Stormwater Management Report

339 Electric Ave.
Lunenburg, MA

August 2015
Revision 1 - 9/15/15

COMMONWEALTH OF MASSACHUSETTS
DOUGLAS E. MILLER
CIVIL
No. 33965
REGISTERED PROFESSIONAL ENGINEER

9/17/15

Submitted to:
Lunenburg Planning Board
960 Massachusetts Avenue
Lunenburg, MA 01462

Submitted by:
339 Electric Ave. Corporation
339 Electric Avenue
Lunenburg, MA 01462

Prepared by:
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Project No:
091058

GPR Engineering Solutions for Land & Structures

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- conducted January 22, 2015

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"Comercial Redevelopment, 339 Electric Ave., Lunenburg, MA"
prepared by Goldsmith, Prest & Ringwal, Inc. dated August 2015, Revised 9/15/15

Long-Term Pollution Prevention Plan by GPR Inc, Dated August 2015

Section 1

Introduction and Methodology

Introduction and Methodology

This Stormwater Management Report is intended to accompany plans for the proposed site redevelopment at 339 Electric Avenue in Lunenburg, MA. Included in this report are the calculations that support the final engineering design of the stormwater management system as required by the Town of Lunenburg Protective bylaw. Site specific information is presented under two scenarios, "pre-development" and "post-development" conditions, so that potential impacts due to the project can be identified, quantified and, as necessary, mitigated.

The final design intent seeks to meet the following interrelated goals:

1. Limit stormwater runoff rates for the 2-, 10- and 100-year storm events to existing (pre-development) levels;

2. Limit stormwater runoff volumes for the 2-, 10- and 100-year storm events to existing (pre-development) levels;

3. Maintain or increase the volume of stormwater recharged per storm event to those of existing (pre-development) levels;

4. Prevent appreciable sediment and other suspended solids and contaminants transport by trapping them on site via Best Management Practices;

5. Provide adequate drainage for new surfaces;

6. Maintain existing drainage patterns while providing a cost-effective engineering solution that addresses regulatory as well as real-world constraints.

Site Description

The proposed development is located at 339 Electric Avenue (Route 13), approximately 1 mile south of Electric Avenue's intersection with Massachusetts Avenue (Route 2A). The Leominster Monument Company currently occupies the only structure on 32,364± square feet (0.74± acres) project property. Paved and gravel parking areas provide access off of Electric Ave. to three sides of the existing structure with a crushed stone monument display area on the fourth. The property is triangular in shape with the former Central Mass Motorsports business along the upgradient northern boundary and the former drive in movie complex along the downgradient southern boundary. Previous site work on the project site excavated material along the northern boundary, leaving a 2 foot horizontal to 1 foot vertical slope from the Motorsports property, leveling the subject property center portion of the property and filling the southern part of the property creating a 2 foot horizontal to 1 foot vertical slope downward to the drainage channel on the drive in property.

The subcatchment area evaluated for the development contains a total of 36,762± square feet,

which does not include all of the subject property but does include some of the upgradient abutting Motorsports lot. Available NRCS Soil mapping for the property shows the parent material to be Urban Land. An onsite soil evaluation done by this office in January revealed the past site work and filling activates over a Loamy Sand soil. Based on the characteristics found during the onsite evaluation a hydraulic soil group B designation has been used in the following calculations.

Under the pre-development scenario, the site has been divided into 2 subcatchments, as shown on the plan entitled "WATERSHED MAP – EXISTING CONDITIONS", included within the attached Appendix. These two subcatchments outline the majority of the usable area on the subject site along with contributing areas of the northern abutting property and the Electric Ave. right of way onto the property before discharging to the drainage channel on the southern abutting property. The rear portion of the property, outlined in Subcatchment SC1, contains a portion of the paved and gravel access along with scrub growth with mature trees along the southern drive in property boundary. Subcatchment SC2, outlines the contributing area directing runoff from the majority of the existing structures roof, front paved parking and the offsite abutting property and Electric Ave. right of way. Each of the subcatchments ultimately discharge surface runoff to the drainage channel on the abutting drive in property, quantified as Analysis Point (AP).

Project Description

The proposed development will include the construction of a mixed use commercial building, maintaining the Leominster Monument Company business along with a Kennel type establishment called Preppy Pet Suites which has a current location in Fitchburg. A paved parking area containing 10 spaces will provide parking and access off of Electric Ave. to the 6,400± square foot structure. Associated with the mixed use building is a fenced area containing 3,750± square feet of outdoor play area for dogs during the doggy day care hours of operation. A 500± square foot shed is also proposed in the rear portion of the property access by a gravel drive off of the main buildings loading area. To accommodate stormwater runoff generated from the proposed pavement areas, the parking areas has been designed to direct runoff into a deep sump hooded catch basin prior to discharge into a sediment forebay and infiltration basin along the southern property line.

Under the post-development scenario, the site has been divided into four drainage subcatchments, shown on the plan entitled "WATERSHED MAP – DEVELOPED CONDITIONS", included in the attached Appendix. Stormwater runoff generated from the rear portion of the main building, roof of the proposed shed and approximately half of the outdoor play area is outlined with subcatchment SC1. SC1 directs runoff into a stone swale located at the base of the proposed reshaped slope extending from the northern property line, directing flows easterly around the shed and ultimately discharging to the drainage channel on the drive in property. Subcatchment SC2, outlines surface runoff from the remaining portion of the outdoor play area, which sheets flows to the previously mentioned drive in property drainage channel. Subcatchment SC3 characterizes runoff from the front portion of the main building along with the proposed parking area and driveway off of Electric Ave. Runoff generated within this subcatchment is directed into a drop inlet of a deep sump hooded catch basin prior to continuing into a sediment forebay associated with an infiltration basin. A spillway has been provided to allow collected runoff in excess of the design infiltration and water quality volume to continue to the drive in property drainage channel. The last subcatchment, SC4,

describes runoff from the abutting property parking and the Electric Ave. pavement which flowed onto the subject property under pre-development conditions, flowing across the existing parking area prior to continuing over a grassed area and ultimately into the drive in drainage channel. Under developed conditions, the proposed grading of the development will keep this runoff within the Electric Ave. gutter line, continuing to an existing catch basin within the right of way which also discharges into the drive in drainage channel. While this subcatchment does not directly contribute stormwater runoff to the section of the drainage channel being classified as the Analysis Point for these calculations, to maintain the continuity of the drainage model it has still been accounted for in the developed condition.

Hydrologic and Hydraulic Computation Methodology

Runoff rates were computed using the Soil Conservation Service TR-20 Method entitled "Urban Hydrology for Small Watersheds". The following 24-hour rainfall events were analyzed:

Frequency (years): 2, 10, and 100

Runoff from the site has been analyzed at one point under both the pre-development and post-development conditions. The PRE analysis point represents runoff to the drainage channel on the abutting drive in property under current pre-development conditions, while the POST analysis point reflects the same flows under the proposed conditions.

