STORMWATER REPORT

16 Bulge Road

Devens, Massachusetts

PREPARED FOR

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PREPARED BY

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March 2021 Rev April 23, 20

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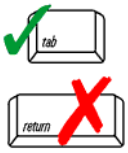
Checklist for Stormwater Report

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

Stormwater Report Narrative

This Stormwater Report has been prepared to demonstrate compliance with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00). This report also demonstrates compliance with the Devens Enterprise Commission, Industrial Performance Standards and General Regulations (974 CMR 4.00), Section 4.08, Stormwater Management.

Project Description

The Applicant, Scannell Properties, is proposing to construct a manufacturing facility on a parcel of land, about 25 acres, located at 16 Bulge Road in Devens, Massachusetts (the Site). As proposed, the Project consists of 120,000 square foot building footprint, ancillary landscape improvements, parking spaces for 299 vehicles, loading area, and utility improvements to support this use.

The Project will entail the construction of manufacturing space and office space and is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL).

Portions of the proposed outfalls are connected to a system which directly discharges to the Cold Spring Brook, a tributary of the Nashua River (an impaired waterway), and that the connected portion of the site system has been design to be fully compliant with all requirements of the MA MS4 General Permit and conditions of the Devens NOI including reduction of applicable impairments in the Nashua R. The overall stormwater system should be reviewed by the DEC consultant to ensure that the proposed system adequately addresses all relevant issues.

Site Description

The Site is approximately 25± acres identified as parcel 16-0018-0200. The site is located on the northeast side of Bulge Road and is bounded by mostly undeveloped wooded land to the north, and southeast. An existing maintenance building for the adjacent Red Tail Golf Club is located on the property on the west side of the site.

The site was previously developed with multi-family residential housing identified as the Davao Housing Area for the Fort Devens Army Base. The buildings were razed approximately 15 years ago. The site is now predominantly grass meadows and woods with only the roadway paving, sidewalks, and some utility infrastructure remaining from the previous housing development (see Figure 1). The Site lies within the Nashua River watershed.

MassGIS indicates there are no wetlands located on the site, but there are wetlands located on the properties adjacent to the site. On October 1, 2020, a VHB biologist performed a site walk and determined there are no wetlands or wetland buffer zones on the site.

The Natural Resource Conservation Service (NRCS) has multiple mapped soil types on the site with the predominant soil type identified as Quonset loamy sand with a Hydrologic Soil

Group (HSG) A rating. The site also contains areas with Hinckley loamy sand, Windsor loamy sand, and Quonset loamy sand, which all have an HSG A rating. Based on the soil evaluation included in Appendix C, the Site is within an area of rapid infiltration (soils with a saturated hydraulic conductivity greater than 2.4 inches per hour). An infiltration rate of 8.27 in/hr was used to model the stormwater BMPs, based on geotechnical investigations performed in the area of the basins. Additionally, test pits and boring logs indicate that no mottling or groundwater was observed within four feet of the bottom of basins.

The northern portion of the site is within the Aquifer District of the Water Resource Protection (WRP) Overlay District, and the front portion of the site along Bulge Road is within a Zone II Wellhead Protection area. Based on this, the design for the site must follow additional requirements according to the DEC rules and regulations Section 4.09 paragraph 2.a.

The entire site lies within an area identified as a priority habitat of rare species by the Natural Heritage and Endangered Species Program (NHESP). Preliminary review has identified the Blanding's Turtle as a species of concern. Additional information has been requested from the NHESP by MassDevelopment to determine if there are any other species of concern and to determine any specific requirements or restrictions for the project.

The site contains "Slope Resource Areas," an area delineated and regulated by the DEC, around the north, east, and south side of the site. There is a 15 foot and additional 35 foot "no disturbance" buffer associated with this resource area.

An Activity Use Limitation (AUL) was implemented at the site in 2017 to maintain a Condition of No Significant Risk. Development of the site must comply with the requirements of the AUL. See Phase 1 Environmental Site Assessment under separate cover for additional information.

Existing Drainage Conditions

Under existing conditions, the Site is predominantly grass meadows and woods with only the roadway paving and sidewalks remaining. The Site is bordered on three sides by a forested slope, 35' or more in elevation. Figure 2 illustrates the existing drainage patterns on the Site. Currently, the Site is divided into four drainage areas as stormwater runoff flows to three Design Points, which have been identified as Robbins Pond, Bulge Rd. drainage, and Cold Spring Brook.

In accordance with the Devens Enterprise Commission Development Rules and Regulations, the existing drainage conditions were analyzed in an undeveloped "green field" condition. This analysis resulted in very small peak discharge flows and runoff volumes due to the Site's predominately wooded ground cover, long times of concentration, and rapidly infiltrating HSG A soils.

Proposed Drainage Conditions

Figure 3 illustrates the proposed "post construction" drainage conditions for the project. As shown, the Site will be divided into 12 drainage areas that discharge treated stormwater to the 3 existing Design Points.

Integrated into the site design is a comprehensive stormwater management system that has been developed in accordance with the Massachusetts Stormwater Handbook and Devens Rules and Regulations.

Because the Project is located within an area of rapid infiltration and a critical area, the proposed stormwater management system has been designed to treat the one-inch Water Quality Volume and provide 44% Total Suspended Solids (TSS) pretreatment prior to infiltration. Furthermore, pursuant to 974 CMR 4.08(6)(h), stormwater discharging to a subsurface infiltration system has been treated to achieve 80% TSS removal prior to entering the system.

The perimeter road will be collected in deep sump catch basins and piped to sediment forebay prior to discharge to at grade infiltration / detention basins.

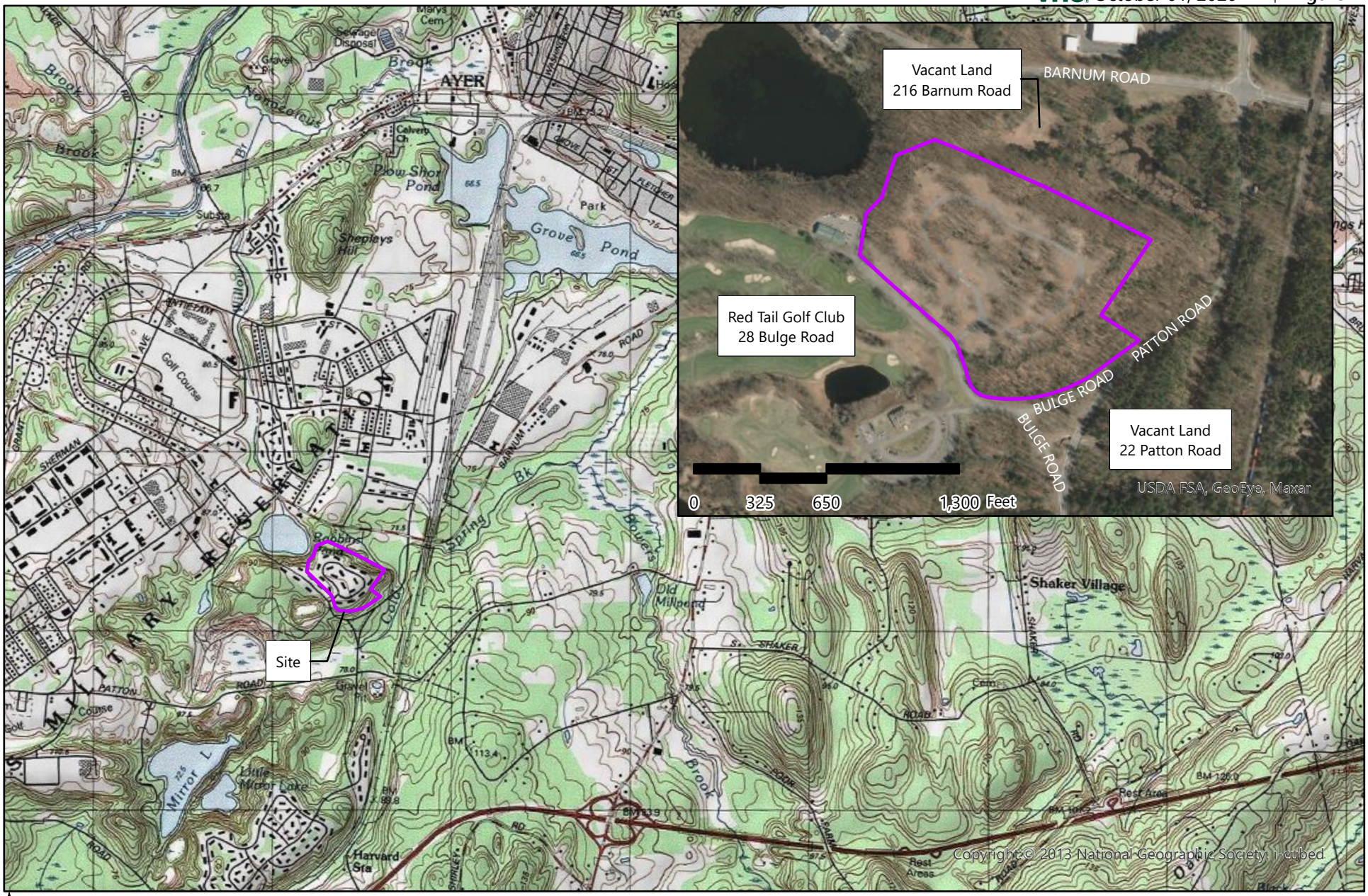
The front parking lot area is graded to drain to a wide landscape island that will collect runoff prior to entering deep sum catch basins. The deep sump catch basins drain to a water quality unit, Contech Cascade separator, to achieve the required 80 % TSS removal prior to infiltration in a subsurface system. The subsurface will be installed as designed and no additional flows will be allowed without written approval from Mass Development.

The roof runoff will be piped directly to an at grade infiltration / detention basin.

There are two additional infiltration / detention basins located north of the perimeter road that will infiltrate and detain overflow water to help minimize runoff off-site.

Area set aside for future development, including building and parking areas, will maintain existing surface treatment which is woods/grass cover. Likewise, the area beyond the limit of disturbance will remain as woods/grass cover. Post-development peak rate of stormwater discharge off-site has been reduced below pre-development rates. See Table 1.

Figure 1: Site Locus Map



0 1,250 2,500 5,000 Feet

Site Boundary

Housing Property
Former Davao Circle | 16 Bulge Road, Devens, Massachusetts

Site Location and Local Area Map

Sources: ESRI, US Topographic Map

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Figure 2: Existing Drainage Areas

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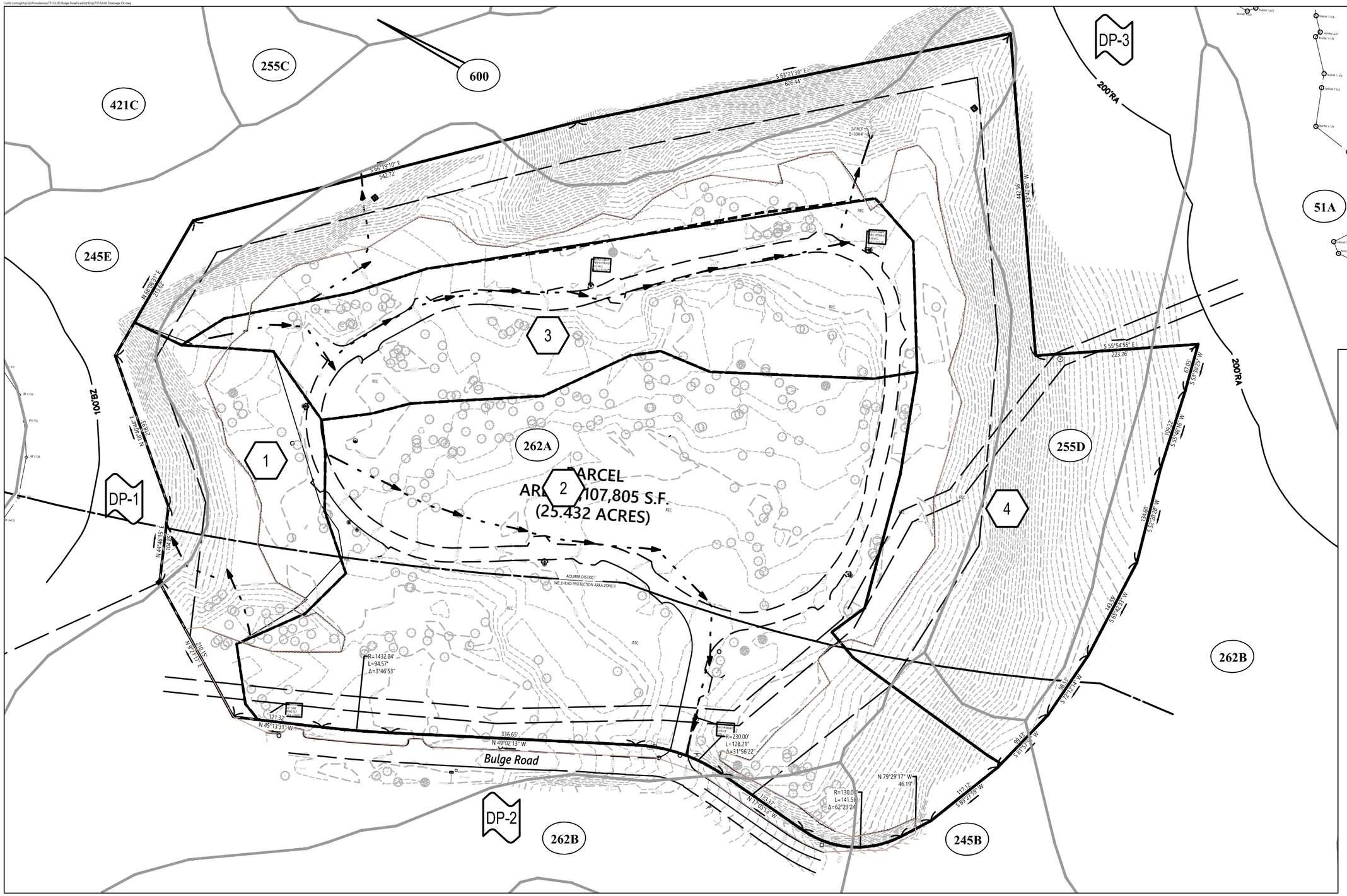

Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND

LINETYPES

- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY
- 100' BUFFER ZONE
- WETLAND BOUNDARY

SCS SOIL CLASSIFICATIONS

51A	SWANSEA MUCK, 0 TO 1 PERCENT SLOPES, HSG B/D
245B	HINCKLEY LOAMY SAND, 3 TO 8 PERCENT SLOPES, HSG A
245E	HINCKLEY LOAMY SAND, 25 TO 35 PERCENT SLOPES, HSG A
255C	WINDSOR LOAMY SAND, 8 TO 15 PERCENT SLOPES, HSG A
255D	WINDSOR LOAMY SAND, 15 TO 25 PERCENT SLOPES, HSG A
262A	QUONSET LOAMY SAND, 0 TO 3 PERCENT SLOPES, HSG A
262B	QUONSET LOAMY SAND, 3 TO 8 PERCENT SLOPES, HSG A
262C	QUONSET LOAMY SAND, 8 TO 15 PERCENT SLOPES, HSG A
421C	CANTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY, HSG B
600	PITS, GRAVEL

0 30 60 120 Feet

Existing Drainage Conditions

16 Bulge Road, Scannell

Devens, MA

Source: **VHB**
Prepared for: **Permit**
Date: **1/22/2021**

Figure 3: Proposed Drainage Areas

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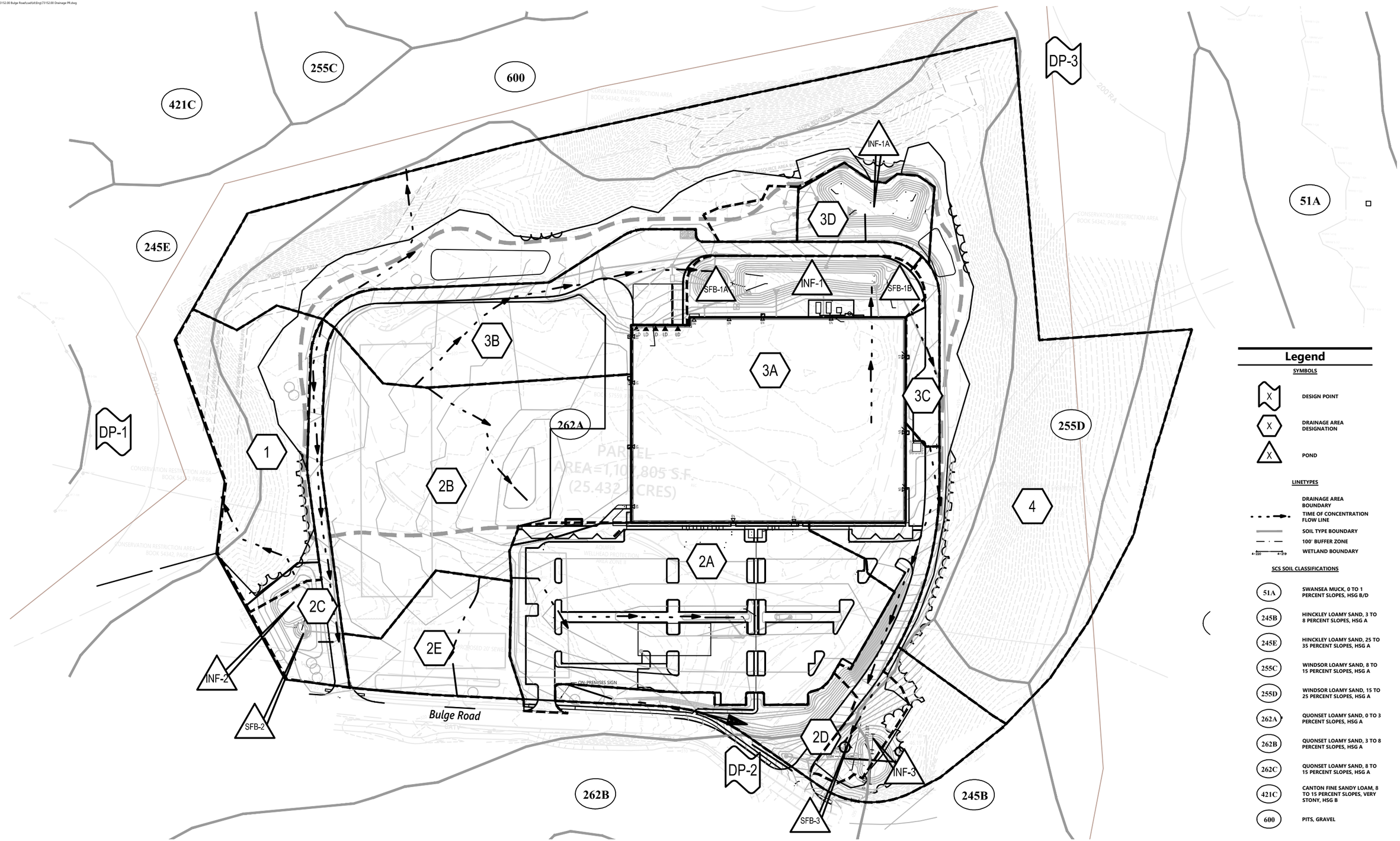


Legend

SYMBOLS

- DESIGN POINT
- DRAINAGE AREA DESIGNATION
- POND

LINETYPES

- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL TYPE BOUNDARY
- 100' BUFFER ZONE
- WETLAND BOUNDARY

SCS SOIL CLASSIFICATIONS

51A	SWANSEA MUCK, 0 TO 1 PERCENT SLOPES, HSG B/D
245B	HINCKLEY LOAMY SAND, 3 TO 8 PERCENT SLOPES, HSG A
245E	HINCKLEY LOAMY SAND, 25 TO 35 PERCENT SLOPES, HSG A
255C	WINDSOR LOAMY SAND, 8 TO 15 PERCENT SLOPES, HSG A
255D	WINDSOR LOAMY SAND, 15 TO 25 PERCENT SLOPES, HSG A
262A	QUONSET LOAMY SAND, 0 TO 3 PERCENT SLOPES, HSG A
262B	QUONSET LOAMY SAND, 3 TO 8 PERCENT SLOPES, HSG A
262C	QUONSET LOAMY SAND, 8 TO 15 PERCENT SLOPES, HSG A
421C	CANTON FINE SANDY LOAM, 8 TO 15 PERCENT SLOPES, VERY STONY, HSG B
600	PITS, GRAVEL

0 30 60 120 Feet

Proposed Drainage Conditions

16 Bulge Road, Scannell

Devens, MA

Source: **VHB**
Prepared for: **Permit**
Date: **4/13/2021**

Regulatory Compliance

Massachusetts Department of Environmental Protection (DEP) - Stormwater Management Standards

As demonstrated below, the proposed Project fully complies with the DEP Stormwater Management Standards.

Standard 1: No New Untreated Discharges or Erosion to Wetlands

The Project has been designed to fully comply with Standard 1.

The Best Management Practices (BMPs) included in the proposed stormwater management system have been designed in accordance with the Massachusetts Stormwater Handbook. Supporting information and computations demonstrating that no new untreated discharges will result from the Project are presented through compliance with Standards 4 through 6.

All proposed Project stormwater outlets and conveyances have been designed to not cause erosion or scour to wetlands or receiving waters. Outlets from closed drainage systems have been designed with flared end sections and stone protection to dissipate discharge velocities.

Computations and supporting information for the sizing and selection of materials used to protect from scour and erosion are included in Appendix A.

Standard 2: Peak Rate Attenuation

The Project has been designed to fully comply with Standard 2.

The rainfall-runoff response of the Site under existing and proposed conditions was analyzed for storm events with recurrence intervals of 2, 10, 25, 50, and 100 years. The stormwater management system is designed to capture and infiltrate all storm events up to and including the 100-year storm. Areas not collected will continue to sheet flow off site.

Computations and supporting information regarding the hydrologic modeling are included in Appendix B.

Table 1 - Peak Discharge Rates (cfs*)

Design Point	2-year	10-year	25-year	50-year	100-year
Design Point: DP1 Offsite to West					
Existing	0.00	0.01	0.06	0.20	0.47
Proposed	0.00	0.00	0.02	0.05	0.18
Design Point: DP2 Bulge Rd. Drainage					
Existing	0.00	0.18	0.98	2.19	3.98
Proposed	0.00	0.00	0.01	0.02	0.04
Design Point: DP3 Offsite to North and West					
Existing	0.00	0.09	0.48	1.21	2.76
Proposed	0.00	0.02	0.14	0.31	1.02

*cfs- cubic feet per second

Standard 3: Stormwater Recharge

The Project has been designed to fully comply with Standard 3.

Recharge of stormwater has been provided using surface and subsurface infiltration, which have been sized using the static method. Each infiltration BMP has been designed to drain completely within 72 hours. The proposed infiltration BMPs are designed to recharge runoff from 98% of the impervious cover on the site. The capture area adjustment factor has been applied to the required recharge volume. The recharge volume has been met. Soil evaluation (including Geotechnical Report), computations, and supporting information are included in Appendix C.

Standard 4: Water Quality

The Project has been designed to fully comply with Standard 4.

The proposed stormwater management system implements a treatment train of BMPs that has been designed to provide 80% TSS removal of stormwater runoff from 98% of proposed impervious surfaces as well as 44% pretreatment prior to infiltration BMPs. Per Devens Industrial Performance Standard 974 CMR 4.08 (6)(h), subsurface infiltration systems are considered closed drainage systems and achieve an 80% TSS removal rate prior to infiltration.

The Nashaua River has a TMDL for Pathogen, and an impairment for Phosphorous. Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook notes that Infiltration Basins have pollutant removal efficiencies of 90 % for Pathogens and 60% to 70% removal of Phosphorous.

Computations and supporting information, including the Long-Term Pollution Prevention Plan, are included in Appendix D.

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

The Project is not considered a LUHPPL.

Standard 6: Critical Areas

The Project has been designed with suitable BMPs sized to treat the 1 inch Water Quality Volume and provide the pretreatment requirement of 44% TSS or 80% TSS removal prior to infiltration. Proposed source controls and pollution prevention measures have been identified in the Long-Term Pollution Prevention Plan included in Appendix D.

For computations and supporting information regarding the sizing of BMPs suitable for treatment of runoff near or to critical areas, see Appendix D.

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable

The Project has been designed to fully comply with all ten of the Stormwater Management Standards.

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

The Project will disturb approximately 13 acres of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required under this permit, a Stormwater Pollution Prevention Plan (SWPPP) will be developed and submitted before land disturbance begins. Recommended construction period pollution prevention and erosion and sedimentation controls to be finalized in the SWPPP are included in Appendix E.

Standard 9: Operation and Maintenance Plan

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the Project. The O&M Plan is included in Appendix D as part of the Long-Term Pollution Prevention Plan.

