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# DRAINAGE REPORT

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## THE DASCOMB ROAD PROJECT

**146 DASCOMB ROAD  
ANDOVER, MASSACHUSETTS**

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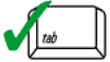
# Stormwater Checklist



# Checklist for Stormwater Report

## A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.<sup>1</sup> 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<sup>2</sup>
- 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.

<sup>1</sup> 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.

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



# Checklist for Stormwater Report

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## 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.

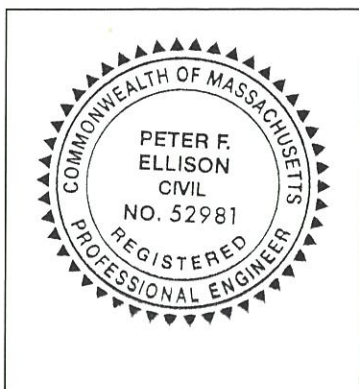
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

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### 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



 6/5/2019  
\_\_\_\_\_  
Signature and Date

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## 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

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## 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): Subsurface Infiltration Basins

### 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

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## 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<sup>1</sup>
- 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.

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



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 3: Recharge (continued)

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

### Standard 4: Water Quality

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

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



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 4: Water Quality (continued)

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

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

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

### Standard 6: Critical Areas

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



# Checklist for Stormwater Report

## Checklist (continued)

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

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

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

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

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



# Checklist for Stormwater Report

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## 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.

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# 1

## Narrative

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### Introduction

The proposed project is located on a 16.23-acre parcel of land located at 146 Dascomb Road in Andover, Massachusetts, identified as Assessor's Map 203, Lot 2A-1 (the "Site"). Approximately 0.38-acres of the parcel is located within the Town of Tewksbury, identified as Assessor's Map 113, Lot 24. The Site is abutted by Dascomb Road, Smith Drive, and the Hewlett Packard Site to the north; I-93 to the east; Restaurant Depot, wetlands and a rail road right of way to the south; and Smith Drive and other industrial properties to the west. The Site is identified on the Project Location Map (Figure 1), at the end of this section.

The Applicant is proposing to redevelop the Site by constructing a multi building mixed use development consisting of approximately 524,000 square feet (SF) of retail, office, hotel, fitness, grocery store and restaurant uses with associated parking, landscape, utility and stormwater management infrastructure improvements (the "Project"). The Project is consistent with the vision the Town of Andover developed with the new zoning for the ID-2 District, which was developed to provide amenities in certain industrial and commercial areas of Town.

The drainage study was performed in order to assess the potential impact of the Project. The Site currently consists of a vacant warehouse and office building and paved parking areas. Runoff from the existing site is primarily collected in catch basins and roof drains and conveyed in pipes to a large detention basin located within a drainage easement on the southerly side of the Restaurant Depot property to the south. The Project will provide a stormwater management system incorporating traditional and Low Impact Design (LID) Best Management Practices (BMPs) elements. This analysis has been prepared to verify that the Project will not have an adverse effect on the stormwater conditions both on-site and off-site.

The proposed Stormwater Management Plan has been designed to meet the Stormwater Standards identified in the Massachusetts Department of Environmental Protection (DEP) Massachusetts Stormwater Handbook and the Town of Andover Stormwater Management and Erosion Control

Regulations. The Stormwater Management Design reduces peak runoff rates, reduces the risk of erosion and sedimentation, and improves stormwater runoff quality.

## **Existing Site Conditions**

The existing site is primarily developed consisting of a 153,000 sf warehouse and office building, with associated paved parking and loading areas. Along the frontage of the property to Dascomb Road, the property is primarily wooded area with a cell phone tower located on the north easterly corner adjacent to Dascomb Road and Interstate 93. An intermittent stream and associated bordering vegetated wetlands are located at the north westerly corner adjacent Dascomb Road and Smith Way. The Site ranges in elevation from approximately elevation 152 feet at the top of a hill adjacent to the cell tower and slopes towards the south west to an elevation of approximately 120 feet at the elevation of the office entrance and 110 feet at the Smith Way driveway connection. The existing building has two entry locations, with the warehouse elevation at approximately 112 feet.

### **Wetland Resource Areas**

There is an intermittent stream and associated bordering vegetated wetland located on the north westerly edge of the Property that have been defined in an Outstanding Resource Area Delineation (ORAD) by the Andover + Conservation Commission on August 26, 2013. Additionally, in April 2015, Wetlands Preservation, Inc. flagged additional bordering vegetated wetland at the far southerly finger of the Property. Refer to the Notice of Intent (DEP file number 090-1247) for additional information on jurisdictional wetland areas at the Property.

### **100-Year Flood Plain**

According to the FEMA Flood Insurance Rate Maps (FIRM), map number 25009C0356F, dated July 3, 2012, the site is not located within the 100-year floodplain. Refer to the attached FIRM Figure at the end of this section (Figure 3).

### **Subsurface Conditions**

According to the National Resource Conservation Service (NRCS), the site is comprised of Hinkley loamy sand, Charlton-Rock outcrop-Hollis complex and Urban land. This soil surrounding the Urban land is classified as hydrologic soil group (HSG) A. Refer to the NRCS Soils Map (Figure 2) at the end of this section.

Two sets of test pits, nine in total, were performed on site. The first set of test pits (4) were performed on June 1<sup>st</sup>, 2015 by S&R Corporation under the supervision of TEC, Inc. and Merrimack Engineering Services. The second set of test pits (5) were performed on November 16, 2017 by S&R Corporation under the supervision of TEC, Inc. The test pits were logged by a licensed

soil evaluator to confirm the soil types onsite and estimate seasonal high groundwater (ESHGW) elevation at nine different locations. The test pit logs and a map showing the pit locations can be found in Appendix F.

Test pit logs shows that the ESHGW onsite was found between 30" and >80" below the ground surface at the four different test pits. The soils onsite range from a coarse sand to a fine sandy loam, which is consistent with NRCS data.

For the purposes of stormwater management and infiltration best management practices (BMPs), an infiltration rate of 2.41 inches per hour (in/hr) will be used as a conservative value for a HSG A soil group. The proposed stormwater BMPs have been designed to incorporate the findings of the soil evaluations. All infiltrating BMPs have been designed to provide four feet minimum separation from ESHGW. A Geotechnical Report will be developed for the Project prior to start of construction.

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## **Proposed Site Conditions**

The proposed Site will convert the Property to a desirable commercial development including approximately 524,000 SF of retail, office, hotel, fitness, grocery store and restaurant uses with associated parking, landscape, utility and stormwater management infrastructure improvements. The proposed site layout includes seven separate buildings totaling approximately 165,000 SF of footprint area. Associated parking to support the development will be located at-grade and also within a three-level parking deck to be constructed beneath portions of the site.

## **Proposed Construction Sequencing Plan**

The following outline presents key construction activities in typical sequences that are generally anticipated for the project:

1. Perform survey layout of erosion and sediment control measures
2. Selectively remove vegetation for haybale/silt fence installation
3. Install hay bales/silt fence
4. Install construction fencing as needed
5. Stabilize construction entrance
6. Construct temporary stormwater features as needed
7. Clear and grub areas according to Site Plans
8. Strip and stockpile soil
9. Conduct earthwork cuts and fills as needed
10. Temporarily stabilize open cut and fill areas as needed
11. Construct wetland replication area
12. Construct utilities/permanent stormwater features
13. Initiate building construction
14. Construct parking/driveways through binder course
15. Complete building construction
16. Finish grade green space areas

17. Permanently stabilize green space areas
18. Construct parking/driveways through top course
19. Install pavement markings/signage
20. Remove all erosion and sediment control measures upon completion of construction

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## Methodology

The overall Stormwater Management Plan, which will be implemented as part of the Project, will improve the collection, management, and treatment of the stormwater.

Existing and proposed hydrologic conditions were analyzed using HydroCAD, an SCS TR-20 based program, to calculate existing and proposed peak discharge rates. This method takes into account existing and proposed pervious and impervious areas including soil types and hydrologic classifications. Runoff curve numbers from the Town of Andover regulations were used in the drainage study. The 2, 10, 25, and 100-year, 24-hour storm frequencies were used in the analysis in accordance with the MassDEP and the Town of Andover requirements.

The "Regulatory Compliance" portion of this report addresses the MassDEP Stormwater Management Performance Standards under the Wetlands Protection Act.

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## Pre-Development Runoff

The existing site is divided into six subcatchment areas discharging to four design points. Design Point 1 (DP-1) consists of runoff from the northerly portion of the site, which ultimately flows towards Dascomb Road and into the intermittent stream at the north westerly edge of the Property. Design Point 2 (DP-2) consists of runoff from the parking lot and half of the building rooftop, which ultimately flows towards the southerly property line and into the existing closed drainage system. Design Point 3 (DP-3) consists of runoff from the easterly portion of the site, which flows to the southeasterly corner of the site and discharges to an existing drainage swale flowing parallel to the existing building. Design Point 4 (DP-4) consists of runoff from the second driveway along Smith Drive and discharges into the drainage system in Smith Drive. Refer to Figure D-1, *Pre-Development Drainage Areas*, for the existing conditions drainage areas. The subcatchments are described in more detail below.

The northern portion of the site (EX-1) is comprised of 136,858 SF of wooded/vegetated area, 14,866 SF of pervious grass area, and 7,602 SF of gravel road area (leading up to cell tower). Stormwater runoff from EX-1

flows over land northerly toward Dascomb Road and ultimately into the intermittent stream at the northwesterly corner of the Property (DP-1).

Subcatchment area EX-2a is comprised of approximately 14,656 SF of wooded/vegetated area, 54,046 SF of pervious grass area, 833 SF of gravel roads, 8,360 SF of rooftop, and 151,738 SF of impervious pavement. The rooftop runoff is collected by roof drains and conveyed by piping to the existing closed drainage system (DP-2). The remaining stormwater runoff from EX-2a flows overland and is collected by the same existing closed drainage system. The runoff is conveyed by piping to the southerly property line (DP-2).

Subcatchment area EX-2b is comprised of approximately 76,387 SF of rooftop area. Stormwater runoff from EX-2b is collected by roof drains and conveyed by piping to the southerly property line (DP-2).

The easterly portion of the site (EX-3a) is comprised of approximately 67,324 SF of wooded/vegetated area, and 27,087 SF of pervious grass area. Stormwater runoff from EX-3a flows over land to an existing drainage swale at the southeasterly corner of the Property (DP-3).

The easterly portion of the site (EX-3b) is comprised of approximately 76,790 SF of rooftop area. Stormwater runoff from EX-3b is collected by roof drains and conveyed to an existing drainage swale at the southeasterly corner of the Property (DP-3).

Subcatchment area EX-4 is comprised of approximately 5,000 SF of pervious grass area and 4,450 SF of impervious pavement. Runoff from EX-4 sheet flows over land and down the second driveway along Smith Drive where it is collected by catch basins and enters the existing drainage system along Smith Drive.

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## **Post-Development Runoff**

The Project consists of construction of approximately 165,000 square feet of retail/office building footprint, with associated parking, landscape, utility and stormwater management infrastructure. There is an overall increase in impervious area with the proposed site due to the undeveloped nature of a portion of the existing site.

The proposed stormwater management system for this project involves traditional and low impact design BMPs. BMPs proposed for the site include pavement sweeping, deep sump catch basins with hoods, water quality units, infiltration basins, and subsurface infiltration basins with isolator row technology.

The proposed stormwater management system is designed to mitigate the effects of the proposed development by reducing the peak rates of runoff as compared to the existing conditions. In the proposed conditions analysis, the same design points identified and analyzed under the existing conditions were analyzed. The post-development subcatchment areas are identified in Figure D-2, *Post-Development Drainage Areas*, and described in more detail below.

Proposed Subcatchment Area #1 (PR-1) has a total area of 55,733 SF, all of which is green area, located along the northern border of the Property. Runoff from PR-1 flows overland and discharges directly into the intermittent stream along Dascomb Road (DP-1).

Proposed Subcatchment Area #2 (PR-2) consists of the northern drive entrance, parking, impervious sidewalk, roof area and green space in the northern corner of the Property. PR-2 totals 136,422 SF, comprised of 53,929 SF of green space, 17,745 SF of roof area and 64,748 SF of impervious parking, driveway and sidewalk. Runoff from PR-2 is collected by catch basins and conveyed into the proposed subsurface infiltration basin P1 for infiltration. Overflow from the subsurface infiltration basin will be conveyed by piping to the existing closed drainage system at the southerly Property line (DP-2).

Proposed Subcatchment Area #3 (PR-3) consists of roof area, parking, impervious sidewalk, and greenspace. PR-3 totals 174,957 SF, comprised of 88,030 SF of roof area, 14,354 SF of green space, and 72,573 SF of impervious parking, driveway, and sidewalk. Runoff from PR-3 is collected by catch basins and is conveyed into the proposed subsurface infiltration basin P1 for infiltration. Overflow from the subsurface infiltration basin will be conveyed by piping to the existing closed drainage system at the southerly Property line (DP-2).

Proposed Subcatchment Area #4 (PR-4) consists of parking, roof area, and green space. The total area for PR-4 is 84,569 SF and is comprised of 6,476 SF of green space, 48,795 SF of roof space and 29,298 SF of impervious parking and sidewalks. Runoff from PR-4 is collected by catch basins and is conveyed by piping and treated in a subsurface infiltration basin P2. Overflow from the subsurface infiltration basin is conveyed by piping to the existing closed drainage system at the southerly Property line (DP-2).

Proposed Subcatchment Area #5 (PR-5) consists of parking, sidewalks, and green space. The total area for PR-5 is 81,090 SF and is comprised of 27,244 SF of green space and 53,846 SF of impervious parking and sidewalks. Runoff from PR-5 is collected by catch basins and conveyed by piping and treated in a subsurface infiltration basin P3. Overflow from the subsurface infiltration basin is conveyed by piping to the existing closed drainage system at the southerly Property line (DP-2).

Proposed Subcatchment Area #6 (PR-6) consists of parking, roof area, and green space. The total area for PR-6 is 22,193 SF and is comprised of 1,570 SF of green space, 10,085 SF of roof space and 30,362 SF of impervious parking and sidewalks. Runoff from PR-6 is conveyed by piping to the existing closed drainage system at the Southerly Property line (DP-2).

Proposed Subcatchment Area #7 (PR-7) consists of parking, impervious sidewalk, and green space in the eastern side of the Property. PR-7 area totals 79,925 SF, comprised of 28,730 SF of proposed green space and 51,195 SF of impervious parking and sidewalk. Runoff from PR-7 will be collected by catch basins and conveyed to DP-3.

Proposed Subcatchment Area #8 (PR-8) consists of impervious driveway area along the southwesterly side of the Property. PR-8 area totals 2,011 SF and is comprised entirely of 2,011 SF of impervious driveway. Runoff from PR-8 will be conveyed to the existing drainage system along Smith Drive (DP-4).

Table 1 presents a summary of the pre and post development hydrologic analysis comparing the peak flow rates generated from the 2-, 10-, 25-, and 100-year storm events.

**Table 1 Peak Flow Summary**

Discharge Point	2-Year Storm		10-Year Storm		25-Year Storm		100-Year Storm	
	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)	Exist (cfs)	Prop (cfs)
DP-1	0.00	0.00	0.03	0.10	0.10	0.30	0.58	0.93
DP-2	16.64	8.52	27.49	18.18	34.03	23.00	42.73	29.98
DP-3	5.33	4.04	7.98	6.97	9.56	8.74	11.68	11.09
DP-4	0.37	0.14	0.69	0.21	0.89	0.26	1.17	0.31

For DP-2, DP-3, and DP-4, the proposed project does not increase peak runoff rates over the existing conditions for the 2, 10, 25, and 100-Year storm events, in accordance with local and state regulations.

DP-1 does result in a small increase in peak flows, well under 1 cfs. The increase in flow is mainly due to modeling the pre- condition as "woods" and the post- condition as "woods/grass combo". The small increase will have negligible effects on the intermittent stream. Further calculations to prove this point are included in the Regulatory Compliance section of this report.

Refer to Appendix A for the hydrologic modeling calculations.

The closed drainage system has been designed to control the 10-year storm event at a minimum. Additionally, the 100-year storm event was analyzed and adequate pipe capacity is available within the pipe network to control the discharge from the subsurface infiltration basins.

---

## TSS Removal

The stormwater management plan for this project utilizes BMPs including street sweeping, deep sump catch basins with hoods, water quality units, and subsurface infiltration basins with an isolator row. No credit has been taken for street sweeping in the TSS removal calculations; however, the Operations and Maintenance plan calls for at least quarterly sweeping of the property.

The Site is considered a Land Use with Higher Potential Pollutant Loads (LUHPPL) due to the projected traffic generation in excess of 1,000 vehicle trips per day. LUHPPLs require a 44% pretreatment rate for stormwater runoff prior to entering an infiltrating device. Also, LUHPPLs require a 1" water quality volume be provided for all BMPs.

The BMP treatment trains were designed to provide a minimum of 44% pretreatment prior to discharge into an infiltrating device and achieving a minimum of 80% TSS removal, for 1" of runoff, as required by the Massachusetts Stormwater Regulations. Two treatment trains have been incorporated into the Stormwater Management System.

Treatment Train #1, consists of:

1. Deep sump catch basins with hoods
2. Water quality unit (Stormceptor)
3. Isolator Row (Stormtech)
4. Subsurface Infiltration Basin (Stormtech Chambers)

Treatment Train #2, consists of:

1. Deep sump catch basins with hoods
2. Water Quality Unit (Stormceptor)

Refer to *Appendix B-Water Quality Data* for TSS Removal Spreadsheets and data supporting the use and effectiveness of the water quality units.

---

## Regulatory Compliance

The DEP/CZM Stormwater Management Policy prescribes ten performance standards for site development projects. Because the project will increase the overall impervious area onsite, it cannot be considered a redevelopment project, and has been designed to comply with the MassDEP Stormwater Management Standards completely. Compliance with the standards is outlined below.

1. *No new stormwater conveyances may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

This project proposes no new untreated stormwater discharges or will cause erosion in the wetlands or waters of the Commonwealth.

*2. Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

As summarized in Table 1 Peak Flow Summary, for DP-2, DP-3, and DP-4, the project reduces peak discharge rates for the 2, 10, 25, and 100-Year storm events.

DP-1 results in an increase of 0.35 cfs in the 100-year storm event. The increase is only occurring because of the curve numbers used to model the pre- and post- condition. Subcatchment PR-1 is the woods/grass area where the intermittent stream will be reconstructed. This portion of the site meets all of the criteria listed in Volume 3, Chapter 1, page 35 of the Massachusetts Stormwater Handbook for "De Minimus" discharges. Below is a calculation of weighted average TSS removal across the entire site:

$$\text{Weighted Average} = [(3.74 \text{ ac})(83\% \text{ TSS removal}) + (10.88 \text{ ac})(99\% \text{ TSS removal})] / (14.621 \text{ acres}) = 95\%$$

The weighted average method shows that a 95% TSS removal is achieved across the entire site, and the small increase at DP-1 is less than 1 cfs. Therefore, the increase in peak rate is considered "De Minimus" and meets the intent of the stormwater handbook.

The HydroCAD analysis and output can be found in Appendix A, *Hydrology Calculations*.

*3. Loss of annual recharge to groundwater should be minimized through the use of infiltration measures where feasible.*

The proposed stormwater management utilizes three subsurface infiltration basins to provide groundwater recharge. The required recharge volume is determined based on the total proposed impervious area and the classification of the soils on site (Hydrologic Soil Type A).

Calculation Method 1 (Mass DEP Stormwater Handbook)

$$R_v = F \times \text{Impervious Area}$$

$R_v$  = Required Recharge Volume, expressed in cubic feet

$F$  = Target Depth Factor associated with each Hydrologic Soil Group

Impervious Area = Pavement and rooftop area on site

NRCS HYDROLOGIC SOIL TYPE	APPROX. SOIL TEXTURE	TARGET DEPTH FACTOR (F)
---------------------------------	----------------------------	----------------------------

A	sand	0.6-inch
B	loam	0.35-inch
C	silty loam	0.25-inch
D	clay	0.1-inch

***Recharge Target Depth by Hydrologic Soil Group***

Impervious Area Draining to Infiltration BMP = 375,045 SF

Total Imperious Area = 448,886 SF

**Percent of Imperious Area Draining to Infiltration BMP = 83.55%**

$R_v = (0.60\text{-inch}) \times 448,886 \text{ SF of Total Impervious Area}$

**$R_v = 22,445 \text{ cubic feet of Required Recharge Volume}$**

Volume below lowest outlet (From HydroCAD):

P1 = 12,457 cubic feet

P2 = 4,286 cubic feet

P3 = 5,875 cubic feet

**Total Proposed  $R_v = 22,618 \text{ cubic feet (volume below lowest outlet)}$**

Volume infiltrated in 2-year storm (From HydroCAD):

P1 = 0.854 af = 37,200 cubic feet

P2 = 0.390 af = 16,988 cubic feet

P3 = 0.296 af = 12,893 cubic feet

**Total Proposed  $R_v = 67,171 \text{ cubic feet (volume infiltrated in 2-year storm)}$**

Therefore, storage volume of the basins and volume of stormwater infiltrated exceed the requirements of Standard 3.

Calculation Method 2 (Town of Andover Stormwater Regulations Section IX.A.1)

$Re_v = [(S)(R_v)(A)]/12$ , where

$Re_v$  = Recharge volume (acre\*feet)

$R_v = 0.05 + 0.009(I)$  where I is the percent impervious cover

A = site area in acres

S = Soil specific recharge factor

<u>Hydrologic Group</u>	<u>Soil Specific Recharge Factor</u>
A	0.60
B	0.35
C	0.25
D	0.10

For A Soils

$I=70.5$ ,  $R_v = 0.685$ ,  $A=14.62$ ,  $S=0.60$   
 $Re_v = [(0.60)(0.685)(14.62)]/12 = 0.501 \text{ acre}\cdot\text{feet}$   
 **$Re_v = 21,812 \text{ CF}$**   
**Total Proposed  $Re_v = 22,618 \text{ CF}$  (below lowest outlets)**  
**Total Proposed  $Re = 67,171 \text{ CF}$  (infiltrated in 2-year storm)**

Confirm that P1 will empty within 72 hours:

Volume of Storage Below Outlet = 12,457 CF  
 Infiltration Rate (HSG A soil) = 2.4"/hr  
 Footprint Area of P1 bottom = 9,100 SF  
 Time to Drain = 12,457 CF / (2.4"/hr) x (9,100 SF) = **6.84 hr < 72 hr**

Confirm that P2 will empty within 72 hours:

Volume of Storage Below Outlet = 4,286 CF  
 Infiltration Rate (HSG A soil) = 2.4"/hr  
 Footprint Area of P2 = 5,757 SF  
 Time to Drain = 4,286 CF / (2.4"/hr) x (5,757 SF) = **3.72 hr < 72 hr**

Confirm that P3 will empty within 72 hours:

Volume of Storage Below Outlet = 5,875 CF  
 Infiltration Rate (HSG A soil) = 2.4"/hr  
 Footprint Area of P3 = 6,350 SF  
 Time to Drain = 5,875 CF / (2.4"/hr) x (6,350 SF) = **4.63 hr < 72 hr**

*4. For new development, stormwater management systems must be designed to remove 80 percent of Total Suspended Solids.*

The proposed stormwater management design will implement BMP's including street sweeping, deep sump catch basins with hoods, water quality units, and subsurface infiltration basin with an isolator row to exceed the 80% TSS removal rate for all on-site runoff. The project proposes two different treatment trains that all meet the 80% minimum TSS removal requirement. Treatment train 1 achieves a 99% removal rate and treatment train 2 achieves a 83% removal rate. Please see the attached TSS removal sheets for reference.

The proposed BMPs have been sized to accommodate 1-year worth of sediment as required by Town of Andover Stormwater Regulations. Please see below calculations:

Sediment volume = Area to be sanded (acres) x 750 (lb/acre-storm) / 90 (pounds/cf) x 10 (storms/year) = (cf of sediment/year)

Sediment volume (WQU 1) = 1.18 ac x 750lb/ac-storm / 90lb/cf x 10storm/yr  
 Sediment volume (WQU 1) = 98 cf of sediment/year < **127 cf (STC 1200)**

Sediment volume (WQU 2) = 3.15 ac x 750lb/ac-storm / 90lb/cf x 10storm/yr  
 Sediment volume (WQU 2) = 263 cf of sediment/year < **373 cf (STC 3600)**

Sediment volume (WQU 3) = 0.67 ac x 750lb/ac-storm / 90lb/cf x 10storm/yr  
Sediment volume (WQU 3) = 56 cf of sediment/year < **89 cf (STC 900)**

Sediment volume (WQU 4) = 1.24 ac x 750lb/ac-storm / 90lb/cf x 10storm/yr  
Sediment volume (WQU 4) = 103 cf of sediment/year < **127 cf (STC 1200)**

Sediment volume (WQU 5) = 0.24 ac x 750lb/ac-storm / 90lb/cf x 10storm/yr  
Sediment volume (WQU 5) = 20 cf of sediment/year < **46 cf (STC 450)**

Stormceptor sizing has also been prepared using the MassDEP method with a Water Quality Flow rate. Please refer to Appendix B.

*5. Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs.*

The proposed project is considered a LUHPPL due to the traffic generation associated with the development. All stormwater will receive a 44% minimum TSS pretreatment rate prior to entering an infiltrating device. Also, all BMPs have been sized to provide a 1" minimum water quality volume.

Water Quality Volumes for P1:

Impervious pavement flowing to P1 = 137,321 SF

Required 1" WQV = 11,444 CF

Provided WQV below lowest outlet = 12,457 CF

Water Quality Volumes for P2:

Impervious pavement flowing to P2 = 29,298 SF

Required 1" WQV = 2,442 CF

Provided WQV below lowest outlet = 4,286 CF

Water Quality Volumes for P3:

Impervious pavement flowing to P3 = 53,846 SF

Required 1" WQV = 4,487 CF

Provided WQV below lowest outlet = 5,875 CF

Overall Site Water Quality Volume:

Impervious pavement area = 220,465 SF

Required 1" WQV = 18,372 CF

Provided WQV below onsite = 22,618 CF

*6. Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies.*

The site is not located within a critical area.