Summary of Results

Peak discharge rates and volumes of the calculated runoff for both conditions analyzed are displayed in the HYDROLOGY SUMMARY that follows. As shown within the summary the discharge rates during the 2- and 10-year storm event under the developed conditions are less than those of the pre-developed. A slight increase in discharge rate, 0.2± cfs, is expected during the 100-year event. While the calculations show the slight increase in peak rate, the calculated peak discharge volume is 1,700± cubic feet less than those of pre-development conditions, decreasing potential flooding of the adjacent property in accordance with the Stormwater Management regulations.

The proposed deep sump hooded catch basin, sediment forebay and infiltration basin provide an expected Total Suspended Solids (TSS) removal of 85%. The infiltration basin also retains runoff off volume well in excess of the required site infiltration and water quality volumes.

Stormwater Quality

The development meets the MADEP Stormwater Management Standards through the employment of Best Management Practices that address groundwater recharge, water quality (first flush) retention, and suspended solids removal within sustainable BMP's. See Appendix for computed solids quantities / removal process trains, and water quality runoff volumes.

Section 2

Hydrology Summary for 24-hour Storm

HYDROLOGY SUMMARY FOR 24-HOUR STORM

339 Electric Ave.
Lunenburg, MA
Project No. 091058

PEAK DISCHARGE RATE

Pre-Development (cfs)

Analysis Point	2-YR	10-YR	100-YR
PRE	0.96	2.03	3.59

Development (cfs)

Analysis Point	2-YR	10-YR	100-YR
POST	0.61	1.29	3.81

Pre-Development vs. Developed (cfs)

Analysis Point	2-YR	10-YR	100-YR
PRE vs POST	**-0.35**	**-0.74**	**0.22**

PEAK DISCHARGE VOLUME

Pre-Development (Cubic feet)

Analysis Point	2-YR	10-YR	100-YR
PRE	3,271	6,684	11,824

Development (cubic feet)

Analysis Point	2-YR	10-YR	100-YR
POST	1,958	5,094	10,105

Pre-Development vs. Developed (cubic feet)

Analysis Point	2-YR	10-YR	100-YR
PRE vs POST	**-1,313**	**-1,590**	**-1,719**

Section 3

Mass DEP Stormwater Management Report Checklist

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

COMMONWEALTH OF MASSACHUSETTS
DOUGLAS E. MILLER
CIVIL
No. 33965
REGISTERED PROFESSIONAL ENGINEER

Douglas C. Miller 8/4/15
Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

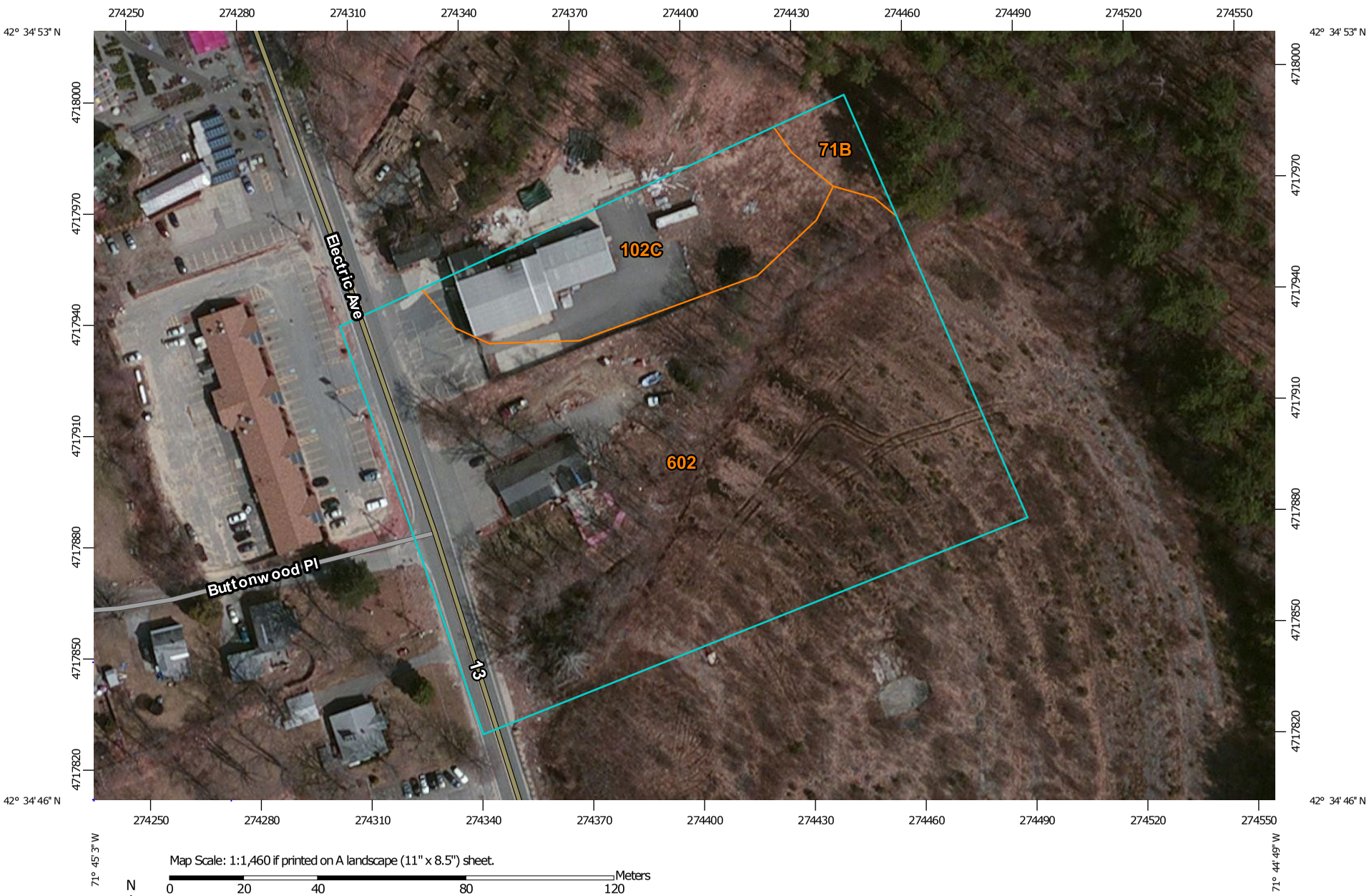
☐ An Illicit Discharge Compliance Statement is attached;

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

Section 4

Appendix

Soil Map—Worcester County, Massachusetts, Northeastern Part
(091058A - Preppy Pets / Lunenburg)



Map Scale: 1:1,460 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 9, Sep 19, 2014

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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

Worcester County, Massachusetts, Northeastern Part (MA613)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.1	HsG C 2.4%
102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	0.8	HsG B/D/D 16.8%
602	Urban land	3.7	HsG N/A 80.8%
Totals for Area of Interest		**4.6**	**100.0%**

FORM 11 - SOIL EVALUATOR FORM

No. 091058A Date: 1/22/15

Commonwealth of Massachusetts
Lunenburg Massachusetts

Soil Suitability Assessment for Stormwater Management

Performed by: Nicholas Pauling, PE, GPR, Inc. Date: 1/30/15
Witnessed by: -- Unwitnessed --

Location Address:	Owner's Name: Preppy Pet Suites
or Lot No. 339 Electric Avenue Lunenburg, MA 01462	Address: 147 John Fitch Highway Fitchburg, MA 01420 Telephone No. 978-490-4590