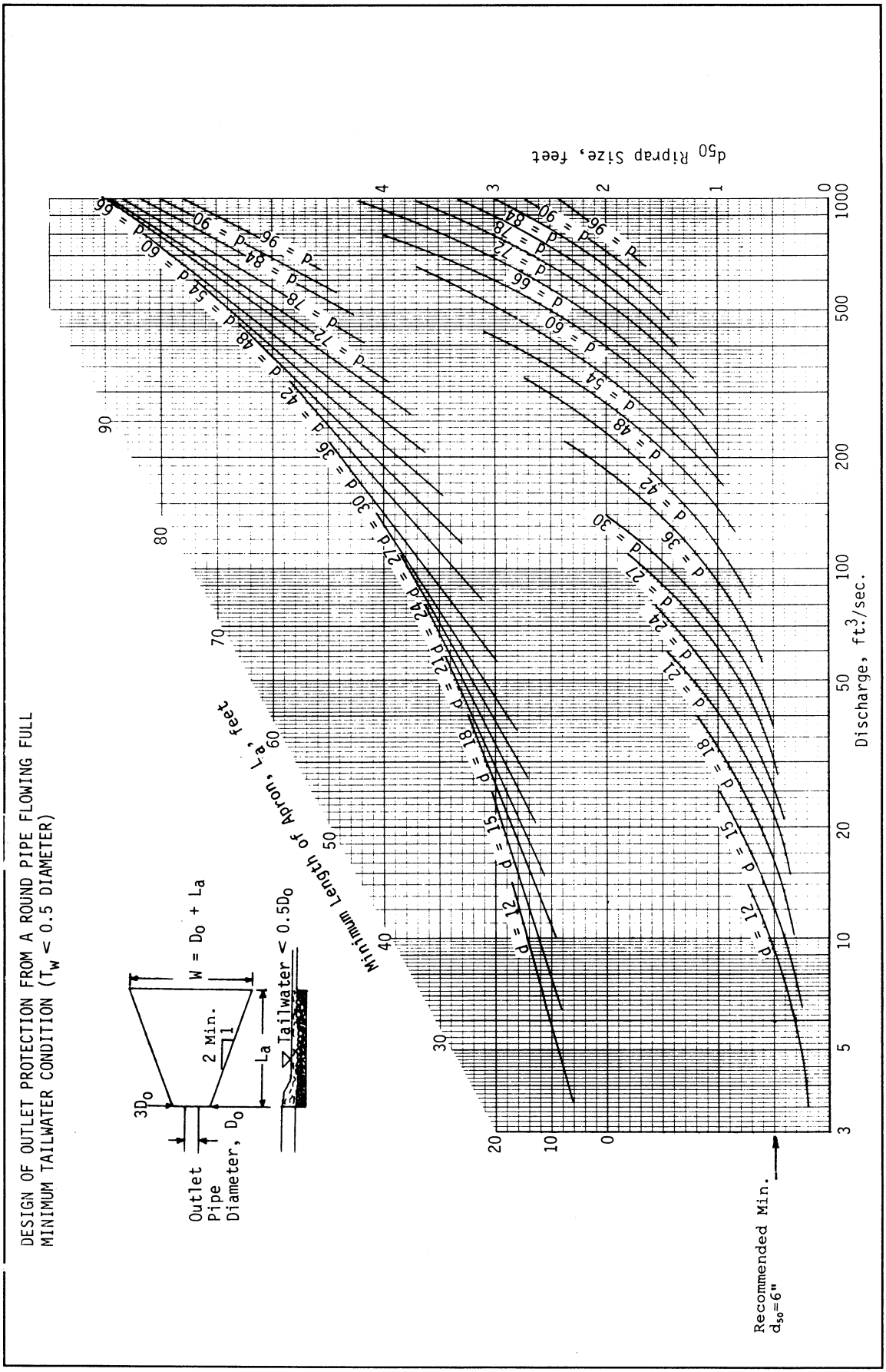
Standard 10: Prohibition of Illicit Discharges

Sanitary sewer and storm drainage structures remaining from previous development which are part of the redevelopment area will be removed or will be incorporated into updated sanitary sewer and separate stormwater sewer systems. The design plans submitted with this report have been designed so that the components included therein are in full compliance with current standards. The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges.

Local Municipal Rules and Regulations

The stormwater management system was designed in accordance with the Devens Enterprise Commission Development Rules and Regulations, the Massachusetts MS4 General Permit, and Devens Notice of Intent.

Appendix A - Standard 1 Computations and Supporting Information



Source: USDA-SCS Plate 3.18-3

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

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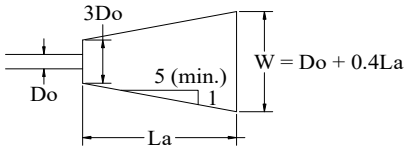

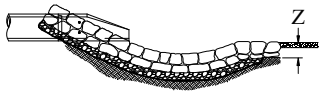

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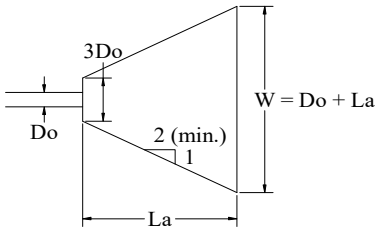


FES-1

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	12 in.	3Do =	36 in.
Q =	1.16 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

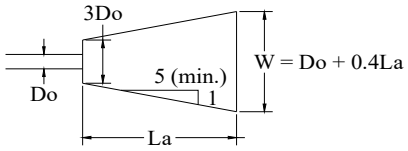
Outlet Protection Calculations: Stone For Pipe Ends

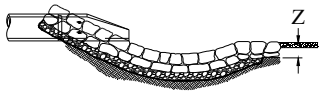
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

Tw ≥ 0.5Do





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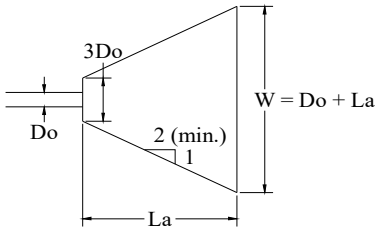


FES-2

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	12 in.	3Do =	36 in.
Q =	1.95 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

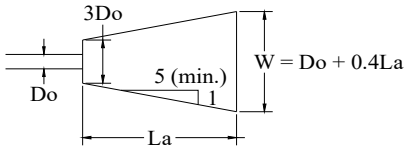
Stone Protection Dimensions:

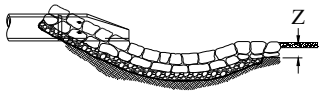
3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: 16 Bulge Road, Scannell
Proj. No.: 73152.00
Date: 2/4/2021
Project Location: Devens, MA
Calculated by: SAP

Tw ≥ 0.5Do





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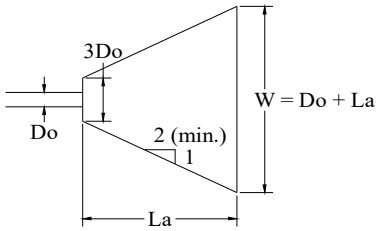

FES-3
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Input from USDA-SCS Plate 3.18-3

Do =	12 in.	3Do =	36 in.
Q =	1.14 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

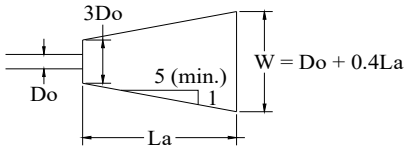
Outlet Protection Calculations: Stone For Pipe Ends

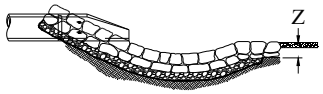
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 3/8/2021

Project Location: Devens, MA **Calculated by:** kc

Tw ≥ 0.5Do





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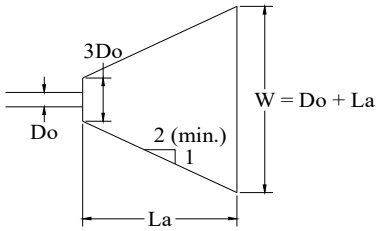

FES-4

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Do =	12 in.	3Do =	36 in.
Q =	0.41 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

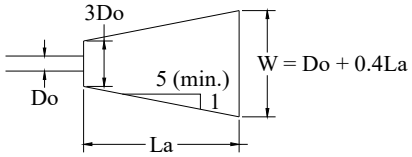
Outlet Protection Calculations: Stone For Pipe Ends

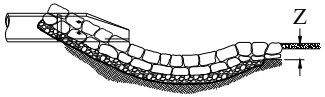
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

Tw ≥ 0.5Do





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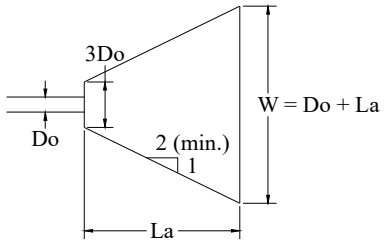

FES-5

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Do =	12 in.	3Do =	36 in.
Q =	2.26 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

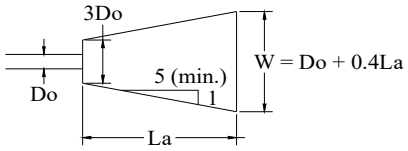
Outlet Protection Calculations: Stone For Pipe Ends

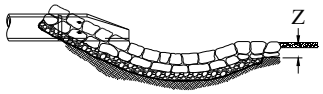
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

Tw ≥ 0.5Do





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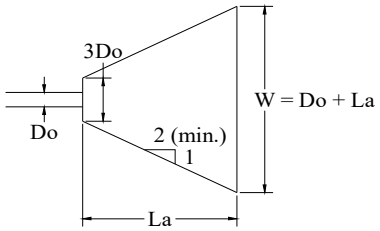


FES-6

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	10 in.	3Do =	30 in.
Q =	3.16 cfs	W =	5.8 ft.
La =	5.0 ft. (min.)	W (2:1) =	7.5 ft.

Stone Protection Dimensions:

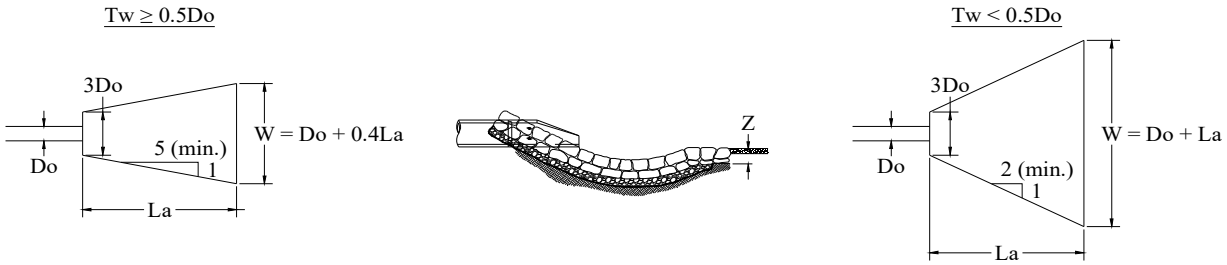
3Do =	2.5 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	7.5 ft.		

Outlet Protection Calculations: Stone For Pipe Ends

Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP



FES-7

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	12 in.	3Do =	36 in.
Q =	3.16 cfs	W =	6.0 ft.
La =	5.0 ft. (min.)	W (2:1) =	8.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	8.0 ft.		

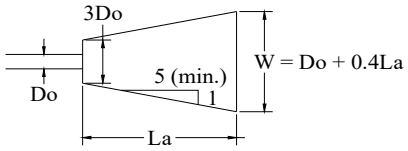
Outlet Protection Calculations: Stone For Pipe Ends

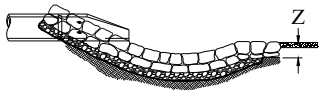
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

Tw ≥ 0.5Do





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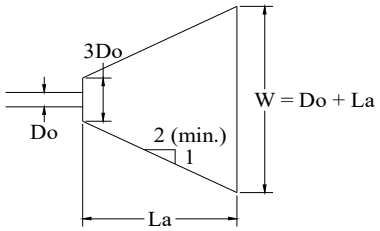


FES-8

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	18 in.	3Do =	54 in.
Q =	6.32 cfs	W =	6.5 ft.
La =	5.0 ft. (min.)	W (2:1) =	9.5 ft.

Stone Protection Dimensions:

3Do =	4.5 ft.	d_{50} =	12 in.
La =	5.0 ft.	Z =	24 in.
W =	9.5 ft.		

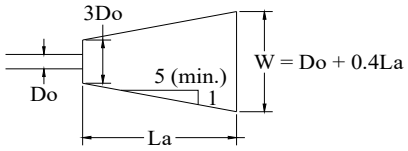
Outlet Protection Calculations: Stone For Pipe Ends

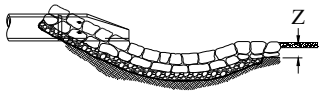
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 2/4/2021

Project Location: Devens, MA **Calculated by:** SAP

Tw ≥ 0.5Do





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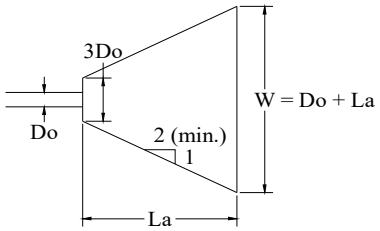


FES-9

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	10 in.	3Do =	30 in.
Q =	3.16 cfs	W =	5.8 ft.
La =	5.0 ft. (min.)	W (2:1) =	7.5 ft.

Stone Protection Dimensions:

3Do =	2.5 ft.	d_{50} =	6 in.
La =	5.0 ft.	Z =	12 in.
W =	7.5 ft.		

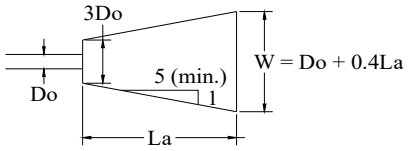
Outlet Protection Calculations: Stone For Pipe Ends

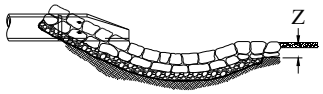
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 3/8/2021

Project Location: Devens, MA **Calculated by:** kc

Tw ≥ 0.5Do





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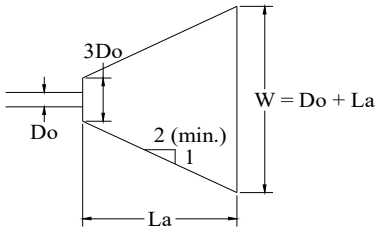


FES-10

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	15 in.	3Do =	45 in.
Q =	10.44 cfs	W =	13.3 ft.
La =	12.0 ft. (min.)	W (2:1) =	15.8 ft.

Stone Protection Dimensions:

3Do =	3.8 ft.	d_{50} =	6 in.
La =	12.0 ft.	Z =	12 in.
W =	15.8 ft.		

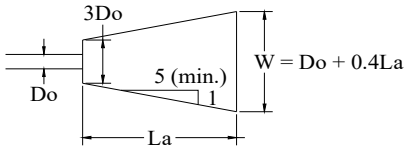
Outlet Protection Calculations: Stone For Pipe Ends

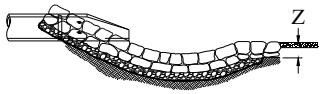
Project Name: 16 Bulge Road, Scannell **Proj. No.:** 73152.00

Date: 3/8/2021

Project Location: Devens, MA **Calculated by:** kc

Tw ≥ 0.5Do





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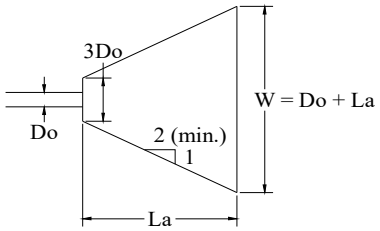

FES-11

Tw < 0.5Do

Input from USDA-SCS Plate 3.18-3

Do =	12 in.	3Do =	36 in.
Q =	2.28 cfs	W =	7.0 ft.
La =	6.0 ft. (min.)	W (2:1) =	9.0 ft.

Stone Protection Dimensions:

3Do =	3.0 ft.	d_{50} =	6 in.
La =	6.0 ft.	Z =	12 in.
W =	9.0 ft.		

Pipe Sizing Calculations

The closed drainage system was designed for the 25-Year storm event, in accordance with the Devens Enterprise Commission Development Rules and Regulations.

Drainage pipes were sized using Manning's Equation for full-flow capacity and the Rational Method.

1 Cedar Street
Providence, RI 02903

Storm Drainage Computations

Name: 16 Bulge Road, Devens, MA

Client: Scannell

Proj. No.: **73152**
Date: **4/8/2021**

Computed by: SP
Checked by: KC

Rainfall Intensity - 25 Year Duration TP-40

DESCRIPTION	LOCATION		AREA	C	C x A	SUM	FLOW TIME (MIN)		i*	DESIGN					CAPACITY		PROFILE						
	FROM	TO	(AC.)			C x A	PIPE	CONC TIME		Q cfs	V fps	n	PIPE SIZE	SLOPE	Q full ft^3/s	V full ft/s	LENGTH ft	FALL ft	RIM	INV UPPER	INV LOWER	W.S.E. ft	Freeboard ft	
	CB-1	DMH-1	0.036	0.900	0.032	0.032	0.40	5.0	6.5	0.21	2.1	0.012	12	1.40%	4.57	5.8	50	0.70	321.20	317.70	317.00	317.6	3.6	
	CB-2	DMH-1	0.204	0.900	0.184	0.184	1.36	5.0	6.5	1.19	2.4	0.012	12	0.33%	2.21	2.8	198	0.65	319.30	316.75	316.10	316.7	2.6	
	DMH-1	FES-1	0.000	0.000	0.000	0.184	0.26	6.4	6.3	1.16	2.7	0.012	12	0.47%	2.63	3.4	43	0.20	322.10	316.00	315.80	315.9	6.2	
	CB-3	DMH-2	0.140	0.750	0.105	0.105	1.03	5.0	6.5	0.68	3.0	0.012	12	1.02%	3.89	5.0	187	1.90	317.50	313.10	311.20	313.0	4.5	
	CB-4	DMH-2	0.165	0.670	0.111	0.111	0.05	5.0	6.5	0.72	2.6	0.012	12	0.62%	3.05	3.9	8	0.05	313.50	310.90	310.85	310.8	2.7	
	DMH-2	DMH-3	0.000	0.000	0.000	0.216	0.90	6.0	6.3	1.36	3.1	0.012	12	0.60%	2.98	3.8	168	1.00	313.90	310.75	309.75	310.6	3.3	
	CB-5	DMH-3	0.122	0.900	0.110	0.110	0.28	5.0	6.5	0.71	2.9	0.012	12	0.82%	3.49	4.4	49	0.40	314.00	310.90	310.50	310.8	3.2	
	DMH-3	FES-2	0.000	0.000	0.000	0.325	0.17	6.9	6.0	1.95	3.2	0.012	12	0.45%	2.60	3.3	33	0.15	313.17	309.65	309.50	309.5	3.6	
	CB-6	FES-3	0.258	0.680	0.175	0.175	0.84	5.0	6.5	1.14	2.7	0.012	12	0.44%	2.57	3.3	135	0.60	315.50	312.60	312.00	312.5	3.0	
	CB-7	DMH-4	0.199	0.630	0.125	0.125	0.68	5.0	6.5	0.81	4.7	0.012	12	3.19%	6.90	8.8	191	6.10	312.60	307.00	300.90	306.7	5.9	
	CB-8	DMH-4	0.342	0.640	0.219	0.219	0.04	5.0	6.5	1.42	3.8	0.012	12	1.00%	3.86	4.9	10	0.10	304.85	301.00	300.90	300.8	4.0	
	DMH-4	DMH-6	0.000	0.000	0.000	0.344	0.24	5.7	6.3	2.17	6.5	0.012	12	3.16%	6.86	8.7	95	3.00	304.00	300.50	297.50	300.0	4.0	
	CB-11	DMH 6	0.150	0.430	0.065	0.065	0.11	5.0	6.5	0.42	2.2	0.012	12	0.67%	3.15	4.0	15	0.10	300.80	297.00	296.90	296.9	3.9	
	CB-12	DMH 6	0.370	0.320	0.118	0.118	0.13	5.0	6.5	0.77	3.7	0.012	12	1.67%	4.98	6.3	30	0.50	302.00	298.00	297.50	297.8	4.2	
	DMH-6	FES-10	0.000	0.000	0.000	0.710	0.14	5.1	6.3	4.47	7.0	0.012	12	2.17%	5.68	7.2	60	1.30	301.75	296.80	295.50	296.2	5.6	
	CB-13	WQU	0.906	0.820	0.743	0.743	0.19	5.0	6.5	4.83	5.1	0.012	15	0.92%	6.70	5.5	60	0.55	312.70	309.70	309.15	309.4	3.3	
	DCB-1	WQU	1.977	0.770	1.522	1.522	0.05	5.0	6.5	9.89	8.5	0.012	15	2.04%	9.99	8.1	27	0.55	312.60	309.70	309.15	308.8	3.8	
	WQU	STORMTRAP	0.000	0.000	0.000	2.265	0.14	5.2	6.5	14.72	5.4	0.012	24	0.45%	16.52	5.3	44	0.20	314.00	309.15	308.95	308.8	5.2	
	ROOF	FES 6	0.540	0.900	0.486	0.486	0.10	5.0	6.5	3.16	7.7	0.012	10	3.62%	4.51	8.3	47	1.70	317.50	313.80	312.10	313.1	4.4	
	ROOF	FES 7	0.540	0.900	0.486	0.486	0.10	5.0	6.5	3.16	7.7	0.012	10	3.62%	4.51	8.3	47	1.70	317.50	313.80	312.10	313.1	4.4	
	ROOF	DMH5	0.540	0.900	0.486	0.486	0.22	5.0	6.5	3.16	4.5	0.012	12	0.78%	3.40	4.3	58	0.45	314.00	309.85	309.40	309.6	4.4	
	DMH-5	FES 8	1.080	0.900	0.972	0.972	0.38	5.0	6.5	6.32	3.9	0.012	18	0.34%	6.61	3.7	89	0.30	316.00	309.40	309.10	309.2	6.8	
	ROOF	FES 9	0.540	0.900	0.486	0.486	0.10	5.0	6.5	3.16	7.7	0.012	10	3.62%	4.51	8.3	47	1.70	317.50	313.80	312.10	313.1	4.4	

Appendix B - Standard 2 Computations and Supporting Information

Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24-hour storm event and NOAA Atlas 14 precipitation depths for the site: 3.15, 4.82, 5.87, 6.64, 7.48 inches, respectively. Runoff coefficients for the existing and proposed conditions, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD. The HydroCAD model is based on the NRCS Technical Release 20 (TR 20) Model for Project Formulation Hydrology.