*7. Redevelopment of previously developed areas must meet the Stormwater Management Standards to the maximum extent practicable.*

The project is not considered a redevelopment.

*8. Erosion and sediment controls must be implemented to prevent impacts during construction or land disturbance activities.*

The project has been designed to include erosion and sedimentation controls to prevent impacts to downgradient property. Construction activities will be isolated from downgradient areas by creating an erosion control barrier with a compost filter sock/tube, silt sacks for existing and proposed catch basins and construction exits.

*9. All stormwater management systems must have an operation and maintenance plan to ensure that systems function as designed.*

The project will include a long-term Operation and Maintenance Plan, see Appendix C, to provide efficient operation of the features of the proposed drainage system.

*10. Illicit Discharges*

Only stormwater will be conveyed to the stormwater management system. No illicit materials will be permitted.

---

## **Conclusion**

This proposed project will provide a stormwater management system to mitigate the additional impervious area associated with the project. The stormwater management plan controls the flow of stormwater, reduces peak runoff rates, and provides water quality treatment and groundwater recharge. The stormwater management plan provides erosion and sediment control resulting in cleaner stormwater runoff and a Long Term Operation and Maintenance plan to ensure the proper functioning of the system over time. The project has been designed in accordance with the Stormwater Management Policy.

North  
1" = 400'

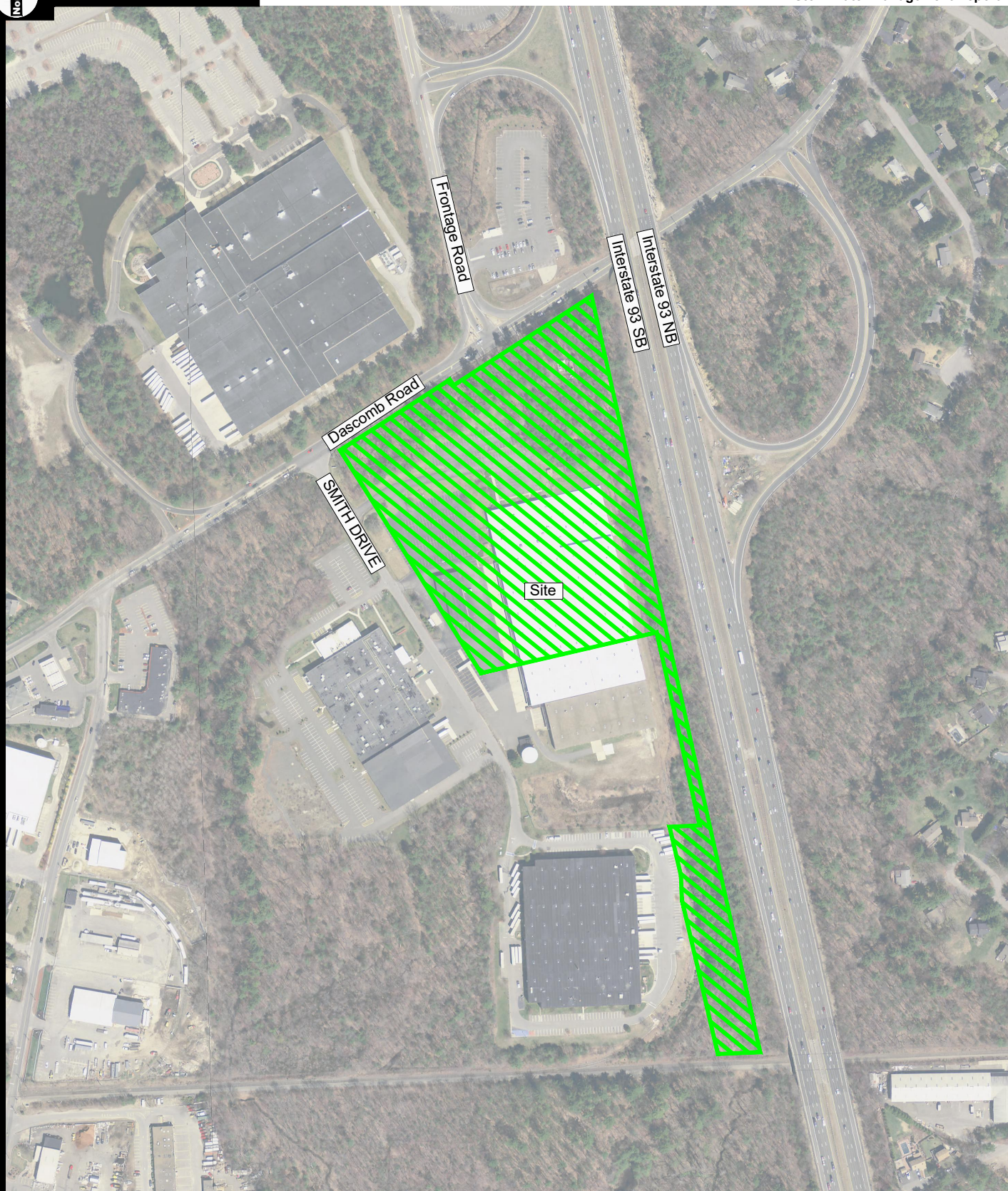


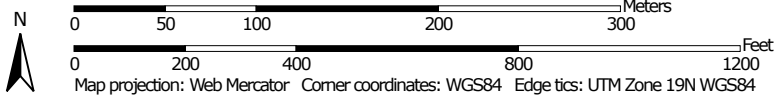
Figure 1  
Project Location Map



Hydrologic Soil Group—Essex County, Massachusetts, Northern Part; and Middlesex County, Massachusetts




Map Scale: 1:4,150 if printed on A portrait (8.5" x 11") sheet.



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points





 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:15,800 to 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Northern Part  
 Survey Area Data: Version 10, Sep 19, 2014

Soil Survey Area: Middlesex County, Massachusetts  
 Survey Area Data: Version 14, Sep 19, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

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

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

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Northern Part (MA605)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	A/D	0.1	0.2%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	11.7	33.6%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.2	0.6%
602	Urban land		18.4	52.9%
711C	Charlton-Rock outcrop-Hollis complex, 8 to 15 percent slopes	A	3.7	10.6%
<b>Subtotals for Soil Survey Area</b>			<b>34.0</b>	<b>97.8%</b>
<b>Totals for Area of Interest</b>			<b>34.8</b>	<b>100.0%</b>

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	A/D	0.2	0.5%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	0.4	1.1%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.2	0.6%
<b>Subtotals for Soil Survey Area</b>			<b>0.8</b>	<b>2.2%</b>
<b>Totals for Area of Interest</b>			<b>34.8</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

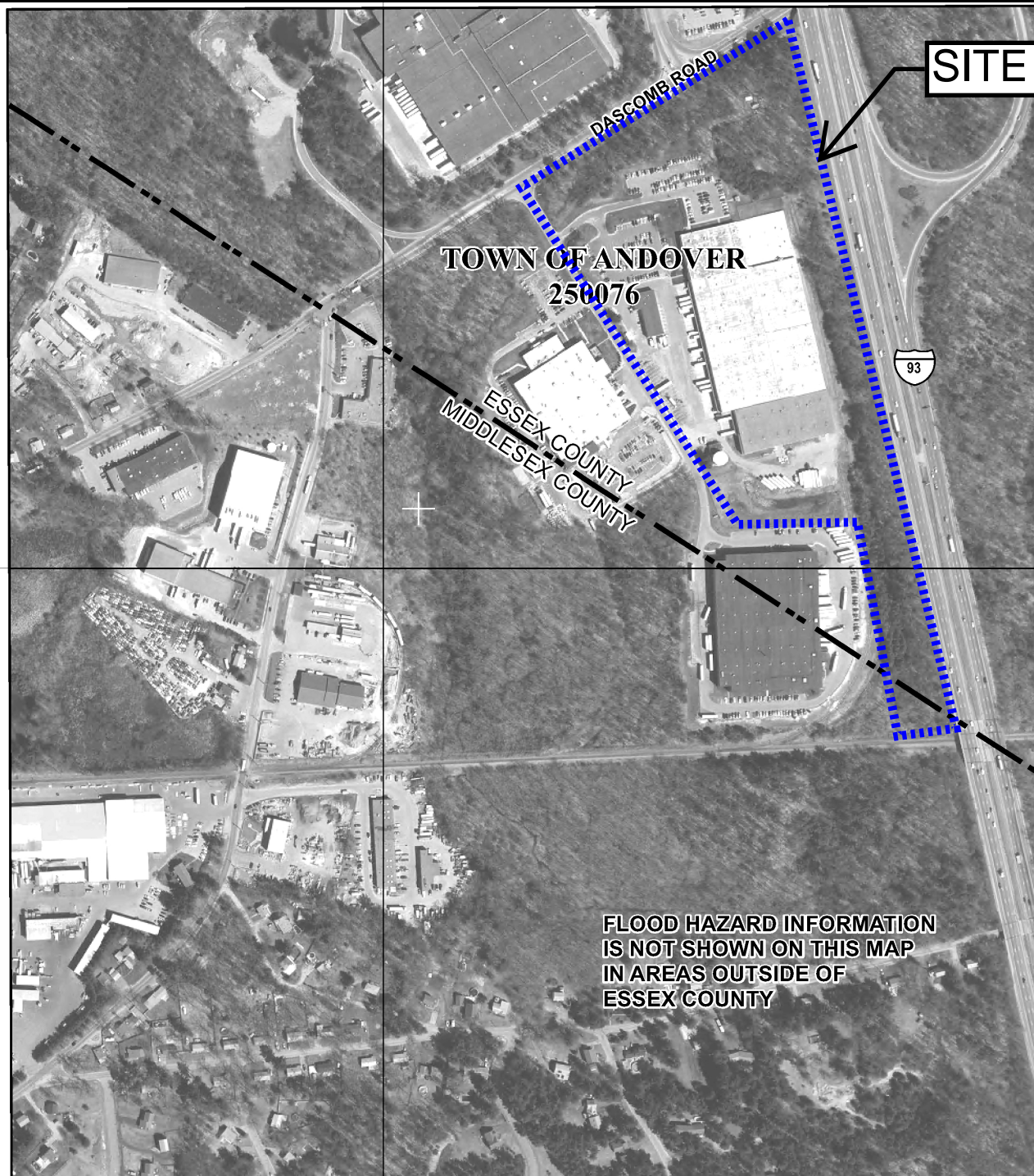
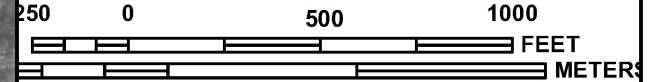
*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher



MAP SCALE 1" = 500'



**SITE**

**TOWN OF ANDOVER**

**250076**

**ESSEX COUNTY  
MIDDLESEX COUNTY**



**FLOOD HAZARD INFORMATION  
IS NOT SHOWN ON THIS MAP  
IN AREAS OUTSIDE OF  
ESSEX COUNTY**

PANEL 0356F

**FIRM**

**FLOOD INSURANCE RATE MAP**

**ESSEX COUNTY,  
MASSACHUSETTS  
(ALL JURISDICTIONS)**

**PANEL 356 OF 600**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ANDOVER, TOWN OF	250076	0356	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



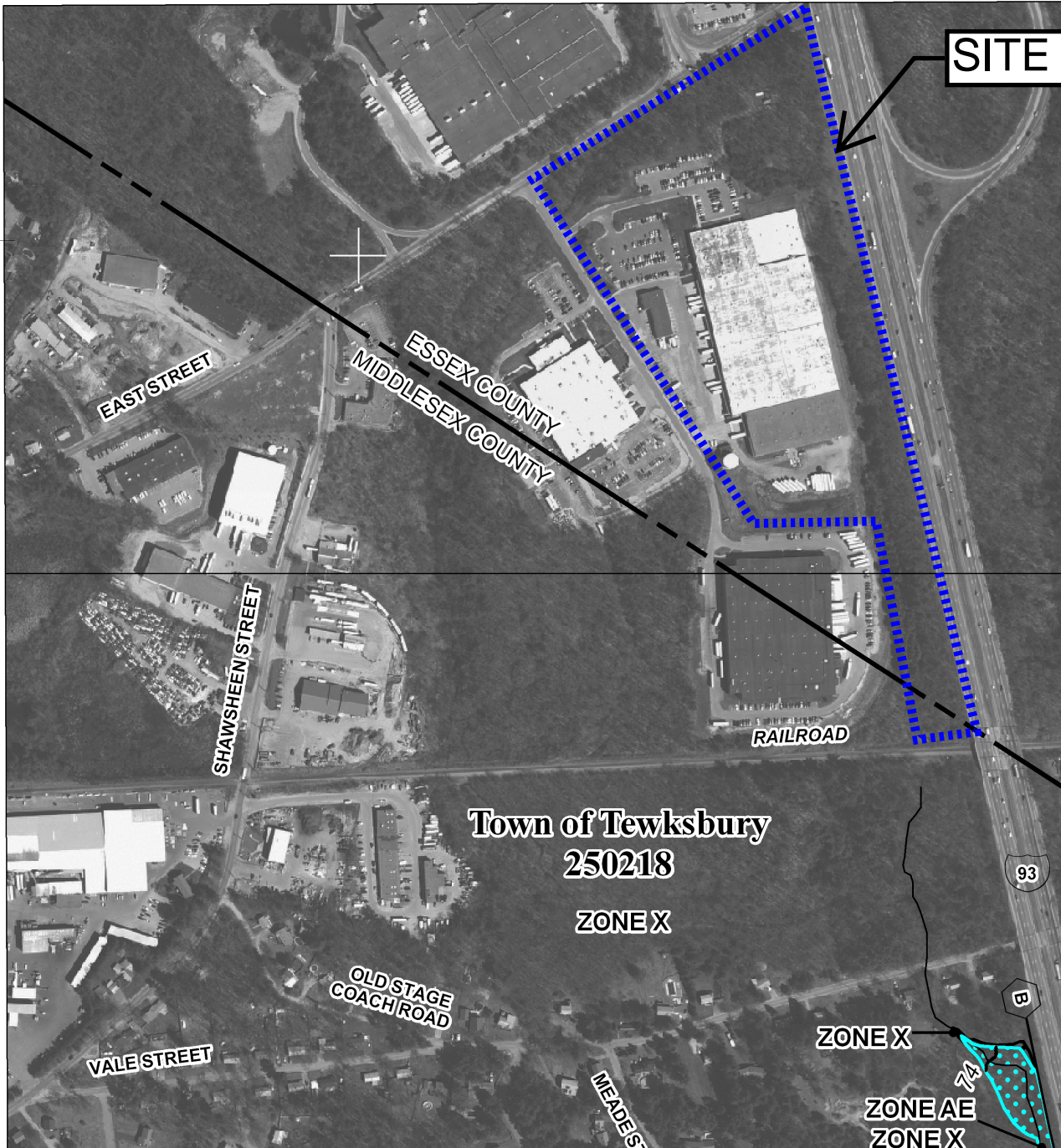
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**EFFECTIVE DATE  
JULY 3, 2012**

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)

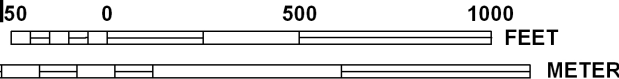
11'15"



**SITE**



MAP SCALE 1" = 500'



PANEL 0281E

**FIRM**  
**FLOOD INSURANCE RATE MAP**  
**MIDDLESEX COUNTY,**  
**MASSACHUSETTS**  
 (ALL JURISDICTIONS)

**PANEL 281 OF 656**  
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
TEWKSBURY, TOWN OF	250218	0281	E
WILMINGTON, TOWN OF	250227	0281	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



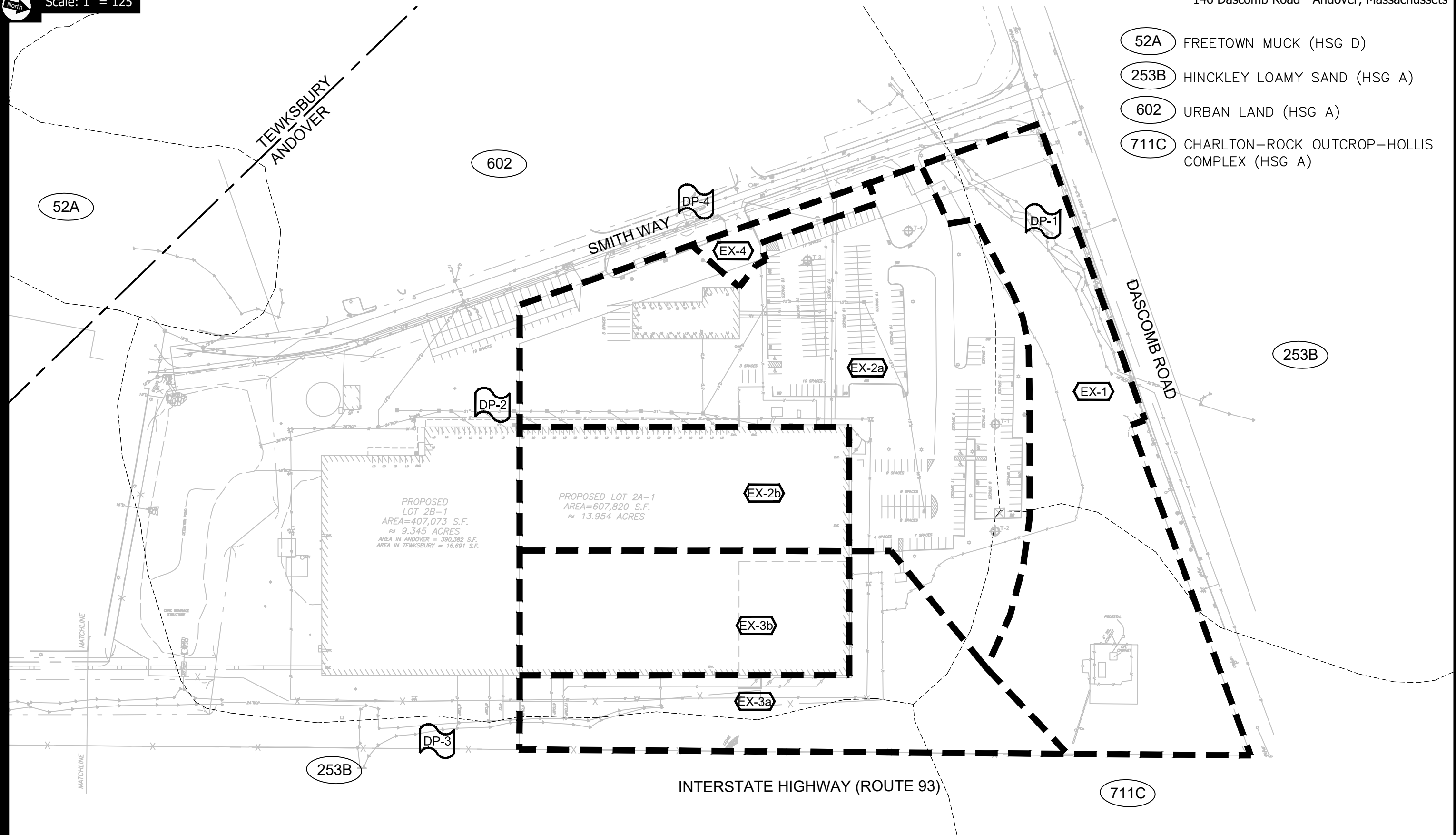
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**25017C0281E**

**EFFECTIVE DATE**  
**JUNE 4, 2010**

Federal Emergency Management Agency

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- 52A FREETOWN MUCK (HSG D)
- 253B HINCKLEY LOAMY SAND (HSG A)
- 602 URBAN LAND (HSG A)
- 711C CHARLTON-ROCK OUTCROP-HOLLIS COMPLEX (HSG A)



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**LEGEND**

- SUBCATCHMENT AREA
- SOIL CLASSIFICATION

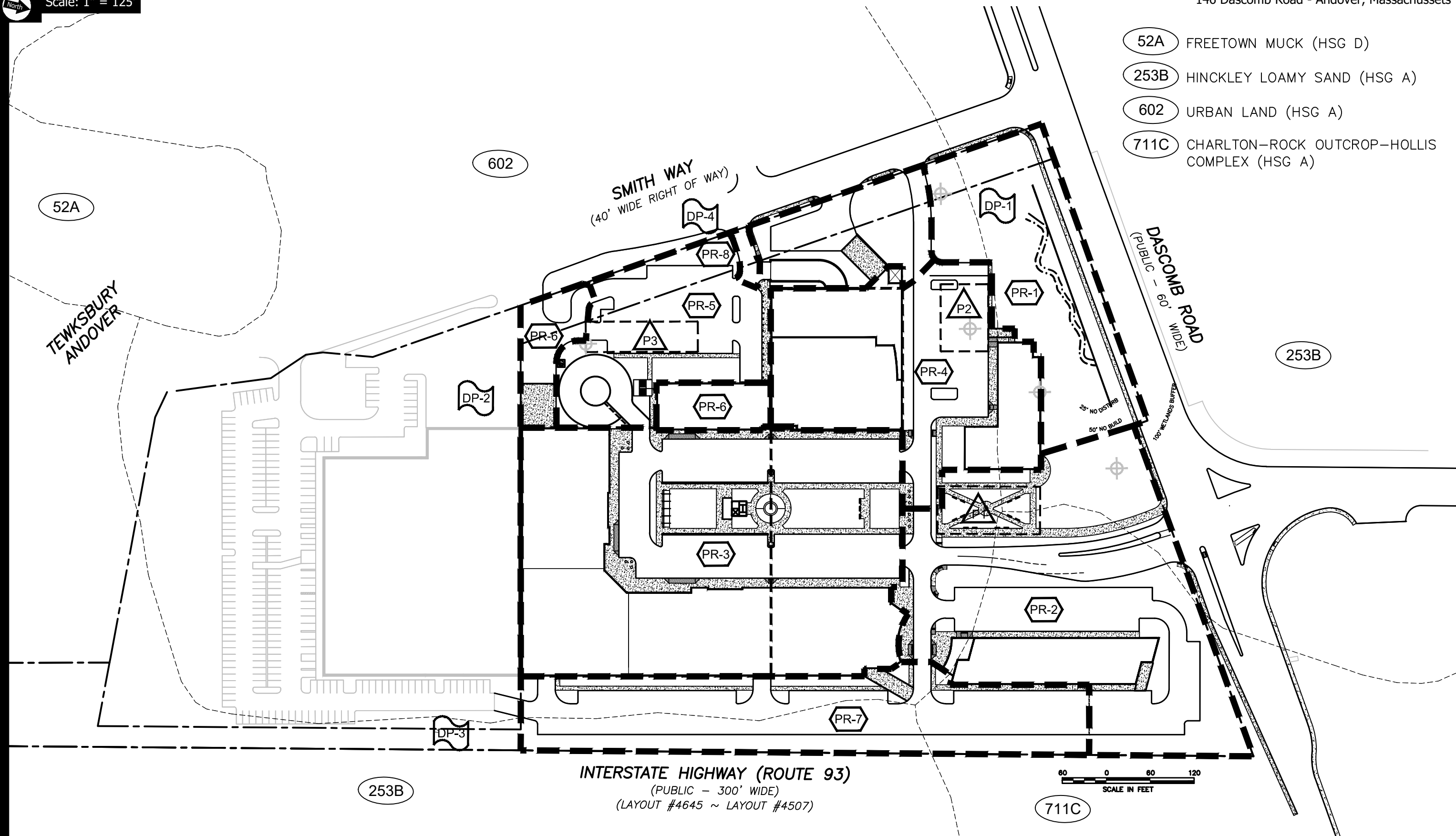
- DESIGN POINT

- DRAINAGE AREA BOUNDARY
- SOIL AREA BOUNDARY

Figure D-1

Pre Development  
Drainage Areas

- 52A FREETOWN MUCK (HSG D)
- 253B HINCKLEY LOAMY SAND (HSG A)
- 602 URBAN LAND (HSG A)
- 711C CHARLTON-ROCK OUTCROP-HOLLIS COMPLEX (HSG A)



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TEC, Inc.