~~New Construction~~ ☐ ~~Upgrade~~ ☐ ~~Repair~~ ☐

Office Review

Published Soil Survey Available: No ☐ Yes ☑

Year Published Internet Publication Scale na Soil Map Unit 602
Soil Name Urban Land Soil Limitations n/a
Soil Name Chatfield-Hollis-Outcrop Soil Limitations rockiness
Soil Name --- Soil Limitations ---

Surficial Geologic Report Available: No ☑ Yes ☐

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

Flood Insurance Rate Map: 250315 0004B

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

Wetland Area:

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

Current Water Resource Conditions (USGS): Month February

Range: Above Normal ☐ Normal ☑ Below Normal ☐
Other Reference Reviewed USGS

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 339 Electric Avenue
Lunenburg, MA 01462

On-Site Review

Deep Hole #: 115-1 Date: 01/22/15 Time: 8:00 AM Weather: Partly Cloudy, 23°
Location (identify on site plan) See Attached Sketch
Land Use Gravel Parking Slope (%) 0 - 5% Surfaces Stones few
(eg woodland, agricultural field, vacant lot etc...)
Vegatation Scrub growth, Trees on perimeter
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body >100 feet Drainage Way >100 feet
Possible Wet Area 125± feet Property Line 15± feet
Drinking Water Well >100 feet Other:
feet

Deep Observation Hole Log

Hole # 115-1 NB E27/8 Suface El. 521.7

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0 - 8	A	Loamy Sand	10YR 2/2	---	gr, mvfr,
8 - 16	B	Loamy Sand	10YR 5/6	---	sbk, mvfr
16 - 78	C	Loamy Sand	2.5Y 4/4	@38" 7.5YR 6/8	ma, mvfr, bedrock weathered, breaks into sbk pieces

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 78 inches
Depth to Groundwater: Standing Water in the Hole 74 inches Weeping from Pit Face: 74 inches
Estimated Seasonal High Groundwater in the Hole 38 inches
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 339 Electric Avenue
Lunenburg, MA 01462

On-Site Review

Deep Hole #: 115-2 Date: 01/22/15 Time: 8:15 AM Weather: Partly Cloudy, 23°
Location (identify on site plan) See Attached Sketch
Land Use Gravel Parking Slope (%) 0 - 5% Surfaces Stones few
(eg woodland, agricultural field, vacant lot etc…)
Vegatation Scrub growth, Trees on perimeter
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body >100 feet Drainage Way >100 feet
Possible Wet Area 90± feet Property Line 15± feet
Drinking Water Well >100 feet Other:
feet

Deep Observation Hole Log

Hole # 115-2 NB E27/8 Suface El. 521.0

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0 - 13	A	Loamy Sand	10YR 2/2	---	gr, mvfr,
13 - 20	B	Loamy Sand	10YR 5/6	---	sbk, mvfr
20 - 47	C	Loamy Sand	2.5Y 4/4	@40" 7.5YR 6/8	ma, mvfr, bedrock weathered, breaks into sbk pieces

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 47 inches
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 40 inches
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 339 Electric Avenue
Lunenburg, MA 01462

On-Site Review

Deep Hole #: 115-3 Date: 01/22/15 Time: 8:20 AM Weather: Partly Cloudy, 23°
Location (identify on site plan) See Attached Sketch
Land Use Gravel Parking Slope (%) 0 - 5% Surfaces Stones few
(eg woodland, agricultural field, vacant lot etc...)
Vegatation Scrub growth, Trees on perimeter
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body >100 feet Drainage Way >100 feet
Possible Wet Area 32± feet Property Line 11± feet
Drinking Water Well >100 feet Other:
feet

Deep Observation Hole Log

Hole # 115-3 NB E27/9 Suface El. 518.6

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0 - 48	Fill	---	---	---	---
48 - 58	A	Loamy Sand	10YR 2/2	---	gr, mvfr,
58 - 66	B	Loamy Sand	10YR 5/6	---	sbk, mvfr
66 - 102	C	Loamy Sand	2.5Y 4/4	@82" 7.5YR 6/8	ma, mvfr, bedrock weathered, breaks into sbk pieces

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: 102 inches
Depth to Groundwater: Standing Water in the Hole 100 inches Weeping from Pit Face: 100 inches
Estimated Seasonal High Groundwater in the Hole 82 inches
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot #: 339 Electric Avenue
Lunenburg, MA 01462

On-Site Review

Deep Hole #: 115-4 Date: 01/22/15 Time: 8:35 AM Weather: Partly Cloudy, 23°
Location (identify on site plan) See Attached Sketch
Land Use Display Area Slope (%) 0 - 5% Surfaces Stones few
(eg woodland, agricultural field, vacant lot etc…)
Vegatation Scrub growth, Trees on perimeter
Landform Ground Morraine
Position on landscape See attached Sketch
Distances from:

Open Water Body >100 feet Drainage Way >100 feet
Possible Wet Area 20± feet Property Line 8± feet
Drinking Water Well >100 feet Other:
feet

Deep Observation Hole Log

Hole # 115-4 NB E27/9 Suface El. 514.9

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (MUNSELL)	Soil Mottling	Other (Stucture, Stones, Boulders, Consistency, % Gravel)
0 - 65	Fill	---	---	---	---
65 - 70	A	Loamy Sand	10YR 2/2	---	gr, mvfr,
70 - 78	B	Loamy Sand	10YR 5/6	---	sbk, mvfr
78 - 120	C	Loamy Sand	2.5Y 4/4	@82" 7.5YR 6/8	ma, mvfr, few stones

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Glacial Till Depth to Bedrock: >120 inches
Depth to Groundwater: Standing Water in the Hole None Weeping from Pit Face: None
Estimated Seasonal High Groundwater in the Hole 80 inches
Aditional Notes

FORM 11 - SOIL EVALUATOR FORM

Location Address or Lot#: 339 Electric Avenue
Lunenburg, MA 01462

Determination for Seasonal High Water Table

Method Used:

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

Index Well Number ..... Reading Date ..... Index Well Level .....

Adjustment Factor ..... Adjusted Ground Water Level .....

