STORMWATER MANAGEMENT REPORT

371 BOSTON STREET

TOPSFIELD, MASSACHUSETTS

October 23, 2019

SUBMITTED TO:

TOWN OF TOPSFIELD
TOPSFIELD PLANNING BOARD
8 WEST COMMON STREET
TOPSFIELD, MA 01983

APPLICANT:

MAUREEN & RANDY SABINO
447 BOSTON STREET, SUITE 4
TOPSFIELD, MA 01983

PREPARED BY:

THE MORIN-CAMERON GROUP, INC.
66 ELM STREET
DANVERS, MA 01923

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STORMWATER MANAGEMENT REPORT

STORMWATER MANAGEMENT REPORT NARRATIVE
371 Boston Street

I. Executive Summary

Maureen and Randy Sabino, the project proponents, are proposing to re-develop their existing residential property located at 371 Boston Street with a mixed-use development. The mixed use will include a proposed market, retail space and residential dwelling units. The parcel is shown on Assessor's Map 26 as Lot 14 (See Figure 1: USGS Map) and is located within the IRA (Inner Residential & Agricultural), BHN (Business Highway North) Zoning Districts, and the Groundwater Protection Overlay District.

II. Existing Site Description

The existing site currently contains a two-family dwelling, detached garage with associated driveway and a storage building. A majority of the existing parcel is comprised of lawn area, with a small section of tree line/brush line surrounding an isolated wetland in the southwest of the property. The isolated wetland is non-jurisdictional under the Wetlands Protection Act, but is greater than 5,000 sf (9,710 sf±) and is therefore jurisdictional under the Topsfield General Wetlands Bylaw. An Order of Resource Area Delineation (ORAD) was issued by the Topsfield Conservation Commission on November 17, 2016 under file number TCC 2016-01.

The existing site slopes to the south towards the isolated wetland. A defined gutter line along Boston Street (Newburyport Turnpike - Route 1) keeps all runoff from the roadway from entering the site but a large off site watershed discharges runoff to the isolated wetland through the project site (See Figure 5: Offsite Subcatchment Map). The existing soils on site are mapped as Deerfield loamy fine sand (HSG A) and the presence of loamy sands was confirmed with in-situ soil testing. Soils contributing to the offsite watershed change as the grade increases and the HSG also transitions from HSG A to HSG B soils (See Figure 2: SCS Soils Map).

The subject parcel is not located within 200' of Mile Brook and is shown to be in a Zone X on the FEMA Federal Insurance Rate Maps (FIRM) #25009C0268F, dated July 3, 2012.

III. Proposed Site Description

The proposed re-development/development project includes construction of multiple structures, relocation of an existing structure, conversion of an existing structure, the construction of parking facilities and construction of underground utilities and general landscape improvements. The structures proposed to be newly constructed include a proposed building to be used as a market, an addition to the existing (converted) storage building, and a retail space building with dwelling units above. The existing two-family dwelling is proposed to be relocated from the front of the property to the northeast corner of the property and will continue to be used as a residential building. Suitable soils for a subsurface sewage disposal system were located on an adjacent parcel (owned by the client), and the existing parcel will be expanded to include the proposed 'Parcel A'. This parcel is composed of woods and will remain undisturbed with the exception of the area required for the leaching facility installation.

In order to accommodate the proposed development a new parking facility and stormwater management system is required to be constructed. All run-off associated with the proposed

pavement area as well as adjacent landscaping areas will be collected by two hydrodynamic separator units. One of these units will discharge into an infiltration basin while the other will discharge to a subsurface infiltration chamber system. Both the infiltration basin and subsurface chamber system will provide the required groundwater recharge volume and will control peak outflows with the aid of outlet control structures.

IV. Stormwater Management

The purpose of this analysis is to design an on-site drainage system which complies with the DEP's Stormwater Management Standards and the Town of Topsfield's Stormwater and Erosion Control Regulations.

The analysis was performed using U.S. Soil Conservation Service (S.C.S.) methods of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The model used for this calculation is referred to as HydroCAD. The HydroCAD analysis was performed by examined using the previously described Design Point.

A. Existing Watershed Characteristics

The design point and tributary watersheds are illustrated on Figure 3: Existing Subcatchment Plan and Figure 5: Offsite Subcatchment Plan, which are included herein. The table below lists the total area associated with each watershed contributing to the design point (existing wetland – DP1).

Summary of Existing Watersheds

Existing Drainage Area (ES)	Total Area (SF)	% Impervious	Composite Curve Number
1	296,709	12.0	53
2	60,667	7.5	41
Total	**657,376 (15.1 acres)**	**11.3**	**51**

Description of Existing Watersheds

The watershed analyzed in the existing condition can be described as follows:

- **Watershed ES1:** This area consists of the offsite areas that flow overland to DP 1.
- **Watershed ES2:** This area consists of onsite areas that flow overland to DP 1.

B. Proposed Watershed Characteristics

The same design point used in the pre-development condition of the site was used to evaluate the impact of the proposed project. To understand and analyze the proposed development, smaller watersheds were delineated to analyze stormwater impacts on a more detailed scale. The table below provides the total area of each watershed and the percentage that will be impervious in the post-development condition. The design points and the tributary watersheds are illustrated on Figure 4: Proposed Subcatchment Plan, which is included herein.

Summary of Proposed Watersheds

Proposed Drainage Area (PS)	Total Area (SF)	% Impervious Number	Composite Curve
1	296,709	12.0	53
2	30,016	0	37
3	13,881	66.5	78
4	10,629	73.7	82
5	3,889	100	98
6	2,252	100	98
Total	**657,376 (15.1 acres)**	**16.5**	**54**

Description of Proposed Watersheds

- **Watershed PS1:** This area consists of the offsite areas that flow overland to DP 1.
- **Watershed PS2:** This area consists of onsite areas that flow overland directly to DP 1.
- **Watershed PS3:** This area consists of the portion of the driveway and landscaped area that is collected, treated and discharged to the infiltration basin.
- **Watershed PS4:** This area consists of the portion of the driveway and landscaped area that is collected, treated and discharged to the subsurface chamber system.
- **Watershed PS5:** This area consists of the roof areas that are directed to the infiltration basin.
- **Watershed PS6:** This area consists of the roof areas that are directed to the subsurface chamber system.

C. Stormwater Best Management Practices

- **Infiltration Basin:** Roof, driveway and landscaped area will be directed to an infiltration basin located in the eastern portion of the property. Pretreatment for driveway and landscaped areas is provided by a hydrodynamic separator. The basin provides groundwater recharge and excess runoff discharges through an outlet control structure to a level spreader and ultimately Design Point 1.
- **Subsurface Infiltration System:** Roof, driveway and landscaped area will be directed to a subsurface infiltration chamber system located in the southern portion of the property. Pretreatment for driveway and landscaped areas is provided by a hydrodynamic separator. The system groundwater recharge and excess runoff discharges through an outlet control structure to a level spreader and ultimately Design Point 1.

D. Hydrologic Analysis

A HydroCAD model was used to analyze the storm drainage system designed for the development to demonstrate that the drainage system follows the Town's Stormwater and Erosion Control Regulations and MA DEP Stormwater Management Standards.

The HydroCAD analysis was performed by examining the two design points that were discussed above. The rainfall data used in the analysis was taken from the NOAA Atlas 14. The following is a summary of the peak rates and volumes of stormwater runoff for the pre-and post-development conditions. Four (4) storm intensities were evaluated. These storm "events" included the 2, 10, 25 and 100-year rainfall events. By examining the table below you will note that the peak flow rates for the 2, 10, 25 and 100-year storms.

Design Point	Storm Event (Years)	Existing Conditions (Peak CFS)	Proposed Conditions (Peak CFS)	Change in Peak (CFS)
DP-1	2	1.3	1.2	-0.1
	10	5.6	5.6	0
	25	10.3	10.8	0.5
	100	22.3	24.9	2.6

V. Erosion and Sedimentation Control

A proposed mulch sock and silt fence combination shall be placed along the lot line along the disturbed downstream areas (see proposed plan for location) prior to the commencement of any clearing, grubbing, earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Operations and Maintenance Plans for the construction phase and long term operation of the site have been included in this report.

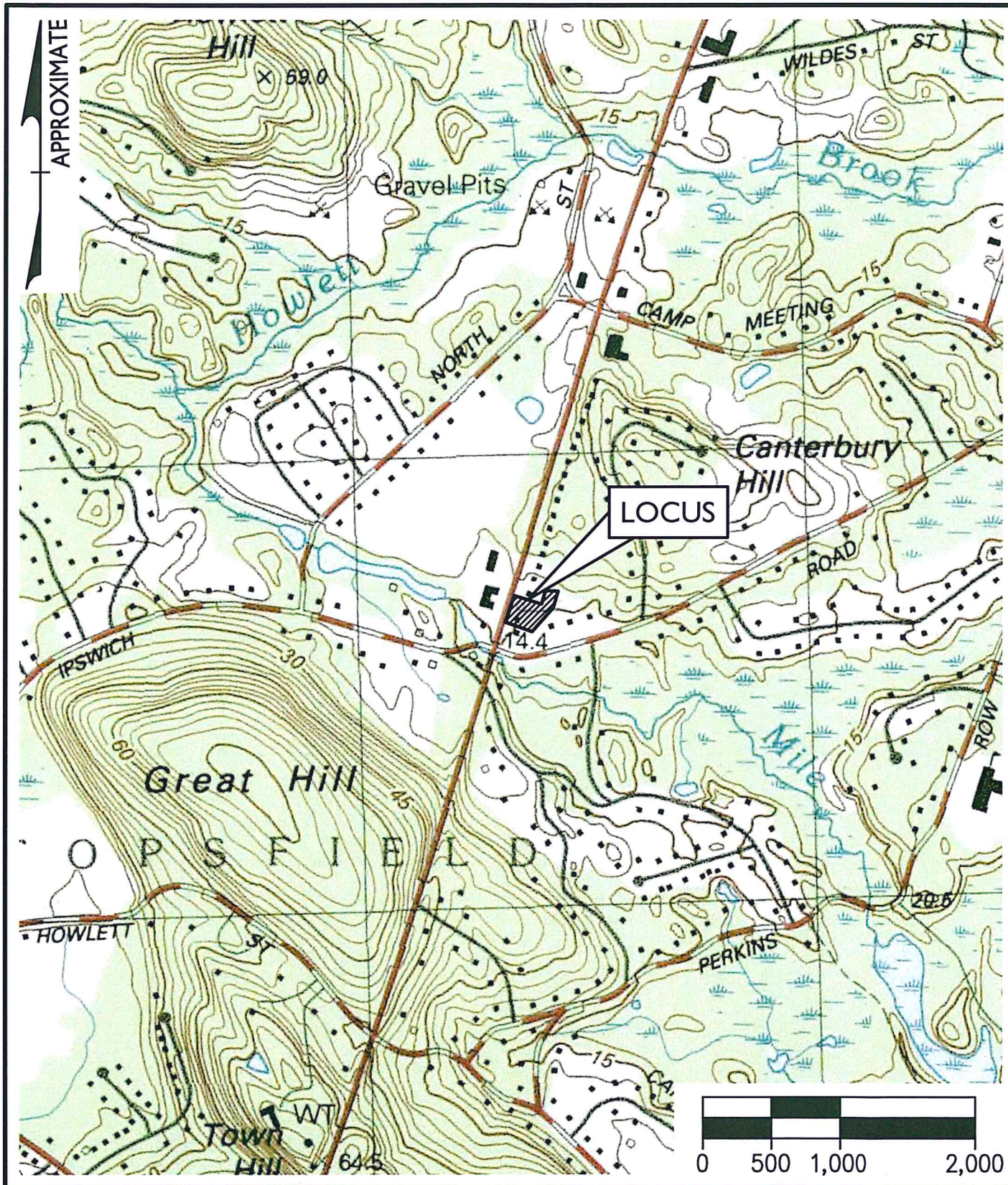
VI. Summary of Stormwater Standards

- ***Standard 1: No New Untreated Discharges: Meets Standard***
  All discharges from new impervious areas within the limit of work will be treated prior to discharge.
- ***Standard 2: Peak Rate Attenuation: Meets Standard***
  The project will maintain or reduce the pre-development rates of runoff post-development for the 2-year and 10-year storm events. The 25 and 100-year storm events were evaluated and determined to have no negative impacts for flooding or erosion. When the existing isolated wetland overtops, it flows overland across 130 Ipswich Road (owned by the applicant) before ultimately discharging to the municipal stormwater system.
- ***Standard 3: Recharge: Meets Standard***
  The infiltration basin and subsurface chamber infiltration system provide the required recharge volume.
- ***Standard 4: Water Quality: Meets Standard***
  The project will utilize treatment trains involving hydrodynamic separators prior to infiltration and groundwater recharge. The treatment trains will provide 80% TSS removal in accordance with the Massachusetts Stormwater Handbook.
- ***Standard 5: LUHPPL's: Does not apply to this project***
- ***Standard 6: Critical Areas: Meets Standard***
  The project is located within a Zone II wellhead protection area. The treatment train will provide TSS removal of at least 44% pretreatment and 80% total treatment using BMPs designed in accordance with the Stormwater Handbook for all proposed impervious surfaces.
- ***Standard 7: Redevelopment Projects: Does not apply to this project***
- ***Standard 8: Construction Phase O&M: Meets Standard***

The submittal includes a Construction Phase Operation and Maintenance Plan for the construction phase of the project.