**LEGEND**

- SUBCATCHMENT AREA
- SOIL CLASSIFICATION



DESIGN POINT



DRAINAGE AREA BOUNDARY



SOIL AREA BOUNDARY

Figure D-2

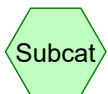
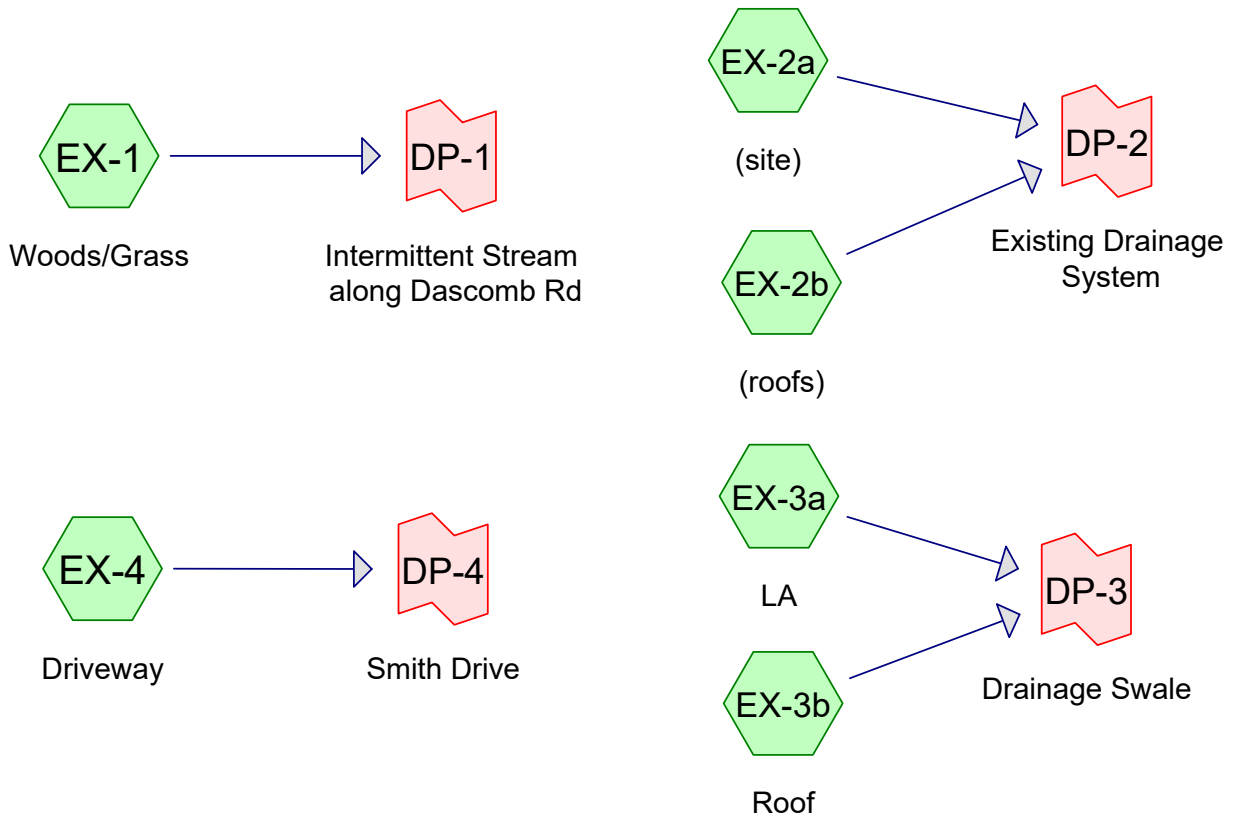
Post Development  
Drainage Areas

# 2

## Appendix

# A

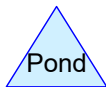
## Hydrology Calculations



Subcat



Reach



Pond



Link

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
2.319	68	<50% Grass cover, Poor, HSG A (EX-1, EX-2a, EX-3a, EX-4)
0.194	76	Gravel roads, HSG A (EX-1, EX-2a)
3.586	98	Paved parking, HSG A (EX-2a, EX-4)
0.192	98	Roofs, HSG A (EX-2a)
3.516	98	Unconnected roofs, HSG A (EX-2b, EX-3b)
5.024	30	Woods, Good, HSG A (EX-1, EX-2a, EX-3a)
<b>14.830</b>	<b>70</b>	<b>TOTAL AREA</b>

**Summary for Subcatchment EX-1: Woods/Grass**

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

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
136,858	30	Woods, Good, HSG A
2,348	76	Gravel roads, HSG A
5,254	76	Gravel roads, HSG A
1,953	68	<50% Grass cover, Poor, HSG A
12,913	68	<50% Grass cover, Poor, HSG A
159,326	36	Weighted Average
159,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.0	453	0.0640	1.26		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.5	503	Total			

**Summary for Subcatchment EX-2a: (site)**

Runoff = 11.28 cfs @ 12.08 hrs, Volume= 0.802 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
151,738	98	Paved parking, HSG A
54,046	68	<50% Grass cover, Poor, HSG A
14,656	30	Woods, Good, HSG A
833	76	Gravel roads, HSG A
8,360	98	Roofs, HSG A
229,633	87	Weighted Average
69,535		30.28% Pervious Area
160,098		69.72% Impervious Area

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

**Summary for Subcatchment EX-2b: (roofs)**

Runoff = 5.31 cfs @ 12.07 hrs, Volume= 0.419 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
76,387	98	Unconnected roofs, HSG A
76,387		100.00% Impervious Area
76,387		100.00% Unconnected

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

**Summary for Subcatchment EX-3a: LA**

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
67,324	30	Woods, Good, HSG A
27,087	68	<50% Grass cover, Poor, HSG A
94,411	41	Weighted Average
94,411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.3	513	0.0740	1.36		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	200	0.0200	4.93	11.33	<b>Channel Flow,</b> Area= 2.3 sf Perim= 3.9' r= 0.59' n= 0.030 Stream, clean & straight
23.3	763	Total			

**Summary for Subcatchment EX-3b: Roof**

Runoff = 5.33 cfs @ 12.07 hrs, Volume= 0.421 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
76,790	98	Unconnected roofs, HSG A
76,790		100.00% Impervious Area
76,790		100.00% Unconnected

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

**Summary for Subcatchment EX-4: Driveway**

Runoff = 0.37 cfs @ 12.08 hrs, Volume= 0.026 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
4,450	98	Paved parking, HSG A
5,000	68	<50% Grass cover, Poor, HSG A
9,450	82	Weighted Average
5,000		52.91% Pervious Area
4,450		47.09% Impervious Area

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

**Summary for Link DP-1: Intermittent Stream along Dascomb Rd**

Inflow Area = 3.658 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-YEAR event  
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-2: Existing Drainage System**

Inflow Area = 7.025 ac, 77.28% Impervious, Inflow Depth = 2.09" for 2-YEAR event  
 Inflow = 16.64 cfs @ 12.07 hrs, Volume= 1.222 af  
 Primary = 16.64 cfs @ 12.07 hrs, Volume= 1.222 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 3.930 ac, 44.85% Impervious, Inflow Depth = 1.29" for 2-YEAR event  
 Inflow = 5.33 cfs @ 12.07 hrs, Volume= 0.422 af  
 Primary = 5.33 cfs @ 12.07 hrs, Volume= 0.422 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.217 ac, 47.09% Impervious, Inflow Depth = 1.46" for 2-YEAR event  
Inflow = 0.37 cfs @ 12.08 hrs, Volume= 0.026 af  
Primary = 0.37 cfs @ 12.08 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Subcatchment EX-1: Woods/Grass**

Runoff = 0.03 cfs @ 15.62 hrs, Volume= 0.018 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
136,858	30	Woods, Good, HSG A
2,348	76	Gravel roads, HSG A
5,254	76	Gravel roads, HSG A
1,953	68	<50% Grass cover, Poor, HSG A
12,913	68	<50% Grass cover, Poor, HSG A
159,326	36	Weighted Average
159,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.0	453	0.0640	1.26		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.5	503	Total			

**Summary for Subcatchment EX-2a: (site)**

Runoff = 19.56 cfs @ 12.07 hrs, Volume= 1.402 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
151,738	98	Paved parking, HSG A
54,046	68	<50% Grass cover, Poor, HSG A
14,656	30	Woods, Good, HSG A
833	76	Gravel roads, HSG A
8,360	98	Roofs, HSG A
229,633	87	Weighted Average
69,535		30.28% Pervious Area
160,098		69.72% Impervious Area

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

**Summary for Subcatchment EX-2b: (roofs)**

Runoff = 7.93 cfs @ 12.07 hrs, Volume= 0.638 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
76,387	98	Unconnected roofs, HSG A
76,387		100.00% Impervious Area
76,387		100.00% Unconnected

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

**Summary for Subcatchment EX-3a: LA**

Runoff = 0.06 cfs @ 13.04 hrs, Volume= 0.033 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
67,324	30	Woods, Good, HSG A
27,087	68	<50% Grass cover, Poor, HSG A
94,411	41	Weighted Average
94,411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.3	513	0.0740	1.36		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	200	0.0200	4.93	11.33	<b>Channel Flow,</b> Area= 2.3 sf Perim= 3.9' r= 0.59' n= 0.030 Stream, clean & straight
23.3	763	Total			

**Summary for Subcatchment EX-3b: Roof**

Runoff = 7.98 cfs @ 12.07 hrs, Volume= 0.641 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
76,790	98	Unconnected roofs, HSG A
76,790		100.00% Impervious Area
76,790		100.00% Unconnected

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

**Summary for Subcatchment EX-4: Driveway**

Runoff = 0.69 cfs @ 12.08 hrs, Volume= 0.049 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
4,450	98	Paved parking, HSG A
5,000	68	<50% Grass cover, Poor, HSG A
9,450	82	Weighted Average
5,000		52.91% Pervious Area
4,450		47.09% Impervious Area

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

**Summary for Link DP-1: Intermittent Stream along Dascomb Rd**

Inflow Area = 3.658 ac, 0.00% Impervious, Inflow Depth = 0.06" for 10-YEAR event  
Inflow = 0.03 cfs @ 15.62 hrs, Volume= 0.018 af  
Primary = 0.03 cfs @ 15.62 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-2: Existing Drainage System**

Inflow Area = 7.025 ac, 77.28% Impervious, Inflow Depth = 3.48" for 10-YEAR event  
Inflow = 27.49 cfs @ 12.07 hrs, Volume= 2.040 af  
Primary = 27.49 cfs @ 12.07 hrs, Volume= 2.040 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 3.930 ac, 44.85% Impervious, Inflow Depth = 2.06" for 10-YEAR event  
Inflow = 7.98 cfs @ 12.07 hrs, Volume= 0.674 af  
Primary = 7.98 cfs @ 12.07 hrs, Volume= 0.674 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.217 ac, 47.09% Impervious, Inflow Depth = 2.72" for 10-YEAR event  
Inflow = 0.69 cfs @ 12.08 hrs, Volume= 0.049 af  
Primary = 0.69 cfs @ 12.08 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Subcatchment EX-1: Woods/Grass**

Runoff = 0.10 cfs @ 13.80 hrs, Volume= 0.058 af, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
136,858	30	Woods, Good, HSG A
2,348	76	Gravel roads, HSG A
5,254	76	Gravel roads, HSG A
1,953	68	<50% Grass cover, Poor, HSG A
12,913	68	<50% Grass cover, Poor, HSG A
159,326	36	Weighted Average
159,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.0	453	0.0640	1.26		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.5	503	Total			

**Summary for Subcatchment EX-2a: (site)**

Runoff = 24.53 cfs @ 12.07 hrs, Volume= 1.775 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
151,738	98	Paved parking, HSG A
54,046	68	<50% Grass cover, Poor, HSG A
14,656	30	Woods, Good, HSG A
833	76	Gravel roads, HSG A
8,360	98	Roofs, HSG A
229,633	87	Weighted Average
69,535		30.28% Pervious Area
160,098		69.72% Impervious Area

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

**Summary for Subcatchment EX-2b: (roofs)**

Runoff = 9.51 cfs @ 12.07 hrs, Volume= 0.769 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
76,387	98	Unconnected roofs, HSG A
76,387		100.00% Impervious Area
76,387		100.00% Unconnected

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

**Summary for Subcatchment EX-3a: LA**

Runoff = 0.27 cfs @ 12.60 hrs, Volume= 0.073 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
67,324	30	Woods, Good, HSG A
27,087	68	<50% Grass cover, Poor, HSG A
94,411	41	Weighted Average
94,411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.3	513	0.0740	1.36		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	200	0.0200	4.93	11.33	<b>Channel Flow,</b> Area= 2.3 sf Perim= 3.9' r= 0.59' n= 0.030 Stream, clean & straight
23.3	763	Total			

**Summary for Subcatchment EX-3b: Roof**

Runoff = 9.56 cfs @ 12.07 hrs, Volume= 0.773 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
76,790	98	Unconnected roofs, HSG A
76,790		100.00% Impervious Area
76,790		100.00% Unconnected

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

**Summary for Subcatchment EX-4: Driveway**

Runoff = 0.89 cfs @ 12.08 hrs, Volume= 0.064 af, Depth= 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
4,450	98	Paved parking, HSG A
5,000	68	<50% Grass cover, Poor, HSG A
9,450	82	Weighted Average
5,000		52.91% Pervious Area
4,450		47.09% Impervious Area

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

**Summary for Link DP-1: Intermittent Stream along Dascomb Rd**

Inflow Area = 3.658 ac, 0.00% Impervious, Inflow Depth = 0.19" for 25-YEAR event  
 Inflow = 0.10 cfs @ 13.80 hrs, Volume= 0.058 af  
 Primary = 0.10 cfs @ 13.80 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-2: Existing Drainage System**

Inflow Area = 7.025 ac, 77.28% Impervious, Inflow Depth = 4.35" for 25-YEAR event  
 Inflow = 34.03 cfs @ 12.07 hrs, Volume= 2.544 af  
 Primary = 34.03 cfs @ 12.07 hrs, Volume= 2.544 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 3.930 ac, 44.85% Impervious, Inflow Depth = 2.58" for 25-YEAR event  
 Inflow = 9.56 cfs @ 12.07 hrs, Volume= 0.846 af  
 Primary = 9.56 cfs @ 12.07 hrs, Volume= 0.846 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.217 ac, 47.09% Impervious, Inflow Depth = 3.53" for 25-YEAR event  
Inflow = 0.89 cfs @ 12.08 hrs, Volume= 0.064 af  
Primary = 0.89 cfs @ 12.08 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Subcatchment EX-1: Woods/Grass**

Runoff = 0.58 cfs @ 12.52 hrs, Volume= 0.144 af, Depth= 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
136,858	30	Woods, Good, HSG A
2,348	76	Gravel roads, HSG A
5,254	76	Gravel roads, HSG A
1,953	68	<50% Grass cover, Poor, HSG A
12,913	68	<50% Grass cover, Poor, HSG A
159,326	36	Weighted Average
159,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.0	453	0.0640	1.26		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
16.5	503	Total			

**Summary for Subcatchment EX-2a: (site)**

Runoff = 31.13 cfs @ 12.07 hrs, Volume= 2.280 af, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
151,738	98	Paved parking, HSG A
54,046	68	<50% Grass cover, Poor, HSG A
14,656	30	Woods, Good, HSG A
833	76	Gravel roads, HSG A
8,360	98	Roofs, HSG A
229,633	87	Weighted Average
69,535		30.28% Pervious Area
160,098		69.72% Impervious Area

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

**Summary for Subcatchment EX-2b: (roofs)**

Runoff = 11.60 cfs @ 12.07 hrs, Volume= 0.944 af, Depth= 6.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
76,387	98	Unconnected roofs, HSG A
76,387		100.00% Impervious Area
76,387		100.00% Unconnected

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

**Summary for Subcatchment EX-3a: LA**

Runoff = 0.78 cfs @ 12.50 hrs, Volume= 0.145 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
67,324	30	Woods, Good, HSG A
27,087	68	<50% Grass cover, Poor, HSG A
94,411	41	Weighted Average
94,411		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	50	0.0100	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.20"
6.3	513	0.0740	1.36		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
0.7	200	0.0200	4.93	11.33	<b>Channel Flow,</b> Area= 2.3 sf Perim= 3.9' r= 0.59' n= 0.030 Stream, clean & straight
23.3	763	Total			

**Summary for Subcatchment EX-3b: Roof**

Runoff = 11.66 cfs @ 12.07 hrs, Volume= 0.949 af, Depth= 6.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
76,790	98	Unconnected roofs, HSG A
76,790		100.00% Impervious Area
76,790		100.00% Unconnected

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

**Summary for Subcatchment EX-4: Driveway**

Runoff = 1.17 cfs @ 12.07 hrs, Volume= 0.084 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
4,450	98	Paved parking, HSG A
5,000	68	<50% Grass cover, Poor, HSG A
9,450	82	Weighted Average
5,000		52.91% Pervious Area
4,450		47.09% Impervious Area

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

**Summary for Link DP-1: Intermittent Stream along Dascomb Rd**

Inflow Area = 3.658 ac, 0.00% Impervious, Inflow Depth = 0.47" for 100-YEAR event  
 Inflow = 0.58 cfs @ 12.52 hrs, Volume= 0.144 af  
 Primary = 0.58 cfs @ 12.52 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-2: Existing Drainage System**

Inflow Area = 7.025 ac, 77.28% Impervious, Inflow Depth = 5.51" for 100-YEAR event  
 Inflow = 42.73 cfs @ 12.07 hrs, Volume= 3.224 af  
 Primary = 42.73 cfs @ 12.07 hrs, Volume= 3.224 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-3: Drainage Swale**

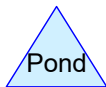
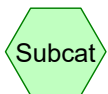
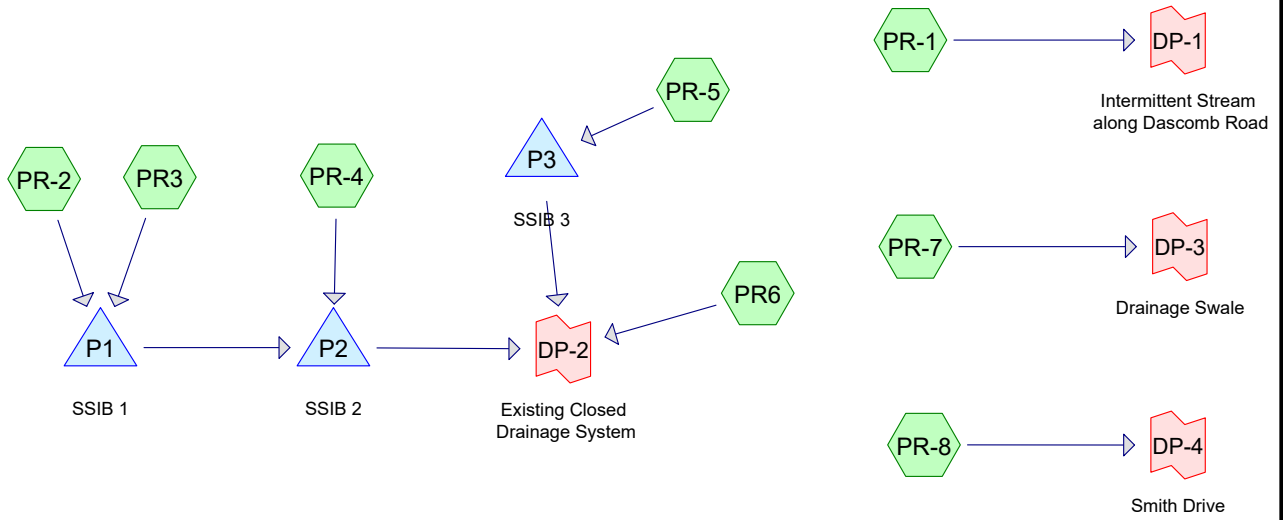
Inflow Area = 3.930 ac, 44.85% Impervious, Inflow Depth = 3.34" for 100-YEAR event  
 Inflow = 11.68 cfs @ 12.07 hrs, Volume= 1.094 af  
 Primary = 11.68 cfs @ 12.07 hrs, Volume= 1.094 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.217 ac, 47.09% Impervious, Inflow Depth = 4.64" for 100-YEAR event  
Inflow = 1.17 cfs @ 12.07 hrs, Volume= 0.084 af  
Primary = 1.17 cfs @ 12.07 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-40.00 hrs, dt= 0.05 hrs



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## Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.037	68	<50% Grass cover, Poor, HSG A (PR-2, PR-4, PR-5, PR-7, PR3, PR6)
6.525	98	Paved parking, HSG A (PR-2, PR-4, PR-5, PR-7, PR-8, PR3, PR6)
3.780	98	Roofs, HSG A (PR-2, PR-4, PR3, PR6)
1.279	43	Woods/grass comb., Fair, HSG A (PR-1)
<b>14.621</b>	<b>87</b>	<b>TOTAL AREA</b>

**Summary for Subcatchment PR-1:**

Runoff = 0.00 cfs @ 21.25 hrs, Volume= 0.002 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
55,733	43	Woods/grass comb., Fair, HSG A
55,733		100.00% Pervious Area

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

**Summary for Subcatchment PR-2:**

Runoff = 6.59 cfs @ 12.08 hrs, Volume= 0.456 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
17,745	98	Roofs, HSG A
53,929	68	<50% Grass cover, Poor, HSG A
64,748	98	Paved parking, HSG A
136,422	86	Weighted Average
53,929		39.53% Pervious Area
82,493		60.47% Impervious Area

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

**Summary for Subcatchment PR-4:**

Runoff = 5.79 cfs @ 12.07 hrs, Volume= 0.429 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
6,476	68	<50% Grass cover, Poor, HSG A
13,000	98	Roofs, HSG A
22,113	98	Roofs, HSG A
13,682	98	Roofs, HSG A
29,298	98	Paved parking, HSG A
84,569	96	Weighted Average
6,476		7.66% Pervious Area
78,093		92.34% Impervious Area

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Type III 24-hr 2-YEAR Rainfall=3.10"

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

**Summary for Subcatchment PR-5:**

Runoff = 4.11 cfs @ 12.07 hrs, Volume= 0.284 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
27,244	68	<50% Grass cover, Poor, HSG A
50,634	98	Paved parking, HSG A
77,878	88	Weighted Average
27,244		34.98% Pervious Area
50,634		65.02% Impervious Area

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

**Summary for Subcatchment PR-7:**

Runoff = 4.04 cfs @ 12.07 hrs, Volume= 0.279 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
28,730	68	<50% Grass cover, Poor, HSG A
51,195	98	Paved parking, HSG A
79,925	87	Weighted Average
28,730		35.95% Pervious Area
51,195		64.05% Impervious Area

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

**Summary for Subcatchment PR-8:**

Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

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Type III 24-hr 2-YEAR Rainfall=3.10"

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Area (sf)	CN	Description
2,011	98	Paved parking, HSG A
2,011		100.00% Impervious Area

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

**Summary for Subcatchment PR3:**

Runoff = 11.98 cfs @ 12.07 hrs, Volume= 0.887 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
43,802	98	Roofs, HSG A
20,988	98	Roofs, HSG A
23,240	98	Roofs, HSG A
6,018	68	<50% Grass cover, Poor, HSG A
8,336	68	<50% Grass cover, Poor, HSG A
72,573	98	Paved parking, HSG A
174,957	96	Weighted Average
14,354		8.20% Pervious Area
160,603		91.80% Impervious Area

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

**Summary for Subcatchment PR6:**

Runoff = 1.74 cfs @ 12.07 hrs, Volume= 0.129 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 2-YEAR Rainfall=3.10"

Area (sf)	CN	Description
10,085	98	Roofs, HSG A
1,570	68	<50% Grass cover, Poor, HSG A
13,750	98	Paved parking, HSG A
25,405	96	Weighted Average
1,570		6.18% Pervious Area
23,835		93.82% Impervious Area

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

**Summary for Pond P1: SSIB 1**

Inflow Area = 7.148 ac, 78.07% Impervious, Inflow Depth = 2.26" for 2-YEAR event  
 Inflow = 18.59 cfs @ 12.07 hrs, Volume= 1.343 af  
 Outflow = 8.07 cfs @ 12.25 hrs, Volume= 1.343 af, Atten= 57%, Lag= 10.8 min  
 Discarded = 0.57 cfs @ 12.25 hrs, Volume= 0.848 af  
 Primary = 7.50 cfs @ 12.25 hrs, Volume= 0.496 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 128.80' @ 12.25 hrs Surf.Area= 9,073 sf Storage= 18,441 cf

Plug-Flow detention time= 152.5 min calculated for 1.343 af (100% of inflow)  
 Center-of-Mass det. time= 152.4 min ( 943.1 - 790.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	126.00'	14,457 cf	<b>64.83'W x 139.94'L x 6.75'H Field A</b> 61,242 cf Overall - 25,099 cf Embedded = 36,143 cf x 40.0% Voids
#2A	126.75'	25,099 cf	<b>ADS_StormTech MC-4500 +Cap x 231 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 231 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		39,556 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	127.00'	<b>24.0" Round Culvert</b> L= 83.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 127.00' / 126.30' S= 0.0084 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	128.00'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	132.00'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 4.0' Crest Height
#4	Discarded	126.00'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.57 cfs @ 12.25 hrs HW=128.80' (Free Discharge)  
 ↳4=Exfiltration (Exfiltration Controls 0.57 cfs)

**Primary OutFlow** Max=7.50 cfs @ 12.25 hrs HW=128.80' (Free Discharge)  
 ↳1=Culvert (Passes 7.50 cfs of 12.70 cfs potential flow)  
 ↳2=Orifice/Grate (Orifice Controls 7.50 cfs @ 3.21 fps)  
 ↳3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond P2: SSIB 2**

Inflow Area = 9.090 ac, 81.12% Impervious, Inflow Depth = 1.22" for 2-YEAR event  
 Inflow = 10.45 cfs @ 12.16 hrs, Volume= 0.925 af  
 Outflow = 8.39 cfs @ 12.40 hrs, Volume= 0.925 af, Atten= 20%, Lag= 14.2 min  
 Discarded = 0.37 cfs @ 12.40 hrs, Volume= 0.371 af  
 Primary = 8.02 cfs @ 12.40 hrs, Volume= 0.553 af

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Type III 24-hr 2-YEAR Rainfall=3.10"

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Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 120.36' @ 12.40 hrs Surf.Area= 5,941 sf Storage= 8,653 cf

Plug-Flow detention time= 53.1 min calculated for 0.924 af (100% of inflow)  
 Center-of-Mass det. time= 53.1 min ( 826.9 - 773.8 )

Volume	Invert	Avail.Storage	Storage Description
#1A	118.25'	9,580 cf	<b>64.83'W x 91.64'L x 6.75'H Field A</b> 40,105 cf Overall - 16,154 cf Embedded = 23,951 cf x 40.0% Voids
#2A	119.00'	16,154 cf	<b>ADS_StormTech MC-4500 +Cap x 147 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 147 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		25,734 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	118.25'	<b>24.0" Round Culvert</b> L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 118.25' / 116.00' S= 0.0180 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	119.50'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	124.50'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 5.7' Crest Height
#4	Discarded	118.25'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.37 cfs @ 12.40 hrs HW=120.36' (Free Discharge)

↳ **4=Exfiltration** (Exfiltration Controls 0.37 cfs)

**Primary OutFlow** Max=8.02 cfs @ 12.40 hrs HW=120.36' (Free Discharge)

↳ **1=Culvert** (Passes 8.02 cfs of 15.95 cfs potential flow)

↳ **2=Orifice/Grate** (Orifice Controls 8.02 cfs @ 3.44 fps)

↳ **3=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond P3: SSIB 3**

Inflow Area =	1.788 ac, 65.02% Impervious, Inflow Depth = 1.91" for 2-YEAR event
Inflow =	4.11 cfs @ 12.07 hrs, Volume= 0.284 af
Outflow =	0.38 cfs @ 12.99 hrs, Volume= 0.284 af, Atten= 91%, Lag= 55.2 min
Discarded =	0.38 cfs @ 12.99 hrs, Volume= 0.284 af
Primary =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 110.01' @ 12.99 hrs Surf.Area= 6,338 sf Storage= 4,700 cf

Plug-Flow detention time= 103.9 min calculated for 0.284 af (100% of inflow)  
 Center-of-Mass det. time= 103.9 min ( 919.3 - 815.4 )