Depth of Naturally Occuring Pervious Material

Does at least four feet of naturally occuring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? No

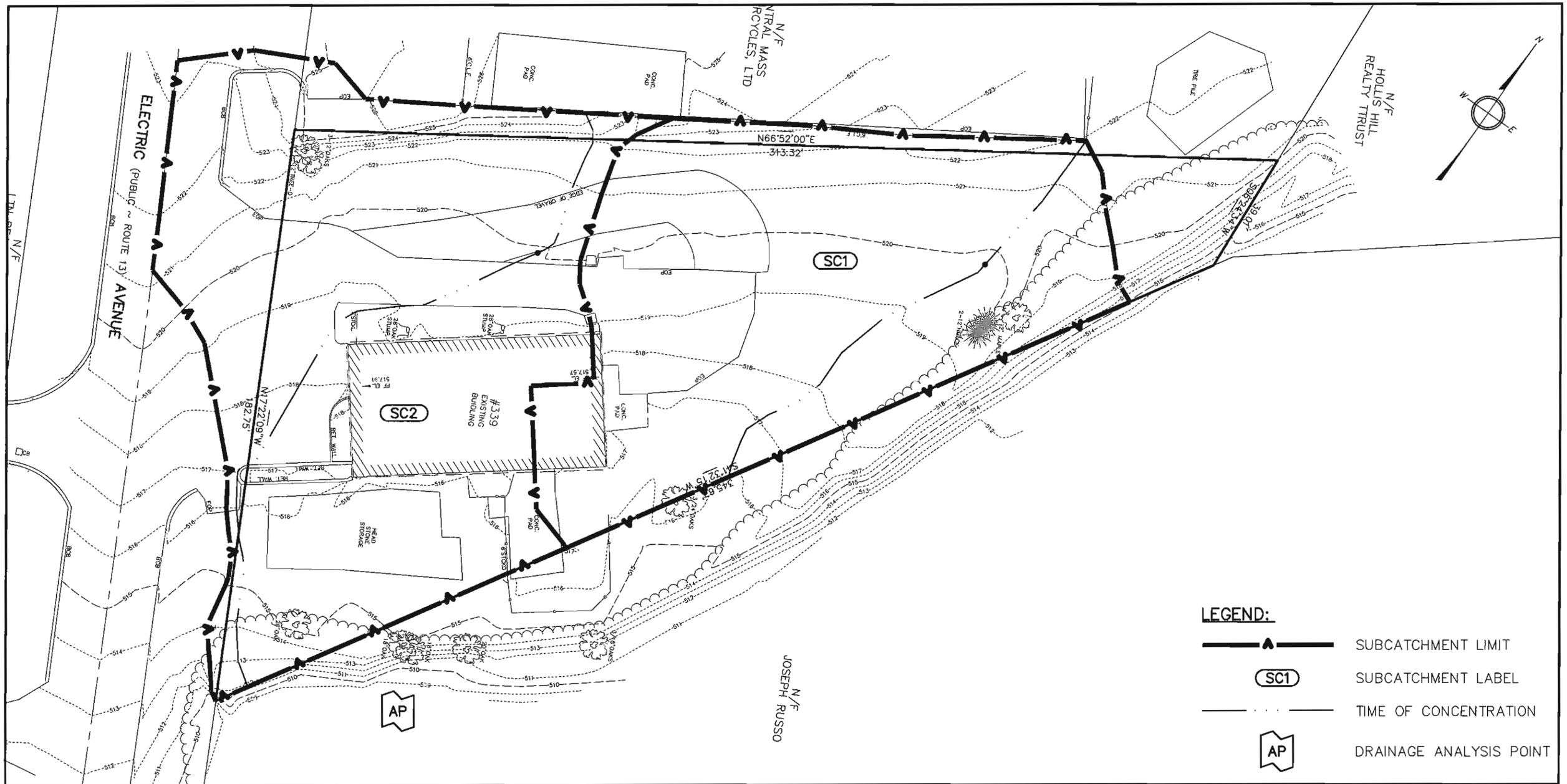
If not, what is the depth of naturally occuring pervious material? _____ Feet

Certification

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

Signature Nicholas Pawlenty Date 1/30/15

Notes: _____



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)

1 INCH = 30 FEET

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PREPARED FOR:

339 ELECTRIC AVE. CORPORATION
339 ELECTRIC AVENUE
LUNENBURG, MA 01462

DES'D BY: NMP | CHK'D BY: DEM

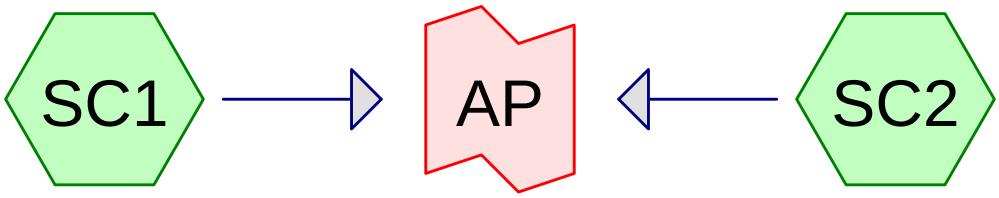
DATE: AUGUST 2015 (REVISED 9/15/15)

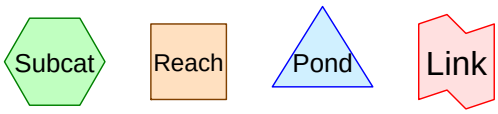
WATERSHED MAP EXISTING CONDITIONS

339 ELECTRIC AVE.
LUNENBURG, MA

PROJECT: 091058A | PRE

P:\09----\091058\DWG\PERMIT\DEVELOPMENT PLAN.DWG 09-16-15 3:21:23 PM - LAYOUT PRE





Routing Diagram for 091058 Pre
Prepared by Goldsmith, Prest & Ringwall, Inc.
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.437	61	>75% Grass cover, Good, HSG B (SC1, SC2)
0.042	48	Brush, Good, HSG B (SC1, SC2)
0.083	96	Gravel surface, HSG B (SC1, SC2)
0.201	98	Paved parking, HSG B (SC1, SC2)
0.081	98	Roofs, HSG B (SC1, SC2)
0.844	**76**	**TOTAL AREA**

Summary for Subcatchment SC1:

Runoff = 0.22 cfs @ 12.14 hrs, Volume= 895 cf, Depth> 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
681	98	Roofs, HSG B
1,151	96	Gravel surface, HSG B
2,112	98	Paved parking, HSG B
10,997	61	>75% Grass cover, Good, HSG B
1,130	48	Brush, Good, HSG B
16,071	69	Weighted Average
13,278		82.62% Pervious Area
2,793		17.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0364	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	110	0.0367	1.34		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.1	160	Total			

Summary for Subcatchment SC2:

Runoff = 0.76 cfs @ 12.09 hrs, Volume= 2,376 cf, Depth> 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
2,845	98	Roofs, HSG B
2,458	96	Gravel surface, HSG B
6,657	98	Paved parking, HSG B
8,030	61	>75% Grass cover, Good, HSG B
701	48	Brush, Good, HSG B
20,691	82	Weighted Average
11,189		54.08% Pervious Area
9,502		45.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	10	0.2640	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.4	17	0.0565	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.3	23	0.0404	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.1	8	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0197	2.85		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	28	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	70	0.0368	3.89		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0488	1.55		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	21	0.1293	0.90		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
5.3	247	Total			

Summary for Link AP:

Inflow Area = 0.844 ac, 33.44% Impervious, Inflow Depth > 1.07" for 2-YR event
Inflow = 0.96 cfs @ 12.10 hrs, Volume= 3,271 cf
Primary = 0.96 cfs @ 12.10 hrs, Volume= 3,271 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment SC1:

Runoff = 0.61 cfs @ 12.12 hrs, Volume= 2,142 cf, Depth> 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
681	98	Roofs, HSG B
1,151	96	Gravel surface, HSG B
2,112	98	Paved parking, HSG B
10,997	61	>75% Grass cover, Good, HSG B
1,130	48	Brush, Good, HSG B
16,071	69	Weighted Average
13,278		82.62% Pervious Area
2,793		17.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0364	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	110	0.0367	1.34		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.1	160	Total			