- ***Standard 9: Long Term O&M: Meets Standard***
  The submittal includes a Long Term Operation and Maintenance Plan for the site.
- ***Standard 10: Illicit Discharges: Meets Standard***
  The project will not result in any illicit discharges. An Illicit Discharge Statement is contained within.

FIGURES



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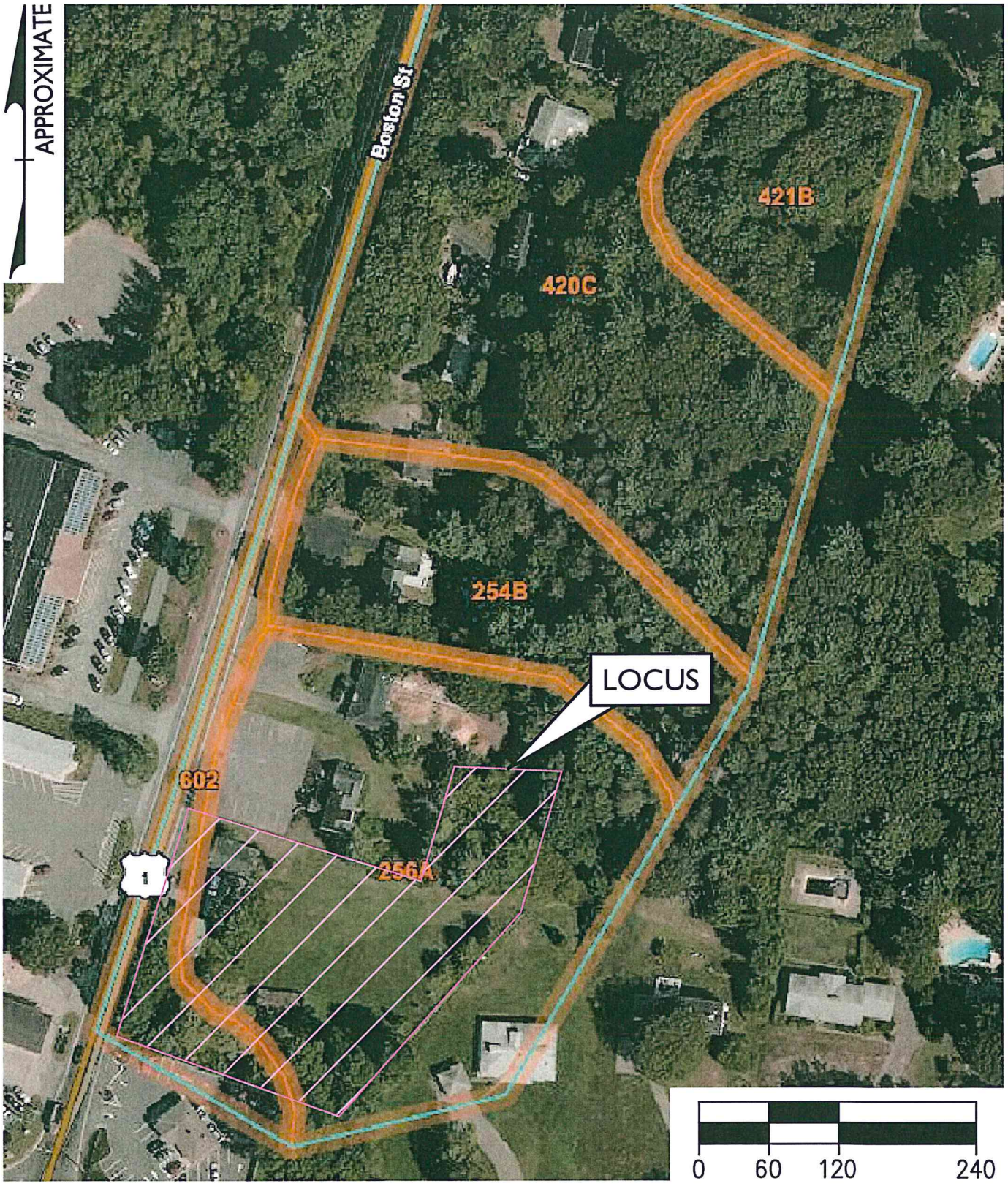
USGS MAP
371 BOSTON STREET
IN
TOPSFIELD, MA

DATE: OCTOBER 23, 2019 | SCALE: 1" = 1,000'

FIGURE #1



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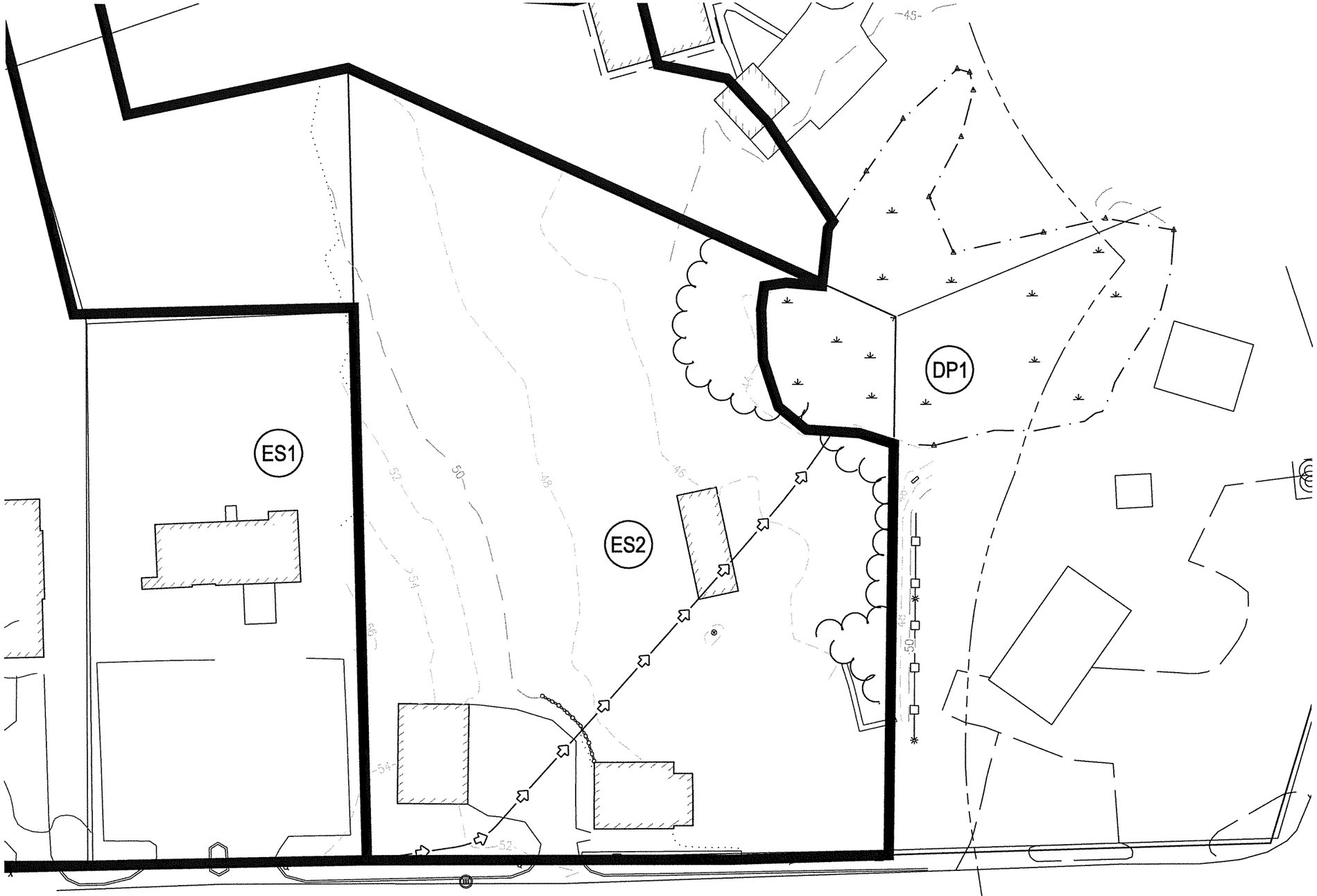
SCS SOILS MAP
371 BOSTON STREET
IN
TOPSFIELD, MA

DATE: OCTOBER 23, 2019 | SCALE: 1" = 120'

FIGURE #2

NOTE:
SEE FIGURE 5
FOR OFF-SITE
DRAINAGE AREA



PLAN
SCALE: 1" = 40'
0 20 40 80

NEWBURYPORT TURNPIKE
(ROUTE 1 - BOSTON STREET)

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FIGURE 3

DATE: OCTOBER 23, 2019
SCALE: 1" = 40'

EXISTING SUBCATCHMENT PLAN
371 BOSTON STREET
(ASSESSOR'S MAP 26, LOT 14)
TOPSFIELD, MASSACHUSETTS
PREPARED FOR:
MAUREEN & RANDY SABINO

PROJ. #2669

NOTE:
SEE FIGURE 5
FOR OFF-SITE
DRAINAGE AREA

PLAN
SCALE: 1" = 40'
0 20 40 80

NEWBURYPORT TURNPIKE
(ROUTE 1 - BOSTON STREET)

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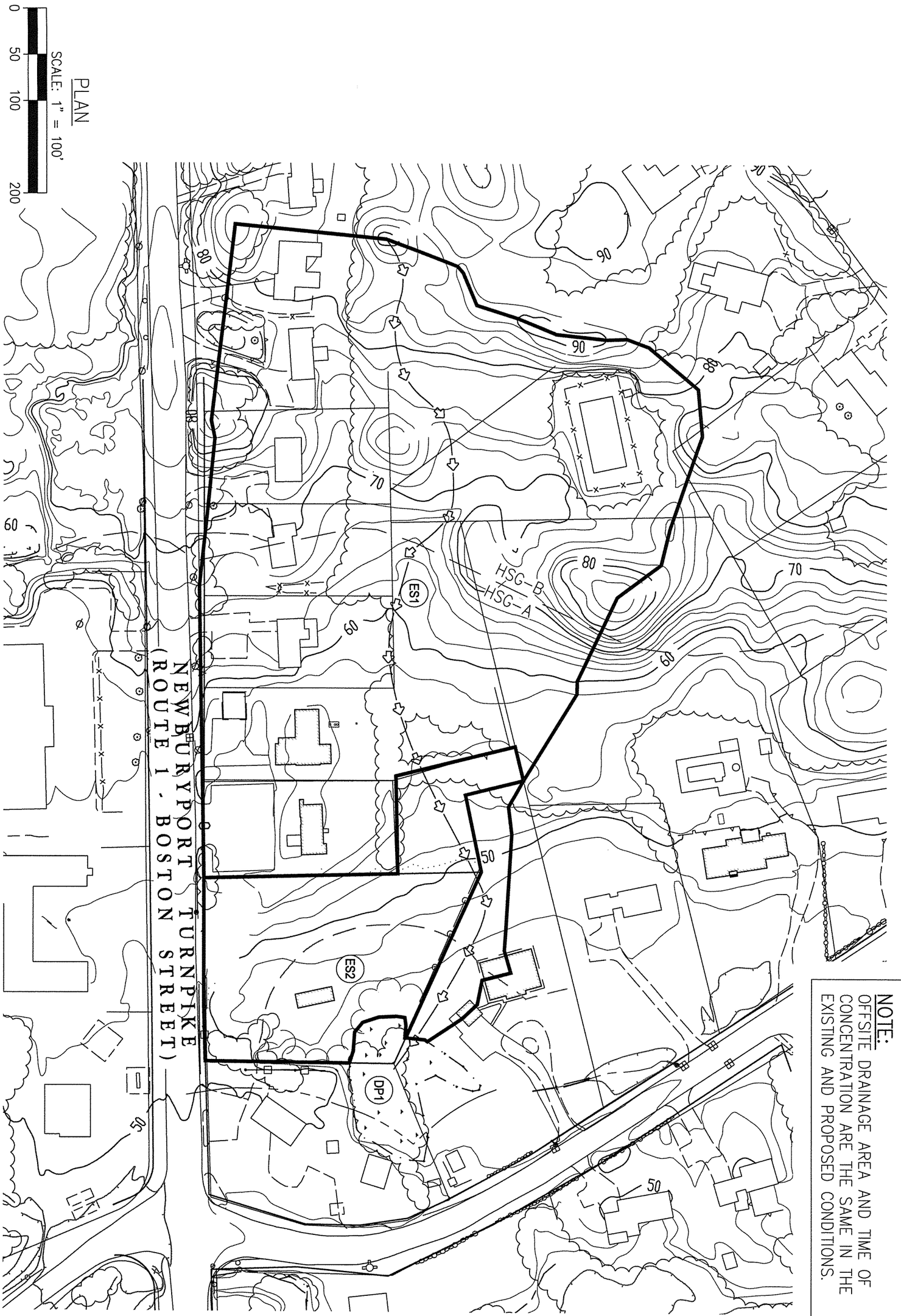
FIGURE 4

DATE: OCTOBER 23, 2019
SCALE: 1" = 40'

PROPOSED SUBCATCHMENT PLAN
371 BOSTON STREET
(ASSESSOR'S MAP 26, LOT 14)
TOPSFIELD, MASSACHUSETTS
PREPARED FOR:
MAUREEN & RANDY SABINO

PROJ. #2669



NOTE:
OFFSITE DRAINAGE AREA AND TIME OF CONCENTRATION ARE THE SAME IN THE EXISTING AND PROPOSED CONDITIONS.