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Type III 24-hr 2-YEAR Rainfall=3.10"

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Volume	Invert	Avail.Storage	Storage Description
#1A	108.80'	4,429 cf	<b>41.50'W x 152.72'L x 2.33'H Field A</b> 14,788 cf Overall - 3,715 cf Embedded = 11,073 cf x 40.0% Voids
#2A	109.30'	3,715 cf	<b>ADS_StormTech SC-310 +Cap x 252</b> Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 12 Rows
		8,144 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	108.80'	<b>21.0" Round Culvert</b> L= 45.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 108.80' / 104.50' S= 0.0956 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 2.41 sf
#2	Device 1	110.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	108.80'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.38 cfs @ 12.99 hrs HW=110.01' (Free Discharge)↑**3=Exfiltration** (Exfiltration Controls 0.38 cfs)**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=108.80' (Free Discharge)↑**1=Culvert** ( Controls 0.00 cfs)↑**2=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)**Summary for Link DP-1: Intermittent Stream along Dascomb Road**

Inflow Area = 1.279 ac, 0.00% Impervious, Inflow Depth = 0.01" for 2-YEAR event  
 Inflow = 0.00 cfs @ 21.25 hrs, Volume= 0.002 af  
 Primary = 0.00 cfs @ 21.25 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-2: Existing Closed Drainage System**

Inflow Area = 11.461 ac, 79.25% Impervious, Inflow Depth = 0.71" for 2-YEAR event  
 Inflow = 8.52 cfs @ 12.38 hrs, Volume= 0.682 af  
 Primary = 8.52 cfs @ 12.38 hrs, Volume= 0.682 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 1.835 ac, 64.05% Impervious, Inflow Depth = 1.83" for 2-YEAR event  
 Inflow = 4.04 cfs @ 12.07 hrs, Volume= 0.279 af  
 Primary = 4.04 cfs @ 12.07 hrs, Volume= 0.279 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.046 ac, 100.00% Impervious, Inflow Depth = 2.87" for 2-YEAR event  
Inflow = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af  
Primary = 0.14 cfs @ 12.07 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

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Type III 24-hr 10-YEAR Rainfall=4.60"

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**Summary for Subcatchment PR-1:**

Runoff = 0.10 cfs @ 12.39 hrs, Volume= 0.027 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
55,733	43	Woods/grass comb., Fair, HSG A
55,733		100.00% Pervious Area

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

**Summary for Subcatchment PR-2:**

Runoff = 11.58 cfs @ 12.07 hrs, Volume= 0.808 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
17,745	98	Roofs, HSG A
53,929	68	<50% Grass cover, Poor, HSG A
64,748	98	Paved parking, HSG A
136,422	86	Weighted Average
53,929		39.53% Pervious Area
82,493		60.47% Impervious Area

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

**Summary for Subcatchment PR-4:**

Runoff = 8.82 cfs @ 12.07 hrs, Volume= 0.669 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
6,476	68	<50% Grass cover, Poor, HSG A
13,000	98	Roofs, HSG A
22,113	98	Roofs, HSG A
13,682	98	Roofs, HSG A
29,298	98	Paved parking, HSG A
84,569	96	Weighted Average
6,476		7.66% Pervious Area
78,093		92.34% Impervious Area

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Type III 24-hr 10-YEAR Rainfall=4.60"

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

**Summary for Subcatchment PR-5:**

Runoff = 6.97 cfs @ 12.07 hrs, Volume= 0.490 af, Depth= 3.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
27,244	68	<50% Grass cover, Poor, HSG A
50,634	98	Paved parking, HSG A
77,878	88	Weighted Average
27,244		34.98% Pervious Area
50,634		65.02% Impervious Area

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

**Summary for Subcatchment PR-7:**

Runoff = 6.97 cfs @ 12.07 hrs, Volume= 0.488 af, Depth= 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
28,730	68	<50% Grass cover, Poor, HSG A
51,195	98	Paved parking, HSG A
79,925	87	Weighted Average
28,730		35.95% Pervious Area
51,195		64.05% Impervious Area

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

**Summary for Subcatchment PR-8:**

Runoff = 0.21 cfs @ 12.07 hrs, Volume= 0.017 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

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Type III 24-hr 10-YEAR Rainfall=4.60"

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Area (sf)	CN	Description
2,011	98	Paved parking, HSG A
2,011		100.00% Impervious Area

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

**Summary for Subcatchment PR3:**

Runoff = 18.24 cfs @ 12.07 hrs, Volume= 1.384 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
43,802	98	Roofs, HSG A
20,988	98	Roofs, HSG A
23,240	98	Roofs, HSG A
6,018	68	<50% Grass cover, Poor, HSG A
8,336	68	<50% Grass cover, Poor, HSG A
72,573	98	Paved parking, HSG A
174,957	96	Weighted Average
14,354		8.20% Pervious Area
160,603		91.80% Impervious Area

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

**Summary for Subcatchment PR6:**

Runoff = 2.65 cfs @ 12.07 hrs, Volume= 0.201 af, Depth= 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 10-YEAR Rainfall=4.60"

Area (sf)	CN	Description
10,085	98	Roofs, HSG A
1,570	68	<50% Grass cover, Poor, HSG A
13,750	98	Paved parking, HSG A
25,405	96	Weighted Average
1,570		6.18% Pervious Area
23,835		93.82% Impervious Area

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

**Summary for Pond P1: SSIB 1**

Inflow Area = 7.148 ac, 78.07% Impervious, Inflow Depth = 3.68" for 10-YEAR event  
 Inflow = 29.82 cfs @ 12.07 hrs, Volume= 2.192 af  
 Outflow = 15.08 cfs @ 12.20 hrs, Volume= 2.192 af, Atten= 49%, Lag= 7.9 min  
 Discarded = 0.60 cfs @ 12.20 hrs, Volume= 1.003 af  
 Primary = 14.48 cfs @ 12.20 hrs, Volume= 1.189 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 130.00' @ 12.20 hrs Surf.Area= 9,073 sf Storage= 26,745 cf

Plug-Flow detention time= 121.8 min calculated for 2.190 af (100% of inflow)  
 Center-of-Mass det. time= 121.9 min ( 901.3 - 779.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	126.00'	14,457 cf	<b>64.83'W x 139.94'L x 6.75'H Field A</b> 61,242 cf Overall - 25,099 cf Embedded = 36,143 cf x 40.0% Voids
#2A	126.75'	25,099 cf	<b>ADS_StormTech MC-4500 +Cap x 231 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 231 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		39,556 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	127.00'	<b>24.0" Round Culvert</b> L= 83.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 127.00' / 126.30' S= 0.0084 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	128.00'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	132.00'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 4.0' Crest Height
#4	Discarded	126.00'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.60 cfs @ 12.20 hrs HW=130.00' (Free Discharge)  
 ↳4=Exfiltration (Exfiltration Controls 0.60 cfs)

**Primary OutFlow** Max=14.47 cfs @ 12.20 hrs HW=130.00' (Free Discharge)  
 ↳1=Culvert (Passes 14.47 cfs of 20.64 cfs potential flow)  
 ↳2=Orifice/Grate (Orifice Controls 14.47 cfs @ 6.20 fps)  
 ↳3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond P2: SSIB 2**

Inflow Area = 9.090 ac, 81.12% Impervious, Inflow Depth = 2.45" for 10-YEAR event  
 Inflow = 21.19 cfs @ 12.10 hrs, Volume= 1.858 af  
 Outflow = 15.59 cfs @ 12.39 hrs, Volume= 1.858 af, Atten= 26%, Lag= 17.2 min  
 Discarded = 0.39 cfs @ 12.39 hrs, Volume= 0.463 af  
 Primary = 15.20 cfs @ 12.39 hrs, Volume= 1.396 af

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Type III 24-hr 10-YEAR Rainfall=4.60"

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Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 121.67' @ 12.39 hrs Surf.Area= 5,941 sf Storage= 14,832 cf

Plug-Flow detention time= 38.7 min calculated for 1.857 af (100% of inflow)  
 Center-of-Mass det. time= 38.7 min ( 809.3 - 770.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	118.25'	9,580 cf	<b>64.83'W x 91.64'L x 6.75'H Field A</b> 40,105 cf Overall - 16,154 cf Embedded = 23,951 cf x 40.0% Voids
#2A	119.00'	16,154 cf	<b>ADS_StormTech MC-4500 +Cap x 147 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 147 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		25,734 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	118.25'	<b>24.0" Round Culvert</b> L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 118.25' / 116.00' S= 0.0180 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	119.50'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	124.50'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 5.7' Crest Height
#4	Discarded	118.25'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.39 cfs @ 12.39 hrs HW=121.67' (Free Discharge)

↳ **4=Exfiltration** (Exfiltration Controls 0.39 cfs)

**Primary OutFlow** Max=15.20 cfs @ 12.39 hrs HW=121.67' (Free Discharge)

↳ **1=Culvert** (Passes 15.20 cfs of 23.52 cfs potential flow)  
 ↳ **2=Orifice/Grate** (Orifice Controls 15.20 cfs @ 6.51 fps)  
 ↳ **3=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond P3: SSIB 3**

Inflow Area =	1.788 ac, 65.02% Impervious, Inflow Depth = 3.29" for 10-YEAR event
Inflow =	6.97 cfs @ 12.07 hrs, Volume= 0.490 af
Outflow =	2.62 cfs @ 12.31 hrs, Volume= 0.490 af, Atten= 62%, Lag= 14.3 min
Discarded =	0.39 cfs @ 12.31 hrs, Volume= 0.400 af
Primary =	2.22 cfs @ 12.31 hrs, Volume= 0.090 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 110.61' @ 12.31 hrs Surf.Area= 6,338 sf Storage= 6,804 cf

Plug-Flow detention time= 115.4 min calculated for 0.490 af (100% of inflow)  
 Center-of-Mass det. time= 115.4 min ( 915.4 - 800.0 )

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Type III 24-hr 10-YEAR Rainfall=4.60"

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Volume	Invert	Avail.Storage	Storage Description
#1A	108.80'	4,429 cf	<b>41.50'W x 152.72'L x 2.33'H Field A</b> 14,788 cf Overall - 3,715 cf Embedded = 11,073 cf x 40.0% Voids
#2A	109.30'	3,715 cf	<b>ADS_StormTech SC-310 +Cap x 252</b> Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 12 Rows
		8,144 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	108.80'	<b>21.0" Round Culvert</b> L= 45.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 108.80' / 104.50' S= 0.0956 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 2.41 sf
#2	Device 1	110.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	108.80'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.39 cfs @ 12.31 hrs HW=110.60' (Free Discharge)↑**3=Exfiltration** (Exfiltration Controls 0.39 cfs)**Primary OutFlow** Max=2.21 cfs @ 12.31 hrs HW=110.60' (Free Discharge)↑**1=Culvert** (Passes 2.21 cfs of 11.16 cfs potential flow)↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 2.21 cfs @ 1.85 fps)**Summary for Link DP-1: Intermittent Stream along Dascomb Road**

Inflow Area = 1.279 ac, 0.00% Impervious, Inflow Depth = 0.25" for 10-YEAR event  
 Inflow = 0.10 cfs @ 12.39 hrs, Volume= 0.027 af  
 Primary = 0.10 cfs @ 12.39 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-2: Existing Closed Drainage System**

Inflow Area = 11.461 ac, 79.25% Impervious, Inflow Depth = 1.77" for 10-YEAR event  
 Inflow = 18.18 cfs @ 12.33 hrs, Volume= 1.687 af  
 Primary = 18.18 cfs @ 12.33 hrs, Volume= 1.687 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 1.835 ac, 64.05% Impervious, Inflow Depth = 3.19" for 10-YEAR event  
 Inflow = 6.97 cfs @ 12.07 hrs, Volume= 0.488 af  
 Primary = 6.97 cfs @ 12.07 hrs, Volume= 0.488 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.046 ac, 100.00% Impervious, Inflow Depth = 4.36" for 10-YEAR event  
Inflow = 0.21 cfs @ 12.07 hrs, Volume= 0.017 af  
Primary = 0.21 cfs @ 12.07 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

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Type III 24-hr 25-YEAR Rainfall=5.50"

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**Summary for Subcatchment PR-1:**

Runoff = 0.30 cfs @ 12.28 hrs, Volume= 0.054 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
55,733	43	Woods/grass comb., Fair, HSG A
55,733		100.00% Pervious Area

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

**Summary for Subcatchment PR-2:**

Runoff = 14.60 cfs @ 12.07 hrs, Volume= 1.027 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
17,745	98	Roofs, HSG A
53,929	68	<50% Grass cover, Poor, HSG A
64,748	98	Paved parking, HSG A
136,422	86	Weighted Average
53,929		39.53% Pervious Area
82,493		60.47% Impervious Area

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

**Summary for Subcatchment PR-4:**

Runoff = 10.61 cfs @ 12.07 hrs, Volume= 0.814 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
6,476	68	<50% Grass cover, Poor, HSG A
13,000	98	Roofs, HSG A
22,113	98	Roofs, HSG A
13,682	98	Roofs, HSG A
29,298	98	Paved parking, HSG A
84,569	96	Weighted Average
6,476		7.66% Pervious Area
78,093		92.34% Impervious Area

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Type III 24-hr 25-YEAR Rainfall=5.50"

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

**Summary for Subcatchment PR-5:**

Runoff = 8.69 cfs @ 12.07 hrs, Volume= 0.618 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
27,244	68	<50% Grass cover, Poor, HSG A
50,634	98	Paved parking, HSG A
77,878	88	Weighted Average
27,244		34.98% Pervious Area
50,634		65.02% Impervious Area

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

**Summary for Subcatchment PR-7:**

Runoff = 8.74 cfs @ 12.07 hrs, Volume= 0.618 af, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
28,730	68	<50% Grass cover, Poor, HSG A
51,195	98	Paved parking, HSG A
79,925	87	Weighted Average
28,730		35.95% Pervious Area
51,195		64.05% Impervious Area

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

**Summary for Subcatchment PR-8:**

Runoff = 0.26 cfs @ 12.07 hrs, Volume= 0.020 af, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

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Type III 24-hr 25-YEAR Rainfall=5.50"

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Area (sf)	CN	Description
2,011	98	Paved parking, HSG A
2,011		100.00% Impervious Area

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

**Summary for Subcatchment PR3:**

Runoff = 21.96 cfs @ 12.07 hrs, Volume= 1.683 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
43,802	98	Roofs, HSG A
20,988	98	Roofs, HSG A
23,240	98	Roofs, HSG A
6,018	68	<50% Grass cover, Poor, HSG A
8,336	68	<50% Grass cover, Poor, HSG A
72,573	98	Paved parking, HSG A
174,957	96	Weighted Average
14,354		8.20% Pervious Area
160,603		91.80% Impervious Area

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

**Summary for Subcatchment PR6:**

Runoff = 3.19 cfs @ 12.07 hrs, Volume= 0.244 af, Depth= 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 25-YEAR Rainfall=5.50"

Area (sf)	CN	Description
10,085	98	Roofs, HSG A
1,570	68	<50% Grass cover, Poor, HSG A
13,750	98	Paved parking, HSG A
25,405	96	Weighted Average
1,570		6.18% Pervious Area
23,835		93.82% Impervious Area

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

**Summary for Pond P1: SSIB 1**

Inflow Area = 7.148 ac, 78.07% Impervious, Inflow Depth = 4.55" for 25-YEAR event  
 Inflow = 36.56 cfs @ 12.07 hrs, Volume= 2.711 af  
 Outflow = 18.09 cfs @ 12.21 hrs, Volume= 2.711 af, Atten= 51%, Lag= 8.2 min  
 Discarded = 0.61 cfs @ 12.21 hrs, Volume= 1.074 af  
 Primary = 17.47 cfs @ 12.21 hrs, Volume= 1.637 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 130.76' @ 12.21 hrs Surf.Area= 9,073 sf Storage= 31,359 cf

Plug-Flow detention time= 110.8 min calculated for 2.709 af (100% of inflow)  
 Center-of-Mass det. time= 111.0 min ( 885.7 - 774.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	126.00'	14,457 cf	<b>64.83'W x 139.94'L x 6.75'H Field A</b> 61,242 cf Overall - 25,099 cf Embedded = 36,143 cf x 40.0% Voids
#2A	126.75'	25,099 cf	<b>ADS_StormTech MC-4500 +Cap x 231 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 231 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		39,556 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	127.00'	<b>24.0" Round Culvert</b> L= 83.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 127.00' / 126.30' S= 0.0084 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	128.00'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	132.00'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 4.0' Crest Height
#4	Discarded	126.00'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.61 cfs @ 12.21 hrs HW=130.75' (Free Discharge)  
 ↳4=Exfiltration (Exfiltration Controls 0.61 cfs)

**Primary OutFlow** Max=17.47 cfs @ 12.21 hrs HW=130.75' (Free Discharge)  
 ↳1=Culvert (Passes 17.47 cfs of 24.81 cfs potential flow)  
 ↳2=Orifice/Grate (Orifice Controls 17.47 cfs @ 7.49 fps)  
 ↳3=Sharp-Crested Rectangular Weir ( Controls 0.00 cfs)

**Summary for Pond P2: SSIB 2**

Inflow Area = 9.090 ac, 81.12% Impervious, Inflow Depth = 3.24" for 25-YEAR event  
 Inflow = 25.58 cfs @ 12.10 hrs, Volume= 2.450 af  
 Outflow = 18.78 cfs @ 12.40 hrs, Volume= 2.450 af, Atten= 27%, Lag= 17.9 min  
 Discarded = 0.40 cfs @ 12.40 hrs, Volume= 0.509 af  
 Primary = 18.37 cfs @ 12.40 hrs, Volume= 1.941 af

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Type III 24-hr 25-YEAR Rainfall=5.50"

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Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 122.51' @ 12.40 hrs Surf.Area= 5,941 sf Storage= 18,454 cf

Plug-Flow detention time= 35.6 min calculated for 2.449 af (100% of inflow)  
 Center-of-Mass det. time= 35.6 min ( 806.3 - 770.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	118.25'	9,580 cf	<b>64.83'W x 91.64'L x 6.75'H Field A</b> 40,105 cf Overall - 16,154 cf Embedded = 23,951 cf x 40.0% Voids
#2A	119.00'	16,154 cf	<b>ADS_StormTech MC-4500 +Cap x 147 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 147 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		25,734 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	118.25'	<b>24.0" Round Culvert</b> L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 118.25' / 116.00' S= 0.0180 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	119.50'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	124.50'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 5.7' Crest Height
#4	Discarded	118.25'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.40 cfs @ 12.40 hrs HW=122.51' (Free Discharge)

↳ **4=Exfiltration** (Exfiltration Controls 0.40 cfs)

**Primary OutFlow** Max=18.36 cfs @ 12.40 hrs HW=122.51' (Free Discharge)

↳ **1=Culvert** (Passes 18.36 cfs of 27.31 cfs potential flow)  
 ↳ **2=Orifice/Grate** (Orifice Controls 18.36 cfs @ 7.87 fps)  
 ↳ **3=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond P3: SSIB 3**

Inflow Area =	1.788 ac, 65.02% Impervious, Inflow Depth = 4.15" for 25-YEAR event
Inflow =	8.69 cfs @ 12.07 hrs, Volume= 0.618 af
Outflow =	5.20 cfs @ 12.18 hrs, Volume= 0.618 af, Atten= 40%, Lag= 6.2 min
Discarded =	0.40 cfs @ 12.18 hrs, Volume= 0.443 af
Primary =	4.81 cfs @ 12.18 hrs, Volume= 0.175 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 110.81' @ 12.18 hrs Surf.Area= 6,338 sf Storage= 7,320 cf

Plug-Flow detention time= 104.2 min calculated for 0.617 af (100% of inflow)  
 Center-of-Mass det. time= 104.1 min ( 897.7 - 793.6 )

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Type III 24-hr 25-YEAR Rainfall=5.50"

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Volume	Invert	Avail.Storage	Storage Description
#1A	108.80'	4,429 cf	<b>41.50'W x 152.72'L x 2.33'H Field A</b> 14,788 cf Overall - 3,715 cf Embedded = 11,073 cf x 40.0% Voids
#2A	109.30'	3,715 cf	<b>ADS_StormTech SC-310 +Cap x 252</b> Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 12 Rows
		8,144 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	108.80'	<b>21.0" Round Culvert</b> L= 45.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 108.80' / 104.50' S= 0.0956 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 2.41 sf
#2	Device 1	110.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	108.80'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.40 cfs @ 12.18 hrs HW=110.81' (Free Discharge)↑**3=Exfiltration** (Exfiltration Controls 0.40 cfs)**Primary OutFlow** Max=4.78 cfs @ 12.18 hrs HW=110.81' (Free Discharge)↑**1=Culvert** (Passes 4.78 cfs of 12.32 cfs potential flow)↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 4.78 cfs @ 2.42 fps)**Summary for Link DP-1: Intermittent Stream along Dascomb Road**

Inflow Area = 1.279 ac, 0.00% Impervious, Inflow Depth = 0.50" for 25-YEAR event  
 Inflow = 0.30 cfs @ 12.28 hrs, Volume= 0.054 af  
 Primary = 0.30 cfs @ 12.28 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-2: Existing Closed Drainage System**

Inflow Area = 11.461 ac, 79.25% Impervious, Inflow Depth = 2.47" for 25-YEAR event  
 Inflow = 23.00 cfs @ 12.20 hrs, Volume= 2.361 af  
 Primary = 23.00 cfs @ 12.20 hrs, Volume= 2.361 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 1.835 ac, 64.05% Impervious, Inflow Depth = 4.04" for 25-YEAR event  
 Inflow = 8.74 cfs @ 12.07 hrs, Volume= 0.618 af  
 Primary = 8.74 cfs @ 12.07 hrs, Volume= 0.618 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.046 ac, 100.00% Impervious, Inflow Depth = 5.26" for 25-YEAR event  
Inflow = 0.26 cfs @ 12.07 hrs, Volume= 0.020 af  
Primary = 0.26 cfs @ 12.07 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Subcatchment PR-1:**

Runoff = 0.93 cfs @ 12.11 hrs, Volume= 0.101 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
55,733	43	Woods/grass comb., Fair, HSG A
55,733		100.00% Pervious Area

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

**Summary for Subcatchment PR-2:**

Runoff = 18.62 cfs @ 12.07 hrs, Volume= 1.325 af, Depth= 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
17,745	98	Roofs, HSG A
53,929	68	<50% Grass cover, Poor, HSG A
64,748	98	Paved parking, HSG A
136,422	86	Weighted Average
53,929		39.53% Pervious Area
82,493		60.47% Impervious Area

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

**Summary for Subcatchment PR-4:**

Runoff = 13.00 cfs @ 12.07 hrs, Volume= 1.007 af, Depth= 6.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
6,476	68	<50% Grass cover, Poor, HSG A
13,000	98	Roofs, HSG A
22,113	98	Roofs, HSG A
13,682	98	Roofs, HSG A
29,298	98	Paved parking, HSG A
84,569	96	Weighted Average
6,476		7.66% Pervious Area
78,093		92.34% Impervious Area

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Type III 24-hr 100-YEAR Rainfall=6.70"

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

**Summary for Subcatchment PR-5:**

Runoff = 10.97 cfs @ 12.07 hrs, Volume= 0.790 af, Depth= 5.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
27,244	68	<50% Grass cover, Poor, HSG A
50,634	98	Paved parking, HSG A
77,878	88	Weighted Average
27,244		34.98% Pervious Area
50,634		65.02% Impervious Area

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

**Summary for Subcatchment PR-7:**

Runoff = 11.09 cfs @ 12.07 hrs, Volume= 0.794 af, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
28,730	68	<50% Grass cover, Poor, HSG A
51,195	98	Paved parking, HSG A
79,925	87	Weighted Average
28,730		35.95% Pervious Area
51,195		64.05% Impervious Area

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

**Summary for Subcatchment PR-8:**

Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.025 af, Depth= 6.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

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Type III 24-hr 100-YEAR Rainfall=6.70"

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Area (sf)	CN	Description
2,011	98	Paved parking, HSG A
2,011		100.00% Impervious Area

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

**Summary for Subcatchment PR3:**

Runoff = 26.90 cfs @ 12.07 hrs, Volume= 2.083 af, Depth= 6.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
43,802	98	Roofs, HSG A
20,988	98	Roofs, HSG A
23,240	98	Roofs, HSG A
6,018	68	<50% Grass cover, Poor, HSG A
8,336	68	<50% Grass cover, Poor, HSG A
72,573	98	Paved parking, HSG A
174,957	96	Weighted Average
14,354		8.20% Pervious Area
160,603		91.80% Impervious Area

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

**Summary for Subcatchment PR6:**

Runoff = 3.91 cfs @ 12.07 hrs, Volume= 0.303 af, Depth= 6.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
Type III 24-hr 100-YEAR Rainfall=6.70"

Area (sf)	CN	Description
10,085	98	Roofs, HSG A
1,570	68	<50% Grass cover, Poor, HSG A
13,750	98	Paved parking, HSG A
25,405	96	Weighted Average
1,570		6.18% Pervious Area
23,835		93.82% Impervious Area

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

**Summary for Pond P1: SSIB 1**

Inflow Area = 7.148 ac, 78.07% Impervious, Inflow Depth = 5.72" for 100-YEAR event  
 Inflow = 45.52 cfs @ 12.07 hrs, Volume= 3.409 af  
 Outflow = 22.52 cfs @ 12.21 hrs, Volume= 3.409 af, Atten= 51%, Lag= 8.2 min  
 Discarded = 0.64 cfs @ 12.21 hrs, Volume= 1.144 af  
 Primary = 21.88 cfs @ 12.21 hrs, Volume= 2.264 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 132.06' @ 12.21 hrs Surf.Area= 9,073 sf Storage= 37,045 cf

Plug-Flow detention time= 99.2 min calculated for 3.409 af (100% of inflow)  
 Center-of-Mass det. time= 99.1 min ( 868.8 - 769.7 )