NOAA Atlas 14, Volume 10, Version 3
Location name: Devens, Massachusetts, USA*
Latitude: 42.5357°, Longitude: -71.6118°
Elevation: 291.28 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.330** (0.259-0.415)	**0.390** (0.305-0.491)	**0.488** (0.380-0.615)	**0.569** (0.440-0.721)	**0.680** (0.510-0.895)	**0.764** (0.561-1.02)	**0.852** (0.607-1.18)	**0.950** (0.641-1.34)	**1.09** (0.707-1.58)	**1.21** (0.763-1.78)
10-min	**0.468** (0.366-0.588)	**0.553** (0.432-0.695)	**0.692** (0.538-0.872)	**0.806** (0.624-1.02)	**0.964** (0.722-1.27)	**1.08** (0.795-1.45)	**1.21** (0.859-1.67)	**1.35** (0.908-1.90)	**1.55** (1.00-2.25)	**1.71** (1.08-2.53)
15-min	**0.551** (0.431-0.692)	**0.650** (0.508-0.818)	**0.813** (0.633-1.02)	**0.948** (0.734-1.20)	**1.13** (0.849-1.49)	**1.27** (0.935-1.71)	**1.42** (1.01-1.96)	**1.58** (1.07-2.23)	**1.82** (1.18-2.64)	**2.01** (1.27-2.97)
30-min	**0.743** (0.581-0.933)	**0.877** (0.686-1.10)	**1.10** (0.854-1.38)	**1.28** (0.990-1.62)	**1.53** (1.15-2.01)	**1.72** (1.26-2.30)	**1.92** (1.36-2.65)	**2.14** (1.44-3.01)	**2.45** (1.59-3.56)	**2.71** (1.72-4.01)
60-min	**0.935** (0.732-1.18)	**1.10** (0.863-1.39)	**1.38** (1.08-1.74)	**1.61** (1.25-2.04)	**1.93** (1.44-2.53)	**2.16** (1.59-2.90)	**2.41** (1.72-3.34)	**2.69** (1.82-3.79)	**3.09** (2.00-4.48)	**3.41** (2.16-5.04)
2-hr	**1.17** (0.922-1.46)	**1.41** (1.11-1.75)	**1.79** (1.41-2.24)	**2.11** (1.65-2.65)	**2.55** (1.93-3.34)	**2.88** (2.13-3.85)	**3.23** (2.33-4.47)	**3.65** (2.47-5.10)	**4.26** (2.78-6.15)	**4.79** (3.04-7.03)
3-hr	**1.34** (1.06-1.66)	**1.62** (1.28-2.01)	**2.08** (1.64-2.59)	**2.46** (1.93-3.08)	**2.99** (2.27-3.90)	**3.38** (2.52-4.50)	**3.80** (2.76-5.26)	**4.31** (2.92-6.01)	**5.08** (3.31-7.30)	**5.73** (3.65-8.38)
6-hr	**1.70** (1.36-2.09)	**2.07** (1.65-2.55)	**2.67** (2.13-3.30)	**3.17** (2.51-3.93)	**3.86** (2.96-5.00)	**4.37** (3.28-5.78)	**4.92** (3.60-6.77)	**5.59** (3.81-7.74)	**6.62** (4.33-9.44)	**7.50** (4.79-10.9)
12-hr	**2.15** (1.74-2.63)	**2.62** (2.11-3.20)	**3.37** (2.71-4.13)	**3.99** (3.19-4.92)	**4.86** (3.75-6.25)	**5.49** (4.16-7.21)	**6.18** (4.55-8.43)	**7.02** (4.81-9.64)	**8.29** (5.45-11.7)	**9.37** (6.01-13.5)
24-hr	**2.59** (2.11-3.13)	**3.15** (2.56-3.81)	**4.06** (3.29-4.94)	**4.82** (3.89-5.89)	**5.87** (4.57-7.49)	**6.64** (5.06-8.65)	**7.48** (5.53-10.1)	**8.49** (5.85-11.6)	**10.0** (6.62-14.1)	**11.3** (7.30-16.2)
2-day	**2.94** (2.42-3.53)	**3.59** (2.95-4.32)	**4.67** (3.82-5.63)	**5.57** (4.53-6.75)	**6.80** (5.34-8.62)	**7.71** (5.92-9.98)	**8.70** (6.49-11.7)	**9.90** (6.86-13.4)	**11.8** (7.79-16.4)	**13.3** (8.62-18.9)
3-day	**3.21** (2.65-3.83)	**3.91** (3.23-4.68)	**5.07** (4.17-6.09)	**6.03** (4.93-7.27)	**7.35** (5.80-9.27)	**8.33** (6.43-10.7)	**9.39** (7.03-12.6)	**10.7** (7.42-14.4)	**12.6** (8.40-17.6)	**14.3** (9.27-20.2)
4-day	**3.45** (2.87-4.11)	**4.19** (3.48-5.00)	**5.40** (4.46-6.45)	**6.40** (5.25-7.69)	**7.77** (6.15-9.76)	**8.79** (6.80-11.3)	**9.89** (7.41-13.2)	**11.2** (7.82-15.1)	**13.2** (8.81-18.3)	**14.9** (9.69-21.0)
7-day	**4.14** (3.47-4.90)	**4.93** (4.12-5.84)	**6.21** (5.17-7.37)	**7.27** (6.01-8.68)	**8.73** (6.94-10.9)	**9.82** (7.62-12.5)	**11.0** (8.23-14.4)	**12.3** (8.64-16.4)	**14.3** (9.59-19.7)	**16.0** (10.4-22.4)
10-day	**4.81** (4.05-5.67)	**5.62** (4.72-6.63)	**6.94** (5.81-8.21)	**8.04** (6.68-9.56)	**9.55** (7.62-11.8)	**10.7** (8.31-13.5)	**11.9** (8.90-15.5)	**13.2** (9.29-17.5)	**15.2** (10.2-20.7)	**16.8** (10.9-23.3)
20-day	**6.84** (5.81-7.99)	**7.70** (6.53-9.01)	**9.11** (7.70-10.7)	**10.3** (8.62-12.1)	**11.9** (9.56-14.5)	**13.1** (10.3-16.3)	**14.4** (10.8-18.4)	**15.7** (11.1-20.6)	**17.4** (11.7-23.6)	**18.7** (12.2-25.9)
30-day	**8.53** (7.28-9.91)	**9.43** (8.04-11.0)	**10.9** (9.27-12.7)	**12.1** (10.2-14.2)	**13.8** (11.2-16.7)	**15.2** (11.9-18.6)	**16.4** (12.3-20.7)	**17.7** (12.6-23.1)	**19.3** (13.1-26.0)	**20.4** (13.4-28.1)
45-day	**10.6** (9.13-12.3)	**11.6** (9.94-13.4)	**13.2** (11.2-15.3)	**14.5** (12.3-16.9)	**16.2** (13.2-19.5)	**17.7** (13.9-21.5)	**19.0** (14.2-23.8)	**20.2** (14.5-26.3)	**21.7** (14.7-29.1)	**22.7** (14.9-31.1)
60-day	**12.4** (10.7-14.3)	**13.4** (11.5-15.4)	**15.0** (12.9-17.4)	**16.4** (14.0-19.1)	**18.3** (14.9-21.8)	**19.8** (15.6-24.0)	**21.2** (15.9-26.3)	**22.4** (16.0-29.0)	**23.8** (16.2-31.8)	**24.7** (16.3-33.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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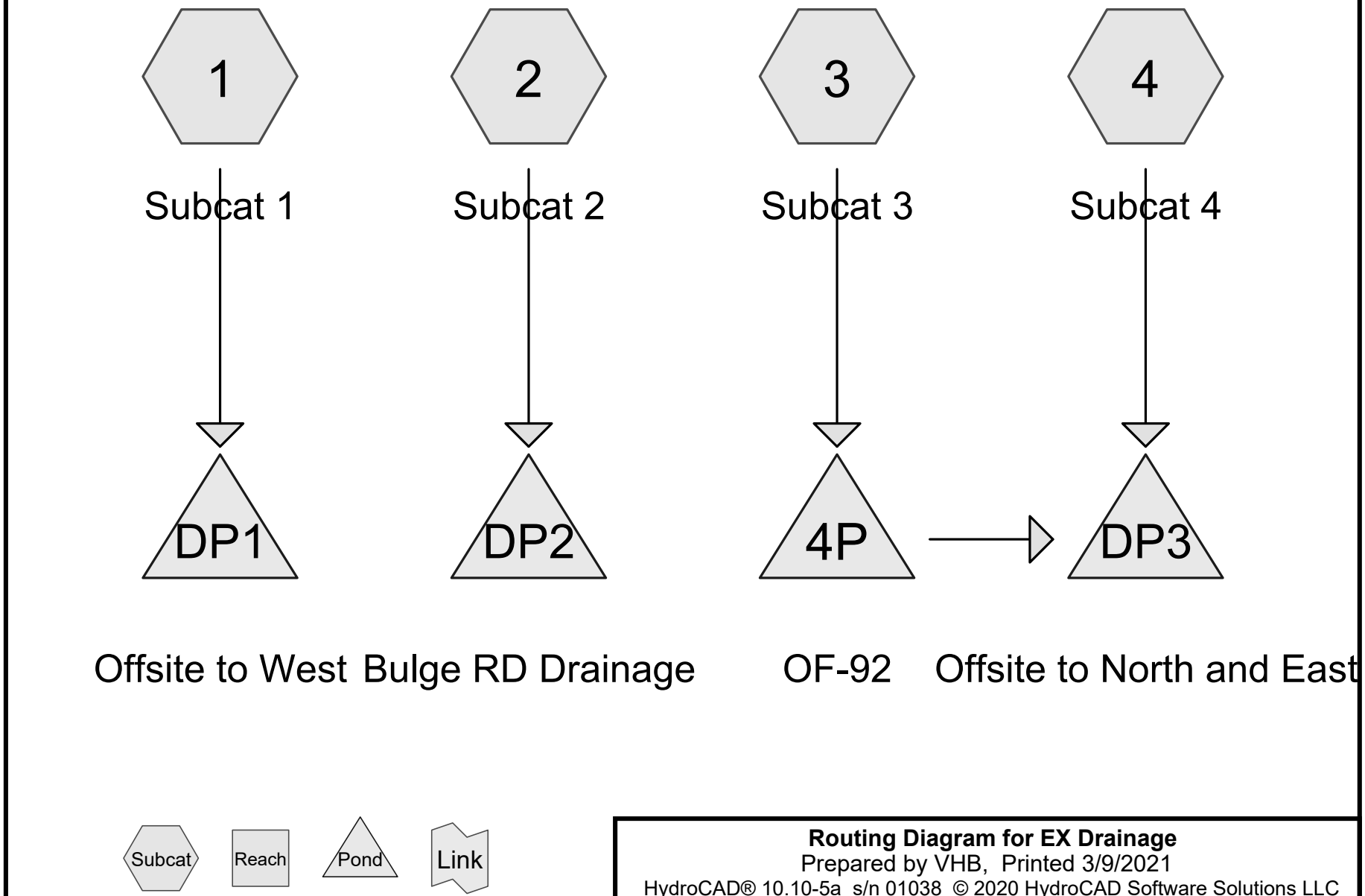
PF graphical

HydroCAD Analysis: Existing Conditions



Routing Diagram for EX Drainage
Prepared by VHB, Printed 3/9/2021
HydroCAD® 10.10-5a s/n 01038 © 2020 HydroCAD Software Solutions LLC

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=94,009 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=207' Tc=10.0 min CN=34/0 Runoff=0.00 cfs 0.000 af

Subcatchment2: Subcat 2 Runoff Area=431,068 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=739' Tc=19.4 min CN=38/0 Runoff=0.00 cfs 0.000 af

Subcatchment3: Subcat 3 Runoff Area=169,745 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,074' Tc=22.0 min CN=39/0 Runoff=0.00 cfs 0.000 af

Subcatchment4: Subcat 4 Runoff Area=410,004 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=209' Tc=17.1 min CN=32/0 Runoff=0.00 cfs 0.000 af

Pond 4P: OF-92 Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP1: Offsite to West Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP2: Bulge RD Drainage Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP3: Offsite to North and East Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 25.363 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 25.363 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1: Subcat 1

Runoff = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
52,330	30	Woods, Good, HSG A
41,679	39	>75% Grass cover, Good, HSG A
94,009	34	Weighted Average
94,009	34	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	40	0.0250	0.07		**Sheet Flow, Woods Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.15"
0.5	167	0.1190	5.55		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
10.0	207	Total			

Summary for Subcatchment 2: Subcat 2

Runoff = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
377,922	39	>75% Grass cover, Good, HSG A
53,146	30	Woods, Good, HSG A
431,068	38	Weighted Average
431,068	38	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	50	0.0200	0.07		**Sheet Flow, Woods Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.15"
0.1	17	0.0590	3.91		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
1.2	155	0.0190	2.22		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
3.3	310	0.0097	1.59		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
2.0	153	0.0065	1.30		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.4	54	0.0185	2.19		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
19.4	739	Total			

Summary for Subcatchment 3: Subcat 3

Runoff = 0.00 cfs @ 24.13 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
1,656	30	Woods, Good, HSG A
168,089	39	>75% Grass cover, Good, HSG A
169,745	39	Weighted Average
169,745	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0300	0.08		**Sheet Flow, Woods Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.15"
0.8	64	0.0078	1.42		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.1	20	0.1000	5.09		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
2.9	200	0.0050	1.14		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
2.2	260	0.0154	2.00		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
4.4	330	0.0060	1.25		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.9	115	0.0170	2.10		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.1	35	0.1430	6.09		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
22.0	1,074	Total			

Summary for Subcatchment 4: Subcat 4

Runoff = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
80,136	39	>75% Grass cover, Good, HSG A
329,868	30	Woods, Good, HSG A
410,004	32	Weighted Average
410,004	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	50	0.0100	0.05		**Sheet Flow, Woods Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.15"
0.5	81	0.0300	2.79		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2	78	0.2300	7.72		**Shallow Concentrated Flow, Woods Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
17.1	209	Total			

Summary for Pond 4P: OF-92

Inflow Area = 3.897 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 24.13 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.13 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Summary for Pond DP1: Offsite to West

Inflow Area = 2.158 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Summary for Pond DP2: Bulge RD Drainage

Inflow Area = 9.896 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Summary for Pond DP3: Offsite to North and East

Inflow Area = 13.309 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 24.13 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 24.13 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=94,009 sf 0.00% Impervious Runoff Depth=0.04"
Flow Length=207' Tc=10.0 min CN=34/0 Runoff=0.01 cfs 0.008 af

Subcatchment2: Subcat 2 Runoff Area=431,068 sf 0.00% Impervious Runoff Depth=0.14"
Flow Length=739' Tc=19.4 min CN=38/0 Runoff=0.18 cfs 0.112 af

Subcatchment3: Subcat 3 Runoff Area=169,745 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=1,074' Tc=22.0 min CN=39/0 Runoff=0.09 cfs 0.054 af

Subcatchment4: Subcat 4 Runoff Area=410,004 sf 0.00% Impervious Runoff Depth=0.01"
Flow Length=209' Tc=17.1 min CN=32/0 Runoff=0.02 cfs 0.012 af

Pond 4P: OF-92 Inflow=0.09 cfs 0.054 af
Primary=0.09 cfs 0.054 af

Pond DP1: Offsite to West Inflow=0.01 cfs 0.008 af
Primary=0.01 cfs 0.008 af

Pond DP2: Bulge RD Drainage Inflow=0.18 cfs 0.112 af
Primary=0.18 cfs 0.112 af

Pond DP3: Offsite to North and East Inflow=0.09 cfs 0.065 af
Primary=0.09 cfs 0.065 af

Total Runoff Area = 25.363 ac Runoff Volume = 0.185 af Average Runoff Depth = 0.09"
100.00% Pervious = 25.363 ac 0.00% Impervious = 0.000 ac

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=94,009 sf 0.00% Impervious Runoff Depth=0.18"
Flow Length=207' Tc=10.0 min CN=34/0 Runoff=0.05 cfs 0.033 af

Subcatchment2: Subcat 2 Runoff Area=431,068 sf 0.00% Impervious Runoff Depth=0.36"
Flow Length=739' Tc=19.4 min CN=38/0 Runoff=0.98 cfs 0.296 af

Subcatchment3: Subcat 3 Runoff Area=169,745 sf 0.00% Impervious Runoff Depth=0.41"
Flow Length=1,074' Tc=22.0 min CN=39/0 Runoff=0.48 cfs 0.133 af

Subcatchment4: Subcat 4 Runoff Area=410,004 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=209' Tc=17.1 min CN=32/0 Runoff=0.14 cfs 0.090 af

Pond 4P: OF-92 Inflow=0.48 cfs 0.133 af
Primary=0.48 cfs 0.133 af

Pond DP1: Offsite to West Inflow=0.05 cfs 0.033 af
Primary=0.05 cfs 0.033 af

Pond DP2: Bulge RD Drainage Inflow=0.98 cfs 0.296 af
Primary=0.98 cfs 0.296 af

Pond DP3: Offsite to North and East Inflow=0.48 cfs 0.223 af
Primary=0.48 cfs 0.223 af

Total Runoff Area = 25.363 ac Runoff Volume = 0.552 af Average Runoff Depth = 0.26"
100.00% Pervious = 25.363 ac 0.00% Impervious = 0.000 ac

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=94,009 sf 0.00% Impervious Runoff Depth=0.34"
Flow Length=207' Tc=10.0 min CN=34/0 Runoff=0.20 cfs 0.062 af

Subcatchment2: Subcat 2 Runoff Area=431,068 sf 0.00% Impervious Runoff Depth=0.58"
Flow Length=739' Tc=19.4 min CN=38/0 Runoff=2.19 cfs 0.478 af

Subcatchment3: Subcat 3 Runoff Area=169,745 sf 0.00% Impervious Runoff Depth=0.64"
Flow Length=1,074' Tc=22.0 min CN=39/0 Runoff=1.00 cfs 0.209 af

Subcatchment4: Subcat 4 Runoff Area=410,004 sf 0.00% Impervious Runoff Depth=0.24"
Flow Length=209' Tc=17.1 min CN=32/0 Runoff=0.32 cfs 0.190 af

Pond 4P: OF-92 Inflow=1.00 cfs 0.209 af
Primary=1.00 cfs 0.209 af

Pond DP1: Offsite to West Inflow=0.20 cfs 0.062 af
Primary=0.20 cfs 0.062 af

Pond DP2: Bulge RD Drainage Inflow=2.19 cfs 0.478 af
Primary=2.19 cfs 0.478 af

Pond DP3: Offsite to North and East Inflow=1.21 cfs 0.399 af
Primary=1.21 cfs 0.399 af

Total Runoff Area = 25.363 ac Runoff Volume = 0.938 af Average Runoff Depth = 0.44"
100.00% Pervious = 25.363 ac 0.00% Impervious = 0.000 ac

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=94,009 sf 0.00% Impervious Runoff Depth=0.56"
Flow Length=207' Tc=10.0 min CN=34/0 Runoff=0.47 cfs 0.101 af

Subcatchment2: Subcat 2 Runoff Area=431,068 sf 0.00% Impervious Runoff Depth=0.87"
Flow Length=739' Tc=19.4 min CN=38/0 Runoff=3.98 cfs 0.714 af

Subcatchment3: Subcat 3 Runoff Area=169,745 sf 0.00% Impervious Runoff Depth=0.95"
Flow Length=1,074' Tc=22.0 min CN=39/0 Runoff=1.75 cfs 0.308 af

Subcatchment4: Subcat 4 Runoff Area=410,004 sf 0.00% Impervious Runoff Depth=0.43"
Flow Length=209' Tc=17.1 min CN=32/0 Runoff=1.06 cfs 0.334 af

Pond 4P: OF-92 Inflow=1.75 cfs 0.308 af
Primary=1.75 cfs 0.308 af

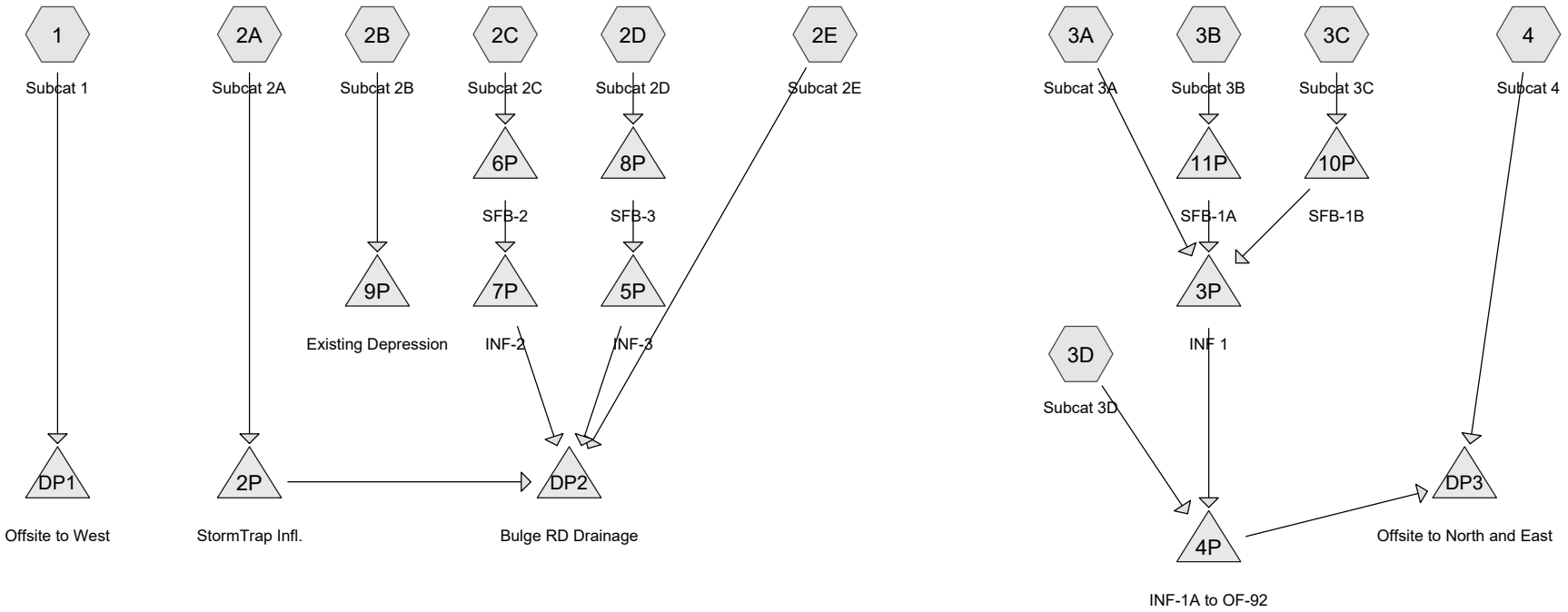
Pond DP1: Offsite to West Inflow=0.47 cfs 0.101 af
Primary=0.47 cfs 0.101 af

Pond DP2: Bulge RD Drainage Inflow=3.98 cfs 0.714 af
Primary=3.98 cfs 0.714 af

Pond DP3: Offsite to North and East Inflow=2.76 cfs 0.642 af
Primary=2.76 cfs 0.642 af

Total Runoff Area = 25.363 ac Runoff Volume = 1.457 af Average Runoff Depth = 0.69"
100.00% Pervious = 25.363 ac 0.00% Impervious = 0.000 ac

HydroCAD Analysis: Proposed Conditions



Subcat Reach Pond Link

Routing Diagram for PR Drainage

Prepared by VHB, Printed 4/22/2021

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Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=59,549 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=184' Tc=6.0 min CN=32/0 Runoff=0.00 cfs 0.000 af

Subcatchment2A: Subcat 2A Runoff Area=123,359 sf 82.18% Impervious Runoff Depth=2.40"
Flow Length=102' Tc=6.0 min CN=39/98 Runoff=6.95 cfs 0.566 af

Subcatchment2B: Subcat 2B Runoff Area=127,168 sf 1.47% Impervious Runoff Depth=0.04"
Flow Length=253' Tc=13.6 min CN=31/98 Runoff=0.10 cfs 0.010 af

Subcatchment2C: Subcat 2C Runoff Area=26,084 sf 40.92% Impervious Runoff Depth=1.19"
Flow Length=467' Tc=6.0 min CN=39/98 Runoff=0.73 cfs 0.060 af

Subcatchment2D: Subcat 2D Runoff Area=79,578 sf 23.29% Impervious Runoff Depth=0.68"
Flow Length=358' Tc=7.7 min CN=35/98 Runoff=1.21 cfs 0.103 af

Subcatchment2E: Subcat 2E Runoff Area=33,891 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=6.0 min CN=30/0 Runoff=0.00 cfs 0.000 af

Subcatchment3A: Subcat 3A Runoff Area=148,714 sf 81.00% Impervious Runoff Depth=2.36"
Flow Length=190' Tc=6.0 min CN=39/98 Runoff=8.25 cfs 0.672 af

Subcatchment3B: Subcat 3B Runoff Area=80,907 sf 37.26% Impervious Runoff Depth=1.09"
Flow Length=490' Tc=8.2 min CN=31/98 Runoff=1.94 cfs 0.168 af

Subcatchment3C: Subcat 3C Runoff Area=11,045 sf 66.97% Impervious Runoff Depth=1.95"
Flow Length=98' Tc=7.4 min CN=38/98 Runoff=0.49 cfs 0.041 af

Subcatchment3D: Subcat 3D Runoff Area=0.444 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=40' Tc=6.0 min CN=39/0 Runoff=0.00 cfs 0.000 af

Subcatchment4: Subcat 4 Runoff Area=395,156 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=209' Tc=17.1 min CN=32/98 Runoff=0.00 cfs 0.000 af

Pond 2P: StormTrap Infl. Peak Elev=307.24' Storage=7,302 cf Inflow=6.95 cfs 0.566 af
Discarded=0.96 cfs 0.566 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 0.566 af

Pond 3P: INF 1 Peak Elev=312.14' Storage=12,727 cf Inflow=8.67 cfs 0.796 af
Discarded=1.20 cfs 0.796 af Primary=0.00 cfs 0.000 af Outflow=1.20 cfs 0.796 af

Pond 4P: INF-1A to OF-92 Peak Elev=308.15' Storage=0 cf Inflow=0.00 cfs 0.000 af
Discarded=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond 5P: INF-3 Peak Elev=296.22' Storage=1,012 cf Inflow=1.21 cfs 0.099 af
Discarded=0.31 cfs 0.099 af Primary=0.00 cfs 0.000 af Outflow=0.31 cfs 0.099 af

Pond 6P: SFB-2 Peak Elev=318.11' Storage=451 cf Inflow=0.73 cfs 0.060 af
Outflow=0.72 cfs 0.050 af

Pond 7P: INF-2 Peak Elev=318.15' Storage=253 cf Inflow=0.72 cfs 0.050 af
Discarded=0.34 cfs 0.050 af Primary=0.00 cfs 0.000 af Outflow=0.34 cfs 0.050 af

Pond 8P: SFB-3 Peak Elev=297.62' Storage=202 cf Inflow=1.21 cfs 0.103 af
Outflow=1.21 cfs 0.099 af

Pond 9P: Existing Depression Peak Elev=315.01' Storage=17 cf Inflow=0.10 cfs 0.010 af
Outflow=0.10 cfs 0.010 af

Pond 10P: SFB-1B Peak Elev=313.68' Storage=413 cf Inflow=0.49 cfs 0.041 af
Outflow=0.48 cfs 0.033 af

Pond 11P: SFB-1A Peak Elev=313.17' Storage=3,659 cf Inflow=1.94 cfs 0.168 af
Outflow=1.41 cfs 0.091 af

Pond DP1: Offsite to West Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP2: Bulge RD Drainage Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP3: Offsite to North and East Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Summary for Subcatchment 1: Subcat 1

Runoff = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
12,143	39	>75% Grass cover, Good, HSG A
47,406	30	Woods, Good, HSG A
59,549	32	Weighted Average
59,549	32	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	17	0.0250	0.06		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
0.5	167	0.1190	5.55		**Shallow Concentrated Flow, Woods** Unpaved Kv= 16.1 fps
5.3	184	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2A: Subcat 2A

Runoff = 6.95 cfs @ 12.09 hrs, Volume= 0.566 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
691	30	Woods, Good, HSG A
1	30	Meadow, non-grazed, HSG A
21,292	39	>75% Grass cover, Good, HSG A
101,375	98	Paved parking, HSG A
123,359	87	Weighted Average
21,984	39	17.82% Pervious Area
101,375	98	82.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	30	0.1000	0.25		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.15"
0.5	72	0.0140	2.40		**Shallow Concentrated Flow, Parking Lot Pavement** Paved Kv= 20.3 fps
2.5	102	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2B: Subcat 2B

Runoff = 0.10 cfs @ 12.18 hrs, Volume= 0.010 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
19,602	39	>75% Grass cover, Good, HSG A
1,871	98	Paved parking, HSG A
0	98	Paved roads w/curbs & sewers, HSG A
105,682	30	Meadow, non-grazed, HSG A
12	30	Woods, Good, HSG A
127,168	32	Weighted Average
125,297	31	98.53% Pervious Area
1,871	98	1.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	50	0.0030	0.07		**Sheet Flow, Grass/Woods** Grass: Short n= 0.150 P2= 3.15"
0.4	45	0.0130	1.84		**Shallow Concentrated Flow, Woods/Grass** Unpaved Kv= 16.1 fps
0.2	40	0.0500	3.60		**Shallow Concentrated Flow, Woods/Grass** Unpaved Kv= 16.1 fps
0.9	118	0.0170	2.10		**Shallow Concentrated Flow, Woods/Grass** Unpaved Kv= 16.1 fps
13.6	253	Total			

Summary for Subcatchment 2C: Subcat 2C

Runoff = 0.73 cfs @ 12.09 hrs, Volume= 0.060 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
391	30	Woods, Good, HSG A
14,999	39	>75% Grass cover, Good, HSG A
10,675	98	Paved roads w/curbs & sewers, HSG A
19	30	Meadow, non-grazed, HSG A
26,084	63	Weighted Average
15,409	39	59.08% Pervious Area
10,675	98	40.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0120	0.97		**Sheet Flow, Pavement** Smooth surfaces n= 0.011 P2= 3.15"
1.6	193	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.8	224	0.0080	4.80	3.77	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
3.3	467	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 2D: Subcat 2D