OFFSITE SUBCATCHMENT PLAN

371 BOSTON STREET
(ASSESSOR'S MAP 26, LOT 14)
TOPSFIELD, MASSACHUSETTS
PREPARED FOR:
MAUREEN & RANDY SABINO

FIGURE 5

DATE: OCTOBER 23, 2019
SCALE: 1" = 40'

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APPENDIX A:

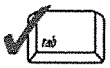
MASS DEP STORMWATER MANAGEMENT REPORT CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

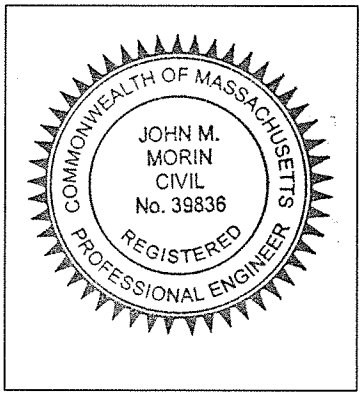
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



John Morin 10/23/19
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): Hydrodynamic Separator, Surface & Subsurface Infiltration System

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 (MAXIMUM EXTENT PRACTICABLE)

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) (NOT APPLICABLE)

☐ 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 (NOT APPLICABLE)

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

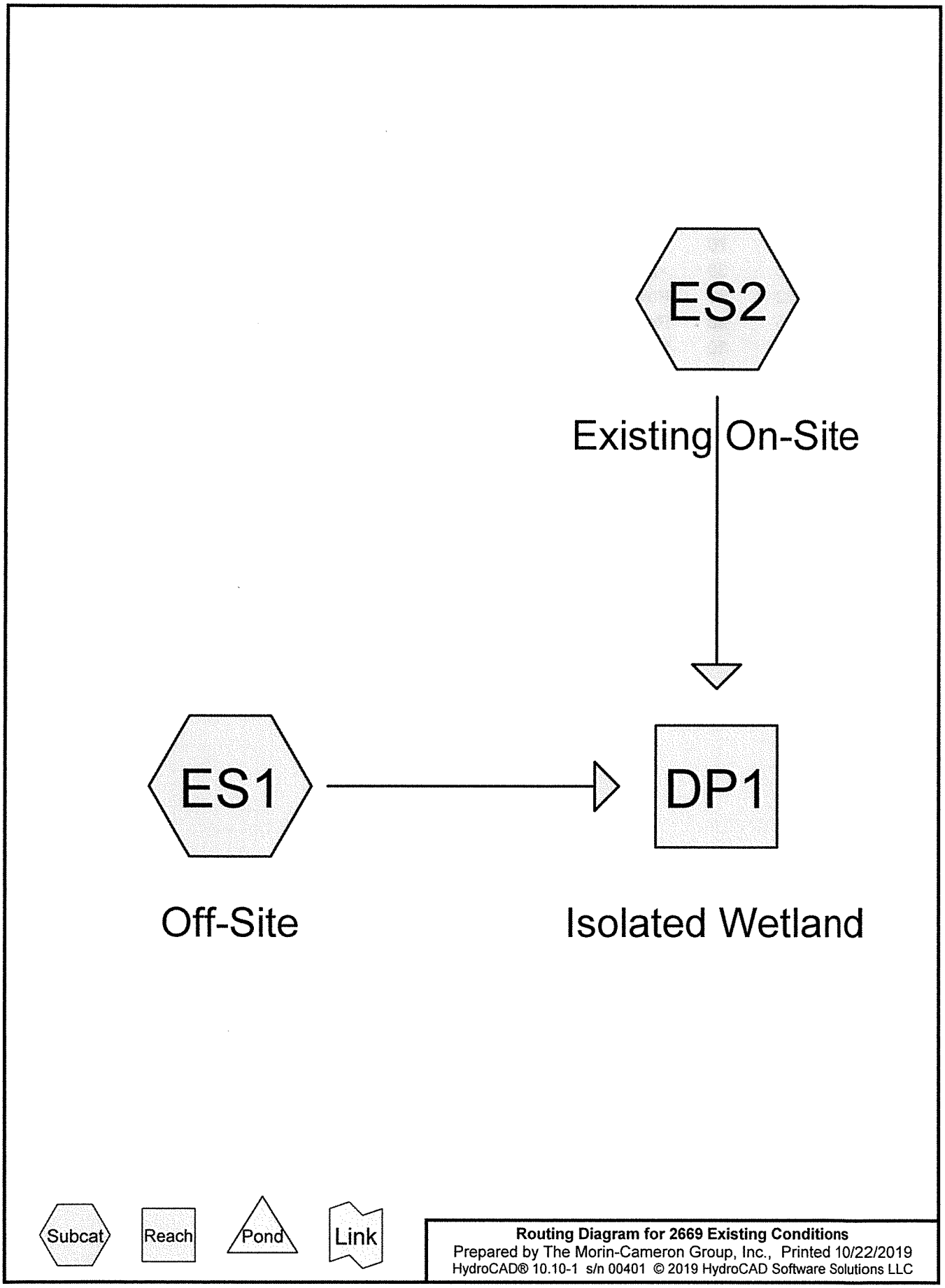
☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B:

EXISTING CONDITIONS

HYDROLOGIC ANALYSIS



Routing Diagram for 2669 Existing Conditions
Prepared by The Morin-Cameron Group, Inc., Printed 10/22/2019

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
86,417	54	1/2 acre lots, 25% imp, HSG A (ES1)
56,305	70	1/2 acre lots, 25% imp, HSG B (ES1)
42,900	39	>75% Grass cover, Good, HSG A (ES2)
1,962	98	Paved parking, HSG A (ES2)
2,555	98	Roofs, HSG A (ES2)
68,009	30	Woods, Good, HSG A (ES1, ES2)
99,228	55	Woods, Good, HSG B (ES1)
357,376	**51**	**TOTAL AREA**

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

Subcatchment ES1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=0.31"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=1.1 cfs 7,570 cf

Subcatchment ES2: Existing On-Site Runoff Area=60,667 sf 7.45% Impervious Runoff Depth=0.22"
Flow Length=250' Tc=6.0 min CN=WQ Runoff=0.3 cfs 1,118 cf

Reach DP1: Isolated Wetland Inflow=1.3 cfs 8,688 cf
Outflow=1.3 cfs 8,688 cf

Total Runoff Area = 357,376 sf Runoff Volume = 8,688 cf Average Runoff Depth = 0.29"
88.75% Pervious = 317,179 sf 11.25% Impervious = 40,198 sf

Summary for Subcatchment ES1: Off-Site

Runoff = 1.1 cfs @ 12.19 hrs, Volume= 7,570 cf, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment ES2: Existing On-Site

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 1,118 cf, Depth= 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	1,962	98	Paved parking, HSG A
	2,555	98	Roofs, HSG A
	13,250	30	Woods, Good, HSG A
*	42,900	39	>75% Grass cover, Good, HSG A
	60,667		Weighted Average
	56,150		92.55% Pervious Area
	4,517		7.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
0.3	50	0.0200	2.87		**Shallow Concentrated Flow, Shallow Concentrated** Paved Kv= 20.3 fps
0.8	150	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Direct Entry**
6.0	250	Total			

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 11.25% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 1.3 cfs @ 12.18 hrs, Volume= 8,688 cf
Outflow = 1.3 cfs @ 12.18 hrs, Volume= 8,688 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, 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-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ES1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=0.93"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=5.3 cfs 22,975 cf

Subcatchment ES2: Existing On-Site Runoff Area=60,667 sf 7.45% Impervious Runoff Depth=0.47"
Flow Length=250' Tc=6.0 min CN=WQ Runoff=0.5 cfs 2,381 cf

Reach DP1: Isolated Wetland Inflow=5.6 cfs 25,356 cf
Outflow=5.6 cfs 25,356 cf

Total Runoff Area = 357,376 sf Runoff Volume = 25,356 cf Average Runoff Depth = 0.85"
88.75% Pervious = 317,179 sf 11.25% Impervious = 40,198 sf

Summary for Subcatchment ES1: Off-Site

Runoff = 5.3 cfs @ 12.18 hrs, Volume= 22,975 cf, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment ES2: Existing On-Site

Runoff = 0.5 cfs @ 12.13 hrs, Volume= 2,381 cf, Depth= 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	1,962	98	Paved parking, HSG A
	2,555	98	Roofs, HSG A
	13,250	30	Woods, Good, HSG A
*	42,900	39	>75% Grass cover, Good, HSG A
	60,667		Weighted Average
	56,150		92.55% Pervious Area
	4,517		7.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
0.3	50	0.0200	2.87		**Shallow Concentrated Flow, Shallow Concentrated** Paved Kv= 20.3 fps
0.8	150	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Direct Entry**
6.0	250	Total			

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 11.25% Impervious, Inflow Depth = 0.85" for 10-Year event
Inflow = 5.6 cfs @ 12.18 hrs, Volume= 25,356 cf
Outflow = 5.6 cfs @ 12.18 hrs, Volume= 25,356 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, 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-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ES1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=1.58"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=9.7 cfs 39,174 cf

Subcatchment ES2: Existing On-Site Runoff Area=60,667 sf 7.45% Impervious Runoff Depth=0.82"
Flow Length=250' Tc=6.0 min CN=WQ Runoff=0.7 cfs 4,167 cf

Reach DP1: Isolated Wetland Inflow=10.3 cfs 43,341 cf
Outflow=10.3 cfs 43,341 cf

Total Runoff Area = 357,376 sf Runoff Volume = 43,341 cf Average Runoff Depth = 1.46"
88.75% Pervious = 317,179 sf 11.25% Impervious = 40,198 sf

Summary for Subcatchment ES1: Off-Site

Runoff = 9.7 cfs @ 12.18 hrs, Volume= 39,174 cf, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment ES2: Existing On-Site

Runoff = 0.7 cfs @ 12.14 hrs, Volume= 4,167 cf, Depth= 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

	Area (sf)	CN	Description
	1,962	98	Paved parking, HSG A
	2,555	98	Roofs, HSG A
	13,250	30	Woods, Good, HSG A
*	42,900	39	>75% Grass cover, Good, HSG A
	60,667		Weighted Average
	56,150		92.55% Pervious Area
	4,517		7.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
0.3	50	0.0200	2.87		**Shallow Concentrated Flow, Shallow Concentrated** Paved Kv= 20.3 fps
0.8	150	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Direct Entry**
6.0	250	Total			

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 11.25% Impervious, Inflow Depth = 1.46" for 25-Year event
Inflow = 10.3 cfs @ 12.18 hrs, Volume= 43,341 cf
Outflow = 10.3 cfs @ 12.18 hrs, Volume= 43,341 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, 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-Q
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ES1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=3.26"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=20.4 cfs 80,717 cf

Subcatchment ES2: Existing On-Site Runoff Area=60,667 sf 7.45% Impervious Runoff Depth=1.92"
Flow Length=250' Tc=6.0 min CN=WQ Runoff=2.3 cfs 9,705 cf

Reach DP1: Isolated Wetland Inflow=22.3 cfs 90,422 cf
Outflow=22.3 cfs 90,422 cf

Total Runoff Area = 357,376 sf Runoff Volume = 90,422 cf Average Runoff Depth = 3.04"
88.75% Pervious = 317,179 sf 11.25% Impervious = 40,198 sf

Summary for Subcatchment ES1: Off-Site

Runoff = 20.4 cfs @ 12.18 hrs, Volume= 80,717 cf, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment ES2: Existing On-Site

Runoff = 2.3 cfs @ 12.14 hrs, Volume= 9,705 cf, Depth= 1.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

	Area (sf)	CN	Description
	1,962	98	Paved parking, HSG A
	2,555	98	Roofs, HSG A
	13,250	30	Woods, Good, HSG A
*	42,900	39	>75% Grass cover, Good, HSG A
	60,667		Weighted Average
	56,150		92.55% Pervious Area
	4,517		7.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.20"
0.3	50	0.0200	2.87		**Shallow Concentrated Flow, Shallow Concentrated** Paved Kv= 20.3 fps
0.8	150	0.0400	3.22		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Direct Entry**
6.0	250	Total			