Volume	Invert	Avail.Storage	Storage Description
#1A	126.00'	14,457 cf	<b>64.83'W x 139.94'L x 6.75'H Field A</b> 61,242 cf Overall - 25,099 cf Embedded = 36,143 cf x 40.0% Voids
#2A	126.75'	25,099 cf	<b>ADS_StormTech MC-4500 +Cap x 231 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 231 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		39,556 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	127.00'	<b>24.0" Round Culvert</b> L= 83.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 127.00' / 126.30' S= 0.0084 1' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	128.00'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	132.00'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 4.0' Crest Height
#4	Discarded	126.00'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.64 cfs @ 12.21 hrs HW=132.05' (Free Discharge)  
 ↳4=Exfiltration (Exfiltration Controls 0.64 cfs)

**Primary OutFlow** Max=21.83 cfs @ 12.21 hrs HW=132.05' (Free Discharge)  
 ↳1=Culvert (Passes 21.83 cfs of 30.46 cfs potential flow)  
 ↳2=Orifice/Grate (Orifice Controls 21.67 cfs @ 9.29 fps)  
 ↳3=Sharp-Crested Rectangular Weir (Weir Controls 0.17 cfs @ 0.77 fps)

**Summary for Pond P2: SSIB 2**

Inflow Area = 9.090 ac, 81.12% Impervious, Inflow Depth = 4.32" for 100-YEAR event  
 Inflow = 30.99 cfs @ 12.10 hrs, Volume= 3.272 af  
 Outflow = 22.97 cfs @ 12.39 hrs, Volume= 3.272 af, Atten= 26%, Lag= 17.5 min  
 Discarded = 0.43 cfs @ 12.39 hrs, Volume= 0.570 af  
 Primary = 22.54 cfs @ 12.39 hrs, Volume= 2.702 af

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Type III 24-hr 100-YEAR Rainfall=6.70"

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Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 123.86' @ 12.39 hrs Surf.Area= 5,941 sf Storage= 23,019 cf

Plug-Flow detention time= 33.7 min calculated for 3.269 af (100% of inflow)  
 Center-of-Mass det. time= 33.7 min ( 805.3 - 771.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	118.25'	9,580 cf	<b>64.83'W x 91.64'L x 6.75'H Field A</b> 40,105 cf Overall - 16,154 cf Embedded = 23,951 cf x 40.0% Voids
#2A	119.00'	16,154 cf	<b>ADS_StormTech MC-4500 +Cap x 147 Inside #1</b> Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap 147 Chambers in 7 Rows Cap Storage= +35.7 cf x 2 x 7 rows = 499.8 cf
		25,734 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	118.25'	<b>24.0" Round Culvert</b> L= 125.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 118.25' / 116.00' S= 0.0180 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	119.50'	<b>42.0" W x 8.0" H Vert. Orifice/Grate</b> C= 0.600
#3	Device 1	124.50'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 5.7' Crest Height
#4	Discarded	118.25'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.43 cfs @ 12.39 hrs HW=123.86' (Free Discharge)

↳ **4=Exfiltration** (Exfiltration Controls 0.43 cfs)

**Primary OutFlow** Max=22.54 cfs @ 12.39 hrs HW=123.86' (Free Discharge)

↳ **1=Culvert** (Passes 22.54 cfs of 32.48 cfs potential flow)

↳ **2=Orifice/Grate** (Orifice Controls 22.54 cfs @ 9.66 fps)

↳ **3=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Summary for Pond P3: SSIB 3**

Inflow Area =	1.788 ac, 65.02% Impervious, Inflow Depth = 5.30" for 100-YEAR event
Inflow =	10.97 cfs @ 12.07 hrs, Volume= 0.790 af
Outflow =	9.26 cfs @ 12.12 hrs, Volume= 0.790 af, Atten= 16%, Lag= 3.1 min
Discarded =	0.40 cfs @ 12.12 hrs, Volume= 0.492 af
Primary =	8.85 cfs @ 12.12 hrs, Volume= 0.298 af

Routing by Stor-Ind method, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs  
 Peak Elev= 111.06' @ 12.12 hrs Surf.Area= 6,338 sf Storage= 7,959 cf

Plug-Flow detention time= 93.6 min calculated for 0.789 af (100% of inflow)  
 Center-of-Mass det. time= 93.6 min ( 880.4 - 786.9 )

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Type III 24-hr 100-YEAR Rainfall=6.70"

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Volume	Invert	Avail.Storage	Storage Description
#1A	108.80'	4,429 cf	<b>41.50'W x 152.72'L x 2.33'H Field A</b> 14,788 cf Overall - 3,715 cf Embedded = 11,073 cf x 40.0% Voids
#2A	109.30'	3,715 cf	<b>ADS_StormTech SC-310 +Cap x 252</b> Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 252 Chambers in 12 Rows
		8,144 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	108.80'	<b>21.0" Round Culvert</b> L= 45.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 108.80' / 104.50' S= 0.0956 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 2.41 sf
#2	Device 1	110.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s) 1.5' Crest Height
#3	Discarded	108.80'	<b>2.400 in/hr Exfiltration over Wetted area</b>

**Discarded OutFlow** Max=0.40 cfs @ 12.12 hrs HW=111.06' (Free Discharge)↑**3=Exfiltration** (Exfiltration Controls 0.40 cfs)**Primary OutFlow** Max=8.78 cfs @ 12.12 hrs HW=111.06' (Free Discharge)↑**1=Culvert** (Passes 8.78 cfs of 13.61 cfs potential flow)↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 8.78 cfs @ 3.02 fps)**Summary for Link DP-1: Intermittent Stream along Dascomb Road**

Inflow Area = 1.279 ac, 0.00% Impervious, Inflow Depth = 0.95" for 100-YEAR event  
 Inflow = 0.93 cfs @ 12.11 hrs, Volume= 0.101 af  
 Primary = 0.93 cfs @ 12.11 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-2: Existing Closed Drainage System**

Inflow Area = 11.461 ac, 79.25% Impervious, Inflow Depth = 3.46" for 100-YEAR event  
 Inflow = 29.98 cfs @ 12.13 hrs, Volume= 3.302 af  
 Primary = 29.98 cfs @ 12.13 hrs, Volume= 3.302 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-3: Drainage Swale**

Inflow Area = 1.835 ac, 64.05% Impervious, Inflow Depth = 5.19" for 100-YEAR event  
 Inflow = 11.09 cfs @ 12.07 hrs, Volume= 0.794 af  
 Primary = 11.09 cfs @ 12.07 hrs, Volume= 0.794 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

**Summary for Link DP-4: Smith Drive**

Inflow Area = 0.046 ac, 100.00% Impervious, Inflow Depth = 6.46" for 100-YEAR event  
Inflow = 0.31 cfs @ 12.07 hrs, Volume= 0.025 af  
Primary = 0.31 cfs @ 12.07 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-39.99 hrs, dt= 0.03 hrs

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Type III 24-hr 100-YEAR Rainfall=6.70"

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**Stage-Area-Storage for Pond P1: SSIB 1**

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
126.00	9,073	0	131.30	11,243	34,154
126.10	9,114	363	131.40	11,284	34,575
126.20	9,155	726	131.50	11,325	34,975
126.30	9,196	1,089	131.60	11,366	35,365
126.40	9,237	1,452	131.70	11,407	35,744
126.50	9,278	1,815	131.80	11,448	36,109
126.60	9,319	2,177	131.90	11,489	36,471
126.70	9,360	2,540	132.00	11,530	36,834
126.80	9,401	3,118	132.10	11,571	37,197
126.90	9,441	3,908	132.20	11,612	37,560
127.00	9,482	4,697	132.30	11,653	37,923
127.10	9,523	5,483	132.40	11,694	38,286
127.20	9,564	6,268	132.50	11,735	38,649
127.30	9,605	7,051	132.60	11,776	39,012
127.40	9,646	7,831	132.70	<b>11,817</b>	<b>39,375</b>
127.50	9,687	8,609			
127.60	9,728	9,384			
127.70	9,769	10,157			
127.80	9,810	10,927			
127.90	9,851	11,693			
<b>128.00</b>	<b>9,892</b>	<b>12,457</b>	Lowest outlet elevation		
128.10	9,933	13,217			
128.20	9,974	13,974			
128.30	10,015	14,727			
128.40	10,056	15,476			
128.50	10,097	16,221			
128.60	10,138	16,961			
128.70	10,179	17,697			
128.80	10,220	18,428			
128.90	10,261	19,154			
129.00	10,302	19,875			
129.10	10,342	20,591			
129.20	10,383	21,301			
129.30	10,424	22,005			
129.40	10,465	22,703			
129.50	10,506	23,394			
129.60	10,547	24,078			
129.70	10,588	24,756			
129.80	10,629	25,426			
129.90	10,670	26,088			
130.00	10,711	26,741			
130.10	10,752	27,386			
130.20	10,793	28,022			
130.30	10,834	28,648			
130.40	10,875	29,263			
130.50	10,916	29,868			
130.60	10,957	30,460			
130.70	10,998	31,040			
130.80	11,039	31,607			
130.90	11,080	32,158			
131.00	11,121	32,692			
131.10	11,162	33,207			
131.20	11,203	33,697			

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Type III 24-hr 100-YEAR Rainfall=6.70"

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**Stage-Area-Storage for Pond P2: SSIB 2**

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
118.25	5,941	0	123.55	7,600	22,198
118.35	5,973	238	123.65	7,631	22,473
118.45	6,004	475	123.75	7,663	22,735
118.55	6,035	713	123.85	7,694	22,990
118.65	6,067	951	123.95	7,725	23,237
118.75	6,098	1,188	124.05	7,757	23,476
118.85	6,129	1,426	124.15	7,788	23,714
118.95	6,160	1,664	124.25	7,819	23,952
119.05	6,192	2,039	124.35	7,850	24,189
119.15	6,223	2,552	124.45	7,882	24,427
119.25	6,254	3,064	124.55	7,913	24,665
119.35	6,286	3,574	124.65	7,944	24,902
119.45	6,317	4,083	124.75	7,976	25,140
119.55	6,348	4,591	124.85	8,007	25,378
119.65	6,380	5,097	124.95	<b>8,038</b>	<b>25,615</b>
119.75	6,411	5,602			
119.85	6,442	6,105			
119.95	6,473	6,606			
120.05	6,505	7,106			
120.15	6,536	7,603			
120.25	6,567	8,099			
120.35	6,599	8,592			
120.45	6,630	9,083			
120.55	6,661	9,572			
120.65	6,693	10,058			
120.75	6,724	10,542			
120.85	6,755	11,022			
120.95	6,786	11,500			
121.05	6,818	11,975			
121.15	6,849	12,446			
121.25	6,880	12,914			
121.35	6,912	13,379			
121.45	6,943	13,840			
121.55	6,974	14,297			
121.65	7,005	14,750			
121.75	7,037	15,199			
121.85	7,068	15,644			
121.95	7,099	16,084			
122.05	7,131	16,519			
122.15	7,162	16,949			
122.25	7,193	17,374			
122.35	7,225	17,793			
122.45	7,256	18,207			
122.55	7,287	18,613			
122.65	7,318	19,014			
122.75	7,350	19,407			
122.85	7,381	19,792			
122.95	7,412	20,170			
123.05	7,444	20,538			
123.15	7,475	20,897			
123.25	7,506	21,245			
123.35	7,537	21,580			
123.45	7,569	21,900			

Lowest  
outlet  
119.50

**T0681\_POST**

Prepared by TEC, Inc.

HydroCAD® 10.00-24 s/n 02793 © 2018 HydroCAD Software Solutions LLC

Type III 24-hr 100-YEAR Rainfall=6.70"

Printed 6/5/2019

**Stage-Area-Storage for Pond P3: SSIB 3**

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)	
108.80	6,338	0	
108.85	6,357	127	
108.90	6,377	254	
108.95	6,396	380	
109.00	6,416	507	
109.05	6,435	634	
109.10	6,454	761	
109.15	6,474	887	
109.20	6,493	1,014	
109.25	6,513	1,141	
109.30	6,532	1,268	
109.35	6,552	1,524	
109.40	6,571	1,779	
109.45	6,590	2,033	
109.50	6,610	2,285	
109.55	6,629	2,535	
109.60	6,649	2,782	
109.65	6,668	3,028	
109.70	6,687	3,270	
109.75	6,707	3,509	
109.80	6,726	3,745	
109.85	6,746	3,978	
109.90	6,765	4,207	
109.95	6,785	4,433	
110.00	6,804	4,655	
110.05	6,823	4,872	
110.10	6,843	5,084	
110.15	6,862	5,291	
110.20	6,882	5,492	
110.25	6,901	5,687	
110.30	6,921	5,875	Lowest outlet 110.30
110.35	6,940	6,052	
110.40	6,959	6,218	
110.45	6,979	6,372	
110.50	6,998	6,518	
110.55	7,018	6,657	
110.60	7,037	6,791	
110.65	7,056	6,919	
110.70	7,076	7,046	
110.75	7,095	7,173	
110.80	7,115	7,299	
110.85	7,134	7,426	
110.90	7,154	7,553	
110.95	7,173	7,680	
111.00	7,192	7,806	
111.05	7,212	7,933	
111.10	<b>7,231</b>	<b>8,060</b>	

# TEC

TRANSPORTATION ENGINEERING + CONSTRUCTION, INC.  
 65 GLENN STREET  
 LAWRENCE, MA 01843  
 T-978.794.1792 F-978.794.1793

## Storm Drainage Computations

Name: 146 Dascomb Road  
 Client: Riverwalk, LLC  
 Subject: Proposed Conditions  
 Proj. No.: T0681  
 Date: 12/8/2017  
 Comp.: Definitive  
 Check: \_\_\_\_\_  
 Design Parameters: 10 Year Storm  
 8" Min. Pipe Size  
 Project File: newpipe1.xls  
 Location in Massachusetts: 1 (1-Boston, 2-Barnstable, 3-Worcester, 4-Springfield, 5-Pittsfield)  
 Manning's roughness coefficient: 0.013

(NOTE ENTER CELLS AS HIGHLIGHTED IN FIRST ROW)

### ENGLISH

Rainfall Data is For Boston

LOCATION FROM DRAINAGE NO.	TO DRAINAGE NO.	RAINFALL CONCENTRATION PERIOD IN MINUTES		COMBINED RUNOFF COEFF.	TRIBUTARY AREA IN ACRES		C x A		RAINFALL INTENSITY (i)	PEAK FLOW	PIPE						PROFILE				Qf/Qd		
		PIPE	TOTAL		C	INC	TOTAL	INC			TOTAL	IN/HR	CFS	SIZE IN	n VALUE	SLOPE FT/FT	LENGTH FT	FULL CAPACITY CFS	FULL VELOCITY FT/S	PEAK FLOW CONDITIONS		INVERT ELEVATION	
				VELOCITY FT/S					d/D	UPPER END										LOWER END		UPPER RIM	DEPTH
CB 1	DMH 1		5.00	0.66	0.230	0.230	0.15	0.15	5.40	0.82	12	0.013	0.011	9	3.75	4.8	3.8	0.31	127.20	127.10	131.20	3.00	0.218347964
CB 2	DMH 1		5.00	0.84	0.330	0.330	0.28	0.28	5.40	1.50	12	0.013	0.009	32	3.45	4.4	4.2	0.46	127.80	127.50	132.00	3.20	0.434073935
DMH 1	DMH 2	0.13	5.13	0.00	0.000	0.560	0.00	0.43	5.40	2.32	12	0.013	0.035	200	6.66	8.5	7.7	0.40	127.00	120.00	131.20	3.20	0.347679746
CB 3	DMH 2		5.00	0.67	0.250	0.250	0.17	0.17	5.40	0.90	12	0.013	0.011	9	3.75	4.8	3.9	0.33	118.40	118.30	122.40	3.00	0.240930725
CB4	DMH 2		5.00	0.77	0.250	0.250	0.19	0.19	5.40	1.04	12	0.013	0.013	31	4.05	5.2	4.3	0.34	118.70	118.30	122.70	3.00	0.256943542
DMH 2	DMH 3	0.44	5.56	0.00	0.000	1.060	0.00	0.79	5.40	4.26	12	0.013	0.039	277	7.00	8.9	9.3	0.56	118.20	107.50	122.50	3.30	0.608668911
CB5	DMH 3		5.00	0.67	0.290	0.290	0.19	0.19	5.40	1.05	12	0.013	0.011	9	3.75	4.8	4.1	0.36	107.60	107.50	111.60	3.00	0.279479641
CB 6	DMH 3		5.00	0.78	0.350	0.350	0.27	0.27	5.40	1.47	12	0.013	0.008	37	3.21	4.1	4.0	0.47	107.80	107.50	111.80	3.00	0.459683593
DMH 3	DMH 4	0.50	6.06	0.00	0.000	0.640	0.00	1.26	5.20	6.53	18	0.013	0.017	24	13.56	7.7	7.5	0.48	107.40	107.00	112.10	3.20	0.48190119
DMH 4	WQU 1	0.05	6.11	0.00	0.000	0.640	0.00	1.26	5.20	6.53	18	0.013	0.038	97	20.51	11.6	10.2	0.38	106.90	103.20	111.60	3.20	0.318542496
WQU 1	FES 1	0.16	6.27	0.00	0.000	0.640	0.00	1.26	5.20	6.53	18	0.013	0.007	15	8.57	4.9	5.3	0.65	103.10	103.00	107.80	3.20	0.761952684
CB 7	NULL 1		5.00	0.74	0.330	0.330	0.24	0.24	5.40	1.32	12	0.013	0.013	67	4.04	5.1	4.6	0.39	131.50	130.64	135.50	3.00	0.326805951
RD 1	NULL 1		5.00	0.90	0.130	0.130	0.12	0.12	5.40	0.63	12	0.013	0.013	64	4.13	5.3	3.8	0.26	131.50	130.64	132.25	137.00	0.153032173
NULL 1	DMH 5	0.28	5.24	0.00	0.000	0.460	0.00	0.36	5.40	1.95	12	0.013	0.009	59	3.41	4.3	4.5	0.54	130.64	130.10	111.00	136.00	0.572443975
CB 8	DMH 5		5.00	0.77	0.110	0.110	0.08	0.08	5.40	0.46	12	0.013	0.014	21	4.26	5.4	3.5	0.22	131.70	131.40	135.70	3.00	0.107445579
DMH 5	DMH 6	0.22	5.46	0.00	0.000	0.570	0.00	0.45	5.40	2.41	12	0.013	0.010	69	3.59	4.6	4.9	0.59	130.00	129.30	135.90	4.90	0.671226538
CB 9	DMH 6		5.00	0.86	0.250	0.250	0.22	0.22	5.40	1.16	12	0.013	0.015	20	4.36	5.6	4.7	0.35	131.70	131.40	135.70	3.00	0.266163777
RD 2	DMH 6		5.00	0.90	0.130	0.130	0.12	0.12	5.40	0.63	12	0.013	0.009	47	3.29	4.2	3.2	0.29	131.80	131.40	131.05	136.00	0.192291867
DMH 6	DMH 7	0.25	5.70	0.00	0.000	0.950	0.00	0.78	5.40	4.20	18	0.013	0.012	135	11.43	6.5	5.9	0.41	129.20	127.60	135.90	5.20	0.36746002
RD 3	DMH 7		5.00	0.90	0.130	0.130	0.12	0.12	5.40	0.63	12	0.013	0.015	64	4.34	5.5	3.9	0.25	130.45	129.50	137.00	5.55	0.145602948
CB 10	DMH 7		5.00	0.89	0.350	0.350	0.31	0.31	5.40	1.68	12	0.013	0.013	126	4.01	5.1	4.9	0.45	131.60	130.00	135.60	3.00	0.419121031
DMH 7	DMH 12	0.43	6.08	0.00	0.000	1.430	0.00	1.21	5.20	6.27	18	0.013	0.019	53	14.42	8.2	7.9	0.46	127.50	126.50	135.80	6.80	0.434928911
CB 16	DMH 11		5.00	0.71	0.200	0.200	0.14	0.14	5.40	0.77	12	0.013	0.005	48	2.57	3.3	2.8	0.37	127.30	127.05	130.50	2.20	0.29832873
CB 15	DMH 11		5.00	0.75	0.140	0.140	0.11	0.11	5.40	0.57	12	0.013	0.005	19	2.58	3.3	2.6	0.31	127.30	127.20	130.50	2.20	0.219443247
DMH 11	DMH 12	0.12	5.28	0.00	0.000	0.340	0.00	0.25	5.40	1.33	12	0.013	0.005	89	2.53	3.2	3.3	0.51	126.95	126.50	130.10	2.15	0.526673929
RD 4	AD 1		5.00	0.90	0.180	0.180	0.16	0.16	5.40	0.87	12	0.013	0.004	46	2.35	3.0	2.8	0.42	134.00	133.80	137.00	2.00	0.372507528
AD 1	NULL 2	0.28	5.28	0.87	0.180	0.360	0.16	0.32	5.40	1.72	12	0.013	0.005	19	2.45	3.1	3.4	0.61	133.80	133.71	136.00	1.20	0.701871226
NULL 2	NULL 3	0.09	5.37	0.00	0.000	0.360	0.00	0.32	5.40	1.72	12	0.013	0.005	99	2.56	3.3	3.5	0.60	133.71	133.20	136.00	1.29	0.673029967
AD 2	NULL 3		5.00	0.81	0.360	0.360	0.29	0.29	5.40	1.57	12	0.013	0.032	19	6.33	8.1	6.6	0.33	133.80	133.20	136.00	1.20	0.248796815

NULL 3	DMH 8		5.84	0.00	0.000	0.720	0.00	0.61	5.40	3.30	18	0.013	0.007	162	8.65	4.9	4.5	0.42	133.20	132.10	136.00	1.30	0.380813905
CB 11	DMH 8		5.00	0.79	0.430	0.430	0.34	0.34	5.40	1.83	12	0.013	0.012	17	3.86	4.9	4.8	0.48	132.00	131.80	136.00	3.00	0.474855126
DMH 8	DMH 9		6.44	0.00	0.000	1.150	0.00	0.95	5.20	4.94	18	0.013	0.010	105	10.25	5.8	5.6	0.48	132.00	131.00	136.30	2.80	0.482016108
CB 12	DMH 9		5.00	0.79	0.430	0.430	0.34	0.34	5.40	1.83	12	0.013	0.042	12	7.27	9.3	7.7	0.34	132.00	131.50	136.00	3.00	0.252323261
RD 5	NULL 4		5.00	0.90	0.180	0.180	0.16	0.16	5.40	0.87	12	0.013	0.006	50	2.76	3.5	3.1	0.38	133.50	133.20	137.00	2.50	0.317099466
AD 3	NULL 4		5.00	0.87	0.190	0.190	0.17	0.17	5.40	0.89	12	0.013	0.050	12	7.96	10.1	6.6	0.22	133.80	133.20	136.00	1.20	0.112084091
NULL 4	NULL 5	0.03	5.27	0.00	0.000	0.370	0.00	0.33	5.40	1.77	12	0.013	0.033	102	6.50	8.3	7.0	0.35	133.20	129.80	136.40	2.20	0.271808325
AD 4	NULL 5		5.00	0.81	0.370	0.370	0.30	0.30	5.40	1.62	12	0.013	0.015	13	4.42	5.6	5.1	0.41	130.00	129.80	136.00	5.00	0.366352823
NULL 5	DMH 9	0.04	5.51	0.00	0.000	0.740	0.00	0.63	5.40	3.39	18	0.013	0.005	168	7.25	4.1	4.0	0.48	129.80	129.00	136.00	4.70	0.467257863
RD 6	NULL 6		5.00	0.90	0.470	0.470	0.42	0.42	5.40	2.28	12	0.013	0.004	67	2.38	3.0	3.5	0.78	134.00	133.70	137.00	2.00	0.958458388
RD 7	NULL 6		5.00	0.90	0.320	0.320	0.29	0.29	5.40	1.56	12	0.013	0.011	9	3.75	4.8	4.5	0.44	133.80	133.70	137.00	2.20	0.414257007
NULL 6	NULL 7	0.03	5.32	0.00	0.000	0.790	0.00	0.71	5.40	3.84	18	0.013	0.007	97	8.92	5.0	4.8	0.45	133.70	133.00	137.00	1.80	0.430413494
RD 8	NULL 7		5.00	0.90	0.320	0.320	0.29	0.29	5.40	1.56	12	0.013	0.033	3	6.50	8.3	6.8	0.33	133.10	133.00	137.00	2.90	0.239171395
NULL 7	NULL 8	0.01	5.66	0.00	0.000	1.110	0.00	1.00	5.40	5.39	18	0.013	0.005	134	7.59	4.3	4.7	0.62	130.10	129.40	137.00	5.40	0.710801438
RD 9	NULL 8		5.00	0.90	0.320	0.320	0.29	0.29	5.40	1.56	12	0.013	0.050	2	7.96	10.1	7.7	0.29	129.50	129.40	137.00	6.50	0.195282626
NULL 8	DMH 9	0.00	6.14	0.00	0.000	1.430	0.00	1.29	5.20	6.69	18	0.013	0.009	32	10.17	5.8	6.1	0.59	129.40	129.10	137.00	6.10	0.658236442
DMH 9	DMH 10		6.14	0.82	0.110	1.860	0.09	1.67	5.20	8.66	18	0.013	0.009	201	10.21	5.8	6.5	0.70	129.00	127.10	136.10	5.60	0.848157769
CB 14	DMH 10		5.00	0.67	0.120	0.120	0.08	0.08	5.40	0.43	12	0.013	0.122	18	12.45	15.9	7.1	0.12	132.20	130.00	134.20	1.00	0.034868806
CB 13	DMH 10		5.00	0.77	0.130	0.130	0.10	0.10	5.40	0.54	12	0.013	0.025	12	5.63	7.2	4.4	0.20	130.30	130.00	134.30	3.00	0.095988719
DMH 10	DMH 12	0.05	5.04	0.00	0.000	2.110	0.00	1.85	5.40	9.97	24	0.013	0.007	75	18.46	5.9	6.0	0.52	127.00	126.50	135.40	6.40	0.539779278
DMH 12	WQU 2	0.21	5.25	0.00	0.000	3.880	0.00	3.30	5.40	17.82	24	0.013	0.014	14	27.03	8.6	9.2	0.59	126.40	126.20	133.20	4.80	0.659104028
WQU 2	DMH 13		5.25	0.70	0.180	4.060	0.13	3.43	5.40	18.50	24	0.013	0.017	6	29.20	9.3	9.8	0.57	126.10	126.00	133.80	5.70	0.633517107
OCS 1	DMH 14		5.00	0.90	3.750	3.750	3.38	3.38	5.40	18.23	24	0.013	0.020	84	32.17	10.2	10.5	0.53	128.00	126.30	136.00	6.00	0.566498058
DMH 14	NULL 9	0.13	5.13	0.00	0.000	3.750	0.00	3.38	5.40	18.23	24	0.013	0.021	53	32.58	10.4	10.6	0.53	126.20	125.10	134.10	5.90	0.559403057
RD 10	NULL 9		5.00	0.90	0.500	0.500	0.45	0.45	5.40	2.43	12	0.013	0.018	20	4.84	6.2	6.2	0.50	124.60	124.23	137.00	11.40	0.501629156
NULL 9	DMH 16	0.05	5.22	0.00	0.000	4.250	0.00	3.83	5.40	20.66	24	0.013	0.024	49	35.39	11.3	11.6	0.54	125.00	123.80	133.50	6.50	0.583644399
RD 11	DMH 16		5.00	0.90	0.160	0.160	0.14	0.14	5.40	0.78	12	0.013	0.017	23	4.70	6.0	4.4	0.27	124.20	123.80	137.00	11.80	0.165558901
CB 18	DMH 15		5.00	0.89	0.320	0.320	0.28	0.28	5.40	1.54	12	0.013	0.005	20	2.52	3.2	3.354	1	124.80	124.70	127.80	2.00	0.6106764
CB 17	DMH 15		5.00	0.79	0.480	0.480	0.38	0.38	5.40	2.05	12	0.013	0.006	17	2.73	3.5	3.805	1	124.40	124.30	127.40	2.00	0.7496334
DMH 15	NULL 10	0.07	5.10	0.00	0.000	0.800	0.00	0.66	5.40	3.59	18	0.013	0.005	64	7.65	4.3	4.210	0	124.20	123.86	128.00	2.30	0.4684875
RD 12	NULL 10		5.00	0.90	0.160	0.160	0.14	0.14	5.40	0.78	12	0.013	0.042	24	7.27	9.3	6.017	0	124.60	123.60	137.00	11.40	0.1069607
NULL 10	DMH 16	0.07	5.35	0.00	0.000	0.960	0.00	0.81	5.40	4.36	18	0.013	0.005	50	7.57	4.3	4.413	1	123.86	123.60	131.00	5.64	0.5762210
DMH 16	WQU 3		5.54	0.00	0.000	5.370	0.00	4.78	5.40	25.80	24	0.013	0.021	17	32.45	10.3	11.444	1	123.50	123.15	132.86	7.36	0.7949781
WQU 3	DMH 17	0.02	5.57	0.00	0.000	5.370	0.00	4.78	5.40	25.80	24	0.013	0.021	12	32.64	10.4	11.512	1	123.05	122.80	132.80	7.75	0.7902879
RD 13	DMH 17		5.00	0.90	0.300	0.300	0.27	0.27	5.40	1.46	12	0.013	0.013	77	4.06	5.2	4.718	0	124.00	123.00	134.00	9.00	0.3592239
OCS 2	DMH 18		5.00	0.90	3.150	3.150	2.84	2.84	5.40	15.31	24	0.013	0.020	125	31.98	10.2	9.895	0	118.50	116.00	129.50	9.00	0.4786825
CB 20	DMH 18		5.00	0.90	0.040	0.040	0.04	0.04	5.40	0.19	12	0.013	0.018	57	4.72	6.0	2.841	0	116.00	115.00	119.00	2.00	0.0412094
CB 19	DMH 18		5.00	0.90	0.040	0.040	0.04	0.04	5.40	0.19	12	0.013	0.005	39	2.55	3.2	1.874	0	115.20	115.00	118.20	2.00	0.0762212
DMH 18	DMH 19	0.35	5.21	0.00	0.000	3.230	0.00	2.91	5.40	15.70	24	0.013	0.018	222	29.97	9.5	9.617	1	114.90	111.00	119.50	2.60	0.5237194

