0.926	5.00	6.5	6.02	18	0.005	0.012	8.06	4.56	12	0.06	92.10	88.60	88.54
CDS #2	INFIL	-	-	-	-	-	-	0.926	5.00	6.5	6.02	18	0.029	0.012	19.41	10.99	10	0.29	92.53	88.54	88.25
CB #3	CDS #3	0.000	0.30	0.000	1.233	0.90	1.110	1.110	5.00	6.5	7.21	18	0.020	0.012	16.12	9.13	10	0.20	101.84	97.65	97.45
CDS #3	INFIL	-	-	-	-	-	-	1.110	5.00	6.5	7.21	18	0.020	0.012	16.12	9.13	10	0.20	102.05	97.45	97.25
CB #4	CDS #4	0.000	0.30	0.000	0.684	0.90	0.616	0.616	5.00	6.5	4.00	18	0.020	0.012	16.12	9.13	32	0.64	101.84	98.13	97.49
CDS #4	INFIL	-	-	-	-	-	-	0.616	5.00	6.5	4.00	18	0.020	0.012	16.12	9.13	12	0.24	102.44	97.49	97.25