Summary for Reach DP1: Isolated Wetland

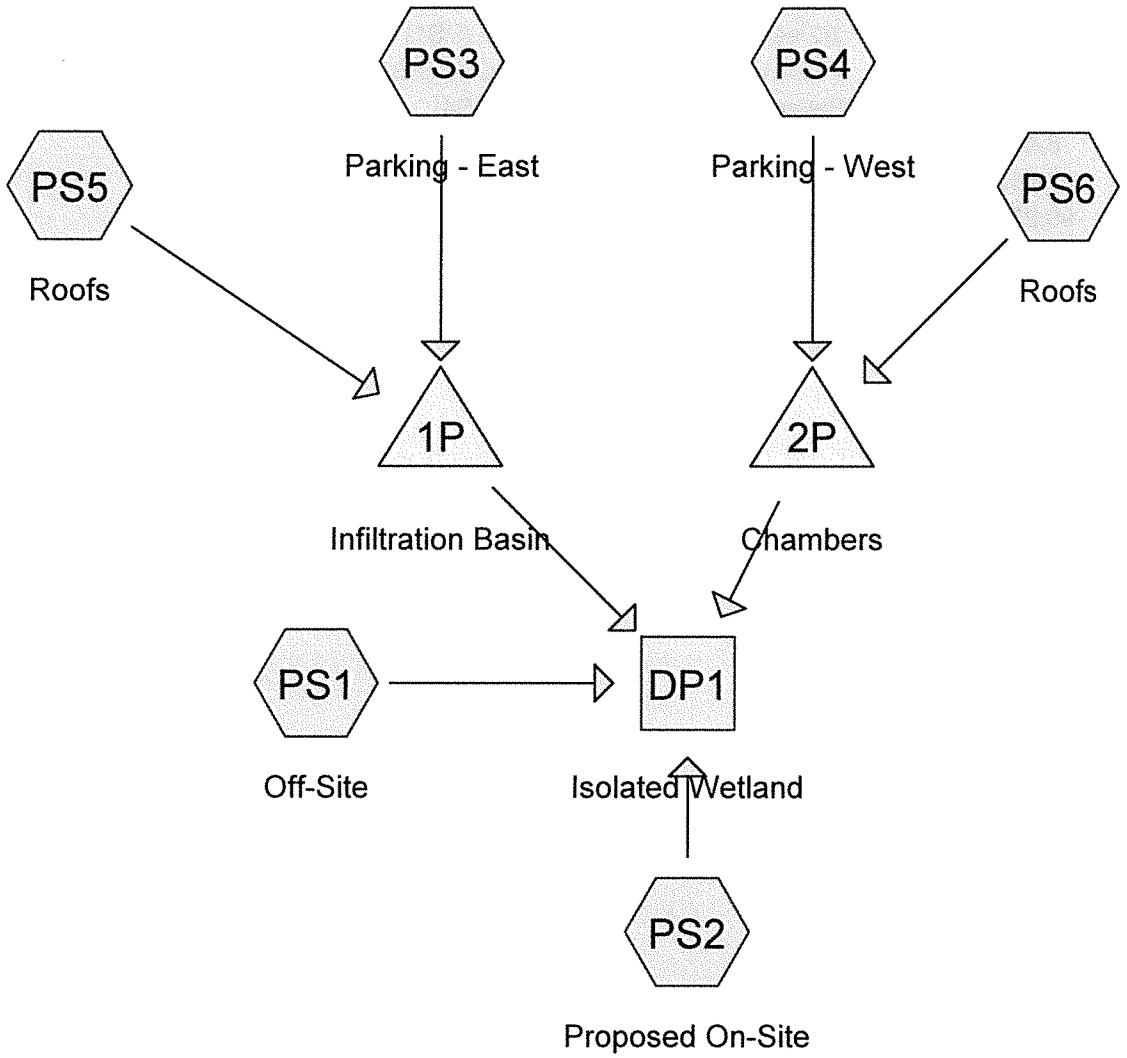
Inflow Area = 357,376 sf, 11.25% Impervious, Inflow Depth = 3.04" for 100-Year event
Inflow = 22.3 cfs @ 12.17 hrs, Volume= 90,422 cf
Outflow = 22.3 cfs @ 12.17 hrs, Volume= 90,422 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

APPENDIX C:

PROPOSED CONDITIONS

HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 2669 Proposed Conditions
Prepared by The Morin-Cameron Group, Inc., Printed 10/22/2019

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
86,417	54	1/2 acre lots, 25% imp, HSG A (PS1)
56,305	70	1/2 acre lots, 25% imp, HSG B (PS1)
29,699	39	>75% Grass cover, Good, HSG A (PS2, PS3, PS4)
17,074	98	Paved parking, HSG A (PS3, PS4)
6,141	98	Roofs, HSG A (PS5, PS6)
62,512	30	Woods, Good, HSG A (PS1, PS2, PS4)
99,228	55	Woods, Good, HSG B (PS1)
357,376	**54**	**TOTAL AREA**

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

Subcatchment PS1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=0.31"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=1.1 cfs 7,570 cf

Subcatchment PS2: Proposed On-Site Runoff Area=30,016 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=WQ Runoff=0.0 cfs 1 cf

Subcatchment PS3: Parking - East Runoff Area=13,881 sf 66.54% Impervious Runoff Depth=1.97"
Tc=6.0 min CN=WQ Runoff=0.6 cfs 2,284 cf

Subcatchment PS4: Parking - West Runoff Area=10,629 sf 73.74% Impervious Runoff Depth=2.19"
Tc=6.0 min CN=WQ Runoff=0.5 cfs 1,938 cf

Subcatchment PS5: Roofs Runoff Area=3,889 sf 100.00% Impervious Runoff Depth=2.97"
Tc=6.0 min CN=98 Runoff=0.3 cfs 962 cf

Subcatchment PS6: Roofs Runoff Area=2,252 sf 100.00% Impervious Runoff Depth=2.97"
Tc=6.0 min CN=98 Runoff=0.1 cfs 557 cf

Reach DP1: Isolated Wetland Inflow=1.2 cfs 8,185 cf
Outflow=1.2 cfs 8,185 cf

Pond 1P: Infiltration Basin Peak Elev=46.85' Storage=937 cf Inflow=0.9 cfs 3,246 cf
Discarded=0.1 cfs 2,862 cf Primary=0.1 cfs 384 cf Outflow=0.1 cfs 3,246 cf

Pond 2P: Chambers Peak Elev=47.19' Storage=677 cf Inflow=0.7 cfs 2,495 cf
Discarded=0.1 cfs 2,265 cf Primary=0.0 cfs 230 cf Outflow=0.1 cfs 2,495 cf

Total Runoff Area = 357,376 sf Runoff Volume = 13,312 cf Average Runoff Depth = 0.45"
83.52% Pervious = 298,481 sf 16.48% Impervious = 58,896 sf

Summary for Subcatchment PS1: Off-Site

Runoff = 1.1 cfs @ 12.19 hrs, Volume= 7,570 cf, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment PS2: Proposed On-Site

Runoff = 0.0 cfs @ 24.02 hrs, Volume= 1 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
	7,650	30	Woods, Good, HSG A
*	22,366	39	>75% Grass cover, Good, HSG A
	30,016		Weighted Average
	30,016		100.00% Pervious Area

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

Summary for Subcatchment PS3: Parking - East

Runoff = 0.6 cfs @ 12.13 hrs, Volume= 2,284 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

Area (sf)	CN	Description
9,236	98	Paved parking, HSG A
4,645	39	>75% Grass cover, Good, HSG A
13,881		Weighted Average
4,645		33.46% Pervious Area
9,236		66.54% Impervious Area

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

Summary for Subcatchment PS4: Parking - West

Runoff = 0.5 cfs @ 12.13 hrs, Volume= 1,938 cf, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

Area (sf)	CN	Description
7,838	98	Paved parking, HSG A
2,688	39	>75% Grass cover, Good, HSG A
103	30	Woods, Good, HSG A
10,629		Weighted Average
2,791		26.26% Pervious Area
7,838		73.74% Impervious Area

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

Summary for Subcatchment PS5: Roofs

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 962 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	3,889	98	Roofs, HSG A
	3,889		100.00% Impervious Area

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

Summary for Subcatchment PS6: Roofs

Runoff = 0.1 cfs @ 12.13 hrs, Volume= 557 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 2-Year Rainfall=3.20"

	Area (sf)	CN	Description
*	2,252	98	Roofs, HSG A
	2,252		100.00% Impervious Area

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

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 16.48% Impervious, Inflow Depth = 0.27" for 2-Year event
Inflow = 1.2 cfs @ 12.20 hrs, Volume= 8,185 cf
Outflow = 1.2 cfs @ 12.20 hrs, Volume= 8,185 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 17,770 sf, 73.86% Impervious, Inflow Depth = 2.19" for 2-Year event
Inflow = 0.9 cfs @ 12.13 hrs, Volume= 3,246 cf
Outflow = 0.1 cfs @ 12.57 hrs, Volume= 3,246 cf, Atten= 84%, Lag= 26.7 min
Discarded = 0.1 cfs @ 12.57 hrs, Volume= 2,862 cf
Primary = 0.1 cfs @ 12.57 hrs, Volume= 384 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 46.85' @ 12.57 hrs Surf.Area= 1,328 sf Storage= 937 cf

Plug-Flow detention time= 69.6 min calculated for 3,245 cf (100% of inflow)
Center-of-Mass det. time= 69.6 min (830.1 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	2,835 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	885	0	0	885
47.00	1,413	1,139	1,139	1,426
48.00	1,997	1,697	2,835	2,028

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	47.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	46.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 3	46.80'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 3	47.20'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.57 hrs HW=46.85' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.1 cfs @ 12.57 hrs HW=46.85' (Free Discharge)
├─**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└─**3=Culvert** (Passes 0.1 cfs of 1.8 cfs potential flow)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.50 fps)
  ├─**5=Orifice/Grate** (Orifice Controls 0.0 cfs @ 0.78 fps)
  └─**6=Orifice/Grate** (Controls 0.0 cfs)

Summary for Pond 2P: Chambers

Inflow Area =	12,881 sf,	78.33% Impervious,	Inflow Depth =	2.32" for 2-Year event
Inflow =	0.7 cfs @	12.13 hrs, Volume=	2,495 cf	
Outflow =	0.1 cfs @	12.57 hrs, Volume=	2,495 cf,	Atten= 84%, Lag= 26.8 min
Discarded =	0.1 cfs @	12.57 hrs, Volume=	2,265 cf	
Primary =	0.0 cfs @	12.57 hrs, Volume=	230 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 47.19' @ 12.57 hrs Surf.Area= 868 sf Storage= 677 cf

Plug-Flow detention time= 62.5 min calculated for 2,495 cf (100% of inflow)
Center-of-Mass det. time= 62.5 min (822.9 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.00'	691 cf	**28.00'W x 31.00'L x 3.21'H Field A** 2,785 cf Overall - 1,056 cf Embedded = 1,728 cf x 40.0% Voids
#2A	46.50'	1,056 cf	**Cultec R-280HD** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		1,748 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	46.90'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	47.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	48.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	48.60'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.57 hrs HW=47.19' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 12.57 hrs HW=47.19' (Free Discharge)
└─**2=Culvert** (Passes 0.0 cfs of 2.5 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.0 cfs @ 2.19 fps)
  ├─**4=Orifice/Grate** (Controls 0.0 cfs)
  ├─**5=Orifice/Grate** (Controls 0.0 cfs)
  └─**6=Orifice/Grate** (Controls 0.0 cfs)

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

Subcatchment PS1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=0.93"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=5.3 cfs 22,975 cf

Subcatchment PS2: Proposed On-Site Runoff Area=30,016 sf 0.00% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=WQ Runoff=0.0 cfs 330 cf

Subcatchment PS3: Parking - East Runoff Area=13,881 sf 66.54% Impervious Runoff Depth=3.15"
Tc=6.0 min CN=WQ Runoff=0.9 cfs 3,642 cf

Subcatchment PS4: Parking - West Runoff Area=10,629 sf 73.74% Impervious Runoff Depth=3.47"
Tc=6.0 min CN=WQ Runoff=0.8 cfs 3,072 cf

Subcatchment PS5: Roofs Runoff Area=3,889 sf 100.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=98 Runoff=0.4 cfs 1,505 cf

Subcatchment PS6: Roofs Runoff Area=2,252 sf 100.00% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=98 Runoff=0.2 cfs 871 cf

Reach DP1: Isolated Wetland Inflow=5.6 cfs 25,523 cf
Outflow=5.6 cfs 25,523 cf

Pond 1P: Infiltration Basin Peak Elev=47.22' Storage=1,468 cf Inflow=1.3 cfs 5,147 cf
Discarded=0.1 cfs 3,836 cf Primary=0.3 cfs 1,311 cf Outflow=0.3 cfs 5,147 cf

Pond 2P: Chambers Peak Elev=47.82' Storage=1,107 cf Inflow=1.0 cfs 3,944 cf
Discarded=0.1 cfs 3,038 cf Primary=0.1 cfs 906 cf Outflow=0.2 cfs 3,944 cf

Total Runoff Area = 357,376 sf Runoff Volume = 32,396 cf Average Runoff Depth = 1.09"
83.52% Pervious = 298,481 sf 16.48% Impervious = 58,896 sf

Summary for Subcatchment PS1: Off-Site

Runoff = 5.3 cfs @ 12.18 hrs, Volume= 22,975 cf, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment PS2: Proposed On-Site

Runoff = 0.0 cfs @ 13.34 hrs, Volume= 330 cf, Depth= 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	7,650	30	Woods, Good, HSG A
*	22,366	39	>75% Grass cover, Good, HSG A
	30,016		Weighted Average
	30,016		100.00% Pervious Area