DMH 19	DMH 19A	0.38	5.60	0.00	0.000	3.230	0.00	2.91	5.40	15.70	24	0.013	0.018	276	30.13	9.6	9.668	1	110.90	106.00	116.45	3.55	0.5209679
CB 21	DMH 20		5.00	0.87	0.140	0.140	0.12	0.12	5.40	0.66	12	0.013	0.009	45	3.36	4.3	3.318	0	110.00	109.60	112.87	1.87	0.1958753
CB 22	DMH 20		5.00	0.88	0.350	0.350	0.31	0.31	5.40	1.66	12	0.013	0.006	52	2.71	3.4	3.603	1	109.90	109.60	112.27	1.37	0.6148199
DMH 20	WQU 4	0.24	5.24	0.70	0.120	0.610	0.08	0.51	5.40	2.77	12	0.013	0.018	22	4.80	6.1	6.298	1	109.50	109.10	116.35	5.85	0.5777388
WQU 4	DMH 21	0.06	5.30	0.00	0.000	0.610	0.00	0.51	5.40	2.77	12	0.013	0.014	14	4.26	5.4	5.745	1	109.00	108.80	112.85	2.85	0.6517773
OCS 3	DMH 22		5.00	0.90	0.450	0.450	0.41	0.41	5.40	2.19	18	0.013	0.015	63	12.89	7.3	5.341	0	105.40	104.45	113.60	6.70	0.1696067
CB 23	DMH 22		5.00	0.72	0.460	0.460	0.33	0.33	5.40	1.79	12	0.013	0.005	50	2.52	3.2	3.476	1	106.25	106.00	109.50	2.25	0.7101686
DMH 19A	DMH 22	0.48	6.07	0.00	0.000	3.230	0.00	2.91	5.20	15.12	24	0.013	0.013	55	25.51	8.1	8.438	1	105.90	105.20	109.80	1.90	0.5925110
DMH 22	DMH 23	0.11	6.18	0.00	0.000	4.140	0.00	3.64	5.20	18.94	24	0.013	0.008	76	20.09	6.4	7.272	1	105.10	104.50	109.80	2.70	0.9428297
RD 14	RD 15		5.00	0.90	0.120	0.120	0.11	0.11	5.40	0.58	12	0.013	0.031	59	6.31	8.0	4.938	0	107.50	105.65	137.00	28.50	0.0924741
RD 15	RD 16	0.20	5.20	0.90	0.120	0.240	0.11	0.22	5.40	1.17	12	0.013	0.004	134	2.18	2.8	2.815	1	110.00	109.50	137.00	26.00	0.5361388
RD 16	DMH 23		5.20	0.90	0.180	0.420	0.16	0.38	5.40	2.04	12	0.013	0.026	19	5.78	7.4	6.716	0	109.50	109.00	116.33	5.83	0.3532968
DMH 23	WQU 5	0.05	6.35	0.00	0.000	4.560	0.00	4.02	5.20	20.91	24	0.013	0.010	30	22.61	7.2	8.156	1	104.30	104.00	111.33	5.03	0.9246444
WQU 5	EX DRAIN	0.06	6.42	0.00	0.000	4.560	0.00	4.02	5.20	20.91	24	0.013	0.019	16	30.97	9.9	10.566	1	104.30	104.00	109.90	3.60	0.6752648

# B

## Water Quality Data

Location: Treatment Train 1

A BMP <sup>1</sup>	B TSS Removal Rate <sup>1</sup>	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
Water Quality Unit (Stormceptor)	0.77	0.75	0.58	0.17
Isolator Row (Stormtech)	0.66	0.17	0.11	0.06
Infiltration Basin	0.80	0.06	0.05	0.01

**TSS Removal  
Calculation  
Worksheet**

**Total TSS Removal =**

99%

Separate Form Needs  
to be Completed for  
Each Outlet or BMP  
Train

Project: 146 Dascomb Road  
 Prepared By: TEC, Inc.  
 Date: 10/26/2018

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

Location: Treatment Train 2

A BMP <sup>1</sup>	B TSS Removal Rate <sup>1</sup>	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
Water Quality Unit (Stormceptor)	0.77	0.75	0.58	0.17

**TSS Removal  
Calculation  
Worksheet**

**Total TSS Removal =**

83%

Separate Form Needs  
to be Completed for  
Each Outlet or BMP  
Train

Project: 146 Dascomb Road  
 Prepared By: TEC, Inc.  
 Date: 10/26/2018

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

# Stormwater Technology: Stormceptor (Hydro Conduit, formerly CSR New England Pipe)

Revised February 2003

The *Stormceptor Fact Sheet* is one in a series of fact sheets for stormwater technologies and related performance evaluations, which are undertaken by the *Massachusetts Strategic Envirotechnology Partnership (STEP)*.

The STEP evaluation entitled, *Technology Assessment, Stormceptor CSR New England Pipe*, January 1998 is the information source for this fact sheet. When a more thorough understanding of a system is required, the full *Technology Assessment* should be reviewed. Copies are available for downloading from the STEP Web site ([www.STEPSITE.org/](http://www.STEPSITE.org/)) or by contacting the STEP Program (Phone: 617/626/1197, FAX: 617/626/1180, email: [linda.benevides@state.ma.us](mailto:linda.benevides@state.ma.us)). This fact sheet is subject to future updates as additional performance information becomes available.

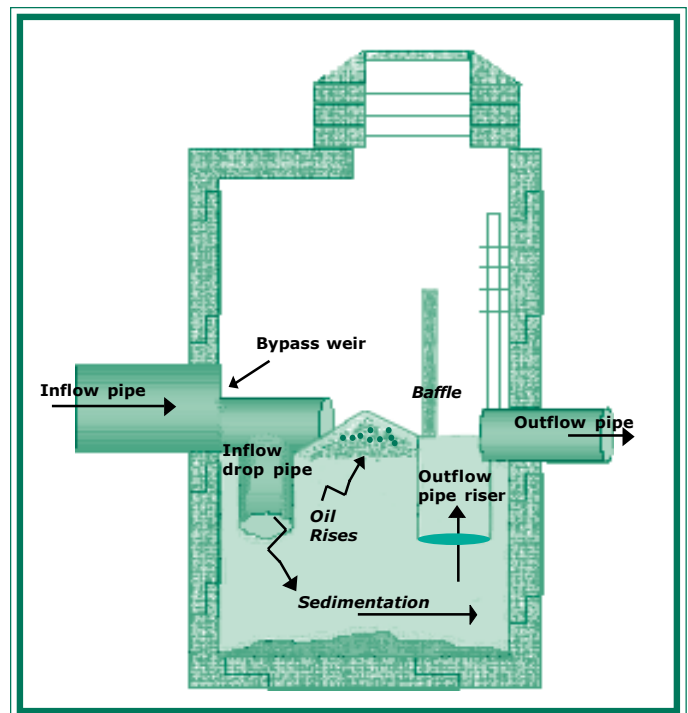
## Description/Definition

Stormceptor is a prefabricated, underground unit that separates oils, grease, and sediment from stormwater runoff when installed with an existing or new pipe conveyance system. The unit is divided into two chambers—a treatment and a flow bypass chamber. During typical storm events, runoff is directed by the inflow weir through a drop pipe into the lower treatment chamber where sediment, oil, and grease are separated from the flow by gravity. The bypass chamber is designed to convey excess stormwater, which overtops the inflow weir, through the system without treatment.

## Equipment and Sizing

The on-line Stormceptor units are available in eight sizes ranging from six and twelve feet in diameter with capacities of 900 to 7200 gallons. Since issuing the STEP assessment in 1998, the manufacturer has expanded the Stormceptor product line to include a storm drain inlet (STC 450i) and three units (Models STC 11000, STC 13000, and STC16000). These systems are not included in the STEP evaluation. Users and decision-makers may require additional field test results and new data for these new systems in order to accept performance ratings, particularly if they are higher than those reported in the STEP technology assessment and this fact sheet.

Stormceptor units are available in either precast concrete or fiberglass for special applications. Concrete units are pre-engineered for HS-20 min. traffic loading at the surface. Fiberglass units can be used in areas where there is a potential for oil and chemical spills.



**Figure 1. Stormceptor operation during average flow conditions.**

## Performance/Effectiveness

The system is designed to provide separation of sediment, oil, and grease from stormwater by routing runoff into a low-turbulence environment where solids settle and oils float out of solution. The system sizing is based on the drainage area, historical rainfall data, and the solids removal efficiency required. It is recommended that the system be used in combination with other stormwater controls to conform with the Massachusetts Stormwater Management Policy and standards.



An Imperial Model STC 2000 (equivalent to the Model STC 2400) in Edmonton, Canada treats flow from a 9.8 acre commercial parking lot. This system was monitored during four storm events in 1996 and shown to have an average total suspended solids (TSS) removal efficiency of 52 percent. In designing a system to achieve a comparable removal efficiency, the relationship between system size and impervious drainage area should be considered, as detailed in Table 1 and the Technology Assessment Report.

A Model STC 1200 in Westwood, Massachusetts treats flow from 0.65 acres consisting of a paved truck loading area at a manufacturing facility. The unit was monitored for six storm events in 1997, but only four events had measurable TSS influent concentrations. Of these four events, the average TSS removal efficiency was calculated to be 77 percent, which is less than the 80 percent removal targeted by the manufacturer.

Based on these field monitoring results, and when the unit sizing follows the guidance in Table 1, removal efficiencies between 52 percent and 77 percent may be achieved where installations have similar rainfall and land use characteristics as those reviewed for the STEP evaluation. It is recommended that additional field research and new data be evaluated to validate performance ratings higher than those verified by STEP.

Specific performance claims for oil and grease were not evaluated by STEP. However, total petroleum hydrocarbons (TPH) were analyzed during the Westwood study. Results indicated that the unit was effective in capturing oils.

Stormceptor Model Number	Maximum Impervious Area (acres)	
	77% TSS removal	52% TSS removal
STC 900	0.45	0.9
STC 1200	0.7	1.45
STC 1800	1.25	2.55
STC 2400	1.65	3.35
STC 3600	2.6	5.3
STC 4800	3.6	7.25
STC 6000	4.6	9.25
STC 7200	5.55	11.25

**Table 1: Sizing for TSS removal (adapted from the manufacturer’s sizing in the 1998 STEP Report)** Use the table to determine a TSS removal rate. Use the new Rinker method for sizing Stormceptor units. The sizing method has been changed since publication of the STEP Report. **Note:** To achieve 52% and 77% TSS removal rates on some sites, it may be necessary to use lower maximum impervious areas than those in Table 1.

## Technology Status

The Stormceptor system provides greater solids separation and higher TSS removal efficiencies than oil and grit separators. Stormceptor systems are among the category of hydrodynamic separators, which are flow-through devices with the capacity to settle or separate grit, oil, sediment, or other pollutants from stormwater. According to the U.S. Environmental Protection Agency, “Hydrodynamic separators are most effective where the materials to be removed from runoff are heavy particulates - which can be settled - or floatables - which can be captured, rather than solids with poor settleability or dissolved pollutants.”

The field studies evaluated for the STEP assessment predate the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), which is applicable in Massachusetts and other states in the Technology Acceptance Reciprocity Partnership (TARP), to ensure quality controlled studies that can be shared among participating states. Therefore, interstate reciprocity is not available to the manufacturer, based on performance claims that were evaluated by STEP in 1998. If the TARP Protocol requirements are fulfilled in the future, the manufacturer could pursue reciprocal verification for Stormceptor systems in participating TARP states. More information on the TARP Protocol is available on the following Web site: [www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp](http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp).

## Applications/Advantages

- ⊕ Stormceptor systems identified in Table 1 should be used in combination with other BMPs to remove 80 percent of the average annual load of TSS (DEP Stormwater Policy Standard 4). Systems may be well suited for pretreatment in a mixed component system designed for stormwater recharge.
- ⊕ Performance data show that Stormceptor may provide TSS removal rates in the range of 52 percent to 77 percent when sized according to Table 1. Higher TSS removal rates were achieved during low flow, low intensity storms with less than one third of an inch of runoff. Also, by reducing the impervious drainage area, relative to the system size, the STEP Technology Assessment Report indicated that higher removal efficiencies may be achievable. However, STEP recommends collection of additional data “representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80 percent.”
- ⊕ The Stormceptor system is suitable for new and retrofit applications. For retrofit applications, it should not

take the place of a catch basin for the systems that have been verified. Also, for retrofit applications, it should be installed in lateral lines and not main trunk lines.

- ⊕ The system is particularly well suited in constricted areas and where space is limited.
- ⊕ It also is suitable for use in areas of high potential pollutant loads (DEP Stormwater Policy Standard 5), where it may be used effectively in capturing and containing oil and chemical spills. *Web site:* [www.state.ma.us/dep/brp/stormwtr/stormpub.htm](http://www.state.ma.us/dep/brp/stormwtr/stormpub.htm).

## Considerations/Limitations

- ⊕ Systems are not expected to provide significant nutrient (nitrogen and phosphorus) or fecal coliform removal.
- ⊕ The systems are not recommended for use in critical areas, such as public drinking water supplies, certified vernal pools, public swimming beaches, shellfish growing areas, cold water fisheries, and some Areas of Critical Environmental Concern (ACECs), except as a pre-treatment device for BMPs that have been approved by DEP for use in critical areas. The structural BMPs approved for use in critical areas are described in Standard 6 of the Stormwater Management Policy, [www.state.ma.us/dep/brp/stormwtr/stormpub.htm](http://www.state.ma.us/dep/brp/stormwtr/stormpub.htm).
- ⊕ There is a limited set of useful data for predicting the relationship between treatment efficiency and loading rates. Removal efficiencies have not been demonstrated for all unit sizes.
- ⊕ Further research is needed to determine how much TSS bypasses the treatment chamber during certain, higher velocity storm events which recur less frequently.
- ⊕ Systems require regular maintenance to minimize the potential for washout of the accumulated sediments.

## Reliability/Maintenance

All BMPs require scheduled, routine maintenance to ensure that they operate as efficiently as possible. Although maintenance requirements are site specific, a general relationship between cleaning needs and depths of sediment has been established by the manufacturer. Inspection of the Stormceptor interior should be done after major storm events, particularly in the first year of operation. It is recommended that material in the treatment chamber be pumped out by a vacuum truck semiannually, or when the sediment and pollutant loads reach about 15 percent of the total storage. If the unit is used for spill containment, it should be pumped after the event is contained. Typical cleaning costs were estimated by the manufacturer in 1998 to be \$250, with disposal costs

averaging \$300 to \$500. The expected life of a system has been estimated to be 50 to 100 years.

Sediment Depths Indicating Required Maintenance	
Model Number	Sediment Depth (feet)
STC 900	0.5
STC 1200	0.75
STC 1800	1
STC 2400	1
STC 3600	1.25
STC 4800	1
STC 6000	1.5
STC 7200	1.25

**Table 2: The Stormceptor clean out is based on 15 percent of the sediment storage volume in the**

## References

- Winkler, E.S. 1998. "Technology Assessment, Stormceptor." University of Massachusetts, Amherst, MA. *STEP Web site:* [www.STEPSITE.org/](http://www.STEPSITE.org/)
- Massachusetts Department of Environmental Protection and Office of Coastal Zone Management. 1997. "Stormwater Management Handbooks, Volumes One and Two." Boston, MA. *Handbooks Web site:* [www.state.ma.us/dep/brp/stormwtr/stormpub.htm](http://www.state.ma.us/dep/brp/stormwtr/stormpub.htm).
- United States Environmental Protection Agency. "Storm Water Technology Fact Sheet Hydrodynamic Separators." EPA 832-F-99-017.
- Stormceptor Web sites:* [www.rinkermaterials.com/stormceptor](http://www.rinkermaterials.com/stormceptor)
- TARP Web site:* [www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp](http://www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp)

### STEP Verification vs. Regulatory Approval

STEP assistance to developers of innovative technologies and STEP verification of stormwater treatment systems is not required to receive necessary approvals from conservation commissions or the Department of Environmental Protection (DEP). However, if a system has received verification, a conservation commission shall presume that the technology will function as proposed, provided the conditions are similar to those in which performance was verified. STEP reports are not technology approvals, and do not constitute an endorsement or recommendation for use. Questions on regulatory issues should be referred to the DEP regional offices.



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JOB: The Dascomb Road Project  
LOCATION: 146 Dascomb Road, Andover, MA  
TITLE: WQV to WQF calculations  
CALCULATED BY: PFE

JOB NUMBER: T0681  
DATE: June 5, 2019  
SHEET: 1 OF 5  
CHECKED BY: PFE

### WQU1 - Water Quality Flow Calculation

$$Q_1 = (q_u)(A)(WQV) \text{ [MassDEP Q Rate - Sept. 10, 2013. Page 5]}$$

$Q_1$  = flow rate associated with first inch of runoff

$q_u$  = unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch)

Area, A = 1.18 acres =  $18.44 \times 10^{-4} \text{ mi}^2$

CN=98 (impervious surface)

$T_c$  = 6 minutes

Use  $T_c$  to find  $q_u$ . [MassDEP Q Rate - Sept. 10, 2013. Figure 4, page 7]

$$q_u = 774 \text{ csm/in}$$

$$Q_1 = (774 \text{ csm/in})(18.44 \times 10^{-4} \text{ mi}^2)(1.0 \text{ in}) = 1.43 \text{ cfs}$$

$$Q_1 = 1.43 \text{ cfs}$$

THEREFORE, Stormceptor model 900 will provide 80%+ TSS removal at the design water quality flow rate (see attached sizing sheet). Town of Andover regulations are more stringent, model 1200 will be used.

## Brief Stormceptor Sizing Report - Dascomb Road

Project Information & Location			
<b>Project Name</b>	Dascomb Road	<b>Project Number</b>	T0515
<b>City</b>	Andover	<b>State/ Province</b>	Unknown
<b>Country</b>	United States of America	<b>Date</b>	2/1/2019
Designer Information		EOR Information (optional)	
<b>Name</b>	Peter Ellison	<b>Name</b>	
<b>Company</b>	TEC, Inc.	<b>Company</b>	
<b>Phone #</b>	978-794-1792	<b>Phone #</b>	
<b>Email</b>	pellison@theengineeringcorp.com	<b>Email</b>	

### Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

<b>Site Name</b>	Dascomb Road
<b>Target TSS Removal (%)</b>	80
<b>TSS Removal (%) Provided</b>	84
<b>Recommended Stormceptor Model</b>	STC 900

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	74
STC 900	84
STC 1200	84
STC 1800	85
STC 2400	88
STC 3600	89
STC 4800	92
STC 6000	92
STC 7200	94
STC 11000	96
STC 13000	96
STC 16000	97
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	1.17	TSS Removal (%)	80.0
Imperviousness %	100.0	Runoff Volume Capture (%)	
Rainfall		Oil Spill Capture Volume (Gal)	
Station Name	ROCKPORT 1 ESE	Peak Conveyed Flow Rate (CFS)	11.09
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	1.43
Station ID #	6977	Up Stream Storage	
Years of Records	36	Storage (ac-ft)	Discharge (cfs)
Latitude	42°39'0"N	0.000	1.180
Longitude	70°36'0"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes
<ul style="list-style-type: none"> <li>Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.</li> <li>Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.</li> <li>For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.</li> </ul>

**For Stormceptor Specifications and Drawings Please Visit:  
<http://www.imbriumsystems.com/technical-specifications>**



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JOB NUMBER: T0681  
DATE: June 5, 2019  
SHEET: 1 OF 5  
CHECKED BY: PFE

### WQU2 - Water Quality Flow Calculation

$$Q_1 = (q_u)(A)(WQV) \text{ [MassDEP Q Rate - Sept. 10, 2013. Page 5]}$$

$Q_1$  = flow rate associated with first inch of runoff

$q_u$  = unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch)

Area, A = 3.15 acres =  $49.22 \times 10^{-4} \text{ mi}^2$

CN=98 (impervious surface)

$T_c$  = 6 minutes

Use  $T_c$  to find  $q_u$ . [MassDEP Q Rate - Sept. 10, 2013. Figure 4, page 7]

$q_u$  = 774 csm/in

$$Q_1 = (774 \text{ csm/in})(49.22 \times 10^{-4} \text{ mi}^2)(1.0 \text{ in}) = 3.81 \text{ cfs}$$

$Q_1 = 3.81 \text{ cfs}$

THEREFORE, Stormceptor Model 3600 will provide 80%+ TSS removal for the design water quality rate. See attached sizing information.

## Brief Stormceptor Sizing Report - Dascomb Road - WQU 2

Project Information & Location			
<b>Project Name</b>	Dascomb Road	<b>Project Number</b>	T0515
<b>City</b>	Andover	<b>State/ Province</b>	Unknown
<b>Country</b>	United States of America	<b>Date</b>	2/1/2019
Designer Information		EOR Information (optional)	
<b>Name</b>	Peter Ellison	<b>Name</b>	
<b>Company</b>	TEC, Inc.	<b>Company</b>	
<b>Phone #</b>	978-794-1792	<b>Phone #</b>	
<b>Email</b>	pellison@theengineeringcorp.com	<b>Email</b>	

### Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

<b>Site Name</b>	Dascomb Road - WQU 2
<b>Target TSS Removal (%)</b>	80
<b>TSS Removal (%) Provided</b>	80
<b>Recommended Stormceptor Model</b>	STC 3600

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	60
STC 900	72
STC 1200	72
STC 1800	73
STC 2400	79
STC 3600	80
STC 4800	84
STC 6000	85
STC 7200	88
STC 11000	91
STC 13000	92
STC 16000	93
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	3.15	TSS Removal (%)	80.0
Imperviousness %	100.0	Runoff Volume Capture (%)	
Rainfall		Oil Spill Capture Volume (Gal)	
Station Name	ROCKPORT 1 ESE	Peak Conveyed Flow Rate (CFS)	45.52
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	3.81
Station ID #	6977	Up Stream Storage	
Years of Records	36	Storage (ac-ft)	Discharge (cfs)
Latitude	42°39'0"N	0.000	1.180
Longitude	70°36'0"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes
<ul style="list-style-type: none"> <li>Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.</li> <li>Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.</li> <li>For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.</li> </ul>

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### WQU3 - Water Quality Flow Calculation

$$Q_1 = (q_u)(A)(WQV) \text{ [MassDEP Q Rate - Sept. 10, 2013. Page 5]}$$

$Q_1$  = flow rate associated with first inch of runoff

$q_u$  = unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch)

Area, A = 0.67 acres =  $10.47 \times 10^{-4} \text{ mi}^2$

CN=98 (impervious surface)

$T_c$  = 6 minutes

Use  $T_c$  to find  $q_u$ . [MassDEP Q Rate - Sept. 10, 2013. Figure 4, page 7]

$q_u$  = 774 csm/in

$$Q_1 = (774 \text{ csm/in})(10.47 \times 10^{-4} \text{ mi}^2)(1.0 \text{ in}) = 0.81 \text{ cfs}$$

$Q_1 = 0.81 \text{ cfs}$

THEREFORE, Stormceptor model 450 will provide 80%+ TSS removal at the design water quality flow rate. See attached Stormceptor Sizing sheet. Town of Andover Regulations are more stringent, model 900 will be used.