Runoff = 1.21 cfs @ 12.11 hrs, Volume= 0.103 af, Depth= 0.68"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
24,074	30	Woods, Good, HSG A
36,972	39	>75% Grass cover, Good, HSG A
10,755	98	Paved roads w/curbs & sewers, HSG A
7,778	98	Paved parking, HSG A
79,578	50	Weighted Average
61,045	35	76.71% Pervious Area
18,533	98	23.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	50	0.0400	0.13		**Sheet Flow, grass** Grass: Dense n= 0.240 P2= 3.15"
1.4	308	0.0487	3.55		**Shallow Concentrated Flow, overland grass** Unpaved Kv= 16.1 fps
7.7	358	Total			

Summary for Subcatchment 2E: Subcat 2E

Runoff = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
33,891	30	Meadow, non-grazed, HSG A
33,891	30	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.19		**Sheet Flow, Woods/Grass** Grass: Short n= 0.150 P2= 3.15"
1.5	130	0.0080	1.44		**Shallow Concentrated Flow, Woods/Grass** Unpaved Kv= 16.1 fps
5.8	180	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 3A: Subcat 3A

Runoff = 8.25 cfs @ 12.09 hrs, Volume= 0.672 af, Depth= 2.36"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
67	30	Woods, Good, HSG A
1,675	98	Paved parking, HSG A
118,770	98	Roofs, HSG A
28,191	39	>75% Grass cover, Good, HSG A
12	98	Paved roads w/curbs & sewers, HSG A
148,714	87	Weighted Average
28,257	39	19.00% Pervious Area
120,457	98	81.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	50	0.5000	4.31		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.15"
0.1	100	0.5000	11.38		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	40	0.0800	12.31	6.71	**Pipe Channel,** 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' n= 0.012 Concrete pipe, finished
0.4	190	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 3B: Subcat 3B

Runoff = 1.94 cfs @ 12.11 hrs, Volume= 0.168 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
643	30	Woods, Good, HSG A
7,541	39	>75% Grass cover, Good, HSG A
42,581	30	Meadow, non-grazed, HSG A
30,142	98	Paved roads w/curbs & sewers, HSG A
80,907	56	Weighted Average
50,765	31	62.74% Pervious Area
30,142	98	37.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow, Woods/Grass** Grass: Short n= 0.150 P2= 3.15"
1.0	140	0.0200	2.28		**Shallow Concentrated Flow, Woods/Grass** Unpaved Kv= 16.1 fps
1.2	210	0.0200	2.87		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
0.3	90	0.0080	4.80	3.77	**Pipe Channel, Pipe** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
8.2	490	Total			

Summary for Subcatchment 3C: Subcat 3C

Runoff = 0.49 cfs @ 12.10 hrs, Volume= 0.041 af, Depth= 1.95"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
220	30	Woods, Good, HSG A
25	98	Paved parking, HSG A
7,372	98	Paved roads w/curbs & sewers, HSG A
3,428	39	>75% Grass cover, Good, HSG A
11,045	78	Weighted Average
3,648	38	33.03% Pervious Area
7,397	98	66.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	55	0.0140	0.13		**Sheet Flow, Grass** Grass: Short n= 0.150 P2= 3.15"
0.3	43	0.0120	2.22		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
7.4	98	Total			

Summary for Subcatchment 3D: Subcat 3D

Runoff = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (ac)	CN	Description
0.444	39	>75% Grass cover, Good, HSG A
0.444	39	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	10	0.3000	0.31		**Sheet Flow, Grass**
					Grass: Short n= 0.150 P2= 3.15"
1.0	12	0.0830	0.20		**Sheet Flow, Grass**
					Grass: Short n= 0.150 P2= 3.15"
0.0	18	0.3300	9.25		**Shallow Concentrated Flow, Grass**
					Unpaved Kv= 16.1 fps
1.5	40	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 4: Subcat 4

Runoff = 0.00 cfs @ 12.22 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-yr Rainfall=3.15"

Area (sf)	CN	Description
321,503	30	Woods, Good, HSG A
73,638	39	>75% Grass cover, Good, HSG A
15	98	Paved roads w/curbs & sewers, HSG A
395,156	32	Weighted Average
395,141	32	100.00% Pervious Area
15	98	0.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	50	0.0100	0.05		**Sheet Flow, Woods**
					Woods: Light underbrush n= 0.400 P2= 3.15"
0.5	81	0.0300	2.79		**Shallow Concentrated Flow, Woods**
					Unpaved Kv= 16.1 fps
0.2	78	0.2300	7.72		**Shallow Concentrated Flow, Woods**
					Unpaved Kv= 16.1 fps
17.1	209	Total			

Summary for Pond 2P: StormTrap Infl.

Inflow Area = 2.832 ac, 82.18% Impervious, Inflow Depth = 2.40" for 2-yr event
Inflow = 6.95 cfs @ 12.09 hrs, Volume= 0.566 af
Outflow = 0.96 cfs @ 11.65 hrs, Volume= 0.566 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.96 cfs @ 11.65 hrs, Volume= 0.566 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 307.24' @ 12.61 hrs Surf.Area= 4,992 sf Storage= 7,302 cf

Plug-Flow detention time= 46.9 min calculated for 0.566 af (100% of inflow)
Center-of-Mass det. time= 46.9 min (803.6 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1B	304.50'	3,993 cf	**47.23'W x 105.69'L x 8.17'H Field B** 40,764 cf Overall - 30,781 cf Embedded = 9,983 cf x 40.0% Voids
#2B	306.50'	25,240 cf	**StormTrap ST2 SingleTrap 5-8** x 24 Inside #1 Inside= 101.7"W x 68.0"H => 43.55 sf x 15.40'L = 670.5 cf Outside= 101.7"W x 74.0"H => 52.29 sf x 15.40'L = 805.0 cf 24 Chambers in 4 Rows 33.92' x 92.38' Core + 6.66' Border = 47.23' x 105.69' System
#3	312.17'	34 cf	**4.00'D x 2.73'H Vertical Cone/Cylinder**
		29,267 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	304.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	312.80'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 312.80' / 312.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.96 cfs @ 11.65 hrs HW=304.61' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.96 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=304.50' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 3P: INF 1

Inflow Area = 5.525 ac, 65.65% Impervious, Inflow Depth = 1.73" for 2-yr event
Inflow = 8.67 cfs @ 12.09 hrs, Volume= 0.796 af
Outflow = 1.20 cfs @ 12.78 hrs, Volume= 0.796 af, Atten= 86%, Lag= 41.1 min
Discarded = 1.20 cfs @ 12.78 hrs, Volume= 0.796 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Peak Elev= 312.14' @ 12.78 hrs Surf.Area= 6,280 sf Storage= 12,727 cf

Plug-Flow detention time= 96.1 min calculated for 0.796 af (100% of inflow)
Center-of-Mass det. time= 96.1 min (869.3 - 773.2)

Volume	Invert	Avail.Storage	Storage Description
#1	309.10'	38,381 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
309.10	2,178	0	0
310.00	3,326	2,477	2,477
311.00	4,660	3,993	6,470
312.00	6,071	5,366	11,835
313.00	7,520	6,796	18,631
314.00	9,026	8,273	26,904
315.00	13,928	11,477	38,381

Device	Routing	Invert	Outlet Devices
#1	Discarded	309.10'	**8.270 in/hr Exfiltration over Surface area**
#2	Device 3	312.35'	**2.5" x 2.5" Horiz. Orifice/Grate X 72.00** C= 0.600 Limited to weir flow at low heads
#3	Primary	309.70'	**15.0" Round Culvert** L= 77.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 309.70' / 308.20' S= 0.0195 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=1.20 cfs @ 12.78 hrs HW=312.14' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 1.20 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=309.10' (Free Discharge)
↑—**3=Culvert** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 4P: INF-1A to OF-92

Inflow Area = 5.969 ac, 60.76% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af, Atten= 8%, Lag= 2.4 min
Discarded = 0.00 cfs @ 24.03 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 308.15' @ 24.03 hrs Surf.Area= 2,878 sf Storage= 0 cf

Plug-Flow detention time= 5.1 min calculated for 0.000 af (100% of inflow)
Center-of-Mass det. time= 5.0 min (1,434.7 - 1,429.7)

Volume	Invert	Avail.Storage	Storage Description
#1	308.15'	36,039 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
308.15	2,878	0	0
309.00	3,855	2,862	2,862
310.00	4,905	4,380	7,242
311.00	6,003	5,454	12,696
312.00	7,157	6,580	19,276
313.00	8,368	7,763	27,038
314.00	9,634	9,001	36,039

Device	Routing	Invert	Outlet Devices
#1	Discarded	308.15'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	313.00'	**6.0' long x 6.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.55 cfs @ 24.03 hrs HW=308.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.55 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=308.15' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 5P: INF-3

Inflow Area = 1.827 ac, 23.29% Impervious, Inflow Depth = 0.65" for 2-yr event
Inflow = 1.21 cfs @ 12.11 hrs, Volume= 0.099 af
Outflow = 0.31 cfs @ 12.49 hrs, Volume= 0.099 af, Atten= 74%, Lag= 23.1 min
Discarded = 0.31 cfs @ 12.49 hrs, Volume= 0.099 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 296.22' @ 12.49 hrs Surf.Area= 1,641 sf Storage= 1,012 cf

Plug-Flow detention time= 19.5 min calculated for 0.099 af (100% of inflow)
Center-of-Mass det. time= 19.5 min (797.3 - 777.8)

Volume	Invert	Avail.Storage	Storage Description
#1	295.50'	8,440 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
295.50	1,183	0	0
297.00	2,140	2,492	2,492
298.00	2,949	2,545	5,037
299.00	3,857	3,403	8,440

Device	Routing	Invert	Outlet Devices
#1	Discarded	295.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	298.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.31 cfs @ 12.49 hrs HW=296.22' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=295.50' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 6P: SFB-2

Inflow Area = 0.599 ac, 40.92% Impervious, Inflow Depth = 1.19" for 2-yr event
Inflow = 0.73 cfs @ 12.09 hrs, Volume= 0.060 af
Outflow = 0.72 cfs @ 12.10 hrs, Volume= 0.050 af, Atten= 2%, Lag= 1.1 min
Primary = 0.72 cfs @ 12.10 hrs, Volume= 0.050 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 318.11' @ 12.10 hrs Surf.Area= 627 sf Storage= 451 cf

Plug-Flow detention time= 118.3 min calculated for 0.050 af (85% of inflow)
Center-of-Mass det. time= 53.1 min (809.8 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1	316.00'	1,982 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
316.00	70	0	0
317.00	184	127	127
318.00	356	270	397
319.00	2,814	1,585	1,982

Device	Routing	Invert	Outlet Devices
#1	Primary	318.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.71 cfs @ 12.10 hrs HW=318.11' (Free Discharge)
└**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.71 cfs @ 1.08 fps)

Summary for Pond 7P: INF-2

Inflow Area = 0.599 ac, 40.92% Impervious, Inflow Depth = 1.01" for 2-yr event
Inflow = 0.72 cfs @ 12.10 hrs, Volume= 0.050 af
Outflow = 0.34 cfs @ 12.27 hrs, Volume= 0.050 af, Atten= 52%, Lag= 10.1 min
Discarded = 0.34 cfs @ 12.27 hrs, Volume= 0.050 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Peak Elev= 318.15' @ 12.27 hrs Surf.Area= 1,798 sf Storage= 253 cf

Plug-Flow detention time= 4.3 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (814.1 - 809.8)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	6,065 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
318.00	1,621	0	0
319.00	2,814	2,218	2,218
320.00	4,881	3,848	6,065

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	320.00'	**6.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.34 cfs @ 12.27 hrs HW=318.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.34 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=318.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 8P: SFB-3

Inflow Area = 1.827 ac, 23.29% Impervious, Inflow Depth = 0.68" for 2-yr event
Inflow = 1.21 cfs @ 12.11 hrs, Volume= 0.103 af
Outflow = 1.21 cfs @ 12.11 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.2 min
Primary = 1.21 cfs @ 12.11 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 297.62' @ 12.11 hrs Surf.Area= 211 sf Storage= 202 cf

Plug-Flow detention time= 42.9 min calculated for 0.099 af (96% of inflow)
Center-of-Mass det. time= 19.5 min (777.8 - 758.3)

Volume	Invert	Avail.Storage	Storage Description
#1	295.50'	291 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
295.50	7	0	0
296.00	35	11	11
297.00	134	85	95
298.00	258	196	291

Device	Routing	Invert	Outlet Devices
#1	Primary	297.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.18 cfs @ 12.11 hrs HW=297.62' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 1.18 cfs @ 0.84 fps)

Summary for Pond 9P: Existing Depression

Inflow Area = 2.919 ac, 1.47% Impervious, Inflow Depth = 0.04" for 2-yr event
Inflow = 0.10 cfs @ 12.18 hrs, Volume= 0.010 af
Outflow = 0.10 cfs @ 12.23 hrs, Volume= 0.010 af, Atten= 5%, Lag= 2.8 min
Discarded = 0.10 cfs @ 12.23 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 315.01' @ 12.23 hrs Surf.Area= 2,795 sf Storage= 17 cf

Plug-Flow detention time= 2.9 min calculated for 0.010 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (766.7 - 763.8)

Volume	Invert	Avail.Storage	Storage Description
#1	315.00'	7,074 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
315.00	2,741	0	0
316.00	11,407	7,074	7,074

Device	Routing	Invert	Outlet Devices
#1	Discarded	315.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.16 cfs @ 12.23 hrs HW=315.01' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Summary for Pond 10P: SFB-1B

Inflow Area = 0.254 ac, 66.97% Impervious, Inflow Depth = 1.95" for 2-yr event
Inflow = 0.49 cfs @ 12.10 hrs, Volume= 0.041 af
Outflow = 0.48 cfs @ 12.12 hrs, Volume= 0.033 af, Atten= 2%, Lag= 0.9 min
Primary = 0.48 cfs @ 12.12 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 313.68' @ 12.12 hrs Surf.Area= 406 sf Storage= 413 cf

Plug-Flow detention time= 142.8 min calculated for 0.033 af (79% of inflow)
Center-of-Mass det. time= 64.7 min (822.7 - 758.0)

Volume	Invert	Avail.Storage	Storage Description
#1	312.00'	1,160 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
312.00	106	0	0
313.00	262	184	184
314.00	473	368	552
315.00	743	608	1,160

Device	Routing	Invert	Outlet Devices
#1	Primary	313.60'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.47 cfs @ 12.12 hrs HW=313.68' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.47 cfs @ 0.94 fps)

Summary for Pond 11P: SFB-1A

Inflow Area = 1.857 ac, 37.26% Impervious, Inflow Depth = 1.09" for 2-yr event
Inflow = 1.94 cfs @ 12.11 hrs, Volume= 0.168 af
Outflow = 1.41 cfs @ 12.22 hrs, Volume= 0.091 af, Atten= 27%, Lag= 6.6 min
Primary = 1.41 cfs @ 12.22 hrs, Volume= 0.091 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 313.17' @ 12.22 hrs Surf.Area= 1,629 sf Storage= 3,659 cf

Plug-Flow detention time= 236.5 min calculated for 0.091 af (54% of inflow)
Center-of-Mass det. time= 118.8 min (877.6 - 758.8)

Volume	Invert	Avail.Storage	Storage Description
#1	309.10'	7,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
309.10	326	0	0
310.00	530	385	385
311.00	808	669	1,054
312.00	1,150	979	2,033
313.00	1,548	1,349	3,382
314.00	2,013	1,781	5,163
315.00	2,552	2,283	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	313.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.30 cfs @ 12.22 hrs HW=313.16' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 1.30 cfs @ 1.33 fps)

Summary for Pond DP1: Offsite to West

Inflow Area = 1.367 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Summary for Pond DP2: Bulge RD Drainage

Inflow Area = 6.036 ac, 49.67% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Summary for Pond DP3: Offsite to North and East

Inflow Area = 15.041 ac, 24.12% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 12.22 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 12.22 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=59,549 sf 0.00% Impervious Runoff Depth=0.01"
Flow Length=184' Tc=6.0 min CN=32/0 Runoff=0.00 cfs 0.002 af

Subcatchment2A: Subcat 2A Runoff Area=123,359 sf 82.18% Impervious Runoff Depth=3.80"
Flow Length=102' Tc=6.0 min CN=39/98 Runoff=10.71 cfs 0.896 af

Subcatchment2B: Subcat 2B Runoff Area=127,168 sf 1.47% Impervious Runoff Depth=0.07"
Flow Length=253' Tc=13.6 min CN=31/98 Runoff=0.16 cfs 0.018 af

Subcatchment2C: Subcat 2C Runoff Area=26,084 sf 40.92% Impervious Runoff Depth=1.97"
Flow Length=467' Tc=6.0 min CN=39/98 Runoff=1.13 cfs 0.098 af

Subcatchment2D: Subcat 2D Runoff Area=79,578 sf 23.29% Impervious Runoff Depth=1.12"
Flow Length=358' Tc=7.7 min CN=35/98 Runoff=1.87 cfs 0.170 af

Subcatchment2E: Subcat 2E Runoff Area=33,891 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=6.0 min CN=30/0 Runoff=0.00 cfs 0.000 af

Subcatchment3A: Subcat 3A Runoff Area=148,714 sf 81.00% Impervious Runoff Depth=3.74"
Flow Length=190' Tc=6.0 min CN=39/98 Runoff=12.73 cfs 1.065 af

Subcatchment3B: Subcat 3B Runoff Area=80,907 sf 37.26% Impervious Runoff Depth=1.71"
Flow Length=490' Tc=8.2 min CN=31/98 Runoff=2.99 cfs 0.265 af

Subcatchment3C: Subcat 3C Runoff Area=11,045 sf 66.97% Impervious Runoff Depth=3.11"
Flow Length=98' Tc=7.4 min CN=38/98 Runoff=0.75 cfs 0.066 af

Subcatchment3D: Subcat 3D Runoff Area=0.444 ac 0.00% Impervious Runoff Depth=0.17"
Flow Length=40' Tc=6.0 min CN=39/0 Runoff=0.01 cfs 0.006 af

Subcatchment4: Subcat 4 Runoff Area=395,156 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=209' Tc=17.1 min CN=32/98 Runoff=0.02 cfs 0.011 af

Pond 2P: StormTrap Infl. Peak Elev=308.66' Storage=13,598 cf Inflow=10.71 cfs 0.896 af
Discarded=0.96 cfs 0.896 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 0.896 af

Pond 3P: INF 1 Peak Elev=312.63' Storage=15,958 cf Inflow=15.97 cfs 1.309 af
Discarded=1.34 cfs 1.060 af Primary=7.98 cfs 0.250 af Outflow=9.32 cfs 1.309 af

Pond 4P: INF-1A to OF-92 Peak Elev=310.23' Storage=8,399 cf Inflow=7.98 cfs 0.256 af
Discarded=0.99 cfs 0.256 af Primary=0.00 cfs 0.000 af Outflow=0.99 cfs 0.256 af

Pond 5P: INF-3 Peak Elev=296.72' Storage=1,912 cf Inflow=1.87 cfs 0.166 af
Discarded=0.38 cfs 0.166 af Primary=0.00 cfs 0.000 af Outflow=0.38 cfs 0.166 af

Pond 6P: SFB-2 Peak Elev=318.15' Storage=476 cf Inflow=1.13 cfs 0.098 af
Outflow=1.11 cfs 0.089 af

Pond 7P: INF-2 Peak Elev=318.34' Storage=627 cf Inflow=1.11 cfs 0.089 af
Discarded=0.39 cfs 0.089 af Primary=0.00 cfs 0.000 af Outflow=0.39 cfs 0.089 af

Pond 8P: SFB-3 Peak Elev=297.66' Storage=210 cf Inflow=1.87 cfs 0.170 af
Outflow=1.87 cfs 0.166 af

Pond 9P: Existing Depression Peak Elev=315.01' Storage=27 cf Inflow=0.16 cfs 0.018 af
Outflow=0.15 cfs 0.018 af

Pond 10P: SFB-1B Peak Elev=313.71' Storage=424 cf Inflow=0.75 cfs 0.066 af
Outflow=0.74 cfs 0.057 af

Pond 11P: SFB-1A Peak Elev=313.28' Storage=3,829 cf Inflow=2.99 cfs 0.265 af
Outflow=2.85 cfs 0.187 af

Pond DP1: Offsite to West Inflow=0.00 cfs 0.002 af
Primary=0.00 cfs 0.002 af

Pond DP2: Bulge RD Drainage Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Pond DP3: Offsite to North and East Inflow=0.02 cfs 0.011 af
Primary=0.02 cfs 0.011 af

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=59,549 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=184' Tc=6.0 min CN=32/0 Runoff=0.02 cfs 0.013 af

Subcatchment2A: Subcat 2A Runoff Area=123,359 sf 82.18% Impervious Runoff Depth=4.70"
Flow Length=102' Tc=6.0 min CN=39/98 Runoff=13.08 cfs 1.109 af

Subcatchment2B: Subcat 2B Runoff Area=127,168 sf 1.47% Impervious Runoff Depth=0.17"
Flow Length=253' Tc=13.6 min CN=31/98 Runoff=0.19 cfs 0.041 af

Subcatchment2C: Subcat 2C Runoff Area=26,084 sf 40.92% Impervious Runoff Depth=2.55"
Flow Length=467' Tc=6.0 min CN=39/98 Runoff=1.38 cfs 0.127 af

Subcatchment2D: Subcat 2D Runoff Area=79,578 sf 23.29% Impervious Runoff Depth=1.48"
Flow Length=358' Tc=7.7 min CN=35/98 Runoff=2.28 cfs 0.226 af

Subcatchment2E: Subcat 2E Runoff Area=33,891 sf 0.00% Impervious Runoff Depth=0.06"
Flow Length=180' Tc=6.0 min CN=30/0 Runoff=0.01 cfs 0.004 af

Subcatchment3A: Subcat 3A Runoff Area=148,714 sf 81.00% Impervious Runoff Depth=4.64"
Flow Length=190' Tc=6.0 min CN=39/98 Runoff=15.54 cfs 1.320 af

Subcatchment3B: Subcat 3B Runoff Area=80,907 sf 37.26% Impervious Runoff Depth=2.15"
Flow Length=490' Tc=8.2 min CN=31/98 Runoff=3.65 cfs 0.333 af

Subcatchment3C: Subcat 3C Runoff Area=11,045 sf 66.97% Impervious Runoff Depth=3.89"
Flow Length=98' Tc=7.4 min CN=38/98 Runoff=0.92 cfs 0.082 af

Subcatchment3D: Subcat 3D Runoff Area=0.444 ac 0.00% Impervious Runoff Depth=0.41"
Flow Length=40' Tc=6.0 min CN=39/0 Runoff=0.07 cfs 0.015 af

Subcatchment4: Subcat 4 Runoff Area=395,156 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=209' Tc=17.1 min CN=32/98 Runoff=0.14 cfs 0.087 af

Pond 2P: StormTrap Infl. Peak Elev=309.69' Storage=18,195 cf Inflow=13.08 cfs 1.109 af
Discarded=0.96 cfs 1.109 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 1.109 af

Pond 3P: INF 1 Peak Elev=313.00' Storage=18,648 cf Inflow=19.53 cfs 1.649 af
Discarded=1.44 cfs 1.199 af Primary=9.67 cfs 0.450 af Outflow=11.11 cfs 1.649 af

Pond 4P: INF-1A to OF-92 Peak Elev=311.45' Storage=15,538 cf Inflow=9.73 cfs 0.465 af
Discarded=1.25 cfs 0.465 af Primary=0.00 cfs 0.000 af Outflow=1.25 cfs 0.465 af

Pond 5P: INF-3 Peak Elev=297.03' Storage=2,551 cf Inflow=2.28 cfs 0.222 af
Discarded=0.41 cfs 0.222 af Primary=0.00 cfs 0.000 af Outflow=0.41 cfs 0.222 af

Pond 6P: SFB-2 Peak Elev=318.17' Storage=492 cf Inflow=1.38 cfs 0.127 af
Outflow=1.36 cfs 0.118 af

Pond 7P: INF-2 Peak Elev=318.49' Storage=946 cf Inflow=1.36 cfs 0.118 af
Discarded=0.42 cfs 0.118 af Primary=0.00 cfs 0.000 af Outflow=0.42 cfs 0.118 af

Pond 8P: SFB-3 Peak Elev=297.68' Storage=215 cf Inflow=2.28 cfs 0.226 af
Outflow=2.28 cfs 0.222 af

Pond 9P: Existing Depression Peak Elev=315.01' Storage=39 cf Inflow=0.19 cfs 0.041 af
Outflow=0.16 cfs 0.041 af

Pond 10P: SFB-1B Peak Elev=313.73' Storage=431 cf Inflow=0.92 cfs 0.082 af
Outflow=0.91 cfs 0.073 af

Pond 11P: SFB-1A Peak Elev=313.32' Storage=3,898 cf Inflow=3.65 cfs 0.333 af
Outflow=3.49 cfs 0.255 af

Pond DP1: Offsite to West Inflow=0.02 cfs 0.013 af
Primary=0.02 cfs 0.013 af

Pond DP2: Bulge RD Drainage Inflow=0.01 cfs 0.004 af
Primary=0.01 cfs 0.004 af

Pond DP3: Offsite to North and East Inflow=0.14 cfs 0.087 af
Primary=0.14 cfs 0.087 af

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=59,549 sf 0.00% Impervious Runoff Depth=0.24"
Flow Length=184' Tc=6.0 min CN=32/0 Runoff=0.05 cfs 0.028 af

Subcatchment2A: Subcat 2A Runoff Area=123,359 sf 82.18% Impervious Runoff Depth=5.38"
Flow Length=102' Tc=6.0 min CN=39/98 Runoff=14.89 cfs 1.269 af

Subcatchment2B: Subcat 2B Runoff Area=127,168 sf 1.47% Impervious Runoff Depth=0.29"
Flow Length=253' Tc=13.6 min CN=31/98 Runoff=0.22 cfs 0.070 af

Subcatchment2C: Subcat 2C Runoff Area=26,084 sf 40.92% Impervious Runoff Depth=3.00"
Flow Length=467' Tc=6.0 min CN=39/98 Runoff=1.63 cfs 0.150 af

Subcatchment2D: Subcat 2D Runoff Area=79,578 sf 23.29% Impervious Runoff Depth=1.80"
Flow Length=358' Tc=7.7 min CN=35/98 Runoff=2.59 cfs 0.273 af