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

Summary for Subcatchment PS3: Parking - East

Runoff = 0.9 cfs @ 12.13 hrs, Volume= 3,642 cf, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

Area (sf)	CN	Description
9,236	98	Paved parking, HSG A
4,645	39	>75% Grass cover, Good, HSG A
13,881		Weighted Average
4,645		33.46% Pervious Area
9,236		66.54% Impervious Area

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

Summary for Subcatchment PS4: Parking - West

Runoff = 0.8 cfs @ 12.13 hrs, Volume= 3,072 cf, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

Area (sf)	CN	Description
7,838	98	Paved parking, HSG A
2,688	39	>75% Grass cover, Good, HSG A
103	30	Woods, Good, HSG A
10,629		Weighted Average
2,791		26.26% Pervious Area
7,838		73.74% Impervious Area

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

Summary for Subcatchment PS5: Roofs

Runoff = 0.4 cfs @ 12.13 hrs, Volume= 1,505 cf, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	3,889	98	Roofs, HSG A
	3,889		100.00% Impervious Area

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

Summary for Subcatchment PS6: Roofs

Runoff = 0.2 cfs @ 12.13 hrs, Volume= 871 cf, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	2,252	98	Roofs, HSG A
	2,252		100.00% Impervious Area

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

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 16.48% Impervious, Inflow Depth = 0.86" for 10-Year event
Inflow = 5.6 cfs @ 12.18 hrs, Volume= 25,523 cf
Outflow = 5.6 cfs @ 12.18 hrs, Volume= 25,523 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 17,770 sf, 73.86% Impervious, Inflow Depth = 3.48" for 10-Year event
Inflow = 1.3 cfs @ 12.13 hrs, Volume= 5,147 cf
Outflow = 0.3 cfs @ 12.35 hrs, Volume= 5,147 cf, Atten= 75%, Lag= 13.5 min
Discarded = 0.1 cfs @ 12.35 hrs, Volume= 3,836 cf
Primary = 0.3 cfs @ 12.35 hrs, Volume= 1,311 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 47.22' @ 12.35 hrs Surf.Area= 1,535 sf Storage= 1,468 cf

Plug-Flow detention time= 72.7 min calculated for 5,146 cf (100% of inflow)
Center-of-Mass det. time= 72.7 min (828.1 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	2,835 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	885	0	0	885
47.00	1,413	1,139	1,139	1,426
48.00	1,997	1,697	2,835	2,028

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	47.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	46.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 3	46.80'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 3	47.20'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.35 hrs HW=47.22' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.3 cfs @ 12.35 hrs HW=47.22' (Free Discharge)
├─**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└─**3=Culvert** (Passes 0.3 cfs of 2.5 cfs potential flow)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 3.85 fps)
  ├─**5=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.63 fps)
  └─**6=Orifice/Grate** (Weir Controls 0.0 cfs @ 0.50 fps)

Summary for Pond 2P: Chambers

Inflow Area =	12,881 sf,	78.33% Impervious,	Inflow Depth =	3.67" for 10-Year event
Inflow =	1.0 cfs @	12.13 hrs, Volume=	3,944 cf	
Outflow =	0.2 cfs @	12.41 hrs, Volume=	3,944 cf,	Atten= 80%, Lag= 16.8 min
Discarded =	0.1 cfs @	12.41 hrs, Volume=	3,038 cf	
Primary =	0.1 cfs @	12.41 hrs, Volume=	906 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 47.82' @ 12.41 hrs Surf.Area= 868 sf Storage= 1,107 cf

Plug-Flow detention time= 69.8 min calculated for 3,943 cf (100% of inflow)
Center-of-Mass det. time= 69.8 min (824.1 - 754.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.00'	691 cf	**28.00'W x 31.00'L x 3.21'H Field A** 2,785 cf Overall - 1,056 cf Embedded = 1,728 cf x 40.0% Voids
#2A	46.50'	1,056 cf	**Cultec R-280HD** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		1,748 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	46.90'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	47.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	48.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	48.60'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.41 hrs HW=47.82' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.1 cfs @ 12.41 hrs HW=47.82' (Free Discharge)
└─**2=Culvert** (Passes 0.1 cfs of 3.4 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.1 cfs @ 4.41 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.35 fps)
  ├─**5=Orifice/Grate** (Controls 0.0 cfs)
  └─**6=Orifice/Grate** (Controls 0.0 cfs)

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

Subcatchment PS1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=1.58"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=9.7 cfs 39,174 cf

Subcatchment PS2: Proposed On-Site Runoff Area=30,016 sf 0.00% Impervious Runoff Depth=0.40"
Tc=6.0 min CN=WQ Runoff=0.1 cfs 1,006 cf

Subcatchment PS3: Parking - East Runoff Area=13,881 sf 66.54% Impervious Runoff Depth=4.14"
Tc=6.0 min CN=WQ Runoff=1.2 cfs 4,793 cf

Subcatchment PS4: Parking - West Runoff Area=10,629 sf 73.74% Impervious Runoff Depth=4.53"
Tc=6.0 min CN=WQ Runoff=1.0 cfs 4,015 cf

Subcatchment PS5: Roofs Runoff Area=3,889 sf 100.00% Impervious Runoff Depth=5.97"
Tc=6.0 min CN=98 Runoff=0.5 cfs 1,935 cf

Subcatchment PS6: Roofs Runoff Area=2,252 sf 100.00% Impervious Runoff Depth=5.97"
Tc=6.0 min CN=98 Runoff=0.3 cfs 1,121 cf

Reach DP1: Isolated Wetland Inflow=10.8 cfs 44,054 cf
Outflow=10.8 cfs 44,054 cf

Pond 1P: Infiltration Basin Peak Elev=47.36' Storage=1,686 cf Inflow=1.7 cfs 6,728 cf
Discarded=0.1 cfs 4,454 cf Primary=0.9 cfs 2,274 cf Outflow=1.0 cfs 6,728 cf

Pond 2P: Chambers Peak Elev=48.38' Storage=1,436 cf Inflow=1.3 cfs 5,136 cf
Discarded=0.1 cfs 3,536 cf Primary=0.3 cfs 1,600 cf Outflow=0.3 cfs 5,136 cf

Total Runoff Area = 357,376 sf Runoff Volume = 52,043 cf Average Runoff Depth = 1.75"
83.52% Pervious = 298,481 sf 16.48% Impervious = 58,896 sf

Summary for Subcatchment PS1: Off-Site

Runoff = 9.7 cfs @ 12.18 hrs, Volume= 39,174 cf, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment PS2: Proposed On-Site

Runoff = 0.1 cfs @ 12.17 hrs, Volume= 1,006 cf, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

	Area (sf)	CN	Description
	7,650	30	Woods, Good, HSG A
*	22,366	39	>75% Grass cover, Good, HSG A
	30,016		Weighted Average
	30,016		100.00% Pervious Area

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

Summary for Subcatchment PS3: Parking - East

Runoff = 1.2 cfs @ 12.13 hrs, Volume= 4,793 cf, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

Area (sf)	CN	Description
9,236	98	Paved parking, HSG A
4,645	39	>75% Grass cover, Good, HSG A
13,881		Weighted Average
4,645		33.46% Pervious Area
9,236		66.54% Impervious Area

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

Summary for Subcatchment PS4: Parking - West

Runoff = 1.0 cfs @ 12.13 hrs, Volume= 4,015 cf, Depth= 4.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

Area (sf)	CN	Description
7,838	98	Paved parking, HSG A
2,688	39	>75% Grass cover, Good, HSG A
103	30	Woods, Good, HSG A
10,629		Weighted Average
2,791		26.26% Pervious Area
7,838		73.74% Impervious Area

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

Summary for Subcatchment PS5: Roofs

Runoff = 0.5 cfs @ 12.13 hrs, Volume= 1,935 cf, Depth= 5.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

	Area (sf)	CN	Description
*	3,889	98	Roofs, HSG A
	3,889		100.00% Impervious Area

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

Summary for Subcatchment PS6: Roofs

Runoff = 0.3 cfs @ 12.13 hrs, Volume= 1,121 cf, Depth= 5.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 25-Year Rainfall=6.21"

	Area (sf)	CN	Description
*	2,252	98	Roofs, HSG A
	2,252		100.00% Impervious Area

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

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 16.48% Impervious, Inflow Depth = 1.48" for 25-Year event
Inflow = 10.8 cfs @ 12.18 hrs, Volume= 44,054 cf
Outflow = 10.8 cfs @ 12.18 hrs, Volume= 44,054 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 17,770 sf, 73.86% Impervious, Inflow Depth = 4.54" for 25-Year event
Inflow = 1.7 cfs @ 12.13 hrs, Volume= 6,728 cf
Outflow = 1.0 cfs @ 12.20 hrs, Volume= 6,728 cf, Atten= 41%, Lag= 4.5 min
Discarded = 0.1 cfs @ 12.20 hrs, Volume= 4,454 cf
Primary = 0.9 cfs @ 12.20 hrs, Volume= 2,274 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 47.36' @ 12.20 hrs Surf.Area= 1,613 sf Storage= 1,686 cf

Plug-Flow detention time= 71.9 min calculated for 6,726 cf (100% of inflow)
Center-of-Mass det. time= 71.9 min (826.0 - 754.1)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	2,835 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	885	0	0	885
47.00	1,413	1,139	1,139	1,426
48.00	1,997	1,697	2,835	2,028

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	47.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	46.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 3	46.80'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 3	47.20'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.20 hrs HW=47.36' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.9 cfs @ 12.20 hrs HW=47.36' (Free Discharge)
├**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.9 cfs of 2.8 cfs potential flow)
  ├**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 4.25 fps)
  ├**5=Orifice/Grate** (Orifice Controls 0.2 cfs @ 3.18 fps)
  └**6=Orifice/Grate** (Weir Controls 0.7 cfs @ 1.32 fps)

Summary for Pond 2P: Chambers

Inflow Area = 12,881 sf, 78.33% Impervious, Inflow Depth = 4.78" for 25-Year event
Inflow = 1.3 cfs @ 12.13 hrs, Volume= 5,136 cf
Outflow = 0.3 cfs @ 12.35 hrs, Volume= 5,136 cf, Atten= 74%, Lag= 13.5 min
Discarded = 0.1 cfs @ 12.35 hrs, Volume= 3,536 cf
Primary = 0.3 cfs @ 12.35 hrs, Volume= 1,600 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 48.38' @ 12.35 hrs Surf.Area= 868 sf Storage= 1,436 cf

Plug-Flow detention time= 72.1 min calculated for 5,136 cf (100% of inflow)
Center-of-Mass det. time= 72.1 min (824.5 - 752.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.00'	691 cf	**28.00'W x 31.00'L x 3.21'H Field A** 2,785 cf Overall - 1,056 cf Embedded = 1,728 cf x 40.0% Voids
#2A	46.50'	1,056 cf	**Cultec R-280HD** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		1,748 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	46.90'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	47.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	48.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	48.60'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.35 hrs HW=48.38' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.3 cfs @ 12.35 hrs HW=48.38' (Free Discharge)
└─**2=Culvert** (Passes 0.3 cfs of 4.1 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.1 cfs @ 5.69 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 4.29 fps)
  ├─**5=Orifice/Grate** (Orifice Controls 0.1 cfs @ 2.62 fps)
  └─**6=Orifice/Grate** (Controls 0.0 cfs)

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

Subcatchment PS1: Off-Site Runoff Area=296,709 sf 12.03% Impervious Runoff Depth=3.26"
Flow Length=1,000' Tc=9.9 min CN=WQ Runoff=20.4 cfs 80,717 cf

Subcatchment PS2: Proposed On-Site Runoff Area=30,016 sf 0.00% Impervious Runoff Depth=1.35"
Tc=6.0 min CN=WQ Runoff=0.8 cfs 3,388 cf

Subcatchment PS3: Parking - East Runoff Area=13,881 sf 66.54% Impervious Runoff Depth=6.34"
Tc=6.0 min CN=WQ Runoff=1.9 cfs 7,334 cf

Subcatchment PS4: Parking - West Runoff Area=10,629 sf 73.74% Impervious Runoff Depth=6.85"
Tc=6.0 min CN=WQ Runoff=1.6 cfs 6,064 cf

Subcatchment PS5: Roofs Runoff Area=3,889 sf 100.00% Impervious Runoff Depth=8.73"
Tc=6.0 min CN=98 Runoff=0.7 cfs 2,829 cf

Subcatchment PS6: Roofs Runoff Area=2,252 sf 100.00% Impervious Runoff Depth=8.73"
Tc=6.0 min CN=98 Runoff=0.4 cfs 1,638 cf

Reach DP1: Isolated Wetland Inflow=24.9 cfs 92,167 cf
Outflow=24.9 cfs 92,167 cf

Pond 1P: Infiltration Basin Peak Elev=47.52' Storage=1,942 cf Inflow=2.6 cfs 10,163 cf
Discarded=0.1 cfs 5,468 cf Primary=2.2 cfs 4,695 cf Outflow=2.3 cfs 10,163 cf