## Brief Stormceptor Sizing Report - Dascomb Road - WQU 3

Project Information & Location			
<b>Project Name</b>	Dascomb Road	<b>Project Number</b>	T0515
<b>City</b>	Andover	<b>State/ Province</b>	Unknown
<b>Country</b>	United States of America	<b>Date</b>	2/1/2019
Designer Information		EOR Information (optional)	
<b>Name</b>	Peter Ellison	<b>Name</b>	
<b>Company</b>	TEC, Inc.	<b>Company</b>	
<b>Phone #</b>	978-794-1792	<b>Phone #</b>	
<b>Email</b>	pellison@theengineeringcorp.com	<b>Email</b>	

### Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

<b>Site Name</b>	Dascomb Road - WQU 3
<b>Target TSS Removal (%)</b>	80
<b>TSS Removal (%) Provided</b>	83
<b>Recommended Stormceptor Model</b>	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	83
STC 900	90
STC 1200	90
STC 1800	91
STC 2400	93
STC 3600	94
STC 4800	95
STC 6000	96
STC 7200	97
STC 11000	98
STC 13000	98
STC 16000	98
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	0.67	TSS Removal (%)	80.0
Imperviousness %	100.0	Runoff Volume Capture (%)	
Rainfall		Oil Spill Capture Volume (Gal)	
Station Name	ROCKPORT 1 ESE	Peak Conveyed Flow Rate (CFS)	30.99
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	0.81
Station ID #	6977	Up Stream Storage	
Years of Records	36	Storage (ac-ft)	Discharge (cfs)
Latitude	42°39'0"N	0.000	1.180
Longitude	70°36'0"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes
<ul style="list-style-type: none"> <li>Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.</li> <li>Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.</li> <li>For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.</li> </ul>

**For Stormceptor Specifications and Drawings Please Visit:  
<http://www.imbriumsystems.com/technical-specifications>**



WWW.THEENGINEERINGCORP.COM

JOB: The Dascomb Road Project  
LOCATION: 146 Dascomb Road, Andover, MA  
TITLE: WQV to WQF calculations  
CALCULATED BY: PFE

JOB NUMBER: T0681  
DATE: June 5, 2019  
SHEET: 1 OF 5  
CHECKED BY: PFE

### WQU4 - Water Quality Flow Calculation

$$Q_1 = (q_u)(A)(WQV) \text{ [MassDEP Q Rate - Sept. 10, 2013. Page 5]}$$

$Q_1$  = flow rate associated with first inch of runoff

$q_u$  = unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch)

Area, A = 1.24 acres =  $19.38 \times 10^{-4} \text{ mi}^2$

CN=98 (impervious surface)

$T_c$  = 6 minutes

Use  $T_c$  to find  $q_u$ . [MassDEP Q Rate - Sept. 10, 2013. Figure 4, page 7]

$q_u$  = 774 csm/in

$$Q_1 = (774 \text{ csm/in})(19.38 \times 10^{-4} \text{ mi}^2)(1.0 \text{ in}) = 1.50 \text{ cfs}$$

**$Q_1 = 1.50 \text{ cfs}$**

THEREFORE, Stormceptor model 900 will provide 80%+ TSS removal for the design water quality flow rate. See attached Stormceptor Sizing sheet. Town of Andover regulations more stringent, model 1200 will be used.

## Brief Stormceptor Sizing Report - Dascomb Road - WQU 4

Project Information & Location			
<b>Project Name</b>	Dascomb Road	<b>Project Number</b>	T0515
<b>City</b>	Andover	<b>State/ Province</b>	Unknown
<b>Country</b>	United States of America	<b>Date</b>	2/1/2019
Designer Information		EOR Information (optional)	
<b>Name</b>	Peter Ellison	<b>Name</b>	
<b>Company</b>	TEC, Inc.	<b>Company</b>	
<b>Phone #</b>	978-794-1792	<b>Phone #</b>	
<b>Email</b>	pellison@theengineeringcorp.com	<b>Email</b>	

### Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

<b>Site Name</b>	Dascomb Road - WQU 4
<b>Target TSS Removal (%)</b>	80
<b>TSS Removal (%) Provided</b>	83
<b>Recommended Stormceptor Model</b>	STC 900

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	73
STC 900	83
STC 1200	83
STC 1800	84
STC 2400	88
STC 3600	89
STC 4800	92
STC 6000	92
STC 7200	94
STC 11000	96
STC 13000	96
STC 16000	97
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	1.24	TSS Removal (%)	80.0
Imperviousness %	100.0	Runoff Volume Capture (%)	
Rainfall		Oil Spill Capture Volume (Gal)	
Station Name	ROCKPORT 1 ESE	Peak Conveyed Flow Rate (CFS)	10.97
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	1.50
Station ID #	6977	Up Stream Storage	
Years of Records	36	Storage (ac-ft)	Discharge (cfs)
Latitude	42°39'0"N	0.000	1.180
Longitude	70°36'0"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes
<ul style="list-style-type: none"> <li>Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.</li> <li>Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.</li> <li>For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.</li> </ul>

**For Stormceptor Specifications and Drawings Please Visit:  
<http://www.imbriumsystems.com/technical-specifications>**



WWW.THEENGINEERINGCORP.COM

JOB: The Dascomb Road Project  
LOCATION: 146 Dascomb Road, Andover, MA  
TITLE: WQV to WQF calculations  
CALCULATED BY: PFE

JOB NUMBER: T0681  
DATE: June 5, 2019  
SHEET: 1 OF 5  
CHECKED BY: PFE

### WQU5 - Water Quality Flow Calculation

$$Q_1 = (q_u)(A)(WQV) \text{ [MassDEP Q Rate - Sept. 10, 2013. Page 5]}$$

$Q_1$  = flow rate associated with first inch of runoff

$q_u$  = unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch)

Area, A = 0.24 acres =  $3.8 \times 10^{-4} \text{ mi}^2$

CN=98 (impervious surface)

$T_c$  = 6 minutes

Use  $T_c$  to find  $q_u$ . [MassDEP Q Rate - Sept. 10, 2013. Figure 4, page 7]

$q_u$  = 774 csm/in

$$Q_1 = (774 \text{ csm/in})(3.8 \times 10^{-4} \text{ mi}^2)(1.0 \text{ in}) = 0.29 \text{ cfs}$$

**$Q_1 = 0.29 \text{ cfs}$**

THEREFORE, Stormceptor 450i model will provide 80%+ TSS removal at this water quality flow rate. See attached Stormceptor sizing sheet.

## Brief Stormceptor Sizing Report - Dascomb Road - WQU 5

Project Information & Location			
<b>Project Name</b>	Dascomb Road	<b>Project Number</b>	T0515
<b>City</b>	Andover	<b>State/ Province</b>	Unknown
<b>Country</b>	United States of America	<b>Date</b>	2/1/2019
Designer Information		EOR Information (optional)	
<b>Name</b>	Peter Ellison	<b>Name</b>	
<b>Company</b>	TEC, Inc.	<b>Company</b>	
<b>Phone #</b>	978-794-1792	<b>Phone #</b>	
<b>Email</b>	pellison@theengineeringcorp.com	<b>Email</b>	

### Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

<b>Site Name</b>	Dascomb Road - WQU 5
<b>Target TSS Removal (%)</b>	80
<b>TSS Removal (%) Provided</b>	92
<b>Recommended Stormceptor Model</b>	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	% TSS Removal Provided
STC 450i	92
STC 900	96
STC 1200	96
STC 1800	96
STC 2400	97
STC 3600	98
STC 4800	98
STC 6000	98
STC 7200	99
STC 11000	99
STC 13000	99
STC 16000	99
StormceptorMAX	Custom

Sizing Details			
Drainage Area		Water Quality Objective	
Total Area (acres)	0.24	TSS Removal (%)	80.0
Imperviousness %	100.0	Runoff Volume Capture (%)	
Rainfall		Oil Spill Capture Volume (Gal)	
Station Name	ROCKPORT 1 ESE	Peak Conveyed Flow Rate (CFS)	3.91
State/Province	Massachusetts	Water Quality Flow Rate (CFS)	0.29
Station ID #	6977	Up Stream Storage	
Years of Records	36	Storage (ac-ft)	Discharge (cfs)
Latitude	42°39'0"N	0.000	1.180
Longitude	70°36'0"W	Up Stream Flow Diversion	
		Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD) The selected PSD defines TSS removal		
OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Notes
<ul style="list-style-type: none"> <li>Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.</li> <li>Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.</li> <li>For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.</li> </ul>

**For Stormceptor Specifications and Drawings Please Visit:  
<http://www.imbriumsystems.com/technical-specifications>**

**C**

# **Operation and Maintenance Plan**

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# **STORMWATER MANAGEMENT OPERATIONS AND MAINTENANCE PLAN**

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## **THE DASCOMB ROAD PROJECT**

**146 DASCOMB ROAD  
ANDOVER, MASSACHUSETTS**

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Prepared for: **Dascomb Road Redevelopment, LLC**  
354 Merrimack Street, Ste 1  
Lawrence, MA 01843

Prepared by: **TEC, Inc.**  
169 Ocean Blvd.  
Unit 101, P.O. Box 249  
Hampton, NH 03842



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October 26, 2018  
*Revised June 5, 2019*

**Stormwater Management Operation and Maintenance Plan**  
**October 26, 2018**  
**Revised June 5, 2019**

**Name of Applicant:** Salvatore N. Lupoli  
**Name of Facility:** Proposed Dascomb Road Redevelopment  
**Location:** 146 Dascomb Road, Andover, MA 01810

A detailed, written log of all scheduled preventative and corrective maintenance performed for the stormwater management measures must be kept on site, including a record of all inspections and copies of maintenance-related work orders.

Attachment 1, "Inspection and Maintenance Check List" shall be maintained as a record of regularly scheduled inspection and maintenance items as outlined below for every year. Maintenance required and actions taken shall be recorded in Attachment 2, Inspection and Maintenance Log". The funding, operation, and maintenance of all stormwater management Best Management Practices (BMPs) shall be provided by the Applicant, or their appointee.

Maintenance routine and schedule: Routine inspections will be conducted on a monthly basis and thorough investigations will be conducted twice a year. Tasks that are common to all systems include regular removal of accumulated sediments, floatables and debris. Inspections will occur after every major storm event for the first six (6) months after construction. Inspections will be conducted by a Professional Engineer registered in the Commonwealth of Massachusetts experienced in drainage design. Annual reports will be prepared detailing the status of the stormwater system and the maintenance performed. A copy of the annual report will be sent to the Town of Andover.

**Estimated annual budget:**

The anticipated inspections and reports will cost approximately \$500 per month. Maintenance items are anticipated to cost around \$2,000 per item. The anticipated annual budget will range from \$5,000 to \$10,000 depending on the number of maintenance items that year.

The owner agrees to comply with a minimum maintenance schedule as follows:

- 1. Monthly inspection for damaged or clogged catch basin grates.**  
Catch basin grates shall be inspected and cleared of debris to maintain inlet capacity.
- 2. Quarterly sweeping of the parking lot.**  
The parking lot shall be swept four (4) times per year. Sweepings should be concentrated in the late spring after winter sanding and late fall after

the leaves have fallen. Sweeping of the parking areas shall be performed with a mechanical sweeper (rotary broom).

**3. Quarterly cleaning of catch basins**

Sumps and inlets shall be cleaned four (4) times per year and inspected on a monthly basis. All sediments shall be properly handled and disposed of in accordance with local, state and federal guidelines and regulations.

**4. Inspection and cleaning of drainage pipes and manholes.**

Drainage pipes and manhole structures, including those associated with the sub surface infiltration systems, shall be inspected and cleaned of sediment at least every five (5) years or as required to maintain adequate functionality of the stormwater conveyance system. All sediments shall be properly handled and disposed of in accordance with local, state and federal guidelines and regulations.

**5. Water Quality Unit Maintenance**

The water quality units, which include all sub-surface infiltration structures and particle separator structures, shall be monitored and maintained on a regular basis according to manufacturer's specifications. All structures shall be cleaned of sediment buildup at least twice annually.

**6. Subsurface Infiltration Basin**

The subsurface infiltration system shall be inspected two (2) times per year to ensure that its performance has not become sacrificed. Any debris that might clog the system will be removed. The outlet weirs and overflows shall also be inspected to maintain proper hydraulics. Mosquito controls will be implemented.

**7. Bioretention Swale/Rain Garden**

The Bioretention Swale/Rain Garden shall be inspected monthly to remove any accumulated trash and debris as well as repair eroded areas. Re-mulch areas annually (spring). Treat diseased vegetation as needed and Replace dead vegetation twice per year (spring and fall). No snow shall be stored in the rain garden during the winter months.

**8. Grass Landscaping**

The grass landscaping will be inspected after every major storm event for the first two (2) months after seeding to ensure functionality. Thereafter, inspections should take place every six (6) months in the spring and fall and after severe storm events. Grass and mulched landscaping showing signs of wear and erosion will be re-loaded/re-seeded or re-mulched as necessary to prevent further erosion from taking place.

## 9. Snow Removal

Snow shall be plowed from driveway system/parking garage and stored in the designated snow storage areas.

### **The Long-Term Pollution Prevention Plan**

The Owner agrees to comply with the following Long-Term Pollution Prevention Plan to ensure long-term stormwater quality discharge from the site:

- *Good housekeeping practices:* The project is retail, professional office, and restaurant development that will be maintained by the owner, including snow removal, de-icing, and BMP inspection/maintenance.
- *Provisions for storing materials and waste products inside or under cover:* No materials or waste products will be stored on-site.
- *Vehicle washing controls:* Vehicle washing is not anticipated as a reasonably foreseeable use of the site.
- *Requirements for routine inspections and maintenance of stormwater BMPs:* The owner will be responsible for providing the necessary inspections and maintenance for the stormwater BMPs.
- *Spill prevention and response plans:* There are no proposed uses at the site that would provide an opportunity for a spill of oil or hazardous materials, other than a sudden, catastrophic, vehicle failure. If a vehicle release is the result of an accident, the police and fire department will respond and address any release.
- *Provisions for maintenance of lawns, gardens, and other landscaped areas:* The owner will provide long-term maintenance for the landscaped areas, BMPs, and possible future great lawn.
- *Requirements for storage and use of fertilizers, herbicides, and pesticides:* At this time there would be no foreseeable need for fertilizers, herbicides, and pesticides.
- *Provisions for operation and management of septic systems:* Not Applicable
- *Provisions for solid waste management:* The owner will provide trash receptacles for each tenant of the proposed redevelopment. The trash

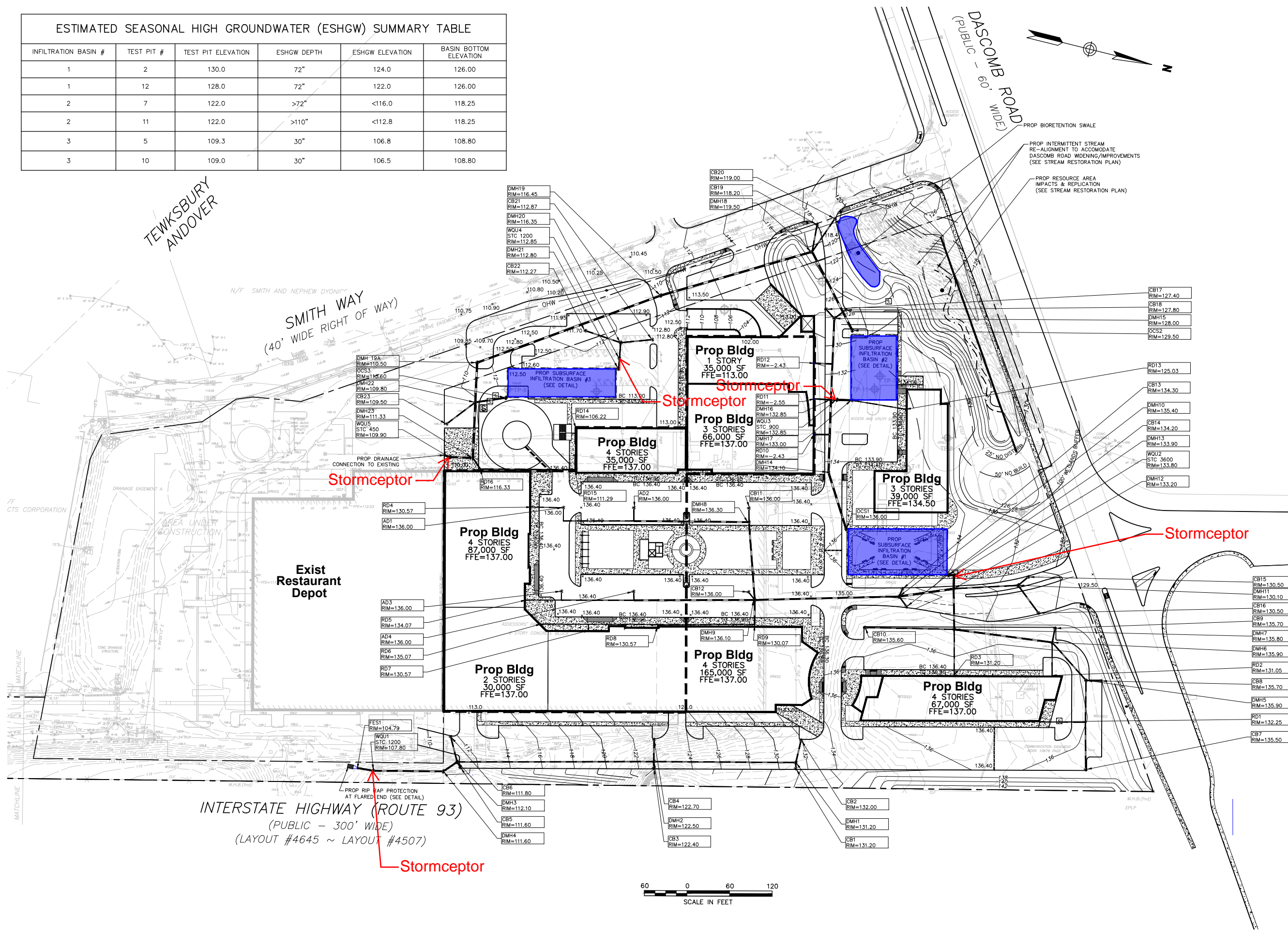
receptacles will have lids of the type and nature to prevent windblown trash from escaping and will be emptied regularly.

- *Snow disposal and plowing plans relative to Wetland Resource Areas:* Snow will be stored in the various landscaped islands onsite temporarily. During large storm events, snow will be trucked off site. Snow disposal will be prohibited within the 100' wetland buffer.
- *Street sweeping schedules:* The owner will be responsible for monthly street sweeping with sweepings concentrated in the Spring and Fall as stated in the Operations and Maintenance plan. Sweeping will be performed with a mechanical sweeper (rotary broom).
- *Provisions for prevention of illicit discharges to the stormwater management system:* Only stormwater is proposed to be conveyed through the stormwater management system. No illicit materials will be permitted. The owner will be responsible to maintain this 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:* The BMPs selected provide adequate containment of contaminants in the unlikely event of a spill.
- *Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan:* Prior to implementation of the LTPPP, the owner shall provide an on-site meeting with the maintenance personnel to present the contents and requirements of the Stormwater Operation and Maintenance Plan and the LTPPP.
- *Provisions for future property owners:* Future property owners will be notified for of the presence of the stormwater management system and the requirement for proper operations and maintenance.
- *List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:*

Riverwalk Properties  
(978)681-7777 x 24  
290 Merrimack Street  
Lawrence, MA 01843

ESTIMATED SEASONAL HIGH GROUNDWATER (ESHGW) SUMMARY TABLE

INFILTRATION BASIN #	TEST PIT #	TEST PIT ELEVATION	ESHGW DEPTH	ESHGW ELEVATION	BASIN BOTTOM ELEVATION
1	2	130.0	72"	124.0	126.00
1	12	128.0	72"	122.0	126.00
2	7	122.0	>72"	<116.0	118.25
2	11	122.0	>110"	<112.8	118.25
3	5	109.3	30"	106.8	108.80
3	10	109.0	30"	106.5	108.80



TEC, Inc.  
 146 Dascomb Road | 169 Ocean Boulevard  
 Andover, MA 01810 | Hampton, NH 03842  
 (978) 794-1792 | (603) 601-8154  
 www.TheEngineeringCorp.com

DESIGNED BY: CPR  
 DRAWN BY: DGR  
 CHECKED BY: RJF  
 DATE: 10/31/2018  
 SCALE: AS NOTED

PREPARED FOR:  
**Dascomb Road Development, LLC**  
 354 Merrimack Street  
 Suite 1  
 Lawrence, MA 01843

REVISIONS

1. STORMWATER RTC	6-5-2019
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ISSUED FOR:  
**Permitting**

PROJECT TITLE:  
**The Dascomb Road Project**

PROJECT LOCATION:  
 146 Dascomb Road  
 Andover, MA

DRAWING TITLE:  
**Operations & Maintenance Plan**

PROJECT NO. T0681  
 TEC CAD FILE T0681\_GD  
 DRAWING NO. C-6  
 SHEET 6 OF 27

Peter F. Ellison  
 6/5/2019

**D**

**Construction Period Pollution  
Prevention and Erosion and Sediment  
Control Plan**

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# **CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN**

---

## **THE DASCOMB ROAD PROJECT**

**146 DASCOMB ROAD  
ANDOVER, MASSACHUSETTS**

---

Prepared for:

**Dascomb Road Redevelopment, LLC**  
354 Merrimack Street, Ste 1  
Lawrence, MA 01843

Prepared by:

**TEC, Inc.**  
169 Ocean Blvd,  
Unit 101, P.O. Box 249  
Hampton, NH 03842



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October 26, 2018

**CONSTRUCTION PERIOD POLLUTION PREVENTION AND  
EROSION AND SEDIMENTATION CONTROL PLAN**  
**October 26, 2018**

**Name of Applicant: Salvatore N. Lupoli**  
**Name of Facility: Proposed Dascomb Road Redevelopment**  
**Location: 146 Dascomb Road**  
**Andover, MA**

**Good Housekeeping BMPs**

**Goals**

Minimize the potential for contaminants to enter or runoff the site during construction activities. Fuel and other equipment related fluids will be properly stored. The Contractor shall establish secure storage areas that collect any spillage to meet requirements of the Town of Andover Fire Department regarding the storage of flammable materials. The Contractor shall complete and submit the plans to the Engineer.

**General Requirements**

The following presents a proactive approach to all of the best management practices, erosion and sedimentation controls, mitigation measures, and monitoring activities for this Project.

**Compost Filter Sock**

A compost filter sock is a type of contained compost filter berm. It is a mesh tube filled with composted material that is placed perpendicular to sheet-flow runoff to control erosion and retain sediment in disturbed areas. The filter sock can be used in place of a traditional sediment and erosion control tool such as a silt fence or straw bale barrier.

Compost filter socks are flexible and can be placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. Filter socks can also be used on pavement as inlet protection for storm drains and to slow water flow in small ditches. Filter socks used for erosion control are usually 12 inches in diameter, although 8 inch, 18 inch, and 24 inch– diameter socks are used in some applications. The smaller, 8 inch–diameter filter socks are commonly used for stormwater inlet protection. The outer shell of a compost filter sock is typically biodegradable and can remain on pervious surfaces post construction versus having to be removed as construction waste.

**Temporary Stabilized Construction Vehicle Entrance/Exit**

The purpose of stabilized entrances to a construction site is to minimize the amount of sediment leaving the area as mud and sediment attached to vehicles. Installing a pad of gravel over filter cloth where construction traffic leaves a site can help stabilize a construction entrance. As a vehicle drives over the pad, the pad removes mud and sediment from the wheels and reduces soil transport off the site. The filter cloth separates the gravel from the soil below, keeping the gravel from being ground into the soil. The fabric also reduces the amount of rutting caused by vehicle tires. It spreads the vehicle's weight over a soil area larger than the tire width.

### **Storm Drain Inlet Protection**

Storm drain inlet protection measures prevent soil and debris from entering storm drain inlets. These measures will be implemented before the Site is disturbed by using silt sacks, compost filter socks, or staked bales in combination with silt fence. Storm drain inlet protection will be installed at all down gradient catch basins adjacent to the project site outside the protection of other erosion control barriers, all catch basins within the construction site, and at low points within the construction site that are connected to the storm drainage system.

### **General Maintenance**

Refer to the Inspection and Maintenance Checklist (at the end of this section) identifying inspection and maintenance measures for each specific practice.

The contractor or subcontractor will be responsible for implementing each control shown on the Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

The onsite contractor will inspect all sediment and erosion control structures weekly and after each rainfall event meeting the minimum requirements as defined in the Plan. Records of the inspections will be prepared and maintained onsite by the contractor as required by the Plan.

- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of straw bales should be kept in close contact with the earth and reset as necessary.
- Sediment that is collected in structures shall be disposed of properly and covered if stored onsite.
- At a minimum establish good housekeeping BMPs for:
  - Material handling and waste management
  - Staging areas
  - Designate washout areas
  - Equipment vehicle fueling and maintenance
  - Spill prevention and control

Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

### **Spill Prevention and Control**

The Contractor will actively maintain and manage the site activities with the procedures outlined in this Plan. In the event of petroleum or other deleterious substance spill, action will be taken by the Contractor to contain and remove the spill. The Contractor will comply with the relevant section(s) of the Oil Pollution Prevention Act, 40 CFR 112.7.