Summary for Subcatchment SC2:

Runoff = 1.46 cfs @ 12.08 hrs, Volume= 4,542 cf, Depth> 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
2,845	98	Roofs, HSG B
2,458	96	Gravel surface, HSG B
6,657	98	Paved parking, HSG B
8,030	61	>75% Grass cover, Good, HSG B
701	48	Brush, Good, HSG B
20,691	82	Weighted Average
11,189		54.08% Pervious Area
9,502		45.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	10	0.2640	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.4	17	0.0565	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.3	23	0.0404	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.1	8	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0197	2.85		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	28	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	70	0.0368	3.89		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0488	1.55		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	21	0.1293	0.90		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
5.3	247	Total			

Summary for Link AP:

Inflow Area = 0.844 ac, 33.44% Impervious, Inflow Depth > 2.18" for 10-YR event
Inflow = 2.03 cfs @ 12.09 hrs, Volume= 6,684 cf
Primary = 2.03 cfs @ 12.09 hrs, Volume= 6,684 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment SC1:

Runoff = 1.23 cfs @ 12.12 hrs, Volume= 4,157 cf, Depth> 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
681	98	Roofs, HSG B
1,151	96	Gravel surface, HSG B
2,112	98	Paved parking, HSG B
10,997	61	>75% Grass cover, Good, HSG B
1,130	48	Brush, Good, HSG B
16,071	69	Weighted Average
13,278		82.62% Pervious Area
2,793		17.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	50	0.0364	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	110	0.0367	1.34		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.1	160	Total			

Summary for Subcatchment SC2:

Runoff = 2.43 cfs @ 12.08 hrs, Volume= 7,667 cf, Depth> 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

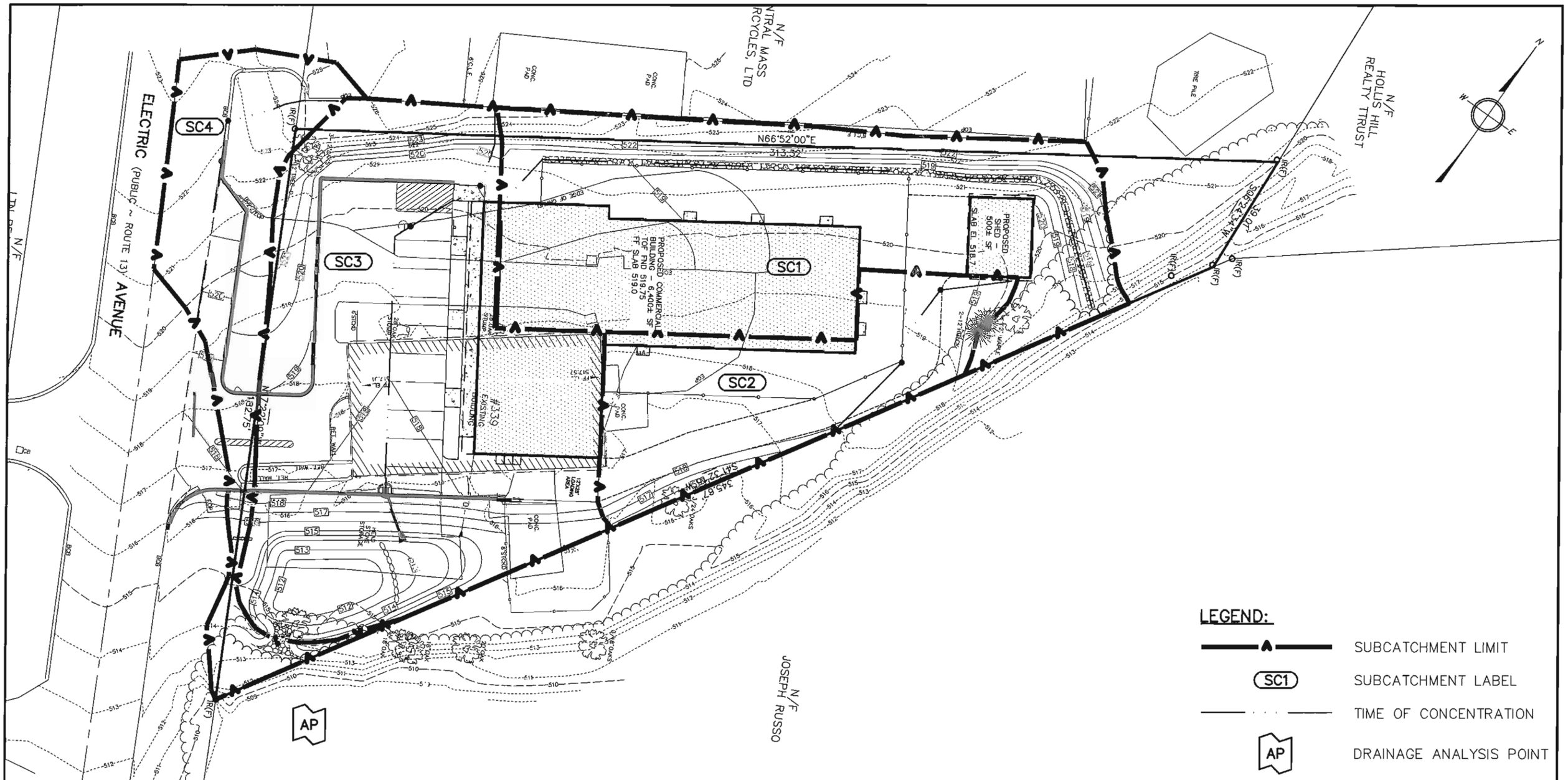
Area (sf)	CN	Description
2,845	98	Roofs, HSG B
2,458	96	Gravel surface, HSG B
6,657	98	Paved parking, HSG B
8,030	61	>75% Grass cover, Good, HSG B
701	48	Brush, Good, HSG B
20,691	82	Weighted Average
11,189		54.08% Pervious Area
9,502		45.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	10	0.2640	0.20		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
2.4	17	0.0565	0.12		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.3	23	0.0404	1.32		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.1	8	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	34	0.0197	2.85		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	28	0.0220	1.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	70	0.0368	3.89		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0488	1.55		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	21	0.1293	0.90		**Shallow Concentrated Flow,** Forest w/Heavy Litter Kv= 2.5 fps
5.3	247	Total			

Summary for Link AP:

Inflow Area = 0.844 ac, 33.44% Impervious, Inflow Depth > 3.86" for 100-YR event
Inflow = 3.59 cfs @ 12.09 hrs, Volume= 11,824 cf
Primary = 3.59 cfs @ 12.09 hrs, Volume= 11,824 cf, Atten= 0%, Lag= 0.0 min

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



GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 INCH = 30 FEET

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PREPARED FOR:

339 ELECTRIC AVE. CORPORATION
339 ELECTRIC AVENUE
LUNENBURG, MA 01462

DES'D BY: NMP | CHK'D BY: DEM

DATE: AUGUST 2015 (REVISED 9/15/15)