Subcatchment2E: Subcat 2E Runoff Area=33,891 sf 0.00% Impervious Runoff Depth=0.15"
Flow Length=180' Tc=6.0 min CN=30/0 Runoff=0.02 cfs 0.010 af

Subcatchment3A: Subcat 3A Runoff Area=148,714 sf 81.00% Impervious Runoff Depth=5.31"
Flow Length=190' Tc=6.0 min CN=39/98 Runoff=17.70 cfs 1.510 af

Subcatchment3B: Subcat 3B Runoff Area=80,907 sf 37.26% Impervious Runoff Depth=2.51"
Flow Length=490' Tc=8.2 min CN=31/98 Runoff=4.14 cfs 0.388 af

Subcatchment3C: Subcat 3C Runoff Area=11,045 sf 66.97% Impervious Runoff Depth=4.48"
Flow Length=98' Tc=7.4 min CN=38/98 Runoff=1.05 cfs 0.095 af

Subcatchment3D: Subcat 3D Runoff Area=0.444 ac 0.00% Impervious Runoff Depth=0.64"
Flow Length=40' Tc=6.0 min CN=39/0 Runoff=0.14 cfs 0.024 af

Subcatchment4: Subcat 4 Runoff Area=395,156 sf 0.00% Impervious Runoff Depth=0.24"
Flow Length=209' Tc=17.1 min CN=32/98 Runoff=0.31 cfs 0.183 af

Pond 2P: StormTrap Infl. Peak Elev=310.54' Storage=21,987 cf Inflow=14.89 cfs 1.269 af
Discarded=0.96 cfs 1.269 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 1.269 af

Pond 3P: INF 1 Peak Elev=313.32' Storage=21,144 cf Inflow=22.26 cfs 1.906 af
Discarded=1.53 cfs 1.298 af Primary=10.23 cfs 0.608 af Outflow=11.77 cfs 1.906 af

Pond 4P: INF-1A to OF-92 Peak Elev=312.25' Storage=21,072 cf Inflow=10.37 cfs 0.632 af
Discarded=1.43 cfs 0.632 af Primary=0.00 cfs 0.000 af Outflow=1.43 cfs 0.632 af

Pond 5P: INF-3 Peak Elev=297.31' Storage=3,189 cf Inflow=2.59 cfs 0.269 af
Discarded=0.46 cfs 0.269 af Primary=0.00 cfs 0.000 af Outflow=0.46 cfs 0.269 af

Pond 6P: SFB-2 Peak Elev=318.19' Storage=507 cf Inflow=1.63 cfs 0.150 af
Outflow=1.59 cfs 0.141 af

Pond 7P: INF-2 Peak Elev=318.62' Storage=1,241 cf Inflow=1.59 cfs 0.141 af
Discarded=0.45 cfs 0.141 af Primary=0.00 cfs 0.000 af Outflow=0.45 cfs 0.141 af

Pond 8P: SFB-3 Peak Elev=297.70' Storage=219 cf Inflow=2.59 cfs 0.273 af
Outflow=2.59 cfs 0.269 af

Pond 9P: Existing Depression Peak Elev=315.02' Storage=56 cf Inflow=0.22 cfs 0.070 af
Outflow=0.16 cfs 0.070 af

Pond 10P: SFB-1B Peak Elev=313.74' Storage=436 cf Inflow=1.05 cfs 0.095 af
Outflow=1.04 cfs 0.086 af

Pond 11P: SFB-1A Peak Elev=313.35' Storage=3,946 cf Inflow=4.14 cfs 0.388 af
Outflow=3.96 cfs 0.310 af

Pond DP1: Offsite to West Inflow=0.05 cfs 0.028 af
Primary=0.05 cfs 0.028 af

Pond DP2: Bulge RD Drainage Inflow=0.02 cfs 0.010 af
Primary=0.02 cfs 0.010 af

Pond DP3: Offsite to North and East Inflow=0.31 cfs 0.183 af
Primary=0.31 cfs 0.183 af

Time span=0.05-72.00 hrs, dt=0.05 hrs, 1440 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1: Subcat 1 Runoff Area=59,549 sf 0.00% Impervious Runoff Depth=0.43"
Flow Length=184' Tc=6.0 min CN=32/0 Runoff=0.18 cfs 0.049 af

Subcatchment2A: Subcat 2A Runoff Area=123,359 sf 82.18% Impervious Runoff Depth=6.12"
Flow Length=102' Tc=6.0 min CN=39/98 Runoff=16.95 cfs 1.444 af

Subcatchment2B: Subcat 2B Runoff Area=127,168 sf 1.47% Impervious Runoff Depth=0.46"
Flow Length=253' Tc=13.6 min CN=31/98 Runoff=0.33 cfs 0.113 af

Subcatchment2C: Subcat 2C Runoff Area=26,084 sf 40.92% Impervious Runoff Depth=3.52"
Flow Length=467' Tc=6.0 min CN=39/98 Runoff=1.95 cfs 0.176 af

Subcatchment2D: Subcat 2D Runoff Area=79,578 sf 23.29% Impervious Runoff Depth=2.17"
Flow Length=358' Tc=7.7 min CN=35/98 Runoff=3.05 cfs 0.331 af

Subcatchment2E: Subcat 2E Runoff Area=33,891 sf 0.00% Impervious Runoff Depth=0.30"
Flow Length=180' Tc=6.0 min CN=30/0 Runoff=0.04 cfs 0.020 af

Subcatchment3A: Subcat 3A Runoff Area=148,714 sf 81.00% Impervious Runoff Depth=6.04"
Flow Length=190' Tc=6.0 min CN=39/98 Runoff=20.17 cfs 1.720 af

Subcatchment3B: Subcat 3B Runoff Area=80,907 sf 37.26% Impervious Runoff Depth=2.93"
Flow Length=490' Tc=8.2 min CN=31/98 Runoff=4.66 cfs 0.453 af

Subcatchment3C: Subcat 3C Runoff Area=11,045 sf 66.97% Impervious Runoff Depth=5.13"
Flow Length=98' Tc=7.4 min CN=38/98 Runoff=1.21 cfs 0.109 af

Subcatchment3D: Subcat 3D Runoff Area=0.444 ac 0.00% Impervious Runoff Depth=0.95"
Flow Length=40' Tc=6.0 min CN=39/0 Runoff=0.27 cfs 0.035 af

Subcatchment4: Subcat 4 Runoff Area=395,156 sf 0.00% Impervious Runoff Depth=0.43"
Flow Length=209' Tc=17.1 min CN=32/98 Runoff=1.02 cfs 0.322 af

Pond 2P: StormTrap Infl. Peak Elev=311.55' Storage=26,489 cf Inflow=16.95 cfs 1.444 af
Discarded=0.96 cfs 1.444 af Primary=0.00 cfs 0.000 af Outflow=0.96 cfs 1.444 af

Pond 3P: INF 1 Peak Elev=313.66' Storage=23,941 cf Inflow=25.35 cfs 2.195 af
Discarded=1.63 cfs 1.400 af Primary=10.79 cfs 0.795 af Outflow=12.42 cfs 2.195 af

Pond 4P: INF-1A to OF-92 Peak Elev=313.04' Storage=27,375 cf Inflow=11.02 cfs 0.830 af
Discarded=1.61 cfs 0.827 af Primary=0.14 cfs 0.002 af Outflow=1.75 cfs 0.830 af

Pond 5P: INF-3 Peak Elev=297.65' Storage=4,061 cf Inflow=3.05 cfs 0.327 af
Discarded=0.51 cfs 0.327 af Primary=0.00 cfs 0.000 af Outflow=0.51 cfs 0.327 af

Pond 6P: SFB-2 Peak Elev=318.21' Storage=528 cf Inflow=1.95 cfs 0.176 af
Outflow=1.91 cfs 0.167 af

Pond 7P: INF-2 Peak Elev=318.77' Storage=1,607 cf Inflow=1.91 cfs 0.167 af
Discarded=0.49 cfs 0.167 af Primary=0.00 cfs 0.000 af Outflow=0.49 cfs 0.167 af

Pond 8P: SFB-3 Peak Elev=297.72' Storage=224 cf Inflow=3.05 cfs 0.331 af
Outflow=3.05 cfs 0.327 af

Pond 9P: Existing Depression Peak Elev=315.09' Storage=276 cf Inflow=0.33 cfs 0.113 af
Outflow=0.20 cfs 0.113 af

Pond 10P: SFB-1B Peak Elev=313.75' Storage=442 cf Inflow=1.21 cfs 0.109 af
Outflow=1.19 cfs 0.100 af

Pond 11P: SFB-1A Peak Elev=313.38' Storage=3,997 cf Inflow=4.66 cfs 0.453 af
Outflow=4.47 cfs 0.375 af

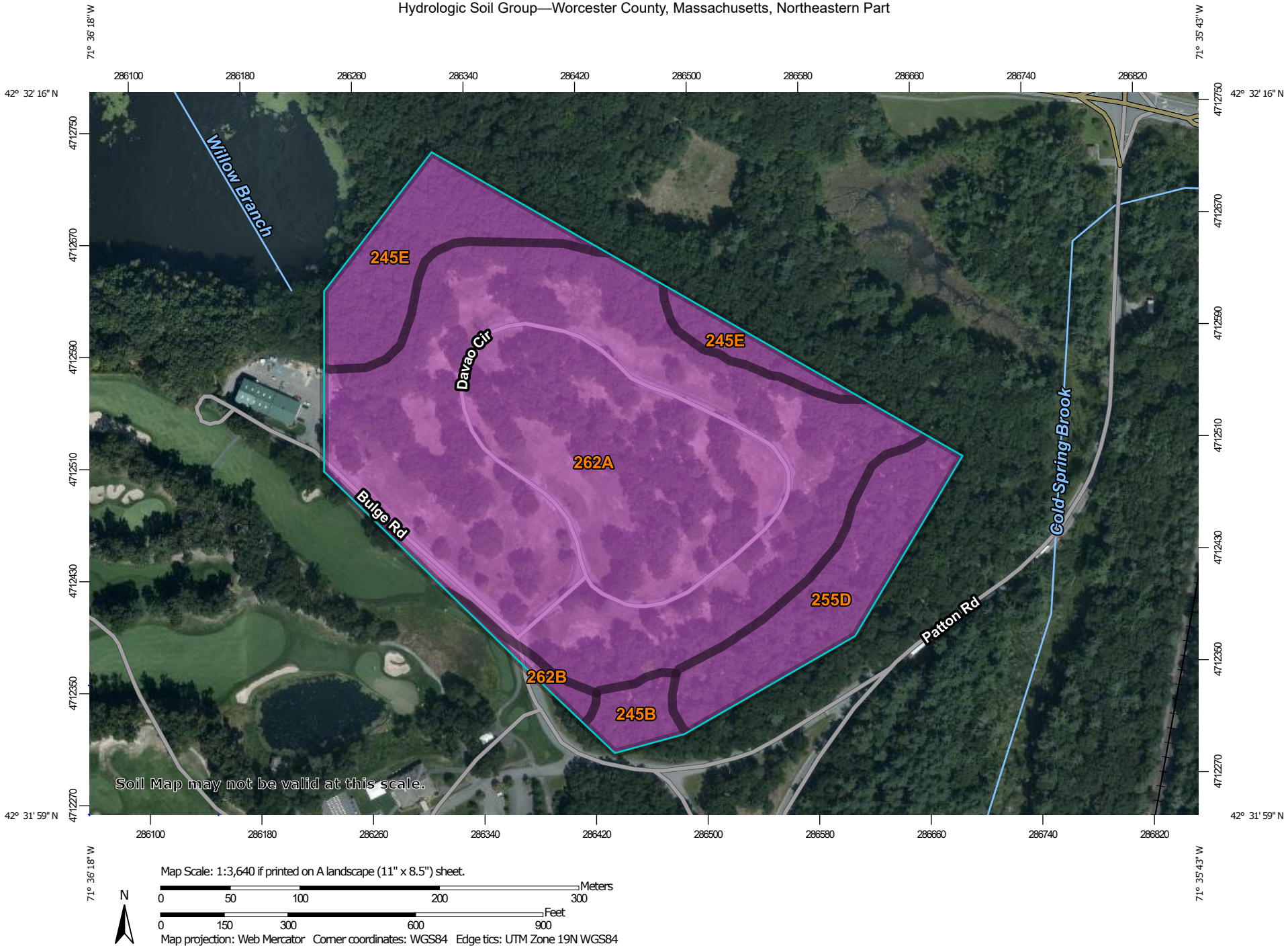
Pond DP1: Offsite to West Inflow=0.18 cfs 0.049 af
Primary=0.18 cfs 0.049 af

Pond DP2: Bulge RD Drainage Inflow=0.04 cfs 0.020 af
Primary=0.04 cfs 0.020 af

Pond DP3: Offsite to North and East Inflow=1.02 cfs 0.325 af
Primary=1.02 cfs 0.325 af

Appendix C - Standard 3 Computations and Supporting Information

Soil Evaluation and Analysis



Map Scale: 1:3,640 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil 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 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 15, Jun 10, 2020

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

Date(s) aerial images were photographed: Aug 12, 2019—Sep 29, 2019

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	0.7	2.4%
245E	Hinckley loamy sand, 25 to 35 percent slopes	A	3.3	11.8%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	3.1	10.9%
262A	Quonset loamy sand, 0 to 3 percent slopes	A	20.7	73.8%
262B	Quonset loamy sand, 3 to 8 percent slopes	A	0.3	1.1%
Totals for Area of Interest			**28.0**	**100.0%**

SANBORN HEAD
Building Trust. Engineering Success.

1 Technology Park Drive
Westford, MA 01886

Mr. Matt Boone, P.E.
Scannell Properties
8801 River Crossing Boulevard, Suite 300
Indianapolis, IN 46240

February 8, 2021
File No. 4864.00

Re: Subsurface Evaluation for Stormwater
16 Bulge Road
Devens, Massachusetts

Dear Matt:

This data report summarizes the results of subsurface explorations completed to support design of the proposed stormwater systems for the proposed redevelopment project at 16 Bulge Road in Devens, Massachusetts (Site) as shown on the Locus Plan in Figure 1. We understand this information will be used by the Vanasse Hangen Brustlin, Inc. (VHB) and the project team to design the surface and subsurface stormwater infiltration systems.

This report has been prepared by Sanborn, Head & Associates, Inc. (Sanborn Head) on behalf of Scannell Properties (Client) in accordance with our proposal dated August 14, 2020 and amendment dated January 15, 2021. This report is subject to the Limitations stated in Attachment A.

SITE AND PROJECT DESCRIPTION

Based on the information provided, we understand that the proposed redevelopment project consists of constructing a new building with an approximate footprint of 118,260 square feet (sf) (with the potential for an additional 122,000 sf in the future) along with paved parking and stormwater management systems. Based on our knowledge of the Site area, we understand Davao Circle was previously developed in the late 1950s to early 1960s as barracks which were subsequently razed in 2005 with the foundations being removed in 2016. The proposed Site concept is shown on the Exploration Location Plan in Figure 2.

SUBSURFACE EXPLORATION PROGRAM

Between January 20 and 22, 2020, Sanborn Head completed a subsurface exploration program which included a total of sixteen (16) stormwater test pits located in the general areas of the six proposed stormwater basins:

- Infiltration/Detention Basin 1 (IDB1) – SH-TP-11 through SH-TP-13;
- Infiltration/Detention Basin 1A (IDB1A) – SH-TP-14 through SH-TP-16;
- Infiltration/Detention Basin 2 (IDB2) –SH-TP-1 through SH-TP-3;
- Infiltration/Detention Basin 3 (IDB3) –SH-TP-8 through SH-TP-10;
- Stormtrap Chamber System 1 (SCS1) –SH-TP-4 through SH-TP-6; and,
- Rain Garden 1 (RG1) - SH-TP-7 (SH-TP-4 and SH-TP-6 located adjacent to RG1).

The approximate test pit locations are shown on the Exploration Location Plan included as Figure 2.

The stormwater test pits were excavated to total depths of approximately 10 to 12 feet below ground surface (bgs) by Machine Time, LLC of Hudson, New Hampshire, using a Bobcat E50 excavator. The explorations were observed by Sanborn Head personnel on a full-time basis. Logs of the subsurface explorations were prepared by a Soil Evaluator certified in Massachusetts from Sanborn Head and are included in Attachment B.

The test pits were logged by Sanborn Head personnel using the United States Department of Agriculture (USDA) Textural Classification System. Soil samples were collected by Sanborn Head at depths and locations that are representative of the proposed receiving layer soils for the proposed stormwater infiltration systems and submitted to GeoTesting Express of Acton, Massachusetts for a sieve analysis with USDA Textural Classification. The laboratory testing results are included in Attachment C.

SUBSURFACE CONDITIONS

The explorations generally encountered a surface layer of organic topsoil approximately 2 to 10 inches thick, underlain by a natural sand or loamy sand subsoil with varying amounts of gravel that is approximately 0.5 to 4.5 feet thick, underlain by natural sand with slightly varying silt content. As an exception, the subsoil layer was not continuously observed in the proposed stormwater areas of IDB1 & IDB1A (SH-TP-12, SH-TP-13, SH-TP-14, SH-TP-16).

Fill materials were observed in the proposed stormwater areas of IDB1 & IDB1A, IDB2, and SCS1. At IDB2 and SCS1, there was an approximately 1.7 to 4 feet thick layer of general raise-in-grade fill comprised of loamy sand with varying amounts of gravel (SH-TP-1, SH-TP-2, SH-TP-4). At test pit location SH-TP-2, the fill was placed over an approximate 4-inch buried topsoil layer. Additionally, at test pit location SH-TP-6 (adjacent to the existing Davao Circle roadway) sand and gravel fill layers associated with roadway and utility construction were observed to approximately 8 feet bgs.

At IDB1 & IDB1A, there was there approximately 0.5 to 4 feet of general raise-in-grade fill and/or pavement base course fill (SH-TP-12 through SH-TP-16). At test pit locations SH-TP-15 and SH-TP-16, the fill was placed over an approximate 4- to 5-inch thick buried topsoil layer.

Groundwater was not encountered during excavation activities to depths up to 12 feet bgs and corresponding to between El. 314.5 and 293.5 feet. Weak and isolated redoximorphic features were observed in the areas of IDB1, IDB2, and IDB3 between 4 and 8 feet bgs, as shown on the test pit logs in Attachment B; however, these observations were generally not interpreted as evidence of seasonal high groundwater (SHGW). In general, the isolated redoximorphic features were interpreted as discontinuities in hydraulic conductivity at the interface of sandy and silty lenses. Based on limited subsurface investigations previously conducted by Sanborn Head at the Site, groundwater is higher along the eastern portion of the Site (observed at approximately El. 287 feet) and dips to the west (observed at approximately El. 273 feet).

SUMMARY OF RESULTS

Based on the results summarized above, we recommend using the following stormwater design values:

Basin ID	Bottom of System Elevation[1] (feet)	USDA Soil Texture	Hydrologic Soil Group (HSG)	Infiltration Rate[2] (in/hr)	ESHGW (feet)
IDB1 (northeast)	309.0	Sand	A	8.27	< 304.5
IDB1A (northeast)	309.5	Sand	A	8.27	< 302.5
IDB2 (west)	318.0	Sand	A	8.27	< 312.5
IDB3 (southwest)	302.5	Sand	A	8.27	< 293.5
SCS1 (southwest)	304.5	Sand	A	8.27	< 300.0
RG1 (southwest)	313.0	Sand	A	8.27	< 303.5

Our recommendations assume the following construction activities are completed:

- In IDB3, the discontinuous subsoil layer at the proposed bottom of basin will be removed and replaced with suitable on-Site, free-draining natural Sand (per USDA Textural Classification); and,
- In SCS1, the discontinuous natural loamy sand layer at the proposed bottom of basin will be removed and replaced with suitable on-Site, free-draining, natural Sand (per USDA Textural Classification).

We trust this data report meets the current needs of the project. If you should have any questions, please call us at (978) 392-0900.

Very truly yours,
SANBORN, HEAD & ASSOCIATES, INC.

Luke Norton, P.E.
Project Director

Kevin Stetson, P.E.
Senior Vice President

LDN/KPS: jtm

Encl. Figure 1 – Locus Plan
Figure 2 – Exploration Location Plan
Attachment A – Limitations
Attachment B – USDA Test Pit Logs
Attachment C – Laboratory Test Results

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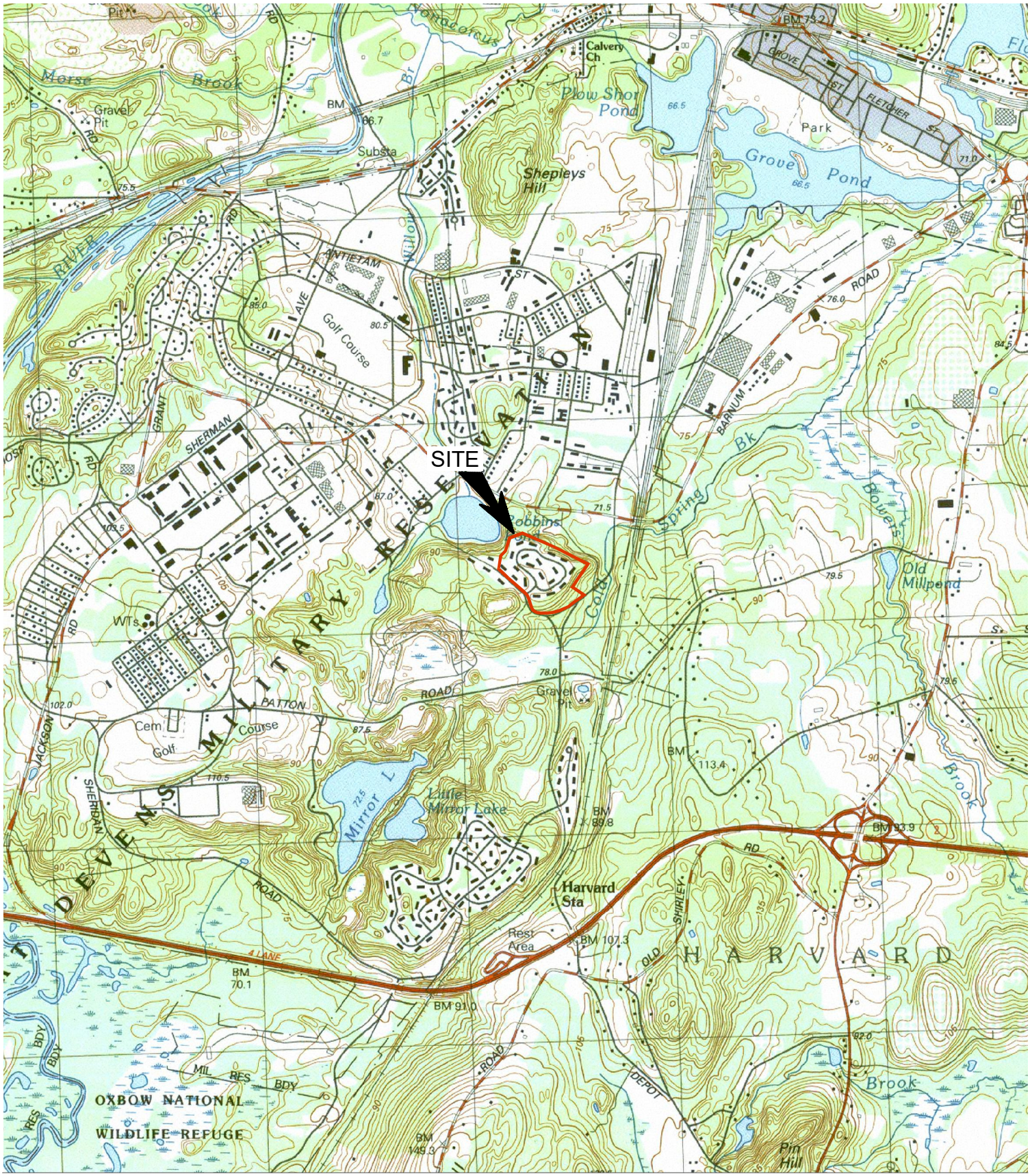
[1] *Bottom of System Elevations provided electronically by VHB on February 5, 2021.*
[2] *Massachusetts Stormwater Handbook, Table 2.3.3:* Sands are classified in Hydrologic Soil Group (HSG) A with a Rawl's infiltration rate of 8.27 in/hr.

File:P:\4800s\4864.00\Graphics Files\CAD\ELP-FEB21\ELP.dwg Plot Date: 1-29-21
©2021 SANBORN, HEAD & ASSOCIATES, INC.