Pond 2P: Chambers Peak Elev=48.88' Storage=1,633 cf Inflow=2.0 cfs 7,702 cf
Discarded=0.1 cfs 4,335 cf Primary=1.9 cfs 3,367 cf Outflow=1.9 cfs 7,702 cf

Total Runoff Area = 357,376 sf Runoff Volume = 101,970 cf Average Runoff Depth = 3.42"
83.52% Pervious = 298,481 sf 16.48% Impervious = 58,896 sf

Summary for Subcatchment PS1: Off-Site

Runoff = 20.4 cfs @ 12.18 hrs, Volume= 80,717 cf, Depth= 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

Area (sf)	CN	Description
86,417	54	1/2 acre lots, 25% imp, HSG A
56,305	70	1/2 acre lots, 25% imp, HSG B
54,759	30	Woods, Good, HSG A
99,228	55	Woods, Good, HSG B
296,709		Weighted Average
261,029		87.97% Pervious Area
35,681		12.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	50	0.1500	0.15		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
4.4	950	0.0500	3.60		**Shallow Concentrated Flow, Shallow Concentrated** Unpaved Kv= 16.1 fps
9.9	1,000	Total			

Summary for Subcatchment PS2: Proposed On-Site

Runoff = 0.8 cfs @ 12.14 hrs, Volume= 3,388 cf, Depth= 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

	Area (sf)	CN	Description
	7,650	30	Woods, Good, HSG A
*	22,366	39	>75% Grass cover, Good, HSG A
	30,016		Weighted Average
	30,016		100.00% Pervious Area

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

Summary for Subcatchment PS3: Parking - East

Runoff = 1.9 cfs @ 12.13 hrs, Volume= 7,334 cf, Depth= 6.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

Area (sf)	CN	Description
9,236	98	Paved parking, HSG A
4,645	39	>75% Grass cover, Good, HSG A
13,881		Weighted Average
4,645		33.46% Pervious Area
9,236		66.54% Impervious Area

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

Summary for Subcatchment PS4: Parking - West

Runoff = 1.6 cfs @ 12.13 hrs, Volume= 6,064 cf, Depth= 6.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

Area (sf)	CN	Description
7,838	98	Paved parking, HSG A
2,688	39	>75% Grass cover, Good, HSG A
103	30	Woods, Good, HSG A
10,629		Weighted Average
2,791		26.26% Pervious Area
7,838		73.74% Impervious Area

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

Summary for Subcatchment PS5: Roofs

Runoff = 0.7 cfs @ 12.13 hrs, Volume= 2,829 cf, Depth= 8.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

	Area (sf)	CN	Description
*	3,889	98	Roofs, HSG A
	3,889		100.00% Impervious Area

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

Summary for Subcatchment PS6: Roofs

Runoff = 0.4 cfs @ 12.13 hrs, Volume= 1,638 cf, Depth= 8.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
NRCC 24-hr D 100-Year Rainfall=8.97"

	Area (sf)	CN	Description
*	2,252	98	Roofs, HSG A
	2,252		100.00% Impervious Area

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

Summary for Reach DP1: Isolated Wetland

Inflow Area = 357,376 sf, 16.48% Impervious, Inflow Depth = 3.09" for 100-Year event
Inflow = 24.9 cfs @ 12.17 hrs, Volume= 92,167 cf
Outflow = 24.9 cfs @ 12.17 hrs, Volume= 92,167 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Infiltration Basin

Inflow Area = 17,770 sf, 73.86% Impervious, Inflow Depth = 6.86" for 100-Year event
Inflow = 2.6 cfs @ 12.13 hrs, Volume= 10,163 cf
Outflow = 2.3 cfs @ 12.16 hrs, Volume= 10,163 cf, Atten= 13%, Lag= 2.0 min
Discarded = 0.1 cfs @ 12.16 hrs, Volume= 5,468 cf
Primary = 2.2 cfs @ 12.16 hrs, Volume= 4,695 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 47.52' @ 12.16 hrs Surf.Area= 1,702 sf Storage= 1,942 cf

Plug-Flow detention time= 71.3 min calculated for 10,163 cf (100% of inflow)
Center-of-Mass det. time= 71.3 min (824.5 - 753.2)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	2,835 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
46.00	885	0	0	885
47.00	1,413	1,139	1,139	1,426
48.00	1,997	1,697	2,835	2,028

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	47.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#3	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	46.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 3	46.80'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 3	47.20'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.16 hrs HW=47.52' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=2.2 cfs @ 12.16 hrs HW=47.52' (Free Discharge)
├─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.31 fps)
└─**3=Culvert** (Passes 2.1 cfs of 3.0 cfs potential flow)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 4.65 fps)
  ├─**5=Orifice/Grate** (Orifice Controls 0.2 cfs @ 3.70 fps)
  └─**6=Orifice/Grate** (Weir Controls 1.8 cfs @ 1.84 fps)

Summary for Pond 2P: Chambers

Inflow Area =	12,881 sf,	78.33% Impervious,	Inflow Depth =	7.18" for 100-Year event
Inflow =	2.0 cfs @	12.13 hrs, Volume=	7,702 cf	
Outflow =	1.9 cfs @	12.15 hrs, Volume=	7,702 cf,	Atten= 3%, Lag= 1.0 min
Discarded =	0.1 cfs @	12.15 hrs, Volume=	4,335 cf	
Primary =	1.9 cfs @	12.15 hrs, Volume=	3,367 cf	

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 48.88' @ 12.15 hrs Surf.Area= 868 sf Storage= 1,633 cf

Plug-Flow detention time= 72.3 min calculated for 7,700 cf (100% of inflow)
Center-of-Mass det. time= 72.3 min (822.8 - 750.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	46.00'	691 cf	**28.00'W x 31.00'L x 3.21'H Field A** 2,785 cf Overall - 1,056 cf Embedded = 1,728 cf x 40.0% Voids
#2A	46.50'	1,056 cf	**Cultec R-280HD** x 24 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 6 rows
		1,748 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	46.00'	**2.410 in/hr Exfiltration over Wetted area**
#2	Primary	46.00'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 46.00' / 45.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	46.90'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 2	47.50'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 2	48.00'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 2	48.60'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.1 cfs @ 12.15 hrs HW=48.88' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=1.8 cfs @ 12.15 hrs HW=48.88' (Free Discharge)
└─**2=Culvert** (Passes 1.8 cfs of 4.6 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 0.1 cfs @ 6.62 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 0.1 cfs @ 5.47 fps)
  ├─**5=Orifice/Grate** (Orifice Controls 0.1 cfs @ 4.29 fps)
  └─**6=Orifice/Grate** (Weir Controls 1.5 cfs @ 1.72 fps)

APPENDIX D:

SUPPLEMENTAL STORMWATER MANAGEMENT CALCULATIONS

Stormwater Management Calculations

STANDARD 3: Recharge To Groundwater: Static Method

- Calculate Impervious Area
  (From HydroCAD Model)

  Existing Impervious Area (HSG A Soil) =4,517 SF
  Proposed Impervious Area (HSG A Soil) = 23,215 SF

- Determine Rainfall Depth to be Recharged
  (MassDEP Stormwater Management Handbook: Table 2.3.2)

Hydrologic Soil Group	Recharge Rainfall Depth
A	0.60"

- Calculate Recharge Volume
  'Rv' = [0.60" x (23,215 SF – 4,517 SF)] = 11,219 SF
  'Rv' = [11,219 SF] / 12 SF-In = 935 CF
  'Rv' **= 935 CF**

- Calculate Provided Recharge
  Schedule of Proposed Recharge System Volumes

HCAD System ID	10-Yr Storm Peak Elevation	Lowest System Outlet	System Volume @ Outlet	Description
1P	47.22'	46.50'	503 CF	Infiltration Basin
2P	47.82'	46.90'	469 CF	Cultec Chambers
		Total Volume: 972 CF		

Recharge volume provided measured to lowest outlet

Required Recharge Volume Summary of Results

Total Volume Provided = 972 CF
Total Volume Required = 935 CF

Verify Drawdown, Maximum 72-Hours: Static Method

HCAD System ID	Recharge Volume (CF)	Bottom Surface Area (SF)	Rawls Rate Inches/Hour	Drawdown Time Rv / (K x A) - Hours	Description
1P	503	885	2.41	**2.8**	Infiltration Basin
2P	469	868	2.41	**2.7**	Cultec Chambers

*****Design Complies with Standard 3***

THE MORIN-CAMERON GROUP, INC.
66 Elm Street
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin (1P) (Pretreatment)

Name: 371 Boston Street
Location: 371 Boston Street
Topsfield, MA
County: Essex County
Applicant: Maureen & Randy Sabino

Proj. No.: 2669
Date: 10/23/2019
Revised:
Computed by: Daniel Powers
Checked by: John M. Morin, P.E.

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

Total TSS Removal = 80%

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

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66 Elm Street
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin (1P)

Name: 371 Boston Street
Location: 371 Boston Street
Topsfield, MA
County: Essex County
Applicant: Maureen & Randy Sabino

Proj. No.: 2669
Date: 10/23/2019
Revised:
Computed by: Daniel Powers
Checked by: John M. Morin, P.E.

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice	0.80	1.00	0.80	0.20
Infiltration Basin	0.80	0.20	0.16	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04
	0.00	0.04	0.00	0.04

Total TSS Removal = 96%

Note: Subsurface Infiltration Structures are Concrete Galleys

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

THE MORIN-CAMERON GROUP, INC.
66 Elm Street
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration System (2P) (Pretreatment)

Name: 371 Boston Street
Location: 371 Boston Street
Topsfield, MA
County: Essex County
Applicant: Maureen & Randy Sabino

Proj. No.: 2669
Date: 10/23/2019
Revised:
Computed by: Daniel Powers
Checked by: John M. Morin, P.E.

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

THE MORIN-CAMERON GROUP, INC.
66 Elm Street
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration System (2P)

Name: 371 Boston Street
Location: 371 Boston Street
Topsfield, MA
County: Essex County
Applicant: Maureen & Randy Sabino

Proj. No.: 2669
Date: 10/23/2019
Revised:
Computed by: Daniel Powers
Checked by: John M. Morin, P.E.

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice	**0.80**	**1.00**	**0.80**	**0.20**
Subsurface Infiltration Structure	**0.80**	**0.20**	**0.16**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**
	0.00	**0.04**	**0.00**	**0.04**

Total TSS Removal = **96%**

Note: Subsurface Infiltration Structures are Concrete Galleys

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet
must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX E:

CONSTRUCTION PHASE BEST MANAGEMENT PRACTICES PLAN

Construction Phase Best Management Practices (BMP's)

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "Site Plan of Land in Topsfield. Massachusetts, 371 Boston Street (assessor's Map 26, Lot 14) prepared for Maureen & Randy Sabino," sheets 1 through 6, prepared by The Morin-Cameron Group, Inc. dated October 23, 2019 as revised and approved by the Topsfield Planning Board, hereinafter referred to as the Site Plans.

Responsible Party Contact Information:

Stormwater Management System Owner:	Maureen & Randy Sabino 447 Boston Street, Suite 4 Topsfield, MA 01983 P: (978) 887-8447
Topsfield Department of Public Works:	279 Boston Street Topsfield, MA 01983 P: (978) 887-1517
Topsfield Planning Board:	Town Hall 8 West Common Street Topsfield, MA 01983 P: (978) 887-1504
Topsfield Conservation Commission	Town Hall 8 West Common Street Topsfield, MA 01983 P: (978) 887-1510
Site Design Engineer Information:	The Morin-Cameron Group, Inc. 66 Elm Street Danvers, MA 01923 Phone: (978) 777-8586

Structural Practices:

1) **Mulch Sock & Silt Fence Barrier** – Mulch sock and siltation fence shall be installed in accordance with the approved plans where high rates of stormwater runoff are anticipated.
   a) Installation Schedule: Prior to Start of land disturbance

   b) Maintenance and Inspection: The site supervisor shall inspect the barrier at least once per week and shall repair any damaged or affected areas of the fence at the time they are noted.

2) **Inlet Protection** – Inlet Protection will be utilized around the catch basin and hydrodynamic separator grates in the street layout along the frontage of the property. The inlet protection will allow the storm drain inlets to be used before final stabilization. This structural practice will allow early use of the drainage system. Siltsack or equivalent will be utilized for the inlet protection. Siltsack is manufactured by ACF Environmental. The telephone number is 800-448-3636. Regular flow siltsack will be utilized, and if it does not allow enough storm water flow, hi-flow siltsack will be utilized.

Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *

a) The silt sack trapping device and the inlet grates should be inspected after every rain storm and repairs made as necessary.

b) Sediment should be removed from the silt sack after the sediment has reached a maximum depth of one-half the depth of the trap.

c) Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

d) The silt sack must be replaced if it is ripped or torn in any way.

e) Temporary traps should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

3) Sediment Track-Out: Stabilized Construction Exit: Prior to the commencement of site work, crushed stone anti-tracking pads will be installed at the entrance to the site. This will prevent trucks from tracking material onto the road from the construction site. If, at any point during the project, the tracking pad becomes ineffective due to accumulation of soil, the crushed stone shall be replaced. Details for construction of the stabilized entrance can be found in the Details sheets that are part of the comprehensive permit plan set associated with the project. The site supervisor will inspect the tracking pads weekly to ensure that they are properly limiting the tracking of soil onto the road. If tracking onto the roadway is noted, it shall be removed immediately via a mechanical street sweeper.