WATERSHED MAP EXISTING CONDITIONS

339 ELECTRIC AVE.
LUNENBURG, MA

PROJECT: 121072 | POST

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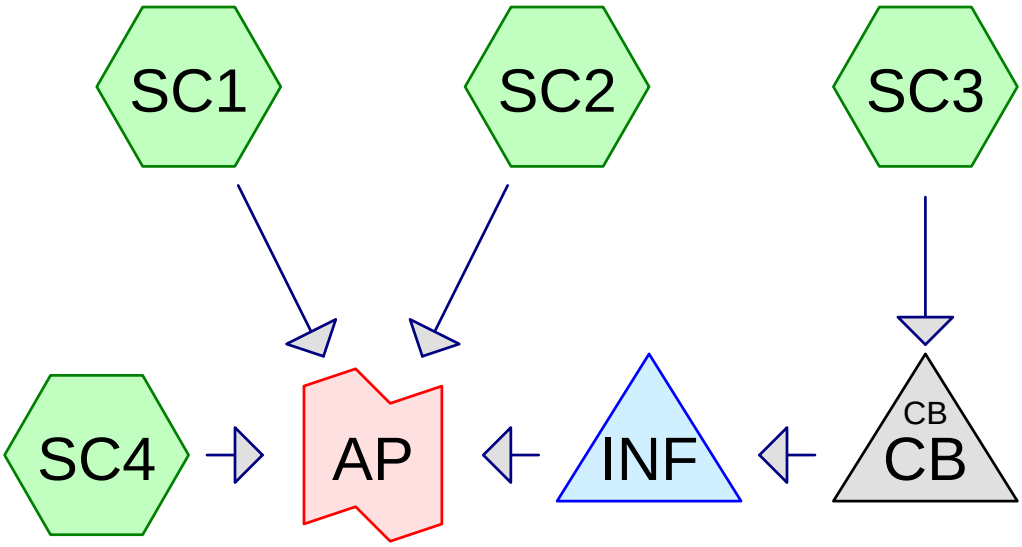

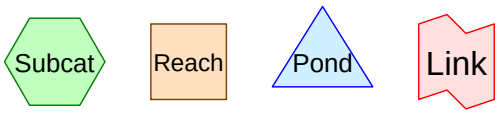

Routing Diagram for 091058 Post Rev 1
Prepared by Goldsmith, Prest & Ringwall, Inc.
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.419	61	>75% Grass cover, Good, HSG B (SC1, SC2, SC3, SC4)
0.022	48	Brush, Good, HSG B (SC1, SC2, SC4)
0.045	96	Gravel surface, HSG B (SC1, SC2)
0.190	98	Paved parking, HSG B (SC3, SC4)
0.168	98	Roofs, HSG B (SC1, SC2, SC3)
0.844	**78**	**TOTAL AREA**

Summary for Subcatchment SC1:

Runoff = 0.34 cfs @ 12.09 hrs, Volume= 1,071 cf, Depth> 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
4,857	98	Roofs, HSG B
483	96	Gravel surface, HSG B
6,132	61	>75% Grass cover, Good, HSG B
541	48	Brush, Good, HSG B
12,013	77	Weighted Average
7,156		59.57% Pervious Area
4,857		40.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	40	0.1667	2.59		**Sheet Flow, Roof** Smooth surfaces n= 0.011 P2= 3.00"
0.3	18	0.0207	1.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	205	0.0100	1.54	11.48	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=0.50' Z= 1.7 & 50.0 '/' Top.W=27.85' n= 0.040 Earth, cobble bottom, clean sides
2.8	263	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC2:

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 375 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
334	98	Roofs, HSG B
1,460	96	Gravel surface, HSG B
3,305	61	>75% Grass cover, Good, HSG B
155	48	Brush, Good, HSG B
5,254	73	Weighted Average
4,920		93.64% Pervious Area
334		6.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	23	0.0730	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.6	27	0.0100	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	31	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.6	81	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC3:

Runoff = 0.51 cfs @ 12.08 hrs, Volume= 1,594 cf, Depth> 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
2,136	98	Roofs, HSG B
5,686	98	Paved parking, HSG B
6,754	61	>75% Grass cover, Good, HSG B
14,576	81	Weighted Average
6,754		46.34% Pervious Area
7,822		53.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.3563	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	14	0.1414	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.4	26	0.0179	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	88	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	138	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC4:

Runoff = 0.16 cfs @ 12.08 hrs, Volume= 512 cf, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YR Rainfall=3.00"

Area (sf)	CN	Description
2,590	98	Paved parking, HSG B
2,046	61	>75% Grass cover, Good, HSG B
283	48	Brush, Good, HSG B
4,919	80	Weighted Average
2,329		47.35% Pervious Area
2,590		52.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	37	0.0889	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	13	0.0277	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.2	53	0.0466	4.38		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.1	103	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond CB:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 1.31" for 2-YR event
Inflow = 0.51 cfs @ 12.08 hrs, Volume= 1,594 cf
Outflow = 0.51 cfs @ 12.08 hrs, Volume= 1,594 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.51 cfs @ 12.08 hrs, Volume= 1,594 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 514.71' @ 12.08 hrs
Flood Elev= 517.63'

Device	Routing	Invert	Outlet Devices
#1	Primary	514.30'	**12.0" Round Culvert** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 514.30' / 514.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.50 cfs @ 12.08 hrs HW=514.70' TW=512.53' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 0.50 cfs @ 1.70 fps)

Summary for Pond INF:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 1.31" for 2-YR event
Inflow = 0.51 cfs @ 12.08 hrs, Volume= 1,594 cf
Outflow = 0.03 cfs @ 15.02 hrs, Volume= 1,162 cf, Atten= 95%, Lag= 176.5 min
Discarded = 0.03 cfs @ 15.02 hrs, Volume= 1,162 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 513.15' @ 15.02 hrs Surf.Area= 971 sf Storage= 832 cf
Flood Elev= 513.25' Surf.Area= 1,017 sf Storage= 929 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 199.2 min (1,040.6 - 841.4)

Volume	Invert	Avail.Storage	Storage Description
#1	512.00'	2,610 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
512.00	498	89.3	0	0	498
513.00	901	121.7	690	690	1,052
514.00	1,408	153.7	1,145	1,835	1,767
514.50	1,699	169.7	776	2,610	2,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	512.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 508.10'
#2	Primary	513.25'	**5.0' long x 9.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 Coef. (English) 2.48 2.55 2.70 2.69 2.68 2.69 2.67 2.64 2.64 2.64 2.64 2.64 2.64 2.65 2.65 2.66

Discarded OutFlow Max=0.03 cfs @ 15.02 hrs HW=513.15' (Free Discharge)
└**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=512.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP:

Inflow Area = 0.844 ac, 42.44% Impervious, Inflow Depth > 0.64" for 2-YR event
Inflow = 0.61 cfs @ 12.09 hrs, Volume= 1,958 cf
Primary = 0.61 cfs @ 12.09 hrs, Volume= 1,958 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment SC1:

Runoff = 0.71 cfs @ 12.08 hrs, Volume= 2,211 cf, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
4,857	98	Roofs, HSG B
483	96	Gravel surface, HSG B
6,132	61	>75% Grass cover, Good, HSG B
541	48	Brush, Good, HSG B
12,013	77	Weighted Average
7,156		59.57% Pervious Area
4,857		40.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	40	0.1667	2.59		**Sheet Flow, Roof** Smooth surfaces n= 0.011 P2= 3.00"
0.3	18	0.0207	1.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	205	0.0100	1.54	11.48	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=0.50' Z= 1.7 & 50.0 '/' Top.W=27.85' n= 0.040 Earth, cobble bottom, clean sides
2.8	263	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC2:

Runoff = 0.27 cfs @ 12.08 hrs, Volume= 829 cf, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
334	98	Roofs, HSG B
1,460	96	Gravel surface, HSG B
3,305	61	>75% Grass cover, Good, HSG B
155	48	Brush, Good, HSG B
5,254	73	Weighted Average
4,920		93.64% Pervious Area
334		6.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	23	0.0730	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.6	27	0.0100	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	31	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.6	81	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC3:

Runoff = 1.00 cfs @ 12.08 hrs, Volume= 3,093 cf, Depth> 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
2,136	98	Roofs, HSG B
5,686	98	Paved parking, HSG B
6,754	61	>75% Grass cover, Good, HSG B
14,576	81	Weighted Average
6,754		46.34% Pervious Area
7,822		53.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.3563	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	14	0.1414	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.4	26	0.0179	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	88	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	138	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC4:

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,008 cf, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
2,590	98	Paved parking, HSG B
2,046	61	>75% Grass cover, Good, HSG B
283	48	Brush, Good, HSG B
4,919	80	Weighted Average
2,329		47.35% Pervious Area
2,590		52.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	37	0.0889	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	13	0.0277	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.2	53	0.0466	4.38		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.1	103	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond CB:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 2.55" for 10-YR event
Inflow = 1.00 cfs @ 12.08 hrs, Volume= 3,093 cf
Outflow = 1.00 cfs @ 12.08 hrs, Volume= 3,093 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.00 cfs @ 12.08 hrs, Volume= 3,093 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 514.89' @ 12.08 hrs
Flood Elev= 517.63'

Device	Routing	Invert	Outlet Devices
#1	Primary	514.30'	**12.0" Round Culvert** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 514.30' / 514.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.97 cfs @ 12.08 hrs HW=514.88' TW=513.10' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.97 cfs @ 2.05 fps)

Summary for Pond INF:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 2.55" for 10-YR event
Inflow = 1.00 cfs @ 12.08 hrs, Volume= 3,093 cf
Outflow = 0.50 cfs @ 12.24 hrs, Volume= 2,429 cf, Atten= 50%, Lag= 10.0 min
Discarded = 0.03 cfs @ 12.24 hrs, Volume= 1,384 cf
Primary = 0.47 cfs @ 12.24 hrs, Volume= 1,045 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 513.36' @ 12.24 hrs Surf.Area= 1,072 sf Storage= 1,047 cf
Flood Elev= 513.25' Surf.Area= 1,017 sf Storage= 929 cf

Plug-Flow detention time= 175.1 min calculated for 2,429 cf (79% of inflow)
Center-of-Mass det. time= 94.6 min (916.9 - 822.2)

Volume	Invert	Avail.Storage	Storage Description
#1	512.00'	2,610 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
512.00	498	89.3	0	0	498
513.00	901	121.7	690	690	1,052
514.00	1,408	153.7	1,145	1,835	1,767
514.50	1,699	169.7	776	2,610	2,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	512.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 508.10'
#2	Primary	513.25'	**5.0' long x 9.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 Coef. (English) 2.48 2.55 2.70 2.69 2.68 2.69 2.67 2.64 2.64 2.64 2.64 2.64 2.64 2.65 2.65 2.66

Discarded OutFlow Max=0.03 cfs @ 12.24 hrs HW=513.36' (Free Discharge)
└**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.47 cfs @ 12.24 hrs HW=513.36' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.47 cfs @ 0.83 fps)

Summary for Link AP:

Inflow Area = 0.844 ac, 42.44% Impervious, Inflow Depth > 1.66" for 10-YR event
Inflow = 1.29 cfs @ 12.08 hrs, Volume= 5,094 cf
Primary = 1.29 cfs @ 12.08 hrs, Volume= 5,094 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Subcatchment SC1:

Runoff = 1.27 cfs @ 12.08 hrs, Volume= 3,921 cf, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
4,857	98	Roofs, HSG B
483	96	Gravel surface, HSG B
6,132	61	>75% Grass cover, Good, HSG B
541	48	Brush, Good, HSG B
12,013	77	Weighted Average
7,156		59.57% Pervious Area
4,857		40.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	40	0.1667	2.59		**Sheet Flow, Roof** Smooth surfaces n= 0.011 P2= 3.00"
0.3	18	0.0207	1.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	205	0.0100	1.54	11.48	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=0.50' Z= 1.7 & 50.0 '/' Top.W=27.85' n= 0.040 Earth, cobble bottom, clean sides
2.8	263	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC2:

Runoff = 0.50 cfs @ 12.08 hrs, Volume= 1,535 cf, Depth> 3.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
334	98	Roofs, HSG B
1,460	96	Gravel surface, HSG B
3,305	61	>75% Grass cover, Good, HSG B
155	48	Brush, Good, HSG B
5,254	73	Weighted Average
4,920		93.64% Pervious Area
334		6.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	23	0.0730	0.14		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.6	27	0.0100	0.78		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.3	31	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.6	81	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC3:

Runoff = 1.70 cfs @ 12.07 hrs, Volume= 5,271 cf, Depth> 4.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
2,136	98	Roofs, HSG B
5,686	98	Paved parking, HSG B
6,754	61	>75% Grass cover, Good, HSG B
14,576	81	Weighted Average
6,754		46.34% Pervious Area
7,822		53.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	10	0.3563	0.23		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
1.4	14	0.1414	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.4	26	0.0179	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	88	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	138	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SC4:

Runoff = 0.56 cfs @ 12.07 hrs, Volume= 1,735 cf, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YR Rainfall=6.50"

Area (sf)	CN	Description
2,590	98	Paved parking, HSG B
2,046	61	>75% Grass cover, Good, HSG B
283	48	Brush, Good, HSG B
4,919	80	Weighted Average
2,329		47.35% Pervious Area
2,590		52.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	37	0.0889	0.17		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.00"
0.2	13	0.0277	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.2	53	0.0466	4.38		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.1	103	Total, Increased to minimum Tc = 5.0 min			

Summary for Pond CB:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 4.34" for 100-YR event
Inflow = 1.70 cfs @ 12.07 hrs, Volume= 5,271 cf
Outflow = 1.70 cfs @ 12.07 hrs, Volume= 5,271 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.07 hrs, Volume= 5,271 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 515.13' @ 12.07 hrs
Flood Elev= 517.63'

Device	Routing	Invert	Outlet Devices
#1	Primary	514.30'	**12.0" Round Culvert** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 514.30' / 514.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.63 cfs @ 12.07 hrs HW=515.10' TW=513.48' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 1.63 cfs @ 2.41 fps)

Summary for Pond INF:

Inflow Area = 0.335 ac, 53.66% Impervious, Inflow Depth > 4.34" for 100-YR event
Inflow = 1.70 cfs @ 12.07 hrs, Volume= 5,271 cf
Outflow = 1.58 cfs @ 12.11 hrs, Volume= 4,446 cf, Atten= 7%, Lag= 2.2 min
Discarded = 0.03 cfs @ 12.11 hrs, Volume= 1,531 cf
Primary = 1.55 cfs @ 12.11 hrs, Volume= 2,914 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 513.50' @ 12.11 hrs Surf.Area= 1,140 sf Storage= 1,198 cf
Flood Elev= 513.25' Surf.Area= 1,017 sf Storage= 929 cf

Plug-Flow detention time= 109.4 min calculated for 4,446 cf (84% of inflow)
Center-of-Mass det. time= 43.7 min (850.8 - 807.1)

Volume	Invert	Avail.Storage	Storage Description
#1	512.00'	2,610 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
512.00	498	89.3	0	0	498
513.00	901	121.7	690	690	1,052
514.00	1,408	153.7	1,145	1,835	1,767
514.50	1,699	169.7	776	2,610	2,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	512.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 508.10'
#2	Primary	513.25'	**5.0' long x 9.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 Coef. (English) 2.48 2.55 2.70 2.69 2.68 2.69 2.67 2.64 2.64 2.64 2.64 2.64 2.64 2.65 2.65 2.66

Discarded OutFlow Max=0.03 cfs @ 12.11 hrs HW=513.49' (Free Discharge)
└**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=1.51 cfs @ 12.11 hrs HW=513.49' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.51 cfs @ 1.23 fps)

Summary for Link AP:

Inflow Area = 0.844 ac, 42.44% Impervious, Inflow Depth > 3.30" for 100-YR event
Inflow = 3.81 cfs @ 12.09 hrs, Volume= 10,105 cf
Primary = 3.81 cfs @ 12.09 hrs, Volume= 10,105 cf, Atten= 0%, Lag= 0.0 min

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

Stormwater Management Standard 3
GROUNDWATER RECHARGE

Pre-Development Conditions

339 Electric Ave.
Lunenburg, MA
Project No. 091058

		Area (sf)	Area (Ac)
Total Subcatchment Areas		36,762	0.8
Total Area of Hydrolic Soil Groups	B	36,762	0.8
Surface Type Areas			
Buildings	B	3,526	0.1
Paved, Gravel & Other Impervious Areas	B	12,378	0.3
Woods / Brush growth	B	20,858	0.5
Total Impervious Area	B	15,904	0.4

Infiltration Volume

Inches of Recharge per Storm Event	B	0.35

Infiltration Volume = ∑ {[(Total Subcatchment Area within HSG) - (Total Impervious Area within HSG)] x (inches of Recharge Per Storm)}

Infiltration Volume **608 CF**

Notes:
[1] per Protective Bylaw of the Town of Lunenburg, impervious surfaces include surfaces with a runoff coefficent greater than 90 (ie. gravel surfaces)

Stormwater Management Standard 3
GROUNDWATER RECHARGE

Post Development Conditions

339 Electric Ave.
Lunenburg, MA
Project No. 091058

		Area (sf)	Area (Ac)
Total Subcatchment Area (On-Site)		36,762	0.8
Total Area of Hydrolic Soil Groups	B	36,762	0.8
Surface Type Areas			
Buildings	B	7,327	0.2
Paved, Gravel & Other Impervious Areas	B	10,219	0.2
Grass / Landscape	B	19,216	0.4
Total Impervious Area	B	17,546	0.4

Infiltration Volume

Inches of Recharge per Storm Event B 0.35

Infiltration Volume = ∑ {[(Total Subcatchment Area within HSG) - (Total Impervious Area within HSG)] x (inches of Recharge Per Storm)}

Natural Infiltration Volume	560	CF
Pre-Development Infiltration Volume	608	CF
Required Iniltration Volume	**48**	**CF**

Provided Infiltration Volume

Infiltration basin	929	CF
Total Provided Iniltration Volume	**929**	**CF**

Notes:
[1] per Protective Bylaw of the Town of Lunenburg, impervious surfaces include surfaces with a runoff coefficent greater than 90 (ie. gravel surfaces)

Stormwater Management Standard 3
GROUNDWATER RECHARGE

Infiltration Area Requirements

339 Electric Ave.
Lunenburg, MA
Project No. 091058

Drawdown Time

(Per Massachusetts Stormwater regulations, infiltration areas must completely drain within 72 hours)

		Rain Garden
Infiltration Area Storage Volume	cf	929
Design infiltration Rate	in/hr	1.02
Infiltration Bottom Area	sf	498

Drawdown Time = Infiltration Area Storage Volume / [Design Infiltration Rate x Infiltration Area Bottom Area]

Drawdown Time (Hrs)	**21.9**

Mounding Analysis

Per the Massachusetts Stormwater Handbook, mounding analysis is required when ".. The vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm." The mounding analysis "... must show that the REQUIRED RECHARGE VOLUME is fully dewatered within 72 hours..."

Infiltration Basin

Hydraulic Conductivity	ft/day	16	Standard Value for "Fine Sand" material
Specific Yield		0.23	Standard Value for "Fine Sand" material
Initial Saturated Thickness	ft	15	Depth to bedrock
Design Recharge Rate	ft/day	2.04	infiltration rate
Time	days	3	Minimum 72 hr evaluation period
Bottom Infiltrating Area	sf	498	
Length of Infiltration Area	ft	33	
Width of Infiltration Area	ft	15.1	
Time when Infiltration Stops	days	0.91	Calculated Drawdown Time (see Above)

Maximum Water table rise at 72 hours[1]	**ft**	**0.12**
	in	**1 1/2**

- Resulting mound will not interfere with the full draining of the infiltration area in accordance with Mass Stormwater Standards -

[1] - mounding analysis calculated using the Hantush (1967) method. Automated calculator available online from the Aquifer Test Forum sponsored by HydroSOLVE, Inc.

Stormwater Management Standard 4
WATER QUALITY RETENTION VOLUME

339 Electric Ave.
Lunenburg, MA
Project No. 091058

Parameter	Unit	Quantity	Remarks
Watershed area	sf	36,762	
Predevelopment impervious area	sf	15,904	
Total impervious area added	sf	1,642	
Total impervious area	sf	17,546	
Total impervious area required for retention	sf	1,642	
Runoff depth over impervious area	IN	0.5	
REQUIRED WATER QUALITY RETENTION VOLUME			**VOLUME PROVIDED BY:**
	CF	**68**	
DESIGN VOLUME PROVIDED	**CF**	929	Infiltration basin

Stormwater Management Standard 4
TSS REMOVAL

339 Electric Ave.
Lunenburg, MA
Project No. 091058

BMP Type	TSS Removal Rate	TSS Remaining at Discharge	TSS Removed at Discharge
CB	25%	75%	25%
FB / INF BSN	80%	15%	**85%**

ABBREVIATIONS:
TSS=total suspended solids; SC=subcatchment; SS = Street Sweeping; GC=grassed channel; AP=analysis point; BMP=best management practices; TB = Tree Box Filter; BIO=bioretention area; CB=deep sump catch basin; FB = Sediment Forebay; INF BSN = Infiltration Basin