NOTES:
Base map was taken from the "Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Information Technology Division"
7.5 minute USGS Quadrangle Maps: Harvard, Massachusetts, REV: 1988

Drawn By: C.Dias
Designed By: J.McCarthy
Reviewed By: K.Stetson
Project No: 4864.00
Date: February 2021

SCALE: 1:25,000

SANBORN HEAD

Figure 1

Locus Plan

Geotechnical Engineering Services

16 Bulge Road
Devens, Massachusetts

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NOTES:

1. THE BASE MAP WAS DRAWN FROM A PLAN ENTITLED, "GRADING AND DRAINAGE PLAN", PREPARED BY VANASSE HANGEN BRUSTLIN, INC. (VHB) OF WATERTOWN, MA, DATED OCTOBER 2, 2020 WITH AN ORIGINAL SCALE OF 1" = 50'.
2. TEST PITS DESIGNATED SH-TP-1 THROUGH SH-TP-16 WERE EXCAVATED BY MACHINE TIME, LLC. (MACHINE TIME) OF HUDSON, NH AND OBSERVED BY SANBORN HEAD BETWEEN JANUARY 20 AND 22, 2021.
3. APPROXIMATE LOCATIONS OF EXPLORATIONS ARE BASED ON TAPED MEASUREMENTS MADE IN THE FIELD RELATIVE TO PROMINENT SITE FEATURES. THIS DATA SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

LEGEND:

APPROXIMATE SITE BOUNDARY

SH-TP-1 APPROXIMATE LOCATION AND DESIGNATION OF TEST PIT OBSERVED BY SANBORN HEAD (JANUARY 2021)

SH-TP-14
SH-TP-16
SH-TP-15
SH-TP-11
SH-TP-12
SH-TP-13
SH-TP-1
SH-TP-2
SH-TP-3
SH-TP-4
SH-TP-5
SH-TP-6
SH-TP-7
SH-TP-8
SH-TP-9
SH-TP-10

STORMWATER MANAGEMENT INFILTRATION/DETENTION BASIN 1A

STORMWATER MANAGEMENT INFILTRATION/DETENTION BASIN 1

STORMWATER MANAGEMENT INFILTRATION/DETENTION BASIN 2

STORMWATER MANAGEMENT STORMTRAP CHAMBER SYSTEM

STORMWATER MANAGEMENT INFILTRATION/DETENTION BASIN 3

FUTURE BUILDING EXPANSION 122,000 SF± POSSIBLE

BUILDING
118,260 SF, 2-Story
FFE = 318.00

PROPOSED RAIN GARDEN

15' SLOPE RESOURCE AREA BUFFER

50' SLOPE RESOURCE AREA BUFFER

HYDRANT (TYP)

LOW

DAVID CIRCLE

PATON ROAD

Bulge Road

SANBORN HEAD

GRAPHICAL SCALE
60' 30' 0' 60' 120'

NO.	DATE	DESCRIPTION	BY

DRAWN BY: C.DIAS
DESIGNED BY: J.MCCARTY
REVIEWED BY: L.NORTON
PROJECT MGR: L.NORTON
PIC: K.STETSON
DATE: FEBRUARY 2021

GEOTECHNICAL ENGINEERING SERVICES
16 BULGE ROAD
DEVENS, MASSACHUSETTS

PROJECT NUMBER: 4864.00

EXPLORATION LOCATION PLAN

SHEET NUMBER: 2

XREFS: P:\4800s\4864.00\Graphics Files\CAD\Work\20210202_OCC_TOPO_alt4.dwg
P:\4800s\4864.00\Graphics Files\CAD\Work\20210202_Bridge.dwg
P:\4800s\4864.00\Graphics Files\CAD\Work\20210224_Bridge_NLT.dwg
IMAGES: S:\CAD Library\Shared\SURVEY\STATION.dwg
FILE: P:\4800s\4864.00\Graphics Files\CAD\LDP_PERMIT\EXP.dwg
LAYOUT: 2 - 24x36
USER: KStetson
PLOT DATE: 1/29/21 - 10:11 PM

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	12:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	324.5	Weather :	Partly Cloudy, 10-30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-1 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 8	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
8 - 36	Fill	10 YR 4/3	-	-	-	Very Gravelly Loamy Sand	30	5	Structureless	Very Friable	1
36 - 48	Fill	10 YR 6/8	-	-	-	Sand	--	--	Structureless	Very Friable	2
44 - 96	B_b	2.5 Y 6/4	-	-	-	Very Gravelly Sand	30	10	Single Grain	Loose	
96 - 120	C_1	10 YR 4/6	96	10 YR 5/8	10	Sand	<5	<5	Single Grain	Loose	3
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill (contains Concrete/Asphalt fragments).
2. Bedding Sand used for 4-inch PVC utility at 3.5 feet bgs.
3. Redoximorphic features not interpreted as seasonal high groundwater; observed at layer interface.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	9:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	324.0	Weather :	Partly Cloudy, 10-30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-2 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
6 - 42	Fill	10 YR 4/3	-	-	-	Very Gravelly Loamy Sand	30	5	Structureless	Very Friable	1
42 - 46	A_b	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
46 - 96	B_b	2.5 Y 6/4	90	10 YR 5/8	10	Gravelly Sand	20	5	Single Grain	Loose	2
96 - 120	C_1	10 YR /6	-	-	-	Sand	<5	<5	Single Grain	Loose	
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill (contains Concrete/Asphalt fragments).
2. Redoximorphic features not interpreted as seasonal high groundwater; observed at layer interface.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	10:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	322.5	Weather :	Partly Cloudy, 10-30°F
Test Pit Number:	SH-TP-3	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
6 - 24	B_w	2.5 Y 5/6	-	-	-	Loamy Sand	10	<5	Single Grain	Very Friable	
24 - 84	C_1	2.5 Y 6/4	-	-	-	Very Gravelly Sand	30	--	Single Grain	Loose	
84 - 120	C_2	10 YR 4/6	90	10 YR 5/8	10	Sand	<5	<5	Single Grain	Loose	1, 2
-											
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Stratified from 84-120 inches
2. Redoximorphic features not interpreted as seasonal high groundwater; observed at layer interface.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	8:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	317.0	Weather :	Partly Cloudy, 20-30°F
Test Pit Number:	SH-TP-4	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 20	Fill	10 YR 4/3	-	-	-	Very Gravelly Loamy Sand	30	5	Structureless	Very Friable	1
20 - 36	B_w	2.5 Y 6/4	-	-	-	Sand	10	<5	Single Grain	Very Friable	2
36 - 144	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 144 **Reason for Termination:** Target Depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill (contains Asphalt fragments).
2. Subsoil horizon observed to a depth of 54 inches on western sidewall.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	9:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	315.5	Weather :	Partly Cloudy, 20-30°F
Test Pit Number:	SH-TP-5	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 12	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
12 - 54	B_w	2.5 Y 5/6	-	-	-	Sand	10	<5	Single Grain	Very Friable	
54 - 132	C_1	10 YR 4/6	-	-	-	Loamy Sand	<5	<5	Single Grain	Very Friable	
132 - 144	C_2	10 YR 4/6	-	-	-	Sand	10	<5	Single Grain	Loose	
-											
-											
-											

Test Pit Termination Depth (in.): 144 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	10:30
Project No.:	4864.00		
Ground Surface Elev. (ft.):	312.0	Weather :	Partly Cloudy, 20-30°F
Test Pit Number:	SH-TP-6	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 1	Asphalt	-	-	-	-	-	-	-	-	-	
1 - 6	Fill	10 YR 4/3	-	-	-	Very Gravelly Sand	50	<5	Structureless	Very Friable	1
6 - 96	Fill	10 YR 4/3	-	-	-	Gravelly Sand	15	5	Structureless	Very Friable	2,3,4
96 - 144	C_1	2.5 Y 5/6	-	-	-	Sand	5	<5	Single Grain	Loose	
-											
-											
-											

Test Pit Termination Depth (in.): 144 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Pavement base course fill.
2. General raise-in-grade fill.
3. Gas line at 2.4 feet bgs
4. Drainage line at 6.5 feet bgs

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	12:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	313.5	Weather :	Partly Cloudy, 20-30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-7 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 10	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
10 - 18	B_w	2.5 Y 5/6	-	-	-	Sand	10	<5	Single Grain	Very Friable	
18 - 120	C_1	2.5 Y 5/6	-	-	-	Sand	5	<5	Single Grain	Loose	1
-											
-											
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. 2" Gravelly seam at 3.5 feet bgs.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	13:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	312.0	Weather :	Partly Cloudy, 20-30°F
Test Pit Number:	SH-TP-8	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
2 - 18	B_w	2.5 Y 5/6	-	-	-	Loamy Sand	5	<5	Single Grain	Very Friable	
18 - 120	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	1
-											
-											
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Stratified from 75-120 inches

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/20/2021
Site Address:	Davao Circle	Time:	14:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	307.0	Weather :	Partly Cloudy, 20-30°F
Test Pit Number:	SH-TP-9	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 2	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
2 - 24	B_w	2.5 Y 5/6	-	-	-	Loamy Sand	5	<5	Single Grain	Very Friable	
24 - 120	C_1	10 YR 4/6	48	10 YR 5/8	10	Sand	<5	<5	Single Grain	Loose	1, 2
-											
-											
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Stratified from 84-120 inches
2. Redoximorphic features not interpreted as seasonal high groundwater; observed at layer discontinuity.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	12:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	303.5	Weather :	Partly Cloudy, 10-30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-10 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 5	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
5 - 20	B_w	2.5 Y 5/6	-	-	-	Loamy Sand	5	<5	Single Grain	Very Friable	
20 - 120	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 120 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/22/2021
Site Address:	Davao Circle	Time:	10:30
Project No.:	4864.00		
Ground Surface Elev. (ft.):	318.5	Weather :	Partly Cloudy, 30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-11 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	A_P	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
6 - 9	B_w	2.5 Y 5/6	-	-	-	Loamy Sand	5	<5	Single Grain	Very Friable	
9 - 126	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	1
-											
-											
-											
-											

Test Pit Termination Depth (in.): 126 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Stratified deposit.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/22/2021
Site Address:	Davao Circle	Time:	9:30
Project No.:	4864.00		
Ground Surface Elev. (ft.):	315.5	Weather :	Partly Cloudy, 30°F

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-12 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 6	Fill	7.5 YR 3/2	-	-	-	Gravelly Loamy Sand	20	<5	Structureless	Very Friable	1
6 - 96	C_1	10 YR 4/6	-	-	-	Sand	5	<5	Single Grain	Loose	
96 - 132	C_2	10 YR 4/6	60	10 YR 5/8	5	Sand	<5	<5	Single Grain	Loose	2
-											
-											
-											
-											

Test Pit Termination Depth (in.): 132 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. Pavement base course fill.
2. Redoximorphic features not interpreted as seasonal high groundwater; observed at layer discontinuity.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/22/2021
Site Address:	Davao Circle	Time:	8:30
Project No.:	4864.00		
Ground Surface Elev. (ft.):	315.0	Weather :	Partly Cloudy, 30's
Test Pit Number:	SH-TP-13	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 8	Fill	7.5 YR 3/2	-	-	-	Very Gravelly Loamy Sand	35	5	Structureless	Very Friable	1
8 - 126	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	2
-											
-											
-											
-											
-											

Test Pit Termination Depth (in.): 126 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:
1. Pavement base course fill.
2. Stratified deposit.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/22/2021
Site Address:	Davao Circle	Time:	7:30
Project No.:	4864.00		
Ground Surface Elev. (ft.):	314.5	Weather :	Partly Cloudy, 30's

SANBORN HEAD

Logged by: J. McCarthy/L. Norton

Test Pit Number: SH-TP-14 Soil Evaluator #: SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 14	Fill	10 YR 4/6	-	-	-	Sand	5	<5	Structureless	Very Friable	1
14 - 18	Fill	7.5 YR 3/2	-	-	-	Gravelly Loamy Sand	25	<5	Structureless	Very Friable	2
18 - 48	Fill	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Structureless	Very Friable	3
48 - 132	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Very Friable	4
-											
-											
-											

Test Pit Termination Depth (in.): 132 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill.
2. Pavement base course fill.
3. General raise-in-grade fill.
4. Stratified deposit.

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	14:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	314.0	Weather :	Snow, 10-30°F
Test Pit Number:	SH-TP-15	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 7	Fill	10 YR 4/6	-	-	-	Sand	5	<5	Structureless	Very Friable	1
7 - 12	A_b	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
12 - 21	B_b	2.5 Y 5/6	-	-	-	Loamy Sand	10	<5	Single Grain	Very Friable	
21 - 132	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	2
-											
-											
-											

Test Pit Termination Depth (in.): 132 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill.
2. Gas line at 2 feet bgs

Deep Observation Hole

Site Name:	Devens, Massachusetts	Date:	1/21/2021
Site Address:	Davao Circle	Time:	13:00
Project No.:	4864.00		
Ground Surface Elev. (ft.):	313.0	Weather :	Partly Cloudy/Snow, 10-30's
Test Pit Number:	SH-TP-16	Logged by:	J. McCarthy/L. Norton
		Soil Evaluator #:	SE13281

Depth (inches)	Soil Horizon or Layer	Soil Matrix Color (Moist)	Redoximorphic Features			Soil Texture (NRCS)	Coarse Fragments (% by Volume)		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles			
0 - 5	Fill	10 YR 4/6	-	-	-	Gravelly Sand	20	<5	Structureless	Very Friable	1
5 - 9	A_b	7.5 YR 2.5/2	-	-	-	Sandy Loam	5	--	Granular	Very Friable	
9 - 126	C_1	10 YR 4/6	-	-	-	Sand	<5	<5	Single Grain	Loose	
-											
-											
-											
-											

Test Pit Termination Depth (in.): 126 **Reason for Termination:** Target depth achieved

Groundwater Observations:			**In-Situ Testing:**		
Depth to water weeping from pit face (in.):	N/A		Percolation Test:	N/A	Depth (in.):
Depth to standing water in hole (in.):	N/A	Stabilization Time:	Permeameter Test:	N/A	Depth (in.):
Depth to estimated seasonal high groundwater [ESHGW] (in.):	N/A	Basis for ESHGW:	Falling Head Test:	N/A	Depth (in.):
			Other Test:	N/A	Depth (in.):

Additional Notes:

1. General raise-in-grade fill.

Required and Provided Recharge Volumes

Recharge Calculations

Project Name: 16 Bulge Rd, Scannell
Proj. No.: 73152.00
Date: 4/14/2021
Project Location: Devens, MA
Calculated by: KC

Proposed Impervious Surface Summary

Net Proposed Impervious Areas by Hydrologic Soil Group (HSG) in acres

Subcatchment	HSG A	HSG B	HSG C	HSG D	Total Area
PR 1	0.00				0.00
PR 2A	2.30				2.30
PR 2B	0.04				0.04
PR 2C	0.25				0.25
PR 2D	0.43				0.43
PR 2E	0.00				0.00
PR 3A	2.76				2.76
PR 3B	0.69				0.69
PR 3C	0.17				0.17
PR 3D	0.00				0.00
PR 3E	0.00				0.00
PR 4	0.00				0.00
TOTAL	**6.64**	**0.00**	**0.00**	**0.00**	**6.64**

Required Recharge Volume (Cubic Feet)

HSG	Area (acres)	Recharge Depth* (in.)	Volume (c.f.)
A	6.6	0.60	14,462
B	0.0	0.35	0
C	0.0	0.25	0
D	0.0	0.10	0
TOTAL			**14,462**

Assumptions:

* Massachusetts DEP Infiltration requirement: HSG A = 0.60 in; HSG B = 0.35 in; HSG C = 0.25 in; HSG D = 0.10 in.

Capture Area Adjustment

Required Recharge Volume	14,462	c.f.
Total Site Impervious Area	6.64	acres
Total Site Impervious Area Draining to Recharge Facilities	6.63	acres
Capture Area Adjustment Factor	1.002	-
Adjusted Required Recharge Volume:	**14,484**	**c.f.**

Provided Recharge Volume and Drawdown Times Summary

BMP	Outlet Elev.	Vol. Below Outlet(CF)	Drawdown
INF 1	312.75	14,076	24.65 HRS
INF 1A	313.0'	27,038	24.1 HRS
INF 2	320'	5,462	24.25 HRS
INF 3	298'	5,037	24.25 HRS
STORM TRAP	311.63'	29,241	24.3 HRS

RECHARGE VOLUME (CF) PROVIDED TOTAL = 80,854

72-hour Drawdown Analysis

Hydrograph for Pond 2P: StormTrap Infl.

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.05	0.00	0	304.50	0.00	0.00	**0.00**
2.55	0.12	26	304.51	0.12	0.12	0.00
5.05	0.22	48	304.52	0.22	0.22	0.00
7.55	0.39	83	304.54	0.38	0.38	0.00
10.05	**0.84**	179	304.59	**0.82**	**0.82**	0.00
12.55	**2.91**	**24,064**	**311.01**	**0.96**	**0.96**	0.00
15.05	0.71	**25,991**	**311.44**	0.96	0.96	0.00
17.55	0.35	21,855	310.51	0.96	0.96	0.00
20.05	0.25	15,832	309.16	0.96	0.96	0.00
22.55	0.19	9,219	307.67	0.96	0.96	0.00
25.05	0.00	1,608	305.31	0.96	0.96	0.00
27.55	0.00	0	304.50	0.00	0.00	0.00
30.05	0.00	0	304.50	0.00	0.00	0.00
32.55	0.00	0	304.50	0.00	0.00	0.00
35.05	0.00	0	304.50	0.00	0.00	0.00
37.55	0.00	0	304.50	0.00	0.00	0.00
40.05	0.00	0	304.50	0.00	0.00	0.00
42.55	0.00	0	304.50	0.00	0.00	0.00
45.05	0.00	0	304.50	0.00	0.00	0.00
47.55	0.00	0	304.50	0.00	0.00	0.00
50.05	0.00	0	304.50	0.00	0.00	0.00
52.55	0.00	0	304.50	0.00	0.00	0.00
55.05	0.00	0	304.50	0.00	0.00	0.00
57.55	0.00	0	304.50	0.00	0.00	0.00
60.05	0.00	0	304.50	0.00	0.00	0.00
62.55	0.00	0	304.50	0.00	0.00	0.00
65.05	0.00	0	304.50	0.00	0.00	0.00
67.55	0.00	0	304.50	0.00	0.00	0.00
70.05	0.00	0	304.50	0.00	0.00	0.00

Hydrograph for Pond 3P: INF 1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.05	0.00	0	309.10	0.00	0.00	0.00
2.55	0.15	43	309.12	0.14	0.14	0.00
5.05	0.26	79	309.14	0.26	0.26	0.00
7.55	0.46	144	309.16	0.43	0.43	0.00
10.05	**1.06**	**2,249**	**309.93**	**0.62**	**0.62**	**0.00**
12.55	**4.99**	**20,319**	**313.22**	**11.56**	**1.50**	**10.05**
15.05	1.16	13,999	312.34	1.26	1.26	0.00
17.55	0.58	10,576	311.79	1.10	1.10	0.00
20.05	0.41	5,963	310.89	0.86	0.86	0.00
22.55	0.32	2,498	310.01	0.64	0.64	0.00
25.05	0.00	0	309.10	0.00	0.00	0.00
27.55	0.00	0	309.10	0.00	0.00	0.00
30.05	0.00	0	309.10	0.00	0.00	0.00
32.55	0.00	0	309.10	0.00	0.00	0.00
35.05	0.00	0	309.10	0.00	0.00	0.00
37.55	0.00	0	309.10	0.00	0.00	0.00
40.05	0.00	0	309.10	0.00	0.00	0.00
42.55	0.00	0	309.10	0.00	0.00	0.00
45.05	0.00	0	309.10	0.00	0.00	0.00
47.55	0.00	0	309.10	0.00	0.00	0.00
50.05	0.00	0	309.10	0.00	0.00	0.00
52.55	0.00	0	309.10	0.00	0.00	0.00
55.05	0.00	0	309.10	0.00	0.00	0.00
57.55	0.00	0	309.10	0.00	0.00	0.00
60.05	0.00	0	309.10	0.00	0.00	0.00
62.55	0.00	0	309.10	0.00	0.00	0.00
65.05	0.00	0	309.10	0.00	0.00	0.00
67.55	0.00	0	309.10	0.00	0.00	0.00
70.05	0.00	0	309.10	0.00	0.00	0.00

Hydrograph for Pond 4P: INF-1A to OF-92

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.05	0.00	0	308.15	0.00	0.00	0.00
2.55	0.00	0	308.15	0.00	0.00	0.00
5.05	0.00	0	308.15	0.00	0.00	0.00
7.55	0.00	0	308.15	0.00	0.00	0.00
10.05	**0.00**	0	308.15	0.00	0.00	0.00
12.55	**10.17**	**20,621**	**312.19**	**1.41**	**1.41**	**0.00**
15.05	0.04	**19,379**	**312.01**	**1.37**	**1.37**	**0.00**
17.55	0.02	8,940	310.33	1.01	1.01	0.00
20.05	0.02	1,578	308.65	0.66	0.66	0.00
22.55	0.01	4	308.15	0.01	0.01	0.00
25.05	0.00	0	308.15	0.00	0.00	0.00
27.55	0.00	0	308.15	0.00	0.00	0.00
30.05	0.00	0	308.15	0.00	0.00	0.00
32.55	0.00	0	308.15	0.00	0.00	0.00
35.05	0.00	0	308.15	0.00	0.00	0.00
37.55	0.00	0	308.15	0.00	0.00	0.00
40.05	0.00	0	308.15	0.00	0.00	0.00
42.55	0.00	0	308.15	0.00	0.00	0.00
45.05	0.00	0	308.15	0.00	0.00	0.00
47.55	0.00	0	308.15	0.00	0.00	0.00
50.05	0.00	0	308.15	0.00	0.00	0.00
52.55	0.00	0	308.15	0.00	0.00	0.00
55.05	0.00	0	308.15	0.00	0.00	0.00
57.55	0.00	0	308.15	0.00	0.00	0.00
60.05	0.00	0	308.15	0.00	0.00	0.00
62.55	0.00	0	308.15	0.00	0.00	0.00
65.05	0.00	0	308.15	0.00	0.00	0.00
67.55	0.00	0	308.15	0.00	0.00	0.00
70.05	0.00	0	308.15	0.00	0.00	0.00

Hydrograph for Pond 5P: INF-3

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.05	0.00	0	295.50	0.00	0.00	**0.00**
2.55	0.00	0	295.50	0.00	0.00	0.00
5.05	0.04	7	295.51	0.04	0.04	0.00
7.55	0.07	13	295.51	0.07	0.07	0.00
10.05	**0.15**	27	295.52	0.15	0.15	0.00
12.55	**0.86**	**3,967**	**297.62**	**0.51**	**0.51**	0.00
15.05	0.22	**2,696**	**297.09**	**0.42**	**0.42**	0.00
17.55	0.11	834	296.11	0.30	0.30	0.00
20.05	0.08	15	295.51	0.08	0.08	0.00
22.55	0.07	12	295.51	0.07	0.07	0.00
25.05	0.00	0	295.50	0.00	0.00	0.00
27.55	0.00	0	295.50	0.00	0.00	0.00
30.05	0.00	0	295.50	0.00	0.00	0.00
32.55	0.00	0	295.50	0.00	0.00	0.00
35.05	0.00	0	295.50	0.00	0.00	0.00
37.55	0.00	0	295.50	0.00	0.00	0.00
40.05	0.00	0	295.50	0.00	0.00	0.00
42.55	0.00	0	295.50	0.00	0.00	0.00
45.05	0.00	0	295.50	0.00	0.00	0.00
47.55	0.00	0	295.50	0.00	0.00	0.00
50.05	0.00	0	295.50	0.00	0.00	0.00
52.55	0.00	0	295.50	0.00	0.00	0.00
55.05	0.00	0	295.50	0.00	0.00	0.00
57.55	0.00	0	295.50	0.00	0.00	0.00
60.05	0.00	0	295.50	0.00	0.00	0.00
62.55	0.00	0	295.50	0.00	0.00	0.00
65.05	0.00	0	295.50	0.00	0.00	0.00
67.55	0.00	0	295.50	0.00	0.00	0.00
70.05	0.00	0	295.50	0.00	0.00	0.00

Hydrograph for Pond 7P: INF-2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.05	0.00	0	318.00	0.00	0.00	**0.00**
2.55	0.00	0	318.00	0.00	0.00	0.00
5.05	0.00	0	318.00	0.00	0.00	0.00
7.55	0.04	4	318.00	0.04	0.04	0.00
10.05	**0.09**	**9**	**318.01**	**0.09**	**0.09**	0.00
12.55	**0.42**	**1,603**	**318.77**	**0.49**	**0.49**	0.00
15.05	0.10	11	318.01	0.10	0.10	0.00
17.55	0.05	5	318.00	0.05	0.05	0.00
20.05	0.04	4	318.00	0.04	0.04	0.00
22.55	0.03	3	318.00	0.03	0.03	0.00
25.05	0.00	0	318.00	0.00	0.00	0.00
27.55	0.00	0	318.00	0.00	0.00	0.00
30.05	0.00	0	318.00	0.00	0.00	0.00
32.55	0.00	0	318.00	0.00	0.00	0.00
35.05	0.00	0	318.00	0.00	0.00	0.00
37.55	0.00	0	318.00	0.00	0.00	0.00
40.05	0.00	0	318.00	0.00	0.00	0.00
42.55	0.00	0	318.00	0.00	0.00	0.00
45.05	0.00	0	318.00	0.00	0.00	0.00
47.55	0.00	0	318.00	0.00	0.00	0.00
50.05	0.00	0	318.00	0.00	0.00	0.00
52.55	0.00	0	318.00	0.00	0.00	0.00
55.05	0.00	0	318.00	0.00	0.00	0.00
57.55	0.00	0	318.00	0.00	0.00	0.00
60.05	0.00	0	318.00	0.00	0.00	0.00
62.55	0.00	0	318.00	0.00	0.00	0.00
65.05	0.00	0	318.00	0.00	0.00	0.00
67.55	0.00	0	318.00	0.00	0.00	0.00
70.05	0.00	0	318.00	0.00	0.00	0.00

Appendix D - Standard 4 Computations and Supporting Information

Required:

- Long-Term Pollution Prevention Plan
- Water Quality Volume Calculations
- TSS Removal Worksheets

Long –Term Pollution Prevention Plan

Long-Term Pollution Prevention Plan

This Long-Term Pollution Prevention Plan has been developed to establish site management practices that improve the quality of stormwater discharges from the Project.

Pollutant Control Approach

Maintenance of Pavement Systems

Standard Asphalt Pavement

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas annually with a commercial cleaning unit and dispose of removed material.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.

- The grass vegetation should be cut to a height between three and four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.
- Pet waste provision if applicable.

Management of Snow and Ice

Storage and Disposal

Snow shall be stockpiled on standard pavement surfaces so sand and salt may be swept in the spring or removed as snow melts and drains through the stormwater management system. Key practices for the safe storage and disposal of snow include:

- Under no circumstances shall snow be disposed or stored in stormwater management areas.

Salt and Deicing Chemicals

The amount of salt and deicing chemicals to be used on the site shall be reduced to the minimum amount needed to provide safe pedestrian and vehicle travel. The following practices should be followed to control the amount of salt and deicing materials that come into contact with stormwater runoff:

- Devices used for spreading salt and deicing chemicals should be capable of varying the rate of application based on the site specific conditions.
- Sand and salt should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials

Spill Prevention and Response Plan

Spill prevention equipment and training will be provided by CFS.