Stabilization Practices:

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seeding will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

   Temporary Seeding Planting Procedures *

   a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

   b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.

   c) Select the appropriate seed species for temporary cover from the following table.

Species	Seeding Rate (lbs./1,000 sq.)	Seeding Rate (lbs./acre)	Recommended Seeding Dates	Seed Cover required
Annual Ryegrass	1	40	April 1st to June 1st August 15th to Sept. 15th	¼ inch
Foxtail Millet	0.7	30	May 1st to June 30th	½ to ¾ inch
Oats	2	80	April 1st to July 1st August 15th to Sept. 15th	1 to 1-½ inch
Winter Rye	3	120	August 15th to Oct. 15th	1 to 1-½ inch

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

d) Use effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four-hour period). Stands should be uniform and dense. Reseed and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	Manufacturer	Product	Remarks
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening
Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening
Erosion Control (slope stability)	Amoco	Supergro or equivalent	Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim

Amoco may be reached at (800) 445-7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through

the application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch (Hay or Straw) Materials and Installation

a) Straw has been found to be one of the most effective organic mulch materials. The specifications for straw are described below, but other material may be appropriate. The straw should be air-dried; free of undesirable seeds & coarse materials. The application rate per 1,000 sq. is 90-100 lbs. (2-3 bales) and the application rate per acre is 2 tons (100-120 bales). The application should cover about 90% of the surface. The use of straw mulch is appropriate where mulch is maintained for more than three months. Straw mulch is subject to wind blowing unless anchored, is the most commonly used mulching material, and has the best microenvironment for germinating seeds.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.

b) Straw or grass mulches that blow or wash away should be repaired promptly.

c) If plastic netting is used to anchor mulch, care should be taken during initial mowing to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.

d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.

b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.

c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.

d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.

e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.

b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.

c) Areas requiring revegetation should be repaired immediately. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling *** – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.

b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.

c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather

comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and re-spread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.

b) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.

c) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydro-seeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

Dust Control:

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction access roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction roads; will also be effective for dust control.

The general contractor shall employ an on-site water vehicle for the control of dust as necessary.

Non-Stormwater Discharges:

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges, (N.P.D.E.S., Section 402 and 40 C.F.R. 122.26(b) (14) (x).

Inspection/Maintenance:

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½-inch or greater. The applicant shall be responsible to secure the services of a design professional or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.

- What should be done to correct any problems with the measure.

The inspector should complete a Stormwater Management Construction Phase BMP Inspection Schedule and Evaluation Checklist for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector should notify the appropriate person to make the changes and submit copies of the form to the Topsfield Conservation Commission.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Operation and Maintenance Plan to control or eliminate unforeseen pollution of storm water.

APPENDIX F:

LONG TERM BEST MANAGEMENT PRACTICES

OPERATION & MAINTENANCE PLAN

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan
for
371 Boston Street
Topsfield, Massachusetts
Issued October 23, 2019

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the Mass DEP Stormwater Management Handbook associated with development of the site and associated infrastructure. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plans.
2. The catch basin, subsurface infiltration system, infiltration basin and hydrodynamic separator units shall be inspected and maintained as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.
4. A Stormwater Management Maintenance Log is included at the end of this Appendix.

Basic Information

Stormwater Management System Owner:	Maureen & Randy Sabino 447 Boston Street, Suite 4 Topsfield, MA 01983 P: (978) 887-8447
Topsfield Department of Public Works:	279 Boston Street Topsfield, MA 01983 P: (978) 887-1517
Topsfield Planning Board:	Town Hall 8 West Common Street Topsfield, MA 01983 P: (978) 887-1504
Topsfield Conservation Commission	Town Hall 8 West Common Street Topsfield, MA 01983 P: (978) 887-1510

Erosion and Sedimentation Controls during Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.

A proposed silt sock backed with silt fence will be placed as shown on the Grading, Drainage & Utility Plan prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Silt sacks will also be placed over the new catch basin and hydrodynamic separators once constructed.

Operations and maintenance plans for the Stormwater Management construction phase and long term operation of the system have been attached to this report.

General Conditions

1. The developer shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's. The BMP maintenance shall be conducted as detailed in the following long-term pollution prevention plan and illustrated on the approved design plans:
   "Site Plan of Land in Topsfield. Massachusetts, 371 Boston Street (assessor's Map 26, Lot 14) prepared for Maureen & Randy Sabino," prepared by The Morin-Cameron Group, Inc. dated October 23, 2019 as revised and approved by the Topsfield Planning Board.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Pollution Prevention Plan.
3. The owner shall:
   a. Maintain an Operation and Maintenance Log for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);
   b. Make the log available to the Topsfield Department of Public Works, Planning Board and Conservation Commission upon request;
   c. Allow members and agents of the Topsfield Department of Public Works, Planning Board and Conservation Commission to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.
4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

Long-Term Pollution Prevention Plan (LTPPP)

Vegetated Areas:

Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Cost: Included with annual landscaping budget. Consult with local landscape contractors.

Paved Areas:

Sweepers shall sweep paved areas periodically during dry weather to remove excess sediments and to reduce the amount of sediments that the drainage system shall have to remove from the runoff. The sweeping shall be conducted primarily between March 15th and November 15th. Special attention should be made to sweeping paved surfaces in March and April before spring rains wash residual sand into the drainage system.

Cost: Consult with local landscaping companies for associated costs if necessary.

Salt used for de-icing on the driveway during winter months shall be limited as much as possible as this will reduce the need for removal and treatment. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

Deep Sump Hooded Catch Basins:

The Catch basin grates shall be checked quarterly and following heavy rainfalls to verify that the inlet openings are not clogged by debris. Debris shall be removed from the grates and disposed of properly. Deep sump catch basins shall be inspected twice per year and cleaned as needed when accumulated sediments exceeds 2' from the bottom of the sump (approximately 1/2 of the sump capacity). Catch basins with hoods shall be inspected annually to check oil build-up and outlet obstructions. Material shall be removed from catch basins and disposed of in accordance with all applicable regulations

Cost: Consult with local landscaping companies for associated costs if necessary.

Public Safety Concerns: Catch basins shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken or missing grates or frames shall be replaced immediately. At no time shall any person enter the basin structure unless measures have been taken to ensure safe access in accordance with OSHA enclosed space regulations.

Hydrodynamic Separator Unit:

The Hydrodynamic Separator Units shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.9 inches of rainfall in a 24-hour period (5 year storm). Thereafter, the system shall be inspected twice per year in April and October. The units shall be cleaned per manufacturer's instructions.

Cost: The owner shall consult local landscaping contractor for details.

Public Safety Concerns: The manhole covers shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken covers or frames shall be replaced immediately.

Subsurface Infiltration Chambers:
The subsurface infiltration chambers and outlet structures shall be checked for debris accumulation twice per year. Each system is equipped with an inspection port on the first tank in the series and on the last tank in the series. Additional inspections should be scheduled during the first few months to make sure that the facility is functioning as intended. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed annually. Material removed from the system shall be disposed of in accordance with all applicable local, state, and federal regulations. In the case that water remains in the infiltration facilities for greater than three (3) days after a storm event, an inspection is warranted and necessary maintenance or repairs should be addressed as necessary.

The outlet structure shall be inspected annually for structural integrity. The inspections shall be conducted by qualified personnel.

Cost: Consult with local landscaping companies for associated costs if necessary.

Public Safety Concerns: The inspection port covers shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken covers or frames shall be replaced immediately. At no time shall any person enter the subsurface structure unless measures have been taken to ensure safe access in accordance with OSHA enclosed space regulations.

Grassed Infiltration Basin:
The infiltration basin shall be inspected after every major storm event for the first 3 months after construction: a major storm event is 3.9 inches of rainfall in a 24-hour period (5-year storm). Thereafter, the depression shall be inspected twice per year. All debris and sediment shall be removed and disposed of properly. If the system does not drain within 72 hours of a rainstorm, the operator shall inform the design engineer.

Cost: Consult with local landscaping companies for associated costs if necessary.

Level Spreader:
The inlet pipe, rip-rap basin and overflow berm shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.1 inches of rainfall in a 24 hour period (2 year storm). Thereafter, the system shall be inspected on an annual basis, typically in the spring months. Any signs of erosion shall be repaired immediately, and any trash or debris shall be removed,

Cost: Consult with local landscaping companies for associated costs if necessary.

Overall Site Grading and Stormwater Management on Lots:
After construction, and during the initial vegetation establishment period, the site should be inspected after every rainfall. Mowing, litter removal, and spot vegetation repair should be performed on a regular basis.

Debris & Litter:
All debris and litter shall be removed from the driveway/parking area as necessary to prevent migration into the drainage system.

Pesticides, Herbicides, and Fertilizers:
Pesticides and herbicides shall be used sparingly. Fertilizers shall be restricted to the use of organic fertilizers only. All fertilizers, herbicides, pesticides, sand and salt for deicing and the like shall be stored in dry area that is protected from weather.

Cost: Included in the routine landscaping maintenance schedule. The Owner shall consult local landscaping contractors for details.

Public Safety Concerns: Chemicals shall be stored in a secure area to prevent children from obtaining access to them. Any major spills shall be reported to municipal officials.

Prevention of Illicit Discharges:

Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to Mass DEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, DE chlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Provisions For Storing Materials And Waste Products Inside Or Under Cover
2. Vehicle Maintenance And Washing Controls
3. Requirements for Routine Inspections of the Stormwater Management System (i.e.: catch basins, proprietary treatment unit & subsurface infiltration system.)
4. Spill Prevention and Response Plans.

APPENDIX G:

ILLICIT DISCHARGE

COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

I, John M. Morin, P.E., hereby notify the Topsfield Planning Board that I have not witnessed, nor am aware of any existing illicit discharges at the site known as 371 Boston Street in Topsfield, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "Site Plan of Land in Topsfield, Massachusetts, 371 Boston Street (Assessor's Map 26, Lot 4)," prepared by The Morin-Cameron Group, Inc. dated October 23, 2019 and as revised and approved by the Topsfield Planning Board and maintenance thereof in accordance with the "Construction Period Pollution Prevention Plan" and "Long Term Stormwater Best Management Practices Operation and Maintenance Plan" prepared by The Morin-Cameron Group, Inc dated October 23, 2019 and as revised and approved by the Topsfield Planning Board will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: John M. Morin, P.E.

Company: The Morin-Cameron Group, Inc.

Title: Owner's Representative

Signature: John M Morin

Date: 10/23/19

APPENDIX H:

SOIL TEST PIT LOGS

No. 2669 Date: 5/5/08

Commonwealth of Massachusetts
Topsfield, Massachusetts

Soil Suitability Assessment for On-site Sewage Disposal

Performed By: Greg Hochmuth Date: 4/30/08
Witnessed By: John Coulon Date: 4/30/08

Location Address or Lot #	371 Boston Street Topsfield, MA 01983	Owner's Name Address and Telephone #	Randy Sabino 371 Boston Street Topsfield, MA 978-887-8441

New Construction [X] Repair [ ]

Office Review
Published Soil Survey Available: No [ ] Yes [X]

Year Published 1981 Publication Scale 1" = 1320' Soil Map Unit De

Drainage Class B Soil Limitations

Surficial Geologic Report Available: No [X] Yes [ ]

Year Published Publication Scale

Geologic Material (Map Unit)

Landform Drumlin

Flood Insurance Rate Map:

Above 500 year flood boundary	No	[ ]	Yes	[X]
Within 500 year flood boundary	No	[X]	Yes	[ ]
Within 100 year flood boundary	No	[X]	Yes	[ ]

Wetland Area:
National Wetland Inventory Map (map unit)
Wetlands Conservancy Program Map (map unit)
Current Water Resource Conditions (USGS): Month

Range: Above Normal [ ] Normal [X] Below Normal [ ]

Other References Reviewed:

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-1 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-16"	A	FSL	10YR3/2		
16-32"	Bw	FSL	10YR5/6		
32-90"	C	LS	2.5Y5/6		ESHWT @ 44" Damp on Bottom

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: NA Weeping from Pit Face: NA

Estimated Seasonal High Ground Water: 44"

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-2 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-16"	A	FSL	10YR3/2		
16-30"	Bw	FSL	10YR5/6		
30-72"	C1	SIL	2.5Y5/4		(C1 LAYER TBR) ESHWT @ 43"
72-138"	C2	LS	2.5Y5/6		Weep @ 102"

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: 102" Weeping from Pit Face: 102"

Estimated Seasonal High Ground Water: 43"

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-3 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-16"	A	FSL	10YR3/2		
16-23"	Bw	FSL	10YR5/6		
23-90"	C1	SIL	2.5Y5/4		(C1 LAYER TBR) ESHWT @ 42"
90-142"	C2	LS	2.5Y5/6		Weep @ 102"

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: 102" Weeping from Pit Face: 102"

Estimated Seasonal High Ground Water: 42"