### **Responsibility**

All project personnel share the responsibility for the initial control and reporting of the oil and other substance spill, especially the personnel that first discover the spill. The Site Safety and Health Officer (SSHO) will be responsible for determining the necessary safety equipment and for establishing safety practices to be followed by the Contractor during the clean-up operations. All personnel will be trained in the use of and location of this equipment, prior to the commencement of the construction.

The Contractor's goal is to provide effective, efficient and coordinated action to minimize or mitigate damages to the environment and public health and welfare from oil or other substance discharges, conforming to applicable federal, state, and local regulations, as well as other provisions and restrictions. In the event of spills or releases that may occur during the Project, a representative on-site qualified by OSHA training requirements (29 CFR 1910.120) for a Level 3 Hazmat Technician will be provided and will have the responsibility and authority for supervising the cleanup. If the representative determines that the clean up operations are beyond the capacity of the Contractor, assistance shall be requested from its Subcontractor.

In the event of an emergency spill, the Contractor will be responsible for retaining the environmental Subcontractor. The selected environmental subcontractor will develop a Hazardous Materials Health and Safety Plan, which will be referenced when a spill or release is discovered, and the control of the spill or release is beyond the scope of the Spill Prevention Control and Countermeasure plan. The Contractor's Project Manager is responsible for giving the SSHO directions for initiating the Hazardous Materials Health and Safety Plan.

Alert and reporting procedures will become effective immediately upon observance and indication of a spill or discharge of oil or other substances on the project.

Reportable observations are:

1. Leaks or spills
2. Soils which are discolored or have an odor
3. Discharge of oil or other similar substances from drain pipes

The Engineer will be informed immediately of all substantial spills, releases, or other substance discharges. All telephone numbers for the Emergency Response agencies will be posted on site. The Contractor or its Subcontractors will implement control and countermeasures immediately.

### **Fuel and Oil Delivery Trucks**

The equipment superintendent or designee will monitor all truck unloading procedures to verify all hoses are tight and do not leak, and if necessary, will tighten, adjust, or replace them to prevent a release of any kind. In the event of a major spill, alert and initial report procedures will be implemented, and an emergency response contractor will be called in to perform the cleanup.

### **Equipment**

Motorized equipment that require fuel and oil to operate will be inspected prior to the start of each work shift by the operator (in the field) to ensure there is no leakage of oil, fuel, or other material. Trucks will be inspected prior to use for potential leaks or drips. If a leak is found, repairs will be made immediately, and spillage will be cleaned up manually using sorbent material. Vehicles that are found to be leaking will be immediately taken out of service until repairs can be made.

### **Drum Storage**

Drum storage, if any, will be located in a secure area within the Project limits away from environmental areas of concern. Petroleum liquids and other substances stored in drums will be kept in a drum container that consists of a drum rack and drip containment pan that is capable of containing 110% of the stored volume should the drum rupture.

### **Lubrication / Oil Maintenance**

Replacement lubrication will be directly deposited from the lubrication truck to the equipment lubrication reservoir. No other container system will be used to transport oil to the equipment. Mobile equipment will be serviced off site or in the lay-down area. Equipment that cannot be moved will be serviced in the field. The Contractor will place a containment pan or absorbent below the service area prior to initiating service activities in the field. Waste disposal will be completed by the Contractor or by a waste disposal firm. Miscellaneous lubricants for operating equipment will be limited to daily quantities.

### **Spent Oil**

Oil that has already been used on the job will be disposed of via a certified waste disposal firm. Spent oil will be stored in a labeled (hazardous waste signs) and vented fuel storage cell located at the staging area awaiting disposal by a certified waste disposal firm (i.e. Enpro, Inc.). The staging area will be located within the boundary of the project and inspected daily for leaks or spills. The storage cell will be bermed to contain 110% of the largest container or 10% of the total volume in storage, whichever is greater.

## **Special Oil Spill Equipment**

### **Sorbent Pads**

Sorbent pads will be available to absorb oil and petroleum compounds. If necessary, the pads will be used to absorb oil spills or leaks by placing them on the oil and giving them antiquated time to absorb it. The sorbent pads will be stored in equipment box located in the maintenance area. The pads shall float and be water repellent, so they can absorb oil on water. Saturated/contaminated pads will be placed in an appropriate container and stored within the maintenance area. A certified waste disposal firm will dispose of the approved containers.

### **Sorbent Compound**

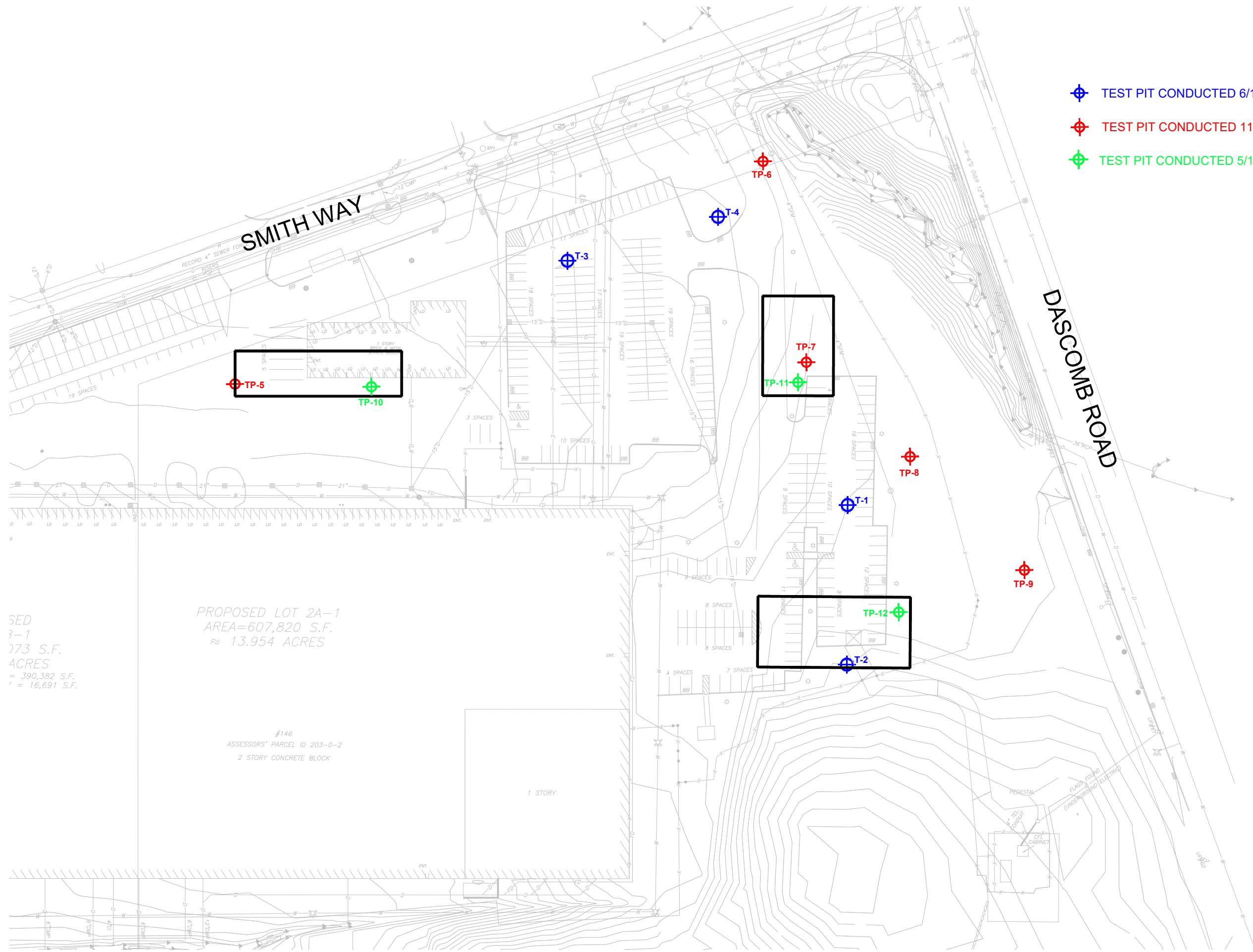
The compound will be used for contaminants spilled on decks or hard surfaces. In most cases, it can be applied directly to spills, but if the spill is large, it can be used to form a dike around the spill to prevent further migration.

**Best Management Practices – Maintenance/Evaluation Checklist  
Construction Practices**

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed	Date of Cleaning/Repair	Performed by
					<input type="checkbox"/> yes <input type="checkbox"/> no (List Items)		
Compost Filter Sock	Inspect at least once per week and after each rainstorm of 0.25 inch or greater.			<ul style="list-style-type: none"> <li>Ensure that compost filter sock is intact and the area behind the sock is not filled with sediment. If there is excessive ponding behind the filter sock or accumulated sediments reach the top of the sock, an additional sock should be added on top or in front of the existing filter sock in these areas, without disturbing the soil or accumulated sediment.</li> <li>If the filter sock was overtopped during a storm event, the operator should consider installing an additional filter sock on top of the original, placing an additional filter sock further up the slope.</li> </ul>			
Catch Basin Inlet Protection	Inspect at least once per week and after each rainstorm of 0.25 inch or greater.			<ul style="list-style-type: none"> <li>Check all temporary control measures after each storm event.</li> <li>To maintain the capacity, remove accumulated sediment when the capacity is reduced by half.</li> </ul>			
Stabilized Construction Exit	Inspect at least once per week and after each rainstorm of 0.25 inch or greater.			<ul style="list-style-type: none"> <li>The exit shall be maintained in a condition that will prevent tracking of sediment onto public rights-of-way.</li> <li>When the control pad becomes ineffective, the stone shall be removed along with the collected soil material and redistributed on site in a stable manner. The entrance should then be reconstructed.</li> <li>The contractor shall sweep or wash pavement at exits, which have experienced mud-tracking on to the pavement or traveled way.</li> <li>When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment trapping device.</li> <li>All sediment shall be prevented from entering storm drains, ditches, or waterways</li> </ul>			

# E

## **Test Pit Data and Soil Evaluations**



SED  
 3-1  
 173 S.F.  
 ACRES  
 = 390,382 S.F.  
 ' = 16,691 S.F.

PROPOSED LOT 2A-1  
 AREA=607,820 S.F.  
 ≈ 13.954 ACRES

#146  
 ASSESSORS' PARCEL ID 203-0-2  
 2 STORY CONCRETE BLOCK

1 STORY

- ⊕ TEST PIT CONDUCTED 6/1/2015
- ⊕ TEST PIT CONDUCTED 11/16/2017
- ⊕ TEST PIT CONDUCTED 5/10/2019



TEC, Inc.  
 65 Glenn Street | 169 Ocean Boulevard  
 Lawrence, MA 01843 | Unit 101, PO Box 249  
 (978) 794-1792 | (603) 601-8154  
 www.TheEngineeringCorp.com

DESIGNED BY	CPR
DRAWN BY	CPR
CHECKED BY	RJF
DATE	6/5/2019
SCALE	N.T.S.

PREPARED FOR  
**Lupoli Companies**  
 290 Merrimack Street  
 Lawrence, MA 01843

REVISIONS

ISSUED FOR  
**Test Pits**

PROJECT TITLE  
**Dascomb Road Redevelopment**

PROJECT LOCATION  
**Andover, Massachusetts**

DRAWING TITLE  
**Test Pit Locations**

PROJECT NO.	T0681
TEC CAD FILE	T0681_TEST PITTS.dwg
DRAWING NO.	<b>1</b>
SHEET	1 OF 1

Location: <u>146 DRACOMB RD.</u>	Owner's Name: <u>TEC.</u>
Map/Parcel: <u>203 12</u>	Address: <u>65 (614) ST - LAWRENCE</u>
Installer: _____	Tel #: _____ New (\$150) _____ Repair _____

Date: 6-15 Wetlands 7100 Zone II — Soil Symbol 259 Soil Name HINKLEY Soil Class A  
RAINY - 100  
0-3% (PARKING LOT) Deep Observation Hole Logs Back Hoe: 4' R - LOWELL

Elevation	Depth	Soil Horizon	Soil Texture	Soil Color	Soil Mottling	% Gravel, Stones, etc:
<u>T-3</u>	<u>0-10"</u>	<u>BIT. COAR. COR. BWC</u>	—	—	—	—
	<u>10-20"</u>	<u>B</u>	<u>L.S.</u>	<u>10YR4/6</u>	—	<u>MASSIVE - FRIABLE</u>
	<u>20-60"</u>	<u>C</u>	<u>FINE SAND</u>	<u>2.5Y6/2</u>	<u>REDUCE 30"</u>	<u>MASSIVE V. FRIABLE</u>
Parent Material <u>OUTWASH</u> Depth to Bedrock: — Standing Water in the Hole: <u>45"</u> Weeping from Pit Face: <u>40"</u> ESHGW: <u>30"</u>						
<u>T-4</u>	<u>0-8"</u>	<u>LOAM/FILL</u>	—	—	—	—
	<u>8-32"</u>	<u>C</u>	<u>V. FINE SAND</u>	<u>2.5Y6/4</u>	—	<u>MASSIVE - FRIABLE</u>
	<u>32-64"</u>	<u>C2</u>	<u>MED. SAND</u>	<u>2.5Y6/2</u>	<u>REDUCE 32"</u>	<u>LOOSE / SINGLE GRAIN</u>
Parent Material <u>OUTWASH</u> Depth to Bedrock: — Standing Water in the Hole: <u>82"</u> Weeping from Pit Face: <u>65"</u> ESHGW: <u>32"</u>						

Date 6-15 Percolation Tests

Observation Hole #				
Depth of Perc				
Start Pre-soak				
Time at 12"				
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate Min/Inch	<u>22</u>			

Performed By: WILLIAM DUFFRENE Witnessed By: DAVID DARGIE / ANDREW PPW

Location: 146 DRACOMB RD. Owner's Name: TEC  
 Map/Parcel: 203/2 Address: 65 (OLD) ST. - LAWRENCE  
 Installer: \_\_\_\_\_ Tel #: \_\_\_\_\_ New (S150) \_\_\_\_\_ Repair \_\_\_\_\_

Date: 6-1-15 Wetlands >100 Zone II — Soil Symbol 25B Soil Name HINKLEY Soil Class A  
 RAINY - 600  
 0-3% (PARKING LOT) Deep Observation Hole Logs Backhoe: S&R - LOWELL

Elevation	Depth	Soil Horizon	Soil Texture	Soil Color	Soil Mottling	% Gravel, Stones, etc:
T-1	0-3"	BIT. CONC				
	3-45"	C <sub>1</sub>	COARSE GR SAND	2.5Y5/3	—	LOOSE/SINGLE GRAIN
	45-80"	C <sub>2</sub>	FINE SAND	2.5Y6/2	REDUC 80" 7.5YR4/6	MASSIVE - V. FRIABLE
Parent Material <u>OUTWASH</u> Depth to Bedrock — Standing Water in the Hole: — Weeping from Pit Face — ESHGW: <u>80"</u>						
T-2	0-12"	A	F.S.L.	10YR2/2	—	W. GRANULAR FRIABLE
	12-29"	B	S.L.	10YR5/6	—	MASSIVE - FRIABLE
	29-71"	C <sub>1</sub>	COARSE GR SAND	2.5Y5/3	—	LOOSE/SINGLE GRAIN
	71-115"	C <sub>2</sub>	FINE SAND	2.5Y6/2	REDUC 72" 5YR4/6	MASSIVE V. FRIABLE
Parent Material <u>OUTWASH</u> Depth to Bedrock — Standing Water in the Hole: — Weeping from Pit Face — ESHGW: <u>72"</u>						

Date 6-1-15 Percolation Tests

Observation Hole # \_\_\_\_\_

Depth of Perc			
Start Pre-soak			
Time at 12"			
Time at 9"			
Time at 6"			
Time (9"-6")			
Rate Min/Inch	<u>2.2</u>		

Performed By: WILLIAM DIERRE Witnessed By: DAVID DARGIE / ADRIAN PRW



65 Glenn Street | 169 Ocean Blvd.  
 Lawrence, MA 01843 | Unit 101, PO Box 249  
 Hampton, NH 03842  
 T:978.794.1792 T:603.601.8154  
 TheEngineeringCorp.com

**Location:** 146 Dascomb Road  
 Andover, MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 11/16/2017    **Wetlands:** >100'    **Zone II:** N/A    **Soil Symbol:** 602    **Soil Name:** Urban Land    **Soil Class:** A

**Test Pit:** TP-5    **Elevation:** 109.3' (See Test Pit Plan)

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-4	Pavement										
4-14	Fill	10 YR 5/4				Sandy Loam			Massive	Friable	
14-60	C	10 YR 7/2	30	10 YR 6/8	20	Fine Sand			Massive	Friable	

**Parent Material:** N/A    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHWG:** 30"

**Additional Notes:**

**Test Pit Performed by:** Peter F. Ellison, PE

**Soil Evaluator Number:** SE13866



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**Location:** 146 Dascomb Road  
 Andover, MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 11/16/2017    **Wetlands:** 35'    **Zone II:** N/A    **Soil Symbol:** 602    **Soil Name:** Urban Land    **Soil Class:** A

**Test Pit:** TP-6    **Elevation:** 117.8' (See Test Pit Plan)

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	Ap	10 YR 3/1				Sandy Loam			Massive	Friable	
6-18	Bw	10 YR 5/6				Sandy Loam			Massive	Friable	
18-40	C1	10 YR 7/3				Fine Sand			Massive	Friable	
40-50	C2	10 YR 5/4				Coarse Sand	15-25		Massive	Friable	
50-72	C3	10 YR 7/2				Fine Sand			Massive	Friable	

**Parent Material:** N/A    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHGW:** N/A

**Additional Notes:**

**Test Pit Performed by:** Peter F. Ellison, PE

**Soil Evaluator Number:** SE13866



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**Location:** 146 Dascomb Road  
 Andover, MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 11/16/2017    **Wetlands:** >100'    **Zone II:** N/A    **Soil Symbol:** 602    **Soil Name:** Urban Land    **Soil Class:** A

**Test Pit:** TP-7    **Elevation:** 122.0' (See Test Pit Plan)

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	Ap	10 YR 3/2				Sandy Loam			Massive	Friable	
6-24	Fill	10 YR 3/2				Sandy Loam			Massive	Friable	
24-31	Bw	10 YR 4/4				Sandy Loam			Massive	Friable	
31-37	C1	10 YR 6/3				Coarse Sand	5-10		Massive	Friable	
37-72	C2	10 YR 7/2				Fine Sand			Massive	Friable	

**Parent Material:** N/A    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHGW:** N/A

**Additional Notes:**

**Test Pit Performed by:** Peter F. Ellison, PE

**Soil Evaluator Number:** SE13866



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**Location:** 146 Dascomb Road  
 Andover, MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 11/16/2017    **Wetlands:** 100'    **Zone II:** N/A    **Soil Symbol:** 253B    **Soil Name:** Hinckley Loamy Sand    **Soil Class:** A

**Test Pit:** TP-8    **Elevation:** 126.0' (See Test Pit Plan)

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-7	Ap	10 YR 4/2				Sandy Loam			Massive	Friable	
7-21	Bw	10 YR 5/6				Sandy Loam			Massive	Friable	
21-46	C1	10 YR 6/2				Coarse Sand	35-50		Massive	Friable	
46-68	C2	10 YR 7/2				Fine Sand			Massive	Friable	

Glacial  
**Parent Material:** Outwash    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHWG:** N/A

**Additional Notes:**

**Test Pit Performed by:** Peter F. Ellison, PE

**Soil Evaluator Number:** SE13866



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**Location:** 146 Dascomb Road  
 Andover, MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 11/16/2017    **Wetlands:** >100'    **Zone II:** N/A    **Soil Symbol:** 253B    **Soil Name:** Hinckley Loamy Sand    **Soil Class:** A

**Test Pit:** TP-9    **Elevation:** 127.8 (See Test Pit Plan)

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	Ap	10 YR 4/2				Sandy Loam			Massive	Friable	
6-48	Fill	10 YR 5/2				Sandy Loam			Massive	Friable	
48-54	C1	10 YR 5/8				Sandy Loam			Massive	Friable	
54-84	C2	10 YR 5/4	72	10 YR 6/8	15	Coarse Sand	10-15		Massive	Friable	

Glacial  
**Parent Material:** Outwash    **Depth to Bedrock:** N/A    **Standing Water:** N/A    **ESHWG:** 72"

**Additional Notes:**

**Test Pit Performed by:** Peter F. Ellison, PE

**Soil Evaluator Number:** SE13866



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**Location:** 146 Dascomb Road  
Andover MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 5/9/2019    **Wetlands:** >100    **Zone II:** N/A    **Soil Symbol:** 602 (253)    **Soil Name:** Urban Land (Hinckley Loamy Sand)    **Soil Class:** A

**Test Pit:** TP-10    **Elevation:** 109+/-    **Start:** 1410    **End:** 1440

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3	Pavement										
3-22	Fill	7.5 YR 5/4	-	-	-	Sandy Loam	-	-	M	F	
22->64	C	7.5 YR 7/3	30"	7.5 YR 5/8	20%	Fine Sand	-	-	SG	L	

Parent Material: Glacial Outwash    **Depth to Bedrock:** -    **Standing Water:** -    **ESHWG:** 30"

**Additional Notes:** 1) Test pit was observed by Benjamin Meade and Jacki Byerley (Town of Andover) in addition to TEC.  
2) Sidewall weeping was observed at approximately 54"

**Test Pit Performed by:** D. Nader

**Soil Evaluator Number:** SE 14257



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**Location:** 146 Dascomb Road  
Andover MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 5/9/2019    **Wetlands:** >100    **Zone II:** N/A    **Soil Symbol:** 602 (253)    **Soil Name:** Urban Land (Hinckley) Loamy Sand    **Soil Class:** A

**Test Pit:** TP-11    **Elevation:** 122 (120-124 Sloped)    **Start:** 1330    **End:** 1405

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-48	Topsoil									F	
48-60	Fill	7.5 YR 6/8	-	-	-	Sand	-	-	SG	L	
60-72	Apb	7.5 YR 3/3	-	-	-	Sandy Loam	-	-	M	F	
72-110	C	7.5 YR 6/6	-	-	-	Sand	5%	-	SG	L	

Glacial

**Parent Material:** Outwash    **Depth to Bedrock:** -    **Standing Water:** -    **ESHWG:** >110"

**Additional Notes:** 1) Test pit was observed by Benjamin Meade and Jacki Byerley (Town of Andover) in addition to TEC.  
2) While ground level sloped from approximate elevations 124' to 120' from the northern to southern extents of the test pit, the soil horizons remained relatively constant, gradually sloping from north to south approximately 0.5 feet. Measurements shown on log are depths taken from the northern sidewall which provided clean and definitive readings.

**Test Pit Performed by:** D. Nader    **Soil Evaluator Number:** SE 14257



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**Location:** 146 Dascomb Road  
 Andover MA

**Client:** Dascomb Road Development, LLC  
**Address:** 354 Merrimack Street, Suite 1, Lawrence, MA 01843  
**Telephone:** 978-681-7777

**Date:** 5/9/2019    **Wetlands:** >100    **Zone II:** N/A    **Soil Symbol:** 602    **Soil Name:** Urban Land (Hinckley) Loamy Sand    **Soil Class:** A  
 (253)

**Test Pit:** TP-12    **Elevation:** 128+/-    **Start:** 1300    **End:** 1345

Depth	Soil Horizon	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	Topsoil								F		
12-56	Fill		-	-	-		-	-	M	F	Note 2
56-65	Bw	7.5YR3/2	-	-	-	Loamy Sand	-	-	SG	L	
65-138+	C	7.5YR6/1	-	-	-	Sand	20%	-	SG	L	

**Parent Material:** Glacial Outwash    **Depth to Bedrock:** -    **Standing Water:** -    **ESHWG:** >138"

**Additional Notes:** 1) Test pit was observed by Benjamin Meade and Jacki Byerley (Town of Andover) in addition to TEC.  
 2) 12" thick concrete and rebar was encountered between 48 and 60 inches (assumed to be abandoned footings based on shape, orientation, and location).

**Test Pit Performed by:** D. Nader    **Soil Evaluator Number:** SE 14257

**F**

# **TEC Stormwater Inspection Report**

## FIELD REPORT

Project	The Dascomb Road Project		Date		Time In		Time Out			
Location	146 Dascomb Road, Andover, MA		5/2/2019		1:00		1:30			
Project No.	T0681		Day	S	M	T	W	T	F	S
Client	Salvatore Lupoli			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contractor	N/A		Temp	To 0	0 - 32	32 - 50	50 - 75		75 +	
TEC PM	Rick Friberg			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		<input type="checkbox"/>	
			Wind	Still	Moder	High		Report No.		
				<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		1		
			Humidity	Dry	Moder	High				
				<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>				

TEC performed a site visit to the Restaurant Depot portion of 146 Dascomb Road on May 2, 2019. According to weather station KMAANDOV42 (weatherunderground.com), the area received about 0.47 inches of rainfall on May 2, and approximately 2.06 inches of rain over a 7 day span.

TEC walked throughout the parking lot area and area of the infiltration basin at the southern edge of the property to observe the overall functionality of the stormwater system. TEC performed a visual inspection of all visible catch basins, infiltration basin, outlets, outlet control structure, culverts, etc.

Based on the field walk, TEC can confirm that the existing stormwater system at Restaurant Depot is in working condition. The infiltration basin appears to be functioning properly, with minimal standing water in the bottom of the basin. All outlets into the basin appeared to be in good condition, unclogged and flowing freely. All catch basin grates were visible, and appeared to have hooded outlets. Sumps were full of water at the time of the observations. It appeared that the owners of Restaurant Depot have done a fairly recent cleaning of the system, no sedimentation was observed in any of the basins or infiltration basin.

By: Peter Ellison Title: 5/2/2019

**FIELD REPORT**



**Figure 1** – catch basin, appears to have been swept recently, water flowing freely, no sedimentation visible



**Figure 2** – infiltration basin with negligible standing water, after receiving 2"+ rain over 7 day span

## FIELD REPORT



**Figure 3** – infiltration basin outlet pipe flowing freely, no sedimentation visible



**Figure 4** – infiltration basin overflow in good condition, basin does not appear to be overflowing as rip rap appears to be in untouched condition