Initial Notification

In the event of a spill the facility and/or construction manager or supervisor will be notified immediately.

FACILITY MANAGER

Name: TBD Home Phone: _____

Phone: _____ E-mail: _____

CONSTRUCTION MANAGER

Name: TBD Home Phone: _____

Phone: _____ E-mail: _____

The supervisor will first contact the Fire Department and then notify the Police Department, the Public Health Commission and the Conservation Commission. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

Further Notification

The State Department of Environmental Protection (DEP)/Department of Environmental Services (DES) and the EPA may be notified depending upon the nature and severity of the spill. The attached list of emergency phone numbers shall be posted in the main construction/facility office and readily accessible to all employees. A hazardous waste spill report shall be completed as necessary using the attached form.

Emergency Notification Phone Numbers

1. FACILITY MANAGER

Name: TBD Home Phone: _____

Phone: _____ E-mail: _____

ALTERENATE

Name: _____ Home Phone: _____

Phone: _____ E-mail: _____

2. FIRE DEPARTMENT

Emergency: **911**

Business: (978) 784-2931

POLICE DEPARTMENT

Emergency: **911**

Business: (978) 772-8800

3. CLEANUP CONTRACTOR:

Address: _____

Phone: _____

4. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION

Emergency: _____

Central Region – Worcester Office: 508-792-7650

5. NATIONAL RESPONSE CENTER

Phone: (800) 424-8802

ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY

Emergency: _____

Business: 888-372-7341

6. DEVENS ENTERPRISE COMMISSION

Contact: Neil Angus

Phone: 978-772-8831

BOARD OF HEALTH

Contact: _____

Phone: _____

Hazardous Waste / Oil Spill Report

Date _____ Time _____ AM / PM

Exact location (Transformer #) _____

Type of equipment _____ Make _____ Size _____

S / N _____ Weather Conditions _____

On or near Water ☐ Yes If Yes, name of body of Water _____

☐ No

Type of chemical/oil spilled _____

Amount of chemical/oil spilled _____

Cause of Spill _____

Measures taken to contain or clean up spill _____

Amount of chemical/oil recovered _____ Method _____

Material collected as a result of cleanup:

_____ Drums containing _____

_____ Drums containing _____

_____ Drums containing _____

Location and method of debris disposal

_____

Name and address of any person, firm, or corporation suffering damages:

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring:

_____

Spill reported to General Office by _____ Time _____ AM / PM

Spill reported to DEP / National Response Center by _____

DEP Date _____ Time _____ AM / PM Inspector _____

NRC Date _____ Time _____ AM / PM Inspector _____

Additional comments: _____

Assessment - Initial Containment

The supervisor or manager will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. A list of recommended spill equipment to be kept on site is included on the following page.

Fire / Police Department	911
Devens Enterprise Commission:	978-772-8831

Emergency Response Equipment

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

Supplies		***Recommended Suppliers***
SORBENT PILLOWS/"PIGS"	**2**	http://www.newpig.com
SORBENT BOOM/SOCK	**25 FEET**	Item # KIT276 — mobile container with two pigs,
SORBENT PADS	**50**	26 feet of sock, 50 pads, and five pounds of
LITE-DRI® ABSORBENT	**5**	absorbent (or equivalent)
POUNDS		http://www.forestry-suppliers.com
SHOVEL	**1**	Item # 43210 — Manhole cover pick (or
PRY BAR	**1**	equivalent)
GOGGLES	**1 PAIR**	Item # 33934 — Shovel (or equivalent)
GLOVES – HEAVY	**1 PAIR**	Item # 90926 — Gloves (or equivalent)
		Item # 23334 — Goggles (or equivalent)

Stormwater Operation and Maintenance Plan

Project Information

Site

16 Bulge Road, Scannell
16 Bulge Road
Devens, Massachusetts

Owner – to be changed after property is sold

MDFA
99 High Street
11th Floor
Boston, MA 02110

Site Supervisor

TBD

Name: _____

Telephone: _____

Cell phone: _____

Email: _____

Description of Stormwater Maintenance Measures

The following Operation and Maintenance (O&M) program is proposed to ensure the continued effectiveness of the stormwater management system. Attached to this plan are a Stormwater Best Management Practices Checklist and Maintenance Figure for use during the long term operation and maintenance of the stormwater management system. Annual stormwater monitoring and maintenance reporting shall be submitted to the DEC and MassDevelopment, in accordance with the Level 2 Permit procedures.

Parking Lot

- Sweep with mechanized cleaning equipment on an annual basis.

Catch Basins

- All catch basins shall be inspected and cleaned a minimum of at least twice per year by a licensed contractor.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any sediment accumulations in excess of half of the unit's sump depth shall be removed.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.
- Material shall be removed by a licensed contractor, who shall be responsible for disposing of the material off-site in a manner consistent with all local, state, and federal regulations.

Subsurface Infiltration System (StormTrap)

- The subsurface infiltration system will be inspected at least twice each year by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than six inches deep, it must be suspended via flushing with clean water and removed using a vacuum truck.
- Follow manufacturer instructions and contact manufacturer if system is malfunctioning. Manufacturer's inspection and maintenance instructions are included with this document.

- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.
- System will be observed after rainfalls to see if it is properly draining.

Structural Water Quality Devices (Contech CS-5)

- Inspect devices monthly for the first three months after construction.
- After initial three month period, all water quality units are to be inspected at least four times per year and cleaned a minimum of at least once per year or when sediment reaches 8" in depth, whichever occurs sooner.
- Remove oil and sediment through manhole access cover.
- Follow manufacturer instructions and contact manufacturer if system is malfunctioning. Manufacturer's inspection and maintenance instructions are included with this document.

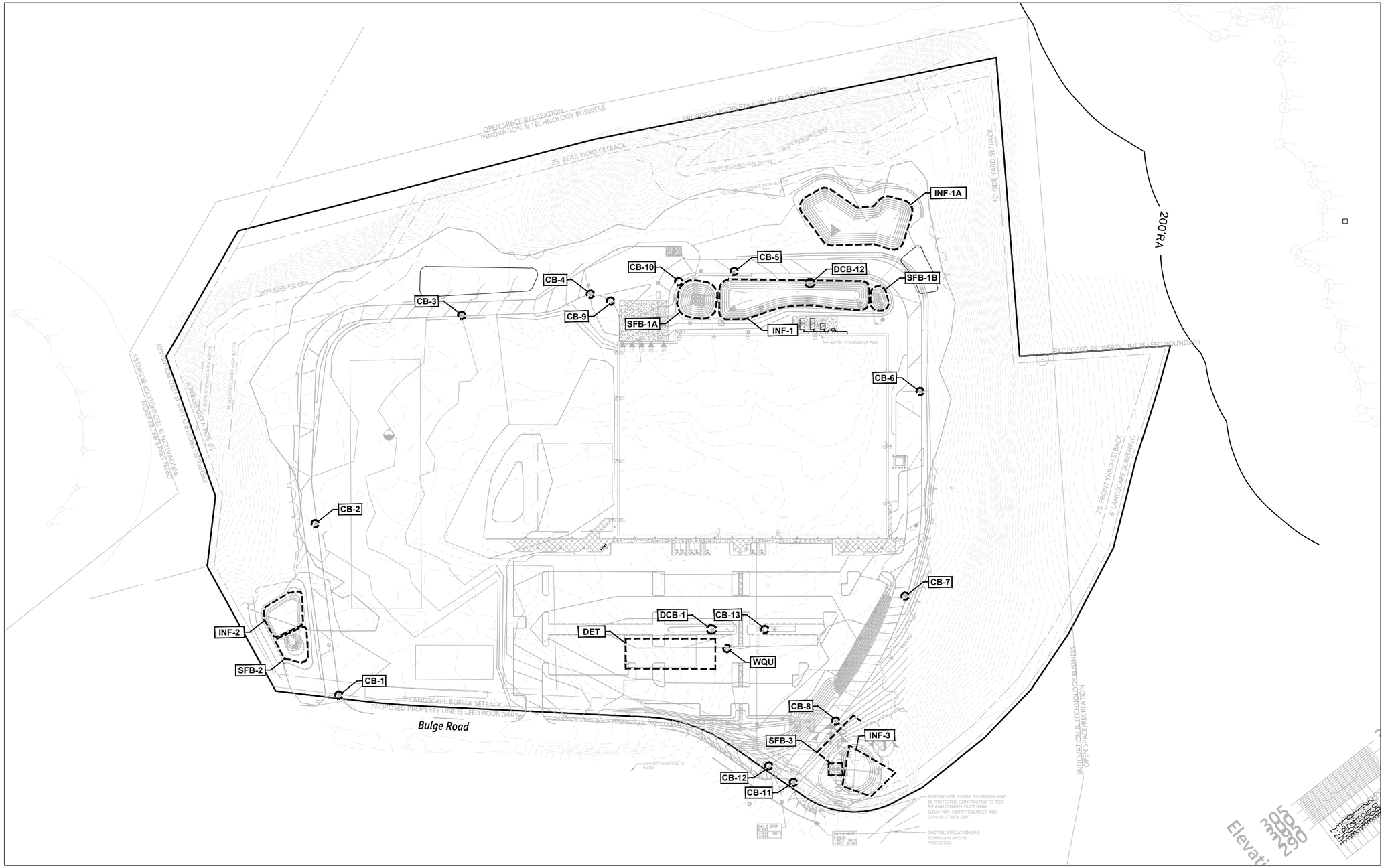
Stormwater Outfalls

- Inspect outfall locations monthly for the first three months after construction to ensure proper functioning and correct any areas that have settled or experienced washouts.
- Inspect outfalls annually after initial three month period.
- Annual inspections should be supplemented after large storms, when washouts may occur.
- Maintain vegetation around outfalls to prevent blockages at the outfall.
- Maintain rip rap pad below each outfall and replace any washouts.
- Remove and dispose of any trash or debris at the outfall.
- .

Surface Infiltration Basin

- Infiltration basins should be inspected after every major storm for the first few months to ensure proper stabilization and function.
- The grass on the side slopes and in the buffer areas should be mowed, and grass clippings, organic matter, and accumulated trash and debris removed, at least twice during the growing season.
- Eroded or barren spots should be reseeded immediately after inspection to prevent additional erosion and accumulation of sediment.
- Deep tilling can be used to break up a clogged surface area.
- Sediment should be removed from the basin as necessary. Removal procedures should not take place until the floor of the basin is thoroughly dry.
- Infiltration basins should be inspected at least twice a year to ensure proper stabilization and function.
- Light equipment, which will not compact the underlying soil, should be used to remove the top layer.

\\vhb.com\gbl\proj\Providence\73152.00 Bulge Road\cad\ld\Eng\Stormwater\O&M Figure.dwg



LEGEND	
CB	CATCH BASIN
DCB	DOUBLE CATCH BASIN
DET	UNDERGROUND DETENTION & INFILTRATION
INF	STORMWATER INFILTRATION
SFB	SEDIMENT FOREBAY
WQU	WATER QUALITY UNIT

Operations and Maintenance Location Plan

16 Bulge Road, Scannell

Devens, MA

Source: **VHB**
Prepared for: **Permits**
Date: **4/09/2021**

0 75 150 300 Feet

16 Bulge Road, Devens MA

Long Term Best Management Practices – Maintenance/ Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Asphalt Pavement	Annually			• Sweep or vacuum asphalt pavement areas annually with a commercial cleaning unit and dispose of removed material. • Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary • Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.			
Deep Sump/Hooded Catch Basin	Bi-annually			• All catch basins / landscape drains shall be inspected and cleaned at least twice per year. • Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations. • Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary. • During colder periods, the catch basin / landscape drain grates must be kept free of snow and ice. • During warmer periods, the catch basin / landscape drain grates must be kept free of leaves, litter, sand, and debris.	☐**yes** ☐**no**		

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Subsurface Infiltration System (StormTrap)	Annually			• The subsurface infiltration systems will be inspected at least once each year by removing the manhole/access port covers and determining the thickness of sediment that has accumulated. • If sediment is more than six inches deep, it must be suspended via flushing with clean water and removed using a vacuum truck. • Follow manufacturer instructions and contact manufacturer if system is malfunctioning. Manufacturer's inspection and maintenance instructions are included in Section F – Product Literature. • Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred. • System will be observed after rainfalls to see if it is properly draining.	☐**yes** ☐**no**		

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Surface Infiltration Basin	Bi-annually			• Infiltration basins should be inspected after every major storm for the first few months to ensure proper stabilization and function. • The grass on the sideslopes and in the buffer areas should be mowed, and grass clippings, organic matter, and accumulated trash and debris removed, at least twice during the growing season. • Eroded or barren spots should be reseeded immediately after inspection to prevent additional erosion and accumulation of sediment. • Deep tilling can be used to break up a clogged surface area. • Sediment should be removed from the basin as necessary. Removal procedures should not take place until the floor of the basin is thoroughly dry. • Infiltration basins should be inspected at least twice a year to ensure proper stabilization and function. • Light equipment, which will not compact the underlying soil, should be used to remove the top layer.	☐**yes** ☐**no**		
Sediment Forebay	Monthly			• Inspect Monthly • Maintain vegetation to prevent erosion and blockage • Clean forebay of sediment at least four times per year	☐**yes** ☐**no**		

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by
Water Quality Units (Contech CS-5)	Quarterly			• Inspect devices monthly for the first three months after construction. • After initial three month period, all water quality units are to be inspected at least four times per year and cleaned a minimum of at least once per year or when sediment reaches 1.5' below permanent pool elevation, whichever occurs sooner. • Remove oil and sediment through manhole access cover. • Follow manufacturer instructions and contact manufacturer if system is malfunctioning.	☐**yes** ☐**no**		
Outfall Structures (Flared End Sections)	Annually			• Inspect annually and after large storms • Maintain surrounding vegetation to prevent blockage • Maintain riprap pad and replace stone from washouts • Dispose of trash	☐**yes** ☐**no**		

Stormwater Control Manager _____

16 Bulge Road, Devens MA

Construction Best Management Practices – Maintenance/ Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning/Repair Needed ☐yes ☐no (List Items)	Date of Cleaning/Repair	Performed by:
Erosion Control Barriers/Silt Fencing	Weekly and after ½" storm events or greater			Inspect for deterioration or failure. Remove sediment as necessary.	☐**yes** ☐**no**		
Silt Sack Catch Basin Protection	Weekly and after ½" storm events or greater			Inspect for proper operation of catch basin. If clogged, dispose of sediment.	☐**yes** ☐**no**		
Gravel and Construction Entrance/Exit	Weekly and after ½" storm events or greater			Inspect for breakdown of crushed-stone. Reapply stone if necessary to depths specified in construction documents.	☐**yes** ☐**no**		
Vegetative Slope Stabilization	Weekly and after ½" storm events or greater			Inspect for erosion. Correct if necessary.	☐**yes** ☐**no**		
Temporary Sediment Basins	Weekly and after ½" storm events or greater			Inspect for proper function. Correct if necessary.	☐**yes** ☐**no**		
					☐**yes** ☐**no**		

Stormwater Control Manager _____

CONTECH®
ENGINEERED SOLUTIONS

Cascade Separator® Inspection and Maintenance Guide

CASCADE
separator®

Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

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

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

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

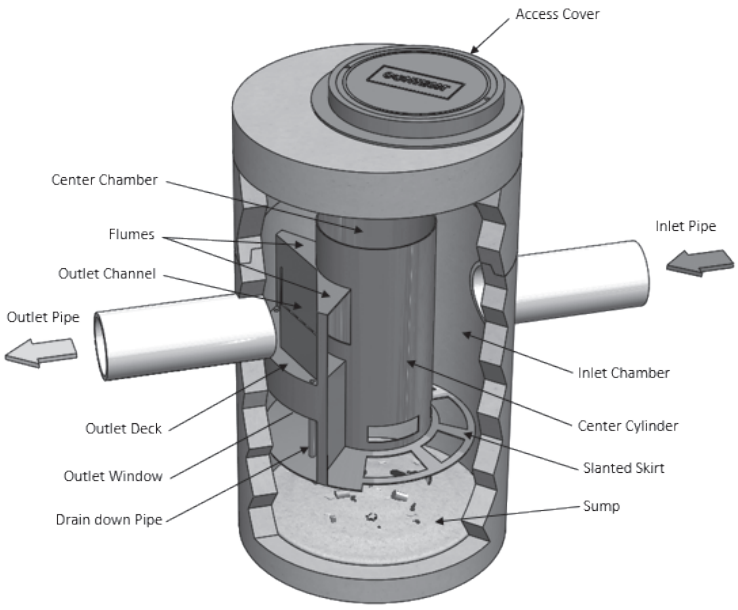
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

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

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	1.5	0.5	0.7	0.5
CS-5	5	1.3	1.5	0.5	1.1	0.8
CS-6	6	1.8	1.5	0.5	1.6	1.2
CS-8	8	2.4	1.5	0.5	2.8	2.1
CS-10	10	3.0	1.5	0.5	4.4	3.3
CS-12	12	3.6	1.5	0.5	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator® Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

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

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800.925.5240
www.ContechES.com

MAINTENANCE PROCEDURE

THE FOLLOWING PROCEDURES ARE FOR THE MAINTENANCE OF STORMTRAP AS SUGGESTED BY STORMTRAP, LLC. ALL REGULATIONS SET BY GOVERNING BODIES RETAIN PRECEDENCE OVER THE SUBSEQUENT INSTRUCTIONS.

DO NOT ENTER STORMTRAP UNLESS PROPERLY TRAINED, EQUIPPED, AND QUALIFIED TO ENTER A CONFINED SPACE AS IDENTIFIED BY LOCAL OCCUPATIONAL SAFETY AND HEALTH REGULATIONS.

STORMTRAP RECOMMENDS AN ANNUAL INSPECTION. FREQUENCY OF CLEANING WILL VARY DUE TO SITE CONDITIONS AND STORAGE CAPACITY. MAINTENANCE IS REQUIRED EVERY 3 TO 5 YEARS OR WHEN SEDIMENT OCCUPIES MORE THAN ONE-TENTH OF THE SYSTEM'S VOLUME. INSPECTIONS SHOULD BE PART OF STANDARD OPERATING PROCEDURE.

MAINTENANCE IS PERFORMED USING A VACUUM TRUCK. REMOVE COVER FROM UNIT AT GRADE AND LOWER HOSE INTO STORMTRAP SYSTEM. VACUUM TRUCKS ARE ABLE TO REMOVE MATERIAL FROM A MAXIMUM DISTANCE OF THIRTY-TWO FEET BELOW GRADE. SEDIMENT MAY BE FLUSHED TOWARD A SPECIFIC POINT OR AREA OF THE STORMTRAP SYSTEM AT THE DISCRETION OF THE OWNER (PREFERABLY DIRECTLY BELOW AN ACCESS OPENING FOR EASE OF REMOVAL).

Water Quality Volume Calculations

Water Quality Volume Calculations

Project Name: 16 Bulge Rd, Scannell

Project Location: Devens, MA

Proj. No.: 73152.00

Date: 3/8/2021 Rev 4/13/2021

Calculated by: KC

Checked by:

	Runoff Depth to be Treated (in.)	Impervious Area (acres)	**Required Volume (c.f.)**
To StormTrap	**3.15**	2.33	26,642
To INF 1	**1**	3.63	13,167
To INF 2	**3.15**	0.25	2,859
To INF 3	**3.15**	0.43	4,917

Provided: (per HydroCAD)	**Provided Static Vol. Below Outlet (c.f.)**
StormTrap	29,241
INF 1	14,051
INF 2	6,065
INF 3	5,037

Summary for Pond 3P: INF 1

Inflow Area = 5.525 ac, 65.65% Impervious, Inflow Depth = 0.40" for WQV event
Inflow = 2.40 cfs @ 12.09 hrs, Volume= 0.185 af
Outflow = 0.60 cfs @ 12.47 hrs, Volume= 0.185 af, Atten= 75%, Lag= 22.9 min
Discarded = 0.60 cfs @ 12.47 hrs, Volume= 0.185 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 309.84' @ 12.47 hrs Surf.Area= 3,117 sf Storage= 1,950 cf

Plug-Flow detention time= 21.4 min calculated for 0.185 af (100% of inflow)
Center-of-Mass det. time= 21.4 min (813.1 - 791.7)

Volume	Invert	Avail.Storage	Storage Description
#1	309.10'	38,381 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
309.10	2,178	0	0
310.00	3,326	2,477	2,477
311.00	4,660	3,993	6,470
312.00	6,071	5,366	11,835
313.00	7,520	6,796	18,631
314.00	9,026	8,273	26,904
315.00	13,928	11,477	38,381

Device	Routing	Invert	Outlet Devices
#1	Discarded	309.10'	**8.270 in/hr Exfiltration over Surface area**
#2	Device 3	312.35'	**2.5" x 2.5" Horiz. Orifice/Grate X 72.00** C= 0.600 Limited to weir flow at low heads
#3	Primary	309.70'	**15.0" Round Culvert** L= 77.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 309.70' / 308.20' S= 0.0195 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=0.60 cfs @ 12.47 hrs HW=309.84' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=309.10' (Free Discharge)
↑—**3=Culvert** (Controls 0.00 cfs)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 3P: INF 1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
309.10	2,178	0
309.20	2,306	224
309.30	2,433	461
309.40	2,561	711
309.50	2,688	973
309.60	2,816	1,248
309.70	2,943	1,536
309.80	3,071	1,837
309.90	3,198	2,151
310.00	3,326	2,477
310.10	3,459	2,816
310.20	3,593	3,169
310.30	3,726	3,535
310.40	3,860	3,914
310.50	3,993	4,307
310.60	4,126	4,713
310.70	4,260	5,132
310.80	4,393	5,564
310.90	4,527	6,010
311.00	4,660	6,470
311.10	4,801	6,943
311.20	4,942	7,430
311.30	5,083	7,931
311.40	5,224	8,447
311.50	5,366	8,976
311.60	5,507	9,520
311.70	5,648	10,077
311.80	5,789	10,649
311.90	5,930	11,235
312.00	6,071	11,835
312.10	6,216	12,450
312.20	6,361	13,078
312.30	6,506	13,722
312.40	6,651	14,380
312.50	6,796	15,052
312.60	6,940	15,739
312.70	7,085	16,440
312.80	7,230	17,156
312.90	7,375	17,886
313.00	7,520	18,631
313.10	7,671	19,390
313.20	7,821	20,165
313.30	7,972	20,955
313.40	8,122	21,759
313.50	8,273	22,579
313.60	8,424	23,414
313.70	8,574	24,264
313.80	8,725	25,129
313.90	8,875	26,009
314.00	9,026	26,904
314.10	9,516	27,831
314.20	10,006	28,807
314.30	10,497	29,832
314.40	10,987	30,906
314.50	11,477	32,030
314.60	11,967	33,202
314.70	12,457	34,423
314.80	12,948	35,693
314.90	13,438	37,013
315.00	**13,928**	**38,381**

Summary for Pond 4P: INF-1A to OF-92

Inflow Area = 5.969 ac, 60.76% Impervious, Inflow Depth = 0.00" for WQV event
Inflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 308.15' @ 0.05 hrs Surf.Area= 2,878 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	308.15'	36,039 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
308.15	2,878	0	0
309.00	3,855	2,862	2,862
310.00	4,905	4,380	7,242
311.00	6,003	5,454	12,696
312.00	7,157	6,580	19,276
313.00	8,368	7,763	27,038
314.00	9,634	9,001	36,039

Device	Routing	Invert	Outlet Devices
#1	Discarded	308.15'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	313.00'	**6.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.00 cfs @ 0.05 hrs HW=308.15' (Free Discharge)
1=Exfiltration (Passes 0.00 cfs of 0.55 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=308.15' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Stage-Area-Storage for Pond 4P: INF-1A to OF-92

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
308.15	2,878	0
308.25	2,993	294
308.35	3,108	599
308.45	3,223	915
308.55	3,338	1,243
308.65	3,453	1,583
308.75	3,568	1,934
308.85	3,683	2,296
308.95	3,798	2,670
309.05	3,907	3,056
309.15	4,012	3,452
309.25	4,118	3,858
309.35	4,222	4,275
309.45	4,327	4,703
309.55	4,432	5,141
309.65	4,537	5,589
309.75	4,643	6,048
309.85	4,747	6,518
309.95	4,852	6,998
310.05	4,960	7,488
310.15	5,070	7,990
310.25	5,180	8,502
310.35	5,289	9,026
310.45	5,399	9,560
310.55	5,509	10,105
310.65	5,619	10,662
310.75	5,729	11,229
310.85	5,838	11,807
310.95	5,948	12,397
311.05	6,061	12,997
311.15	6,176	13,609
311.25	6,292	14,232
311.35	6,407	14,867
311.45	6,522	15,514
311.55	6,638	16,172
311.65	6,753	16,841
311.75	6,869	17,522
311.85	6,984	18,215
311.95	7,099	18,919
312.05	7,218	19,635
312.15	7,339	20,363
312.25	7,460	21,103
312.35	7,581	21,855
312.45	7,702	22,619
312.55	7,823	23,395
312.65	7,944	24,183
312.75	8,065	24,984
312.85	8,186	25,796
312.95	8,307	26,621
313.05	8,431	27,458
313.15	8,558	28,307
313.25	8,685	29,170
313.35	8,811	30,044
313.45	8,938	30,932
313.55	9,064	31,832
313.65	9,191	32,745
313.75	9,318	33,670
313.85	9,444	34,608
313.95	**9,571**	**35,559**

Summary for Pond 2P: StormTrap Infl.