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-4 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-15"	A	FSL	10YR3/2		
15-20"	Bw	FSL	10YR5/6		
20-102"	C	LS	2.5Y5/6		ESHWT @ 64"

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: NA Weeping from Pit Face: NA

Estimated Seasonal High Ground Water: 64"

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-5 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-14"	A	FSL	10YR3/2		
14-26"	Bw	FSL	10YR5/6		
26-100"	C	SIL	2.5Y5/4		(C LAYER UNSUITABLE) ESHWT @ 42" Weep @ 58"

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: 58" Weeping from Pit Face: 58"

Estimated Seasonal High Ground Water: 42"

Location Address or Lot No. 371 Boston Street

On-Site Review

Deep Hole Number 08-6 Date 4/30/08 Time 2:00pm Weather Sunny 60

Location (identify on site plan) See Plan
Land Use Residential Slope (%) 0-3 Surface Stones No
Vegetation Lawn
Landform Kame Terrace

Position on landscape (sketch on the back) See Plan
Distances from:

Open Water Body	NA	feet	Drainage Way	NA	feet
Possible Wet Area	>100	feet	Property Line	>10	feet
Drinking Water Well	NA	feet	Other		

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Bounders, Consistency, % Gravel)
0-16"	A	FSL	10YR3/2		
16-28"	Bw	FSL	10YR5/6		
28-42"	C1	SIL	2.5Y5/6		(C LAYER UNSUITABLE) ESHWT @ 48"
42-102"	C2	LS	2.5Y5/4		

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ice Contact Outwash Depth to Bedrock: NA

Depth to Groundwater: Standing Water in the Hole: NA Weeping from Pit Face: NA

Estimated Seasonal High Ground Water: 48"

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-1

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	44	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

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

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

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 5/5/08

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-2

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	43	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

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

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

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 5/5/08

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-3

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	42	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

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

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

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 5/5/08

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-4

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	64	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

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

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

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature Gary J. Hoehn Date 5/5/08

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-5

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	42	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring 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 occurring pervious material? _____

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 5/5/08

Location Address or Lot No. 371 Boston Street

Determination for Seasonal High Water Table

OP 08-6

Method Used:

[ ]	Depth observed standing in observation hole	_____	inches
[ ]	Depth weeping from side of observation hole	_____	inches
[X]	Depth to soil mottles	48	inches
[ ]	Groundwater adjustment	_____	feet

Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment factor _____ Adjusted ground water level _____

Depth of Naturally Occurring Pervious Material

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

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

Certification

I certify that on 11/13/03 I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 5/5/08

FORM 12 – PERCOLATION TEST

Location Address or Lot No. 371 Boston Street

COMMONWEALTH OF MASSACHUSETTS

Topsfield, Massachusetts

Percolation Test*		
Date: 4/30/08	Time: 2:30 pm	
Observation Hole #	Perc 1	Perc 2
Depth of Perc	68"	46"
Start Pre-soak	2:29	3:11
End Pre-soak	Took 24 Gallons	3:26
Time at 12"	During Pre-Soak	3:26
Time at 9"		3:42
Time at 6"		4:03
Time (7"-6")		7 Minutes
Rate Min./Inch	<2 Minutes/Inch	7 Minutes/Inch

*Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed [X] Site Failed [ ]

Performed by: Greg Hochmuth

Witnessed by: John Coulon

Comments:

FORM 12 – PERCOLATION TEST

Location Address or Lot No. 371 Boston Street

COMMONWEALTH OF MASSACHUSETTS

Topsfield, Massachusetts

Percolation Test*		
Date: 4/30/08	Time: 2:45 pm	
Observation Hole #	Perc 3	
Depth of Perc	52"	
Start Pre-soak	2:42	
End Pre-soak	2:57	
Time at 12"	2:57	
Time at 9"	3:01	
Time at 6"	3:06	
Time (7"-6")	2 Minutes	
Rate Min./Inch	2 Minutes/Inch	

*Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed [X] Site Failed [ ]

Performed by: Greg Hochmuth

Witnessed by: John Coulon

Comments:

SOIL SUITABILITY ASSESSMENT REPORT
COMMONWEALTH OF MASSACHUSETTS
TOPSFIELD, MASSACHUSETTS

SOIL EVALUATION FOR DETERMINATION OF SEASONAL HIGH GROUNDWATER ELEVATIONS

SITE INFORMATION

Street Address: 371 Boston Street Town: Topsfield State: Massachusetts Zip Code: 01983 County: Essex

Land Use: Residential dwelling Latitude: ~42° 39' 01.1"N Longitude: ~70° 56' 07.4" W

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section

Soil map unit: 256A – Deerfield loamy fine sand (Mixed, mesic, Aquic Udipsamments), 0-3% slopes

NRCS/USDA web soil survey: Essex County, Massachusetts, Northern part. Map Scale: 1:600'

Soil hydric or upland: Upland Average depth to water table: 12-36" Depth to restrictive feature: >100"

Frequency of flooding: None Frequency of ponding: None Available water capacity: Low (~3.9")

Drainage Class: Moderately well drained Hydrologic Soil Group: A Ksat: High (6.00 – 20.00 in/hr)

Soil limitations: Loose & structurless substratum, shallow seasonal groundwater table, high permeability in substratum

WETLAND AREA & CLOSEST USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: >200 feet

Current Water Resource Condition (USGS): Well Site # 424520070562401- MA-NIW 27 Newbury, MA

Well completed in Sand and gravel aquifers and ice-contact deposits, including kames and eskers.

Well depth: 19.8 feet Land surface altitude: 55.00 feet above NGVD29 Latitude: ~42°45'19.3"N Longitude: ~70°56'22.1"

Most recent data value: 4.04' on 04/10/16 (depth to water level in feet below land surface). Range: Normal

SURFICIAL & BEDROCK GEOLOGY:

Surficial geology map: Qgi: Deposits in the Ipswich River area Geomorphic landform: Outwash terrace

Geologic parent material: Chiefly light-brown to light-gray, medium, well-sorted sand and gravel in the valleys of the Ipswich River and its tributaries in the Southern part of the quadrangle

Landform position (2D): Foot slope Landform position (3D): Tread Slope aspect: Southerly

Slope gradient: ~03-15% Down slope shape: Concave Across slope shape: Concave Slope complexity: Simple

Bedrock outcropping in vicinity: Not observed Glacial erratics in vicinity: None observed

Bedrock Type: Topsfield granodiorite – Gray to gray-green, porphyritic granodiorite containing blue quartz; cataclastically foliated.

TP-A1 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 11:00 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 11"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
11 → 44"	C	Loamy Sand very fine	2.5Y 6/4 light yellowish brown	36" (f,2,d) 7.5R4/8	Very friable; moderate-grade fine-granular structure; mixed fine to predominately very-fine grained mineral content; well graded; free of clasts; few fine roots to 20"; few iron stains within matrix at and below 36". Excavation difficulty: very low

Depth to bedrock: >44" Seasonal High Groundwater Table: 36" Apparent water table (weep) : >44"

TP-A1 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face:____ (Below land surface) Depth to stabilized apparent water: ____ (Below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 36" (below land surface)

Type: Stringers on and within peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: ____ inches below grade

Observed water weeping from side of deep hole: ____ inches below grade

Observed depth to redoximorphic features: 36" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A1 Upper boundary: ____
Lower boundary: ____

Certification

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

Alexander F. Parker *License #1848*

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification

TP-A2 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 11:17 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 18"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
18 → 30"	C	Loamy Sand fine to medium	2.5Y 6/4 light yellowish brown	25" (c,2,d) 7.5R4/8	Very friable; moderate-grade fine-granular structure; mixed fine to predominately medium grained mineral content; well graded; 15% subrounded gravel content of mixed lithology; few fine roots to 20"; common iron stains within matrix at and below 36". Excavation difficulty: very low

Depth to bedrock: >30" Seasonal High Groundwater Table: 25" Apparent water table (weep) : 11"

TP-A2 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: 11" (Below land surface) Depth to stabilized apparent water: 11" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 23" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 11" inches below grade

Observed water weeping from side of deep hole: 11" inches below grade

Observed depth to redoximorphic features: 23" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A2 Upper boundary: ____
Lower boundary: ____

Certification

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

Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP-A3 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 11:38 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10+ feet Drainage way: 50+ feet Drinking water well: 100+ feet

Wetlands: 100+ feet Open water body: 400+ feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A3

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
12 → 36"	C	Loamy Sand gravelly	10YR 5/4 yellowish brown	21" (c,2,d) 7.5R4/8	Very friable; weak-grade fine-granular structure; mixed fine to predominately medium grained mineral content; well graded; 15-20-25% subrounded gravel content of mixed lithology; few fine roots to 14"; common iron stains within matrix at and below 36". Excavation difficulty: very low

Depth to bedrock: >36" Seasonal High Groundwater Table: 21" Apparent water table (weep): 13"

TP-A3 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 13" (Below land surface) Depth to stabilized apparent water: 13" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 21" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color: _____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 13" inches below grade

Observed water weeping from side of deep hole: 13" inches below grade

Observed depth to redoximorphic features: 21" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A3 Upper boundary: ____
Lower boundary: ____

Certification

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

Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP-A4 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 11:57 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A4

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 33"	A	Sandy Loam	10YR 2/1 black	21" (c,2,d) 7.5R4/8	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; very fine grained mineral content; slightly damp; many fine grass roots; free of clasts; common iron stains within matrix at and below 21".

Depth to bedrock: >36" Seasonal High Groundwater Table: 21" Apparent water table (weep): 18"

TP-A4 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 18" (Below land surface) Depth to stabilized apparent water: 18" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 21" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 18" inches below grade

Observed water weeping from side of deep hole: 18" inches below grade

Observed depth to redoximorphic features: 21" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ▶ NA

Depth of naturally occurring pervious material in TP-A4 Upper boundary: ____
Lower boundary: ____

Certification

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Alexander F. Parker *License #1848* June 1998

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TP-A5 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 12:16 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A5

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
12 → 33"	C	Loamy Sand gravelly	7.5YR 5/8 strong brown	19" (c,2,d) 7.5R4/8	Very friable; weak-grade fine-granular structure; mixed fine to predominately medium grained mineral content; well graded; 20-25% subrounded gravel content of mixed lithology; few fine roots to 14"; common iron stains within matrix at and below 19". Excavation difficulty: very low

Depth to bedrock: >33" Seasonal High Groundwater Table: 19" Apparent water table (weep): 15"

TP-A5 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 15" (Below land surface) Depth to stabilized apparent water: 15" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 19" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 15" inches below grade

Observed water weeping from side of deep hole: 15" inches below grade

Observed depth to redoximorphic features: 19" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A5 Upper boundary: ____
Lower boundary: ____

Certification

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Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP-A6 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 12:33 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A6

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 11"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
11 → 35"	C	Loamy Sand very fine	2.5Y 6/4 light yellowish brown	25" (c,2,d) 7.5R4/8	Very friable; moderate-grade fine-granular structure; mixed fine to predominately very-fine grained mineral content; well graded; free of clasts; few fine roots to 12"; common iron stains within matrix at and below 25". Excavation difficulty: very low

Depth to bedrock: ≥34" Seasonal High Groundwater Table: 25" Apparent water table (weep): 21"

TP-A6 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 21" (Below land surface) Depth to stabilized apparent water: 21" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 25" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 21" inches below grade

Observed water weeping from side of deep hole: 21" inches below grade

Observed depth to redoximorphic features: 25" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A6 Upper boundary: ____
Lower boundary: ____

Certification

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Alexander F. Parker *License #1848* June 1998

Printed name of evaluator & license number Date of Soil Evaluator Certification

TP-A7 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

Date: April 11, 2016 Time: 12:57 Weather: Overcast, light rain, cool, ~50°F, light East wind

Position on landscape: Footslope Slope aspect: Southerly Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet

Wetlands: 100^{+} feet Open water body: 400^{+} feet Abutting septic system: NA

SOIL PROFILE ▶ TP-A7

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 17"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; cohesive matrix; fine grained mineral content; slightly damp; many fine grass roots; free of clasts; clear smooth boundary.
17 → 39"	C	Loamy Sand very fine	2.5Y 6/4 light yellowish brown	18" (c,2,d) 7.5R4/8	Very friable; moderate-grade fine-granular structure; mixed fine to predominately very-fine grained mineral content; well graded; free of clasts; few fine roots to 16"; common iron stains within matrix at and below 18". Excavation difficulty: very low

Depth to bedrock: >39" Seasonal High Groundwater Table: 18" Apparent water table (weep): 15"

TP-A7 HAND AUGER OBSERVATION HOLE

371 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 15" (Below land surface) Depth to stabilized apparent water: 15" (Below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 18" (below land surface)

Type: Stringers on and within peds Abundance: Common Size: Medium Contrast: Distinct

Shape: Lenticular Moisture state: Moist to wet Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5R 4/8 (red) Reduction color:_____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 15" inches below grade

Observed water weeping from side of deep hole: 15" inches below grade

Observed depth to redoximorphic features: 18" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► NA

Depth of naturally occurring pervious material in TP-A7 Upper boundary: ____
Lower boundary: ____

Certification

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Alexander F. Parker *License #1848*

Printed name of evaluator & license number

June 1998

Date of Soil Evaluator Certification