Inflow Area = 2.832 ac, 82.18% Impervious, Inflow Depth = 2.40" for 2-yr event
Inflow = 6.95 cfs @ 12.09 hrs, Volume= 0.566 af
Outflow = 0.96 cfs @ 11.65 hrs, Volume= 0.566 af, Atten= 86%, Lag= 0.0 min
Discarded = 0.96 cfs @ 11.65 hrs, Volume= 0.566 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 307.24' @ 12.61 hrs Surf.Area= 4,992 sf Storage= 7,302 cf

Plug-Flow detention time= 46.9 min calculated for 0.566 af (100% of inflow)
Center-of-Mass det. time= 46.9 min (803.6 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1B	304.50'	3,993 cf	**47.23'W x 105.69'L x 8.17'H Field B** 40,764 cf Overall - 30,781 cf Embedded = 9,983 cf x 40.0% Voids
#2B	306.50'	25,240 cf	**StormTrap ST2 SingleTrap 5-8** x 24 Inside #1 Inside= 101.7"W x 68.0"H => 43.55 sf x 15.40'L = 670.5 cf Outside= 101.7"W x 74.0"H => 52.29 sf x 15.40'L = 805.0 cf 24 Chambers in 4 Rows 33.92' x 92.38' Core + 6.66' Border = 47.23' x 105.69' System
#3	312.17'	34 cf	**4.00'D x 2.73'H Vertical Cone/Cylinder**
		29,267 cf	Total Available Storage

Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	304.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	312.80'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 312.80' / 312.70' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.96 cfs @ 11.65 hrs HW=304.61' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.96 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=304.50' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 2P: StormTrap Infl.

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
304.50	4,992	0
304.70	4,992	399
304.90	4,992	799
305.10	4,992	1,198
305.30	4,992	1,597
305.50	4,992	1,997
305.70	4,992	2,396
305.90	4,992	2,795
306.10	4,992	3,195
306.30	4,992	3,594
306.50	4,992	3,993
306.70	4,992	4,884
306.90	4,992	5,775
307.10	4,992	6,666
307.30	4,992	7,556
307.50	4,992	8,447
307.70	4,992	9,338
307.90	4,992	10,229
308.10	4,992	11,120
308.30	4,992	12,011
308.50	4,992	12,901
308.70	4,992	13,792
308.90	4,992	14,683
309.10	4,992	15,574
309.30	4,992	16,465
309.50	4,992	17,355
309.70	4,992	18,246
309.90	4,992	19,137
310.10	4,992	20,028
310.30	4,992	20,919
310.50	4,992	21,810
310.70	4,992	22,700
310.90	4,992	23,591
311.10	4,992	24,482
311.30	4,992	25,373
311.50	4,992	26,264
311.70	4,992	27,154
311.90	4,992	28,045
312.10	**4,992**	28,936
312.30	**5,004**	29,235
312.50	5,004	29,237
312.70	5,004	29,240
312.90	5,004	29,242
313.10	5,004	29,245
313.30	5,004	29,247
313.50	5,004	29,250
313.70	5,004	29,252
313.90	5,004	29,255
314.10	5,004	29,257
314.30	5,004	29,260
314.50	5,004	29,262
314.70	5,004	29,265
314.90	5,004	**29,267**

Summary for Pond 5P: INF-3

Inflow Area = 1.827 ac, 23.29% Impervious, Inflow Depth = 0.65" for 2-yr event
Inflow = 1.21 cfs @ 12.11 hrs, Volume= 0.099 af
Outflow = 0.31 cfs @ 12.49 hrs, Volume= 0.099 af, Atten= 74%, Lag= 23.1 min
Discarded = 0.31 cfs @ 12.49 hrs, Volume= 0.099 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 296.22' @ 12.49 hrs Surf.Area= 1,641 sf Storage= 1,012 cf

Plug-Flow detention time= 19.5 min calculated for 0.099 af (100% of inflow)
Center-of-Mass det. time= 19.5 min (797.3 - 777.8)

Volume	Invert	Avail.Storage	Storage Description
#1	295.50'	8,440 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
295.50	1,183	0	0
297.00	2,140	2,492	2,492
298.00	2,949	2,545	5,037
299.00	3,857	3,403	8,440

Device	Routing	Invert	Outlet Devices
#1	Discarded	295.50'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	298.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.31 cfs @ 12.49 hrs HW=296.22' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=295.50' (Free Discharge)
↑**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 5P: INF-3

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
295.50	1,183	0
295.55	1,215	60
295.60	1,247	121
295.65	1,279	185
295.70	1,311	249
295.75	1,343	316
295.80	1,374	384
295.85	1,406	453
295.90	1,438	524
295.95	1,470	597
296.00	1,502	671
296.05	1,534	747
296.10	1,566	825
296.15	1,598	904
296.20	1,630	984
296.25	1,662	1,067
296.30	1,693	1,151
296.35	1,725	1,236
296.40	1,757	1,323
296.45	1,789	1,412
296.50	1,821	1,502
296.55	1,853	1,594
296.60	1,885	1,687
296.65	1,917	1,782
296.70	1,949	1,879
296.75	1,981	1,977
296.80	2,012	2,077
296.85	2,044	2,178
296.90	2,076	2,281
296.95	2,108	2,386
297.00	2,140	2,492
297.05	2,180	2,600
297.10	2,221	2,710
297.15	2,261	2,822
297.20	2,302	2,936
297.25	2,342	3,053
297.30	2,383	3,171
297.35	2,423	3,291
297.40	2,464	3,413
297.45	2,504	3,537
297.50	2,545	3,663
297.55	2,585	3,792
297.60	2,625	3,922
297.65	2,666	4,054
297.70	2,706	4,188
297.75	2,747	4,325
297.80	2,787	4,463
297.85	2,828	4,604
297.90	2,868	4,746
297.95	2,909	4,890
298.00	2,949	5,037
298.05	2,994	5,185
298.10	3,040	5,336
298.15	3,085	5,489
298.20	3,131	5,645
298.25	3,176	5,802
298.30	3,221	5,962
298.35	3,267	6,125
298.40	3,312	6,289
298.45	3,358	6,456
298.50	3,403	6,625
298.55	3,448	6,796
298.60	3,494	6,970
298.65	3,539	7,145
298.70	3,585	7,324
298.75	3,630	7,504
298.80	3,675	7,687
298.85	3,721	7,871
298.90	3,766	8,059
298.95	3,812	8,248
299.00	**3,857**	**8,440**

Summary for Pond 7P: INF-2

Inflow Area = 0.599 ac, 40.92% Impervious, Inflow Depth = 1.01" for 2-yr event
Inflow = 0.72 cfs @ 12.10 hrs, Volume= 0.050 af
Outflow = 0.34 cfs @ 12.27 hrs, Volume= 0.050 af, Atten= 52%, Lag= 10.1 min
Discarded = 0.34 cfs @ 12.27 hrs, Volume= 0.050 af
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 318.15' @ 12.27 hrs Surf.Area= 1,798 sf Storage= 253 cf

Plug-Flow detention time= 4.3 min calculated for 0.050 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (814.1 - 809.8)

Volume	Invert	Avail.Storage	Storage Description
#1	318.00'	6,065 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
318.00	1,621	0	0
319.00	2,814	2,218	2,218
320.00	4,881	3,848	6,065

Device	Routing	Invert	Outlet Devices
#1	Discarded	318.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	320.00'	**6.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Discarded OutFlow Max=0.34 cfs @ 12.27 hrs HW=318.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.34 cfs)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=318.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 7P: INF-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
318.00	1,621	0
318.02	1,645	33
318.04	1,669	66
318.06	1,693	99
318.08	1,716	133
318.10	1,740	168
318.12	1,764	203
318.14	1,788	239
318.16	1,812	275
318.18	1,836	311
318.20	1,860	348
318.22	1,883	385
318.24	1,907	423
318.26	1,931	462
318.28	1,955	501
318.30	1,979	540
318.32	2,003	580
318.34	2,027	620
318.36	2,050	661
318.38	2,074	702
318.40	2,098	744
318.42	2,122	786
318.44	2,146	829
318.46	2,170	872
318.48	2,194	916
318.50	2,218	960
318.52	2,241	1,004
318.54	2,265	1,049
318.56	2,289	1,095
318.58	2,313	1,141
318.60	2,337	1,187
318.62	2,361	1,234
318.64	2,385	1,282
318.66	2,408	1,330
318.68	2,432	1,378
318.70	2,456	1,427
318.72	2,480	1,476
318.74	2,504	1,526
318.76	2,528	1,576
318.78	2,552	1,627
318.80	2,575	1,679
318.82	2,599	1,730
318.84	2,623	1,783
318.86	2,647	1,835
318.88	2,671	1,888
318.90	2,695	1,942
318.92	2,719	1,996
318.94	2,742	2,051
318.96	2,766	2,106
318.98	2,790	2,161
319.00	2,814	2,218
319.02	2,855	2,274
319.04	2,897	2,332
319.06	2,938	2,390
319.08	2,979	2,449
319.10	3,021	2,509
319.12	3,062	2,570
319.14	3,103	2,632
319.16	3,145	2,694
319.18	3,186	2,758
319.20	3,227	2,822
319.22	3,269	2,887
319.24	3,310	2,952
319.26	3,351	3,019
319.28	3,393	3,086
319.30	3,434	3,155
319.32	3,475	3,224
319.34	3,517	3,294
319.36	3,558	3,364
319.38	3,599	3,436
319.40	3,641	3,508
319.42	3,682	3,582
319.44	3,723	3,656
319.46	3,765	3,731
319.48	3,806	3,806
319.50	3,848	3,883
319.52	3,889	3,960
319.54	3,930	4,038
319.56	3,972	4,117
319.58	4,013	4,197
319.60	4,054	4,278
319.62	4,096	4,359
319.64	4,137	4,442
319.66	4,178	4,525
319.68	4,220	4,609
319.70	4,261	4,694
319.72	4,302	4,779
319.74	4,344	4,866
319.76	4,385	4,953
319.78	4,426	5,041
319.80	4,468	5,130
319.82	4,509	5,220
319.84	4,550	5,310
319.86	4,592	5,402
319.88	4,633	5,494
319.90	4,674	5,587
319.92	4,716	5,681
319.94	4,757	5,776
319.96	4,798	5,871
319.98	4,840	5,968
320.00	**4,881**	**6,065**

Sediment Forebay

- Inspect the forebay monthly and remove any deposited sediment at least four times per year.
- Correct any ponding, erosion, and replant any vegetation that has died.

Computations

Project:	Scannell, 16 Bulge Road	**Project #**	73152
Location:	Devens, MA	**Sheet:**	of
Calculated By:	kc	**Date:**	03/06/2021 Rev 04/19/2021
Checked By:		**Date:**	
Title:	SFB Pretreatment Calculations		

SFB 1a

- **Contributing impervious =** 30,417 sf
- **WQV** (1′/12″) (30,417 sf)= 2,535 CF
- **Pretreatment Vol. Required** 10% x 2,535 =253 CF
- **Pretreatment Vol Provided (Vol. below weir in HydroCad)** = 3,382 cf

SFB 1b

- **Contributing impervious =** 7,162 sf
- **WQV** (1′/12″) (30,417 sf)= 597 CF
- **Pretreatment Vol. Required** 10% x 597 =60 CF
- **Pretreatment Vol Provided (Vol. below weir in HydroCad)** = 379 cf

SFB 2

- **Contributing impervious =** 10,656 sf
- **WQV** (1′/12″) (10,656 sf)= 888 CF
- **Pretreatment Vol. Required** 10% x 888 =89 CF
- **Pretreatment Vol Provided (Vol. below weir in HydroCad)** = 397 cf

SFB 3

- **Contributing impervious =** 18,533sf
- **WQV** (1′/12″) (18,533 sf)= 1,544 CF
- **Pretreatment Vol. Required** 10% x 1,544 =154 CF
- **Pretreatment Vol Provided (Vol. below weir in HydroCad)** = 178 cf

Summary for Pond 11P: SFB-1A

Inflow Area = 1.857 ac, 37.26% Impervious, Inflow Depth = 0.29" for WQV event
Inflow = 0.56 cfs @ 12.11 hrs, Volume= 0.046 af
Outflow = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.05 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 311.96' @ 24.50 hrs Surf.Area= 1,136 sf Storage= 1,986 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	309.10'	7,445 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
309.10	326	0	0
310.00	530	385	385
311.00	808	669	1,054
312.00	1,150	979	2,033
313.00	1,548	1,349	3,382
314.00	2,013	1,781	5,163
315.00	2,552	2,283	7,445

Device	Routing	Invert	Outlet Devices
#1	Primary	313.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.00 cfs @ 0.05 hrs HW=309.10' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 11P: SFB-1A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
309.10	326	0
309.20	349	34
309.30	371	70
309.40	394	108
309.50	417	149
309.60	439	191
309.70	462	236
309.80	485	284
309.90	507	333
310.00	530	385
310.10	558	440
310.20	586	497
310.30	613	557
310.40	641	619
310.50	669	685
310.60	697	753
310.70	725	824
310.80	752	898
310.90	780	975
311.00	808	1,054
311.10	842	1,137
311.20	876	1,223
311.30	911	1,312
311.40	945	1,405
311.50	979	1,501
311.60	1,013	1,601
311.70	1,047	1,704
311.80	1,082	1,810
311.90	1,116	1,920
312.00	1,150	2,033
312.10	1,190	2,150
312.20	1,230	2,271
312.30	1,269	2,396
312.40	1,309	2,525
312.50	1,349	2,658
312.60	1,389	2,795
312.70	1,429	2,936
312.80	1,468	3,081
312.90	1,508	3,229
313.00	1,548	3,382
313.10	1,595	3,539
313.20	1,641	3,701
313.30	1,688	3,868
313.40	1,734	4,039
313.50	1,781	4,214
313.60	1,827	4,395
313.70	1,874	4,580
313.80	1,920	4,769
313.90	1,967	4,964
314.00	2,013	5,163
314.10	2,067	5,367
314.20	2,121	5,576
314.30	2,175	5,791
314.40	2,229	6,011
314.50	2,283	6,237
314.60	2,336	6,468
314.70	2,390	6,704
314.80	2,444	6,946
314.90	2,498	7,193
315.00	**2,552**	**7,445**

Summary for Pond 10P: SFB-1B

Inflow Area = 0.254 ac, 66.97% Impervious, Inflow Depth = 0.53" for WQV event
Inflow = 0.14 cfs @ 12.10 hrs, Volume= 0.011 af
Outflow = 0.01 cfs @ 14.42 hrs, Volume= 0.002 af, Atten= 95%, Lag= 139.0 min
Primary = 0.01 cfs @ 14.42 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 313.60' @ 14.42 hrs Surf.Area= 389 sf Storage= 380 cf

Plug-Flow detention time= 456.1 min calculated for 0.002 af (22% of inflow)
Center-of-Mass det. time= 281.6 min (1,070.7 - 789.2)

Volume	Invert	Avail.Storage	Storage Description
#1	312.00'	1,160 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
312.00	106	0	0
313.00	262	184	184
314.00	473	368	552
315.00	743	608	1,160

Device	Routing	Invert	Outlet Devices
#1	Primary	313.60'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.00 cfs @ 14.42 hrs HW=313.60' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.00 cfs @ 0.17 fps)

Stage-Area-Storage for Pond 10P: SFB-1B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
312.00	106	0
312.05	114	5
312.10	122	11
312.15	129	18
312.20	137	24
312.25	145	31
312.30	153	39
312.35	161	47
312.40	168	55
312.45	176	63
312.50	184	73
312.55	192	82
312.60	200	92
312.65	207	102
312.70	215	112
312.75	223	123
312.80	231	135
312.85	239	146
312.90	246	159
312.95	254	171
313.00	262	184
313.05	273	197
313.10	283	211
313.15	294	226
313.20	304	241
313.25	315	256
313.30	325	272
313.35	336	289
313.40	346	306
313.45	357	323
313.50	368	341
313.55	378	360
313.60	389	379
313.65	399	399
313.70	410	419
313.75	420	440
313.80	431	461
313.85	441	483
313.90	452	505
313.95	462	528
314.00	473	552
314.05	487	575
314.10	500	600
314.15	513	625
314.20	527	651
314.25	541	678
314.30	554	706
314.35	568	734
314.40	581	762
314.45	594	792
314.50	608	822
314.55	622	852
314.60	635	884
314.65	648	916
314.70	662	949
314.75	676	982
314.80	689	1,016
314.85	703	1,051
314.90	716	1,087
314.95	729	1,123
315.00	**743**	**1,160**

Summary for Pond 6P: SFB-2

Inflow Area = 0.599 ac, 40.92% Impervious, Inflow Depth = 0.32" for WQV event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 0.016 af
Outflow = 0.08 cfs @ 12.42 hrs, Volume= 0.007 af, Atten= 65%, Lag= 19.7 min
Primary = 0.08 cfs @ 12.42 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 318.02' @ 12.42 hrs Surf.Area= 411 sf Storage= 405 cf

Plug-Flow detention time= 264.0 min calculated for 0.007 af (44% of inflow)
Center-of-Mass det. time= 141.3 min (929.2 - 787.9)

Volume	Invert	Avail.Storage	Storage Description
#1	316.00'	1,982 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
316.00	70	0	0
317.00	184	127	127
318.00	356	270	397
319.00	2,814	1,585	1,982

Device	Routing	Invert	Outlet Devices
#1	Primary	318.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.06 cfs @ 12.42 hrs HW=318.02' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 0.06 cfs @ 0.47 fps)

Stage-Area-Storage for Pond 6P: SFB-2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
316.00	70	0
316.05	76	4
316.10	81	8
316.15	87	12
316.20	93	16
316.25	99	21
316.30	104	26
316.35	110	31
316.40	116	37
316.45	121	43
316.50	127	49
316.55	133	56
316.60	138	63
316.65	144	70
316.70	150	77
316.75	156	85
316.80	161	92
316.85	167	101
316.90	173	109
316.95	178	118
317.00	184	127
317.05	193	136
317.10	201	146
317.15	210	157
317.20	218	167
317.25	227	178
317.30	236	190
317.35	244	202
317.40	253	214
317.45	261	227
317.50	270	241
317.55	279	254
317.60	287	268
317.65	296	283
317.70	304	298
317.75	313	313
317.80	322	329
317.85	330	346
317.90	339	362
317.95	347	379
318.00	356	397
318.05	479	418
318.10	602	445
318.15	725	478
318.20	848	517
318.25	971	563
318.30	1,093	614
318.35	1,216	672
318.40	1,339	736
318.45	1,462	806
318.50	1,585	882
318.55	1,708	965
318.60	1,831	1,053
318.65	1,954	1,148
318.70	2,077	1,248
318.75	2,200	1,355
318.80	2,322	1,468
318.85	2,445	1,588
318.90	2,568	1,713
318.95	2,691	1,844
319.00	**2,814**	**1,982**

Summary for Pond 8P: SFB-3

Inflow Area = 1.827 ac, 23.29% Impervious, Inflow Depth = 0.18" for WQV event
Inflow = 0.35 cfs @ 12.11 hrs, Volume= 0.028 af
Outflow = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.4 min
Primary = 0.35 cfs @ 12.11 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.05-72.00 hrs, dt= 0.05 hrs
Peak Elev= 297.55' @ 12.12 hrs Surf.Area= 202 sf Storage= 188 cf

Plug-Flow detention time= 99.8 min calculated for 0.024 af (85% of inflow)
Center-of-Mass det. time= 37.4 min (826.9 - 789.4)

Volume	Invert	Avail.Storage	Storage Description
#1	295.50'	291 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
295.50	7	0	0
296.00	35	11	11
297.00	134	85	95
298.00	258	196	291

Device	Routing	Invert	Outlet Devices
#1	Primary	297.50'	**12.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=0.34 cfs @ 12.11 hrs HW=297.55' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.34 cfs @ 0.55 fps)

Stage-Area-Storage for Pond 8P: SFB-3

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
295.50	7	0
295.55	10	0
295.60	13	1
295.65	15	2
295.70	18	3
295.75	21	4
295.80	24	5
295.85	27	6
295.90	29	7
295.95	32	9
296.00	35	11
296.05	40	12
296.10	45	14
296.15	50	17
296.20	55	19
296.25	60	22
296.30	65	25
296.35	70	29
296.40	75	32
296.45	80	36
296.50	85	40
296.55	89	45
296.60	94	49
296.65	99	54
296.70	104	59
296.75	109	65
296.80	114	70
296.85	119	76
296.90	124	82
296.95	129	88
297.00	134	95
297.05	140	102
297.10	146	109
297.15	153	116
297.20	159	124
297.25	165	132
297.30	171	141
297.35	177	149
297.40	184	159
297.45	190	168
297.50	196	178
297.55	202	187
297.60	208	198
297.65	215	208
297.70	221	219
297.75	227	230
297.80	233	242
297.85	239	254
297.90	246	266
297.95	252	278
298.00	**258**	**291**

TSS Removal Worksheets

TSS Removal Calculation Worksheet

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
101 Walnut Street
Watertown, MA 02471
(617) 924-1770

Project Name:	**16 Bulge Road, Scannell**	Sheet:	**2of 2**
Project Number:	**73152**	Date:	**10-Feb-2021**
Location:	**Devens, MA**	Computed by:	**kc**
Discharge Point:	**At Grade Infiltration**	Checked by:	
Drainage Area(s):			

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (B*C)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Sediment Forebay	**25%**	**75%**	**19%**	**56%**
	0%	**56%**	**0%**	**56%**
			Pre-Treatment TSS Removal =	**44%**

2. Total TSS Removal including Pretreatment 1.

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (B*C)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**25%**	**100%**	**25%**	**75%**
Sediment Forebay	**25%**	**75%**	**19%**	**56%**
Infiltration Basin	**80%**	**56%**	**45%**	**11%**
	0%	**11%**	**0%**	**11%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1. Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 75% removal is used for this calculation based upon the NJCAT study provided on the MA STEP website. (Change name of device and the claimed removal rate shown on the calc. sheet. ALSO provide backup documentation to support TSS removal rate from the MA STEP website. Remove this sentence if not applicable.)

TSS Removal Calculation Worksheet

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
101 Walnut Street
Watertown, MA 02471
(617) 924-1770

Project Name:	**16 Bulge Road, Scannell**	Sheet:	**1 of 2**
Project Number:	**73152**	Date:	**10-Feb-2021**
Location:	**Devens, MA**	Computed by:	**kc**
Discharge Point:	**StormTrap Infiltration**	Checked by:	
Drainage Area(s):			

1. Pre-Treatment prior to Infiltration

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (B*C)	Remaining Load (D-E)
WQU CS-5	**89%**	**100%**	**89%**	**11%**
	0%	**11%**	**0%**	**11%**
	0%	**11%**	**0%**	**11%**
		Pre-Treatment TSS Removal =		**89%**

2. Total TSS Removal including Pretreatment 1.

BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (B*C)	Remaining Load (D-E)
WQU CS-5	**89%**	**100%**	**89%**	**11%**
Infiltration Basin	**80%**	**11%**	**9%**	**2%**
	0%	**2%**	**0%**	**2%**
	0%	**2%**	**0%**	**2%**

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1. Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)
*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 75% removal is used for this calculation based upon the NJCAT study provided on the MA STEP website. (Change name of device and the claimed removal rate shown on the calc. sheet. ALSO provide backup documentation to support TSS removal rate from the MA STEP website. Remove this sentence if not applicable.)

Estimated Net Annual Solids Load Reduction
Based on the Rational Rainfall Method

CONTECH ENGINEERED SOLUTIONS

CASCADE separator™

16 Bulge Road
Devens, MA
WQU

AREA	2.90	acres	CASCADE MODEL	CS-5
WEIGHTED C	0.95			
TC	10.00	minutes	RAINFALL STATION	69

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Hydraulic Loading Rate (gpm/ft2)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	1.26	100.0	10.2
0.04	9.6%	2.52	100.0	9.6
0.06	9.4%	3.78	100.0	9.4
0.08	7.7%	5.04	100.0	7.7
0.10	8.6%	6.30	100.0	8.6
0.12	6.3%	7.56	100.0	6.3
0.14	4.7%	8.82	100.0	4.7
0.16	4.6%	10.08	100.0	4.6
0.18	3.5%	11.34	100.0	3.5
0.20	4.3%	12.60	100.0	4.3
0.25	8.0%	15.74	97.1	7.8
0.30	5.6%	18.89	94.1	5.3
0.35	4.4%	22.04	91.2	4.0
0.40	2.5%	25.19	88.2	2.2
0.45	2.5%	28.34	85.3	2.2
0.50	1.4%	31.49	82.3	1.1
0.75	5.0%	47.23	67.5	3.4
1.00	1.0%	62.98	52.7	0.5
1.50	0.0%	80.01	31.1	0.0
2.00	0.0%	80.01	23.3	0.0
3.00	0.5%	80.01	15.5	0.1
				95.6
			Removal Efficiency Adjustment[2] =	6.5%
			Predicted % Annual Rainfall Treated =	93.3%
			Predicted Net Annual Load Removal Efficiency =	89.2%

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

Appendix E - Standard 8 Supporting Information

Erosion and Sedimentation Control Measures

The following erosion and sedimentation controls are for use during the earthwork and construction phases of the project. The following controls are provided as recommendations for the site contractor and do not constitute or replace the final Stormwater Pollution Prevention Plan that must be fully implemented by the Contractor and owner in Compliance with EPA NPDES regulations.

Siltsock

Filter socks filled with compost will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site.

Silt Fencing

In areas where high runoff velocities or high sediment loads are expected, hay bale barriers will be backed up with silt fencing. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The silt fences and hay bale barrier will be replaced as determined by periodic field inspections.

Catch Basin Protection

Newly constructed and existing catch basins will be protected with hay bale barriers (where appropriate) or silt sacks throughout construction.

Gravel and Construction Entrance/Exit

A temporary crushed-stone construction entrance/exit will be constructed. A cross slope will be placed in the entrance to direct runoff to a protected catch basin inlet or settling area. If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site.

Diversion Channels

Diversion channels will be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

Temporary Sediment Basins

Temporary sediment basins will be designed either as excavations or bermed stormwater detention structures (depending on grading) that will retain runoff for a sufficient period of time to allow suspended soil particles to settle out prior to discharge. These temporary basins will be located based on construction needs as

determined by the contractor and outlet devices will be designed to control velocity and sediment. Points of discharge from sediment basins will be stabilized to minimize erosion.

Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control 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 on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained on-site by the contractor.

- 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 hay 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 on-site.

- 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.